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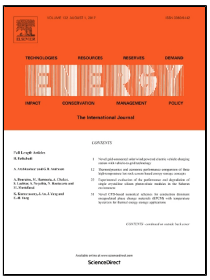

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Optimal Sizing of Renewable Energy Generations in a Community Microgrid Using Markov Model

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Abstract—The installation of renewable energy generation resources (such as photovoltaic arrays and wind-turbine generators) in a microgrid is important because a microgrid can increase the penetration of renewable energies in a smart grid. A community may be a grid-tied microgrid in which an energy management system may dispatch elastic loads (such as air conditioning systems). This paper investigates the optimal sizing of renewable energy generation resources in a community microgrid. The cost of renewables and community welfare are optimized while the comfort zone of indoor temperature in all homes is maintained using air conditioning systems. Community welfare is ensured by minimizing the purchased power from and maximizing the sold power to the utility grid with different time-of-use electricity tariffs. Since the problem of interest involves a large number of variables and chronological constraints, Markov models of photovoltaic power generation, wind generation, load and temperature are utilized to reduce the numbers of variables and constraints. The Markov-based optimization problem is then solved using the interior-point algorithm. The simulation results, based on a smart community of 50 homes, reveal the applicability of the proposed method.

Indexing terms: Demand response, optimization, Markov model, microgrid, renewables.