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Product Carbon Footprint (PCF) Analysis

Product: uevgrtwkgz

Company Name: swxrzhonxe

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Accounting Standard: GHG Protocol

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Product Carbon Footprint Report

Product: uevgrtwkgz

Generated Date: June 3, 2026

Executive Summary

This report details a high-detail Product Carbon Footprint (PCF) analysis for the product uevgrtwkgz, manufactured by swxrzhonxe. The analysis was conducted by veuxiusxin, a Senior Sustainability Consultant specializing in GHG Protocol. Adhering to the GHG Protocol as the accounting standard, this assessment quantifies the greenhouse gas emissions across the product\'s lifecycle, from material extraction to end-of-life. Key parameters, including a detailed Bill of Materials, specific logistics data, energy usage, and end-of-life scenarios, have been incorporated to provide a robust and accurate footprint. The report highlights emission hotspots and provides a foundational understanding for future emission reduction strategies.

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1. Methodology and Scope Definition

The Product Carbon Footprint (PCF) analysis for uevgrtwkgz follows the five-step methodology recommended by the GHG Protocol Product Standard, ensuring a comprehensive and standardized assessment.

1.1. Scope Definition

- **Functional Unit:** The functional unit for this PCF is defined as 1.0 unit of uevgrtwkgz. This unit serves as the reference basis for quantifying inputs and outputs throughout the product lifecycle.
- **System Boundary:** The analysis adopts a "Cradle-to-Gate with Modules" system boundary, specifically defined as \'factory_gate\'. This boundary includes all upstream processes from raw material acquisition, material processing, manufacturing

of components, to the final assembly of the product at the factory gate. Additionally, downstream stages including transport to customer, use phase, and end-of-life are included to provide a holistic view.

- **Geographic Scope:** The final production country for uevgrtwkgz is China, with a specific focus on a Europe-focused supply chain for upstream materials. Downstream impacts consider global average use and end-of-life scenarios.
- **Allocation:** Where multi-functional processes occur (e.g., co-production, recycling), emissions are allocated based on physical allocation (mass) for co-products and economic value where physical allocation is not feasible or representative. Recycling benefits are accounted for using the "System Expansion" approach, crediting avoided virgin material production.
- **Accounting Standard:** The entire analysis strictly adheres to the GHG Protocol Product Life Cycle Accounting and Reporting Standard. This ensures consistency, comparability, and transparency in the reported emissions.

1.2. GHG Protocol Scopes Categorization

Emissions are categorized according to the GHG Protocol Corporate Standard, which provides a framework for understanding direct and indirect emissions:

- **Scope 1 (Direct Emissions):** Emissions from sources owned or controlled by swxrzhonxe. For this product-level assessment, this would typically include direct fuel combustion at the manufacturing facility not covered by purchased energy. Based on the "Energy Intensity (kWh/unit)" parameter, direct combustion for manufacturing processes is considered minimal or integrated into electricity consumption data for this PCF.
- **Scope 2 (Energy Indirect Emissions):** Emissions from the generation of purchased electricity, steam, heating, or cooling consumed by swxrzhonxe\'s manufacturing operations.
- **Scope 3 (Other Indirect Emissions - Value Chain):** All other indirect emissions both upstream and downstream in the value

chain. This forms the majority of the PCF for uevgrtwkgz and includes:

- **Upstream Scope 3:** Material acquisition, pre-processing, inbound logistics, and manufacturing of intermediate products.
- **Downstream Scope 3:** Outbound transportation, distribution, last-mile delivery, product use phase, and end-of-life treatment.

1.3. 2026 Land Sector and Removals (LSR) Update

In anticipation of the 2026 LSR Standard, this report acknowledges the critical importance of integrating land use change and carbon removal activities. While specific land use data for uevgrtwkgz\'s raw materials was not provided, future analyses would incorporate the LSR Standard to:

- Quantify emissions and removals from land-based activities within the product\'s value chain.
- Differentiate between gross and net emissions, providing a more complete picture of climate impact.
- Ensure transparency in reporting both anthropogenic emissions and removals from the biogenic carbon cycle.

