Environmental Engineering and Management Journal

May 2019, Vol. 18, No. 5, 1123-1136
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

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ELECTRIC VEHICLE BATTERY RECYCLING: SYSTEM DYNAMICS GAME BASED ANALYSIS FOR THE INFLUENCING FACTORS

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Abstract

With the rapid development of electric vehicles (EV), more and more EV batteries will intensively face the retirement. If they are treated improperly, EV batteries might pose a serious threat to human health and environment. Therefore, recycling spent EV battery is full of significance. However, the recycling system and specific policies have not be well established in China. This paper aims to evaluate several recycling subsidy policies being considered and tested in China for their influences on recycling effect and economic benefits. We first establish a system dynamics model with game characteristics to describe and analyse the triple-channel (i.e. manufacturer, retailer, and third-party recycler) recycling system. Recycling subsidy policy and technological progress are then introduced. The game equilibrium and evolution of the system under different scenarios are investigated. Results show that: 1) both recycling subsidy and advancement in technology could improve total recycling rate and profit. 2) Particularly, the former can improve recycling rate of manufacturer while the latter can raise the interest of retailer and third-party recycler in spent EV battery recycling. 3) Even with gradual withdrawal of recycling subsidy, the system could still maintain steady growth as long as the technology advances to a higher level. The results could provide support to manufacturer in managing the multi-channel recycling system and the government agencies in optimizing the recycling policy. The hybrid method, game theory combined with system dynamics, can improve the limitations of these two methods and can be applied to other complex systems with game traits.

Key words: game theory, spent electric-vehicle battery recycling, subsidy policy, system dynamics

Received: September, 2018; Revised final: November, 2018; Accepted: January, 2019; Published in final edited form: May 2019

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