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Product Carbon Footprint Analysis Report

Product: qnzdqxeeyx

Company Name: qlnnyzylol

Protocol Data (Accounting Standard):
GHG Protocol

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Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for the product qnzdqxeeyx, manufactured by qlnnyzylol. The analysis was conducted by dtedjytpnk, Senior Sustainability Consultant, adhering to the GHG Protocol standards, including considerations for the 2026 Land Sector and Removals (LSR) Standard update and aiming for at least 95% Scope 3 compliance. The study adopts a cradle-to-grave approach, encompassing all life cycle stages from raw material acquisition to end-of-life, to provide a comprehensive understanding of the product\'s greenhouse gas (GHG) emissions. Key hotspots and opportunities for reduction are identified to support qlnnyzylol\'s sustainability initiatives.

1. Methodology and Scope Definition

The Product Carbon Footprint (PCF) for qnzdqxeeyx was calculated following the five-step methodology outlined by the GHG Protocol Product Life Cycle Accounting and Reporting Standard. This rigorous approach ensures consistency, transparency, and comparability of the results.

1.1 Functional Unit

- The functional unit for this analysis is defined as **1.0 unit of qnzdqxeeyx**. This unit serves as the reference basis for all calculations and comparisons, allowing for a standardized assessment of environmental impacts.

1.2 System Boundary

- The primary system boundary for the core PCF calculation is **factory_gate**, as specified. However, to provide a comprehensive view of the product\'s environmental impact, the analysis extends

to a **cradle-to-grave** perspective. This includes raw material acquisition, manufacturing, transportation, the product\'s use phase, and its end-of-life treatment. This holistic approach aligns with the GHG Protocol\'s guidance for assessing full product life cycle emissions.

1.3 Geographic Scope

- **Final Production Country:** China
- **Supply Chain Focus:** Europe Focused
- This scope acknowledges the global nature of supply chains and focuses on significant emission sources within the specified geographies.

1.4 Allocation

- Allocation refers to the process of partitioning the environmental impacts of a co-product or by-product system. For this single-product PCF, direct allocation of emissions to qnzdqxeeyx is applied for all processes directly attributable to its life cycle. Where shared processes or facilities are involved, impacts are allocated based on relevant physical parameters (e.g., mass, energy consumption) or economic value, in accordance with GHG Protocol guidelines.

1.5 Accounting Standard

- This PCF analysis strictly adheres to the **GHG Protocol Product Life Cycle Accounting and Reporting Standard**. All 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).

1.6 2026 Land Sector and Removals (LSR) Standard Update

- The GHG Protocol\'s Land Sector and Removals (LSR) Standard, released in January 2026 and effective January 1, 2027, provides crucial requirements for accounting for land sector emissions and CO2 removals. While the specific Bill of Materials for qnzdqxeeyx primarily consists of industrial materials (plastics, metals, electronics) and does not directly involve significant land use change or biogenic carbon removals at the production stage, the

principles of the LSR Standard are acknowledged. For this product, direct calculations for land-use related emissions or removals were not explicitly identified in the provided parameters. However, any upstream agricultural or forestry components in the supply chain would be assessed against this standard if relevant data were to become available, ensuring transparent reporting of biogenic carbon and removals.

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2. Lifecycle Mapping and Data Collection

This section details the product lifecycle stages considered and the data points collected, forming the basis of the Life Cycle Inventory (LCI).

2.1 Life Cycle Inventory Stages (GHG Protocol Scope 3 Categories)

The product life cycle for qnzdqxeeyx is mapped across the following stages, aligned with GHG Protocol Scope 3 categories where applicable:

1. **Raw Material Acquisition & Pre-processing (Scope 3, Category 1: Purchased Goods and Services):** Emissions associated with the extraction, processing, and production of all raw materials and components in the Bill of Materials (BOM) for qnzdqxeeyx.
2. **Manufacturing (Scope 1 & 2):** Direct emissions from owned or controlled sources (Scope 1) and indirect emissions from purchased electricity or heat (Scope 2) at the qlnnyzylol manufacturing facility in China.
3. **Transportation (Scope 3, Category 4: Upstream Transportation & Distribution, Category 9: Downstream Transportation & Distribution):** Emissions from transporting raw materials to the factory (upstream) and finished products from the factory to the end-consumer (downstream), including last-mile delivery.
4. **Use Phase (Scope 3, Category 11: Use of Sold Products):** Emissions resulting from the energy consumption during the expected lifespan of the product by the end-user.
5. **End-of-Life (EoL) Treatment (Scope 3, Category 12: End-of-Life Treatment of Sold Products):** Emissions and potential avoided emissions (credits) associated with the disposal, recycling, or recovery of the product and its packaging at the end of its useful life.

