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Product Carbon Footprint Analysis Report

Product: kqtutejdnj

Company Name: uijlxmqoqp

Accounting Standard: GHG
Protocol

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This report is generated based on available data, industry standards, and reasonable assumptions for placeholder values. The accuracy of the results is dependent on the quality and completeness of the input data provided.

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1. Executive Summary

This document presents a high-detail Product Carbon Footprint (PCF) analysis for the product "kqtutejdnj", manufactured by uijlxmqoqp. The analysis was conducted by mvthmfpwuy, a Senior Sustainability Consultant specializing in GHG Protocol, to quantify the greenhouse gas (GHG) emissions across the product's lifecycle. This report adheres to the GHG Protocol standards, including a forward-looking perspective on the 2026 Land Sector and Removals (LSR) Standard and aims for at least 95% coverage for Scope 3 emissions. The total estimated Product Carbon Footprint for one functional unit of kqtutejdnj is calculated to identify key emission hotspots and inform strategic decarbonization efforts.

2. Methodology and Scope Definition

2.1. Accounting Standard

This Product Carbon Footprint (PCF) analysis is conducted in strict accordance with the Greenhouse Gas (GHG) Protocol. Emissions are categorized into Scope 1 (direct emissions from owned or controlled sources), Scope 2 (indirect emissions from the generation of purchased electricity, steam, heating, and cooling), and Scope 3 (all other indirect emissions that occur in the value chain, both upstream and downstream). Compliance with the 2026 requirements

2.2. Functional Unit

The functional unit for this PCF analysis is defined as:
1.0 unit of kqtutejdnj.

2.3. System Boundary

The system boundary for this assessment is "**factory_gate**", encompassing all upstream activities from raw material extraction, material processing, manufacturing, and transport to the point of the product leaving the final production factory. Downstream impacts, including the use phase and end-of-life treatment, are also included to provide a comprehensive "cradle-to-grave" perspective for completeness, beyond the strict 'factory_gate' definition, as per best practice for PCF.

2.4. Geographic Scope

- **Final Production Country:** China
- **Supply Chain Focus:** Europe Focused (for upstream material sourcing)

2.5. Allocation

An attributional Life Cycle Assessment (LCA) approach has been used for this PCF, allocating environmental impacts directly to the functional unit based on physical causality. For co-products or multi-functional processes, mass-based allocation has been primarily applied, unless more specific data allowed for alternative allocation methods.

2.6. 2026 Land Sector and Removals (LSR) Standard Update

The GHG Protocol's Land Sector and Removals (LSR) Standard, taking effect on January 1, 2027, provides crucial guidance for accounting for land emissions, CO₂ removals, and other land-related metrics. While detailed implementation guidance is expected in Q2 2026, this report acknowledges its impending applicability. For the 'factory_gate' system boundary of kqtutejdnj, direct land use change associated with manufacturing operations is assumed to be negligible. However, upstream land-related impacts and potential carbon removals embedded within raw materials (e.g., bio-based materials, if applicable) are implicitly captured through the use of comprehensive emission factors for materials. Future reports will incorporate more explicit quantification of LSR impacts as the standard's guidance becomes fully operational and data availability improves.

3. Lifecycle Mapping and Data Collection

3.1. Lifecycle Stages Included:

1. Raw Material Acquisition & Processing
 2. Manufacturing (Product Assembly & Production)
 3. Transportation (Upstream & Downstream)
 4. Product Use Phase
 5. End-of-Life Treatment
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3.2. Detailed Bill of Materials (BOM) - slouvvkh

The following Bill of Materials (BOM) represents the primary material inputs for one unit of product kqtutejdj. Emission factors are based on industry-standard databases (e.g., Ecoinvent/DEFRA equivalents) for the specified processes and regions, and are sourced to reflect the Europe-focused supply chain for upstream materials and global averages where appropriate.

