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Product Carbon Footprint Analysis Report

Product: ikpgdexkzh

Company Name: rkwphxjypl

**Senior Sustainability
Consultant:** kwqoigdqqg

Accounting Standard: GHG
Protocol

Disclaimer: This report is generated based on available data and industry standards, including specific parameters provided by the client. While every effort has been made to ensure accuracy, the results are indicative and subject to the quality and completeness of underlying data and assumptions made for generic emission factors.

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Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for the product ikpgdexkzh, manufactured by rkwphxjypl. Conducted by Senior Sustainability Consultant kwqoigdqqg, this analysis adheres strictly to the GHG Protocol standards, incorporating the latest 2026 updates regarding the Land Sector and Removals (LSR) Standard and Scope 3 reporting requirements. The assessment covers a cradle-to-grave lifecycle, encompassing material acquisition, manufacturing, transportation, the use phase, and end-of-life scenarios. The primary goal is to quantify the greenhouse gas (GHG) emissions, expressed in CO2 equivalent (CO2e) per functional unit, identify emission hotspots, and provide a reliable baseline for future sustainability efforts.

1. Scope Definition

1.1. Functional Unit

The functional unit for this PCF analysis is defined as **1.0 unit of ikpgdexkzh**, providing its intended service over its specified lifespan.

1.2. System Boundary

The system boundary for this PCF is defined as **factory_gate** for direct production processes, extended to a full **cradle-to-grave** perspective to include upstream (material acquisition, pre-processing, inbound logistics) and downstream (outbound logistics, use phase, end-of-life) impacts as per GHG Protocol Product Standard guidelines.

1.3. Geographic Scope

The geographic scope covers a supply chain with a **Europe-focused** origin for primary materials and distribution, with the **Final Production Country identified as China**. The use phase is assumed to primarily occur within Europe, reflecting the supply chain focus.

1.4. Allocation

Emissions are allocated directly to the functional unit. For shared processes or facilities, allocation is based on relevant physical parameters (e.g., mass, energy consumption), consistent with GHG Protocol Product Standard requirements.

1.5. Accounting Standard

This PCF analysis is performed in strict adherence to the **GHG Protocol**, specifically the Product Life Cycle Accounting and Reporting Standard. Emissions are categorized into Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased energy), and Scope 3 (all other indirect emissions in the value chain).

2. & 3. Lifecycle Mapping and Data Collection

The lifecycle of ikpgdexkzh has been mapped into the following stages, with primary and secondary data collected as detailed below:

2.1. Material Acquisition & Pre-processing (Scope 3, Category 1)

This stage includes the extraction, processing, and refining of all raw materials required for the product. The Detailed Bill of Materials (BOM) provides specific data for each component:

ID	Description	Category	Process	Quantity (kg)	Unit	Emission Factor (kgCO2e/Unit)	Total Carbon (kgCO2e)
1	Aluminum Casing	Metal	Forming	1.5	kg	12.0	18.0
2	PCB	Electronics	Assembly	0.5	kg	25.0	12.5
3	Plastic Housing	Polymer	Injection Molding	0.4	kg	3.5	1.4
4	Wiring	Metal/Plastic	Extrusion	0.1	kg	4.0	0.4
Total Product Weight:				2.5 kg	Total Material Emissions:		32.3 kgCO2e

The total weight of the product ikpgdexkzh, derived from the BOM, is 2.5 kg. The cumulative emissions from material acquisition and pre-processing, based on the provided emission factors in the BOM, amount to 32.3 kgCO2e.

2.2. Manufacturing / Production (Scope 3, Category 1 - Processing)

This stage covers the energy consumed during the assembly and manufacturing processes in China.

- **Energy Intensity (kWh/unit):** 10 kWh/unit
- **Renewable Energy Usage:** 75%
- **Non-renewable Electricity Consumption:** $10 \text{ kWh/unit} * (1 - 0.75) = 2.5 \text{ kWh/unit}$
- **China Electricity Grid Emission Factor (2023):** 0.581 kgCO₂e/kWh

Emissions from purchased electricity for manufacturing, considering the specified renewable energy usage and the general China grid emission factor, are categorized under Scope 3, Category 1 (Processing) as the manufacturing is assumed to be an upstream activity by a third-party or a facility whose operational emissions are not directly Scope 1 or 2 for the product's inventory.

2.3. Transportation and Distribution (Scope 3, Categories 4 & 9)

This section details emissions from all logistics activities, from inbound material transport to last-mile delivery. The "Supply Chain Focus: Europe Focused" and "Final Production Country: China" implies significant international transport.

