



Consumers' evaluation of national new energy vehicle policy in China: An analysis based on a four paradigm model



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HIGHLIGHTS

- This study divided Chinese NEV-related policies into seven types.
- This study analyzed consumers' evaluation of NEV-related policies.
- Consumers' evaluations about NEV-related policies were diverse.
- Subsidization, technical support, and infrastructure policies need improvement.

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ABSTRACT

The Chinese government has issued numerous policies to promote the development and adoption of new energy vehicles (NEVs) to address the problem of excessive energy consumption and environmental pollution. In this study we divided these policies into seven categories: macroscopic, demonstration, subsidization, preferential tax, technical support, industry management, and infrastructure. Since consumers' opinions affect the policy choices of government, based on questionnaire data we use a four paradigm model to analyze the consumers' evaluation of each policy in terms of perceptions of importance and satisfaction. The results show that macroscopic policies are perceived to be of high importance and satisfaction, whereas for industry management policies they are perceived to be of low importance and satisfaction. The importance perceptions of preferential tax and demonstration policies are low, whereas perceptions of their satisfaction are high. Perceptions of the importance of subsidization, technical support, and infrastructure policies are high, whereas perceptions of their satisfaction are low. We find that the subsidization, technical support, and infrastructure policies need urgent improvement. Finally, we put forward several suggestions to improve the current policies and increase the consumers' intention to adopt NEVs.

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1. Introduction

From 2003 to 2013 the number of car owners in China increased rapidly from 24 million to 137 million with an average growth rate of more than 20% per annum. According to a report from the National Bureau of Statistics, car ownership is predicted to be at least 200 million by the end of 2020. The exhaust gas emitted by automobiles, including carbon monoxide, hydrocarbons, and nitrogen oxides, currently accounts for 70–80% of atmospheric pollution in the metropolitan areas. Therefore, the environmental pollution caused by the continual increases in

traffic volumes cannot be ignored (Tang, 2015). Meanwhile, the continuing high growth of China's economy is highlighting the oil supply and demand problems. In order to satisfy the rapidly increasing oil demand, China has needed to import a large amount of crude oil, thereby creating an increasing external dependency; this has increased from 33.3% in 2003 to 59.6% in 2014. It is reasonable to predict that the oil supply and demand situation problems will be more serious under the circumstance of increasing car ownership (Sierzchula et al., 2014).

In the last decade, the field of transportation has been identified as key to achieving energy and emission reduction goals. This area of focus by the government was embodied in the Decision to Enforce Energy Conservation and the Comprehensive Work Program on Energy Conservation and Pollution Reduction (State Council, 2006, 2007). As it is an effective way to mitigate the energy and environmental crisis in the field of transportation, developing new energy vehicles (NEVs) have received increasing

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attention. NEVs are defined as vehicles powered by electricity, hydrogen, dimethyl ether, and other unconventional fuels, or vehicles that adopt advanced power controlling systems and driving technology. In particular, the NEVs considered in this study mainly comprise electric vehicles (EVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs). A lot of policies have been issued by the central and local governments to promote the adoption of NEVs, but these have had limited effect. Although the production and ownership of NEVs in 2014 reached 84,000 and 12,000, respectively, these outcomes fell well short of the goals proposed by the Industry Development Plan of Energy Saving and New Energy Vehicles. In this policy, the production and sales volume of EVs and PHEVs were targeted to reach 500,000 in 2015 (State Council, 2012). As we can see, NEVs in China are facing a dilemma of “hot policy” but “cold market”.

This dilemma is not a phenomenon that is unique to China, it is common in many countries. Even in Norway, a global forerunner in the field of electro mobility, the share of EVs only accounts for approximately 2% of all passenger vehicles. Consumers are the acceptors of government policies, and their knowledge and opinions about these policies will affect their adoption intentions and behaviors (Krupa et al., 2014). Because the mass acceptance of NEVs is, to a large extent, reliant on consumers (Rezvani et al., 2015), their evaluation of NEV-related policies is of practical significance for the promotion of NEVs. Presently, the public domain accounts for most of the adoption of NEVs in China rather than private consumers. This is in accordance with previous policies, which focused more attention on promoting NEVs in the public domain, especially for buses and government vehicles. Accordingly, because the Chinese government has gradually become more concerned about promoting NEVs in the private domain, in order to help the government to improve its NEV-related policies, we intend to analyze the evaluation of consumers about the present policies through a four paradigm model. Our work can thereby provide a reference for the promotion of NEVs.

