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Product Carbon Footprint Analysis Report

BYD Atto 3 Essential 2025

Protocol Data (Accounting Standard): GHG Protocol

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Disclaimer: This report is generated based on available data and industry standards. Actual values may vary based on primary data and specific supply

Executive Summary

This report presents a high-detail Product Carbon Footprint (PCF) analysis for the BYD Atto 3 Essential 2025 model, conducted under the stringent guidelines of the GHG Protocol. The assessment focuses on a factory-gate system boundary for a single unit of the vehicle, with a primary geographic scope of final production in China and an upstream supply chain focus on Oceania and global sources. The objective is to quantify the greenhouse gas (GHG) emissions associated with the production of the vehicle up to the point it leaves the factory, identifying key emission hotspots across its material and energy inputs. Special attention has been paid to the 2026 Land Sector and Removals (LSR) Standard update and the 95% Scope 3 coverage compliance requirements.

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1. Scope Definition

Functional Unit:

The functional unit for this PCF analysis is **1.0 unit of the BYD Atto 3 Essential 2025 electric vehicle**.

System Boundary:

The system boundary for this analysis is defined as **"factory_gate"**. This encompasses all upstream activities related to the extraction and processing of raw materials, the manufacturing of components, and the transportation of these materials and components to the final assembly plant in China. It also includes the

energy consumption and direct emissions (Scope 1 and 2) occurring at the final vehicle assembly factory itself. Emissions associated with the use phase (e.g., electricity consumption during driving) and end-of-life treatment are excluded from this specific system boundary.

Geographic Scope:

- **Final Production Country:** China
- **Supply Chain Focus:** Oceania (for key mineral extraction, e.g., lithium, bauxite) and Global Chain (for other diverse materials and components)

Accounting Standard:

The analysis strictly adheres to the **GHG Protocol Corporate Accounting and Reporting Standard**, supplemented by the Corporate Value Chain (Scope 3) Accounting and Reporting Standard. Furthermore, the analysis considers the implications of the 2026 Land Sector and Removals (LSR) Standard update and the enhanced Scope 3 reporting compliance requirements.

Allocation:

Due to the nature of a product-level PCF, emissions are allocated entirely to the functional unit (one vehicle). Where shared processes occur (e.g., a factory producing multiple vehicle models), emissions are allocated based on mass or economic value as appropriate, though for this high-level analysis, direct material and energy inputs are attributed to the single vehicle.

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2. Lifecycle Mapping (LCI Inventory Stages) & 3. Data Collection

This section details the primary material and energy inputs for the BYD Atto 3 Essential 2025, based on a comprehensive lifecycle inventory approach. Given the proprietary nature of specific manufacturing data, estimations are derived from publicly available vehicle specifications, industry averages for EV material composition, and established LCA databases.

Vehicle Specifications:

- **Model:** BYD Atto 3 Essential 2025
- **Curb Weight:** Approximately 1750 kg
- **Battery Type:** Lithium Iron Phosphate (LFP) Blade Battery
- **Battery Capacity:** 49.9 kWh (Essential model)

Estimated Material Breakdown and Inputs:

Based on the curb weight of 1750 kg and assuming a battery pack weight of approximately 300 kg (derived from its 49.9 kWh capacity and typical LFP energy density of ~166 Wh/kg for the pack), the remaining 1450 kg are distributed across other major vehicle components. These estimations are based on general EV industry composition and adjusted for LFP battery chemistry which typically excludes nickel and cobalt in the cathode. Material production is considered "cradle-to-gate".

Material Category	Estimated Quantity (kg)	Notes / Primary Components
LFP Battery Pack	300	Cells (Lithium, Iron Phosphate, Graphite, Aluminum, Copper),

Material Category	Estimated Quantity (kg)	Notes / Primary Components
		Casing, BMS, Thermal Management. The energy capacity is 49.9 kWh.
Steel	870	Body-in-white, chassis, motor components, structural elements.
Aluminum	217.5	Body panels, chassis components, motor housing, battery tray.
Plastics & Composites	145	Interior trim, dashboards, bumpers, wiring insulation, synthetic leather upholstery.
Copper	72.5	Motor windings, high-voltage cabling, general wiring.
Glass	43.5	Windshield, side windows, rear window.
Rubber	43.5	Tires, seals, hoses, vibration dampeners.
Silicon	14.5	Semiconductors, electronic components, potentially anode additives.
Other Materials	43.5	Paints, fluids, rare earth elements (in motor magnets), adhesives, minor metals.
Total Estimated Mass	**1750**	

Energy Inputs for Vehicle Assembly:

The final assembly of the BYD Atto 3 Essential 2025 in China requires significant energy, primarily in the form of electricity for robotics, lighting, heating, cooling, and various manufacturing processes (e.g., welding, painting, drying ovens). An estimated 800 kWh of

electricity is consumed per vehicle for the assembly process.

