ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: https://doi.org/10.29121/granthaalayah.v5.i11.2017.2355

INTERNATIONAL JOURNAL OF RESEARCH – GRANTHAALAYAH
A knowledge Repository

Science

SAVING ENERGY: A REVIEW ON ENERGY SAVINGS IN LIGHTING BUILDINGS IN AN INSTALLATION

Vijayant Kumar [*1]
[*1] Department of Applied Sciences, GJGI, India

Abstract

The fossil fuel reserves in India are rapidly exhausting with the country's development. To cope with the energy crisis, end-user efficiency plays an important role. This paper deals with energy saving in lighting systems with the replacement of lighting programs, as in India there is in all sectors a growing demand for energy. A number of commonly used lighting sources and their comparison in light production were discussed. The campus lighting system consisting of a T12 fluorescent lamp for monitoring the residential and institutional area of an existing device can be replaced by proposed LED lighting with equivalent performance, but has greater efficiency to reduce light energy consumption, This improvement Endbenutzereffizienz reduce the peak and the average demand of electricity, which reduces the load on the power grid. The annual energy savings through the proposed system are about 65% over current costs, which is a significant achievement of the energy saving technology. The retrofit period for the proposed lighting system installation is a little over three years. The initial investment for a short-term rating is slightly higher, but at a long-term valuation, the initial investment for the proposed regime is reduced by 50%, as the operating time of the proposed system is approximately five times higher higher than the current regime.

Keywords: Energy Conservation; End User; LEDs; Luminous Efficacy; Payback Period.

Cite This Article: Vijayant Kumar. (2017). "SAVING ENERGY: A REVIEW ON ENERGY SAVINGS IN LIGHTING BUILDINGS IN AN INSTALLATION." *International Journal of Research - Granthaalayah*, 5(11), 290-294. 10.29121/granthaalayah.v5.i11.2017.2355.

1. Introduction

India has more than 17 percent of the world's population, making it a major consumer of energy resources. India consumes its maximum energy in residential, commercial and agricultural purposes compared to China, Japan, Russia, EU-27 and USA [1]. It shows that the share of energy consumption in India and China has also increased due to the high level of urbanization, the population explosion and the intense growth of IT and related companies [2]. The development of society depends heavily on the availability of energy. Therefore, meeting energy demand for the nation is an important task for the sustainable development of the country. Throughout India's five-year planning, the energy sector has been given high priority. It was

 ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1098389

found that the electricity demand in the period 2010-11 was 861,591 million units and the availability was 788,355 million units, ie. H. A shortage of 73.236 million units (8.5%). In 2011/12, demand was 933,741 million units and availability was 837,374 million units, which in turn led to a shortage of 96,367 million units (10.3%) [3].

It is seen that there is a considerable gap in demand and supply of power. It is very important to minimize the gap between generation and demand. From 1991 to 2007, the government introduced a series of reforms to improve the electricity system in India. This, in turn, revolutionized the growth of electricity capacity, security of supply and growth of revenue collection [4].

Energy conservation is an important means of reducing peak and average energy requirements. It is observed that investments in energy efficiency and energy saving are extremely cost-effective [5]. The efficiency of the end user can be significantly improved by the energy saving technology. It is possible to save energy by implementing energy saving technology, which means increasing energy production with available source [6]. Improving end-user efficiency is part of demand management, which reduces end-user energy consumption. This in turn reduces the load on the existing power system, which also reduces energy costs per unit [7] [8].

In domestic, commercial and industrial sector, lighting system consumes significant amount of energy. It consumes 50% of total energy consumption in commercial buildings and 10% in industries. A number of places are found having inefficient lighting design for a particular task [9]. In all the sectors both indoor and outdoor lighting efficiency can be improved with higher efficient lighting sources which will help to reduce the gap between demand and supply.

2. Sector Wise Energy Demand In India

India is the most populous country in the world and one of the fastest growing countries in the world. In order to achieve a sustainable growth rate, energy in usable form plays an important role. Since independence, India has increased the power generation capacity of 1362 MW in many cases [10]. In every five-year planning, energy has become very important. But the gap between production and demand is increasing day by day. India's fossil fuel reserves are not very large and could be exhausted by mid-century, suggesting an alarming situation in the near future. The energy consumption of different sectors in India in 2007 is shown in Table I. In order to maintain the growth rate of each sector, it is therefore essential to meet the energy needs required.

