A Comparative Study of Renewable Energy Vehicle Policies between China and Japan and Its Implications

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Abstract. Sustainable green development, with a particular emphasis on reducing carbon footprints, has emerged as a pressing global concern as nations endeavor to transition towards low-carbon economies. This paper focuses on China and Japan, two leading automobile nations that prioritize the development of New Energy Vehicles (NEVs) and Electric Vehicles (EVs) technologies. A comparative analysis of the EV and NEV policies in these two prominent Asian countries is conducted, delving into various aspects such as incentives, innovations, market promotion strategies, and the development of charging infrastructure. China's NEV industry has made significant strides due to robust government support, fostering a thriving ecosystem for electric vehicles. In contrast, Japan's government and market have adopted a more conservative approach, placing a strong emphasis on hybrid vehicles. While both countries excel in their respective areas of focus, limitations remain. China is continuously seeking more sustainable methods to advance its NEV sector, while Japan faces delays in transitioning from hybrid vehicles to fully electric models. To enhance future competitiveness and propel global efforts towards a low-carbon, sustainable future, this paper provides valuable policy suggestions tailored to the unique challenges faced by both countries.

Keywords: New energy vehicle; Japan; China; policy; sustainability.

1. Introduction

The global imperative for green development has intensified in recent years, with countries worldwide actively seeking sustainable growth strategies. One notable manifestation of this trend is the rapid advancement of new energy vehicle (NEV). China and Japan, both Asian countries, have made significant strides in the NEV industry, driven by their respective policy initiatives and market dynamics.

China, the world's largest automotive market, has experienced a remarkable surge in NEV production and sales, supported by a comprehensive policy framework encompassing subsidies, tax incentives, and infrastructure development [1]. Concurrently, Japan, a long-standing automotive powerhouse, has leveraged its technological expertise and industry experience to drive innovation in the NEV sector, emphasizing hybrid and fuel cell technologies [2].

This paper aims to conduct a comparative analysis of the NEV policies implemented in China and Japan, examining their similarities, differences, and effectiveness in promoting the adoption of clean transportation solutions. By understanding the unique approaches taken by these two Asian giants, seek to derive valuable insights and lessons that can inform policy-making and industry practices in other countries pursuing sustainable mobility.

The comparative study is particularly pertinent given the pivotal roles of China and Japan in shaping the global automotive landscape. As the two largest economies in Asia, their experiences in developing the NEV industry can serve as a roadmap for other nations seeking to transition towards a greener transportation future. Furthermore, the contrasting strategies employed by China and Japan - with the former prioritizing pure electric vehicles and the latter focusing on hybrid and fuel cell technologies - provide a diverse range of policy options to consider. Through a systematic review of government policies, industry reports, and academic literature, this paper will delve into the key aspects of NEV development in China and Japan, including regulatory frameworks, financial incentives, charging infrastructure, and technological innovations. By analyzing the successes and

challenges of these policies, this paper aims to contribute to the growing body of knowledge on sustainable transportation and provide actionable recommendations for policymakers, industry stakeholders, and researchers in this field.

2. China's Electric Vehicle (EV) Policy Framework

China has implemented a comprehensive policy framework to support the development and adoption of new energy vehicles (NEVs). This framework includes tax incentives for vehicle purchases, investment in charging infrastructure, national research and development support, and market promotion measures.

2.1. Vehicle Purchase Tax Incentives

The Chinese government has introduced a suite of significant tax incentives to encourage the purchase of NEVs, making them more attractive and affordable for consumers. For example, buyers of pure electric vehicles, such as the popular BYD Han and Tesla Model 3, are exempt from vehicle purchase tax, which can save them thousands of dollars on the upfront cost. Similarly, plug-in hybrid vehicles like the Li Xiang One and fuel cell vehicles like the Toyota Mirai also qualify for this exemption, substantially reducing the financial burden on consumers who choose to adopt these environmentally friendly technologies [3]. According to a recent government announcement, new energy vehicles purchased between January 1, 2024, and December 31, 2025, will be fully exempt from vehicle purchase tax. For new energy passenger vehicles, the tax exemption is capped at 30,000 yuan per vehicle. For NEVs purchased between January 1, 2026, and December 31, 2027, the vehicle purchase tax will be reduced by half, with the tax reduction capped at 15,000 yuan per passenger NEV [4]. Additionally, NEVs that meet certain standards are exempt from vehicle and vessel tax, further lowering the cost of ownership and making them more competitive with traditional internal combustion engine vehicles. Furthermore, fuel-efficient vehicles with engine displacements under 1.6 liters, like the Geely Emgrand and Chery eQ1, also receive a 50% reduction in vehicle and vessel tax, providing an additional incentive for consumers to opt for more eco-friendly transportation options. These tax incentives have played a crucial role in stimulating the demand for NEVs in China, contributing to the country's position as the world's largest NEV market.