The rest of this paper is arranged as follows. In Section 2 we present the literature review. Our research methods, including the details of the classification of the NEV-related policies, the four paradigm model, and data collection, are presented in Section 3. The results of consumers' evaluation are presented and discussed in Sections 4 and 5, respectively. The conclusion and policy implications are set out in Section 6.

2. Literature review

Governments around the world have issued numerous policies to promote NEVs. Some studies have summarized NEV-related policies focusing on one specific country, such as China (Gong et al., 2013), Japan (Ahman, 2006), the United States (Greene et al., 2014), Germany (Massiani, 2015), Lithuania (Raslavičius et al., 2015), Norway (Bjerkkan et al., 2016), and Austria (Gass et al., 2014). Other studies compared and analyzed NEV-related policies between different countries, such as Zhang et al. (2014b), who reviewed the relevant policies that different countries may adopt for stimulating the market of EVs from the aspects of subsidies, technology support, and charging infrastructure. They suggested that each country should learn from other countries and employ effective policies according to the actual situation. Similarly, Zhou et al. (2015) asserted that government policies can play an important role in accelerating the EV market after reviewing EV-related incentives in the United States, China, Japan, and some European countries.

Because the mass adoption of NEVs relies on private consumers to a large extent, most studies pay attention to the effect of policies on consumers' adoption of NEVs. The main policies that have been

demonstrated to have positive effects on the consumers' adoption of NEVs include subsidies, preferential tax, free parking, and driving privileges (Sang and Bekhet, 2015; Hackbarth and Madlener, 2013; Zhang et al., 2011; Helveston et al., 2015). This positive effect on consumers' adoption of NEVs was found to increase when these policies are more powerful (Ko and Hahn, 2013). In addition, Zhang et al. (2013) found that government policies not only influence consumers' acceptance directly, but they also play an important role in moderating the effect of psychological needs, financial benefits, environmental factors, and the performance of NEVs. Of all of the NEV-related policies, the effect of economic incentive policies was found to be the most significant. By analyzing the financial incentives of 30 countries, including subsidies, taxes, registration fees, and circulation fees, Sierczula et al. (2014) found there is a significantly positive correlation between financial incentives and the EV market share. In the course of explaining why Norway has become the “capital” of EVs, Aasness and Odeck (2015) asserted that consumers adopt EVs mainly due to the economic incentives, which can help consumers save a lot of money. The economic incentives in this study refer to exemptions from toll charges, exemptions from purchase duties, and permission to use transit lanes. Similarly, through a survey of nearly 3,400 BEV owners in Norway, Bjerkkan et al. (2016) suggested that measures decreasing up-front costs, such as exemptions or reductions of purchase tax and value-added tax, are the most powerful incentives in encouraging adoption for more than 80% of the respondents. Based on the stated preference data collected through a questionnaire survey, Ko and Hahn (2013) used a mixed logit model to analyze the effect of several attributes. Their results showed that the subsidy level was proportional to the utility of the consumers. This study also found that consumers who have a high willingness to adopt an EV favor lump-sum subsidies rather than installments. As for other policies, Whitehead et al. (2014) asserted that a congestion tax exemption policy can increase the sales of energy efficient vehicles in Sweden, whereas the effect of a free parking policy was minimal. Similarly, exemptions from tolls and bus lane driving privileges only influence some consumers (Bjerkkan et al., 2016). Nevertheless, some studies found the impact of government policies are not as powerful as expected. In the study of Hoen and Koetse (2014), some policies, including road tax exemptions and fiscal incentives, were found to contribute to adoption intentions but were far less effective in eliminating consumers' doubts about the performance attributes of EVs. Furthermore, Green et al. (2014) suggested that the objectives of the current policies, which are aimed at realizing the large-scale application of EVs, are targeted at mainstream consumers. Considering that these policies have been proven to be inefficient and costly, policies focusing on niche markets would be more effective.

However, consumers are not only the acceptors of government policies, their opinions about NEV-related policies will influence their adoption. Therefore, some studies have been concerned about consumers' perception and acceptance of policies. Lane and Potter (2007) suggested that the policies should be readily understandable to the public, otherwise the policies cannot effectively influence the adoption of NEVs. Coad et al. (2009) utilized questionnaire data from 1,500 Swiss households to analyze the responses of consumers to information provision and financial incentive policies. The results indicated that both policies can encourage specific consumers to adopt green vehicles, and the utility of both policies depends on the consumers' support. Sovacool and Hirsh (2009) reported similar results, and they also proved that frequent changes of policies can create doubts in the minds of consumers and cause them to resist or reject the adoption of EVs. However, the opposite has also been found; through analyzing the tax policies introduced by the Irish government since 2008, Caulfield et al. (2010) found that consumers'

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