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Product Carbon Footprint (PCF) Analysis Report

Product Name: izdeofmtyn

Company Name: tvegkudlsx

Accounting Standard: GHG Protocol

Senior Sustainability Consultant: xumsmuioir

Disclaimer: This report is generated based on available data and industry standards at the time of publication. The accuracy of the results depends on the completeness and reliability of the input data and chosen emission factors. Future revisions to

Product Carbon Footprint (PCF) Analysis Report for izdeofmtyn

Generated Date: May 20, 2026

Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for \'izdeofmtyn\', manufactured by \'tvegkudlsx\', conducted by Senior Sustainability Consultant \'xumsmuioir\'. The analysis adheres strictly to the GHG Protocol, including considerations for the 2026 Land Sector and Removals (LSR) update and the stringent 2026 Scope 3 compliance requirements. The study quantifies greenhouse gas (GHG) emissions across the product\'s lifecycle, from raw material extraction to end-of-life, providing critical insights into environmental impacts and identifying key hotspots for reduction strategies.

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1. Define Scope

The initial phase of this Product Carbon Footprint (PCF) analysis involves clearly defining the parameters and boundaries of the study, in accordance with the GHG Protocol Product Standard.

- **Functional Unit:** 1.0 unit of izdeofmtyn.
- **System Boundary:** The analysis employs a "Cradle-to-gate" approach, measuring emissions until the product leaves the factory gate. This includes raw material acquisition, manufacturing, and relevant transport to the factory gate. Downstream emissions (use phase, end-of-life) are calculated separately to provide a more comprehensive view, although the primary system boundary for reporting is factory_gate as specified.

- **Geographic Scope:**
    - Final Production Country: China
    - Supply Chain Focus: Europe Focused
- **Accounting Standard:** GHG Protocol Product Life Cycle Accounting and Reporting Standard. This framework guides the categorization of emissions into Scope 1 (direct), Scope 2 (purchased energy), and Scope 3 (value chain).
- **Allocation:** Emissions are directly attributed to the functional unit (1.0 unit of izdeofmtyn), as this analysis focuses on a single product. In cases of co-products or by-products, allocation methods (e.g., mass-based, economic) would be applied to ensure fair distribution of environmental burdens.

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2. Map Lifecycle (LCI Inventory Stages) & 3. Collect Data (Primary/Secondary Data Points)

The lifecycle mapping identifies all relevant stages of the product\'s existence, from raw material sourcing to manufacturing, distribution, use, and end-of-life. Data collection involved compiling both primary data (where available) and secondary data (industry-standard emission factors) to quantify inputs and outputs at each stage.

Material Inputs (Detailed Bill of Materials - BOM: fyzhtqxx)

The following Bill of Materials (BOM) provides a high-accuracy breakdown of material impacts for \'izdeofmtyn\'. The \'Total Carbon\' values are directly used for material impact calculation, representing emissions from raw material extraction, processing, and manufacturing of the component itself.

ID	Description	Category	Process	Quantity (Qty)	Unit	Emission Factor (kg CO2e/ unit)	Total Carbo (kg CO2e)
M001	Plastic Casing	Polymers	Injection Molding	0.5	kg	2.5	1.25
M002	Aluminum Frame	Metals	Extrusion	0.2	kg	8.0	1.60
M003	Electronic Components (PCB, Chips)	Electronics	Assembly	0.1	kg	15.0	1.50
M004	Packaging	Paper/ Cardboard	Manufacturing	0.05	kg	1.0	0.05

Energy Inputs (Production Phase)

- **Energy Intensity (kWh/unit):** kqxymvdope = 0.5 kWh/ unit
- **Renewable Energy Usage:** rqgrvmtqyh = 70%
- **Non-Renewable Energy Usage:** 30%
- **Geographic Scope for Electricity:** China

Logistics Data (Supply Chain Analysis)

- **Transport Mode (Primary):** Select Mode = Road Freight
- **Transport Distance (Primary):** sjrxkduttn = 1500 km
- **Last-Mile Delivery Channel:** Delivery Type = Parcel Delivery
- **Assumed Product Weight for Transport:** 1.0 kg (for calculating tonne-km for freight)

Use Phase Data

- **Product Lifespan:** hnjkstkztx = 5 years
- **Energy Consumption in Use:** vrwhekgukp = 10 kWh/year

End-of-Life (EoL) Scenarios

- **Recyclability Percentage:** yftikxmgdi = 80%
- **Circular/Take-back Programs:** qsywoojuvg = Established program for component recovery and material recycling.

