ENERGY CONSERVATION MEASURES FOR MSIT HOSTEL

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***Abstract*— The adequate and right kind of energy is necessary for the sustainable development of human society. Due to ever increasing rise in demand take necessary steps to bridge the gap between supply and demand. The paper focuses on the process of energy audit carried out in academic institution in order to suggest various conservative measures to make consumption more economical. Energy Audit in hostel and mess of Maharaja Surajmal Institute of Technology, Janakpuri, New Delhi has been conducted. Thus in this paper, efforts have been done to augment energy use awareness and encourage energy conservation practices by a thorough analysis of the consumption and wastage of energy through the appliances. The detailed study carried out by us in this paper helped to bring out suggestive measures for no cost mitigation , reduction of environmental pollution and monitoring demand supply gap.**

Keywords—Energy audit,Energy Conservation Measures, Payback Period, Biomass, Load demand

I. INTRODUCTION

The sustainable development of today's society is dependent on adequate amount of energy . Total installed capacity of power stations in India is at 334,146.31(MW) as on February, 2018. India's energy consumption is set to grew 4.2% per year by 2035.Owing to such tremendous use in demand, more emphasis is to be laid on renewable sources of energy. When such huge figures surfaces, it becomes inevitable to conduct energy audits so as to loosen the burden of energy production to a certain extent. Energy Conservation means to use energy efficiently and hence cutting out waste to zero level.

Unlike other energy audits in which the reduction in consumption and various method to cut down the usage will be the main focus areas, this paper deals with the idea of reducing the overall electricity bill by replacing existing devices with those devices which consume less power and are more energy efficient. This paper consists of the complete methodology to conserve energy in best way possible and mainly focuses on implementation of solar water heater and biogas system.

II. LITERATURE REVIEW

Many researchers have done various energy audit in different areas like industry, academic institutions etc. After carefully studying the energy consumption pattern, in NIT, Hamirpur, Sanjay et al, proposed some general recommendations like replacing incandescent bulbs with CFLs and use of motion sensors[1].Besides this energy audit also holds immense relevance in the industries too, as presented by Mukesh K. Saini et al. [2] . The suggestions made in the paper [3] by Kompeli S. et al substantiates the claim in context with financially and technically viable alternatives for reducing energy usage. Moreover, a detailed work on Energy Conservation reiterates the inevitable role of energy in near future and how its conservation holds extreme importance [5]. As far as the results and conclusions are concerned, the reference in [6] point out the significant energy savings with fewer changes and adjustments.

III. DATA COLLECTION AND METHODOLOGY

For the collection of data we have taken in account room wise details of the lighting load, fans, air conditioners, PCs, switches, exhaust load etc. that were present in each floor of the MSIT HOSTEL building, to estimate the present load and the load that can be expanded in the future.

The methodology adopted for this audit was:

- Formation of groups for audit in specific areas for inspections and data collection.
- Observation of daily consumptions of various loads and facilities.
- Identifications and measurements of energy consumptions and other parameters .
- Elaborated calculations with assumptions and comparison.
- Implementation of various kind of energy conservation methods.

Some technical data have been gathered regarding the total load present in the MSIT building which can be analyzed and studied through the pie charts and table given below in table 1 and figure1.

Table 1: Electrical Distribution in Hostel

Electric Load	Quantity in hostel area	Rating	P.F.
Fan	142	80W	0.5-0.7
Tube Light	185	40W	0.5
Socket	147	90W	
Bulb	118	15W	0.5-0.9
Exhaust Fan	32	65W, 70W	0.6-0.7
AC	1	2kW	0.8

