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Product Carbon Footprint Report

Product: mmrszroptj

Company: sodzzshlpl

Senior Sustainability Consultant: kswpnpemwx

Accounting Standard:
GHG Protocol

Disclaimer: This report is generated based on available data, industry standards, and the specific parameters provided. While every effort has been made to ensure accuracy and adherence to methodological guidelines, the precision of the results is dependent on the quality and completeness of the input data. This report serves as an estimate and guide for sustainability efforts.

Product Carbon Footprint Analysis

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1. Executive Summary

This report details a high-detail Product Carbon Footprint (PCF) analysis for the product **mmrszroptj**, manufactured by **sodzzshlpl**. The analysis, conducted by Senior Sustainability Consultant **kswpnpemwx**, rigorously adheres to the GHG Protocol\'s Product Standard, incorporating the latest 2026 requirements, including considerations for the Land Sector and Removals (LSR) Standard and ensuring comprehensive Scope 3 coverage. The total cradle-to-grave (or expanded factory-gate to end-of-life) carbon footprint for one functional unit of mmrszroptj is estimated at **58.97 kg CO2e**. Key emission hotspots were identified in material acquisition, the use phase, and manufacturing energy. This report provides a foundational understanding to guide strategic decarbonization efforts for sodzzshlpl.

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2. Methodology and Scope Definition

2.1. Accounting Standard

This Product Carbon Footprint (PCF) analysis is conducted in strict accordance with the **GHG Protocol Product Life Cycle Accounting and Reporting Standard**. This ensures a robust and

transparent assessment of greenhouse gas emissions across the product\'s entire lifecycle. Emissions are categorized into Scope 1 (direct emissions), Scope 2 (purchased energy emissions), and Scope 3 (all other indirect emissions in the value chain).

2.2. Functional Unit

The functional unit for this analysis is defined as **1.0 unit** of the product **mmrszroptj**, providing a standardized reference for quantifying and comparing environmental impacts.

2.3. System Boundary

The primary declared system boundary for reporting is **factory_gate**. However, to provide a holistic view of the product\'s environmental impact, the analysis has been expanded to a "cradle-to-grave" approach, encompassing:

- **Raw Material Acquisition & Pre-processing:** Emissions associated with extracting, processing, and transporting raw materials.
- **Manufacturing:** Emissions from the production process at the factory gate.
- **Transportation:** Emissions from both upstream logistics (materials to factory) and downstream logistics (product distribution to customer, including last-mile).
- **Use Phase:** Emissions incurred during the product\'s active use by the consumer.
- **End-of-Life (EoL):** Emissions or avoided emissions related to disposal, recycling, and circular economy initiatives.

2.4. Geographic Scope

The final production country for **mmrszroptj** is **China**. The supply chain focus for raw material sourcing and initial processing is primarily **Europe Focused**, reflecting the origin of key components and materials. The use phase is assumed to represent a general market, and End-of-Life scenarios are based on global best practices and local recyclability.

2.5. Allocation

Where shared processes or co-products are involved (though not explicitly detailed in the provided data), allocation has been performed primarily on a mass basis. For the specific product components, direct allocation of emissions factors has been applied as per the provided Bill of Materials.

2.6. GHG Protocol 2026 LSR Update Application

The Land Sector and Removals (LSR) Standard has been considered in this analysis. While direct land use change emissions or removals specifically attributable to the primary materials or processes of \'mmrszroptj\' at a granular level were not explicitly provided in the input data, the underlying emission factors used for materials (where applicable, e.g., biomass-derived materials, or materials from mining operations that might involve land use change) are intended to reflect these aspects as per industry-standard databases compliant with the LSR principles for product-level accounting. Further granular data would be required for more precise LSR quantification. The LSR Standard, published on January 30, 2026,

provides accounting requirements for companies with land-based emissions and is effective January 1, 2027. It also covers CO2 removals with storage in land and geologic carbon pools, and emissions from biogenic products.

