

Estimating and Optimizing HVAC Energy Costs in Industrial Building

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In the US, industrial buildings accounts for over 33% of the total energy consumption. Heating, ventilation & air-conditioning (HVAC) system consumes second most energy after production system. In industrial buildings, heat waste from heavy machineries and large building envelope makes the HVAC system work harder when compared to commercial and residential buildings. The objective of this research is to find factors responsible for high HVAC system energy costs and optimize them to maximize energy savings. Most industrial facilities do not have sub-metering of individual energy consuming component. To establish baseline energy consumption model and disaggregate the HVAC component of energy consumption relative to changes in production and weather data, we propose the use of simple inverse linear regression models using monthly utility billing and weather data. In addition, multi-layer Long short-term memory (LSTM) neural network model is used to forecast short term weather to predict temperature. Using the forecasted weather and baseline HVAC energy consumption relation, a mixed integer programming model is used to maximize energy savings by scheduling activities within the building. The optimization model was tested using experimental data to find trends and relation between energy savings and factors affecting it by considering constraints such as resource availability, deadlines etc. The LSTM model achieves a high validation accuracy of up to 80%. This optimization model can potentially achieve up to 30% reduction in HVAC energy consumption.