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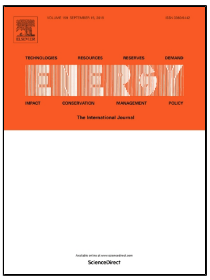

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A multi-objective optimization model of hybrid energy storage system for non-grid-connected wind power: A case study in China

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Abstract: In recent years, the wind curtailment has become a serious problem in China and the government are actively seeking solutions to deal with this energy loss. Therefore, the use of non-grid-connected wind power has received great attention since it can be supplied to local end users equipped with energy storage and then mitigate wind curtailment. Since the non-grid-connected wind power and local power load have to confront dramatic power fluctuations, a hybrid energy storage system (HESS) including batteries and supercapacitors is applied. This paper proposes a multi-objective optimization model of HESS configuration in non-grid-connected wind power/energy storage/local user system. In this model, two decision variables, numbers of batteries and supercapacitors, are determined based on the objective of annual profit maximization and wind curtailment rate minimization. To solve this model, a non-dominated sorting genetic algorithm II (NSGA-II) is employed to obtain Pareto front and VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje) technique is applied to select the optimal solution from Pareto solutions. Finally, a wind farm in Hebei province is studied and discussed. A scenario analysis, a sensitivity analysis and a comparative analysis are performed to show the advantages of the proposed model.

Keywords: multi-objective optimization, non-grid-connected wind power, hybrid energy storage system, China

Nomenclature

Abbreviations

HESS	hybrid energy storage system
NSGA-II	a non-dominated sorting genetic algorithm II
VIKOR	VlseKriterijumska Optimizacija I Kompromisno Resenje
EV	electric vehicle
LPSP	loss of power supply probability
MOEA	multi-objective evolutionary algorithm
MCDM	multi-criteria decision-making method
LPS	loss of power supply
GA	genetic algorithm
BESS	battery energy storage system

Parameters

N_{bat}	number of batteries
N_{sup}	number of supercapacitors
C_{bat}	rated capacity of each battery
U_{bat}	rated voltage of each battery
E_{bat}	rated capacity of the battery bank

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