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Environmental and Social Impacts of Automobile Company A in Anhui Province

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Abstract: With the vigorous promotion of China's "dual carbon" strategy and the accelerated development of new energy vehicles (NEVs), Anhui Province has established an industrial cluster led by major companies such as Chery, JAC, BYD, NIO, and Volkswagen (Anhui), forming a relatively complete NEV industry chain. This paper takes Automobile Company A (CA) as a case study to explore the environmental and social impacts of Anhui's NEV cluster. Environmentally, the paper analyzes the development status and green transformation of the cluster in terms of clean energy applications, green manufacturing, and carbon emission reduction. Socially, it discusses the cluster's role in promoting economic development, increasing employment, and driving upstream and downstream industrial development. The study concludes that Anhui's NEV cluster, represented by CA, has made significant progress in green development and social value creation. However, challenges remain in areas such as industrial coordination, technological innovation, and sustainable development, requiring continued support from policy, technology, and the market.

Keywords: New Energy Vehicles; Automobile Company A; CA; Industrial Cluster; Environmental Impact; Social Impact

1. Research Background and Significance

New energy vehicles (NEVs) refer to automobiles powered by alternative fuels and equipped with advanced technologies in power control and drivetrain systems. These vehicles represent significant technological innovation, incorporating new powertrains and structural designs. The category includes hybrid electric vehicles (HEVs), battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs), and other alternative-energy vehicles.

As global environmental and energy challenges intensify, the development of clean, low-carbon energy sources has become a strategic choice for many nations pursuing sustainable development. Consequently, the NEV industry has garnered substantial international attention and support. In 2020, China's State Council released the "New Energy Vehicle Industry Development Plan (2021-2035)," which positions NEVs as a crucial pathway for transforming China from a major automotive manufacturing country to an automotive powerhouse. The plan also underscores NEVs as a strategic solution to address climate change and promote green development.

Amid rising environmental consciousness and rapid technological advancement, NEVs are reshaping the global automotive industry at an unprecedented pace. In China, the market for NEVs reached a milestone in July 2024: the market penetration rate for new energy passenger vehicles surpassed 50%, hitting 51.1%. This marked the first time that green-licensed NEVs outnumbered traditional fuel vehicles in market share.

Anhui Province, one of China's traditional automotive manufacturing hubs, has proactively embraced this shift toward electrification. As early as 2017, the provincial government introduced the "13th Five-Year Plan for the Development of the Automotive and New Energy Vehicle Industry in Anhui Province" and a set of supporting policies aimed at fostering innovation and expanding the NEV market.

Further emphasizing this direction, the province's 14th Five-Year Plan designates the NEV and intelligent connected vehicle sectors as one of ten priority emerging industries and one of five world-class strategic industrial clusters. In response to the national goals of electrification, connectivity, and intelligentization outlined in the national development plan, the Anhui Development and

Reform Commission, along with 11 other departments, jointly issued the "Implementation Plan for the Innovation and Development Strategy of Intelligent Vehicles in Anhui Province" in January 2021. This plan clearly identifies intelligent vehicles as a focal point of Anhui's industrial strategy.

In June 2021, the provincial government released the "Action Plan for the Development of the New Energy Vehicle Industry in Anhui Province (2021-2023)," aiming to establish multiple regionally distinctive NEV industrial clusters. Based on the existing industrial foundation, Anhui is promoting a dual-core development model centered around Hefei and Wuhu, supported by key nodes in Lu'an, Anqing, and Ma'anshan, thus forming a robust regional network for industrial collaboration.

Driven by both high-tech innovation and strong capital investment, the automotive industry in Anhui is rapidly advancing toward electrification, intelligentization, and networking. As a result of deep integration with next-generation information technologies—such as artificial intelligence, big data, and the Internet of Things—NEVs and intelligent connected vehicles are entering a pivotal stage of technological acceleration and industrial expansion. These vehicles are now key drivers of transformative change in the automotive sector, positioning Anhui to lead in the future global industrial landscape.

