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Product Carbon Footprint Report

Product: onnfrtghpe

Company: hnkxmomgvm

Protocol Data (Accounting Standard): GHG
Protocol

Senior Sustainability Consultant:
vhulqstwgk

Disclaimer: This report is generated based on available data and industry standards. While efforts have been made to ensure accuracy and adherence to the GHG Protocol, results are subject to the completeness and reliability of the provided input parameters and the emission factors used.

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Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for 'onnfrtghpe', manufactured by hnkxmomgvm, in accordance with the GHG Protocol standards. The analysis covers the entire lifecycle, from raw material extraction to end-of-life, categorizing emissions into Scope 1, 2, and 3. Key findings highlight emission hotspots across the product's lifecycle, providing a robust foundation for targeted emission reduction strategies. Special attention has been given to achieving at least 95% coverage for Scope 3 emissions, aligning with 2026 requirements, and applying the Land Sector and Removals (LSR) Standard where applicable.

1. Define Scope

This section outlines the foundational parameters guiding the PCF analysis for onnfrtghpe.

- **Functional Unit:** 1.0 unit of onnfrtghpe. The functional unit defines the quantified performance of a product system for use as a reference unit.

- **System Boundary:** Cradle-to-gate, encompassing all processes from raw material acquisition (cradle) to the point where the product leaves the manufacturing facility (gate), as specified by the 'factory_gate' parameter. Downstream stages (transport to consumer, use phase, and end-of-life) are also analyzed to provide a comprehensive view, despite the 'factory_gate' primary boundary for upstream Scope 3, to meet the high-detail requirement.
- **Geographic Scope:** Final production country is China, with a supply chain focus on Europe. This informs the selection of country-specific electricity grid emission factors and assumptions for transport routes and distances.
- **Accounting Standard:** GHG Protocol. 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).
- **Allocation:** Where co-products or waste streams occur, mass-based allocation has been assumed for simplicity, given the lack of specific allocation rules provided. The focus is on the emissions directly attributable to the production of one functional unit of onnfrtghpe.

2. & 3. Map Lifecycle & Collect Data

This section details the lifecycle stages considered and the primary and secondary data points collected for the analysis. Assumed numerical values for placeholders are explicitly stated.

2.1 Bill of Materials (BOM) Data (Upstream - Scope 3)

The following detailed Bill of Materials (BOM) has been used for high-accuracy material impact calculation. The 'Total Carbon' values provided in the BOM are directly used as material-specific emissions per functional unit. For calculating product weight for transport, a reasonable estimation has been made for the 'Circuit Board' item.

ID	Description	Category	Process	Qty	Unit	Emission Factor (kgCO2e/Unit)	Total Carbon (kgCO2e)
1	Aluminium Casing	Metal	Casting	0.5	kg	7.0	3.5
2	Circuit Board	Electronics	Assembly	1	unit	2.0	2.0
3	Plastic Housing	Plastic	Molding	0.3	kg	3.0	0.9

Total Material Carbon Footprint: 6.4 kgCO2e.

Assumed Product Weight for Transport Calculation: Based on the BOM, assuming the '1 unit' of Circuit Board corresponds to approximately 0.1 kg, the total product weight is estimated at 0.5 kg (Aluminium) + 0.1 kg (Circuit Board assumed) + 0.3 kg (Plastic) = 0.9 kg (0.0009 tonnes).

2.2 Energy Inputs for Production (Midstream - Scope 1 & 2)

- **Final Production Country:** China
- **Energy Intensity (kWh/unit):** 8.5 kWh/unit (Input: lhkpgkiuvy). This is the total electricity consumed during the manufacturing of one unit of onnfrtghpe.
- **Renewable Energy Usage:** 60% (Input: rqidznhpjn). This percentage of the total energy consumed for production is sourced from renewable energy.
- **China Electricity Grid Emission Factor (National Average 2021):** 0.5568 kgCO2e/kWh. This factor is used for the non-renewable portion of purchased electricity.
- **Scope 1 Emissions (Direct):** No specific direct fuel combustion data (e.g., on-site natural gas for heating) was provided. For this analysis, Scope 1 emissions from manufacturing are assumed to be negligible unless specific data becomes available.

2.3 Transport Logistics Data (Upstream & Downstream - Scope 3)

Assumptions for generic transport modes and their associated emission factors are made due to placeholder inputs. The 'Transport Distance' provided is applied to the primary transport of the product.

- **Primary Transport (Finished Product from Factory to European Distribution Hub):**
 - **Transport Mode (Input: Select Mode):** Assumed to be Ocean Freight (container ship) for the long haul from China to Europe.
 - **Transport Distance (Input: fqiagesljs):** Assumed 12000 km for this primary transport phase.
 - **Ocean Freight Emission Factor:** 0.016 kgCO₂e/tonne-km.
- **Last-Mile Delivery (Finished Product from Distribution Hub to Customer):**
 - **Delivery Channel (Input: Delivery Type):** Assumed to be Light Commercial Vehicle (LCV).
 - **Last-Mile Delivery Distance (Assumed):** 50 km per unit.
 - **Light Commercial Vehicle (LCV) Emission Factor:** 0.5 kgCO₂e/tonne-km. This is a conservative factor reflecting the higher intensity of small, less-than-full loads over shorter distances typical of last-mile operations.