GHG Protocol Scope Categorization

All collected data points are categorized according to the GHG Protocol:

- **Scope 1 (Direct Emissions):** None identified within the direct operational control of \'tvegkudlsx\' for the specific product manufacturing within the \'factory_gate\' boundary, assuming purchased electricity and outsourced material production. If \'tvegkudlsx\' had on-site fuel combustion for manufacturing processes not covered by purchased energy, these would fall under Scope 1.
- **Scope 2 (Purchased Energy Emissions):** Emissions from the electricity purchased for the product manufacturing phase (kqxymvdope).
- **Scope 3 (Value Chain Emissions):** This encompasses the vast majority of emissions for a product, including:
    - Raw material acquisition and processing (from BOM: fyzhtqxx).
    - Upstream transportation of materials.
    - Primary transport of finished product to market (sjrxkduttn).

- Last-mile delivery (Delivery Type).
- Use-phase energy consumption (vrwhekgukp).
- End-of-life treatment of sold products (recycling, disposal).

2026 Scope 3 Compliance: The GHG Protocol\'s proposed 2026 revisions mandate at least 95% coverage of total relevant Scope 3 emissions for conformance. This report aims to cover all identified material and energy flows, aligning with the intent of comprehensive reporting and data disaggregation by source type.

2026 Land Sector and Removals (LSR) Update

The GHG Protocol\'s Land Sector and Removals (LSR) Standard was released on January 30, 2026, and is set to take effect on January 1, 2027. This standard provides guidance for accounting and reporting land-based GHG emissions and CO2 removals, including agricultural and land use change activities, as well as technological CO2 removals. While \'izdeofmtyn\' itself may not have direct land-use impacts from its final manufacturing, the LSR Standard is relevant for upstream agricultural or bio-based material suppliers within the supply chain. For this specific PCF, the provided BOM is assumed to already reflect the carbon footprint of materials (including any land-use related emissions within their production), and no direct land-use change from \'tvegkudlsx\' operations for \'izdeofmtyn\' is assumed.

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4. Calculate Emissions (Activity * Emission Factor = CO2e)

Emissions are calculated for each lifecycle stage using activity data multiplied by appropriate emission factors. Industry-standard emission factors are used, largely drawing on commonly accepted values from databases such as Ecoinvent or DEFRA, or recent literature, where specific primary data is

unavailable. All results are expressed in kilograms of Carbon Dioxide Equivalent (kg CO2e).

Emission Factors Used (Illustrative/Proxies)

- **Electricity Grid Mix (China, Location-based):** 0.577 kg CO2e/kWh
- **Renewable Electricity (Residual):** 0.05 kg CO2e/kWh (acknowledging upstream emissions and grid integration)
- **Road Freight (Average, per tonne-km):** 0.09 kg CO2e/tonne-km (proxy for general freight)
- **Parcel Delivery Van (Last Mile, per km):** 0.24934 kg CO2e/km (proxy for average van, UK data)

Detailed Emission Calculations (per 1.0 unit of izdeofmtyn)

1. Materials Acquisition & Processing (Scope 3, Category 1: Purchased Goods and Services)

Calculated directly from the \'Total Carbon\' column in the provided BOM.

Description	Total Carbon (kg CO2e)
Plastic Casing	1.25
Aluminum Frame	1.60
Electronic Components	1.50
Packaging	0.05
Subtotal (Materials)	**4.40**

2. Manufacturing / Production (Scope 2: Purchased Electricity)

Total energy consumed: kqxymvdope = 0.5 kWh/unit

- Renewable energy portion: 0.5 kWh * 70% = 0.35 kWh
- Non-renewable (grid mix) energy portion: 0.5 kWh * 30% = 0.15 kWh

Energy Source	Activity (kWh)	Emission Factor (kg CO2e/kWh)	Emissions (kg CO2e)
Renewable Electricity	0.35	0.05	0.0175
Grid Mix Electricity (China)	0.15	0.577	0.08655
Subtotal (Production Energy)			**0.10405**

3. Transportation (Scope 3, Category 4: Upstream Transportation & Distribution; Category 9: Downstream Transportation & Distribution)

Product weight assumed for transport: 1.0 kg = 0.001 tonnes.

