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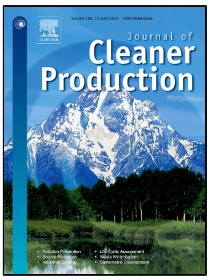

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Risk evaluation of electric vehicle charging infrastructure public-private partnership projects in China using fuzzy TOPSIS

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Abstract: With increasing worldwide attention on clean energy and sustainability of environment development, electric vehicle (EV) projects have been growing in number and scale all over the world. However, increasing demand-supply imbalance in charging infrastructure becomes the major obstacle of Chinese EV development. Governments are applying Public-Private Partnership (PPP) mode in this field to effectively make use of solid capital and advanced technological capability of private sector to improve charging performance and service. To ensure project success, risk evaluation, which has remained nebulous, has become a crucial step. This paper aims to explore risk factors through questionnaire survey and calculate the overall risk levels of EV charging infrastructure PPP projects with an integrated approach with Fuzzy Order Preference by Similarity to Ideal Solution (Fuzzy TOPSIS). Results of risk factors identification consisted of project/technical, political/legal, economic and social/environmental risk categories and four risk factors were selected for specific concern of charging infrastructure in China: inadequate PPP project experience, high battery cost, long charging period and power price rise. Overall risk levels of three alternative projects were evaluated and ranked with proposed approach whose feasibility and effectiveness were verified through a comparative analysis and a sensitivity analysis. Moreover, awareness of existing risks, suggestions were provided for private sectors of EV charging infrastructure PPP project. The detailed implications and limitations were presented in the suggestions and the conclusions.

Key words: electric vehicle; charging infrastructure; PPP; risk evaluation; fuzzy TOPSIS

1 Introduction

As global sustainable development, energy saving and emission reduction have become necessary and urgent issues. Electric vehicles (EVs), which play a key role in strategic development plans as a promising technology to promote environmental quality, livability, and sustainability without significantly reducing convenience or mobility (Stark Juliane et al., 2018; White and Sintov, 2017), has been given more attention for its outstanding performance in carbon emission reduction (Zhang and Han, 2017) and environment protection. Since transport sector has been one of the top contributors in greenhouse gas emissions (He and Zhan, 2018; S. Wang et al., 2017), significant efforts and series of measurements have been taken to satisfy China's sustainable development requirements. As a result, China has become the world's largest electric vehicle market and continues to maintain a high-speed growth (Lin and Wu, 2018) and its sales totaled 777,000 in 2017. Despite the EV development scale, it is noteworthy that demand-supply imbalance in electric vehicle charging infrastructure (EVCI) has become the major obstacle of EV development in China. To satisfy increasingly urgent charging demand, public-private partnership (PPP) mode has been introduced and supported to attract private sectors and make use of their