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

Emissions are calculated by multiplying the activity data (material quantities, energy consumption) by appropriate industry-standard emission factors. These factors are sourced from reputable databases such as Ecoinvent and DEFRA, or recognized industry averages, with a focus on regional specificity (China for manufacturing and energy).

Selected Emission Factors:

Input	Unit	Emission Factor (kg CO_2e/unit)	Source / Notes
Electricity (China Grid Mix)	kWh	0.6205	China National Average 2023
LFP Battery Production (cradle-to-gate)	kWh (battery capacity)	109.3	Based on 3061 kgCO2e for 28 kWh LFP battery in China.
Steel Production (Primary, China)	kg	2.1	Conservative estimate for BF-BOF dominance in China.
Aluminum Production (Primary, China)	kg	13.95	ClimateTRACE 2021 data for China.
	kg	4.5	Industry average for various polymers

Input	Unit	Emission Factor (kg CO_2e/unit)	Source / Notes
Plastics (Generic, production)			(Ecoinvent/DEFRA range).
Copper (Primary, production)	kg	4.0	Industry average (Ecoinvent/DEFRA range).
Glass (Production)	kg	1.0	Industry average (Ecoinvent/DEFRA range).
Rubber (Synthetic, production)	kg	2.5	Representative factor for synthetic rubber production.
Silicon (Metallurgical Grade, production)	kg	15.0	Representative factor for silicon production.
Transportation (Ocean Freight)	tonne-km	0.01	Industry average for container shipping.
Transportation (Truck Freight)	tonne-km	0.1	Industry average for road freight.

Emission Categorization by GHG Protocol Scopes:

Total estimated CO_2e for 1 unit of BYD Atto 3 Essential 2025:

Scope	Category	Activity/ Material	Quantity	Unit	Emission Factor (kg CO_2e/ unit)	Total C (kg)
Scope 1 (Direct Emissions)	Operational Emissions	Minor on-site fuel combustion	-	-	-	~50*

Scope	Category	Activity/ Material	Quantity	Unit	Emission Factor (kg CO_2e/ unit)	Total C (kg)
		(e.g., heating) at assembly plant				
Scope 2 (Purchased Energy)	Purchased Electricity (Manufacturing)	Electricity consumption for vehicle assembly	800	kWh	0.6205	496.4
Scope 3 (Value Chain - Upstream)	Category 1: Purchased Goods & Services (Materials)	LFP Battery Production (49.9 kWh)	49.9	kWh	109.3	5454.07
		Steel Production	870	kg	2.1	1827.0
		Aluminum Production	217.5	kg	13.95	3035.63
		Plastics Production	145	kg	4.5	652.5
		Copper Production	72.5	kg	4.0	290.0
		Glass Production	43.5	kg	1.0	43.5
		Rubber Production	43.5	kg	2.5	108.75
		Silicon Production	14.5	kg	15.0	217.5
	Category 3: Fuel- and Energy-Related Activities	Upstream emissions of purchased electricity (T&D losses, fuel extraction)	800	kWh	~0.15**	120.0

Scope	Category	Activity/ Material	Quantity	Unit	Emission Factor (kg CO_2e/ unit)	Total C (kg)
	Category 4: Upstream Transportation & Distribution (Estimated)	Ocean Freight (e.g., minerals from Oceania/ global to China; 10,000 km for ~1.5 tonnes raw materials)	15000	tonne-km	0.01	150.0
		Truck Freight (within China, 500 km for ~1.5 tonnes materials)	750	tonne-km	0.1	75.0
Total Estimated Product Carbon Footprint (PCF) (Factory-Gate)						**~1247(kg CO_2**

*Scope 1 emissions are typically minor for a final assembly plant and are often better captured as upstream emissions from material production. This is a placeholder for any direct, controlled emissions.

**Using a representative factor for upstream electricity emissions (transmission & distribution losses, fuel extraction) which are typically separate from the generation factor for Scope 2.

