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Product Carbon Footprint Analysis Report

For Product:
****iislwkotwe****

Company: ****wrneyfgzhu****

****Protocol Data (Accounting
Standard): GHG Protocol****

****Senior Sustainability Consultant:
ksldrmmwfd****

This report is generated based on available data and industry standards. While efforts have been made to ensure accuracy and comprehensive coverage, actual emissions may vary depending on specific operational details and evolving data availability.

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Generated Date: May 27, 2026

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Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for the product "iislwkotwe" manufactured by wrneyfgzhu. The analysis adheres to the Greenhouse Gas (GHG) Protocol, including the 2026 Land Sector and Removals (LSR) Standard where applicable, and aims for comprehensive Scope 3 coverage. The PCF quantifies the total greenhouse gas emissions across the product's entire lifecycle, from raw material extraction to end-of-life, providing insights into emission hotspots and potential reduction opportunities.

1. Define Scope

This section outlines the foundational parameters for the Product Carbon Footprint (PCF) study for 'iislwkotwe'.

- **Functional Unit:** The functional unit for this study is 1.0 unit of the product 'iislwkotwe'. This defines the quantified performance of the product system for which the environmental impacts are proportionally calculated.
- **System Boundary:** While the primary calculation system boundary for the core manufacturing process is considered 'factory_gate', this comprehensive report expands to a

****Cradle-to-Grave**** approach. This includes raw material acquisition, manufacturing, transportation to market, product use phase, and end-of-life treatment, as explicitly requested by the detailed parameters.

- **Geographic Scope:**
 - **Final Production Country:** China
 - **Supply Chain Focus:** Europe Focused (implying European markets for materials or final consumption)
- **Accounting Standard:** The analysis strictly adheres to the ****GHG Protocol****, categorizing emissions into Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased energy), and Scope 3 (all other indirect emissions in the value chain).
- **Allocation:** For multi-output processes, allocation has been applied based on mass or economic value where necessary, ensuring emissions are fairly attributed to the functional unit.
- **2026 LSR Update:** The Land Sector and Removals (LSR) Standard, effective for 2026 reporting, has been considered. While specific land use and removal data for '\iislwkotwe\' are not provided, this report acknowledges its importance and highlights the need for dedicated data collection in future assessments for a more accurate application of the standard.
- **Scope 3 Compliance:** This analysis aims for at least 95% coverage for Scope 3 reporting, as per the 2026 requirements, by comprehensively including upstream (materials, inbound transport) and downstream (outbound transport, use phase, end-of-life) activities.

2. Map Lifecycle (LCI Inventory Stages) & 3. Collect Data

This section details the lifecycle stages considered and the primary and secondary data points collected for the PCF analysis of '\iislwkotwe\''. The detailed Bill of Materials (BOM) was used for high-accuracy material impact calculation, overriding default estimates.

2.1. Materials Acquisition & Pre-processing (Scope 3 - Upstream)

Raw materials and components are sourced globally, with a supply chain focus on Europe for certain inputs, and assembled in China.

Detailed Bill of Materials (BOM) - wrneyfgzhu\'s iislwkotwe:

ID	Description	Category	Process	Quantity (kg)	Unit	Emission Factor (kg CO2e/unit or kg)	Total Carbon (kg CO2e)
MAT001	Aluminum Enclosure	Metals	Die Casting	0.8	kg	7.0	5.6
MAT002	ABS Plastic Casing	Polymers	Injection Molding	0.3	kg	2.5	0.75
MAT003	Printed Circuit Board (PCB)	Electronics	Assembly	0.15	kg	12.0	1.8
MAT004	Lithium-ion Battery	Electronics	Manufacturing	0.2	kg	15.0	3.0
MAT005	Copper Wiring	Metals	Extrusion	0.05	kg	6.0	0.3
MAT006	Packaging Cardboard	Paper/ Board	Converting	0.1	kg	1.0	0.1
MAT007	Instruction Manual	Paper/ Board	Printing	0.02	kg	0.7	0.014
Total Material Mass:							1.62 kg
Total Upstream Material Carbon Footprint (Scope 3):							11.564 kg CO2e

2.2. Manufacturing (Scope 1 & 2)

The manufacturing process for 'iislwkotwe' occurs in China.

- **Energy Intensity (kWh/unit):** 25 kWh/unit
- **Renewable Energy Usage:** 40% (of total energy consumption)
- **Non-renewable Electricity Mix (China Grid):** 0.60 kg CO₂e/kWh

2.3. Transportation (Scope 3 - Downstream)

Finished products are transported from the manufacturing facility in China to end-users in Europe.

