Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 95 (2016) 435 – 438

Energy Procedia

International Scientific Conference "Environmental and Climate Technologies", CONECT 2015, 14-16 October 2015, Riga, Latvia

Benchmarking analysis of energy consumption in supermarkets

Lelde Timma*, Roberts Skudritis, Dagnija Blumberga

Institute of Energy Systems and Environment, Riga Technical University, Azenes iela 12/1, Riga, LV–1048, Latvia

Abstract

The energy performance of buildings needs to be monitored and maintained. A well-developed energy management system in the building can help to identify failures in a timely manner and reduce excessive energy consumption. This study attempts to introduce awareness on potential energy savings in supermarkets. A supermarket in Latvia is analysed as a case study. The largest consumption of energy in supermarket was determined to derive from operation of refrigeration systems, HVAC systems and lighting. The methodology used in this study is based on benchmarking analysis. Using benchmarking analysis, the specific energy amount in function of the amount of customer in supermarket is studied in this work. The specific energy consumption shows wide dispersion: from 1.06 kWh per customer up to 1.73 kWh per customer. This leads to a variance of 48 % of consumed electricity for one customer. The variance can be explained by various technological and climate factors, but even more importantly - behavioural factors.

Peer-review under responsibility of Riga Technical University, Institute of Energy Systems and Environment.

Keywords: energy management systems; supermarkets; demand side management; benchmarking

1. Introduction

The energy performance of buildings needs to be monitored and maintained. A well-developed energy management system in a building can help to identify failures in a timely manner and reduce excessive energy consumption. In the field of residential buildings studies on energy efficiency were conducted by Kamendere et al. [1] and Zvaigznitis et al. [2], for municipal and state owned buildings by Asere et al. [3] and for historical buildings by Kass et al. [4]. Nevertheless, commercial buildings have been studied much less, since the availability of the data is limited. From commercial buildings,

* Corresponding author. Tel.: +371-67089908
E-mail address: lelde.timma@rtu.lv

Peer-review under responsibility of Riga Technical University, Institute of Energy Systems and Environment.
doi:10.1016/j.egypro.2016.09.056

the supermarkets are one of the energy intensive buildings; therefore energy management in supermarkets is so vital.

Mavromatidis et al. [5] have applied an artificial neural network for energy management system to meet benchmarking for energy consumption of a complete system. Zhang et al. [6] also define that without capital investments it is possible to reduce up to 15 % of energy consumption in a building by merely adjusting the energy supply more specifically to energy consumer's needs.

This study attempts to introduce awareness on potential energy savings in supermarkets. As the case study, a supermarket in Latvia is analysed.

2. Research methodology

The methodology used in this study is based on benchmarking analysis. This analysis was used by Zogla et al. [7] to study energy performance in breweries and by Tereci et al. [8] in residential buildings. Benchmarking is one of the first steps when considering the implementation of energy management and demand-side management activities.

Using benchmarking analysis, the specific energy amount in function of the number of customers in a supermarket is studied in this work. The work flow algorithm for this study is given in Fig. 1.

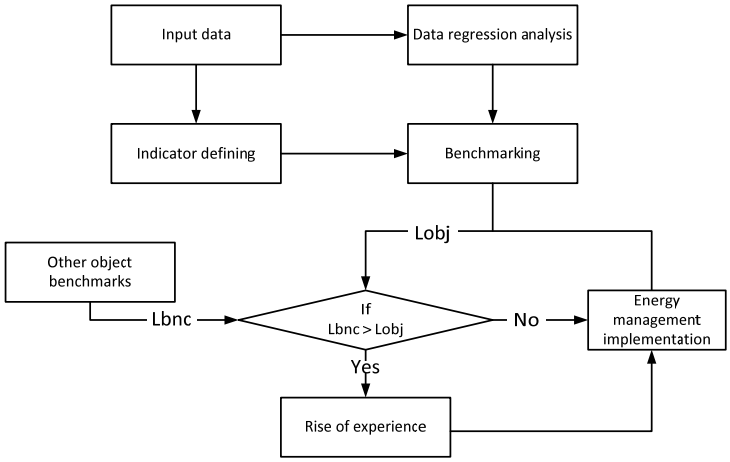

Fig. 1. Algorithm for benchmarking energy consumption in supermarket.

The algorithm starts with data collection, the collected data is evaluated by regression analysis and then by benchmarking. From the obtained data, the indicators used for benchmarking are also defined. After the benchmark is set, it is possible to compare current energy consumption with the benchmark within the same supermarket or to compare with other supermarkets using indicative values. When the results are with values worse than the benchmark, energy management actions should be implemented. Moreover with an increase in experience, the overall benchmark value converges towards better performance standards.

3. Results and analysis

To obtain results, several energy meters where installed in the supermarket with a total area of about 900 m^2. Separate energy flows where evaluated: for refrigeration equipment and storage area, for HVAC system, for office, for inside lighting and outside lighting. The breakdown of the annual energy consumers for 2014 is given in Fig. 2.