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Product Carbon Footprint Analysis Report

Product: mfdxtpueud

Protocol Data (Accounting Standard): GHG Protocol

Name of the Company: uoyppxdzyi

Senior Sustainability Consultant: zdzetoghzz

This report is generated based on available data and industry standards. While every effort has been made to ensure accuracy, specific conditions and evolving data sources may lead to variations in actual impacts.

Product Carbon Footprint Report: mfdxtpueud

Generated Date: June 1, 2026

Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for the product mfdxtpueud, manufactured by uoyppxdzyi. The analysis adheres strictly to the GHG Protocol accounting standard, incorporating the latest 2026 Land Sector and Removals (LSR) Standard updates and aiming for at least 95% Scope 3 coverage. The study covers the entire lifecycle from raw material acquisition (cradle-to-gate) through manufacturing, transport, use phase, and end-of-life, providing a comprehensive overview of the product\'s greenhouse gas emissions (CO2e).

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1. Defining the Scope of the Analysis

As zdzetoghzz, Senior Sustainability Consultant for uoyppxdzyi, the initial phase involves clearly defining the parameters and boundaries for the Product Carbon Footprint (PCF) study of mfdxtpueud:

- **Functional Unit:** 1.0 unit of mfdxtpueud. This represents the quantified performance of the product system for use as a reference unit.
- **System Boundary:** factory_gate. This implies a "cradle-to-gate" assessment for material production, extending to include transport to the customer, the use phase, and end-of-life treatment of the product.
- **Geographic Scope:**
    - **Final Production Country:** China. This dictates the primary energy mix and associated emission factors for manufacturing processes.

    - **Supply Chain Focus:** Europe Focused. This influences emission factors for upstream material acquisition and downstream distribution to market.
- **Accounting Standard:** GHG Protocol. This report strictly follows the Greenhouse Gas Protocol\'s requirements for categorizing and reporting emissions.
- **Allocation:** All emissions are allocated entirely to the functional unit (1.0 unit of mfdxtpueud) as no co-products or by-products are identified in the scope.

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2. Mapping the Product Lifecycle & 3. Data Collection

The lifecycle of mfdxtpueud is mapped into several stages, for which detailed primary and secondary data have been collected. Emissions are categorized according to the GHG Protocol\'s Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased energy), and Scope 3 (all other indirect emissions in the value chain).

2.1. Material Acquisition & Processing (Upstream - Scope 3)

This stage accounts for the emissions associated with the extraction, processing, and manufacturing of all raw materials and components listed in the Bill of Materials (BOM) for mfdxtpueud.

Detailed Bill of Materials (BOM) - udmreisl:

The provided BOM details the specific materials and their pre-calculated carbon impact (Total Carbon), ensuring high-accuracy material impact calculation.

ID	Description	Category	Process	Qty	Unit	Emission Factor (kg CO2e/ unit)	Total Carbon (kg CO2e)
1	Casing	Metal	Stamping	2.0	kg	3.0	6.0

ID	Description	Category	Process	Qty	Unit	Emission Factor (kg CO2e/ unit)	Total Carbon (kg CO2e)
2	Circuit Board	Electronics	Assembly	0.5	kg	15.0	7.5
3	Battery	Chemical	Assembly	0.3	kg	20.0	6.0
4	Packaging	Paper	Conversion	0.2	kg	1.0	0.2

Total Product Weight (based on BOM quantities): 2.0 + 0.5 + 0.3 + 0.2 = 3.0 kg

2.2. Manufacturing/Production (Core Operations - Scope 1 & 2)

This phase covers the energy consumed during the assembly and finishing processes of mfdxtpueud in China.

- **Energy Intensity (kWh/unit):** wtnhpotpsp = 0.25 kWh/unit
- **Renewable Energy Usage:** qugnrreler = 50%
- **Grid Electricity Emission Factor (China):** For China, the national average grid electricity emission factor is approximately 0.5568 kg CO2/kWh as reported by the Ministry of Ecology and Environment of China (MEE) for 2021. Another source indicates 0.556 kgCO2e/kWh for 2019. Provincial factors can vary, with some provinces exceeding 1.0 kg CO2e kWh-1 in 2020. We will use 0.5568 kg CO2e/kWh as a representative national average for the production location.

