

Comparison of Total Actual Cost for Different Types of Lighting Bulbs Used In Typical Houses in Kuwait

Mohammed Alkandari ⁽¹⁾, Abdullatif Ashati ⁽²⁾

Electrical Networks Department, High Institute of Energy, Public Authority of Applied Education and Training, KUWAIT

ABSTRACT

This paper presents a comparison of actual cost for three different lighting bulbs typically used in houses. They are Incandescent light, Compact Florescent Light CFL and Light Emitted Diode Light LED. The comparison takes in respect how much each lighting bulb consumes actual power and how much it costs in respect of Kuwait's regulation. Thus, the cost efficiency of each type is calculated. The study deals with typical houses in Kuwait taking in respect the regulation of the distribution and installation rules (R6), [1] of the ministry of water and electricity in Kuwait for the year 2014

Keywords: house lighting, Incandescent light, Compact Florescent light, house lighting efficiency, LED, CFL, lighting efficiency

I. INTRODUCTION

Lighting bulbs are very important and most used element in buildings and houses. And from that aspect, it is important to study the cost and compare which type is more power efficient. Lighting bulbs, like any electrical element; are continuously developed and renewed in order to find the best type that gives the same brightening result with less power consumption. We can view lighting bulbs as a power converter which converts electricity into waves of visible light. Incandescent lights are one of the first lighting bulb used, it was the evolution of converting electricity into visible light. But that old type, which is still used; consumes a lot of electrical energy in order to convert it into useful visible light, and that pushed scientists to develop types like Compact Florescent light (CFL) and Light Emitted Diode (LED). In this paper, we will consider the three types of lighting bulbs: incandescent, CFL and LED bulbs

that are used in typical houses in Kuwait. Moreover, we will take in respect the regulation of the distribution and installation rules (R6), [1] of the ministry of water and electricity in Kuwait for the year 2014.

II. DEMINSSIONS OF TYPICAL HOUSE IN KUWAIT

Kuwait is one of fortunate countries that still distributes housing rights to its citizen, the ministry of housing in Kuwait issues a piece of land with construction loan for each family in order to build a house. The land area is 400 meter square and the loan is enough to build three floor house with a basement. We will consider a typical house as 400 square meter land with three floors and a basement. The considered numbers and sizes of rooms (in square meter) for typical Kuwaiti house in this paper is as the following table.

Description	Rooms number	area in m ²
living room	12	30
bathroom	12	10
bedroom	12	20
kitchen	5	25
stair room	2	45
basement	1	300
study room	5	20

III. CALCULATION OF CONSUMPTION

In order to put a model of this study, we must state the rules of R6 (the regulation of distribution and installation rules of the ministry of

water and electricity in Kuwait for the year 2014) for lighting limits. The following table contains the distribution of brightness limit (in Lux/m²) for each room type:

Description	Lux/m ²
living room	150
bathroom	100
bedroom	150
kitchen	300
stair room	100
basement	300
study room	300

Having Lux/m² limit and rooms size, we can calculate the number of bulbs needed to lighten each room. **The bulbs power in this paper are 30 watts/Hr and the brightness in Lumen are 300,**

900 and 1800 for the incandescent, CFL and LED respectively. The calculations and equations are shown in the following table.

Description	Lux/m ²	area in m ²	Lumen limit	Incandescent bulb needed (300 Lm/30Watt)	CFL bulb needed (900Lm/30Watt)	LED bulb needed (1800 Lm/30Watt)
			(Lux*area)	(Lux*area)/Lm	(Lux*area)/Lm	(Lux*area)/Lm
living room	150	30	4500	15	5	3
bathroom	100	10	1000	3	1	1
bedroom	150	20	3000	10	3	2
kitchen	300	25	7500	25	8	4
stair room	100	45	4500	15	5	3
basement	300	300	90000	300	100	50
study room	300	20	6000	20	7	3

* num. of bulbs approximated to the nearest number

Having the estimated number and the power of bulbs, we can calculate the required total power (in Watts) consumed in each room. The

following table shows the total power for each bulb type for the different room's type.

Description	Incandescent bulb	CFL bulb	LED bulb
	Num. of Bulbs*bulb power/Hr	Number of Bulbs*bulb power/Hr	Number of Bulbs*bulb power/Hr
living room	450	150	75
Bathroom	100	33	17
Bedroom	300	100	50
Kitchen	750	250	125
stair room	450	150	75
basement	9000	3000	1500
study room	600	200	100

R6 regulation states the estimated or so called total actual load consumption of houses in a year. The studies in R6 show that houses are functioned just 70% eight hours per day of the

year. The actual load, therefore, 255.5 days times 8 Hr times the total bulb power needed for each room. The table below illustrates the calculation of total actual load (in KWH) for the total year.

Description	Incandescent bulb (300 Lm/30 watt)*	CFL bulb (900Lm/30 watt)	LED bulb (1800 Lm/30 watt)
	Total Load*0.7*365*8h/1000	Total Load*0.7*365*8h/1000	Total Load*0.7*365*8h/1000
living room	919.8	306.6	153.3
Bathroom	204.4	68.13333333	34.06666667
Bedroom	613.2	204.4	102.2
Kitchen	1533	511	255.5
stair room	919.8	306.6	153.3
Basement	18396	6132	3066
study room	1226.4	408.8	204.4

Now, having the total actual load, we calculate the total cost (in Kuwaiti Dinars) for each

room type by taking in respect the cost of KWH in Kuwait; which is 0.038 of the dinar.

We got the following results:

Description	Incandescent bulb	CFL bulb	LED bulb
	Actual Load* 0.038KD	Actual Load* 0.038KD	Actual Load* 0.038KD
living room	34.952400	11.650800	5.825400
bathroom	7.767200	2.589067	1.294533
bedroom	23.301600	7.767200	3.883600
kitchen	58.254000	19.418000	9.709000
stair room	34.952400	11.650800	5.825400
basement	699.048000	233.016000	116.508000
study room	46.603200	15.534400	7.767200

The cost appeared in the above table is for a house functioning 70% of the year's days 8 hours per a day as R6 regulation states. By using the proposed dimension and the numbers of rooms of Kuwaiti's house, we can calculate the actual total cost per a year for each type of bulb.

It appears, as in the table and flow-chart below; the cost of incandescent bulbs are the most costly (2085.5 Kd) as LED bulbs are less in cost (347.6 Kd). CFL bulbs costs 695.16 Kd, it is 66.6 % less than incandescent bulbs cost. LED bulbs are 84.3 % less than incandescent bulbs and 50% less than CFL bulbs in cost wise.

Description	Rooms number	Incandescent bulb	CFL bulb	LED bulb
		Room number* Actual Cost	Room number* Actual Cost	Room number* Actual Cost
living room	12	419.4288	139.8096	69.9048
bathroom	12	93.2064	31.07	15.53
bedroom	12	279.6192	93.2064	46.6032
kitchen	5	291.27	97.09	48.545
stair room	2	69.9048	23.3016	11.6508
basement	1	699.048	233.016	116.508
study room	5	233.016	77.672	38.836
total cost		2085.4932	695.1644	347.5822



IV. CONCLUSION

The result of the study insures that LED bulbs are most efficient than Incandescent light and Compact Florescent Light CFL bulbs. Where it save more money in converting the same amount of electricity into visible light.

REFERENCE

- [1]. The regulation of distribution and installation rules (R6), [1] of the ministry of water and electricity in Kuwait for the year 2014.