



# Research on Environmental Management Accounting under Changan Automobile's ESG System

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**Abstract.** Against the backdrop of the global ESG philosophy and China's "dual carbon" goals, environmental management accounting has become a key tool linking corporate environmental and financial performance. This study takes Changan Automobile as a case to explore the practical logic, paths, and effectiveness of its application of environmental management accounting under the ESG framework. Through case analysis, literature review, and quantitative analysis, it is found that Changan Automobile has made progress in improving resource efficiency, reducing environmental risks, and optimizing green decisions by building an ESG-aligned environmental management accounting system. However, common problems such as imprecise environmental cost allocation and difficulties in monetizing non-financial information remain. This paper proposes optimization suggestions to provide reference for peer enterprises.

**Keywords:** ESG, Environmental Management Accounting, Changan Automobile

## 1 Introduction

### 1.1 Research Background

Globally, ESG integration has made environmental management accounting (EMA) a crucial internal tool. By systematically measuring environmental costs and performance, EMA supports strategic decision-making aligned with sustainability goals. In China, the "Dual Carbon" goals are accelerating the green transformation of industries like automotive, which urgently requires EMA for precise cost management and compliance. Consequently, EMA acts as a key quantitative instrument within the ESG framework, not only aiding disclosure and green investment but also serving as a core converter that embeds environmental accountability into internal management, enhancing both ecological and economic efficiency. Its application thus holds significant practical importance.

## **1.2 Research Purpose and Significance**

This study aims to expand the application of environmental management accounting in ESG practices in the automotive manufacturing industry, explore its synergy mechanism with ESG goals, provide theoretical references and practical paradigms for the industry, and assist enterprises in their green transformation and the realization of the country's "dual carbon" goals.

## **1.3 Research Methods**

This study employs case analysis, literature review, and quantitative methods to examine Changan Automobile's environmental management accounting under ESG. The case study explores its real-world environmental cost management, supported by a theoretical framework from literature. Quantitative data on energy and emissions objectively assess effectiveness. These methods are interconnected: theory guides the case analysis, which refines practical logic, and quantitative results verify management outcomes, forming a complete evidence chain from theory to practice and from qualitative to quantitative validation.

# **2 Theories Related to Environmental Management Accounting**

## **2.1 The Concept and Framework of Environmental Management Accounting**

Environmental management accounting is an interdisciplinary field that combines traditional management accounting with environmental protection concepts. Its core lies in identifying and measuring environmental costs and environmental performance through systematic accounting methods, and internalizing external environmental costs, thereby guiding and optimizing the environmental behaviors and decisions of enterprises. This system encompasses core elements such as environmental costs, environmental benefits, environmental assets and liabilities, as well as physical information flow, collectively forming a management closed loop from information identification, measurement to analysis and reporting. In practice, through meticulous cost accounting and the construction of a multi-dimensional environmental performance indicator system, it not only provides crucial information support for the enterprise's internal green investment, process optimization and risk management, but also lays a solid data foundation for the external disclosure of high-quality and verifiable ESG environmental information.

## 2.2 The Current Development Status of Environmental Management Accounting

### (1) The development of environmental management accounting internationally

Since 2023, many international finance and accounting scholars have conducted separate research on environmental management accounting and ESG measurement systems. Most of them unanimously agree that while environmental management accounting and ESG measurement systems have a significant and continuous impact on the sustainable performance of enterprises, the ESG measurement system is not yet perfect, and the application of environmental management accounting is limited.

First of all, both groups of scholars have found the imperfection of the ESG measurement system. Passerini, El Tarabishy<sup>[1]</sup> et al. pointed out that the current ESG measurement system is diverse and not uniform, similar to the development stage of early knowledge management. Through enterprise cases, it is demonstrated that the integration of ESG strategies can create long-term value. The author calls for promoting the standardization and simplification of ESG to make it applicable to enterprises of different scales, in order to achieve economic and social benefits. Drempetic, Klein<sup>[2]</sup> et al. found based on ASSET4 data that the larger the scale of an enterprise, the higher its ESG score, mainly due to its stronger disclosure resources and data availability. However, when the greenhouse gas emission intensity of large companies is taken as the actual indicator, their environmental performance is not better, indicating that the current ESG scores have "scale bias" and there is an urgent need to improve the measurement methods.

Finally, Portillo-Tarragona<sup>[3]</sup> et al. analyzed five circular economy innovation projects of manufacturing enterprises in Spain and found that the application of environmental Management Accounting (EMA) was limited, and the accounting department was mostly involved in cost accounting; The research proposed a comprehensive performance measurement method and pointed out that project information disclosure has significantly decreased over time, calling for enhanced long-term transparency and standardized reporting.

