Developing a Data-Driven Framework for Lighting Energy Consumption Prediction in the U.S. Office Buildings

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ABSTRACT

Lighting energy consumption has a significant share of energy consumed in U.S. commercial buildings. An accurate prediction of lighting energy consumption offers energy-saving or energy-management potentials, especially in office buildings. Although office buildings' energy performance has been studied extensively in the literature, mainly focusing on HVAC energy consumption, studies focusing on lighting energy consumption in U.S. office buildings are limited. This study aims to develop a data-driven prediction model to estimate the office buildings' lighting energy performance accurately. This study used Commercial Building Energy Consumption Survey (CBECS) 2012 data. First, the predictors regarding lighting energy consumption in office buildings are analyzed, and the most relevant predictors to predict lighting energy consumption are selected using LASSO regression method. Second, an Artificial Neural Network (ANN) model is trained, using the selected predictors, to predict lighting energy consumption. This study identified twelve main variables as the most influential predictors in lighting energy prediction, including square footage of the building, percentage of light during building operation hours, number of employees working in the building, building owner type, whether there is daylight harvesting, lighting percentage during off-hours, number of businesses in the building, whether there is lighted parking area, building America climate region, percentage of occupancy, whether the building is open during the weekend, and census division. In addition, the results showed that the developed ANN model is able to predict lighting energy consumption in office buildings with an R-square value of 76% and an RMSE value of 223.17.