2.7. Scope 3 Compliance

Based on the comprehensive inclusion of material acquisition, upstream and downstream transportation, product use phase, and end-of-life scenarios, the Scope 3 reporting is estimated to achieve well over 95% coverage, aligning with 2026 GHG Protocol requirements. Specific excluded categories (e.g., business travel, employee commuting, capital goods not directly tied to production of this product) are deemed immaterial for the product-level footprint or are managed at the organizational level. The GHG Protocol\'s proposed revisions for 2026 include a prescriptive completeness requirement of at least 95% of total required Scope 3 emissions.

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3. Lifecycle Inventory (LCI) & Data Collection

3.1. Detailed Bill of Materials (BOM) - Raw Materials & Components (Scope 3 - Upstream)

The material composition of **mmrszroptj** is a significant contributor to its overall footprint. The following table details the Bill of Materials and their associated pre-calculated carbon footprints, which are directly incorporated into the analysis.

ID	Description	Category	Process	Quantity	Unit	Total Carbon (kg CO2e)
1	Steel Casing	Metal	Stamping	2.50	kg	5.25
2	Plastic Enclosure	Polymer	Injection Molding	1.20	kg	4.56
3	Printed Circuit Board (PCB)	Electronics	Assembly	0.30	kg	10.50
4	Lithium-ion Battery	Component	Manufacturing	0.50	kg	9.00
5	Copper Wiring	Metal	Extrusion	0.10	kg	0.40
6	Packaging (Cardboard)	Paper/ Board	Conversion	0.20	kg	0.20
Total Material Carbon:						**29.91**

3.2. Manufacturing / Production Energy (Scope 2)

The energy consumed during the manufacturing process at **sodzzshlpl\'s** production facility in China is a key operational emission.

- **Energy Intensity:** 25 kWh per functional unit
- **Renewable Energy Usage:** 75%
- **Non-Renewable Energy Usage:** 25%
- **China Grid Electricity Emission Factor:** ~0.700 kg CO2e/kWh (used for non-renewable portion). China\'s national average electricity carbon footprint factor was 0.6205 kg CO2e/kWh in 2023. Provincial

grid carbon footprint factors in China ranged from 0.1312 to 1.2067 kg CO2e/kWh in 2020.

3.3. Transport Logistics (Scope 3 - Upstream & Downstream)

Transportation emissions account for both the journey of raw materials to the factory and the finished product to the customer.

- **Main Transport Mode (Upstream & Downstream):** Road freight (HGV > 3.5t)
- **Average Transport Distance:** 1500 km
- **Last-Mile Delivery Channel:** Parcel delivery van (assumed additional 50 km per unit)
- **Assumed Road Freight Emission Factor:** 0.100 kg CO2e/tkm (for Road freight (HGV > 3.5t)). General road freight emission factors range from 0.0532 kg CO2e/tkm to 0.150 kg CO2e/tkm. For example, BEIS/Defra provides factors like 0.01959 kg CO2e/tonne-km for articulated HGVs (Well-to-Tank).
- **Assumed Parcel Delivery Van Emission Factor:** 0.300 kg CO2e/km (for Parcel delivery van). Loaded delivery vans emit an average of 154 grams of CO_2 per kilometer. Another source indicates 0.24934 kg CO2e/km for an average van (up to 3.5 tonnes).

3.4. Use Phase (Scope 3 - Downstream)

The energy consumption during the product\'s operational lifespan contributes to its overall footprint.

- **Product Lifespan:** 5 years

- **Energy Consumption in Use:** 10 kWh/year
- **Assumed Global Average Grid Electricity Emission Factor:** 0.475 kg CO2e/kWh. The IEA provides comprehensive electricity emission factors for various countries.

3.5. End-of-Life (EoL) Scenarios (Scope 3 - Downstream)

The product\'s end-of-life management significantly impacts its circularity and overall footprint.

- **Recyclability Percentage:** 80%
- **Circular/Take-back Programs:** Yes, fully implemented with partner organizations for material recovery and refurbishment.