- **Product Weight:** 1.62 kg (0.00162 tonnes)
- **Primary Transport Mode:** Ocean Freight
- **Transport Distance (Ocean):** 15000 km
- **Ocean Freight Emission Factor:** 0.016 kg CO₂e/tkm
- **Last-Mile Delivery Channel:** Road Freight (Light Commercial Vehicle)
- **Assumed Last-Mile Distance (Europe):** 500 km
- **Road Freight (LCV) Emission Factor:** 0.10 kg CO₂e/tkm (Estimated average for light commercial vehicles carrying mixed loads)

2.4. Product Use Phase (Scope 3 - Downstream)

Emissions associated with the product's lifespan and energy consumption by the end-user.

- **Product Lifespan:** 7 years
- **Energy Consumption in Use:** 10 kWh/year
- **Electricity Mix (European Grid):** 0.25 kg CO₂e/kWh

2.5. End-of-Life (EoL) Treatment (Scope 3 - Downstream)

Scenarios for the disposal and recycling of the product and its packaging after consumer use.

- **Recyclability Percentage:** 65% (of total product mass)
- **Circular/Take-back Programs:** Partial implementation (collection points for key components). This contributes to the assumed recyclability.
- **End-of-Life Emission Factors/Credits:**
 - Plastic Incineration: 2.75 kg CO₂e/kg
 - Plastic Landfill: 0.08 kg CO₂e/kg
 - Plastic Recycling Credit: -1.5 kg CO₂e/kg (avoided virgin production)
 - Metal Landfill: 0.02 kg CO₂e/kg
 - Metal Recycling Credit: -4.0 kg CO₂e/kg (avoided virgin production)
 - Paper/Cardboard Incineration: 0.7 kg CO₂e/kg
 - Paper/Cardboard Landfill: 1.2 kg CO₂e/kg
 - Paper/Cardboard Recycling Credit: -0.7 kg CO₂e/kg (avoided virgin production)

4. Calculate Emissions (Activity * Emission Factor = CO₂e)

Emissions are calculated for each lifecycle stage and categorized according to the GHG Protocol.

4.1. Scope 3 - Upstream Emissions

Materials Acquisition & Pre-processing

- **Total Material Emissions:** Sum of 'Total Carbon' from BOM.

- Calculation: 5.6 (Aluminum) + 0.75 (ABS Plastic) + 1.8 (PCB) + 3.0 (Li-ion Battery) + 0.3 (Copper) + 0.1 (Packaging) + 0.014 (Manual) = **11.564 kg CO₂e**

4.2. Scope 2 - Purchased Energy Emissions

Manufacturing Production Energy

- **Total Energy Intensity:** 25 kWh/unit
- **Non-renewable Energy Portion:** 25 kWh/unit * (1 - 0.40 Renewable Usage) = 15 kWh/unit
- **Emissions from Non-renewable Energy:** 15 kWh/unit * 0.60 kg CO₂e/kWh (China grid EF) = **9.0 kg CO₂e**

4.3. Scope 3 - Downstream Emissions

Transportation to Market

- **Ocean Freight Emissions:** 15000 km * 0.00162 tonnes (product weight) * 0.016 kg CO₂e/tkm = **0.3888 kg CO₂e**
- **Last-Mile Road Freight Emissions:** 500 km * 0.00162 tonnes (product weight) * 0.10 kg CO₂e/tkm = **0.081 kg CO₂e**
- **Total Transportation Emissions:** 0.3888 + 0.081 = **0.4698 kg CO₂e**

Product Use Phase

- **Total Energy in Use:** 7 years (lifespan) * 10 kWh/year (energy consumption) = 70 kWh
- **Use Phase Emissions:** 70 kWh * 0.25 kg CO₂e/kWh (Europe grid EF) = **17.5 kg CO₂e**

End-of-Life (EoL) Treatment

Product mass (1.62 kg) distributed proportionally by material category for EoL treatment based on 65% recyclability and 35% non-recycled (incineration/landfill) distribution. Electronics are grouped

with plastics for EoL estimation due to lack of specific e-waste factors.

- **Recycled Portion:** $1.62 \text{ kg} * 0.65 = 1.053 \text{ kg}$
- **Non-recycled Portion:** $1.62 \text{ kg} * 0.35 = 0.567 \text{ kg}$

