



Light auditing in residential buildings of Jorhat, Assam

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Abstract

The present study was undertaken to assess the energy efficiency of household lighting appliances through a lighting audit. Data were collected using a standard interview schedule through interview and observation methods. The study audits the age, wattage, usage pattern, and BEE star rating of household lighting appliances. The findings revealed a shift towards newer and more energy-efficient lighting technologies, particularly LED bulbs and LED tube lights. Most households used lighting appliances for 1–4 hours per day, while none reported using them for more than eight hours per day. LED appliances had different BEE star ratings, whereas CFL appliances were non-star-rated. The present study suggests that replacing older and higher-wattage lighting appliances with low-wattage, energy-efficient LED lighting can improve household energy efficiency, reduce electricity consumption, and reduce household carbon emissions.

Keywords: Lighting audit, residential buildings, energy efficiency, LED, electricity consumption, BEE star rating, carbon emissions

Introduction

Electrical energy utilization in residential area is around 40 percent of total electricity production and in businesses around 60 percent of the total electricity generation in India (Saravanan, *et.al* 2021) ^[1]. lighting is the most basic use of electricity in home and its share in the total residential electricity consumption is estimated to be in the range of 18 to 27 per cent (Chunekar *et. al.*, 2017) ^[2]. in India, 68.70 percent of GHG (Greenhouse Gases) emissions come from the energy sector (World Resources Institute Climate Analysis Indicators Tool, 2017) ^[3]. the carbon footprint is the measure of carbon dioxide emissions directly or indirectly caused by an activity or accumulated over the life stages of a product (Wiedmann *et al*, 2008) ^[4].

Nowadays several methods are being used to save electricity in residential buildings such as high-efficiency lighting systems like high-intensity fluorescent lamps which saves as much as 30 to 50% of lighting costs but its main demerit is a short life cycle. LED lighting and other energy efficient has a vast potential in India, especially in North East region, which facing immense power shortage and high electricity cost. The nation is building more power plants to meet the increasing demand of electricity in the state like Assam and other six sisters. According to Vats and Mathur (2022), the three mainstays of India's decarbonisation strategy that could plausibly turn the energy sector towards a net -zero emission future are transformative levels of electrification, energy efficiency improvements, and a switch towards decarbonised fuels (largely green hydrogen, decarbonised electricity, and bioenergy).

"Energy conserved is energy produced" is the slogan used to promote the importance of efficient use of energy. Electricity conservation measures are often cheaper than building new power plants for electricity generation. The energy audit is an extensive study that helps to identify energy consumption pattern among different households and provides opportunities for energy conservation. Measures

should be taken to shorten carbon footprint by reducing the emission of greenhouse gases mainly carbon dioxide.

Methodology

A standard interview schedule was used to collect information in according with the objective of the study. Data were collected from a total of selected 373 households from all 19 municipal wards of the urban area of Jorhat district. Both interview and observation methods were adopted for data collection. A lighting audit was conducted to measure household lighting appliances based on their age, wattage, usage hours, and BEE star rating. The collected data were analysed using frequency and percentage to determine the energy consumption patterns of household lighting appliances.

Results and Discussion

Lighting represents the most basic use of electricity in households, accounting for approximately 18-27% of total household electricity consumption (Chunekar, 2017) ^[2]. Lighting audit examines the age, wattage, usage and star rating of lighting appliances used by the households. The finding on the age of the lighting appliances indicate a shift toward newer and likely more energy-efficient lighting options, as the majority of households have upgraded or replaced their lighting within the last four years. The majority of households used newer lighting appliances that were up to four years old and the highest percentage (93.19%) of respondents had tube lights (CFL), followed by 89.73 percent had tube lights (LED), 80.66 percent LED bulbs, and 79.62 percent CFL bulbs. Under the four to eight years old categories, very less percent (15.28%) households had LED bulbs, followed by 8.48 percent CFL bulbs, and 6.19 percent tube lights (CFL). It was also found that a very fewer households (5.09%) had CFL bulbs, 3.93 percent LED bulbs, and 0.62 percent tube lights (CFL) under the category of above 8 years.