1.4. Scope 3 Compliance

In line with upcoming 2026 requirements, this PCF analysis aims for at least 95% coverage for Scope 3 emissions. The detailed breakdown of materials, transport, use phase, and end-of-life scenarios is designed to capture the most significant emission sources across the value chain, ensuring comprehensive reporting.

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2. Lifecycle Mapping and Data Collection

This section details the lifecycle stages considered and the primary and secondary data points collected for the PCF analysis of uevgrtwkgz.

2.1. Lifecycle Inventory Stages

The product lifecycle of uevgrtwkgz is mapped across the following stages, encompassing all relevant GHG emission sources:

1. **Raw Material Acquisition & Pre-processing (Upstream Scope 3):** Extraction and initial processing of all raw materials required for uevgrtwkgz.
2. **Manufacturing (Scope 2 & Upstream Scope 3):** Production of components, sub-assemblies, and final assembly of uevgrtwkgz at swxrzhonxe\'s facility in China. This includes energy consumption and waste generation during manufacturing.
3. **Transportation (Upstream & Downstream Scope 3):**
   - Inbound: Transport of raw materials and components to the manufacturing facility.
   - Outbound: Transport of the finished product from the factory gate to the customer.
   - Last-Mile: Final delivery to the end-user.
4. **Use Phase (Downstream Scope 3):** Energy consumption during the typical operational lifespan of uevgrtwkgz by the end-user.
5. **End-of-Life (Downstream Scope 3):** Collection, recycling, disposal, and treatment of the product at the end of its functional life.

2.2. Data Collection - Detailed Breakdown

2.2.1. Detailed Bill of Materials (BOM) - hsokmfed

The following detailed Bill of Materials (BOM) was used for high-accuracy material impact calculation. The \'Total Carbon\' for each item represents its embodied carbon from raw material extraction through its processing into a component, provided as specific input for this analysis.

ID	Description	Category	Process	Quantity	Unit	Material Emission Factor (kg CO2e/ unit)	Total Carbon from Material Production (kg CO2e)
1	Aluminum Casing	Metal	Casting	0.5	kg	7.0	3.50
2	Circuit Board	Electronics	Assembly	1	unit	2.0	2.00
3	Plastic Enclosure	Polymer	Injection Molding	0.2	kg	3.0	0.60
4	Battery	Energy Storage	Manufacturing	0.1	kg	15.0	1.50
5	Packaging (Cardboard)	Packaging	Processing	0.05	kg	1.0	0.05

Total Product Weight (estimated from BOM): 0.85 kg

Total Material Carbon Footprint: 7.65 kg CO2e

2.2.2. Energy Inputs for Production Phase

- **Renewable Energy Usage:** 75% of the energy consumed at the manufacturing facility is sourced from renewable energy.
- **Energy Intensity (kWh/unit):** The production of one unit of uevgrtwkgz requires 0.8 kWh of energy.

2.2.3. Logistics Data

- **Transport Mode (Outbound):** Ocean Freight
- **Transport Distance (Outbound):** 8000 km
- **Last-Mile Delivery Channel:** Parcel Post (Van)
- **Assumed Inbound Material Transport:** Given a \'Europe Focused\' supply chain for materials to China production, an average inbound ocean freight distance of 5,000 km is assumed for significant material components.
- **Assumed Last-Mile Distance:** An average last-mile delivery distance of 100 km is assumed.

2.2.4. Use Phase Data

- **Product Lifespan:** uevgrtwkgz has an estimated lifespan of 5 years.
- **Energy Consumption in Use:** During its lifespan, the product consumes 0.05 kWh/day.

2.2.5. End-of-Life (EoL) Scenarios

- **Recyclability Percentage:** 85% of uevgrtwkgz\'s materials are recyclable.
- **Circular/Take-back Programs:** swxrzhonxe operates an Active Buy-back Program for uevgrtwkgz, encouraging product return and material recovery.

2.2.6. Emission Factors (Secondary Data)

Industry-standard emission factors were sourced from reputable databases (e.g., Ecoinvent, DEFRA) and are assumed for this analysis where not provided directly. Specific factors used in calculations are detailed in the next section.

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3. Emission Calculation

This section presents the calculation of GHG emissions (expressed in kg CO2e) for each lifecycle stage, categorized by GHG Protocol Scopes.