2.2 Detailed Bill of Materials (BOM) Data (elxkhggr)

The following detailed Bill of Materials was provided and used for high-accuracy material impact calculation:

ID	Description	Category	Process	Qty	Unit	Emission Factor (kgCO2e/unit or kg)	Total Carbon (kgCO2e)
M001	Plastic Casing	Polymer	Injection Molding	0.5	kg	2.5	1.25
M002	Circuit Board (PCB)	Electronics	Assembly	0.1	unit	15.0	1.50
M003	Metal Fasteners	Metal	Machining	0.05	kg	5.0	0.25
M004	Packaging (Cardboard)	Paper/Fiber	Forming	0.2	kg	1.0	0.20

Note: The "Total Carbon" values from the BOM are directly used for material acquisition emissions. Emission factors are illustrative and representative of typical values found in databases like Ecoinvent.

2.3 Energy Inputs and Customization Data

- **Renewable Energy Usage (qzvdkywmsj):** 50% of the electricity consumed in the manufacturing plant is sourced from renewable energy.
- **Energy Intensity (kWh/unit) (ekzvrrqrzz):** 10 kWh/unit. This is the total electricity consumed during the manufacturing process for one unit of qnzdqxeeyx.
- **Geographic Grid Mix (China):** An average grid emission factor for China is assumed at 0.6 kgCO2e/kWh for non-renewable electricity consumption.

2.4 Logistics Data

- **Main Transport Mode (Select Mode):** Road Freight (Heavy Goods Vehicle, HGV > 3.5-17 tonnes).

- **Main Transport Distance (hojlnmthhd):** 1500 km (representative for Europe-focused supply chain originating from China).
- **Last-Mile Delivery Channel (Delivery Type):** Van Delivery (Diesel).
- **Last-Mile Delivery Distance (Assumed):** 50 km.

2.5 Use Phase Data

- **Product Lifespan (rzmtsgnklv):** 5 years.
- **Energy Consumption in Use (fzvyvkredd):** 20 kWh/year.
- **Assumed Grid Mix for Use Phase:** A generic global average grid emission factor of 0.6 kgCO2e/kWh is used for consumer energy consumption, as the specific country of use is not defined.

2.6 End-of-Life (EoL) Scenarios

- **Recyclability Percentage (vwkthfvqvz):** 70% of the product\'s total material weight is assumed to be recycled.
- **Circular/Take-back Programs (enykwsqwke):** Implemented. This indicates a commitment to circularity, potentially increasing the actual recycling rates and ensuring proper handling of end-of-life products, leading to higher avoided emissions.

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3. Calculation of Emissions (Activity * Emission Factor = CO2e)

Emissions are calculated for each life cycle stage using the activity data collected and appropriate emission factors. Industry-standard emission factors (e.g., from Ecoinvent/DEFRA equivalent datasets) are applied.

3.1 Scope 1, Scope 2, and Scope 3 Categorization

Emissions are categorized according to the GHG Protocol as follows:

- **Scope 1: Direct GHG Emissions** from sources owned or controlled by qlnnyzylol. (Assumed negligible for manufacturing processes without explicit fuel combustion data, primarily embedded in purchased energy via Scope 2 or material production in Scope 3).

- **Scope 2: Indirect GHG Emissions from Purchased Energy**, specifically electricity consumed during manufacturing.
- **Scope 3: Other Indirect GHG Emissions** occurring in the value chain, both upstream and downstream. This forms the majority of the product\'s footprint.

3.2 Emission Calculations Breakdown

3.2.1 Raw Material Acquisition & Pre-processing (Scope 3, Category 1)

Emissions are directly derived from the "Total Carbon" column of the provided BOM, representing the embodied carbon in the materials from extraction through pre-processing.

Total Material Emissions:

- Plastic Casing: 1.25 kgCO2e
- Circuit Board (PCB): 1.50 kgCO2e
- Metal Fasteners: 0.25 kgCO2e
- Packaging (Cardboard): 0.20 kgCO2e

Total Scope 3 (Category 1) Emissions: 1.25 + 1.50 + 0.25 + 0.20 = 3.20 kgCO2e

3.2.2 Manufacturing Phase (Scope 2)

- Total Energy Consumption: 10 kWh/unit
- Renewable Energy Usage: 50% (0.5 * 10 kWh = 5 kWh, 0 kgCO2e)
- Non-Renewable Energy Usage: 50% (0.5 * 10 kWh = 5 kWh)
- China Grid Emission Factor: 0.6 kgCO2e/kWh
- **Scope 2 Emissions: 5 kWh/unit * 0.6 kgCO2e/kWh = 3.00 kgCO2e**

3.2.3 Transportation (Scope 3, Categories 4 & 9)

Total product and packaging weight: 0.5 kg (plastic) + 0.1 kg (PCB) + 0.05 kg (metal) + 0.2 kg (packaging) = 0.85 kg. For transport calculation, assume 1 kg for simplicity of per-tonne-km calculations.

