

Thesis Abstract

No. 1

Registration Number:	<input type="checkbox"/> "KOU" <input type="checkbox"/> "OTSU" No. *Office use only	Name:	Haitham Alkhalaf
Title of Thesis: Benchmarking Energy Performance of Accommodation Buildings Using Regression and ANNs Models			
Summary of Thesis: <p>After great east earthquake 2011 in Japan, a dramatically change in energy policy of Japan have been done through set of new policies and regulations that aim to reduce the energy consumption in different sectors. Buildings sector was one of main target to achieve significant saving of energy since buildings are third high consumer after industrial and transportation sectors. Accommodation building is a main component of hospitality industry especially when these countries aim to improve their tourism sector or to host big event such as the Olympic and Paralympic Games Tokyo 2020. In the same time, accommodation sector is energy intensive category among other commercial buildings with significant potential to reduce energy consumption. The research develops a benchmark tool to assess the energy performance of accommodation building in Kanto region as powerful tool to achieve better saving of energy consumption. Benchmark is an approach to compare the performance of energy use of a building with other peer buildings or its history.</p> <p>The research aims to figure out the impact of different factors on energy consumption of target buildings to select the effective variables that can be used as inputs of benchmark of energy performance using regression model. This tool is the main target of current work to enable managers and owners of accommodation facilities to assess the performance. Finally, the study aims to validate the benchmarking results using Artificial Neural Networks (ANNs) to confirm the accuracy of benchmark in accommodation buildings in Kanto region.</p> <p>Current study follows the general methodology of benchmark system to setting up a benchmark for energy performance of proposed buildings. DECC have been used as dataset to conduct main investigation, statistical analysis was used to quantify DECC variables and to find the correlation between these variables and energy performance. Based on research aims, regression model have been selected to find out the benchmark equations. ANNs model was adapted to fit study's dataset by design learning algorithm and hidden layers, Using designed ANNs, a comparison study have been conducted to verify the regression findings. Dataset of franchised hotel have been utilized to examine the accuracy of benchmark equations of DECC.</p> <p>The study uses a national scale survey of energy use of commercial buildings under project Database for Energy Consumption of Commercial Buildings (DECC) from Japan Sustainable Building Consortium (JSBC), the investigation covers all classes of accommodation buildings in Kanto region from 2006 until 2012.</p>			

Electricity, Gas and clean water was main variables to measure energy use intensity (EUI) using regression and ANNs models to benchmark the energy performance of accommodation buildings in Kanto region. These variables have been selected based on their clear correlation with primary energy consumption. The results introduced basic benchmark equations, which form a reference to assess the energy performance of accommodation buildings in Kanto region. The benchmark enables managers to run energy plan without affecting the satisfaction of users by understand the weight of the variables in benchmark equation. For instance, the current research shows the impact of using electricity is higher than gas usage. Therefore, shifting into gas consumption more than electricity will reduce EUI without compromising service quality for selected building. In the same time this results can be used to evaluate the economic performance or environmental performance by add more parameters which indicate the economic and environmental outputs.

The study is considered as the first study which introduces a benchmarking of energy performance of accommodation buildings in Japan, there is no previous efforts to establish a benchmark reference for this category of buildings or other categories of commercial buildings. The research benefits existing data to set a simple benchmark as a reference for assessment the energy performance of accommodation buildings, the research point out to the necessity of set a benchmark for commercial buildings and more detailed benchmark for accommodation buildings because of its economic and environmental importance.

Study's benchmark supports improving the economic performance of buildings by reducing energy cost and improving the reputation of accommodation facility as sustainable building. The reduction of energy consumption will reduce the CO₂ emission and using other natural resources that means better environmental performance. The research has social contribution through increasing awareness about energy saving, providing sustainable facilities that sustain quality level with less energy and natural resources. In addition, the study pointed out the importance of establishing benchmark tool for accommodation buildings or other commercial buildings. On the other hand, this benchmark enables manager to improve their buildings performance without reduce the comfort level as main function of accommodation buildings. The study emphasizes the necessity to design ANNs model to meet the data set of case study. Both of learning algorithm and hidden layers have been designed to fit the database of DECC.

Keywords: Accommodation Buildings, Artificial Neural Network, Benchmark, Database for Energy Consumption of Commercial Buildings, Energy Performance, Energy Use Intensity, Regression Model