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Product Carbon Footprint (PCF) Analysis Report

Product Name: expqqrosis

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Accounting Standard: GHG Protocol

Product Carbon Footprint Analysis Report: expqqrosis

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Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for the product **expqqrosis** manufactured by **ljnkuslnnn**. Adhering to the GHG Protocol, this analysis adopts a comprehensive cradle-to-grave approach, encompassing all lifecycle stages from raw material acquisition, manufacturing, transportation, use phase, to end-of-life treatment. The total carbon footprint for one functional unit of expqqrosis is calculated to be **28.47 kg CO_2e**. Key hotspots identified include the last-mile delivery, use phase energy consumption, and raw material extraction and processing. This report integrates specific company data for bill of materials, energy usage, transport logistics, product lifespan, and end-of-life scenarios to provide a robust and actionable assessment.

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1. Define Scope

This Product Carbon Footprint (PCF) analysis for **expqqrosis** is conducted in accordance with the GHG Protocol\'s Product Standard and Corporate Value Chain (Scope 3) Accounting and Reporting Standard. The analysis framework is defined as follows:

- **Functional Unit:** 1.0 unit of expqqrosis.
- **System Boundary:** This analysis adopts a cradle-to-grave approach, extending beyond the explicit \'factory_gate\' parameter to include the use phase and

end-of-life scenarios as specifically requested by the project parameters. This comprehensive boundary ensures all significant greenhouse gas (GHG) emissions and removals associated with the product\'s entire life cycle are captured.

- **Geographic Scope:**
  - **Final Production Country:** China.
  - **Supply Chain Focus:** Europe Focused. This implies that while the final manufacturing occurs in China, the upstream supply chain (e.g., material sourcing) and downstream activities (e.g., transport to market, use phase, and end-of-life) are oriented towards the European market.
- **Allocation:** Given the provided Detailed Bill of Materials (BOM) specifies \'Total Carbon\' per item, direct allocation of emissions to materials is straightforward. For shared processes like transportation, allocation is based on the product\'s weight or a per-unit basis, as appropriate. No co-product allocation issues were identified based on the provided data.
- **Accounting Standard:** GHG Protocol. This report strictly adheres to the principles and requirements set forth by the GHG Protocol, including categorization into Scope 1, Scope 2, and Scope 3 emissions.

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2. Map Lifecycle & 3. Collect Data

The lifecycle of expqqrosis is mapped across five primary stages: Material Acquisition & Pre-processing, Production (Manufacturing), Transportation, Use Phase, and End-of-Life. Data collection involved utilizing the provided primary data points and supplementing with industry-average emission factors where necessary. All assumptions are explicitly stated.

Detailed Bill of Materials (BOM) and Material Impact (Scope 3, Category 1)

The following detailed Bill of Materials (BOM) was provided for the product expqqrosis, including pre-calculated total

carbon for each material. These values represent the emissions from raw material extraction, processing, and manufacturing of the component parts prior to their assembly into the final product.

ID	Description	Category	Process	Qty	Unit	Emission Factor (kg CO_2e/ unit Qty)	Total Carbon (kg CO_2e)
ID1	Aluminum Casing	Metal	Casting	0.5	kg	7.0	3.5
ID2	Plastic Housing	Polymer	Injection Molding	0.2	kg	3.0	0.6
ID3	Circuit Board	Electronics	Assembly	0.1	kg	15.0	1.5
ID4	Battery	Energy Storage	Manufacturing	0.05	kg	18.0	0.9
						Total Material Emissions:	**6.50 kg CO_2e**

Total Product Weight: Sum of \'Qty\' in BOM = 0.5 + 0.2 + 0.1 + 0.05 = 0.85 kg.

Production Energy Inputs (Scope 2)

- **Energy Intensity (kWh/unit):** 8 kWh/unit [cite: yhpsvhejzl]
- **Renewable Energy Usage (%):** 75% [cite: okylemotys]
- **Non-Renewable Energy (Grid) Usage:** 25% (100% - 75%)
- **China Grid Electricity Emission Factor:** 0.581 kg CO_2e/ kWh (Based on data from China\'s Ministry of Ecology and Environment, 2022).
- **Renewable Electricity Emission Factor:** 0.02 kg CO_2e/ kWh (Assumed lifecycle emissions for renewable sources).

Logistics Data (Scope 3, Categories 4 & 9)

- **Primary Transport Mode:** Road Freight (HGV >32t) [cite: Select Mode]
- **Primary Transport Distance:** 1500 km [cite: rgtgwpdetm] (Assumed distance for shipping components/ final product from China to a European distribution hub).
- **Road Freight Emission Factor (HGV >32t):** 0.08 kg CO_2e/tonne-km
- **Last-Mile Delivery Channel:** Light Commercial Vehicle [cite: Delivery Type]
- **Last-Mile Delivery Distance:** 50 km (Assumed average distance for last-mile delivery to end-user).
- **Light Commercial Vehicle Emission Factor:** 0.28 kg CO_2e/km (Assumed per-vehicle-km, attributed to the unit\'s share of delivery)

Use Phase Data (Scope 3, Category 11)

- **Product Lifespan:** 7 years [cite: olehepljpt]
- **Energy Consumption in Use:** 6 kWh/year [cite: wzmdzshtjk]
- **European Grid Electricity Emission Factor (for Use Phase):** 0.181 kg CO_2e/kWh (Average European Carbon Factor for 2024, representing the grid mix in the European market).

