

PRESENT LIGHTING SCENARIO IN BHUTAN

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ABSTRACT

Energy in Bhutan has been a primary focus of development in the kingdom under its Five-Year Plans. It was in the early 1986 that Chukha Hydro Power Corporation was first commissioned and the dark nights started getting lighted. Power consumption since then has been increasing at an alarming rate and its time that we use the most efficient lighting systems. At present LED lighting system is the most efficient energy saver. This paper contains the survey carried out to find out the type of lighting system adopted in Bhutan; whether or not the people are aware of the LED lighting system and its efficiency in energy saving.

Keywords: LED lamps, conventional lamps, Awareness, Survey, MATLAB

1. INTRODUCTION

Bhutan has been dominated by incandescent lighting system. When there are high power saving systems available yet the consumers is concentrated in using the incandescent lighting system. It may be due to limited literacy rate that people are not exposed to the technical benefits of the new and efficient energy saving systems. It was known from the dealers who sell the lighting bulbs that the customers coming to buy the lighting bulbs were unaware of the various types of lighting systems and their benefits. Most of the time it was the dealer explaining the advantages of the led

lighting systems and its energy saving advantages but the costumers were found sceptic and insisted on taking the classical lighting bulbs. In other developed countries, they are in a high time switching to better systems discarding the primitive energy consuming systems. Looking into these, this paper has been written to create an awareness and do away with our ignorance. To access this, technical and market research of the various types of lighting systems were carried out from which a MATLAB program has been generated to forecast the power

consumption, number of replacements, the overall cost of different lamps for a particular duration. This program also proves the benefits of LED lamps over conventional Lighting lamps i.e .Incandescent, CFL (compact fluorescent lamps) and Fluorescent tubes.

2. INTRODUCTION: AWARENESS PROGRAM ON LED LAMPS

The survey was carried out in Royal Insurance Cooperation of Bhutan Limited (RICB) colony in Phuntsholing, Bhutan for about hundred and fifty households .It was basically to find out the different scenario of lighting lamp usage and to make people aware of the LED Lamps. Moreover the RICB area was chosen because of same structure of the buildings with same size of room ,which makes it easier for us to collect required data .Also as most of the educated people were residing in that colony it was easy for us to create awareness about the new LED lamp technology.

3. SURVEY RESULT ANALYSIS

3.1 DIFFERENT TYPES OF LIGHTING LAMP USED

The figure- 1.below shows the overall lighting lamp used in every household at Royal Insurance cooperation of Bhutan limited colony, where 40% residential building uses Fluorescent Lamp, 35% uses Incandescent Lamp, 25% uses Compact Fluorescent Lamps and none of household were using LED Lamp.

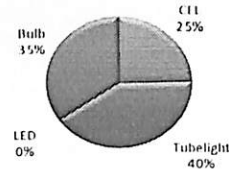


Figure 1: Different lighting lamps used in RICB residential colony.

3.1. AWARENESS ON LED LAMP LIGHTING SYSTEM

The below pie-chart shows the numbers of participants who had the knowledge about LED Lamps. From here it is clear that, 83% of the participants were unaware about the LED lighting lamps and 17% of them were aware about the LED lamps.

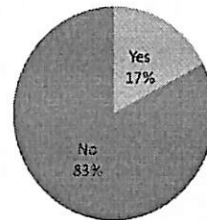


Figure 2: Awareness of LED Lamp for room lighting system.

3.2. ACCEPTANCE OF LED LAMP TO REPLACE EXISTING CONVENTIONAL LAMPS

Though most of the participants were unaware about the LED room lighting system but after explaining some of the advantages and disadvantages to the participants they were ready to adapt or switch to LED room lighting system from conventional lighting systems. From the report analysis 79% were willing to shift to the new LED room lighting system since they felt that it would really benefit them in long run and 21% of them still wanted to continue using conventional lighting

system since they were unsecure of the new technology.