2.2. Charging Infrastructure Construction

Recognizing the critical importance of a robust and extensive charging network in supporting the widespread adoption of NEVs, the Chinese government has provided substantial subsidies and incentives for the construction of NEV charging infrastructure. For instance, the State Grid Corporation of China, the world's largest utility company, has been actively involved in building a vast network of charging stations across the country, to install 120,000 charging points by 2020 [4]. Private companies like Teld and Star Charge have also received generous construction subsidies to build charging facilities in residential areas, shopping malls, and parking lots, making it more convenient for NEV owners to charge their vehicles. The government has also set ambitious targets for the number of charging points to be installed nationwide, aiming to have 500,000 charging points by 2025, ensuring adequate coverage to support the growing NEV market and alleviate range anxiety among potential buyers [5]. These initiatives have been instrumental in creating a comprehensive and reliable charging infrastructure, which is essential for the convenience and practicality of owning and operating NEVs in China.

2.3. National Research and Development Support

China has placed a strong emphasis on advancing NEV technologies through robust national research and development support. The government has allocated substantial funds to support R&D efforts in key areas such as battery technology, electric motors, and power electronics, recognizing the critical role of technological innovation in driving the competitiveness and sustainability of the

NEV industry. According to the Ministry of Industry and Information Technology, in 2020, the Chinese government invested over 37 billion yuan (approximately 5.5 billion USD) in the research and development of NEVs and related technologies [6]. This significant financial support has been instrumental in accelerating the development of cutting-edge NEV technologies and enhancing the competitiveness of Chinese NEV manufacturers in the global market. For example, the Ministry of Science and Technology has launched the "863 Program," which focuses on high-tech research and development, including NEV technologies [7]. Manufacturers of NEVs and related components, such as CATL, BYD, and Sunwoda, are eligible for value-added tax (VAT) reductions on equipment, parts, and assets purchased for production purposes, providing a significant financial incentive for companies to invest in R&D and manufacturing capabilities. Furthermore, NEVs and R&D equipment donated by foreign governments, such as the collaboration between China and Germany on NEV development, are exempt from VAT, fostering international collaboration and knowledge sharing in the field of NEV technology. These measures have encouraged technological innovation, attracted global talent, and helped Chinese NEV manufacturers like NIO, Xpeng, and Li Auto enhance their competitiveness in the global market.

2.4. Market Promotion

To promote the widespread adoption of NEVs and accelerate the transition towards sustainable transportation, the Chinese government has implemented various market promotion measures. Local governments in cities like Beijing, Shanghai, and Shenzhen have introduced preferential policies, such as dedicated NEV license plates and exemptions from traffic restrictions, to incentivize consumers to switch to electric vehicles and make NEV ownership more convenient and attractive [8]. For example, in Beijing, NEV owners are exempt from the city's license plate lottery system, which can take years for conventional vehicle owners to obtain a license plate. The government has also set ambitious targets for the proportion of NEVs in public transportation and government vehicle fleets, aiming to have 50% of all new buses and 30% of new government vehicles be NEVs by 2025, creating a stable and significant demand for these vehicles and demonstrating leadership in the adoption of clean technology [9]. Additionally, public awareness campaigns and educational programs, such as the "New Energy Vehicle Experience" initiative, have been launched to increase consumer knowledge and acceptance of NEVs, addressing common concerns and misconceptions about electric vehicles and highlighting their environmental and economic benefits [10]. These market promotion efforts have contributed to the rapid growth of the NEV market in China, fostering a culture of sustainability and positioning the country as a global leader in the transition towards green transportation.

3. Japan's Electric Vehicle (EV) Policy Framework

Japan has been a global leader in the automotive industry for decades, as Toyota first eclipsed America's automobile output in 1980 [11]. With the concern of climate change and the sustainability of the residents' welfare, the country has put more attention to promoting electric vehicles(EVs). This section analyses Japan's policy framework to accelerate EVs in four key parts: tax incentives for car purchases, charging infrastructure development, national innovation support, and market promotion strategies.

3.1. Tax Incentives for Car Purchases

One of the main strategies Japan uses to promote EV adoption is through tax incentives. According to the International Trade Administration [12], the Government of Japan (GOJ) aims to ensure that all new cars sold will be environmentally friendly by 2035. The Japanese government offers subsidies for purchasing EVs, and in 2021, the maximum Clean Energy Vehicle subsidies per vehicle will be 800,000 (equivalent to 7,200 US dollars); for plug-in hybrids, up to 550,000 yen (approximately USD 4,600). The financial incentive improves EV acceptance among the consumer's choices and further

enhances the changing of user lifestyle into a more environmentally friendly mode [13]. The government also proposed to expand Japan's charging infrastructure (will talk about this in the next section). The Japanese government planning to offer more investments to the manufacturers to boost production, and to reach the car transition achievement.

3.2. Charging Infrastructure Construction

The EVs cannot leave the charging facilities. Developing a comprehensive charging network is important in achieving the goal of popularising EV adoption. According to the main EV charger company, Enechange Ltd., Japan has about 30,000 EV charging stations (including fast charging and level 2 charging ports), and the government aims to increase to 300,000 charging ports by 2030 [14].