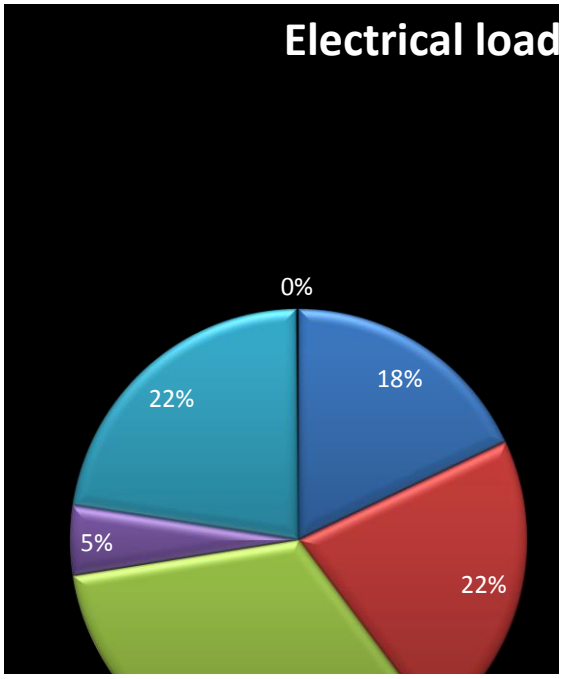

Fig. 1. Electrical Load Distribution in hostel

Measurements were performed in boys hostel and girls hostel and calculations on energy consumptions were done which are tabulated in following table 2 and table 3 respectively.

Table 2:Energy Consumption in boys hostel

Electric Load	Wattage (W)	Qty	Daily hours of use	kWh used in a day	kWh used in a year
Tubelight	40	67	10	26.8	7772
Fan	80	67	17	91.12	16857.2
Bulb	15	67	6	6.03	1748.7
Laptop	60	67	3	12.06	3497.4
Mobile Charger	5	120	6	3.6	1044

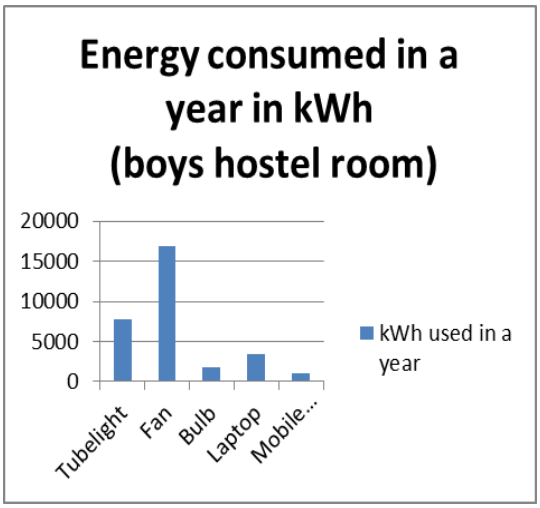

Fig. 2. Energy consumed in a year in boys hostel

IV. MEASUREMENTS PERFORMED

For calculation of energy cost savings and further payback period we first needed to measure the energy consumption in a day and then hence in a year for different areas.

The following measurements and clear view is explained through table and graphs below:

Table 3:Energy Consumption in Girls hostel

Electrical Load	Wattage (W)	Quantity	Daily hours of use	kWh used in a day	kWh used in a year
Tubelight	40	50	10	20	5800
Fan	80	50	17	68	12580
Bulb	15	50	6	4.5	652.5
Laptop	60	50	3	9	2610
Mobile Charger	5	90	6	2.7	783

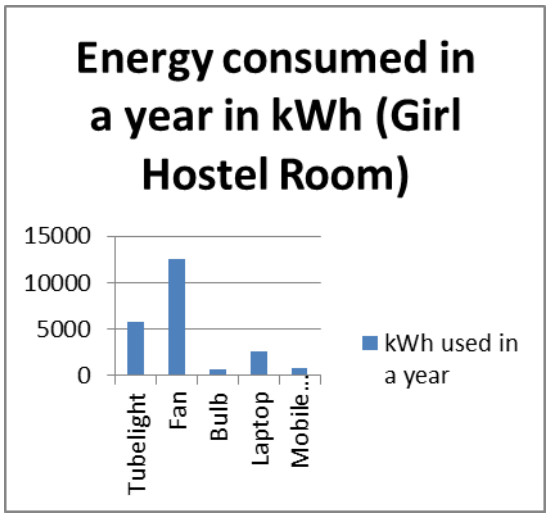

Fig. 3. Energy consumed in a year in girls hostel

Also, further measurements were done in mess to calculate their daily consumptions as shown in table 4.