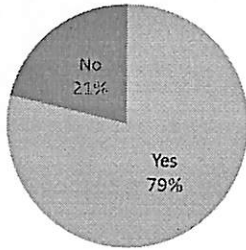


Figure 3: Response of switching from Conventional Lighting Systems to LED Lighting System after explaining advantageous of LED Lighting System.

Since this survey was conducted within small portion of area but the response was very impressive which showed positive result of switching to LED room lighting from conventional lighting system. Thus, in future LED room lighting system can really govern the conventional lighting systems and it would hits the Bhutanese market in future

4. COST PREDICTION USING MATLAB

MATLAB is a great software where large dimensions of arrays can be handled. A program has been developed in this platform to see the cost of using the different lamps (Incandescent, CFL and LED) over time. The illustration is done in the graph and the cost of each lamp is plotted against time. The lamps are assumed to be working in ideal situation where no power fluctuation or external factors such as moistures and temperature variance is accounted. Also the lamps are assumed to be used for 24 hours a day which means the plot would be 6 time longer if plotted for a real scenario of 4 hours a day.

The working and output of the program are discussed below along with the program contents.

4.1. WORKING WITH PROGRAM

The program has two modes the users can use it through **Automatic** mode is for the users who wants to just see the comparison with values already selected ahead. The assumed parameters are:

i. Room with area: 5x5 sq.m

ii. Lamp's lumen: 1100 i.e.
Inc.Bulb=75W, CFL=25W, LED=13W

iii. The number of fixtures required is calculated to be 15 using the formula

$$N = \frac{E \times A}{L \times UF \times MF}$$

where,

E is the illumination level required in the room,

A is the area of the room,

L is the lumen specification of a single bulb,

UF is the Utilization factor and
MF is the Maintenance factor.

Assumed values in the programs,

E = 200 (example: reading room requires 800lux);

UF=0.4;

MF=0.75;

The Manual mode requires all the information for the plot and they are, the initial cost of each lamps, the dimension of the area to be illuminated, the lumens of the lamps and the duration of the observation plot.

4.2. ENTERING INPUT

The program in Manual mode requires set of data to be entered. An example of a manually filled data to the program till the end of its execution is shown below (in italics).

COST COMPARASION ANALYSIS

Please enter the required data

Would you like to fill the data or let us do it automatically? .

1. Automatic

2. Manual

Enter option: 2

Initial cost of one Incandescent Bulb:20

Initial cost of one CFL:100

Initial cost of one LED lighting Bulb:500

Enter room length:3

Enter room breadth:3

What is the observation duration of the comparision? (In years)

3

Enter the required lumens from the options provided:

<i>Lumens</i>	<i>Bulbs Watts</i>	<i>CFL Watts</i>	<i>LED Bulbs Watts</i>
450	40	9-13	4-5
800	60	13-15	6-8
1100	75	18-25	9-13
1600	100	23-30	16-20

2600 | 150 | 30-55 | 25-28

(Anon. (2010, February 9).)

1. 450

2. 800

3. 1100

4. 1600

5. 2600

3

The number of fixtures required is calculated to be

nob = 5

Displaying Incandescent, CFL and LED comparision

Loading...

Done.

The Automatic mode only requires the observation duration of the plot and the option if Incandescent bulb be plotted or omitted from the graph.

The Automatic mode input is shown below (in italics).

Would you like to fill the data or let us do it automatically?

1. Automatic

2. Manual

Enter option: 1

Room with area 5x5 sq.m taken

For lumens of 1100 i.e. Inc.Bulb=75W, CFL=25W, LED=13W

The number of fixtures required is calculated to be

nob =

15

Would you like to include incandenscent bulb in the analysis?

1. No

2. Yes

Enter option:2

Displaying Incandescent, CFL and LED comparison

Loading...

Done.

The Automatic mode only requires the observation duration of the plot and the option if Incandescent bulb be plotted or omitted from the graph.

The Automatic mode input is shown below (in italics).

Would you like to fill the data or let us do it automatically?