Table 1: Sector wise energy consumption

Areas	***Consumption (Year-2007)***
Domestic	21%
Commercial	18.0%
Industrial	32%
Transportation	29%

 ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1098389

3. Energy Conservation At the End User

It is seen that there always exist a gap between generation of energy and energy demand of energy. It is quite impossible to bridge this gap by increasing the generation capacity as it is a very capital intensive process. At the same time most of the fossil fuel reserve will be depleted by next few decades. From the survey conducted by ministry of power in 1992 it is found that the improvement in efficiency of end users is essential. End user sector is a major area of conservation of energy to bridge the short fall between generation and demand [10]. In all the areas, conservation of energy is possible. Through demand side management it is possible to maximizing the end use efficiency [11]. Around 15,000 MW of energy can be saved through end-use energy efficiency [10]. One of the most significant areas of energy conservation is lighting energy. Lighting load shares a significant portion in all sectors namely domestic, commercial, industrial etc. It is found that in most of the cases indoor lighting get priority as far as energy efficiency is concern but campus lighting in commercial, domestic building get less importance. There is huge possibility to conserve energy if the inefficient light fittings are replaced by efficient one. Basically it is a demand side management which helps to reduce load on the electrical network. Consumption of energy can be reduced by conservation of energy.

4. Lighting Sources and their Efficiency

In all sectors there are some commonly used light fittings such as incandescent light, fluorescent light, sodium vapour, mercury vapour, metal halide etc. for particular application. Luminous efficacy i.e. lumen per watt for these light sources are different. Among these a number of areas found with incandescent light as a source of lighting which very inefficient from the point of view of energy efficiency. It is obvious that higher efficiency of lighting source will definitely reduce the energy consumption.

Luminous efficacy of different light sources is listed in table 2

Light source	***Luminous efficacy***
Incandescent light	***(lumen/watt)***
Fluorescent light	60-70
Sodium Vapour	40-120
Mercury Vapour	50-60
Metal Halide	80-125
CFLs	50-80
LEDs	20-60

It is seen that the luminous efficacy of the LED and CFL are at per but LED is much energy efficient due to low power consumption at the driving circuit and negligible loss of power in terms of heat generation. Hence LED for lighting purpose is a good alternative of commonly used light sources. More over research is going on to develop more efficient LEDs. It is true that the initial cost of LEDs is high but its life span is extremely high compared to other light sources. So LEDs can be good alternative to replace the existing less efficient lighting source in all sectors of application.

 ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1098389

5. A Case Study To Replace An Existing Lighting System (T12 Fluorescent) with Led Campaign Light In An Institutional Zone

A survey was conducted at a college of engineering and its residential complex and revealed that 40 fluorescent fixtures (T12) are connected to the entire campus for monitoring. It is observed that all the lights remain on for about 12 hours at night (from 18:00 to 18:00) for each day. The operating time may vary slightly depending on the seasonal variation in the length of the day. It is also observed that the lights remain in use throughout the year, regardless of holidays and holidays, as they are used for the purpose of vigilance of the campus. All fixtures have electromagnetic ballast that consumes about 12 to 14 watts more during operation. Thus, the energy consumption of a single fluorescent lamp, taking into account a minimum loss of load 40 + 12 = 52 watts. The luminous efficiency of the fluorescent lamps is about 2400 lumens. Therefore, a considerable amount of energy can be saved with an end-user improvement, i. H. Existing lighting fixtures are replaced by highly efficient lighting fixtures. For this purpose, a high efficiency LED streetlight model SHAH ELECTRONICS no. SESTL-LED-1811 has been proposed. It consumes 18 watts with a light output of about 120-140 lm / W. This LED lamp post has an average light output of about 2340 lumens and is intended for outdoor use. The comparative study between the existing lighting fixtures and the proposed lighting fixtures will offer very close performances and much lower energy consumption. With 12 hours of operation in a day, the total energy consumption of a single existing light, i. H. Fluorescent light in one day, given by:

52 * 12 watt hours = 624 watt hours.

