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# **Product Carbon Footprint Report**

**Product:** fxzowuxdvf (Smart IoT Sensor)

**Company:** rgzmwwzney

**Senior Sustainability Consultant:**  
lmhojwryko

**Accounting Standard:** GHG Protocol Product  
Standard

This report is generated based on available data and industry standards, providing an estimate of the product's carbon footprint. While every effort has been made to ensure accuracy, actual emissions may vary depending on specific operational conditions and data availability.

# Product Carbon Footprint Analysis: fxyzowuxdvf

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## Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for rgzmwwzney\'s product, fxyzowuxdvf (Smart IoT Sensor), meticulously performed by Imhojwryko, Senior Sustainability Consultant. The analysis adheres to the Greenhouse Gas (GHG) Protocol Product Standard, incorporating the 2026 Land Sector and Removals (LSR) update. The total carbon footprint for one functional unit of fxyzowuxdvf is calculated to be 6.61 kg CO<sub>2</sub>e over its entire lifecycle. Key hotspots have been identified in the Use Phase due to energy consumption and in the materials acquisition phase, offering crucial insights for targeted emission reduction strategies.

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## Methodology

The Product Carbon Footprint analysis for fxyzowuxdvf follows a systematic five-step methodology in accordance with the GHG Protocol Product Standard:

- 1. Define Scope:** Establishment of the functional unit, system boundaries, geographic scope, and allocation rules.

2. **Map Lifecycle (LCI inventory stages):** Identification and mapping of all relevant processes and stages throughout the product's lifecycle.
3. **Collect Data:** Gathering of primary and secondary data points for each lifecycle stage.
4. **Calculate Emissions:** Quantification of greenhouse gas emissions (CO<sub>2</sub>e) using activity data multiplied by appropriate emission factors.
5. **Review & Report:** Analysis of results to identify hotspots, assess reliability, and present findings.

Emissions are categorized into Scope 1 (direct), Scope 2 (purchased energy), and Scope 3 (value chain) to ensure comprehensive reporting under the GHG Protocol. This analysis also applies the principles of the 2026 Land Sector and Removals (LSR) Standard, addressing land use and carbon removals where relevant, though for an IoT sensor, direct significant land use change impacts are predominantly indirect through material supply chains. Furthermore, the Scope 3 reporting aims for comprehensive coverage of relevant categories, aligning with the intent of 2026 requirements for robust value chain accounting.

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## 1. Scope Definition

- **Functional Unit:** 1.0 unit of fxzowuxdvf (Smart IoT Sensor).
- **System Boundary:** Cradle-to-grave, with a primary focus on the 'factory\_gate' for production emissions, extending through transport, use, and end-of-life.
- **Geographic Scope:**
  - Final Production Country: China
  - Supply Chain Focus: Europe Focused
- **Accounting Standard:** GHG Protocol Product Standard.

- **Allocation:** Mass-based allocation is applied where co-products or by-products are present in upstream processes, though not explicitly detailed for this product's BOM.

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## 2. Lifecycle Mapping & 3. Data Collection

The lifecycle of the fxzowuxdvf (Smart IoT Sensor) encompasses material acquisition, manufacturing, distribution, use, and end-of-life. Data was collected from a combination of primary company data (where available, represented by placeholder values) and secondary industry-average emission factors (e.g., from Ecoinvent and DEFRA databases).

### Detailed Bill of Materials (BOM) & Material Impact (Scope 3 - Upstream)

The following Bill of Materials (BOM) data, designated as 'edwourh', was used for high-accuracy material impact calculation. The 'Emission Factor' represents kg CO2e per unit of quantity.

ID	Description	Category	Process	Qty (kg)	Unit	Emission Factor (kg CO2e/kg)	Total Carbon (kg CO2e)
1	Main Casing	Plastic	Injection Molding	0.150	kg	3.5	0.525
2	Circuit Board	Electronics	PCB Manufacturing	0.050	kg	12.0	0.600
<b>Total Material Footprint:</b>							<b>1.775 kg CO2e</b>

ID	Description	Category	Process	Qty (kg)	Unit	Emission Factor (kg CO2e/kg)	Total Carbon (kg CO2e)
3	Battery	Metals	Battery Production	0.030	kg	8.0	0.240
4	Packaging	Paper/ Cardboard	Paper Production	0.020	kg	1.5	0.030
5	Connectors	Metals	Metal Stamping	0.010	kg	6.0	0.060
6	Sensors	Electronics	Semiconductor Mfg	0.020	kg	15.0	0.300
7	Wires	Plastic/ Metal	Wire Drawing	0.005	kg	4.0	0.020
<b>Total Material Footprint:</b>							<b>1.775 kg CO2e</b>

Total product weight for logistics calculations: 0.285 kg.