3.1. Assumed Emission Factors for Calculations

- **China Grid Electricity Mix:** 0.6 kg CO2e/kWh (for non-renewable portion of production energy)
- **Global Average Grid Electricity Mix:** 0.2 kg CO2e/kWh (for use phase energy)
- **Ocean Freight:** 0.01 kg CO2e/tonne-km
- **Parcel Post (Van):** 0.15 kg CO2e/tonne-km
- **Recycling Credit:** -0.5 kg CO2e/kg (for avoided virgin material production)
- **Landfill/Incineration (Disposal):** 0.1 kg CO2e/kg (for non-recycled portion)

3.2. Detailed Emissions Calculation by Stage

3.2.1. Raw Material Acquisition & Pre-processing (Scope 3 - Upstream)

This category directly uses the \'Total Carbon from Material Production\' provided in the BOM.

- **Total Embodied Carbon from Materials:** 7.65 kg CO2e

3.2.2. Manufacturing Energy (Scope 2)

- Energy Intensity: 0.8 kWh/unit
- Renewable Energy Usage: 75%
- Non-renewable Energy Consumption: 0.8 kWh/unit * (1 - 0.75) = 0.2 kWh/unit
- China Grid Electricity Emission Factor: 0.6 kg CO2e/kWh

- **Manufacturing Energy Emissions:** 0.2 kWh/unit * 0.6 kg CO2e/kWh = 0.12 kg CO2e

3.2.3. Transportation (Scope 3 - Upstream & Downstream)

Product Weight = Total BOM Weight = 0.85 kg (0.00085 tonnes)

- **Inbound Material Transport (Upstream Scope 3):**
  - Assumed Average Inbound Distance: 5,000 km
  - Assumed Product Weight: 0.85 kg (as a proxy for components)
  - Ocean Freight Emission Factor: 0.01 kg CO2e/tonne-km
  - Emissions: 0.00085 tonnes * 5000 km * 0.01 kg CO2e/tonne-km = 0.0425 kg CO2e
- **Outbound Product Transport (Downstream Scope 3):**
  - Mode: Ocean Freight
  - Distance: 8000 km
  - Ocean Freight Emission Factor: 0.01 kg CO2e/tonne-km
  - Emissions: 0.00085 tonnes * 8000 km * 0.01 kg CO2e/tonne-km = 0.068 kg CO2e
- **Last-Mile Delivery (Downstream Scope 3):**
  - Channel: Parcel Post (Van)
  - Assumed Last-Mile Distance: 100 km
  - Parcel Post (Van) Emission Factor: 0.15 kg CO2e/tonne-km
  - Emissions: 0.00085 tonnes * 100 km * 0.15 kg CO2e/tonne-km = 0.01275 kg CO2e
- **Total Transportation Emissions:** 0.0425 + 0.068 + 0.01275 = 0.12325 kg CO2e

3.2.4. Use Phase (Scope 3 - Downstream)

- Product Lifespan: 5 years = 1825 days
- Energy Consumption in Use: 0.05 kWh/day
- Total Use Phase Energy: 1825 days * 0.05 kWh/day = 91.25 kWh
- Global Average Grid Electricity Emission Factor: 0.2 kg CO2e/kWh

- **Use Phase Emissions:** 91.25 kWh * 0.2 kg CO2e/kWh = 18.25 kg CO2e

3.2.5. End-of-Life (EoL) (Scope 3 - Downstream)

- Recyclability Percentage: 85%
- Total Product Weight: 0.85 kg
- Recycled Portion Weight: 0.85 kg * 0.85 = 0.7225 kg
- Disposed Portion Weight: 0.85 kg * (1 - 0.85) = 0.1275 kg
- Recycling Credit: 0.7225 kg * -0.5 kg CO2e/kg = -0.36125 kg CO2e
- Disposal Emissions: 0.1275 kg * 0.1 kg CO2e/kg = 0.01275 kg CO2e
- **Net End-of-Life Emissions:** -0.36125 + 0.01275 = -0.3485 kg CO2e (net negative due to recycling credits)
- **Circular/Take-back Programs:** The Active Buy-back Program further enhances the circularity, reducing potential end-of-life impacts and promoting material recovery.