Material Category	Total Mass (kg)	Recycled Mass (kg)	Recycling Credit (kg CO2e)	Non-Recycled Mass (kg)	Non-Recycled Treatment	Non-Recycled Emissions (kg CO2e)
Metals (Aluminum, Copper)	0.85	0.5525	$0.5525 \text{ kg} * (-4.0 \text{ kg CO2e/kg}) = -2.21$	0.2975	Landfill	$0.2975 \text{ kg} * 0.02 \text{ kg CO2e/kg} = 0.00595$
Polymers/ Electronics (ABS, PCB, Battery)	0.65	0.4225	$0.4225 \text{ kg} * (-1.5 \text{ kg CO2e/kg}) = -0.63375$	0.2275	Incineration	$0.2275 \text{ kg} * 2.75 \text{ kg CO2e/kg} = 0.625625$
Paper/ Board (Packaging, Manual)	0.12	0.078	$0.078 \text{ kg} * (-0.7 \text{ kg CO2e/kg}) = -0.0546$	0.042	Incineration	$0.042 \text{ kg} * 0.7 \text{ kg CO2e/kg} = 0.0294$
Total EoL Credit:			-2.89835 kg CO2e	Total EoL Emissions:		0.660 kg CO
Net End-of-Life Impact:						-2.237 kg CO

4.4. Summary of Emissions by GHG Protocol Scope

GHG Scope	Lifecycle Stage	Emissions (kg CO2e per unit)	Notes
Scope 1	Direct Operations	0.0	No direct fuel combustion reported for factory operations in this dataset.

GHG Scope	Lifecycle Stage	Emissions (kg CO2e per unit)	Notes
Scope 2	Purchased Energy (Production)	9.0	From non-renewable portion of electricity used in manufacturing in China.
Scope 3	Upstream: Materials Acquisition & Pre-processing	11.564	Based on detailed BOM and provided carbon values.
	Downstream: Transportation (Ocean & Last-Mile)	0.4698	Transport from China to Europe, including last-mile.
	Downstream: Product Use Phase	17.5	Energy consumption over product lifespan in Europe.
	Downstream: End-of-Life Treatment	-2.237375	Net credit due to high recyclability and avoided virgin material production.
TOTAL PRODUCT CARBON FOOTPRINT (Cradle-to-Grave):			36.296425 kg CO2e per unit

5. Review & Report

5.1. Emission Hotspots

The analysis identifies the following primary emission hotspots for the product:

- Product Use Phase (17.5 kg CO2e):** This stage represents the largest contributor to the overall PCF, primarily due to the product's energy consumption over its 7-year lifespan. This is a critical area for design improvements focused on energy efficiency.
- Materials Acquisition & Pre-processing (11.564 kg CO2e):** The carbon intensity of raw materials, particularly electronics and metals, contributes significantly. Further investigation into low-carbon material alternatives and

increased use of recycled content beyond the end-of-life stage would be beneficial.

- **Manufacturing (9.0 kg CO₂e):** While significant, the company's 40% renewable energy usage already mitigates a portion of these emissions. Increasing renewable energy procurement in manufacturing facilities in China would further reduce this impact.

5.2. Reliability and Limitations

The reliability of this PCF analysis is primarily dependent on the accuracy and representativeness of the input data, especially the assumed emission factors for various processes and the breakdown of end-of-life scenarios.

- **Emission Factor Variances:** Industry-standard emission factors from sources like Ecoinvent/DEFRA (or similar public databases) were used where specific primary data was unavailable. These are averages and may not perfectly reflect the exact processes or regional specificities of every component or activity.
- **BOM Data:** The provided Detailed Bill of Materials (`ysnegvew`) was explicitly used for material impact, enhancing accuracy for this specific component of the footprint.
- **Assumptions:** Assumptions were made for last-mile delivery distance and the breakdown of materials for end-of-life treatment, as detailed in Section 2.5.
- **LSR Standard:** The lack of specific land use change or carbon removal data meant the 2026 LSR Standard could only be conceptually applied, indicating an area for future data collection.
- **Scope 3 Coverage:** While aiming for 95% coverage, some minor Scope 3 categories might be excluded due to data limitations (e.g., business travel, employee commuting, capital goods not directly linked to production).

5.3. Recommendations

- **Enhance Use Phase Efficiency:** Prioritize R&D efforts to reduce the energy consumption of 'iislwkotwe' during its operational life. Educating consumers on energy-efficient usage can also contribute.
- **Sustainable Material Sourcing:** Explore opportunities to integrate more low-carbon materials, certified recycled content, and materials with lower inherent carbon footprints in product design and procurement.
- **Increase Renewable Energy Adoption:** Further increase the share of renewable energy sources for manufacturing operations in China, potentially through on-site generation, Power Purchase Agreements (PPAs), or high-quality Renewable Energy Certificates (RECs).
- **Expand Circularity Initiatives:** Strengthen and expand existing circular economy and take-back programs to maximize the actual recycling and reuse rates of product components, further enhancing the negative (credit) impact of the End-of-Life stage.
- **Data Refinement:** Continuously improve data collection for primary activities, especially for inbound logistics and more granular end-of-life treatment pathways for complex components like electronics, to further refine the accuracy of the PCF.