## Manufacturing Energy Inputs (Scope 2)

- **Production Country:** China
- **Energy Intensity (kWh/unit):** kjnhpoxqtr (4.2 kWh/unit)
- **Renewable Energy Usage (Issxplperd):** 60% (of total electricity consumed)
- **Grid Electricity Emission Factor (China):** 0.6 kg CO2e/kWh (industry average, e.g., from IEA/ Ecoinvent)
- **Non-renewable Electricity:** 4.2 kWh/unit \* (1 - 0.60) = 1.68 kWh/unit

## Logistics Data (Scope 3 - Upstream & Downstream)

- **Transport Mode (Select Mode):** Ocean Freight (Container Ship), Road Freight (Heavy Duty Truck)
- **Transport Distance (jgqylwhjqu):** 15,000 km (Ocean), 800 km (Road)
- **Last-Mile Delivery Channel (Delivery Type):** Standard Parcel Post (Van)
- **Assumed Emission Factors:**
  - Ocean Freight: 0.010 kg CO<sub>2</sub>e/tonne-km
  - Road Freight (Heavy Duty Truck): 0.080 kg CO<sub>2</sub>e/tonne-km
  - Last-Mile Delivery (Standard Parcel Post): 0.2 kg CO<sub>2</sub>e/unit (estimated for urban van delivery)

## Use Phase Data (Scope 3 - Downstream)

- **Product Lifespan (ggsyxholtd):** 7 years
- **Energy Consumption in Use (wgensugydt):** 2 kWh/year
- **Grid Electricity Emission Factor (Europe, average):** 0.25 kg CO<sub>2</sub>e/kWh (e.g., from Eurostat/Ecoinvent)

## End-of-Life (EoL) Scenarios (Scope 3 - Downstream)

- **Recyclability Percentage (xgyeppnngd):** 70%
- **Circular/Take-back Programs (tdgefdloqm):** rgzmwwzney offers a product take-back program for end-of-life devices, promoting material recovery and responsible disposal.
- **Assumed Emission Factors:**
  - Disposal (Landfill/Incineration for non-recycled): 0.5 kg CO<sub>2</sub>e/kg

- Recycling Process Emissions (for recycled materials): 0.1 kg CO2e/kg

## 4. Emissions Calculation

Emissions were calculated by multiplying activity data by relevant emission factors (Activity × Emission Factor = CO2e). The results are categorized according to the GHG Protocol Scopes.

### Summary of Emissions by Lifecycle Stage

Lifecycle Stage	GHG Scope	Emissions (kg CO2e/unit)
Materials Acquisition & Processing	Scope 3 (Upstream)	1.775
Manufacturing	Scope 2	1.008
Transport (Upstream & Downstream)	Scope 3 (Upstream & Downstream)	0.261
Use Phase	Scope 3 (Downstream)	3.500
End-of-Life	Scope 3 (Downstream)	0.063
<b>Total Product Carbon Footprint:</b>		<b>6.607 kg CO2e</b>

### Detailed Scope-based Emissions

#### Scope 1 Emissions (Direct Emissions)

For the defined system boundary and production processes, direct (Scope 1) emissions from owned or controlled sources are assumed to be negligible or captured within upstream material/energy production

by suppliers. No significant on-site fuel combustion for the manufacturing of fxzowuxdvf was identified or allocated to the product boundary from the provided data.

- **Total Scope 1 Emissions:** 0.000 kg CO<sub>2</sub>e/unit

### **Scope 2 Emissions (Purchased Electricity)**

These emissions arise from the generation of purchased electricity consumed during the manufacturing phase in China.

- Energy Intensity: 4.2 kWh/unit
- Renewable Energy Usage: 60%
- Non-renewable Electricity: 1.68 kWh/unit
- Grid Electricity EF (China): 0.6 kg CO<sub>2</sub>e/kWh
- **Total Scope 2 Emissions:** 1.68 kWh/unit \* 0.6 kg CO<sub>2</sub>e/kWh = **1.008 kg CO<sub>2</sub>e/unit**

### **Scope 3 Emissions (Value Chain Emissions)**

Scope 3 emissions constitute the majority of the product's footprint, covering both upstream and downstream activities. This report covers the most significant categories to ensure comprehensive reporting, aligning with the 95% coverage requirement for relevant Scope 3 categories as per emerging 2026 standards.

- **Category 1: Purchased Goods and Services (Materials Acquisition & Processing)**
  - Total Material Footprint: **1.775 kg CO<sub>2</sub>e/unit**
- **Category 4: Upstream Transportation and Distribution**
  - Ocean Freight (15,000 km): 0.000285 tonnes \* 15,000 km \* 0.010 kg CO<sub>2</sub>e/tkm = 0.04275 kg CO<sub>2</sub>e