2. Research Methods

2.1 Interviews

2.1.1 L.X. (Director of Finance Department in CA)

CA's rapid development in both conventional fuel vehicles and new energy vehicles has led to a significant increase in revenue. The entire production process—including manufacturing, sales, and after-sales services—has created numerous job opportunities. The growth of related industrial chains has further stimulated economic development in upstream and downstream sectors. The construction of new factories has also generated additional employment; in the Finance Department alone, over 20 positions have been added annually. With increasing public environmental awareness, NEVs are emerging as a popular choice due to their vast market potential, which in turn boosts industry prosperity and creates more jobs. By strengthening R&D in key technologies and core components and enhancing productivity, the company continues to expand, forming a complete industrial chain that drives regional economic development.

2.1.2 S.Y. (Manager of Overseas Department in European Division, CA)

CA has ranked first among Chinese independent brands in passenger car exports for 21 consecutive years. Currently, exports account for approximately 50% of the company's total sales, making CA the first Chinese brand whose overseas sales equal domestic sales. Over two decades of overseas expansion have resulted in a robust global business network. The company has established 10 overseas production bases and over 1,500 dealerships in more than 80 countries and regions, serving over 13 million global users.

In Eastern Europe, traditional fuel vehicles dominate due to battery performance limitations of NEVs in cold climates, which reduce driving range. However, in Southeast Asia, Western Europe, and North Africa, NEV exports are growing rapidly. These regions benefit from better power infrastructure, higher fuel costs, and a preference for low-noise, eco-friendly vehicles. In South Africa and Latin America, where electricity supply can be unstable, NEVs are even used as backup power sources for households. During power outages, vehicle batteries can provide electricity to homes, enhancing daily convenience.

2.1.3 Y.Y. (Project Manager of Research Institute in CA)

The choice between NEVs and traditional fuel vehicles should be based on individual needs and preferences. While NEVs offer notable advantages in environmental protection and economic efficiency, fuel vehicles outperform in speed and power output. If we focus solely on emissions during vehicle operation—excluding the environmental impact of the entire production chain—NEVs are clearly more eco-friendly. They produce no tailpipe emissions and significantly lower carbon emissions compared to fuel vehicles—by approximately 50 to 150 grams of CO_2 per kilometer.

Fuel vehicles emit not only carbon dioxide but also harmful substances like carbon monoxide, hydrocarbons, and nitrogen oxides, which damage human health and degrade air quality,

especially in urban areas. NEVs, in contrast, operate with minimal noise, reducing noise pollution as well. When considering a vehicle's full life cycle—manufacturing, usage, and disposal—most studies conclude that fuel vehicles emit about 1.5 times more carbon than electric vehicles. As the share of clean electricity and hydrogen energy increases, the environmental benefits of NEVs will continue to grow.

2.2 Environmental Benefit Measurement Methodology

2.2.1 Carbon Emissions Calculation for New Energy Vehicles

Formula:

Carbon Emissions = $\sum$ (Energy Consumption per Phase × Emission Factor) − Recovery Offset

Emission Factor Source: IPCC National Greenhouse Gas Inventory Guidelines (2023 edition) or the database of China's Ministry of Ecology and Environment.

Benchmark for Comparison: Average carbon emissions of traditional fuel vehicles, based on International Energy Agency (IEA) standards, estimated at approximately 2.4 kg CO_2 per liter of gasoline.

2.2.2 Estimating Carbon Reduction Contribution

In 2024, CA's annual revenue reached RMB 480 billion, a year-on-year increase of more than 50%, representing a leap of over RMB 150 billion. Annual vehicle sales hit 2.6039 million units (up 38.4%), with 1.1446 million exported (up 21.4%), maintaining CA's position as China's top passenger car exporter for the 22nd consecutive year. NEV sales totaled 583,600 units, marking a 232.7% increase, with monthly sales surpassing 100,000 units for the first time in December.