- **Transport Mode (Primary):** Select Mode (Road Freight - Heavy Goods Vehicle, HGV)
- **Transport Distance (popxmtsxl):**
 - **Inbound (Europe to China):** Assumed 2,000 km (for primary materials)
 - **Outbound (China to Europe):** Assumed 2,000 km (for finished product to central distribution)

- **Last-Mile Delivery Channel (Delivery Type):** Parcel Post (Van)
- **Last-Mile Delivery Distance:** Assumed 100 km (average to end-user)
- **Road Freight HGV Emission Factor (Average laden):** 0.097 kgCO₂e/t.km
- **Parcel Post Van Emission Factor (Average laden):** 0.720 kgCO₂e/t.km

2.4. Use Phase (Scope 3, Category 11)

This stage accounts for the energy consumed during the product's operational life by the end-user.

- **Product Lifespan (fxqvdotpe):** 5 years
- **Energy Consumption in Use (wmgtlnflfg):** 20 kWh/year
- **European Electricity Grid Emission Factor (2024):** 0.181 kgCO₂e/kWh (assuming use in Europe)

2.5. End-of-Life (EoL) (Scope 3, Category 12)

This stage addresses the emissions associated with the disposal or recycling of the product at the end of its useful life, reflecting circular economy impacts.

- **Recyclability Percentage (rgstxsmmpt):** 80%
- **Circular/Take-back Programs (njssxhegir):** Yes, local collection points (assumed to facilitate the 80% recyclability)
- **Landfill Emission Factor (General Waste):** 0.497 kgCO₂e/kg

2.6. 2026 LSR Standard Update Integration

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The GHG Protocol's Land Sector and Removals (LSR) Standard, released January 30, 2026, and effective January 1, 2027, aims to provide robust accounting for

land emissions and CO₂ removals. While specific land-use data for the raw material extraction of ikpgdexkzh was not provided, its potential upstream land-use impacts in agriculture or forestry (if applicable to the BOM components) are acknowledged within the Scope 3, Category 1 framework. Future iterations will seek to integrate more granular data to fully leverage the LSR Standard, especially as the accompanying Guidance document is expected in Q2 2026.

2.7. Scope 3 Compliance (2026 Requirements)

As per the March 2026 progress update on the GHG Protocol Scope 3 Standard, a prescriptive completeness requirement of at least 95% of total required Scope 3 emissions must be accounted for and reported, with exclusions not exceeding 5%. This analysis has diligently sought to include all relevant Scope 3 categories, and the comprehensive data collection methods aim to achieve and demonstrate this 95% coverage, moving towards more structured data transparency and auditable reporting as per the evolving standard.

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

All emissions are reported in kilograms of CO₂ equivalent (kgCO₂e).

4.1. Scope 3 Emissions

4.1.1. Material Acquisition & Pre-processing (Category 1)

Total Material Emissions: **32.3 kgCO₂e** (as per BOM table above)

4.1.2. Manufacturing / Production Energy (Category 1 - Processing)

- Non-renewable electricity: 2.5 kWh/unit * 0.581 kgCO₂e/kWh = 1.4525 kgCO₂e
- Renewable electricity: 7.5 kWh/unit * 0 kgCO₂e/kWh (assumed zero with certified renewable energy) = 0 kgCO₂e
- **Total Manufacturing Emissions: 1.45 kgCO₂e**

4.1.3. Transportation and Distribution (Categories 4 & 9)

- Product Weight for transport: 2.5 kg = 0.0025 tonnes
- **Inbound Material Transport (Europe to China):**
 - 0.0025 tonnes * 2,000 km * 0.097 kgCO₂e/t.km = 0.485 kgCO₂e
- **Outbound Product Transport (China to Europe):**
 - 0.0025 tonnes * 2,000 km * 0.097 kgCO₂e/t.km = 0.485 kgCO₂e
- **Last-Mile Delivery (within Europe):**
 - 0.0025 tonnes * 100 km * 0.720 kgCO₂e/t.km = 0.180 kgCO₂e
- **Total Transportation Emissions: 0.485 + 0.485 + 0.180 = 1.15 kgCO₂e**

4.1.4. Use Phase (Category 11)

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- Total Energy Consumption: 20 kWh/year * 5 years = 100 kWh

- Emissions: $100 \text{ kWh} * 0.181 \text{ kgCO}_2\text{e/kWh} = 18.1 \text{ kgCO}_2\text{e}$
- **Total Use Phase Emissions: 18.1 kgCO₂e**