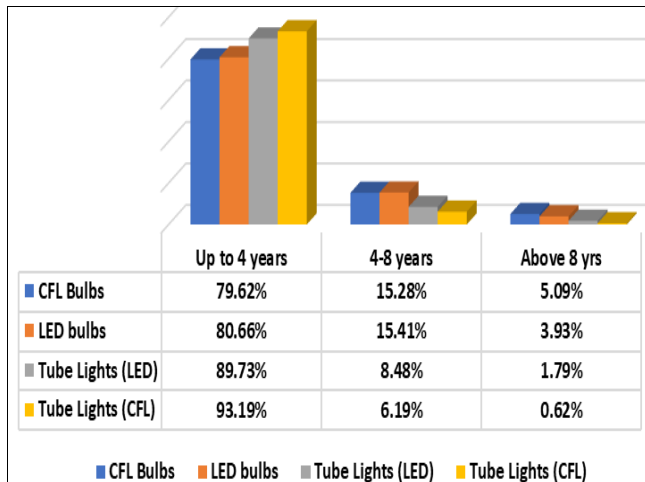


Fig 1: Age of household Lighting Appliances

The wattage distribution of electric lighting appliances. It was observed that approximately one-third, (31.72%) of the respondent households used up to 9 W of LED bulbs, followed by 26.01 percent CFL bulbs, 7.14 percent tube lights (LED), and a meagre percentage (6.50%) had tube lights (CFL). It was further observed that more than two third (68.11%) of the respondents households had tube lights (CFL), followed by almost same percentage of households (45.98% and 45.84%) had tube lights (LED), and CFL bulbs, and nearly less than half (43.20%) had LED bulbs used in between 10–12W. Nearly half of the respondent households (46.88%) used LED tube lights, followed by one fourth (28.15%, 25.39% and 28.15%) of the total respondent households used CFL bulbs, tube lights (CFL), and LED bulbs used above 15W.

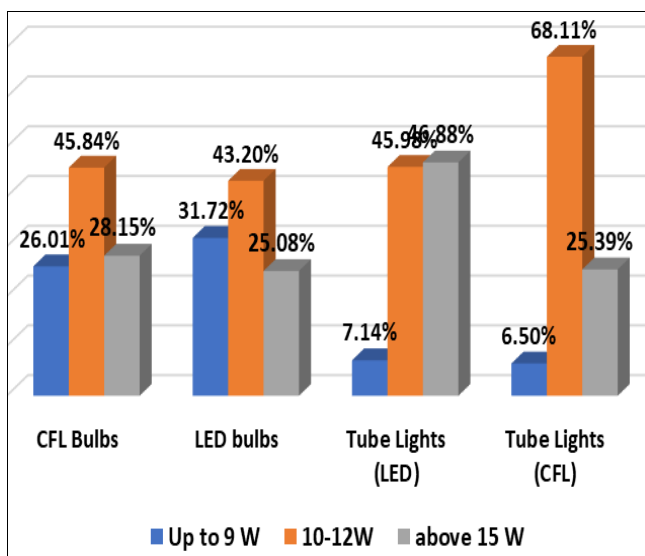


Fig 2: Wattage of household Lighting Appliances

Regarding the distribution of households according to lighting usage patterns. It was depicted that one-third (31.58%) of households used tube lights (CFL), followed by 27.23 percent tube lights (LED), 13.60 percent LED bulbs, and only 8.04 percent CFL bulbs used less than an 1 hour/day. Majority of the respondent households (81.57%) used LED bulbs, followed by 72.12 percent CFL bulbs, 65.02 percent CFL tube lights, and 60.27 percent LED tube lights used for one to four hour/day. A very small percentage (19.84%) used CFL bulbs, 12.50 percent LED

tube lights, 4.83 percent LED bulbs, and 3.41 percent CFL tube lights for four to eight hours/day. It was interesting to note that none of the household used electrical lighting appliances for more than eight hours/day.