Table 4:Energy Consumption in Hostel Mess

Electrical Load	Wattage W	Quantity	Daily hours of use	kWh used in a day	kWh used in a year
Tube light	40	28	10.5	11.68	3387.2
Fan	80	16	10.5	13.28	2456.8
Bulb	15	1	24	0.96	278.4
Exhaust	70	2	8	1.12	324.8

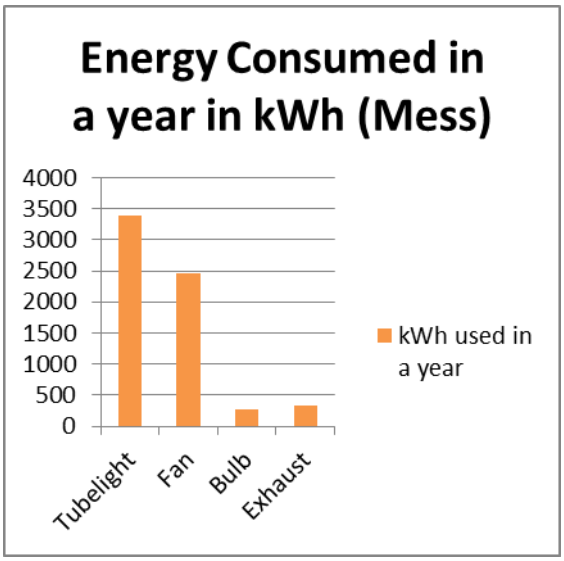

Fig. 4. Energy consumed in a year in hostel mess.

v. ENERGY CONSERVING MEASURES

A. *Current Lightning Scheme in Hostel*

Total number of tubelights:185
Wattage of Tubelight:40W which consume 54W with conventional chokes of 14W
Assumption of operational hours and days: 10 hours and 290 days

Total Energy used in a month = No. of lights x Hours/day * Days in month * Wattage
=185 x 54 x 10 x 290
=28971kWh

i. Replacement of 40 W tubes with 36 W tubes

The 36W tubes consume 50W with conventional choke of 14W
Therefore Total Energy= 185 x 50 x 10 x 290
=26825kWh
Hence Energy saved=2146kWh

Cost of Electricity saved @11.44=24550.24/-
The cost of 36 W is 45,the total investment for replacing 185 tubes will be 8325
The payback period will be as follows:
Payback Period= (8325/24550.24)x12= **4 months**

ii. Using T5 FTL

Characteristics of Conventional 40W:

Expected Life hours is 5000
Energy input per hour is 45 hours
Consumption in 10 hrs per day (kWh) 0.45kWh
Annual Consumption 290 working days(units) 130.5
Annual Consumption(INR) at INR 11.44 per unit 149

Characteristics of T5:

Expected Life hours is 20000
Energy input per hour is 28 hours
Consumption in 10 hrs per day (kWh) 0.28
Annual Consumption 290 working days(units) 81.2
Annual Consumption(INR) at INR 11.44 per unit 929

Savings INR 1493-929=564
Total savings per year considering we replace 185 T8 FTLs with T5 we can save around **INR 104340**
Total investment = 185x400 = INR 74000
Simple payback period is thus calculated to be **8.5 months**

i. Replacement of conventional choke with electronic choke

Calculation of payback period when using electronic choke by comparing it with conventional choke in the following table5.

Table 5: Calculation of payback period using electronic choke

Parameter	Conventional Choke	Electronic Choke
Investment p.a	150x185=27750	220x185=40700
Cost of starters	10x185=1850	-
Net Investment	40700-(27750+1850)=11,100	
Power Rating (W)	(40+14)x185=9990	(40+3)x185=7955
Annual Energy Consumption (kWh)	9990x10x290/1000=28971	7955x10x290/1000=23069.5
Cost of energy@11.4	331428	263915
Net Amount of annual savings	67512	
Simple Payback Period	11,100x12/67512=**2months**	

B. Energy conservation scheme for Fans

Replacement of Rheostatic regulators with electronic regulators

Cost of one electronic fan regulator:180

Duration for which fan is used:16 hours per day

Operational days:200 days
Rating of Fan=80W

Annual energy consumed by a fan=80x16x200=256kWh

If we use electronic fan regulators there is 25% reduction against Conventional Fan Regulators.