In conclusion, international research indicates that environmental management accounting has a positive impact on environmental performance, with high-level management support playing a mediating role and institutional pressure playing a moderating role. The current ESG measurement system has problems such as inconsistent standards and "scale bias".

### (2) The development of environmental management accounting in China

Since 2023, many accounting scholars in China have also conducted research on enterprise environmental management accounting, ESG practice and information disclosure respectively, and deeply discussed the impact of environmental management accounting and ESG on enterprise performance and sustainable development.

A few scholars have conducted a series of studies on the combination of ESG and environmental management accounting and put forward relevant effective suggestions. Zheng Qiong and Liu Chunying<sup>[4]</sup> took Ping An as an example to discuss the integration practice of ESG and environmental management accounting, which achieved a

win-win situation of economic and environmental performance through AI-ESG platform, and suggested improving EMA system, strengthening disclosure and digitalization, and boosting green development and "dual carbon" goals. Wang Qinglin<sup>[5]</sup> studied ESG embedded in environmental management accounting, built the whole process framework, took XJ Electric as an example, and proposed that it should strengthen the combination of digital technology, take ESG strategy as the guidance, improve risk control, and promote enterprises to achieve environmental and economic synergy.

To sum up, the above studies consistently point out that domestic research focuses on the case of local enterprises, focuses on environmental information disclosure, EMA system construction, ESG performance impact, points out challenges such as scattered disclosure and insufficient data technical support, and emphasizes digital integration and policy coordination.

### **(3) Comparison of international and domestic development**

International research focuses on cross-regional empirical research and mechanism discussion, while domestic research pays more attention to local application and policy response. Both call for greater standardization, transparency and integration of systems.

### **(4) The association between ESG and environmental management accounting**

ESG's demand for high-quality environmental information forces enterprises to establish EMA system. EMA provides ESG with the data foundation, management tools and governance basis to promote enterprises from compliance to value creation.

## **3 Practice Analysis of Environmental Management Accounting of Changan Automobile based on ESG System**

### **3.1 Overview of the ESG Management System of Changan Automobile**

Changan Automobile's ESG strategy provides clear top-level design and implementation support for environmental management accounting. Strategically, its "Shangri-La Plan" sets quantifiable targets, offering direction and benchmarks for environmental cost management. Organizationally, an ESG governance committee and cross-departmental working group ensure coordination and resource allocation. Internally, established policies and procedures create standardized processes for data collection and reporting, laying a systematic foundation for environmental management accounting.

### **3.2 The Specific Application of Environmental Management Accounting by Changan Automobile**

Changan Automobile did not issue a separate environmental cost statement in the report, but the data system disclosed by Changan Automobile made it possible for external researchers to conduct environmental cost accounting. This study mainly uses two methods to calculate it:

Monetize accounting of potential external environmental costs. According to the total greenhouse gas emissions from 2022 to 2024 disclosed in Changan Automobile's

public 2024ESG report, multi-scenario carbon price is used for estimation to reveal its potential financial impact. Table 1 sets three scenarios, according to which a carbon price is assumed, and takes the potential cost of carbon emissions in 2024 as an example to show the accounting method. (Total greenhouse gas emissions in 2024:894,45TCo2e)

The estimation formula is as follows:

$$\text{Greenhouse gas carbon emissions} \times \text{Price of carbon} = \text{Potential cost of carbon emissions} \tag{1}$$

**Table 1.** Monetization of potential external environmental costs

| Carbon price scenario                  | Carbon price hypothesis | Calculation of potential cost of carbon emissions in 2024 | Estimated result (100 million yuan) |
|--|-------------------------|---|-------------------------------------|
| Scenario 1: Market performance price   | 60yuan/ton              | 894545×60   | 0.54                                |
| Scenario 2: Social cost price          | 300yuan/ton             | 894545×300  | 2.68                                |
| Scenario 3: International shadow price | 500yuan/ton             | 894545×500  | 4.47                                |

Identification of internal environmental management costs. According to the annual report, Changan Automobile paid 1.0969 million yuan of environmental protection tax in 2024 and 1.4676 million yuan in 2023, and incurred the construction, operation and maintenance of environmental protection facilities. This indicates that the company has identified and managed part of the direct environmental costs, but the more comprehensive internal environmental costs (such as depreciation of environmental protection equipment, environmental protection personnel costs, etc.) still need to be further separated and disclosed.