Application of the 2026 Land Sector and Removals (LSR) Standard Update:

The GHG Protocol\'s Land Sector and Removals Standard, effective January 1, 2027, provides crucial guidance for accounting for land use change, land

management, and biogenic CO2 removals. While this standard specifically targets entities with significant land sector activities (e.g., agriculture, forestry, or those engaged in CO2 removals), its relevance to automotive PCF lies in the upstream supply chain of raw materials. Key materials like lithium, steel (iron ore), and aluminum (bauxite) are derived from mining, an activity with potential land-use change impacts. For a high-detail PCF analysis, the LSR Standard would necessitate:

- Quantifying land use change emissions (e.g., deforestation for mining sites) associated with the extraction of raw materials such as lithium, iron ore, and bauxite.
- Assessing land management emissions/removals across the value chain, particularly if any biogenic materials were used (unlikely for a car\'s main structure, but possibly for some interior components).
- Reporting any CO2 removals if new technologies (e.g., direct air capture used in component manufacturing) or land-based removals were explicitly linked to the product\'s value chain.

For this specific report, without granular primary data on the land footprint of each raw material\'s extraction site, these emissions are implicitly included within the "cradle-to-gate" emission factors of the materials. A full application of the LSR Standard would require deeper supply chain transparency to identify and quantify specific land-related impacts for each material. The accompanying Guidance document, expected in Q2 2026, will provide more practical direction for implementation.

Scope 3 Compliance (95% Coverage):

The GHG Protocol\'s 2026 requirements emphasize at least 95% coverage for Scope 3 reporting. For this factory-gate PCF, the vast majority of emissions are indeed categorized under Scope 3 (Purchased Goods and Services, Fuel- and Energy-Related Activities, Upstream Transportation). By meticulously estimating the emissions from all major material inputs and their transportation, this analysis aims to meet or exceed this 95% threshold for the defined system boundary. Remaining minor categories (e.g., capital goods not directly tied to the product, business travel for product development) are acknowledged but considered immaterial for this specific product-level factory-gate assessment. The use of robust, albeit sometimes averaged, emission factors for the primary materials ensures significant coverage.

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5. Review & Report

Emission Hotspots:

The PCF analysis reveals the following major emission hotspots for the BYD Atto 3 Essential 2025 (factory-gate boundary):

- **LFP Battery Production:** Accounting for approximately 43.7% of the total factory-gate PCF, the manufacturing of the lithium iron phosphate battery is by far the largest contributor. This is consistent with findings across the EV industry, where battery production is highly energy-intensive, particularly in regions with carbon-intensive electricity grids.

- **Aluminum Production:** Primary aluminum production is highly energy-intensive, and its contribution of approximately 24.3% highlights its significant environmental footprint.
- **Steel Production:** Despite being a large component by mass, steel\'s relative emission factor is lower than aluminum or batteries, contributing around 14.6% to the total PCF.
- **Electricity for Vehicle Assembly:** Direct energy use at the assembly plant, constituting about 4.0% of the PCF, demonstrates the importance of transitioning to renewable energy sources for manufacturing operations in China.

Data Reliability and Limitations:

This report is based on a high-level assessment utilizing secondary data, industry averages, and publicly available specifications. While efforts were made to use region-specific and up-to-date emission factors (e.g., for Chinese electricity and LFP battery production), certain limitations exist:

- **Primary Data Absence:** Lacking direct, proprietary data from BYD and its specific suppliers for material compositions, energy consumption, and precise supply chain logistics.
- **Material Granularity:** The material breakdown relies on estimations based on general EV construction. Actual material mix can vary.
- **Average Emission Factors:** While Ecoinvent and ClimateTRACE provide robust data, generic "industry average" factors were used for some materials (e.g., plastics, copper, glass, rubber, silicon) where specific China-based, product-specific factors were not readily available in the search results.

- **LSR Standard Implementation:** Full application of the 2026 LSR Standard requires granular land-use data across the entire supply chain, which is beyond the scope of this generalized PCF.

Recommendations for Emission Reduction:

- **Battery Supply Chain Decarbonization:** Focus on suppliers committed to using renewable energy in battery cell and material production (e.g., lithium extraction and refining, graphite processing).
- **Green Aluminum and Steel Sourcing:** Prioritize sourcing from producers utilizing electric arc furnaces (EAFs) with renewable energy or employing carbon capture technologies for steel, and hydropower-powered smelters for aluminum where feasible.
- **Renewable Energy at Assembly Plants:** Transition the final vehicle assembly plant in China to 100% renewable electricity.
- **Supply Chain Transparency:** Collaborate with Tier 1 and Tier 2 suppliers to gather primary data on material composition, energy consumption, and transportation modes to improve the accuracy of future PCF assessments.
- **Lightweighting:** Continued research and development into lightweight materials and design optimization to reduce overall material consumption.
- **Circular Economy Principles:** Explore increased use of recycled content for materials like aluminum, steel, and plastics.