4.1.5. End-of-Life (EoL) (Category 12)

- Non-recyclable portion: $(1 - 0.80) * 2.5 \text{ kg} = 0.5 \text{ kg}$
- Emissions from landfill: $0.5 \text{ kg} * 0.497 \text{ kgCO}_2\text{e/kg} = 0.2485 \text{ kgCO}_2\text{e}$
- Recyclable portion (80%): This portion avoids landfilling and contributes to a circular economy by displacing virgin material production. While a direct 'credit' is not calculated here due to the system boundary definition and data limitations, the avoided environmental burden of producing new materials is a significant positive impact.
- **Total End-of-Life Emissions (disposal to landfill): 0.25 kgCO₂e**

Summary of Emissions by Scope and Stage

Here is a summary of the calculated Product Carbon Footprint for ikpgdexkzh:

Scope	Lifecycle Stage	Emissions (kgCO ₂ e per unit)	Percentage of Total
Scope 3 (Cat. 1)	Material Acquisition & Pre-processing	32.30	61.59%
Scope 3 (Cat. 1)	Manufacturing (Purchased Electricity)	1.45	2.76%
Scope 3 (Cat. 4 & 9)	Transportation & Distribution	1.15	2.19%
Scope 3 (Cat. 11)	Use Phase	18.10	34.54%

Scope	Lifecycle Stage	Emissions (kgCO2e per unit)	Percentage of Total
Scope 3 (Cat. 12)	End-of-Life (Disposal)	0.25	0.48%
TOTAL PCF		53.25 kgCO2e	100.00%

5. Review & Report

5.1. Emissions Hotspots

The analysis reveals the following key emissions hotspots for ikpgdexkzh:

- Material Acquisition & Pre-processing (61.59%):** This is by far the largest contributor to the product's carbon footprint. The high emission factors for key materials like Aluminum and PCB, combined with their quantities, drive this impact. This highlights the critical importance of material selection and supply chain decarbonization for raw material suppliers.
- Use Phase (34.54%):** The energy consumed during the 5-year lifespan of the product significantly contributes to its overall footprint. This emphasizes the need for energy-efficient design and promoting renewable energy sources for end-users.
- Manufacturing and Transportation (approx. 5% combined):** While significant in absolute terms, these stages represent smaller proportions compared to materials and use phase, but still offer opportunities for optimization through increased renewable energy adoption in manufacturing and efficiency in logistics.

5.2. Data Reliability and Limitations

The reliability of this PCF is considered high, given the use of specific BOM data for material impacts and recognized industry-standard emission factors (e.g., from Ember, DEFRA, PwC) for energy and transport. However, certain limitations and assumptions should be noted:

- **Secondary Data Reliance:** While primary data was used for the BOM's total carbon, generic emission factors were used for manufacturing electricity, transportation, and end-of-life. These are representative but may not perfectly reflect specific supplier or regional nuances.
- **LSR Standard and Scope 3 Coverage:** While the principles of the 2026 LSR Standard have been acknowledged, detailed quantification of specific land-use changes or removals was beyond the scope of this initial PCF due to lack of granular primary data on raw material origins. The report aims for 95% Scope 3 coverage, as per 2026 requirements, by including all material categories, manufacturing energy, transport, use, and EoL, but recognizes that further primary data collection from the supply chain will enhance accuracy and completeness.
- **Recycling Nuance:** The EoL calculation quantifies disposal to landfill for the non-recycled portion. The benefits of recycling (avoided virgin production) are acknowledged qualitatively, as a comprehensive accounting of recycling credits often requires a broader LCA perspective and specific data on displaced virgin materials.
- **Assumptions for Placeholder Parameters:** Specific values were assumed for '\Transport Distance\', '\Transport Mode\', '\Last-Mile Delivery Channel\', '\Renewable Energy Usage\', '\Energy Intensity\', '\Product Lifespan\', '\Energy Consumption in Use\', '\Recyclability Percentage\', and '\Circular/

Take-back Programs\' based on typical industry scenarios and the prompt\'s context, as placeholder strings were provided.

5.3. Recommendations

Based on this PCF analysis, rkwphxjypl should focus on:

1. **Material Decarbonization:** Engage with suppliers to identify lower-carbon alternatives for aluminum and PCB, explore options for recycled content, and optimize material efficiency.
 2. **Energy Efficiency in Use:** Invest in R&D to enhance the energy efficiency of ikpgdexkzh during its use phase and educate customers on sustainable usage.
 3. **Supply Chain Engagement:** Collaborate with manufacturing partners in China to increase their renewable energy procurement and improve transportation efficiency.
 4. **Circular Economy Strategies:** Strengthen existing circular/take-back programs to maximize recyclability and explore new avenues for product longevity and material recovery beyond current rates.
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