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Tools and Solution for Energy Management

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<http://dx.doi.org/10.5772/48401>

1. Introduction

Energy efficiency can be defined as utilizing minimum amounts of energy for heating, cooling, lighting and the equipment that is required to maintain conducive conditions in a building [1,2]. An important factor impacting energy efficiency is not only the building envelope but also the management of energy within the premises. The amount of energy consumed varies depending on the design of the building, the available electrical systems and how they operate. The heating and cooling systems consume the most energy in a building; however control system such as programmable thermostats and building energy management systems can significantly reduce the energy use of these systems. Some buildings also use zone heating and cooling systems, which can reduce heating and cooling in the unused areas of the building. In commercial buildings, integrated space and water cooling/ heating systems can provide the best approach to energy-efficient heating [3]. Energy audits can be conducted as a useful way of determining how energy efficient the building is and what improvements can be made to enhance its efficiency. Tests should be undertaken to ensure that the heating and cooling systems as well as equipments and lightings work effectively and efficiently.

Building cooling and heating also produces Carbon Dioxide (CO₂) emissions, but this sector receives less attention compared to other pollution contributors such as the transportation and industry sectors. In addition to energy conservation and energy efficiency approach, a strategic plan to introduce renewable energy resources would be an advantage to any sector as it will reduce the carbon dioxide emissions as well they could be used for heating, cooling, ventilation and lighting systems [4]. As illustrated in Figure 1, the percentage of energy consumed by various type of building is presented. It was shown that the rental and service buildings utilize the highest energy consumption. It is easier to design energy efficient features for energy management of new buildings using available tools; however existing buildings comprise approximately 99% of the building stock. Although energy efficiency initiatives for existing buildings can be demonstrated to be cost effective, there has

been limited success in convincing large organizations and building owners to undertake energy efficiency projects such as retrofits, and retro commissions [5].

An important factor that rises while doing a comparison is the use of benchmarks as representative standards against the buildings to be compared and monitored. For example, the comparison of energy consumption with a square meter of floor area to the benchmark will allow the decision maker to observe and assess the amount of energy consumed. Therefore determination for the improvements can be made to minimize the consumption within that specific area. An effective energy management of a buildings do not necessarily cost more to build as compares to normal buildings, provided they are well maintained and manages effectively. Due to the use of energy efficient tools they are set to be very reliable, comfortable and as productive as a normal building. Numerous studies have focused on improving energy efficiency in commercial buildings. As stated by Escriva [6] engineers and researchers have developed complex methods to improve energy efficiency, but buildings are often managed by non-specialized technicians who need understandable and cost-effective actions to implement in their buildings. Therefore basic actions for the base improvements in energy efficiency for commercial buildings had to be stated and implemented.

2. Energy efficiency concept

The simple concept of energy flow can be shown in Figure 2. The whole idea is to minimize the energy loss either from the primary to secondary or from secondary to end use. Implementation of energy practices is part of the solution in reducing the loss from the infrastructure requirement to the energy demand. Energy is essential in increasing productivity and ensuring a high quality of life, thus the relation between energy and economic growth is crucial. However, the proportionality of economic growth and energy demand constitutes the depletion of energy resources. One essential and effective way to manage around the depletion of resources while at the same time fostering economic growth is by applying an energy efficiency concept [7, 8]. Since the late 1970s, a considerable increase in energy efficiency has been achieved in response to energy price hikes, supply uncertainties, government policies, and independent technology improvements [9,10]. Nowadays, the focus of international incentives for people to practice energy efficiency is to inject considerable amounts of awareness concerning climate change into the society. Energy efficiency is a generic term which refers to the usage of less energy to produce the same amount of services or useful output [11, 12].

However, the term energy efficiency depends heavily on its application. Thus there is no defined and clear qualitative measure of it. The input, output, analysis and monitoring parameters are very crucial in executing energy efficiency to the maximum in order to achieve the desired result. In general, the energy efficiency indicators are of the form of

$$\text{Energy Efficiency} = \frac{\text{output power}}{\text{input power}} \quad (1)$$

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