1. Automatic

2. Manual

Enter option: 1

Room with area 5x5 sq.m taken

For lumens of 1100 i.e. Inc.Bulb=75W, CFL=25W, LED=13W

The number of fixtures required is calculated to be .

nob =

15

Would you like to include incandenscent bulb in the analysis?

1. No

2. Yes

Enter option:2

Displaying Incandescent, CFL and LED comparison

Loading...

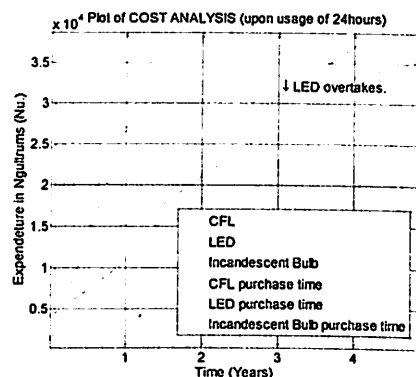
Done.

4.3. FIGURE OUTPUT

A plot illustrated below in Figure 1 is from the Automatic mode from the program. The program also shows that LED lamps

are much beneficial even in comparison to the CFL lamps.

Figure 4: Zoomed MATLAB plot of showing expenditures on using different common lighting lamps



4.4. PROGRAM INFORMATION

The program is able to predict the expenditure approximately on using each type of lamps under the same condition. We can see that LED lamps are found to be more beneficial over the user because of its lifespan. Besides economic benefits, the LED lamps provides cleaner way to light areas. It is found however non beneficial for the LED lamps to be used since the payback time is not reached as also seen in the plot.

The required illumination or the tariff rate can be changed easily reading the comments in the program. The program has also incorporated the reduction of the purchase cost of the lamps over the years of improvements of technology. The rate at which the cost falls is assumed to be of exponential in nature and to decrease to 80% of the input cost at the end of the observation period.

The program is simple and any parameters can be manipulated easily as long as the user know what is being done. The curve is very slight and downwards and is hardly noticeable. If the cost of electricity rises over the years too, the graph will almost be linear in rise.

The lumen to watt relation table illustrated in the Manual mode of the program has been derived from the comparison chart from Design Recycle Inc (Anon, 2010).

5. FUTURE WORKS

The survey can be further carried by taking larger samples size and see the exact savings both in terms of energy and cost. A survey can be conducted for the whole country to determine the number of lighting lamps installed and then calculate the cost and energy savings.

The various performance parameter including lumen depreciation, colour temperature, glare of lamp, colour quality, colour shift, dimming ability can be included in Matlab programming to analysis more on LED lighting system and conventional lighting system.

The further study can be done to determine which system is better for the Intelligent Lighting System or Smart system between LED and Conventional Lighting System. Intelligent Lighting System includes lamps, sensors and control systems to adjust the lighting environment in the installed area with motion and outdoor light as its input

6. CONCLUSION

Technology has advanced in a very fast pace and is still advancing. One of emerging technology is LED based lighting lamps, which may replace the conventional lighting lamps such an Incandescent lamp, Fluorescent lamp and CFL Lamp.

In this paper, the survey was conducted in the Royal Insurance Corporation of Bhutan (RICB) Colony, Phuentsholing, Bhutan and survey results shows that no one is using the LED lamps at the moment and 83% of participants were even unaware of the LED lamps. When the cost, benefits and energy saving by using the LED lamp is explained to the participant's, then 79 % are ready to move from the Conventional Lighting System to the LED Lighting System

The MATLAB program can be simply used by both the technicians and any other curious individuals. The study is particularly focused on the residential room electrification or lighting system.

By doing various studies and it has been found that LED lamps are beneficial in all aspects. Looking at the response of the Bhutanese people, LED lamps have a very promising future in Bhutan like other parts of the world.

7. REFERENCES

Anon. (2010, February 9). *Comparison Chart*. Retrieved from Design Recycle Inc. Home: <http://www.designrecycleinc.com/led%20comp%20chart.html>