ID	Description	Category	Process	Qty	Unit	Emission Factor (kgCO ₂ e/unit or kg)	Total Carbon (kgCO ₂ e)
M1	Aluminum Casing	Metal	Primary Production (Global Mix)	0.4	kg	15.0	6.00
M2	Plastic Housing (ABS)	Plastic	Injection Molding	0.25	kg	3.5	0.88
M3	Printed Circuit Board (PCB)	Electronics	Assembly	1.0	unit	2.0	2.00
M4	Copper Wire	Metal	Extrusion	0.05	kg	8.0	0.40
M5	Lithium-ion Battery	Electronics	Manufacturing	0.1	unit	10.0	1.00
M6	Packaging (Corrugated Cardboard)	Packaging	Manufacturing	0.2	kg	0.7	0.14

Total Emissions from Raw Material Acquisition & Processing: 10.42 kgCO₂e

3.3. Energy Inputs (Manufacturing)

- **Energy Intensity (kWh/unit):** 5.0 kWh/unit
- **Renewable Energy Usage:** 50%
- **Non-renewable Electricity Mix:** China Grid Mix
- **China Grid Emission Factor:** 0.60 kgCO₂e/kWh

3.4. Logistics Data

- **Assumed Product Mass for Transport:** 1.5 kg (including packaging and accounting for components measured in units)
- **Upstream Transport (Materials from Europe to China factory):**
 - **Transport Mode:** Ocean Freight (Container Ship)
 - **Transport Distance:** 20,000 km
 - **Emission Factor (Ocean Freight):** 0.016 kgCO₂e/tonne-km (16 gCO₂e/tkm)
- **Last-Mile Delivery (Factory in China to Customer):**
 - **Delivery Channel:** Road Transport (Van/Lighter HGV)
 - **Transport Distance:** 500 km
 - **Emission Factor (Road Transport):** 0.20 kgCO₂e/tonne-km (200 gCO₂e/tkm)

3.5. Product Use Phase Data

- **Product Lifespan:** 5 years
- **Energy Consumption in Use:** 10 kWh/year
- **Electricity Source for Use Phase:** Assumed global average grid mix for consumer use,

3.6. End-of-Life (EoL) Scenarios

- **Recyclability Percentage:** 70%
 - **Circular/Take-back Programs:** Yes, Product Take-back Program in place for kqtutejdnj.
 - **Remaining 30% Disposal:** Assumed landfill for non-recycled portion.
 - **Average Waste Treatment Emission Factor (Landfill, for non-recycled material):** 0.2 kgCO₂e/kg
 - **Recycling Credits:**
 - Aluminum: -10.0 kgCO₂e/kg (avoided primary production)
 - Plastic: -2.5 kgCO₂e/kg (avoided virgin production)
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4. Emissions Calculation

The Product Carbon Footprint (PCF) for one functional unit of kqtutejdnj is calculated by summing the emissions from each lifecycle stage. Emissions are categorized according to the GHG Protocol Scopes.

4.1. Raw Material Acquisition & Processing (Scope 3 - Upstream)

Calculated directly from the Detailed Bill of Materials (slouvvkh).

- Aluminum Casing: $0.4 \text{ kg} * 15.0 \text{ kgCO}_2\text{e/kg} = 6.00 \text{ kgCO}_2\text{e}$
- Plastic Housing (ABS): $0.25 \text{ kg} * 3.5 \text{ kgCO}_2\text{e/kg} = 0.88 \text{ kgCO}_2\text{e}$
- Printed Circuit Board (PCB): $1.0 \text{ unit} * 2.0 \text{ kgCO}_2\text{e/unit} = 2.00 \text{ kgCO}_2\text{e}$
- Copper Wire: $0.05 \text{ kg} * 8.0 \text{ kgCO}_2\text{e/kg} = 0.40 \text{ kgCO}_2\text{e}$
- Lithium-ion Battery: $0.1 \text{ unit} * 10.0 \text{ kgCO}_2\text{e/unit} = 1.00 \text{ kgCO}_2\text{e}$
- Packaging (Corrugated Cardboard): $0.2 \text{ kg} * 0.7 \text{ kgCO}_2\text{e/kg} = 0.14 \text{ kgCO}_2\text{e}$

Total Material Emissions (Scope 3): $6.00 + 0.88 + 2.00 + 0.40 + 1.00 + 0.14 = 10.42 \text{ kgCO}_2\text{e}$

4.2. Manufacturing (Production Phase)

Emissions from purchased electricity for the manufacturing process.

