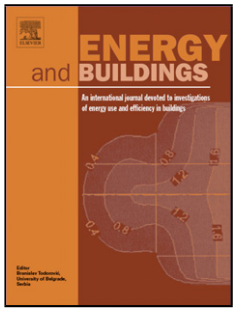

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Optimal scheduling of household appliances with a battery storage system and coordination

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Abstract

This paper demonstrates an optimal household appliance scheduling problem with a battery as an energy storage system under time of use electricity tariff. Power consumption measurements of individual appliances considered were performed and demand profiles were obtained. In this work, a mixed integer nonlinear programming mathematical model with more practical operation constraints for appliance and battery scheduling is formulated and solved. The simulation results show effectiveness of the algorithm in that by optimally scheduling appliances, cost saving is achieved through load shifting. The load shifting results in energy cost saving that might be beneficial to consumers; and peak shaving, which is of great importance to the utility. It is found that consideration of appliance coordination yields smaller cost saving because of interdependent operation. Without the battery and coordination, a cost saving of 22% and peak reduction to 8.405 kW are realized. Consideration of appliance coordination gives a further cost saving of 1% and a relatively smaller peak reduction to 8.30 kW. The battery bank system promotes peak shaving and valley filling and a further cost saving of about 6% and peak reduction of to 5.175 kW. Sensitivity analysis, however, reveals that the energy cost saving is sensitive to consumer's willingness to pay.

Keywords: Demand response, Appliance scheduling, Coordination, Battery storage system, Mixed Integer Nonlinear Program (MINLP), Solving Integer Constraint Problems (SCIP).

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