- **Upstream Transportation (Materials to Factory):**
    - Mode: Road Freight (HGV > 3.5-17 tonnes)

    - Distance: 1500 km
    - Emission Factor: 0.1 kgCO2e/tonne-km (DEFRA equivalent)
    - Calculation: 0.1 kgCO2e/tonne-km * (0.85 kg / 1000 kg/tonne) * 1500 km = 0.1275 kgCO2e
- **Downstream Transportation (Factory to Customer - Last Mile):**
    - Mode: Van Delivery (Diesel)
    - Distance: 50 km (Assumed)
    - Emission Factor: 0.3 kgCO2e/vehicle-km (Assumed average for van delivery, representing a share of the van\'s total emissions per unit of product)
    - Calculation: 0.3 kgCO2e/vehicle-km * (1 unit) / (typical van load, e.g., 500 units) * 50 km = 0.03 kgCO2e (simplified allocation)

Total Scope 3 (Categories 4 & 9) Emissions: 0.1275 + 0.03 = 0.1575 kgCO2e

3.2.4 Use Phase (Scope 3, Category 11)

- Energy Consumption: 20 kWh/year
- Product Lifespan: 5 years
- Total Energy in Use: 20 kWh/year * 5 years = 100 kWh
- Assumed Grid Emission Factor (Global Average): 0.6 kgCO2e/kWh
- **Scope 3 (Category 11) Emissions: 100 kWh * 0.6 kgCO2e/kWh = 60.00 kgCO2e**

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

Total Material Weight (product + packaging): 0.85 kg

- **Recycled Portion:**
    - Recyclability Percentage: 70%
    - Weight Recycled: 0.85 kg * 70% = 0.595 kg
    - Avoided Emission Factor (illustrative average for mixed materials recycling): -1.5 kgCO2e/kg (credit for displacing virgin material production)
    - Avoided Emissions: 0.595 kg * -1.5 kgCO2e/kg = -0.8925 kgCO2e

- **Disposed Portion (Landfill/Incineration):**
    - Weight Disposed: 0.85 kg * (100% - 70%) = 0.255 kg
    - Emission Factor for Disposal (illustrative average): 0.1 kgCO2e/kg
    - Disposal Emissions: 0.255 kg * 0.1 kgCO2e/kg = 0.0255 kgCO2e

Net Scope 3 (Category 12) Emissions: -0.8925 kgCO2e + 0.0255 kgCO2e = -0.867 kgCO2e

The "Implemented" Circular/Take-back Programs (enykwsqwke) positively contribute to achieving this recyclability percentage and could potentially improve it further or allow for higher quality recycling loops in practice, enhancing the avoided emissions.

3.3 Summary of Product Carbon Footprint (PCF) by Scope and Stage

Lifecycle Stage	GHG Protocol Scope	Emissions (kgCO2e per functional unit)
Raw Material Acquisition & Pre-processing	Scope 3, Category 1	3.20
Manufacturing (Electricity)	Scope 2	3.00
Transportation (Upstream & Downstream)	Scope 3, Categories 4 & 9	0.16
Use Phase	Scope 3, Category 11	60.00
End-of-Life Treatment	Scope 3, Category 12	-0.87

Total Product Carbon Footprint (Cradle-to-Grave): 3.20 + 3.00 + 0.16 + 60.00 - 0.87 = 65.49 kgCO2e per unit of qnzdqxeeyx

Scope 3 Compliance: The analysis covers Purchased Goods & Services (Category 1), Upstream Transportation (Category 4), Downstream Transportation (Category 9), Use of Sold Products (Category 11), and End-of-Life Treatment of Sold Products (Category 12). These categories typically represent the most significant Scope 3 emissions for a product,

ensuring that the reporting aims for at least 95% coverage as per 2026 requirements.

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4. Review & Report

4.1 Emission Hotspots

The most significant hotspot in the product\'s life cycle is clearly the **Use Phase**, contributing approximately 60.00 kgCO2e, which is about 91.6% of the total cradle-to-grave PCF. This is primarily due to the product\'s energy consumption over its 5-year lifespan.

Other notable contributions include:

- **Raw Material Acquisition:** 3.20 kgCO2e (~4.9%)
- **Manufacturing (Scope 2):** 3.00 kgCO2e (~4.6%)

Transportation emissions are relatively minor, and End-of-Life treatment provides a net credit due to the high recyclability percentage and the implemented circular programs.

4.2 Reliability and Recommendations

The reliability of this PCF analysis is good, given the use of a detailed Bill of Materials and specific parameters for energy, transport, and EoL. However, the use of illustrative or average emission factors for some stages (e.g., global grid mix for use phase, general transport factors) introduces some uncertainty. Future improvements could focus on:

- **Primary Data Collection:** Seek specific supplier-specific emission factors for materials and components, and more precise transport data (e.g., actual fill rates, specific vehicle types).
- **Geographic Specificity for Use Phase:** If the primary markets for qnzdqxeeyx are known, use country-specific grid emission factors for a more accurate use phase calculation.
- **LSR Standard Integration:** While not directly applicable to the core components here, a deeper dive into the origin of raw materials (e.g., wood-based products if any, or agricultural inputs for any bio-based components) could reveal land-use impacts that warrant explicit accounting under the forthcoming 2026 LSR Standard requirements.

- **Design for Sustainability:** Given the significant impact of the use phase, focus on improving the energy efficiency of qnzdqxeeyx to drastically reduce its overall footprint. Exploring lower energy intensity components or enabling user behavior changes could yield substantial reductions.
- **Circular Economy Initiatives:** Continue to strengthen circular design principles and take-back programs to maximize recycling and material recovery, further increasing avoided emissions.
