World Academy of Science, Engineering and Technology
International Journal of Industrial and Systems Engineering
Vol:18, No:10, 2024

Scheduling Residential Daily Energy Consumption Using Bi-criteria Optimization Methods

Authors : Li-hsing Shih, Tzu-hsun Yen

Abstract : Because of the long-term commitment to net zero carbon emission, utility companies include more renewable energy supply, which generates electricity with time and weather restrictions. This leads to time-of-use electricity pricing to reflect the actual cost of energy supply. From an end-user point of view, better residential energy management is needed to incorporate the time-of-use prices and assist end users in scheduling their daily use of electricity. This study uses bi-criteria optimization methods to schedule daily energy consumption by minimizing the electricity cost and maximizing the comfort of end users. Different from most previous research, this study schedules users' activities rather than household appliances to have better measures of users' comfort/satisfaction. The relation between each activity and the use of different appliances could be defined by users. The comfort level is at the highest when the time and duration of an activity completely meet the user's expectation, and the comfort level decreases when the time and duration do not meet expectations. A questionnaire survey was conducted to collect data for establishing regression models that describe users' comfort levels when the execution time and duration of activities are different from user expectations. Six regression models representing the comfort levels for six types of activities were established using the responses to the questionnaire survey. A computer program is developed to evaluate electricity cost and the comfort level for each feasible schedule and then find the non-dominated schedules. The Epsilon constraint method is used to find the optimal schedule out of the non-dominated schedules. A hypothetical case is presented to demonstrate the effectiveness of the proposed approach and the computer program. Using the program, users can obtain the optimal schedule of daily energy consumption by inputting the intended time and duration of activities and the given time-of-use electricity prices.

Keywords : bi-criteria optimization, energy consumption, time-of-use price, scheduling
Conference Title : ICCIE 2024 : International Conference on Computers and Industrial Engineering
Conference Location : Houston, United States
Conference Dates : October 24-25, 2024