So, Annual energy saved will be = 0.25x256
Cost of energy saved=0.25x256x11.44=732.16
Payback Period=Cost of electronic fan regulator/cost of energy saved
= 180/732.16=**0.24 year**

C. Installation of Solar Water Heater system

Residents 250
Assuming an average requirement of 20 L of hot water per day
Thus daily amount of hot water used=250x20 = 5000 L
An average flat plate collector area of 2 m^2 gives 125L of hot water per day.
Thus total collector area required = 5000/125x2 = 20 m^2
Assuming cost of installation to be around 10,000/m^2 total capital cost comes out to be = 200,000
Total geyser if used in the hostel for approximately 12 hrs on a typical cool day for 2.3 kW geysers installed in the hostel then 10x2.3x10= 230 kWh
Geysers will be typically operational in MSIT for about 130 days from November to February. Thus total energy consumption = 130x230= 29,900 kWh

Total expense with geysers = 29,900x11.44 /kWh = 342,056
Thus simple payback period = 200000 / 342056= **0.58 years**

D. Installation of Bio gas plant

Typical waste food density is 30 Kg/m^3
Total volume of waste food per day is about 30 L.
Installation cost of Biogas=1.5Lakhs
Operational and maintenance cost=2000
If 1m^3 of biogas produce 4.6kWh energy
Then we need 5.87m^3 of biogas
Therefore we need an urban bio gas unit of approx.200 kg capacity.
Assumptions-
Calorific value of biogas = 6kWh/m^3 =20MJ/m^3
Calorific value of LPG = 26.1kWh/ kg=46.1MJ/kg
Energy output of biogas plant per day =175 MJ
This implies that LPG saved = 175/46.1=3.79kg = 0.199 LPG cylinders per day
Therefore, LPG saved= 5.99= 6 LPG/month
Total working days = 290 days approximately
Total annual savings = 290x0.199x600 = 34626
Payback period =152000/34626 x12 = **4 years approx.**

VI. RECOMMENDATION AND CONCLUSION

In this paper, efforts have been made to shed light on how we can significantly cut down on energy wastage by making some basic modifications that included.

1. Replacing conventional ballast [chokes] FTL with Electronic Ballasts of high frequency that reduces energy usage by 25%. Also, the capital cost recovery time for replacing is around 2 months.
2. When it comes to lighting, it was found that replacement of 40W tubes with that of 36W, will also serve the purpose. It shall prove very convenient and economical as payback period is only 4 months.
3. Moving further, we also deduced that using T5 FTL instead of T8 can yet be another measure so as to reduce the energy consumption meanwhile improving the luminous efficiency. It's payback period is found out to be 8.5 months which is more then the above mentioned changes.

4. Realizing the vital role of renewable energy sources to tackle any energy crisis, in this paper emphasis have been laid on usage of solar water heating system and installation of biogas plant. In the mess, 6 LPG cylinder per month can be served that will eventually bring down the costs increased.

Energy audit and various efficient tools and technologies that we have introduced in this paper can help bring monumental changes in the energy pattern. The paper has brought out wastage and conservation of energy. It considerably and identifying and addressing the potential of renewable source of energy. It has been shown in table 6 that payback period is relatively less and will compensate the invested amount in a short period of time.

Table 6: Summary of different payback period for different energy saving measures

Energy Saving Measure	Payback Period
Replacement of 40W with 36W tubes	4 months
Using T5 FTL instead of T8	8.5 months
Replacement of conventional chokes with electronic chokes	2 months
Replacement of Rheostatic regulators with electronic one	0.24 year
Installation of Solar Water heating System	0.58 year
Installation of Bio Gas Plant	4 year

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