Changan Automobile has designed multi-level environmental performance indicators, whose core logic can be summarized as follows:

1) Absolute quantity index (result layer) : total greenhouse gas emissions and breakdown by range 1 (direct emissions) and Range 2 (indirect emissions). As shown in Table 2 below, these indicators are used to meet international disclosure requirements and directly measure the absolute pressure a firm puts on the environment.

**Table 2.** Greenhouse gas emissions of Changan Automobile (autonomous part)

| Type of indicator        |                                | Unit  | 2022   | 2023   | 2024   |
|--------------------------|--------------------------------|-------|--------|--------|--------|
| Greenhouse gas emissions | Range 1                        | tCO2e | 185230 | 201437 | 151868 |
|                          | Range 2                        | tCO2e | 652715 | 722453 | 742676 |
|                          | Total greenhouse gas emissions | tCO2e | 837945 | 923890 | 894545 |

2) Intensity index (efficiency layer) : "Average carbon emission of bicycle manufacturing" and "carbon dioxide emission intensity of output value" (0.0544 tCO2e/ ten thousand yuan) are shown in Table 3. Intensity indicators are the essence of environmental management accounting, which links environmental performance to operational

and financial core indicators (output, output value). For example, "carbon dioxide emission intensity of output value" can be directly multiplied with "operating revenue (159.733 billion yuan)" to verify and predict total emissions, reflecting the integration of environment and business.

**Table 3.** Changan Automobile (full caliber) three-year carbon emission reduction assessment index

| Emission reduction target                        | Unit                                   | 2024   | Objective requirements          | The achieved state  |
|--|--|--------|---------------------------------|---------------------|
| Comprehensive energy consumption of output value | Ton of standard coal/ten thousand yuan | 0.0112 | Annual decrease in value≥12.99% | Have been completed |
| Carbon dioxide emissions of output value         | tCO2e/ ten thousand yuan               | 0.0544 | Annual decrease in value≥13.87% | Have been completed |

3) Target management index (management) : The company has set a clear annual reduction target for "carbon emission of bicycle manufacturing" and other indicators (for example, the target of 2024 is to decrease > 1.9%, but the actual value is 2.2%), and completes the management closed loop by comparing the actual value with the target value, reflecting the active management of environmental performance.

### 3.3 The Overall Implementation Effect of Changan Automobile

In order to evaluate the long-term trend of the implementation effect of environmental management accounting, this study integrates the core data of the company in the last three years as shown in Table 4 below. Among them, the cumulative change rate is calculated with 2022 as the base period, and the calculation formula of output value carbon emission intensity is as follows:

$$\text{Carbon emission intensity of output value} = \frac{\text{Emission rate}}{\text{gross sales}} \tag{2}$$

**Table 4.** Changan Automobile environmental performance and financial performance data table

| Dimension of indicators   | Specific indicators  | 2022    | 2023    | 2024    | Cumulative change in 2022-2024 |
|---------------------------|--|---------|---------|---------|--------------------------------|
| Environmental performance | Total greenhouse gas emissions                                       | 83.79   | 92.39   | 89.45   | +6.8%                          |
|                           | Including: Scope I (direct) (ten thousand tons CO2e)                 | 18.52   | 20.14   | 15.19   | -18.0%                         |
|                           | Including: Scope II (indirect) (ten thousand tons CO2e)              | 65.27   | 72.25   | 74.27   | +13.8%                         |
| Financial Performance     | Carbon emission intensity of output value (tCO2e/ ten thousand tons) | 0.0691  | 0.0611  | 0.0544  | -21.3%                         |
|                           | Gross sales (100 million yuan)                                       | 1212.53 | 1512.98 | 1597.33 | +31.7%                         |

The long-term trend reveals an inflection point of "up first and then down" and continued "decoupling". Observing the three-year data, the total carbon emissions increased with business expansion in 2022-2023, but successfully achieved an absolute decline in 2023-2024, showing an "inflection point" at which environmental management measures had substantial effects. The carbon emission intensity of output value continued to decline (21.3% cumulative decline in three years). This shows that the environmental efficiency per unit of economic output is constantly improving. In order to strengthen the argument for "decoupling," further analysis is conducted by calculating the long-term carbon emission elasticity coefficient for 2022-2024 as follows.

