Advanced Engineering Days

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Energy efficiency application using led lighting in demand side management

Behiye Sefa Akın*[1], Zafer Aydoğmuş [1], Mehmet Rida Tür [2]

[1]*Firat University, Department of Electrical and Electronics Engineering, Elazig, Türkiye, behiyesefakin@gmail.com; zaydogmus@firat.edu.tr*
[2]*Batman University, Department of Electricity and Energy, Batman, Türkiye, mrida.tur@batman.edu.tr*

Cite this study: Akin, B. S., Aydogmus, Z., & Tur, M. R. (2022). Energy efficiency application using led lighting in demand side management. 2nd Advanced Engineering Days, 13-15

Keywords
Demand side management
Energy efficiency
Energy saving
LED lighting

Abstract

Demand Side Management is the planning, implementation, and monitoring of service activities that affect the customer's electricity use. These solutions, named Demand Side Management (DSM), cover many methods for changing the usage profiles of consumers according to the benefits of the network. While making this change in Demand Side Management, the comfort conditions of the consumers should not be impaired. In this study, consumers are encouraged to consume less power by changing their electricity consumption habits and devices. The energy efficiency method has been applied within the scope of demand-side management. LED bulbs with the same light intensity and light color were chosen instead of saving bulbs.

Introduction

Reliable operation of power grid is primarily dependent on perfect balance between supply and load at each given time [1]. It is not an easy task to maintain balance, assuming there is very little control on the demand side. It gets even harder when distributed energy generation increases [2]. Therefore, it is important to use energy efficiency, one of the demand-side management techniques. Energy efficiency is emphasized in this study. Energy efficiency will be achieved by increasing the efficiency of household appliances.

It shows that demand side management consists of energy efficiency, demand response and strategic load growth. The technique we used in our study is energy efficiency [3]. In this study, consumers are encouraged to consume less power by changing their electricity consumption habits and devices. LED bulbs with the same light intensity and light color were chosen instead of saving bulbs.

The lighting system technology is one of branches in fast developing technologies. The lighting system should be considered in the aspect of the human health and environmental conditions. It is also performed in accordance with environmental standards. Otherwise, it causes to damage both human health and the environment [4]. The lighting systems should be harmless and clean in terms of health and environment. On this way, LED lighting systems are very important for the clean energy. While LED lighting systems do not contain harmful substances, they make energy savings and environment friendly [5].

Increasing energy costs and demand for energy have made energy saving mandatory [6]. Lighting also has an important share in total energy consumption. Accordingly, scientists are working to get more luminous flux with less energy. This is due to the ever-increasing demand for lighting, as well as rising energy costs. For this reason, lighting elements that consume little energy have become the focus of attention of consumers. In today's world, LED-based lighting elements have taken the first place in the preference ranking. The main reason for this preference was the high energy consumption and inefficiency of the old lighting systems [7]. By changing only, the

lighting fixture, significant electricity savings can be achieved. In this study, the importance of energy saving, and energy efficiency was emphasized.

LED lighting systems have a lot of advantages. These are luminous efficiency, colors, size, on/off time, dimming, cool light, slow failure, lifetime, focus, and environmentally friendly [8]. LED (Light Emitting Diode) is a semiconductor, diode-based, light-emitting electronic circuit element. High-light LED chips, which are formed by combining many diodes in series parallel groups, are used at every stage of our lives. LEDs show themselves not only in appearance but also with their performance. Recently used in many places thanks to the advances in lighting technology, LED lighting systems offer innovative and beyond-the-century solutions. Currently, LEDs have gradually started to replace classic bulbs [6].

LEDs consume less energy compared to other lighting elements. Other lighting elements emit a significant portion of the power they draw as heat. Because other elements emit light by the principle of electric discharge or by heating the tungsten wire. However, the LEDs emit most of their power as light as soon as they heat up and convert more than 90% of the energy used to light. Thus, energy efficiency can be achieved with LED lighting.

