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## China's new energy vehicle policies: Evolution, comparison and recommendation

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### ABSTRACT

Environmental impact and climate change urge governments across the globe to prioritize to the development of new energy vehicles (NEVs). Since 2010, the Chinese government has introduced numerous policies to accelerate the development of the NEV industry. These policies have various effects on NEVs due to several complex factors, such as timing, regional economies, and other demands on the government's attention. This paper investigates NEV policies that were launched by China's national, provincial, and municipal authorities from 2010 to 2016 in terms of their similarities and differences, as well as their successes and failures. By doing so, we trace the evolution of Chinese NEV policies and compare them, in order to advise on the policies that are most beneficial to the future development of the Chinese NEV industry. The main results are as follows: (1) the implementation of NEV policies consisted of a “plan-pilot-promotion-subsidy-development” process; (2) the coordination mechanisms of central and local governments should be strengthened; (3) future policies should focus on infrastructure construction, research and development (R&D), the recycling of batteries, and private purchase regulations. This paper contributes to policy-making in Chinese NEV industry.

### 1. Introduction

To maintain its rapid economic development, China currently heavily relies on energy resources, the supply of which has been contracted (Guan et al., 2008). Despite a steady economic growth, an increase in externally-sourced oil reliance is evident, along with China's unreasonable energy consumption structure (Oliver et al., 2009; Qin et al., 2017) and gradually worsening environmental pollution (Zhang et al., 2013; He and Qiu, 2016). Due to energy consumption; significant greenhouse gases (GHG) emissions are being released into the atmosphere. Since 2009, China has become the world's largest energy consumer; thus, the country's GHG emissions and its contribution to climate change have received increasing attention worldwide (Zhen et al., 2017).

Energy consumption of transportation sector accounts for one-third of the total energy consumption of the world. Energy saving in transportation sector has received widely concerns. The transportation sector produces significant GHG emissions that are ejected into the natural atmosphere and is a major source of GHG emissions in China. Moreover, this sector emits huge amounts of air pollutants that contribute to health problems (He et al., 2017; Hill et al., 2009). Within the transport sector, road transport is the largest contributor to global warming and air pollutants. Significantly, vehicle exhaust is considered among the largest sources of serious air pollution in China (Yang and He, 2016; Wang et al., 2010). In Beijing, for example, in 2015 vehicle exhaust emissions

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contributed to about 60% of the air pollution (Fan et al., 2017).

The availability of new energy vehicles (NEVs) heralds a breakthrough in automobile energy conservation and environmental protection (Zhang and Bai, 2017; Wang and Dong, 2016). Importantly, NEVs do not rely on fossil fuel. Therefore, NEVs decrease vehicle exhaust emissions, and some even do not produce exhaust emissions (Hao et al., 2014). By transforming economic growth patterns to develop a green economy and low-carbon industries, economic and ecological benefits can be equally prioritized and garnered (Yuan et al., 2015). Therefore, the exploitation and development of NEVs is considering as an alternative technology to cope with the energy and environmental challenges, and has been raised to the strategic level in major vehicle-producing countries (He and Chen, 2013). In November 2015, the cumulative production of Chinese NEVs exceeded 1% of the entire vehicle market. The sales volume of NEVs was 507,000 and 777,000 in 2016 and 2017 respectively, only accounting for 1.81% and 2.69% of the aggregate sales volume of vehicles. Market development was imbalanced, and among 88 pilot cities, the promotion quantity of the last 40 cities accounts for less than 80% of the top five cities. However, the technical innovation and industrial scale of the NEV industry in China still lags behind those of other countries. As yet, China remains in the initial stages of NEV industry development (Xu and Su, 2016). Industrial development was also influenced by other factors such as weak core competitiveness, poor supporting facilities, and conservative consumption habits. As the NEV industry transitioned from the introduction period to the growth period, policy guidance and support, other than market mechanism, were required (US Department, 2007).

Since 2010, China's government (at all levels) issued many policies designed to support the rapid development of NEVs as a critical strategy for the automobile industry. These policies were intended to allow China to overtake advanced countries, but some problems have certainly lingered (Zhou et al., 2015; Hoen and Koetse, 2014). For example, some production enterprises defrauded the government of subsidy payments, and shut down while still awaiting policy announcements. Consumers could not register their ownership after purchasing their NEVs and found vehicle charging to be a complex process. Additionally, public sector procurement is at a much greater level than that in the private sector.

The industrial policies regarding NEVs are complex and varied. These policies involve complex issues such as the time dimension of NEV industry development, the combination of every type of policy instrument, and the connection and coordination of policies at different levels. The government's science-based approach to industry development policies is intended to be a basic guarantee of facilitating the smooth realization of the targets of NEV planning (Li et al., 2016; Wang et al., 2017). Previous research has mainly focused on specific policies or an analytic framework. These studies, therefore, could not fully explain the existing problems. A lack of multidimensional and systematic research specifically aimed at NEV policies in China still prevails. This paper summarizes the evolution, trend and path of NEV policies at all levels in the temporal context, in order to discover the realistic problems that must be solved. By combining government policy and national planning, we propose policy recommendations that are suitable for the industrial development of NEVs. This study may not only benefit policy-making for industrial development, but also improve China's national energy consumption structure, lower carbon exhaust emission aspirations, and benefit the environment.

The rest of this paper is arranged as follows: In Section 2, we introduce the research background including a literature review and research methods. In Section 3, we define NEVs and their development in China. An analysis of policies for NEVs at all levels is presented in Sections 4 and 5. Accounting for the high frequency of financial subsidy policy applications, a comparative analysis of subsidy policies is illustrated in Section 6. Sections 7 and 8 present policy tendencies and recommendations. Finally, the conclusions are given in Section 9.

## 2. Research background

### 2.1. Literature review

In recent years, scholars have studied NEV policies of several countries, using different techniques and tools. These studies can be divided into two groups: macroscopic and medium-microscopic.

In macroscopic studies, scholars study every NEV policy and collect market information in order to completely understand the status of current policies. This allows scholars to compare the policies of different countries, analyze existing problems, and then propose relevant recommendations (Xu and Su, 2016; Zhou et al., 2015; Gong et al., 2013). This kind of research can be used by governments to obtain an insight into the state of the NEV industry, on the other side, may neglect the unique characteristics of and discrepancies between different regions.

Similar to the macroscopic aspect, the medium-microscopic aspect of the NEV industry has also been well studied. Medium-microscopic studies cover almost every aspect of the development of the NEV industry, and have become a hot topic in the field of interdisciplinary research. This type of research provides a powerful reference for governments to develop specific application programs in order to promote NEVs; nonetheless, this method lacks systematic approach. The main topics of the medium-microscopic studies are presented in Table 1.

Scholars have mostly analyzed NEV policies using qualitative methods. Quantitative scale tables are also quite common. Furthermore, some scholars have used automatic text analysis to obtain policy keywords. In this way, they can infer the emphases of different policies.

As NEV research progressed, some scholars designed policy analysis frameworks to study the direction of NEV policies. In addition, more government policy instrument categories exist, such as technology-push and demand-pull (Nemet, 2009; Di Stefano et al., 2012); command-and-control and incentive-based (Wachtmeister, 2013); regulatory and economic (Bergek et al., 2014); upstream investment, market creation, and interface improvement (Taylor, 2008); supply-side, environmental-side, and demand-side (Rothwell and Zegveld, 1981; Steinmueller et al., 2010); government-selection versus market-selection and producer-orientation

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