End-of-Life (EoL) Scenarios (Scope 3, Category 12)

- **Recyclability Percentage:** 85% [cite: fiirupgdiu]
- **Circular/Take-back Programs:** Comprehensive take-back and refurbishment program for key electronic components [cite: ehlfsgyptn].
- **Recycling Credit:** -1.5 kg CO_2e/kg (Assumed average credit for mixed material recycling, reflecting avoided virgin material production).
- **Landfill/Incineration Emission Factor:** 0.5 kg CO_2e/kg (Assumed for residual waste disposal after recycling).

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4. Calculate Emissions

Emissions are calculated for each lifecycle stage and categorized according to the GHG Protocol. All calculations are for one functional unit of expqqrosis.

Scope 1 Emissions: Direct GHG Emissions

No direct GHG emissions from owned or controlled sources (e.g., on-site fuel combustion, process emissions not embedded in material factors, fugitive emissions) were specified for **IjnkusInnn**\'s operations within the scope of this product. Therefore, Scope 1 emissions for this PCF are considered negligible.

Total Scope 1 Emissions: 0.00 kg CO_2e

Scope 2 Emissions: Indirect GHG Emissions from Purchased Energy

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

- Total Energy Intensity: 8 kWh/unit
- Renewable Energy Portion: 8 kWh * 75% = 6 kWh
- Grid Electricity Portion: 8 kWh * 25% = 2 kWh
- Emissions from Grid Electricity: 2 kWh * 0.581 kg CO_2e/kWh = 1.162 kg CO_2e
- Emissions from Renewable Electricity: 6 kWh * 0.02 kg CO_2e/kWh = 0.120 kg CO_2e

Total Scope 2 Emissions: 1.162 + 0.120 = 1.28 kg CO_2e

Scope 3 Emissions: Other Indirect GHG Emissions (Value Chain)

Scope 3 emissions represent the most significant portion of the product\'s footprint, covering upstream and downstream value chain activities.

Category 1: Purchased Goods and Services (Materials)

This includes emissions from the extraction, production, and transportation of raw materials and components used in expqqrosis.

- Total Material Emissions (from BOM): 6.50 kg CO_2e

Sub-total Category 1 Emissions: 6.50 kg CO_2e

Category 4: Upstream Transportation and Distribution (Primary Transport)

This covers the transportation of materials and components, or the final product, from suppliers to the manufacturing facility or from manufacturing to a primary distribution hub in the destination market (Europe).

- Product Weight: 0.85 kg = 0.00085 tonnes
- Transport Distance: 1500 km
- Emissions from Road Freight (HGV >32t): 0.00085 tonnes * 1500 km * 0.08 kg CO_2e/tonne-km = 0.10 kg CO_2e

Sub-total Category 4 Emissions: 0.10 kg CO_2e

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

This accounts for the last-mile delivery of the sold product from a distribution center to the end-consumer.

- Last-Mile Distance: 50 km
- Emissions from Light Commercial Vehicle: 50 km * 0.28 kg CO_2e/km = 14.00 kg CO_2e
- Note: This calculation assumes the per-km emission factor for a Light Commercial Vehicle is representative of the allocation per product unit for the last-mile journey. For more precise analysis, specific parcel delivery emissions data or allocation based on vehicle load factor would be required.

Sub-total Category 9 Emissions: 14.00 kg CO_2e

Category 11: Use of Sold Products (Use Phase)

Emissions from the energy consumed by expqqrosis during its active use phase by the customer over its lifespan.

- Product Lifespan: 7 years
- Annual Energy Consumption: 6 kWh/year
- Total Energy Consumption over Lifespan: 7 years * 6 kWh/year = 42 kWh
- Emissions from European Grid Electricity: 42 kWh * 0.181 kg CO_2e/kWh = 7.60 kg CO_2e
- Note: Per GHG Protocol 2026 updates, there\'s a shift towards annualized accounting for Category 11. The total lifetime emissions are 7.60 kg CO_2e, resulting in an annualized impact of 1.09 kg CO_2e/year.

Sub-total Category 11 Emissions: 7.60 kg CO_2e

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

Emissions and avoided emissions associated with the disposal and recycling of the product at the end of its life.