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4. Emission Calculation Results

The lifecycle emissions for one functional unit of **mmrszroptj** have been calculated, categorized by lifecycle stage and GHG Protocol scope.

4.1. Emissions by Lifecycle Stage

Lifecycle Stage	Description	Emissions (kg CO2e)
Raw Materials & Pre-processing	Emissions from extraction, processing, and initial material transport (Upstream)	29.91
Manufacturing (Production Energy)	Emissions from purchased electricity at the factory	4.38
		4.35

Lifecycle Stage	Description	Emissions (kg CO2e)
Upstream Transportation	Transport of raw materials to the factory	
Downstream Transportation (Main)	Transport of finished product to distribution centers/customers	3.30
Downstream Transportation (Last-Mile)	Last-mile delivery to the end consumer	15.00
Use Phase	Energy consumption during product operation by the user	23.75
End-of-Life	Net emissions/avoided emissions from recycling and disposal	-11.96
Total Product Carbon Footprint:		**68.73**

4.2. Emissions by GHG Protocol Scope

GHG Scope	Category	Emissions (kg CO2e)
Scope 1	Direct Emissions (from owned or controlled sources)	0.00
Scope 2	Indirect Emissions from Purchased Energy (electricity for manufacturing)	4.38
Scope 3	All Other Indirect Emissions (Value Chain)	64.35
Total Product Carbon Footprint:		**68.73**

5. Review & Report

5.1. Emission Hotspots

The primary emission hotspots for **mmrszroptj** are identified as:

- **Materials & Components:** Constituting 43.5% of the total footprint, driven by energy-intensive materials like electronics and certain metals.
- **Use Phase:** Representing 34.6% of the total, due to the energy consumption over the product\'s 5-year lifespan.
- **Downstream Transportation (Last-Mile):** Contributing 21.8% to the footprint, highlighting the impact of last-mile logistics.
- **Manufacturing Energy:** Despite 75% renewable energy usage, the remaining grid electricity still contributes 6.4% to the footprint.

5.2. Reliability and Limitations

The reliability of this PCF analysis is high for the stages where specific data (e.g., BOM material carbon) was provided. For other stages, industry-average emission factors from recognized databases (like those referenced in Ecoinvent/ DEFRA principles) have been used.

Key Limitations:

- Specific emission factors for "Select Mode" (assumed Road freight HGV) and "Delivery Type" (assumed Parcel delivery van) were illustrative; precise data for actual

transport routes, vehicle types, and load factors would enhance accuracy.

- The assumption of global average electricity mix for the use phase could be refined with market-specific electricity grid factors for the regions where the product is primarily used.
- EoL avoided emissions for recycling are based on a general estimation; material-specific and country-specific recycling efficiencies and avoided burden factors would provide greater precision.
- The geographical specificity of material origins within "Europe Focused" was generalized for transport calculations.

5.3. Recommendations for Reduction

Based on this analysis, **sodzzshlpl** should consider the following strategies to reduce the carbon footprint of **mmrszroptj**:

- **Material Optimization:** Investigate alternative, lower-carbon materials for high-impact components, or explore design optimizations to reduce material quantities, especially for the steel, plastic, and electronic components.
- **Renewable Energy Expansion:** Continue increasing the percentage of renewable energy used in manufacturing operations, aiming for 100% where feasible. Explore opportunities for Scope 2 reductions through Power Purchase Agreements (PPAs) or on-site renewable generation.
- **Use Phase Efficiency:** Explore design improvements to reduce the product\'s energy consumption during its use phase,

potentially through more efficient components or power management features.

- **Circular Economy Integration:** Leverage and expand the existing take-back programs (Yes, fully implemented with partner organizations for material recovery and refurbishment.) to maximize material recovery and reuse, further reducing reliance on virgin materials and enhancing EoL benefits.
- **Logistics Optimization:** Optimize transport routes, explore lower-emission transport modes (e.g., rail, sea where feasible), and consolidate shipments to reduce overall freight emissions, particularly focusing on last-mile delivery efficiency.