Furthermore, Alam's (2019) paper has demonstrated the charging facilities' performance in Japan, given that Japan is showing the best performance compared to other countries [15]. It concludes that if Japan maintains a strong focus on advancing technologies will maintain its position as the global Next Generation Vehicles (including hybrid electric vehicles (HEVs), EVs, and others) leader.

3.3. National Innovation Support

Japan has been highly focused on developing high-production batteries since 1992. Lithium batteries have been developed for the foundation of the new EV innovation (Ahman, 2006) [16]. Moreover, in 2023, one of Japan's most representable car brands, Nissan presented their new technology EV that is made with solid-state batteries, which can be the most powerful battery in the current global market. Alam's paper has highlighted Japanese cars' performance by analyzing other brands of cars, resulting in Japanese cars having the best long-term durability and high battery life [15].

Furthermore, according to Ahman, Japan's Ministry of Economy Trade and Industry (METI) has funded a long-term program to invent highly energy-efficient hybrid vehicles and develop hybrid vehicles and EVs to mitigate carbon emissions [16]. As of 2018, Japan has set the target of lowering 26% of GHG emissions by 2030 [17]. Japanese community has strongly emphasized the development of EV innovations to maintain its global competitiveness.

3.4. Market Promotion

To promote the use of the EV market, Japan has employed diverse approaches, such as the Japan METI set growth strategy to assess users' behavior to change in the automobile business and mobility ecosystem. In focusing on green innovations, the Japanese government aims to achieve CO2 reduction and shift to a low-carbon society by 2030 [18]. Therefore, governments take action to collaborate with private companies as the conductor role in supplying innovation support and aligning the automaker production goal with the national EV adoption target [16]. Foster an environment that collaborates policy and industry work and builds a robust domestic EV market.

Japan's EV policy framework has addressed key areas focusing on the increasing adoption of EVs by the public, this paper analyzes four aspects of Japan's policy strategies. While the existing policies have provided a solid foundation challenges still exist (will talk in the later comparative section). Japan's ability to manage its policies will determine its success in leading EVs on both national and global scales.

4. Comparative Analysis and Policy Recommendations

China and Japan represent two significant forces in the global automotive industry. Japan is the head of affordable automobile development, and China has taken over the top EV-developing country globally [19]. As the world shares the same goal of becoming more sustainable, countries have taken transportation transition actions. This section analyses the EV strategies between China and Japan and provides insights into their success and limitations. Further examining the two countries' current condition provides policy suggestions for fostering a better future.

Innovation is the core of China's EV development, especially in the development of battery production. Lithium-ion battery technology helps increase EV production and allows China to position itself as an EV technology leader globally. China is a particular focus on lithium-ion battery technology. Companies like BYD and CATL have dived to innovate in battery efficiency, and these developments have allowed China to position itself as a global leader in EV technology and manufacturing.

In fact, Japan invented lithium batteries very ahead of China. However, this country faces issues of scarce resources and can only rely on imported materials for the batteries. As noted in Renshu Jin's paper, Japan has missed its chance in the EV industry due to some factors, including the wrong focus on hybrid vehicles, which deviate from the pure EV mainstream [20]. Companies like Toyota invested heavily in hybrid technology over fully electric systems. Moreover, the traditional vehicle was the pillar industry of the Japanese economy; many manufacturers initially rejected to transfer to EVs. While Japan has successful hybrid technology, compared to China, it has been delayed many in the market.

Although both countries are global leaders, challenges still exist. China should consider the supply chain for lithium-ion batteries more to find a more sustainable way to supply the EV market. In contrast, Japan's limitations are from its over-reliance on hybrid technology. Japan needs to accelerate its transition from hybrid vehicles to EVs, expand infrastructures, and manage battery technology to regain competitiveness in the global EV market.

5. Conclusion

Japan and China, two global leaders in the automotive industry, have implemented comprehensive policy frameworks to promote the widespread adoption of electric vehicles (EVs). While both countries have made significant strides in their EV adoption efforts, they also face unique challenges. Japan's reliance on imported materials for battery production and its initial focus on hybrid vehicles have hindered its progress, while China must address sustainability concerns in its lithium-ion battery supply chain.

To overcome these challenges and foster a more sustainable future in the automotive industry, Japan and China should prioritize collaboration and knowledge sharing. By leveraging their respective strengths and learning from each other's experiences, both countries can accelerate their EV adoption efforts and contribute to the global effort to mitigate climate change.

Collaboration between Japan and China can take many forms, such as joint research and development projects, technology transfers, and policy alignment. For example, Japan's expertise in developing comprehensive charging infrastructure can be shared with China, while China's advancements in battery technology and manufacturing can benefit Japanese EV manufacturers. Furthermore, by aligning their policies and standards, Japan and China can create a more harmonized and efficient EV market, encouraging greater investment and innovation in the sector.

In addition to bilateral collaboration, Japan and China should also actively participate in multilateral initiatives and forums focused on sustainable transportation. By engaging with other countries and stakeholders, they can contribute to the development of global standards, share best practices, and foster international cooperation in the EV industry. As Japan and China continue to refine their EV strategies and adapt to new challenges, their commitment to collaboration will be crucial in shaping the future of the automotive industry and driving the global transition towards sustainable transportation.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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