- **Primary Transport (Road Freight):**
  - Distance: sjrxkduttn = 1500 km
  - Activity: 0.001 tonnes * 1500 km = 1.5 tonne-km
  - Emissions: 1.5 tonne-km * 0.09 kg CO2e/tonne-km = 0.135 kg CO2e
- **Last-Mile Delivery (Parcel Delivery):**
  - Assuming an average last-mile distance of 50 km for parcel delivery.
  - Emissions: 50 km * 0.24934 kg CO2e/km (per van, assuming one unit contributes proportionally to

the van\'s emissions over the distance) = 12.467 kg CO2e (Note: This factor is per van-km, so the actual impact per product depends on load factor; for simplicity, we attribute the van\'s full emission over 50km to one product as an upper bound, or assume this factor already implies an allocation per package over this distance. For this exercise, we assume it\'s directly attributable per product for the last-mile distance for conservative estimation, but in reality, it would be allocated per parcel/weight). A more refined calculation would consider the average load factor of the delivery van for per-package emissions. Given the parameter `Delivery Type` as "Parcel Delivery", the factor 0.24934 kgCO2e/km for an average van is more appropriate to be allocated. For simplicity, if we assume a generic parcel average mass and an average load factor, the emission per package-km might be lower. However, without further information, we will use the direct van-km and assume an allocation to the specific product for its last mile journey.

Transport Stage	**Activity**	**Emission Factor**	**Emissions (kg CO2e)**
Primary Transport (Road Freight)	1.5 tkm	0.09 kg CO2e/ tkm	0.135
Last-Mile Delivery (Parcel Delivery)	50 km	0.24934 kg CO2e/km (van)	12.467
Subtotal (Transportation)			**12.602**

Note on Last-Mile Calculation: The direct application of a van-km factor to a single product for 50km is a conservative simplification. In a full LCA, this would be allocated based on package volume/weight and average load factor.

4. Use Phase (Scope 3, Category 11: Use of Sold Products)

Product lifespan: hnjkstkztx = 5 years

Energy consumption in use: vrwhekgukp = 10 kWh/year

Assuming the product is used in a region with a grid mix similar to global average for illustrative purposes for the user phase emissions, or assuming China\'s grid mix if product is only used there. Given \'Europe Focused\' for supply chain, but \'China\' for final production, we\'ll assume a global average for use phase electricity, or, more conservatively, China\'s grid for a consistent footprint calculation if the product is predominantly sold there (which is not specified). To be consistent with production location, we use China\'s grid mix here for use phase as well.

- Total Energy in Use: 10 kWh/year * 5 years = 50 kWh
- Emissions: 50 kWh * 0.577 kg CO2e/kWh (China grid mix) = 28.85 kg CO2e

Activity	Energy (kWh)	Emission Factor (kg CO2e/kWh)	Emissions (kg CO2e)
Energy Consumption over Lifespan	50	0.577	28.85
Subtotal (Use Phase)			**28.85**

5. End-of-Life (EoL) (Scope 3, Category 12: End-of-Life Treatment of Sold Products)

Recyclability Percentage: yftikxmgdi = 80%

Circular/Take-back Programs: qsywoojuvg = Established program for component recovery and material recycling.

The EoL calculation considers the potential for recycling to avoid emissions from virgin material production, offset by emissions

from recycling processes and disposal of non-recyclable parts. Without specific EoL emission factors for each material, we apply a simplified approach:

- Total material weight: 0.5 + 0.2 + 0.1 + 0.05 = 0.85 kg
- Recycled portion: 0.85 kg * 80% = 0.68 kg
- Disposed portion: 0.85 kg * 20% = 0.17 kg

Recycling Credit (Illustrative): Assuming a recycling credit of 50% of virgin material emissions for the recycled portion, due to established programs. This is a simplification; a full LCA would use specific EoL factors.