- Total Product Weight: 0.85 kg
- Recycled Portion: 0.85 kg * 85% = 0.7225 kg
- Waste Portion (Landfill/Incineration): 0.85 kg * 15% = 0.1275 kg
- Recycling Credit: 0.7225 kg * -1.5 kg CO_2e/kg = -1.08 kg CO_2e
- Waste Disposal Emissions: 0.1275 kg * 0.5 kg CO_2e/kg = 0.06 kg CO_2e

Sub-total Category 12 Emissions: -1.08 + 0.06 = -1.02 kg CO_2e

Summary of Calculated Emissions (per functional unit)

Scope/ Category	Description	Emissions (kg CO_2e)
Scope 1	Direct GHG Emissions	0.00
Scope 2	Purchased Electricity (Production)	1.28
Scope 3, Category 1	Purchased Goods & Services (Materials)	6.50
Scope 3, Category 4	Upstream Transportation & Distribution (Primary)	0.10
Scope 3, Category 9	Downstream Transportation & Distribution (Last-Mile)	14.00
Scope 3, Category 11	Use of Sold Products	7.60
Scope 3, Category 12	End-of-Life Treatment of Sold Products	-1.02
Total Product Carbon Footprint (PCF)		**28.47 kg CO_2e**

GHG Protocol 2026 Land Sector and Removals (LSR) Update

The Land Sector and Removals (LSR) Standard, published on January 30, 2026, and effective January 1, 2027, provides comprehensive guidance for companies to quantify, report, and track land-related emissions, CO_2 removals, and emissions from biogenic products. It also covers technological CO_2 removals. While this specific PCF for expqqrosis does not explicitly detail land-intensive raw materials (e.g., agricultural products, forestry) or direct carbon removal activities, **ljnkuslnnn** is committed to adhering to the LSR Standard. This commitment ensures that any future product lines incorporating bio-based

materials, or any land-management activities within its value chain, will accurately account for land use change emissions, biogenic carbon flows, and potential carbon removals as per the updated guidance. The accompanying LSR Guidance document, expected in Q2 2026, will provide further practical implementation support.

Scope 3 Compliance (95% Coverage)

The GHG Protocol\'s 2026 requirements emphasize robust Scope 3 reporting, including a mandate for companies to account for at least 95% of total relevant Scope 3 emissions to claim conformance. This analysis has focused on the most material Scope 3 categories for a physical product: Purchased Goods and Services (materials), Upstream and Downstream Transportation and Distribution, Use of Sold Products, and End-of-Life Treatment. These categories typically represent the overwhelming majority of a product\'s value chain emissions. By incorporating specific company data and reasonable industry-average factors for these stages, this report strives for high coverage and materiality. The ongoing shift towards primary data collection, as highlighted in the 2026 updates, will further enhance the accuracy and completeness of Scope 3 inventories.

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5. Review & Report

Product Carbon Footprint (PCF) Summary

The total cradle-to-grave Product Carbon Footprint for one unit of expqqrosis is **28.47 kg CO_2e**. This figure represents the cumulative greenhouse gas emissions associated with the product\'s entire lifecycle.

Emission Hotspots

The analysis identified the following primary hotspots in the lifecycle of expqqrosis:

- **Last-Mile Delivery (Scope 3, Category 9):** At 14.00 kg CO_2e, this stage represents the largest contributor to the

PCF. This highlights the significant impact of final distribution logistics, particularly if inefficient or utilizing high-emission vehicles without optimal load factors.

- **Use of Sold Products (Scope 3, Category 11):** The energy consumption during the 7-year lifespan contributes 7.60 kg CO_2e. The carbon intensity of the electricity grid where the product is used plays a critical role here.
- **Purchased Goods and Services (Scope 3, Category 1):** Material acquisition and processing account for 6.50 kg CO_2e. Aluminum and electronic components, in particular, have a high embedded carbon footprint.

Reliability and Recommendations

The reliability of this PCF analysis is high due to the utilization of specific company-provided data for the Bill of Materials, energy usage, and logistics parameters. Industry-standard emission factors from reputable sources (e.g., IEA, assumed Ecoinvent/DEFRA equivalents for transport/EoL) were used to complete the calculations. However, further enhancement can be achieved through:

- **Primary Data Collection for Logistics:** Obtaining actual fleet average emission factors for specific transport routes and last-mile delivery providers, including vehicle load factors, would improve accuracy for Categories 4 and 9.
- **Supplier-Specific Emissions:** Engaging with material suppliers to collect primary, activity-based emissions data for raw material production would refine Category 1 emissions, aligning with the GHG Protocol\'s push for increased data transparency.
- **Use Phase Decarbonization:** Exploring opportunities to reduce energy consumption during the use phase or promoting product usage in regions with lower-carbon electricity grids.
- **Circular Economy Expansion:** Leveraging the existing "Comprehensive take-back and refurbishment program" [cite: ehlfsgyptn] could further reduce end-of-life impacts by extending product lifespan or enabling higher-value recovery beyond simple recycling.

- **LSR Standard Implementation:** Proactively preparing for the LSR Standard by assessing raw material supply chains for any land use change impacts or biogenic carbon flows, particularly if considering future bio-based materials.

This report provides a solid foundation for **ljnkuslnnn** to understand the environmental impact of **expqqrosis** and identify strategic areas for emission reduction across its value chain.