- Energy Consumption: 5.0 kWh/unit
- Non-renewable portion: $(1 - 50\% \text{ renewable usage}) = 0.50$
- China Grid Emission Factor: $0.60 \text{ kgCO}_2\text{e/kWh}$

Manufacturing Emissions (Scope 2): $5.0 \text{ kWh/unit} * 0.50 * 0.60 \text{ kgCO}_2\text{e/kWh} = 1.50 \text{ kgCO}_2\text{e}$

4.3. Transportation Emissions (Scope 3)

4.3.1. Upstream Transport (Materials to China Factory)

- Product Mass: 1.5 kg = 0.0015 tonnes
- Distance: 20,000 km
- Emission Factor (Ocean Freight): 0.016 kgCO₂e/tonne-km

Upstream Transport Emissions (Scope 3, Cat 4):
 $0.0015 \text{ tonnes} * 20,000 \text{ km} * 0.016 \text{ kgCO}_2\text{e/tonne-km} =$
0.48 kgCO₂e

4.3.2. Last-Mile Delivery (Factory to Customer)

- Product Mass: 1.5 kg = 0.0015 tonnes
- Distance: 500 km
- Emission Factor (Road Transport): 0.20 kgCO₂e/tonne-km

Last-Mile Delivery Emissions (Scope 3, Cat 9):
 $0.0015 \text{ tonnes} * 500 \text{ km} * 0.20 \text{ kgCO}_2\text{e/tonne-km} =$
0.15 kgCO₂e

Total Transportation Emissions (Scope 3): $0.48 + 0.15 =$ **0.63 kgCO₂e**

4.4. Product Use Phase (Scope 3 - Downstream)

Emissions from electricity consumed during the product's lifespan.

- Energy Consumption in Use: 10 kWh/year

Use Phase Emissions (Scope 3, Cat 11): 10 kWh/year * 5 years * 0.60 kgCO₂e/kWh = **30.00 kgCO₂e**

4.5. End-of-Life Treatment (Scope 3 - Downstream)

Calculated based on recyclability and disposal scenarios. Assuming the 70% recyclability applies proportionally to the main material components (Aluminum and Plastic Housing) by mass. Total product mass contributing to EoL is approx. 0.9 kg from primary materials (Aluminum, Plastic Housing, Copper). PCB and Battery EoL are more complex and often handled separately; for simplification, we apply the 30% to the general product mass for landfill and provide credits for the specific recyclable materials.

- Total estimated material mass for EoL consideration: (0.4 kg Al + 0.25 kg Plastic + 0.05 kg Copper + 0.2 kg Packaging) = 0.9 kg
- Non-recycled portion: 30% of 0.9 kg = 0.27 kg
- Landfill Emission Factor: 0.2 kgCO₂e/kg

Landfill Emissions (Scope 3, Cat 12): 0.27 kg * 0.2 kgCO₂e/kg = **0.05 kgCO₂e**

4.5.1. Recycling Credits

Credits are applied for avoided primary production due to recycling the 70% recyclable materials.

- Recycled Aluminum: 0.4 kg * 0.70 (recyclability) * -10.0 kgCO₂e/kg = -2.80 kgCO₂e
- Recycled Plastic: 0.25 kg * 0.70 (recyclability) * -2.5 kgCO₂e/kg = -0.44 kgCO₂e

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- Recycled Copper (assuming similar to Aluminum credit for simplification): $0.05 \text{ kg} * 0.70 * -10.0 \text{ kgCO}_2\text{e/kg} = -0.35 \text{ kgCO}_2\text{e}$

Total Recycling Credits (Scope 3, Cat 12 - Avoided Emissions): $-2.80 - 0.44 - 0.35 = -3.59 \text{ kgCO}_2\text{e}$

Net End-of-Life Emissions (Scope 3): $0.05 \text{ kgCO}_2\text{e} - 3.59 \text{ kgCO}_2\text{e} = -3.54 \text{ kgCO}_2\text{e}$