2.3. Transport & Distribution (Upstream & Downstream - Scope 3)

This stage includes emissions from the transportation of raw materials to the manufacturing facility (inbound logistics) and the finished product to the customer (outbound logistics and last-mile delivery).

- **Transport Mode (Main):** Select Mode = Road Freight

- **Transport Distance:** knytzgztzw = 1500 km
- **Last-Mile Delivery Channel:** Delivery Type = Parcel Carrier

Emission Factors for Transport:

- **Road Freight:** A representative emission factor for road freight (heavy truck) is approximately 0.09 kg CO2e/tonne-km. Some sources suggest 0.062 kg CO2/tonne-km or 0.105 kg CO2/tonne-km. We will use 0.09 kg CO2e/tonne-km for this analysis.
- **Parcel Carrier (Last-Mile):** For parcel carriers, emissions can vary significantly. An average package emission (small package, 500 miles, 1 pound) can be as low as 0.59 kg CO2e via ground. Another source indicates an average package emissions of 1.19 kg CO2e per package for transportation network and last-mile delivery. For a simplified calculation, we will use a value of 0.5 kg CO2e/parcel, acknowledging that this can vary with distance and package weight. This is a simplified estimate, as more granular data would be needed for higher accuracy.

2.4. Use Phase (Downstream - Scope 3)

This involves emissions generated during the product\'s lifespan, primarily from energy consumption by the user.

- **Product Lifespan:** rkyrpkydgf = 5 years
- **Energy Consumption in Use:** nptppojzrs = 10 kWh/year
- **Grid Electricity Emission Factor (Europe Focused):** For the European Union, the average grid electricity emission intensity in 2024 was estimated at 187.08 gCO2e/kWh (0.18708 kg CO2e/kWh). Another source indicates 0.238 kg CO2e/kWh for 2019. We will use 0.187 kg CO2e/kWh as a representative average for the use phase.

2.5. End-of-Life (Downstream - Scope 3)

This stage accounts for emissions and potential credits associated with the disposal or recycling of the product at the end of its useful life.

- **Recyclability Percentage:** uflimpegnv = 70%

- **Circular/Take-back Programs:** nvtomoswot = Active

Emission Factors/Credits for End-of-Life:

- **Landfill Emission Factor:** For mixed waste, a simplified average could be around 0.1 kg CO2e/kg. For plastic, landfilling might result in 33 kg CO2e/tonne. For household waste, a government factor of 497 kg CO2e/tonne for landfill is cited. We will use a general average of 0.1 kg CO2e/kg for the non-recycled portion.
- **Recycling Credit Factor (Metal):** Recycling metals significantly reduces emissions compared to virgin production. For steel, an EoL recovery rate of 85% can result in a Module D impact of -1.36 kg CO2e per kg. A simplified credit of -1.0 kg CO2e/kg is reasonable for mixed metals.
- **Recycling Credit Factor (Plastic):** While recycling plastic involves emissions, it generally results in a lower carbon footprint than producing virgin plastics. However, some studies show emissions from processing plastic for closed-loop recycling as 202 kg CO2e/tonne. We will assume a net avoided emission (credit) of -0.5 kg CO2e/kg for recycled plastic due to avoided virgin material production.
- **Recycling Credit Factor (Paper):** Recycling paper generally provides significant benefits. We\'ll use a credit of -0.7 kg CO2e/kg.

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4. Emission Calculation

The calculation of emissions (Activity * Emission Factor = CO2e) for each lifecycle stage is performed below, categorized by GHG Protocol scopes.

4.1. Scope 3: Upstream Emissions (Materials & Inbound Transport)

4.1.1. Material Production (Cradle-to-Gate)

Based on the provided BOM, the \'Total Carbon\' values are used directly for material impact.

Item ID	Description	Total Carbon (kg CO2e)
1	Casing	6.0
2	Circuit Board	7.5
3	Battery	6.0
4	Packaging	0.2
Subtotal Material Production:		**19.7 kg CO2e**

4.1.2. Inbound Logistics (Raw Material Transport to Factory)

Assuming raw materials are transported over an average distance before reaching the factory. As specific inbound distances are not provided, we will assume an average of 500 km for inbound road freight for the total BOM weight.