Cumulative growth in gross sales:

$$\frac{1597.33-1212.53}{1212.53} \approx +31.7\% \tag{3}$$

Total carbon emissions increased cumulated:

$$\frac{89.45-83.79}{83.79} \approx +6.8\% \tag{4}$$

$$\text{Long run elasticity coefficient} = \frac{6.8\%}{31.7\%} \approx 0.21 \tag{5}$$

Although the long-run elasticity coefficient is positive, it is still far less than 1, indicating that the growth rate of carbon emissions is much lower than the economic growth rate, which is in a benign channel of relative decoupling, and the trend is positive.

Three years of data clearly reveal structural change:

Range 1 (direct emissions) : After a slight increase in 2023, it will sharply decrease to 151,900 tons in 2024, even lower than the level in 2022 (185,200 tons), with a cumulative decrease of 18.0% in three years. This is strong evidence that the surge in capital spending in 2024 is being focused on low-carbon retrofits to in-plant production.

Range 2 (indirect emissions) : continuous rise for three years, with a cumulative increase of 13.8%, becoming the main reason for the increase of total emissions in 2022-2023. This reflects the increase in electricity consumption caused by the expansion of production scale, but also implies that the company still has a lot of room to purchase green electricity or improve the efficiency of purchased electricity.

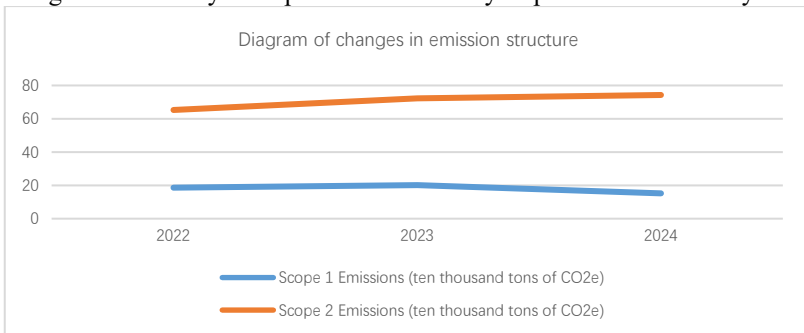


Fig. 1. Diagram of changes in emission structure

As shown in Figure 1, the decline in total carbon emissions in 2024 is mainly driven by a sharp reduction in Scope 1 direct emissions, which is consistent with the company's strategy of significantly increasing capital expenditure and focusing on low-carbon transformation of internal production links.

Core conclusion: The focus of the emission reduction strategy of Changan Automobile is very clear -- to give priority to and effectively overcome the direct emissions that can be directly controlled by itself.

Estimated based on social cost carbon price (300 yuan/ton) :

Scale of potential environmental liabilities: The company's potential cost of carbon emissions in 2024 (268 million yuan) has increased compared to 2022 (about 251 million yuan).

Value of strategic inputs: It was during this period that the Company reversed the upward trend of emissions and significantly optimized the emissions mix through continued R&D and capital expenditure in 2024. This proves that in the face of expanding environmental risks from growth, proactive environmental management investments are not "expenses", but necessary strategic expenditures to control long-term financial risks and escort growth.

## **4 Case Enlightenment and Optimization Suggestions**

### **4.1 Current Domestic Enterprises Have Shortcomings in Environmental Management Accounting and ESG**

Changan Automobile currently faces two main challenges in applying environmental management accounting. First, data and disclosure issues—such as selective reporting and inconsistent metrics—reflect a lack of standardization in its internal data systems. Second, technical shortcomings in accurately allocating environmental costs using traditional methods distort cost accounting, affecting green product pricing and R&D decisions. These interrelated problems limit the overall effectiveness of its environmental management accounting.

### **4.2 Current Domestic Enterprises Have Shortcomings in Environmental Management Accounting and ESG**

To enhance environmental management accounting (EMA), Changan Automobile should: 1) Improve its internal EMA framework with precise tools and explore a "green balance sheet"; 2) Strengthen ESG disclosure by aligning with international standards and introducing third-party assurance; 3) Deepen digital transformation by integrating data platforms and applying AI for cost analysis; 4) Embed environmental cost-benefit analysis into investment decisions and foster company-wide green awareness, fully integrating EMA into strategy and daily operations.

## 5 Conclusion

This study of Changan Automobile finds environmental management accounting (EMA) is vital for strategic ESG and dual-carbon compliance, moving beyond basic reporting. Successful integration improves both environmental and financial performance. However, challenges remain in cost allocation, supply-chain monetization, and valuing non-financial impacts. Effective EMA requires holistic organizational reform, not just accounting changes. Future growth will be driven by stricter disclosure standards and digital tools like IoT and AI. Companies must treat EMA as a strategic investment to build competitiveness in the sustainable development era.

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