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Product Carbon Footprint Analysis Report

Product: vunprejliy

Company Name: rymqzmmwsh

Accounting Standard: GHG Protocol

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Disclaimer: This report is generated based on available data and industry standards. While every effort has been made to ensure accuracy, certain assumptions were necessary due to generalized input parameters. This report serves as a high-level assessment and a foundation for further detailed analysis.

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Executive Summary

This report provides a high-detail Product Carbon Footprint (PCF) analysis for 'vunprejliy' manufactured by 'rymqzmmwsh'. The analysis adheres to the GHG Protocol Product Standard, quantifying greenhouse gas (GHG) emissions across the product's lifecycle from a cradle-to-gate perspective, extended to include the use phase and end-of-life (EoL) scenarios. Key lifecycle stages assessed include material acquisition, manufacturing, transport, use, and end-of-life. The total carbon footprint for 'vunprejliy' is calculated to identify emission hotspots and inform sustainability strategies.

1. Define Scope

1.1 Functional Unit

The functional unit for this PCF analysis is defined as **1.0 unit of vunprejliy**.

1.2 System Boundary

The system boundary for this analysis is primarily **factory_gate**, encompassing all processes from raw material extraction (cradle) through manufacturing (gate). This has been extended to include key downstream stages: distribution (last-mile delivery), the use phase, and end-of-life treatment to provide a more comprehensive view, aligning with a modified cradle-to-grave approach for a product carbon footprint.

1.3 Geographic Scope

- **Final Production Country:** China
- **Supply Chain Focus:** Europe Focused
- **Use Phase Assumption:** For energy consumption during the use phase, it is assumed the product is primarily used within Europe, influencing the electricity emission factors applied.

1.4 Accounting Standard

This Product Carbon Footprint analysis strictly follows the **GHG Protocol Product Life Cycle Accounting and Reporting Standard**. This standard provides comprehensive guidance for quantifying and reporting GHG emissions associated with products across their lifecycle. 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).

1.5 Allocation

Emissions are directly allocated to the functional unit (1.0 unit of vunprejliy). Where co-products or by-products are present in upstream processes, generally accepted allocation methods (e.g., mass or economic allocation, where applicable) are assumed to have been applied in the underlying emission factor datasets. For end-of-life, the avoided burden approach for recycling is implicitly considered by applying emissions only to the non-recycled portion.

2. Map Lifecycle & 3. Collect Data

The lifecycle of 'vunprejliy' is mapped across five main stages, and data is collected from the provided parameters as well as industry-standard emission factors.

2.1 Material Acquisition & Pre-processing (Scope 3, Category 1: Purchased Goods and Services)

The detailed Bill of Materials (BOM) is used for high-accuracy material impact calculation. The BOM components, quantities, and their associated cradle-to-gate emission factors are detailed below. The 'Total Carbon' values provided in the BOM are directly used as the pre-calculated material emissions.

ID	Description	Category	Process	Qty	Unit	Emission Factor (kg CO2e/unit_qty)	Total Carbon (kg CO2e)
1	Plastic Casing	Plastics	Injection Molding	0.5	kg	2.5	1.25
2	Circuit Board	Electronics	Assembly	0.1	kg	15.0	1.50
3	Copper Wire	Metals	Extrusion	0.05	kg	4.0	0.20
4	Packaging Cardboard	Paper & Board	Processing	0.2	kg	0.8	0.16
Total Material Weight					0.85 kg		
Total Material Emissions (Cradle-to-gate)							3.11 kg CO2e

2.2 Manufacturing / Production (Scope 2: Purchased Electricity)

Production energy consumption data is customized as follows:

- **Energy Intensity (kWh/unit):** 12.5 kWh/unit
- **Renewable Energy Usage:** 65%
- **Geographic Location:** China

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- **China Grid Emission Factor:** 0.58 kg CO₂e/kWh (national average)

2.3 Transport of Materials (Upstream, Scope 3, Category 4: Upstream Transportation and Distribution)

Logistics data for material transport to the factory are as follows:

- **Transport Mode:** Road Freight (Heavy Truck)
- **Transport Distance:** 1500 km
- **Road Freight Emission Factor:** 0.13 kg CO₂e/tonne-km (derived from industry averages for heavy-duty trucks)
- **Total Material Weight:** 0.85 kg (0.00085 tonnes)

2.4 Distribution (Downstream, Scope 3, Category 9: Downstream Transportation and Distribution) - Last-Mile Delivery

Last-mile delivery specific data:

- **Last-Mile Delivery Channel:** Courier Van
- **Assumed Last-Mile Distance per unit:** 50 km (allocated assuming 100 units per van trip for average load)
- **Courier Van Emission Factor:** 0.25 kg CO₂e/km (for average vans, up to 3.5 tonnes)

2.5 Use Phase (Scope 3, Category 11: Use of Sold Products)

Durability and consumption data for the use phase are:

- **Product Lifespan:** 7 years
- **Energy Consumption in Use:** 15 kWh/year
- **Assumed Geographic Location for Use:** Europe
- **Estimated Average European Electricity Grid Emission Factor:** 0.25 kg CO₂e/kWh (illustrative average)

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2.6 End-of-Life (EoL) (Scope 3, Category 12: End-of-Life Treatment of Sold Products)

EoL scenarios incorporate circular economy impacts:

- **Recyclability Percentage:** 80%
 - **Circular/Take-back Programs:** Yes, established product take-back scheme
 - **Total Product Mass:** 0.85 kg
 - **Non-recycled portion:** 0.17 kg
 - **Average Material Emission Factor (from BOM):** 3.659 kg CO₂e/kg (for the portion of materials not recovered)
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4. Calculate Emissions

Emissions are calculated for each stage based on activity data multiplied by appropriate emission factors, expressed in kg CO₂e per functional unit.

4.1 Scope 1 Emissions (Direct Emissions)

For this product carbon footprint analysis, assuming the 'factory_gate' boundary and typical manufacturing processes, direct (Scope 1) emissions from on-site fuel combustion owned or controlled by 'rymqzmmwsh' are considered negligible for the product unit, as primary energy-intensive processes like material production are covered in Scope 3.

Total Scope 1 Emissions: 0.00 kg CO₂e

4.2 Scope 2 Emissions (Purchased Electricity)

Emissions from the generation of purchased electricity for manufacturing in China:

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- Total Energy Intensity: 12.5 kWh/unit
 - Renewable Energy Usage: 65%
 - Non-renewable electricity consumed: $12.5 \text{ kWh/unit} * (1 - 0.65)$
= 4.375 kWh/unit

- Emissions from non-renewable electricity: $4.375 \text{ kWh/unit} * 0.58 \text{ kg CO}_2\text{e/kWh} = 2.5375 \text{ kg CO}_2\text{e/unit}$
- Emissions from renewable electricity: $0 \text{ kg CO}_2\text{e/unit}$ (assuming grid-connected renewable sources with zero operational emissions)

Total Scope 2 Emissions: 2.54 kg CO₂e

4.3 Scope 3 Emissions (Value Chain)

4.3.1 Category 1: Purchased Goods and Services (Materials)

The total carbon footprint from the detailed Bill of Materials (BOM) is directly aggregated from the provided 'Total Carbon' values.

- Total Carbon from BOM: $1.25 \text{ (Plastic Casing)} + 1.50 \text{ (Circuit Board)} + 0.20 \text{ (Copper Wire)} + 0.16 \text{ (Packaging Cardboard)} = 3.11 \text{ kg CO}_2\text{e}$

Total Scope 3, Category 1 Emissions: 3.11 kg CO₂e

4.3.2 Category 4: Upstream Transportation and Distribution (Materials to Factory)

- Total Material Weight: 0.00085 tonnes
- Transport Distance: 1500 km
- Emission Factor (Road Freight): $0.13 \text{ kg CO}_2\text{e/tonne-km}$
- Emissions: $0.00085 \text{ tonnes} * 1500 \text{ km} * 0.13 \text{ kg CO}_2\text{e/tonne-km} = 0.16575 \text{ kg CO}_2\text{e}$

Total Scope 3, Category 4 Emissions: 0.17 kg CO₂e

4.3.3 Category 9: Downstream Transportation and Distribution (Last-Mile Delivery)

Assuming a courier van delivers the product over 50 km, shared by 100 units:

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- Courier Van Emission Factor: $0.25 \text{ kg CO}_2\text{e/km}$
- Emissions: $(50 \text{ km} * 0.25 \text{ kg CO}_2\text{e/km}) / 100 \text{ units} = 0.125 \text{ kg CO}_2\text{e}$

Total Scope 3, Category 9 Emissions: 0.13 kg CO₂e

4.3.4 Category 11: Use of Sold Products (Energy Consumption in Use)

- Product Lifespan: 7 years
- Annual Energy Consumption: 15 kWh/year
- Total Energy Consumption: 7 years * 15 kWh/year = 105 kWh/unit
- European Grid Emission Factor (Assumed): 0.25 kg CO₂e/kWh
- Emissions: 105 kWh/unit * 0.25 kg CO₂e/kWh = 26.25 kg CO₂e

Total Scope 3, Category 11 Emissions: 26.25 kg CO₂e

4.3.5 Category 12: End-of-Life Treatment of Sold Products

Considering 80% recyclability, emissions are calculated for the 20% non-recycled portion. The average material emission factor from the BOM is used to represent the lost material value.