- Road Freight (800 km):  $0.000285 \text{ tonnes} * 800 \text{ km} * 0.080 \text{ kg CO}_2\text{e/tkm} = 0.01824 \text{ kg CO}_2\text{e}$
- **Subtotal Upstream Transport: 0.061 kg CO<sub>2</sub>e/unit**
- **Category 9: Downstream Transportation and Distribution (Last-Mile)**
  - Last-Mile Delivery (Standard Parcel Post): 0.2 kg CO<sub>2</sub>e/unit (estimated)
  - **Subtotal Downstream Transport: 0.200 kg CO<sub>2</sub>e/unit**
- **Category 11: Use of Sold Products**
  - Product Lifespan: 7 years
  - Energy Consumption in Use: 2 kWh/year
  - Total Use Phase Energy: 14 kWh
  - Grid Electricity EF (Europe): 0.25 kg CO<sub>2</sub>e/kWh
  - **Total Use Phase Emissions:**  $14 \text{ kWh} * 0.25 \text{ kg CO}_2\text{e/kWh} = 3.500 \text{ kg CO}_2\text{e/unit}$
- **Category 12: End-of-Life Treatment of Sold Products**
  - Total Product Weight: 0.285 kg
  - Non-recycled portion (30%):  $0.0855 \text{ kg} * 0.5 \text{ kg CO}_2\text{e/kg (disposal)} = 0.04275 \text{ kg CO}_2\text{e}$
  - Recycled portion (70%):  $0.1995 \text{ kg} * 0.1 \text{ kg CO}_2\text{e/kg (recycling process)} = 0.01995 \text{ kg CO}_2\text{e}$
  - **Total End-of-Life Emissions:**  $0.04275 + 0.01995 = 0.063 \text{ kg CO}_2\text{e/unit}$

**Total Scope 3 Emissions:**  $1.775 \text{ (Materials)} + 0.061 \text{ (Upstream Transport)} + 0.200 \text{ (Downstream Transport)} + 3.500 \text{ (Use Phase)} + 0.063 \text{ (EoL)} = 5.599 \text{ kg CO}_2\text{e/unit}$

## Summary of Carbon Footprint by GHG Scope

GHG Scope	Emissions (kg CO2e/unit)	Percentage of Total PCF
Scope 1	0.000	0.00%
Scope 2	1.008	15.26%
Scope 3	5.599	84.74%
<b>Total PCF:</b>	<b>6.607</b>	<b>100.00%</b>

The comprehensive coverage of major Scope 3 categories (purchased goods and services, transportation, use of sold products, and end-of-life) ensures that the value chain impacts of fxyzwuxdvf are robustly assessed. The 2026 LSR Standard for land use and carbon removals has been considered; for this product, significant direct land use emissions are not anticipated, but indirect impacts through material production are implicitly included in the emission factors used for BOM items.

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## 5. Review & Report

### Hotspot Analysis

The analysis identifies the following key emission hotspots for fxyzwuxdvf:

- **Use Phase (3.500 kg CO2e, 53% of total):** The primary hotspot is the electricity consumption during the 7-year lifespan of the IoT sensor. Even with a relatively low annual consumption, the cumulative effect over the lifespan is significant, especially considering the average European grid mix.
- **Materials Acquisition & Processing (1.775 kg CO2e, 27% of total):** The production of electronic

components (Circuit Board, Sensors, Battery) and plastic casing are major contributors within the upstream supply chain.

- **Manufacturing (1.008 kg CO<sub>2</sub>e, 15% of total):** Electricity consumed during the manufacturing process contributes significantly, despite 60% renewable energy usage. The remaining grid electricity in China (with a higher carbon intensity) drives this impact.

## Reliability and Limitations

The PCF calculation is based on the best available data, combining specific product parameters with industry-average emission factors (e.g., Ecoinvent, DEFRA). The reliability is considered moderate to high for the identified hotspots. Limitations include:

- Reliance on generic emission factors for certain processes where primary data was unavailable.
- Assumptions regarding last-mile delivery and disposal scenarios.
- The 2026 LSR Standard's direct applicability to an IoT sensor's bill of materials is primarily via embedded carbon in materials and energy, rather than direct land use change.

## Recommendations for Emission Reduction

Based on the hotspot analysis, rgzmwwzney should consider the following actions to reduce the PCF of fxzowuxdvf:

- **Optimise Use Phase Energy:** Explore options for ultra-low power components, enhance energy efficiency algorithms, or investigate integration with renewable energy sources for users. Providing clear user guidance on energy-efficient usage is also important.

- **Sustainable Material Sourcing:** Investigate alternative materials with lower embodied carbon for plastics and electronics, and prioritize suppliers committed to renewable energy in their production processes.
  - **Increase Renewable Energy in Manufacturing:** Further increase the share of renewable energy used in the manufacturing facilities or encourage contract manufacturers to do so, especially in regions with carbon-intensive grids.
  - **Enhance Circularity:** Leverage the existing take-back program to maximize material recovery and explore design for disassembly and repair to extend product lifespan and reduce the need for new materials. Aim to increase the recyclability percentage further.
  - **Supply Chain Engagement:** Collaborate with suppliers to identify and reduce emissions across upstream logistics and material production.
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