

Energy Audit of University Polytechnic of RGPV & Boys Hostel

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Abstract

An energy audit has been conducted for a Rajiv Gandhi prouhyogiki vishwavidhyalaya in a section of University polytechnic and boy's hostel. Out of above in University Polytechnic has much load. These are because two reason. Firstly the building is large and secondary there are lots of A. C. In these building luminous level of light is also higher. By energy audit we remove the wastage and improve efficiency. Every countries economy has needed energy. Per capita energy consumption depends upon the standard of country. Now-a-day technology is improved day by day, so increase energy consumption and harmful effect on environment. Lighting is an area where large scope for energy saving. Energy audit is a comparison between actual readings to the standard readings. By Energy audit we can save energy. We can also save energy by energy efficient lamp, housekeeping, and energy efficient motor. [1]

Keywords

Energy Audit, Energy Saving, Energy Conservation, Data Collection, Recommendation

I. Introduction

Energy needed every country for economic development. India has fifth rank in the world for total energy production. The total power production of India 219.5 GW as on December 2013. The capacity of different type of power plant is follow.[2]

Thermal power plant - 130649 MW Hydro power plants
- 45367 MW Nuclear power plants - 5300 MW
Renewable energy sources- 32 GW

An Energy Audit is an inspection, monitoring and analysis of energy flow for energy conservation in any building. Energy audit is also defined as how and where energy is being used or converted from one form to another to identified these opportunities and action plan for energy saving. The energy manager can compare the performance of past and future level for a proper energy management. The main part of energy audit report is energy saving. The energy auditor find out the relative and useful data for energy related and this useful data can be used into energy saving project. Energy manager take action plan and present it to the organization management for approval. [3]

Basically energy conservation is done by changing the human behavior (switch off lights when not used), turning off unnecessary light, maximum use natural lighting, used stair by replacing lift. [3] At least 10% energy cost can be saved if people are more energy conserving. The reduction of energy consumption is called energy conservation but without lower the quality and quantity of production. [3]

II. Types of Energy Audits

Energy audit can be classified in three ways.

- i. Walk Through Audit
- ii. Mini Audit
- iii. Maxi Audit

A. Walk Through Audit

This is simple types of audit; it carries initial survey of building, plant. It is focus on major energy supply and demands. In other words this type of audit a visual inspection of instrument takes place. During walk through audit we have to visit of college and calculate the building, no. Of floors, no. Of classes, how much load is connected in classes (number Of CFL, number of tube light, number of fan, number of A. C., number of computer etc)? It involves activities related to collection, classification,

presentation and analysis of available data. It also involves collection of necessary data, site operation, energy bill and other data and identifies area of energy waste.

B. Mini Audit

Mini audit is also called general energy audit or complete site energy audit. It is one step leading of walk through audit by collecting more details information about facility operation and performing a more detailed evaluation of energy conservation measure identified. This type of audit is conducted for detailed survey and measurement of system. Major focus is made on energy loses measure and quantification to analyse energy efficiency of system. Generally some actions are taken in this method.

01. Switching off lights and fans when not required.
02. Detection out golden ECOs which involves higher energy wastage cost.
03. Placing of automatic thermostat to control temperature and water heater etc.

This type of audit will be able to identify all energy conservation measure for its operating parameter.

C. Maxi Audit

Maxi audit is also called detail energy audit. This is thorough audit than the previous types of audit. Detailed survey of system as well as subsystem of a college is done. In this type of audit computer simulation take place. It covers idea of energy input for different process, collection of past data on production level and specific energy consumption.

It provides a model of energy used both facility and energy conservation measure identified. This type of audit also identifies the consumption of secondary energy like electricity, steam, gases etc. In this type audit reduce energy cost, consumption for the product manufactured. It should be 8 to 10 percent savings. [4]

III. Some Element of Energy Audit

The energy audit process start by assembling useful information about operation and its past record of electricity bill. This data are useful waste energy as well as reduce energy cost.

- i) Auditors energy audit instrument: To find the best data from control program the auditor should take some measurement during the visit. The instruments are luxmeter, power analyzer, ammeter, voltmeter, tong tester etc.