2.4 Use Phase Data (Downstream - Scope 3)

- **Product Lifespan (Input: hkpkurhznh):** 3 years.
- **Energy Consumption in Use (Input: zhxffvwwvh):** 15 kWh/year. This translates to a total of 45 kWh over the product's lifespan (15 kWh/year * 3 years).
- **Average Electricity Grid Emission Factor (Global Average for Use):** 0.475 kgCO₂e/kWh (generic average for typical use across various regions).

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

- **Recyclability Percentage (Input: xujrjgiqqg):** 75%. This percentage is applied to the recyclable materials within the product (e.g., Aluminium, Plastic Housing from BOM).
 - **Circular/Take-back Programs (Input: ztodvfetij):** "A robust take-back program for key electronic components is in place, aiming for material recovery and refurbishment where feasible." This qualitative input supports the potential for higher recycling rates and material circularity.
 - **EoL Emission Factors (Assumed for Non-Recycled Portion and for Recycling Benefits):**
 - **Plastic Landfill:** 0.033 kgCO₂e/kg for disposed plastic.
 - **Avoided Emissions - Plastic Recycling:** -2.0 kgCO₂e/kg (credit for displacing virgin polymer production).
 - **Avoided Emissions - Aluminium Recycling:** -8.0 kgCO₂e/kg (credit for displacing primary aluminium production, estimated based on a 94-95% reduction from primary production, which is around 8.6 kgCO₂e/kg in Europe).
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4. Calculate Emissions

Emissions are calculated for each lifecycle stage based on activity data multiplied by appropriate emission factors, categorized by GHG Protocol scopes.

4.1 Upstream Emissions (Scope 3)

4.1.1 Materials Acquisition & Pre-processing

Emissions from raw material extraction and processing, as provided by the detailed BOM:

Description	Total Carbon (kgCO ₂ e)
Aluminium Casing	3.5
Circuit Board	2.0
Plastic Housing	0.9
Total Material Emissions	6.400

Total Upstream Material Emissions: 6.400 kgCO₂e

4.1.2 Upstream Transport (Finished Product from Factory to European Hub)

Calculated assuming the full 12000 km for ocean freight of the 0.0009 tonnes (0.9 kg) product.

- Emissions = Distance (km) * Product Weight (tonnes) * Emission Factor (kgCO₂e/tonne-km)
- Emissions = 12000 km * 0.0009 tonnes * 0.016 kgCO₂e/tonne-km
- **Upstream Transport Emissions: 0.173 kgCO₂e**

4.2 Core Emissions (Manufacturing - Scope 1 & 2)

4.2.1 Scope 1: Direct Emissions

As no specific direct fuel combustion data was provided, Scope 1 emissions from manufacturing are considered negligible in this analysis.

Total Scope 1 Emissions: 0.000 kgCO₂e

4.2.2 Scope 2: Purchased Electricity Emissions

Calculated based on energy intensity, non-renewable portion, and China's grid emission factor.

- Total Electricity Consumption = 8.5 kWh/unit (lhkpgkiuvy)
- Non-Renewable Electricity Consumption = 8.5 kWh * (1 - 0.60) = 3.4 kWh/unit

- Emissions = Non-Renewable Electricity Consumption * China Grid Emission Factor
- Emissions = 3.4 kWh/unit * 0.5568 kgCO₂e/kWh
- **Total Scope 2 Emissions: 1.893 kgCO₂e**

4.3 Downstream Emissions (Scope 3)

4.3.1 Downstream Transport (Last-Mile Delivery)

Calculated for last-mile delivery to the consumer, assuming 50 km distance for the 0.0009 tonne product.

- Emissions = Distance (km) * Product Weight (tonnes) * Emission Factor (kgCO₂e/tonne-km)
- Emissions = 50 km * 0.0009 tonnes * 0.5 kgCO₂e/tonne-km
- **Last-Mile Delivery Emissions: 0.023 kgCO₂e**

4.3.2 Use Phase Emissions

Calculated based on product lifespan and energy consumption during use, using a global average electricity mix.

- Total Energy Consumption in Use = 15 kWh/year * 3 years (hkpkurhznh) = 45 kWh/unit
- Emissions = Total Energy Consumption in Use * Average Electricity Grid Emission Factor (Global Average)
- Emissions = 45 kWh/unit * 0.475 kgCO₂e/kWh
- **Total Use Phase Emissions: 21.375 kgCO₂e**

4.3.3 End-of-Life (EoL) Emissions / Credits

Calculated based on recyclability percentage and material-specific EoL factors for Aluminium and Plastic Housing from the BOM.

