

A Green Transformation for Anadolu Airport Terminal Building

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Abstract

Energy is one of the basic necessities of life and, therefore, power management is extremely important these days. In this study, to reduce the electricity consumption and the use of renewable energy sources are considered to meet the current energy demand. Based on this, the lighting systems of Anadolu Airport terminal building in Eskisehir, Turkey have been analyzed. The lighting calculations and their evaluation meet international standards. Following these calculations, greener lighting approaches have been designed to reduce electricity consumption. The suggested lighting design includes new technology lighting production and shows the advantages of its use. Additionally, information on the installation of solar systems to meet the electricity energy demands of the lighting system has been included. When considering the paper as a whole, it follows from the analyses that energy saving applications to be carried out on the lighting systems are very efficient and the use of solar systems provides significant energy saving as well as contributing to the protection of the environment.

1. Introduction

Energy is one of the basic necessities of life and, for this reason, power management is extremely important these days. This being the case, achievements in this field are one of the determining factors for subjects such as the level of development, in order to become energy self-sufficient. In addition to this, many countries are dependent on imported energy in terms of obtaining widely-used energy sources. Hence, the use of domestic energy sources constitutes a key point in terms of a country's independence and economy. When the literature is researched, it can be seen that subjects have been dealt with in a number of different ways. The role of cities on global energy demand [1], the relationship between quality of life and energy savings [2], energy in terms of developing countries [3], domestic energy resources of Turkey [4], the correlation between the mineral industry and renewable energy [5], recoverable resources [6], day lighting control [7], building energy consumption [8,] and energy and the residential sector [9], are all examples of this. This article differs from others in its handling of the subject. The association of energy savings with the illumination system at Anadolu Airport has brought a different perspective to the subject.

When the studies are evaluated as a whole, this paper is an example for both airports, public buildings and universities. It contributes to the literature with certain features such as the bringing together of the aviation-building-lighting sectors, its application area and results on high rate savings and as well as awareness in these areas.

2. A Global Overview of the Energy Concept

Standards of living have rapidly changed along with the needs of people in parallel with developments in technology. Increases in energy demands have witnessed a rapid consumption of

energy sources. With widely-used energy sources being nonrenewable and fossil oil-based resources being extremely damaging to the environment, unfavorable situations such as global warming, a reduction of certain species, climate change, and an increase in natural disasters are outstanding problems which seem to give rise to an irreversible process creating serious problems in life.

Many institutions, organizations of civil society, governments and suchlike have carried out important research on the subject. According to data, 30% of oil is produced in the Middle East, 33% of natural gas in Europe and Eurasia, 67% of coal in the Pacific region, and 44% of renewable energy in Europe and Eurasia. However, 31% of oil in the Asia Pacific region is consumed along with 36% of natural gas in Europe and Eurasia, 67% of coal in the Pacific Region, and 44% of nuclear energy in Europe and Eurasia. From data supplied by the International Energy Agency (IEA), it is clear that fuel shares of total primary energy supply have increased by approximately 52% (Figure 1). In addition, it should be understood that the share of electricity as a source of energy in Turkey has slowly been increasing (Figure 2).

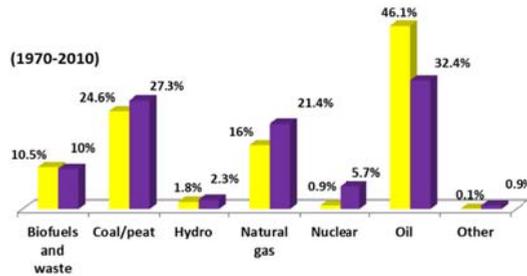


Figure 1 Fuel shares of total primary energy supply

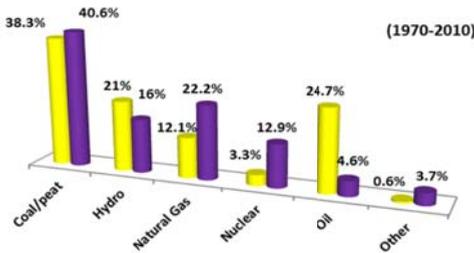


Figure 2 Fuel shares of electricity generation

In addition, it follows from other data from the IEA, that regional shares of crude oil production showed an increase from 1973 to 2011 with certain exceptions (Figure 3).