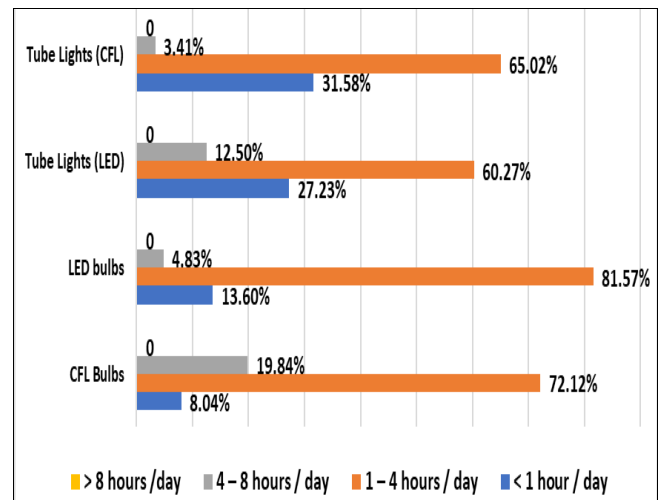


Fig 3: Usage hours /day of household Lighting Appliances

The Bureau of Energy Efficiency (BEE) star rating of the household lighting appliances data revealed that cent percent of the respondents' households CFL bulbs and tube lights (CFL) were no-star-rated, indicated that they lacked BEE star labels. LED bulbs and LED tube lights, on the other hand, had different star ratings. Nearly half (43.20%) of LED bulbs were rated three stars, followed by 18.12 percent were five stars, 16.61 percent two-star, 11.17 percent rated four star and only 10.87 percent rated one star. Further investigation depicted that 39.73 percent of tube lights (LED) were rated as three stars, 26.78 percent as four stars, 13.39 percent as two stars, 6.69 percent as one star, and 6.69 percent as non-star.

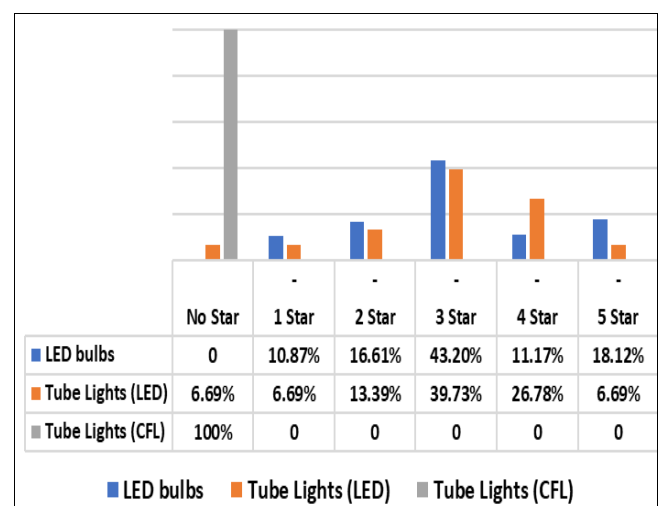


Fig 4: BEE star rating of the household lighting appliances

Conclusion

The present study on lighting audit for residential building revealed a shift transition towards newer and more efficient lighting technologies, especially LED bulbs and LED tube lights, was found in the lighting audits. The majority of households reported using lighting appliances for one to four hours each day, but no reports of using them for more than eight hours were made. The results also revealed that

while LED lighting appliances had a range of BEE star ratings, CFLs were primarily no star rated. It was also noted that households can significantly increase lighting efficiency by switching to low wattage, higher efficiency LED lighting in place of older. This will lower household electricity consumption and related carbon emissions.

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