- **Aluminium Casing (0.5 kg):**
 - Recycled Aluminium = 0.5 kg * 75% = 0.375 kg
 - Avoided Emissions (Aluminium Recycling) = 0.375 kg * -8.0 kgCO₂e/kg = -3.000 kgCO₂e
- **Plastic Housing (0.3 kg):**
 - Recycled Plastic = 0.3 kg * 75% = 0.225 kg

- Disposed Plastic = 0.3 kg * 25% = 0.075 kg
- Emissions (Plastic Landfill) = 0.075 kg * 0.033 kgCO₂e/kg = 0.002 kgCO₂e
- Avoided Emissions (Plastic Recycling) = 0.225 kg * -2.0 kgCO₂e/kg = -0.450 kgCO₂e
- **Total EoL Emissions/Credits:** -3.000 (Aluminium Recycling) + 0.002 (Plastic Landfill) - 0.450 (Plastic Recycling) = -3.448 kgCO₂e

4.4 Summary of PCF by Lifecycle Stage

Lifecycle Stage	Emissions (kgCO ₂ e)	GHG Scope
Materials Acquisition & Pre-processing	6.400	Scope 3 (Upstream)
Upstream Transport	0.173	Scope 3 (Upstream)
Manufacturing (Scope 1)	0.000	Scope 1
Manufacturing (Scope 2 - Purchased Electricity)	1.893	Scope 2
Downstream Transport (Last-Mile Delivery)	0.023	Scope 3 (Downstream)
Use Phase	21.375	Scope 3 (Downstream)
End-of-Life (Net Emissions/Credits)	-3.448	Scope 3 (Downstream)
Total Product Carbon Footprint (PCF)	26.416	

4.5 GHG Protocol Scope Summary

GHG Scope	Emissions (kgCO ₂ e)	Percentage of Total (%)
Scope 1 (Direct Emissions)	0.000	0.0%
	1.893	7.2%

GHG Scope	Emissions (kgCO ₂ e)	Percentage of Total (%)
Scope 2 (Purchased Electricity)		
Scope 3 (Upstream - Materials & Transport)	6.400 + 0.173 = 6.573	24.9%
Scope 3 (Downstream - Transport, Use, EoL)	0.023 + 21.375 - 3.448 = 17.950	67.9%
Total PCF	26.416	100.0%

Scope 3 Coverage: $(6.573 + 17.950) / 26.416 = 92.8\%$. This represents a comprehensive coverage of value chain emissions, aligning closely with the 2026 requirements, though achieving 95% would necessitate even more granular data for all upstream and downstream activities.

2026 LSR Update Applicability: The Land Sector and Removals (LSR) Standard is acknowledged. For 'onnfrtghpe', a manufactured product with no direct agricultural or forestry raw materials specified in the BOM, direct land-use change and removals are not quantified in this report. Should specific bio-based materials with land-use impacts be introduced, this aspect would require detailed analysis under the LSR Standard.

5. Review & Report

5.1 Emission Hotspots

The analysis identifies the following key emission hotspots for onnfrtghpe:

- **Use Phase (67.9% of total PCF):** This is the most significant contributor to the product's carbon footprint, primarily due to the energy consumption of the product over its 3-year lifespan. This highlights the critical importance of

energy efficiency in product design and user behavior for future emission reduction strategies.

- **Materials Acquisition & Pre-processing (24.2% of total PCF):** Emissions embedded in raw materials, particularly the Aluminium Casing, represent the second largest hotspot. This underscores the need for sustainable sourcing, material lightweighting, and increased recycled content in product development.
- **Manufacturing (Scope 2, 7.2% of total PCF):** While smaller than other stages, the purchased electricity for production in China contributes notably. Increasing the use of renewable energy sources beyond the current 60% would further reduce this impact.

5.2 Reliability & Limitations

The reliability of this PCF analysis is dependent on several factors:

- **Data Quality:** The report relies on a combination of primary data (BOM specifics, energy intensity, renewable usage, lifespan, use phase energy, recyclability) and secondary, industry-average emission factors (electricity grids, transport, EoL scenarios). While efforts were made to use relevant and recent secondary data, generic factors may not perfectly reflect specific supplier or regional conditions.
- **Assumptions:** Several assumptions were made for generic input parameters (e.g., specific modes for '\Select Mode\' and '\Delivery Type\', product weight for transport calculations). These assumptions are clearly stated and impact the final results. More precise primary data for these parameters would enhance accuracy.
- **System Boundary:** While the primary system boundary for upstream Scope 3 was '\factory_gate\', a comprehensive cradle-to-grave perspective was adopted for reporting to provide a complete picture of impacts.
- **Scope 3 Coverage:** While substantial, reaching approximately 92.8%, achieving the full 95% 2026 requirement would necessitate even more granular data for all upstream and downstream activities, potentially including

minor components, packaging not explicitly in BOM, or
business travel related to the product's value chain.

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