Evaluation and Policy Implications of the Potential Environmental and Social-economic Benefits of Introducing Green Vehicles in China

(中国における環境配慮型自動車導入による潜在的な環境及び社会経済的便益の総合評価と政策的含意**)**

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Abstract

Global warming is currently one of the environmental problems focused on by the international community. The natural ecological damage caused by global warming, such as melting glaciers, rising sea levels, extreme weather, biological extinction as well as various problems are affecting humans, animals and plants around the world, thus how to protect the Earth's climatic environment has become the most serious challenge faced by humans. China is now at the stage of rapid economic development since reform and opening up. In 2006, China surpassed the US to become the world's largest greenhouse gas emitter. In 2010, China's total GHG emissions accounted for 26% of the total world emissions, which was far greater than the 17.2% of the United States ranked in second place. China's greenhouse gas emission issue has also become a problem and a common concern of the world's governments and academia. The Chinese government clearly established China's GHG emission reduction target when attending COP15 of the United Nations Framework Convention on Climate Change: the CO2 emissions per unit of GDP in 2020 will be reduced by 40%~45% compared to that in 2005.

From 2000 to 2012, China's vehicle parc experienced explosive growth at an annual average growth rate of 17.3%, in 2010, with its 78.02 million vehicle parc, China surpassed the 75.32 million cars in Japan during the same year, and China had more than 100 million of vehicle parc in 2012. According to the estimation of Ministry of Industry and Information Technology of China, there will be over 200 million vehicle parc in China by 2020. Meanwhile, compared to the developed countries using environmentally friendly vehicles to replace the original common gasoline and diesel vehicles, if China directly selects the environmentally friendly vehicle while there is the new growth in vehicles, it will provide a huge economic and environmental advantage, but also will make a significant contribution to the global environment and sustainable development.

After a summary and analysis of the current situation of China's automobile industry, this thesis considers the necessity for adjusting the quantity and quality of China's vehicles to cope with economic and environmental development requirements in future. Through the government introduction of a GHG emission tax, the GHG emission taxes will be used as the financial resource for grants to promote the development of green vehicles, and thus to achieve the purpose of sustainable development by reducing GHG emissions. In practice, the GHG emission tax rate is considered to be the most important policy fulcrum. Through model building, the linear optimization software can calculate the optimum GHG emission tax in terms of economic and environmental aspects.

In order to undertake a comparison of policy effects, this thesis simulated three examples of policy effects respectively: case 1 seeks to lower GHG emissions by using HV only; case 2 uses HV and EV simultaneously; case 3 uses subsidies and development of the electricity industry while using HV and EV. In addition, there is a segment simulation for each case to calculate the most effective

situation when using the policy. For example, different extents of environmental emission reduction targets should be designed for case 1 and case 2, which are used to observe a variety of HV or EV emission reduction policies in line with realistic conditions for socio-economic development, and thus determine the best effect point for certain cases. For case 3, the thermal power will be reformed and evolved further than the original basis to calculate the emission reduction potential of this policy. Comprehensive analysis between cases suggests that, although the short-term effects are not as obvious as those in Case 1 (HV policy), long-term considerations indicate the beneficial points of sustainable development will be a highly desirable policy. In Case 3, due to a new development goal for the new energy electricity, the solution of operating variables is the same within the selectable range. In addition to this, there is also the calculation of closing the small units of thermal power plants and introducing upgrades for large unit thermal power plants (Case 3-V). Since the latter rather than the former can meet EpG emission reduction targets required by the government, the large unit reform of thermal power is inevitable (the analysis in this section is also based on Case 3-V). Due to the decreased electricity emission coefficient, the introducing effect of EV increases year by year. The GHG emission tax rate in Case 3-V was 15.8917 Yuan/Ton, the annual average GDP growth was of 8.02%, which belonged to high growth among all cases. Case 3-V's total GDP of phase 11 was 692 trillion Yuan, a reduction of 2.756% compared to BAU; the total GHG of phase 11 was 141.4 billion tons, a decrease of 16.37% compared to BAU; the marginal GHG reduction was 0.001208619 Ton/Yuan, which was very close to that of Case 1. Since its GDP extreme decline value was much higher than that of Case 1, indicating that Case 3-V is not only with high GHG emission reduction efficiency, its activity scope is also very wide. Its maximum emission reduction could reach 16.37%. In 2020, EpG will be reduced to 0.000159Ton/Yuan, thereby achieving the goal of reducing 40%~45% in 2020 compared to that in 2005 to ultimately reduce the 42.55% EpG (compared to that in 2005). The vehicle parc of green vehicles will reach 1.49 million in 2020, GHG emissions of vehicles will be reduced by 43% compared to that of BAU (budget volume in 2020). The electricity emission coefficient will decrease from 785g/kWh in 2010 to 599g/kWh in 2020, a decline of 23.7%. Solar and wind power has made considerable progress, the overall share of renewable energy will increase from 17.2% in 2010 to 36.2% in 2020. Therefore, in general Case3-V iis better than other two cases, as Case 3-V not only has low impact on the economy and few GHG emissions, but also has made reform on the power sector, so that EV introduction in future will be more efficient, and the effect will be increased year by year.

Keywords:
Input-Output analysis; Computer simulation; Hybrid vehicle; Electric vehicle; GHG emission tax; Clean energy; Vehicle parc.