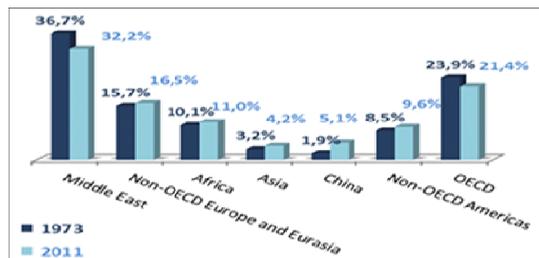


Figure 3 Regional shares of crude oil production

The fluctuations in energy sources and their unconscious use have caused many adverse environmental effects. One of these is climate change. Because this effect is related to several factors, such as average global surface temperatures, day-night temperature ranges, the number of hot and cold days, extreme rainfall events, and frequency and severity of droughts, it is highly significant. The European Environment Agency has stated a number of themes and their indicators. Climate change is one. Its indicators have been defined as atmospheric concentration of greenhouse gases, Europe and the earth's temperature, greenhouse gas emissions, and the production and consumption of ozone-depleting substances. Additionally, greenhouse gases can be analyzed in two main aspects; the sector and the human effect. The sector consists of the headings of energy, industry, agriculture, and waste. The human effect of the energy and industry heading is determined as the consumption of fossil fuels to generate energy, fuels consumed in transportation, and greenhouse gases released during the manufacture of products. All of the above-mentioned studies show that there is a relationship between the consumption of energy, consumed energy sources, climate change, and greenhouse gases. This means that, if savings relating to one of the subjects at issue can be carried out, benefits will be apparent in many other fields.

3. Green Energy and Buildings

In order to protect nature and to obtain various savings, green transformation has been applied to a number of fields. The resources which are alternative to sources that create environmentally hazardous and high greenhouse gas emissions are described as green and renewable energy resources. In addition to these, because the usage time of green energy resources are long compared with the human life span, they are known as unlimited resources. In recent times, electrical energy has become an important part of natural life. When considering the subject in relation to Turkey, it can be understood that the production of electricity has increased annually and that the highest share belongs to the natural gas electricity producing sector (Figure 4 and Figure 5).

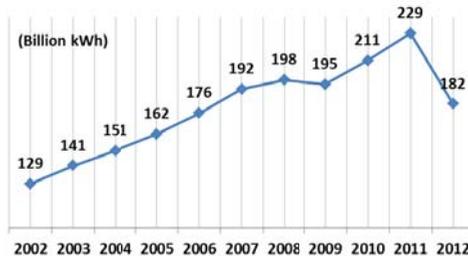


Figure 4 Electricity production values (billion kWh)

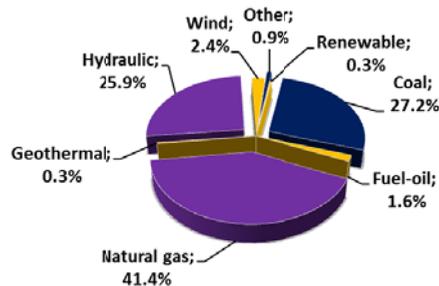


Figure 5 Distribution of electrical energy generation by primary energy sources (%)

In Turkey, many applications have been put into effect and various targets have been determined by the government to improve the current situation. Providing resource diversity, increasing energy efficiency, increasing the share of renewable energy sources in energy supply, and its natural resources contribution to the national economy are prominent targets.

Green transformation has begun in production to regulate the consumption of electricity and to limit environmental damage and has been applied in many sectors. One of these is the building sector. For electricity and other energy types, the consumption of buildings is quite high, making it important that the transformation period in this sector improves quickly. In this context, one of the featured applications is the green building concept and its related certificates.

Green buildings that minimize their energy requirement, and which meet their energy needs through alternative sources are defined as living buildings or eco-efficient buildings. They are certain certificated by some national and international organizations. Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), Comprehensive Assessment System for Built Environment Efficiency (CASBEE), GREENSTAR, and SBTool are some of the certification programs. In these programs, parameters such as waste, land use, impurities, management, energy, transport, water, materials, and indoor air quality are evaluated. Worldwide, an increase can be seen in the number of buildings which have green building certificates. This means that contributions to life and nature have increased in recent times.