3.3. Summary of Product Carbon Footprint (PCF) for uevgrtwkgz

The total Product Carbon Footprint for one functional unit of uevgrtwkgz, from cradle-to-gate with additional modules for transport, use, and end-of-life, is calculated as follows:

Lifecycle Stage	GHG Protocol Scope	Emissions (kg CO2e)
Raw Material Acquisition & Pre-processing	Scope 3 (Upstream)	7.6500
Manufacturing Energy	Scope 2	0.1200
Inbound Material Transport	Scope 3 (Upstream)	0.0425
Outbound Product Transport	Scope 3 (Downstream)	0.0680

Lifecycle Stage	GHG Protocol Scope	Emissions (kg CO2e)
Last-Mile Delivery	Scope 3 (Downstream)	0.0128
Use Phase	Scope 3 (Downstream)	18.2500
End-of-Life (Net)	Scope 3 (Downstream)	-0.3485
TOTAL PRODUCT CARBON FOOTPRINT		**25.7948**

3.4. GHG Protocol Scopes Summary

GHG Protocol Scope	Total Emissions (kg CO2e)	Percentage of Total PCF
Scope 1 (Direct Emissions)	0.0000 [a]	0.00%
Scope 2 (Purchased Energy)	0.1200	0.47%
Scope 3 (Value Chain)	25.6748 [b]	99.53%
TOTAL PCF	**25.7948**	**100.00%**

[a] No significant direct Scope 1 emissions were quantified at the product level based on provided parameters, assuming factory energy is primarily electricity.

[b] Scope 3 includes Raw Materials, Inbound/Outbound/Last-Mile Transport, Use Phase, and Net End-of-Life emissions (7.65 + 0.0425 + 0.068 + 0.0128 + 18.25 - 0.3485 = 25.6748).

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4. Review and Reporting

4.1. Emission Hotspots

Based on the calculations, the primary emission hotspots for uevgrtwkgz are:

- **Use Phase (18.25 kg CO2e - ~70.75% of total):** The significant energy consumption over the product\'s 5-year lifespan is the dominant contributor to its PCF. This highlights the importance of user behavior and the carbon intensity of electricity grids where the product is used.
- **Raw Material Acquisition & Pre-processing (7.65 kg CO2e - ~29.66% of total):** The embodied carbon in materials, particularly from high-impact components like aluminum and batteries, represents the second-largest hotspot.
- **End-of-Life (Net -0.3485 kg CO2e):** The strong recyclability and the active buy-back program lead to a net negative contribution, demonstrating the positive impact of circular economy initiatives.

4.2. Reliability and Limitations

The reliability of this PCF analysis is high due to the detailed input parameters provided and adherence to the GHG Protocol. However, certain limitations should be noted:

- **Emission Factor Assumptions:** While industry-standard emission factors were used, their accuracy can vary depending on the specific supplier, technology, and geographic origin. Primary data for all emission factors would enhance precision.
- **Inbound Transport:** Assumed average distances for inbound material transport were used due to the absence of specific supplier-to-factory logistics data.
- **Use Phase Energy Mix:** The use phase relies on a global average grid mix. Actual emissions would vary significantly based on the end-user\'s local electricity grid carbon intensity.

- **LSR Integration:** Full integration of the 2026 LSR Standard requires specific land-use change data, which was not available for this product.

4.3. Recommendations for Emission Reduction

Based on the identified hotspots, swxrzhonxe should consider the following strategies to reduce the PCF of uevgrtwkgz:

- **Optimize Use Phase Efficiency:** Invest in R&D to further reduce the product\'s energy consumption during its operational life. Educate users on energy-efficient usage patterns.
- **Promote Renewable Energy Adoption:** Encourage end-users to power the product with renewable energy sources where possible, and advocate for decarbonization of electricity grids.
- **Material Optimization:** Continue to explore lightweighting options and alternative, lower-carbon materials for the aluminum casing and battery components. Work with suppliers to reduce the embodied carbon of purchased materials.
- **Enhance Circularity:** Leverage the Active Buy-back Program to maximize material recovery and explore opportunities to increase the recyclability percentage beyond 85%. Investigate repairability and modular design to extend product lifespan.
- **Supply Chain Engagement:** Collaborate with upstream suppliers to identify and mitigate emissions hotspots within the raw material and component manufacturing processes.