- Product Weight: 3.0 kg (0.003 tonnes)
- Assumed Inbound Distance: 500 km
- Road Freight EF: 0.09 kg CO2e/tonne-km

Calculation: 0.003 tonnes * 500 km * 0.09 kg CO2e/tonne-km = 0.135 kg CO2e

Total Upstream (Scope 3) = Material Production + Inbound Logistics = 19.7 + 0.135 = 19.835 kg CO2e

4.2. Scope 2: Purchased Energy Emissions (Manufacturing)

Emissions from electricity consumed during the manufacturing process in China.

- Energy Intensity: 0.25 kWh/unit
- Renewable Energy Usage: 50%
- Non-Renewable Electricity Share: 1 - 0.50 = 0.50
- China Grid Electricity EF: 0.5568 kg CO2e/kWh

Calculation: 0.25 kWh/unit * 0.50 (non-renewable share) * 0.5568 kg CO2e/kWh = 0.0696 kg CO2e

4.3. Scope 3: Downstream Emissions (Outbound Transport, Use Phase, End-of-Life)

4.3.1. Outbound Logistics (Finished Product Transport)

Transport of the finished product from the factory gate to the consumer.

- Product Weight: 3.0 kg (0.003 tonnes)
- Transport Distance: 1500 km
- Transport Mode: Road Freight
- Road Freight EF: 0.09 kg CO2e/tonne-km

Calculation: 0.003 tonnes * 1500 km * 0.09 kg CO2e/tonne-km = 0.405 kg CO2e

4.3.2. Last-Mile Delivery

Delivery from distribution hub to the end customer.

- Delivery Type: Parcel Carrier
- Assumed EF for Parcel Carrier: 0.5 kg CO2e/parcel

Calculation: 1 unit * 0.5 kg CO2e/parcel = 0.5 kg CO2e

4.3.3. Use Phase Emissions

Energy consumption during the product\'s 5-year lifespan by the end-user (Europe Focused).

- Product Lifespan: 5 years
- Energy Consumption per year: 10 kWh/year
- Europe Grid Electricity EF: 0.187 kg CO2e/kWh

Calculation: 5 years * 10 kWh/year * 0.187 kg CO2e/kWh = 9.35 kg CO2e

4.3.4. End-of-Life (EoL) Emissions & Credits

This considers the recyclability percentage and the remaining waste for disposal.

- Total Product Weight: 3.0 kg
- Recyclability Percentage: 70%
- Recycled Portion: 3.0 kg * 0.70 = 2.1 kg
- Disposed Portion (Landfill): 3.0 kg * (1 - 0.70) = 0.9 kg

For the recycled portion, we need to consider the material breakdown from the BOM:

- Metal (Casing): 2.0 kg
- Electronics (Circuit Board): 0.5 kg (assume mixed material, some recyclable)
- Chemical (Battery): 0.3 kg (assume special disposal, limited recycling in this general calculation, but some components may be recovered)
- Paper (Packaging): 0.2 kg

Given 70% recyclability for the *entire product*, we\'ll apply a weighted average or general credit. However, to maintain high detail as requested, let\'s assume the 70% is achieved by recycling all metal (2.0 kg), all paper (0.2 kg), and a portion of electronics/chemicals.

Let\'s simplify: 2.1 kg is recycled. We need to attribute EFs for the recycled mass and disposal mass.

Assuming a breakdown of the 2.1 kg recycled: * Metal: 2.0 kg (Casing) * Paper: 0.1 kg (from Packaging, assuming portion is recycled) * Remaining 0.0 kg is from other components, if the total recycled weight adds up. (Original packaging is 0.2 kg, so 0.1 kg is recycled paper, remaining 0.1 kg is disposed as mixed waste).

Recycling Credits:

- Metal (2.0 kg): Credit of -1.0 kg CO2e/kg = -2.0 kg CO2e (approximate credit for avoided virgin metal production).
- Paper (0.1 kg): Credit of -0.7 kg CO2e/kg = -0.07 kg CO2e.

Total Recycling Credit: -2.0 - 0.07 = -2.07 kg CO2e

Disposal Emissions (Landfill):

- Disposed Portion: 0.9 kg (includes non-recycled packaging, circuit board, battery, and any non-recyclable parts of casing/packaging). * Let\'s assume the 0.9 kg disposed portion is made up of: * Remaining Paper/Mixed Packaging: 0.1 kg * Circuit Board: 0.5 kg * Battery: 0.3 kg * Total: 0.1 + 0.5 + 0.3 = 0.9 kg
- Landfill EF: 0.1 kg CO2e/kg

Calculation: 0.9 kg * 0.1 kg CO2e/kg = 0.09 kg CO2e

Net End-of-Life Emissions: 0.09 kg CO2e (disposal) - 2.07 kg CO2e (recycling credits) = -1.98 kg CO2e (a net credit)

The presence of "Active" Circular/Take-back Programs (nvtomoswot) would enhance the actual recyclability and material recovery rates, potentially increasing this net credit further or reducing disposal impacts. This is a qualitative benefit captured by the high recyclability percentage.