- Material Emissions (Virgin, from BOM): 4.40 kg CO2e
- Recycling Credit: -4.40 kg CO2e * 80% * 50% = -1.76 kg CO2e (emissions avoided)
- Disposal Emissions (Illustrative): Assuming 0.5 kg CO2e/kg for landfill/incineration of residual waste. Total disposed mass * illustrative EF = 0.17 kg * 0.5 kg CO2e/kg = 0.085 kg CO2e.

EoL Scenario	Emissions / Credits (kg CO2e)
Recycling Credit (Avoided Emissions)	-1.76
Disposal (Landfill/Incineration)	0.085
Subtotal (End-of-Life)	**-1.675**

Total Product Carbon Footprint (PCF) Summary (per 1.0 unit)

Lifecycle Stage	GHG Scope	Emissions (kg CO2e)
Materials Acquisition & Processing	Scope 3	4.400
Manufacturing / Production	Scope 2	0.104

Lifecycle Stage	GHG Scope	Emissions (kg CO2e)
Transportation (Primary & Last-Mile)	Scope 3	12.602
Use Phase	Scope 3	28.850
End-of-Life	Scope 3	-1.675
TOTAL PCF (Cradle-to-Grave)		**44.281**
TOTAL PCF (Cradle-to-Gate - Production, as specified by system boundary)		**(4.400 + 0.104) = 4.504**

Note: While the system boundary for the formal PCF reporting is "factory_gate" (4.504 kg CO2e), a comprehensive "Cradle-to-Grave" footprint (44.281 kg CO2e) is provided for a complete understanding of the product\'s environmental impact across its entire lifecycle. The primary reporting value based on the specified system boundary is 4.504 kg CO2e.

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5. Review & Report (Hotspots and Reliability)

Identified Carbon Hotspots

Based on the detailed PCF analysis, the following are the primary carbon hotspots for \'izdeofmtyn\':

- **Use Phase (65.1% of Cradle-to-Grave PCF):** Energy consumption during the product\'s 5-year lifespan is the most significant contributor to its overall carbon footprint, largely due to the electricity mix of the consumption region. This highlights opportunities for energy efficiency improvements in product design or shifting towards renewable energy sources for end-users.

- **Transportation (28.5% of Cradle-to-Grave PCF):** Last-mile parcel delivery contributes substantially, indicating that optimizing logistics, using lower-emission vehicles, or encouraging local distribution could yield significant reductions.
- **Materials Acquisition & Processing (9.9% of Cradle-to-Grave PCF):** While less than the use phase, certain components, particularly electronic components and aluminum, have high embodied emissions. Investigating alternative, lower-carbon materials or increasing recycled content can reduce this impact.
- **End-of-Life (-3.8% of Cradle-to-Grave PCF):** The recycling credit positively impacts the overall footprint, demonstrating the value of robust circular economy programs. Expanding these programs and improving recyclability can further enhance this benefit.

Reliability and Data Quality

This report uses a combination of client-provided parameters and industry-standard secondary emission factors. The reliability of the PCF is directly linked to the quality and specificity of the input data.

- **Primary Data:** The Detailed Bill of Materials (BOM) provides specific quantities for materials, which enhances accuracy for this stage.
- **Secondary Data:** Emission factors for electricity, transportation, and general material processes are derived from recognized industry sources or conservative estimates. While these provide a robust basis, product-specific or supplier-specific primary data would further improve accuracy.
- **Assumptions:** Assumptions were made for generic parameters such as "Select Mode" (assumed Road Freight) and "Delivery Type" (assumed Parcel Delivery with an illustrative distance and allocation method), as

well as certain EoL process emissions, due to lack of explicit client data. These assumptions are clearly stated.

- **Scope 3 Coverage:** Efforts were made to ensure comprehensive Scope 3 coverage, aligning with the 2026 GHG Protocol requirements for at least 95% of relevant emissions. Future data collection efforts should focus on gathering more primary data across the value chain to further enhance compliance and accuracy.
- **LSR Standard:** As the LSR Standard is effective from January 1, 2027, this report acknowledges its relevance for land-based emissions in upstream supply chains. Future reporting should ensure that suppliers of bio-based materials or those with direct land-use activities adhere to the LSR Standard\'s requirements.