- Total Product Mass: 0.85 kg
- Non-recycled portion: 0.85 kg * (1 - 0.80) = 0.17 kg
- Average Material Emission Factor (from BOM): 3.659 kg CO₂e/kg
- Emissions: 0.17 kg * 3.659 kg CO₂e/kg = 0.62203 kg CO₂e

The established take-back scheme ('uhkifzxpwj') positively contributes to circularity, reducing potential landfill or incineration impacts for the recyclable fraction.

Total Scope 3, Category 12 Emissions: 0.62 kg CO₂e

4.4 Application of 2026 LSR Update (Land Sector and Removals Standard)

The GHG Protocol's Land Sector and Removals (LSR) Standard, effective January 1, 2027, provides guidelines for accounting for land sector emissions (e.g., land use change, land management, biogenic products) and CO₂ removals. While the full guidance is still being developed (expected Q2 2026), this analysis acknowledges its importance. For 'vunprejliy', a manufactured product, direct land-use change emissions within the 'factory_gate' boundary are not

significant. Upstream impacts related to raw material production that might involve land use are implicitly covered within the Scope 3, Category 1 emission factors of the Bill of Materials. No explicit carbon removals are claimed or calculated for this product in this assessment, but the established circular economy programs ('uhkifzxpwj') aim to minimize such impacts at EoL.

4.5 Scope 3 Compliance (95% Coverage)

This analysis aims for at least 95% coverage for Scope 3 reporting as per 2026 requirements. By including major upstream (materials, transport) and downstream (distribution, use phase, EoL) categories, the significant value chain emissions for 'vunprejliy' are covered, providing a robust estimate of its full PCF.

4.6 Total Product Carbon Footprint Summary

Emission Scope/ Category	Description	CO2e (kg per functional unit)
Scope 1	Direct Emissions (negligible for PCF)	0.00
Scope 2	Purchased Electricity (Manufacturing)	2.54
Scope 3, Category 1	Purchased Goods and Services (Materials)	3.11
Scope 3, Category 4	Upstream Transportation and Distribution	0.17
Scope 3, Category 9	Downstream Transportation and Distribution (Last-Mile)	0.13
Scope 3, Category 11	Use of Sold Products	26.25
Scope 3, Category 12	End-of-Life Treatment of Sold Products	0.62
TOTAL PRODUCT CARBON FOOTPRINT		32.82 kg CO2e

5. Review & Report

5.1 Emission Hotspots

The analysis reveals the following major emission hotspots for 'vunprejliy':

- **Use Phase (Scope 3, Category 11):** Constitutes the largest portion of emissions (approx. 80%), primarily due to the energy consumption over the product's 7-year lifespan. This highlights the critical importance of energy efficiency in product design.
- **Purchased Goods and Services (Scope 3, Category 1):** Material production accounts for the second largest share of emissions (approx. 9.5%), indicating that material selection and optimization are key areas for reduction.
- **Purchased Electricity (Scope 2):** Manufacturing electricity consumption contributes approximately 7.7% of the total footprint, even with 65% renewable energy usage, due to the emission intensity of the remaining grid electricity in China.

5.2 Reliability and Recommendations

The reliability of this PCF relies heavily on the accuracy of the provided BOM data and the chosen industry-average emission factors. The following recommendations are made for 'rymqzmmwsh':

- **Enhance Use Phase Efficiency:** Focus product design on minimizing energy consumption during the product's lifespan. Explore low-power modes, longer durability without increased energy draw, or shift to passive functionalities.
- **Material Optimization:** Investigate alternative, lower-carbon materials or suppliers with robust primary data on their material production emissions. Evaluate the feasibility of increasing recycled content beyond current levels, ensuring quality and performance.
- **Renewable Energy Sourcing:** While 65% renewable energy usage is commendable, further increasing this percentage or sourcing certified green electricity (with low residual mix

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factors) in the production country (China) would significantly reduce Scope 2 emissions.

- **Supply Chain Engagement:** Work with upstream suppliers to reduce their emissions, especially for high-impact components like circuit boards and plastics.
- **Refine Data Collection:** Where possible, replace generic or industry-average emission factors with supplier-specific primary data for greater accuracy.