4.4. GHG Protocol Scope Summary

Scope	Category	Emissions (kg CO2e)
Scope 1	Direct Emissions from Owned/ Controlled Sources	0.0 (Assuming no direct fossil fuel combustion on-site)
Scope 2	Purchased Electricity for Manufacturing	0.0696
Scope 3	Material Production (Upstream)	19.7
	Inbound Logistics (Upstream)	0.135
	Outbound Logistics (Downstream)	0.405
	Last-Mile Delivery (Downstream)	0.5
	Use Phase (Downstream)	9.35
		-1.98 (Net Credit)

Scope	Category	Emissions (kg CO2e)
	End-of-Life Treatment (Downstream)	
Total Product Carbon Footprint (PCF)		**28.17 kg CO2e**

Breakdown by Scope:

- **Scope 1:** 0.0 kg CO2e (0.0%)
- **Scope 2:** 0.07 kg CO2e (0.2%)
- **Scope 3:** 28.1 kg CO2e (99.8%)

As anticipated for a product PCF, Scope 3 emissions dominate the total footprint, accounting for nearly 99.8% of the total, meeting the 2026 requirement for at least 95% coverage.

4.5. 2026 LSR Update Application

The Land Sector and Removals (LSR) Standard, released on January 30, 2026, and effective January 1, 2027, provides guidelines for accounting for land emissions, CO2 removals, and biogenic products. For mfdxtpueud, specific land use change or biogenic carbon removal data were not explicitly provided within the BOM or other parameters. However, its principles are inherently considered through the material production emission factors (cradle-to-gate) which often implicitly include land-use impacts associated with raw material extraction and processing. In a more granular analysis, if primary data on agricultural or forestry inputs were available, the LSR Standard would be applied to quantify and report these specific land-based emissions and removals. The use of paper for packaging has an indirect land use component, which is generally reflected in its emission factor. Active engagement in circular economy programs (nvtomoswot) would also leverage aspects of the LSR Standard by potentially increasing land-based carbon removals through sustainable sourcing and recycling loops.

5. Review & Reporting

5.1. Hotspot Identification

The analysis clearly identifies the following hotspots in the lifecycle of mfdxtpueud:

- **Material Production (Scope 3 Upstream):** With 19.7 kg CO2e, the raw materials and component manufacturing constitute the largest portion of the footprint. This highlights the importance of sustainable material sourcing, design for lower-impact materials, and increasing recycled content.
- **Use Phase (Scope 3 Downstream):** The energy consumption during the product\'s lifespan contributes 9.35 kg CO2e, making it the second most significant hotspot. Efforts to improve energy efficiency of the product and promote renewable energy at the user end are crucial.
- **Logistics (Scope 3 Upstream & Downstream):** Inbound, outbound, and last-mile transportation collectively contribute 1.04 kg CO2e. Optimizing logistics routes, shifting to lower-emission transport modes, and increasing load factors can reduce these emissions.

5.2. Reliability and Limitations

The reliability of this PCF analysis is high for the material production phase due to the use of specific \'Total Carbon\' values provided in the BOM. For other stages, industry-average emission factors have been applied, which inherently carry a degree of uncertainty. These include:

- **Generic Emission Factors:** Assumed emission factors for grid electricity mixes (China, Europe), road freight, and parcel delivery are industry averages and may not perfectly reflect the specific suppliers or routes.
- **Assumptions for EoL:** While recyclability is given, the allocation of material types to recycling credits and landfill emissions uses simplified assumptions. Actual EoL impacts depend on local infrastructure and consumer behavior.
- **LSR Standard Application:** Explicit data for land use change and removals were not provided, therefore, the LSR

application is currently limited to acknowledging its relevance and how it would be integrated with more specific data.

To further enhance reliability, primary data from specific suppliers for transport, energy consumption at manufacturing sites, and detailed end-of-life processing routes would be highly beneficial.
