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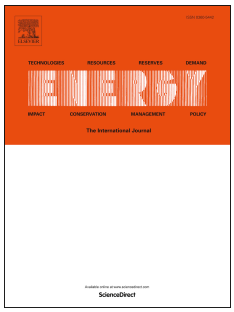

An optimal versatile control approach for plug-in electric vehicles to integrate renewable energy sources and smart grids

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An optimal versatile control approach for plug-in electric vehicles to integrate renewable energy sources and smart grids

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Highlights:

- Optimization problems are solved to size and site smart parking lots of electric vehicles.
- The effectiveness of the proposed algorithm is compared to other reported algorithms.
- An adaptive intelligent control strategy with V2G and G2V applicability is proposed.
- A global optimal solution is guaranteed with the proposed model.

Abstract

This study proposes a practical solution to deal with challenges of integrating renewable energy sources and electric vehicles into the electric grid, considering generation source intermittency and energy usage inconsistency, via a new adaptive intelligent controller. The present research describes a smart grid consisting of power plants and distributed generation, fueled via photovoltaic panels and wind turbines, and augmented with electric vehicles as power storage devices. Employing a parking lot to deal with challenges such as low penetration of the electric vehicles embedded with Vehicle-to-Grid functionalities encounters two difficulties: where they should be installed, and modeling of bi-directional power flow between electric vehicles, the grid, and the distributed generation system. In this regard, a nonlinear multi-objective problem is designed and solved via employing the Non-dominated Sorting Genetic Algorithm-II, and the forward and backward substitution method. In addition, Newton-Raphson Power Flow is adopted and modified to calculate the power flow of the distribution network. The results related to optimal placement and sizing of hybrid renewable energy systems show that bus 16 of the studied grid is the best place to integrate a parking lot – equipped with 117 photovoltaic and 10 wind turbine units - to the tested IEEE-26 buses. Furthermore, this study suggests that the aforementioned grid could employ a complex versatile control unit able to

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