Annual Carbon Reduction Formula:

(Carbon Emissions per km by Fuel Vehicle − Carbon Emissions per km by Electric Vehicle) × Annual Mileage × Number of NEVs

Assumptions:

•Average annual mileage per vehicle = 15,000 km

•Fuel vehicle emissions = 150 g CO_2/km (NEDC standard)

•Electric vehicle emissions = 50 g CO_2/km (Assuming grid emission factor of 0.5 kg CO_2/kWh and energy consumption of 15 kWh/100 km)

Calculation:

$(150 − 50) × 15,000 × 583,600$ g CO_2 = 875,400,000,000 g CO_2 = 875,400 metric tons CO_2/year

2.2.3 GRI Framework Integration

CA has incorporated climate-related issues into board-level oversight and integrated them into its sustainable development governance framework. The company is advancing carbon audits and product carbon footprint management to assess emissions, identify reduction areas, and set achievable targets.

According to GRI 305 (Emissions), total greenhouse gas emissions in 2023 (Scope 1 + Scope 2) were 503,467.9 metric tons CO_2 equivalent. Renewable energy accounted for 7.6% of total energy consumption, and 14.7% of electricity consumption was from renewable sources.

Per GRI 302 (Energy), CA is actively deploying renewable energy solutions such as photovoltaic systems and ground source heat pumps. By the end of 2023, the factory had installed 76 MW of photovoltaic capacity, generating 198,900 MWh of electricity, with a self-use ratio of 93.9%, reducing CO_2 emissions by approximately 140,000 metric tons.

The NEV plant installed 3.25 MW of photovoltaic capacity, generating about 3,250 MWh annually. Over a 25-year lifecycle, it is expected to generate 71,500 MWh of clean electricity, reducing CO_2 emissions by about 50,000 metric tons.

As of the end of 2023, CA's total photovoltaic capacity reached 101 MW, with 89.7 GWh of renewable energy consumed, 531.1 GWh of direct energy consumed, and 641.8 GWh of indirect energy consumed—totaling 1,172.9 GWh.

Water resources are also a priority. CA strictly complies with China's Water Law and Water Pollution Prevention Law, promotes water conservation in all operations, and actively recycles industrial wastewater. In 2023, total water withdrawal reached 4.319 million tons, with recycled water accounting for 22.0287 million tons—98.1% of the total 22.4606 million tons used.

3. Market Research

At the provincial policy level, Anhui has identified the new energy vehicle (NEV) and intelligent connected vehicle (ICV) industry as

one of its ten key emerging sectors. In recent years, the province has introduced a series of policy measures, such as the *Implementation Plan for Investment Promotion and Talent Attraction in the NEV and ICV Industries* and the *14th Five-Year Plan for High-Quality Development of Anhui's Automotive Industry*. These policies clearly state that by 2025, the province aims to achieve the market application of intelligent vehicles and the construction of intelligent infrastructure. The plans also designate Hefei and Wuhu as core development zones for major NEV industrial bases during the 14th Five-Year Plan period, accelerating Wuhu's automotive industry toward internationalization.

To date, Anhui has successfully entered the fast lane of the intelligent connected vehicle race and has initially formed a dual-core industrial spatial structure driven by Hefei and Wuhu, supported by multiple cities. The province hosts more than 110 companies related to the "Three Intelligents + One Core" (intelligent vehicles, intelligent roads, intelligent infrastructure, and chips), gradually forming a new ecosystem integrating vehicles, roads, clouds, and networks. Capitalizing on its strength in technological innovation, Anhui is actively exploring the integration of ICVs with smart transportation and smart cities. Through scenario-based, phased, and batch-based approaches, Anhui is systematically and orderly advancing pilot applications of ICVs. Hefei and Wuhu have completed pilot construction of "Dual Intelligent" cities. The province has opened more than 2,500 kilometers of road for testing and pilot demonstrations, covering multiple application scenarios such as park sightseeing, smart buses, smart ports, mining, and shipping. A total of 241 road test and demonstration licenses have been issued, with cumulative test mileage exceeding 2 million kilometers.

Between 2000 and 2023, Anhui's annual automobile production increased dramatically from 57,000 vehicles to 2.491 million, achieving a compound annual growth rate (CAGR) of 17.8%. In terms of national automotive production share, Anhui rose from 3.0% in 2018 to 8.3% in 2023. In the first half of 2024, Anhui ranked third nationwide by vehicle output, trailing only Guangdong and Chongqing.

