شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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HOSSAM MAGHRABY

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Electrical Power and Machines Engineering

Enhancement of Operating Strategies for Plug in Electric Vehicles

A Thesis submitted in partial fulfillment of the requirements of the degree of
Master of Science in Electrical Engineering
(Electrical Power and Machines Engineering)

By

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Bachelor of Science in Electrical Engineering
(Electrical Power and Machines Engineering)
Faculty of Engineering, Ain Shams University, 2013

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Cairo, Egypt, 2021

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Climate change caused by global warming has become a growing concern in the last few decades. With recognition of CO_2 emissions as the primary source of global warming, its reduction has become critically important. Focusing on the sectors that contribute the most to harmful emissions, such as power generation and transportation is an effective way to achieve this goal. The current structure of distribution systems can tolerate low levels of PEVs penetration; but due to fast expansion in both the PEV market and emission reduction plans, high levels of PEV penetration are expected during the next few years. The energy consumed by charging a high penetration level of PEVs is expected to add considerable loading on distribution networks, with consequences such as thermal overloading, higher losses and equipment degradation.

For these reasons, the purpose of the research presented in this thesis is to address the issues of accommodating a high penetration level of PEVs .The increasing widespread use of PEVs has led to construction of parking lots (PLs) and emergence of aggregators to facilitate the charging of these vehicles.

In this work, three smart charging schemes are introduced and compared to the uncontrolled charging. These schemes are: (1) PEV owners' smart charging scheme, (2) aggregator smart charging scheme and (3) a novel interactive smart charging scheme. These schemes are compared using two pricing plans; the Time of Use (ToU) and Real Time Pricing (RTP).

In the PEVs owners' charging scheme, the charging of the PEVs is decided by their owners in response to pricing signals to minimize the charging costs. In the aggregator charging scheme the charging of PEVs is decided by the aggregator to maximize the profit while considering the network constraints. Finally, the interactive charging scheme considers the benefits of PEVs owners and aggregator as well as the network constraints. In this scheme, several pricing rates are developed by the aggregator based on the network constraints and are passed to the PEVs owners. Hence, the PEVs owners develop

their charging profiles for each pricing signal and send them back to the aggregator who chooses the charging profile for each PEV based on the loading situation of the network.

To study the impact of different charging schemes on the PEVs owners and aggregator benefits while considering the network constraints, an optimization problem is formulated for each scheme and is solved using the Salp Swarm Optimization Algorithm. The uncertainties related to charging of PEVs such as arrival time, battery state of charge and departure time are modeled using Monte Carlo simulations (MCS). Several case studies for the charging schemes are investigated and compared. The results show the ability of the proposed interactive charging scheme to overcome the limitations of the other two schemes without compromising the benefits of both the PEVs owners and aggregator and in the same time respects the network limits.

Key words: Monte Carlo simulations, Salp swarm algorithm, smart charging, Plug-in electric vehicles, aggregator, and parking lot

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