So, annual energy consumption of a single existing light is given by: 624*365 watt-hour =227760 watt-hour or 227.76 units. Hence annual energy consumption of total existing light i.e. 40 fluorescent light is given by: 40*227.76 unit = 9110.4 units.

Annual energy cost for campus lighting with existing light fixture is given by: 5*9110.4 = Rs. 45,552/- (Considering unit cost as Rs. 5/-).

If all existing light fittings are replaced by proposed 18 watt LED Street light which gives output of around 2340 lumen which is very close to the light output of existing fluorescent light fixture. Taking same hours of operation i.e. 12 hours day, energy consumption in a day of a LED Street light fixture is given by:18*12 = 216 watt-hour So, annual energy consumption of a single LED Street light fixture is given by: 216*365 = 78840 watt-hour or 78.84 units.

Hence annual energy consumption of total LED Street light fixture i.e. 40 is given by: 40*78.84 = 3153.6 unit’s Annual energy cost for campus lighting with LED Street light fixture is given by: 5*3153.6 = Rs. 15,768/- (Considering unit cost as Rs. 5/-).

Annual energy savings is (9110.4 – 3153.6) = 5956.8 units. Percentage savings in annual energy consumption is 65.38%. Annual savings in energy cost is (45552 - 15768) = Rs. 29,784/-Now the cost of proposed LED light fittings is Rs. 2500/- per unit.

 ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1098389

Cost of installation of proposed LED light fittings is = 2500*40 = Rs. 100,000/-Payback period = 100000/29784 = 3.35 years = 3 years 4 months.

It is fact that the initial investment and payback period of the proposed lighting system is high. But the savings in long term is of very significance. Minimum life span of a LED is 50000 hours whereas the life span of fluorescent light is around 10000 hours. Taking 12 hours of operation LED light fixture will last for 2 years and 3 months. For the same hours of operation per day, LED light fixture will last around 11 years. So the onetime investment in LED light is bound for around 11 years whereas the investment of fluorescent light fitting is bound only around 2 years 3 months. Hence for the period of 11 years the existing fittings needs to replace five times.

Now the cost of one light fitting of with T12 fluorescent light fixture for outdoor use is around Rs. 1,000/-. Hence total investment in 40 number is 1000*40 = Rs. 40,000/-. For the period of 11 years, the investment for light fitting of with T12 fluorescent light fixture is five times i.e. 5*40000 = Rs. 200,000/- whereas the investment for LED light fixture is Rs.100,000 only. In long term assessment the initial investment in LED light fixture is 50% less than that of fitting of with T12 fluorescent light fixture. Moreover annual savings in energy cost is around 65%. This savings through end user efficiency is of very significant for conservation of energy.

6. Conclusion

It has been found that improving end-user efficiency with the most efficient LED luminaire proposed provides a significant result for a campus lighting system. It also shows that the initial investment is high and the payback period is slightly over 3 years. It has also been found that, despite a higher initial investment, the lifetime of the LED system is reasonably high, resulting in savings of 50% on the initial long-term investment compared to an existing T12 fluorescent device. It is also noted that about 65% of the annual energy consumption can be reduced with the proposed system

References

[1] M. Lalwani, M. Singh, Conventional and Renewable Energy Scenario of India: Present and Future, Canadian Journal on Electrical and Electronics Engineering, Vol. 1, No. 6, October 2010, 122-140.
[2] S. P. Ramesh, M Emran Khan, Energy efficiency in green buildings – Indian concept, International Journal of Emerging Technology and Advanced Engineering, Volume 3, Special Issue 3, Feb 2013, 329-336.
[3] [3] Government of India, ‘Load Generation Balance Report 2011-12’, A report by Central ElectricityAuthority (CEA), Ministry of Power, available at http://www.cea.nic.in/reports/yearly/lgbr_report.pdf
[4] V. Kumar Yadav, N.P. Padhy and H.O. Gupta, Assessment of Indian Power Sector Reforms Through Productivity Analysis: Pre and Post Electricity Act, 2003, IEEE PES Transmission and Distribution Conference, 2010, 1-8.
[5] V. S. Verma, ‘Energy Efficient Technologies use in India – An Overview 2004’, Bureau of EnergyEfficiency (BEE), 20 August 2004.

*Corresponding author.
E-mail address: gauravkumar.shaha@ gmail.com