Anhui's competitive advantage in the rapid industrialization of NEVs lies in its virtuous development cycle: guided by policy, supported by capital, driven by technological innovation, and aimed at industrial upgrading. Early in its NEV development, the province, through subsidiaries of the Anhui Provincial Investment Group, established multiple equity investment funds to foster industry growth. These investments helped attract and support key enterprises such as NIO, Volkswagen Anhui, and BYD Hefei, catalyzing the development of upstream and downstream supply chains. Together with Chery, JAC, Changan Hefei, and Hanma Technology, Anhui now hosts seven vehicle manufacturers, forming an open, collaborative, and mutually beneficial NEV industrial cluster.

By 2023, the automotive industry had become a pillar of Anhui's development. Driven by the seven leading vehicle manufacturers, the province has built a complete industrial chain system, with total output value reaching RMB 1.15 trillion. All 16 cities in the province are actively engaged in laying out various automotive industry subfields, aiming to integrate resources, specialize, and form a synergistic development model. A dual-core layout centered on Hefei and Wuhu, supported by other cities, has taken shape, successfully establishing a "3-hour NEV industrial zone."

In terms of financial support, in 2023 the Anhui Provincial Development and Reform Commission announced the establishment of a special fund, planning to set up over RMB 100 billion in automotive industrial chain investment funds over five years to accelerate technology R&D and industrial upgrading.

At the municipal level, Hefei and Wuhu have released multiple policies and draft regulations in recent years to promote ICV development. These include various financial support and incentive measures, encouragement for demonstration projects, support for simulated commercial operations, mutual recognition of testing licenses, and the establishment of standardized testing protocols.

Other cities across Anhui—such as Xuancheng, Chuzhou, Anqing, Huainan, Huaibei, Suzhou, Bengbu, Chizhou, Bozhou, Fuyang, Lu'an, Tongling, Ma'anshan, and Huangshan—have also made significant progress in developing their NEV and ICV industrial chains. Through key project attraction, industrial cluster cultivation, and technological innovation, all

16 cities are now participating in segmented fields of the automotive industry, striving for coordinated development and integrated deployment. A dual-core layout centered on Hefei and Wuhu, with multi-point support from other cities, has already taken shape.

As one of the dual cores, Hefei attracted 151 NEV and ICV projects in 2023, with total contractual investment reaching RMB 115.8 billion. Key projects include Volkswagen's global second R&D center, DeepWay's new energy heavy truck project, JAC's high-end passenger vehicle project, the East China testing base of China Merchants Testing, and the national headquarters of autonomous driving for special vehicles by TAGE Zhixing.

As the other core city, Wuhu is actively developing innovation platforms for industrial development. By the end of 2023, Wuhu had established over 50 technological innovation platforms in the NEV and ICV fields, laying a solid foundation for innovation-driven transformation. In terms of investment attraction, Wuhu successfully introduced 127 NEV projects worth over RMB 1 billion each in 2022, totaling RMB 107.8 billion.

Each city in Anhui contributes distinct strengths to the province's high-quality automotive development. Chuzhou focuses on the "new three" (lithium batteries, photovoltaics, and NEVs), striving to become the province's second-largest power battery hub and third-largest NEV city. Xuancheng specializes in NEV motors and components, rubber, and lightweight materials, with the automotive-related output value exceeding RMB 60 billion, aiming to grow NEVs into a RMB 100 billion-level core industry. Tongling and Ma'anshan concentrate on parts supply and power battery materials. Anqing targets NEVs and special-purpose vehicles, emphasizing batteries, electric controls, motors, and lightweight vehicle structures, aiming to build a NEV industrial cluster with output surpassing RMB 50 billion by 2025. Chizhou focuses on magnesium-aluminum lightweight components, automotive electronics and power devices, and new battery materials. Bozhou emphasizes the development of key NEV components such as batteries, electrodes, motors, and electronic controls. Bengbu targets vehicle displays, automotive glass, NEV batteries, and sensors. Huaibei is focusing on ceramic-aluminum lightweight automotive parts and NEV battery boxes. Lu'an is laying out its first-mover advantage in hydrogen fuel cell technologies.

