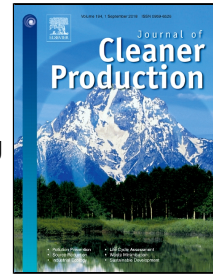


Accepted Manuscript

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PII: S0959-6526(18)31824-9
DOI: 10.1016/j.jclepro.2018.06.174
Reference: JCLP 13320
To appear in: *Journal of Cleaner Production*
Received Date: 01 November 2017
Accepted Date: 16 June 2018

Please cite this article as: Niuliyong, Zhang Peiran, Wang Xiaofeng, Hierarchical Power Control Strategy on Small-scale Electric Vehicle Fast Charging Station, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.06.174

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(Amount of words:5849)

Hierarchical Power Control Strategy on Small-scale Electric Vehicle Fast Charging Station¹

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Abstract: In order to reduce the environmental hazards from non-renewable energy consumption and promote sustainable social development, renewable electric energy has been developed vigorously in countries around the world as the best strategical choice of cleaner energy development. Especially in transportation sector, large quantities of electric vehicles are considered the most promising alternative to alleviate problems caused by energy crisis, environment pollution and climate warming. However, with the rapid growth of EVs, more small-scale fast charging stations (FCSs) have limited distribution capacity to satisfy every charging demand simultaneously and are under big pressure to ensure good service capability. Based on current conditions, this paper proposes a hierarchical power control strategy (HPCS) that considers EVs demand, FCS service capability, FCS daily load fluctuation with weighted dynamic priority (WDP) and fluctuation smoothing index (FSI). The assumed system model is based on each EV unique demand and FCS objective constraints. The simulation results show that the optimal WDP is sufficiently elastic to satisfy EV demand urgency and fast charging station operator (FCSCO) income simultaneously. Moreover, FSI is shown concretely to decrease daily load fluctuation and peak load value, which is inductive of stabilizing FCSCO and reduced power loss. As a result, the HPCS can become a flexible strategy considering multiple entities and gain an optimal balance between EV and FCS.

Keywords: electric vehicle; small-scale fast charging station; dynamic charging power distribution; weighted dynamic priority; fluctuation smoothing index; hierarchical power control strategy

1. Introduction

As we know, primary energy cannot regenerate and has led the environment deterioration, thereby the global energy system construction is bound to be changed. Hence, cleaner energy has been substituted for primary energy in order to promote society sustainable development. According to the World Energy Outlook, more than half of the increase in the consumption of primary energy resources will be absorbed by the production of electricity between 2014 and 2040 [1]. More people are connecting to the grid as living standards improve around the world. Demand for consumer appliances and electronic

¹ The short version of the paper was presented at ICEEE2017/ISEV2017 on July 26-29, Sweden. This paper is a substantial extension of the short version of the conference paper.

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