4.6. Summary of Emissions by Scope and Stage

Lifecycle Stage	Scope 1 (kgCO ₂ e)	Scope 2 (kgCO ₂ e)	Scope 3 (kgCO ₂ e)	Total (kgCO ₂ e)
Raw Material Acquisition & Processing	0.00	0.00	10.42	10.42
Manufacturing (Production)	0.00	1.50	0.00	1.50
Transportation (Upstream)	0.00	0.00	0.48	0.48
Transportation (Downstream/ Last-Mile)	0.00	0.00	0.15	0.15
Product Use Phase	0.00	0.00	30.00	30.00
End-of-Life Treatment (Net)	0.00	0.00	-3.54	-3.54
Grand Total PCF	0.00	1.50	37.51	39.01

Total Product Carbon Footprint for kqtutejdjnj:
39.01 kgCO₂e per unit

Note: Scope 1 emissions are assumed to be negligible for a 'factory gate' boundary in this context, primarily covering direct combustion in owned/controlled sources. No specific direct fuel combustion data for the factory itself was provided, thus focusing on Scope 2 for factory energy and Scope 3 for value chain.

4.7. Scope 3 Coverage Compliance

The comprehensive inclusion of raw materials, upstream and downstream transportation, the use phase, and end-of-life scenarios ensures a high level of Scope 3 coverage. Based on the calculated emissions, Scope 3 activities represent a significant portion of the total footprint, exceeding the 95% coverage requirement. Specifically, Scope 3 accounts for 37.51 kgCO₂e out of a total of 39.01 kgCO₂e, which is approximately 96.15% of the total footprint.

5. Review & Report

5.1. Hotspots Analysis

The analysis identifies the following key emission hotspots for kqtutejdnj:

- **Product Use Phase (30.00 kgCO₂e):** This is by far the largest contributor, highlighting the importance of energy efficiency during the product's operational life. Strategies to reduce this impact should focus on designing for lower power consumption and promoting renewable energy use by end-users.

- **Raw Material Acquisition & Processing (10.42 kgCO₂e):** Materials, particularly aluminum (6.00 kgCO₂e), contribute significantly. This emphasizes the need for sourcing lower-carbon materials, increasing recycled content, and engaging with suppliers on their decarbonization efforts.
- **Manufacturing (1.50 kgCO₂e):** While less than the use phase, increasing the factory's renewable energy usage beyond 50% can further reduce this impact.
- **End-of-Life (-3.54 kgCO₂e):** The negative emissions indicate that the recycling credits for materials outweigh the emissions from the non-recycled portion, demonstrating the positive impact of the high recyclability and circular programs.

5.2. Reliability and Limitations

This PCF report provides a high-detail assessment based on the provided parameters and a robust methodology aligned with the GHG Protocol. However, certain limitations inherent in any LCA apply:

- **Data Availability:** While industry-standard emission factors from sources like Ecoinvent/ DEFRA equivalents are used, primary data for all supply chain stages was not available and proxy data was utilized.
- **Assumptions:** Placeholder values for transport distances, energy consumption, and specific material EFs were established based on reasonable estimations for a generic product of this type. Variations in these actual values could alter the final PCF.
- **System Boundary:** While a comprehensive 'cradle-to-grave' perspective is applied to downstream emissions, the "factory gate"

definition for specific elements means that some upstream corporate activities (e.g., business travel of material suppliers not embedded in material EFs) are outside the direct calculation for this product.

- **LSR Standard:** The qualitative application of the 2026 LSR Standard acknowledges its future impact, but a fully quantitative assessment will require more specific land-use data and the finalized guidance.

5.3. Recommendations

To further reduce the Product Carbon Footprint of kqtutejdnj, uijlxmqoqp should consider:

- **Energy Efficiency in Use:** Invest in R&D to significantly reduce the energy consumption of kqtutejdnj during its operational lifespan.
- **Renewable Energy Sourcing:** Increase the percentage of renewable energy used in manufacturing operations in China, potentially through renewable energy certificates or direct power purchase agreements.
- **Supply Chain Engagement:** Collaborate with material suppliers (especially for aluminum) to identify and implement lower-carbon production methods and increase the use of secondary (recycled) materials.
- **Circular Economy Expansion:** Continue to strengthen and promote the existing product take-back program to maximize recycling rates and explore opportunities for material closed-loop systems.