With regard to energy efficiency, a green building criteria, the reduction of energy consumption of current systems in buildings provides a major contribution to the process. Lighting systems involve high energy consumption, so transformation applications carried out in this field are of great importance and provide significant savings.

The transformation in lighting systems is made a reality real by adding energy-saving devices to existing systems, improving automation and control systems, and meeting energy needs using alternative sources. All these applications are carried out within the boundaries of quality lighting and energy efficiency.

4. Results

In this paper, a green transformation plan for the sterile area at the Anadolu Airport Terminal Building is proposed. When analyzing the lighting systems in question, it can be seen that currently, forty units of Philips TL-D 18*4W/54 type fluorescent lamps are used with a daily electricity consumption of 20.16 kWh. In accordance with the criteria laid down for green buildings, a new generation, using less energy to be integrated into the current system, is outlined. In this regard, the current system has first been modeled and its suitability for international standards has been tested.

When evaluating the data obtained via the simulation program, it follows that the current system is unsuitable for the standard at issue. Although the energy value level (E_m) is determined as 200 lux by the standard, the current system's value is 434 lux. There is a similar situation regarding the value of light power density (LPD). According to the standard, its value must be lower than 6 W/m², but the value relating to the current system is gauged at 9.69 W/m² (Figure 6).

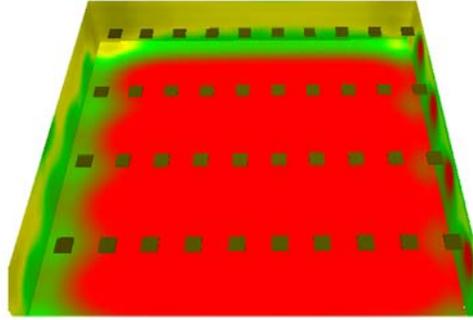


Figure 6 Outputs of the current system

To solve these problems, 24 units of LUXAR 40 W LED Tube types are estimated for use in the current area. If the solution is applied, the daily electricity consumption will be around 6.72 kWh. Additionally, it has been calculated that the E_m value will be 199 lux, and the LPD value will be 5.81 W/m^2 (Figure 7). To sum up, both a 13.44 kWh energy saving and a €18.5 saving will be obtained daily, with the system complying with the terms of the standard.

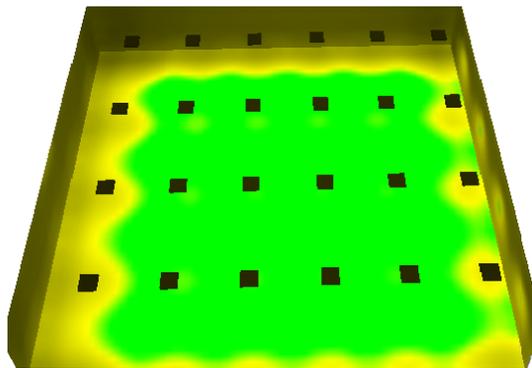


Figure 7 Outputs of the solution

When considering the process of green transformation, the use of solar energy has been identified as a source to meet the energy needs of the new design. The building will have a 611 kWh electricity production capability and its installation cost will be approximately €250,000. Considering this data, the share of the new system will be approximately €3000. This means that the application can meet its installation costs in only five months. Additionally, it will provide 402 kWh of monthly electricity energy savings. This is of great importance in terms of its applicability. Moreover, after meeting the cost of installation, the terminal will be self-sufficient in terms of electricity generation. In addition to this, because its production capacity is greater than demand, it will provide extra benefits through the sale of excess electricity to the city mains power supplier.

5. Conclusion

This paper has revealed that undesired situations can be eradicated through the use of new technological energy saving products and renewable energy sources. Moreover, it is emphasized that the solutions offered are extremely economical to implement in terms of their benefits and advantages. Moreover, the adaptation of designs and analyses for the airport terminal

building is a distinguishing feature of this paper, because when the literature is researched, it can be seen that there has been no research concerning any similar subject. Another important point is that the airport belongs to Anadolu University. The significance of this is that the energy saving applications can be employed in a number of different ways for all the university departments, ranging from the sciences to the arts. If this paper is evaluated as a whole, it can be the basis for further related research, thereby contributing to the protection of our environment.

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