Material and Method

It is important to control residential energy consumption in order to avoid loading points on the grid and to save energy bills by making conscious electricity consumption for consumers [7]. 25% of the total electricity produced in Turkey is used in lighting [9]. Since it is not possible to measure the electricity consumption used for lighting, kWh values were found by noting how much time the lighting was used by people living in the selected abode and multiplying the Watt values of the bulbs and their operating time. Energy efficiency from lighting in the residence will contribute to the budget of family members. An important energy efficiency potential can be mentioned when applied to all dwellings in Turkey. In lighting, significant energy efficiency can be achieved by using effective light sources and efficient luminaires.

In this way, energy efficiency will not only reduce the invoice costs of consumers, but also reduce peak loads and achieve a more stable structure of the network [7]. For this, the armature has been changed. The energy-saving bulbs in the residence have been replaced with LED bulbs.

Energy Efficiency in Residential Lighting

The "Energy Efficiency Law", which aims to increase efficiency in the use of energy resources and energy to use energy effectively, prevent waste, reduce the burden of energy costs on the economy and protect the environment, was published. Its aim is to use energy effectively, prevent waste, ease the burden of energy costs on the economy and increase efficiency in the use of energy resources and energy to protect the environment [10].

Since it is not possible to measure the electricity consumption used for lighting, kWh values were found by noting how much lighting was used by people living in the selected abode and multiplying the Watt values of the bulbs and their operating time. Energy efficiency from lighting in the example abode will contribute to the budget of family members. When energy efficiency from lighting in a residence is adapted to all residences in Turkey, an important energy efficiency potential can be mentioned. 12 ones saving bulbs with 20 watts of power were used in the selected sample house. It is possible to provide significant energy efficiency by using LED bulbs of the same light color and lumen value, which will not disrupt the comfort of the consumer instead of the saving bulbs used. In Demand Side Management, it is important that the comfort conditions of consumers are not disturbed for energy efficiency and load shifting. Therefore, it is important to choose LED bulbs with the same light intensity and light color instead of the energy-saving bulbs to be replaced. A total of 12 20W energy-saving bulbs in this residence were replaced with LED bulbs of the same light color and intensity with a total power of 10W. The characteristics of the energy-saving lamps used, their duration of use, and the characteristics of the LED lamps replaced with energy-saving lamps, their duration of use are given in Table 1 [7].

Table 1. Features of energy saving and LED bulbs used in the residence

Features	Saving bulb	LED
Power	20W	10W
Lumen	1220lm	1200lm
Light color	6500K	6500K
Weekly use	7 days	7 days
Hours	5	5
Month	33.6kWh	16.8kWh

As can be seen in Table 1, the lumen value of saving bulbs with led bulbs, which shows the light color and light intensity, is quite close to each other. In terms of lighting, before the energy saving bulbs are replaced, the electricity consumption for lighting is 33.6 kWh, while the energy consumption for lighting is 16.8 kWh when the energy saving bulbs are replaced with led bulbs. Table 1 shows the share of the bulbs replaced to provide efficiency in lighting on monthly electricity consumption.

Results

An important energy efficiency potential can be mentioned when energy efficiency from lighting in a residence is adapted to all residences in Turkey. This study is only the consumption efficiency obtained by changing the lighting product. In addition to lighting, the demand side will be managed by changing other electrical household appliances. In the demand side management, not only product replacement, but also maintenance and repair of the devices will balance the consumption side. For example, if the maintenance and repair of engines used in industrial enterprises is not carried out for a long time, the engines will heat up more due to dust and dirt. As the windings heat up, consumption imbalance will occur, starting to draw more power from the grid. For all enterprises, it will be a significant consumption, and production will not meet consumption, causing a decrease in frequency. As we mentioned in our study, consumption was reduced by increasing energy efficiency by using LED bulbs instead of other bulbs in lighting with a significant share in electricity consumption. However, the load factor will also improve.

In this study, energy efficiency method was applied within the scope of demand side management. Electricity consumption decreased from 33.60 kWh to 16.80 kWh by using LED bulbs in lighting. The use of efficient lamps has played a major role in the reduction in the total electricity consumption of the house. Trainings and incentives to be provided to consumers by electricity companies on the use and efficiency of lamps are of great importance. Given that the electricity used for lighting is usually consumed during the evening hours, the savings and efficiency from lighting will prevent point loads, especially during the evening hours. Production and consumption will be in balance and the frequency value will be in balance. The balance of production and consumption will also be ensured by changing the consumption habits of consumers.

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