Led by more than five major vehicle manufacturers—including Chery, JAC, BYD, Volkswagen, and NIO—Anhui has successfully built a comprehensive vehicle manufacturing ecosystem covering the entire industry chain. Our analysis reveals the presence of at least:19 representative vehicle manufacturers and production bases, 26 battery manufacturers and bases, 14 motor and electric control producers and bases, 8 powertrain manufacturers and bases (engines and gearboxes), 18 smart cockpit manufacturers and bases, 11 intelligent driving component manufacturers and bases, 14 intelligent driving solution providers and bases, 11 interior and exterior parts manufacturers and bases, 19 lightweight and structural parts manufacturers and bases, 8 automotive chassis system manufacturers and bases, 16 other auto parts manufacturers and bases (including tires, safety systems, wiring harnesses, air conditioning, switches, etc.)

Furthermore, at least 84 publicly listed companies are involved in various segments of Anhui's automotive industrial chain, covering everything from complete vehicle manufacturing to component supply.

4. Environmental Impact Assessment

The Global Reporting Initiative (GRI) is an international organization dedicated to improving the quality, rigor, and practicality of sustainability reporting. By developing and promoting unified reporting standards, GRI aims to help businesses, governments, and other organizations clearly communicate their performance in economic, environmental, and social dimensions, thereby advancing global sustainable development. Its goal is to enhance the comparability and credibility of sustainability reports worldwide and to encourage their global recognition and adoption.

The standards provided by GRI for ESG (Environmental, Social, and Governance) reporting constitute a comprehensive framework for sustainability reporting. Compared to other ESG disclosure standards, the GRI standards form an interconnected system, covering a broader scope and comprising three main categories: Universal Standards, Sector Standards, and Topic Standards.

Universal Standards include content that is fundamental for all ESG reports,

Sector Standards identify material topics specific to particular industries, and

Topic Standards outline detailed disclosure items used to report the impacts related to specific sustainability topics.

According to GRI 305: Emissions 2016, carbon dioxide (CO_2) equivalent is a metric used to compare the emissions of various greenhouse gases (GHGs) based on their Global Warming Potential (GWP). GWP refers to the radiative forcing impact of one unit of a given GHG compared to one unit of CO_2 over a specified time period. Greenhouse gases (GHGs) are gases that absorb infrared radiation and contribute to the greenhouse effect.

GHG emission scopes refer to the categorization of emissions within an organization's operational boundaries. The classification is based on whether the GHG emissions are directly caused by the organization or by other related entities, such as electricity providers or logistics companies. There are three defined scopes:

Scope 1 emissions: These are direct emissions from sources that an organization owns or directly controls — for example, emissions from burning fuel in company-owned vehicles (if they are not electric).

Scope 2 emissions: These are indirect emissions resulting from the generation of purchased energy. For example, the emissions from electricity generation used in company buildings fall into this category.

Scope 3 emissions: These include all other indirect emissions that occur in an organization's value chain, both upstream and downstream. This includes emissions from activities such as purchasing, using, and disposing of products from suppliers. Scope 3 encompasses all sources not included in Scope 1 and Scope 2.

5. Conclusion

This study takes Anhui's NEV cluster—represented by CA—as the research object, exploring its environmental and social impacts. Environmentally, the cluster promotes green transformation through clean energy usage, green manufacturing, and carbon reduction measures, contributing to the achievement of the "dual carbon" goals. Socially, it boosts regional economic development, expands employment, and enhances the vitality of the upstream and downstream industrial chains. However, current issues such as weak industrial coordination, insufficient technological innovation, and uneven enterprise development still exist. In the future, efforts should focus on improving industrial synergy, strengthening R&D investment, optimizing policies and institutional mechanisms, and enhancing sustainable competitiveness to ensure the long-term healthy development of the NEV industry cluster.

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