- ii) Ready for audit visit: The auditor should have some overture works before energy audit. Some argument must be needed are layout, geographical location, equipment list, energy use data, safety of energy auditor and audit team.
- iii) Conducting the audit: During the conducting of audit the energy auditor visit the field on the basis of electricity bill and equipment. After that the energy auditor takes meeting with maintenance manager and audit team and discuss about correct information on equipment and operation.
- iv) Walk through audit: In walk through audit the auditor visit the site. During walk through audit the auditor visually check the lighting HVAC system, electrical motor, water heater and peak equipment load.
- v) Detailed audit: The energy auditor should be examined, organized and reviewed after collected data.
- v) Energy audit report: After detailed energy audit the energy auditors next step is prepare a report in which detailed the final result and testimonial. The report should begin with executive summary in which provide manager of facility with total saving and highlight deficiency.
- vi) Energy action plan: The final step in energy audit process is an action plan. The energy action plan list involves the ECOs which should implement and suggest overall implementation schedule.

IV. Energy Conservation Recommendations

- i) All interior walls should be painted using enameled paint which would reflect light.
- ii) Replace fluorescent lamp by CFL, because its facility is easy and free from labour charge.
- iii) Replacement of CRT monitor by LCD monitor not only gives the cost benefit but also play significant role of radiation due to high potential.
- iv) Good light ventilation and air ventilation to classroom may solve the problem of energy waste.
- v) All air conditioning rooms should be air light and door should be hydraulic closing system.
- vi) We can energy save by replacing LCD desktop with LAPTOP, because its benefits are portability, space saving and less maintenance cost compare to desktop.
- vii) Use good lighting system will reduce the power loading on the whole system.
- viii) Fans which are running without capacitor or under rated capacitor may draw more current so use correct rated capacitor which reduces the power consumption.
- ix) Photocopiers machine when not in working condition switch off the main electric outlet.
- x) In any institution or plant the workers/employees are advised to use only cotton clothes (white or relatively white) in summer. Therefore they can avoid too much sudation and energy save about 10- 20 percent.
- xi) Use focused light or table lamp for reading. Sometimes avoid full room lighting it increase the wastage of illumination and disturbance of sleep to other people, which cause reduce human efficiency and lead to health problem. [5]

V. Methodology

The purpose of RGPV (University polytechnic & boys hostel) survey is to determine general condition of institution with respect to energy performance and the institutional and potential motivation to improve the institutes Energy performance. This

energy audit aimed at detailed idea about various end use energy consumption activities and identifying enumerating and evaluating the possible energy savings opportunity.

A. Survey of University Polytechnic

1. First floor

Room no.	Room Area	Working Lumen	Total Load
Conference hall	20mX15m	L off=220 L on=430	Fan=12, AC=3 Tube light=40 CFL(18w)=30 Computer=2(LCD)
203	6.3mX4.3m	L off=60 L on=100	Fan=2,AC=1 TL=8,computer=1 (LCD) Printer=1
204	9.4mX6.3m	L off=203 L on=230	Fan=2 TL=2
205	9.4mX6.3m	L off=229 L on=259	Fan=4 TL=7,AC=1
206	9.4mX6.3m	L off=290 L on=340	Fan=4 TL=5
207	9.2mX9m	L off=98 L on=142	Fan=6 TL=16,AC=2
208	9.6mX9m	L off=75 L on=110	Fan=5 TL=14,AC=2 CFL(36W)=3
Gallery	34.9mX2.7m	L off=9 L on=120	TL=5 CFL(36W)=3

2. Survey of first floor

Room no.	Room Area	Working Lumen	Total Load
Confer-ence hall	20mX15m	L off=220 L on=430	Fan=12, AC=3 Tube light=40 CFL(18w)=30 Computer=2(LCD)
203	6.3mX4.3m	L off=60 L on=100	Fan=2,AC=1 TL=8,computer=1(LCD) Printer=1
204	9.4mX6.3m	L off=203 L on=230	Fan=2 TL=2
205	9.4mX6.3m	L off=229 L on=259	Fan=4 TL=7,AC=1
206	9.4mX6.3m	L off=290 L on=340	Fan=4 TL=5
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Gallery	34.9mX2.7m	L off=9 L on=120	TL=5 CFL(36W)=3
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3. Percentage distribution of university polytechnic

The loads were segregated based on end use as lighting and fans, air conditioning, computer, printer etc. The details are given below.

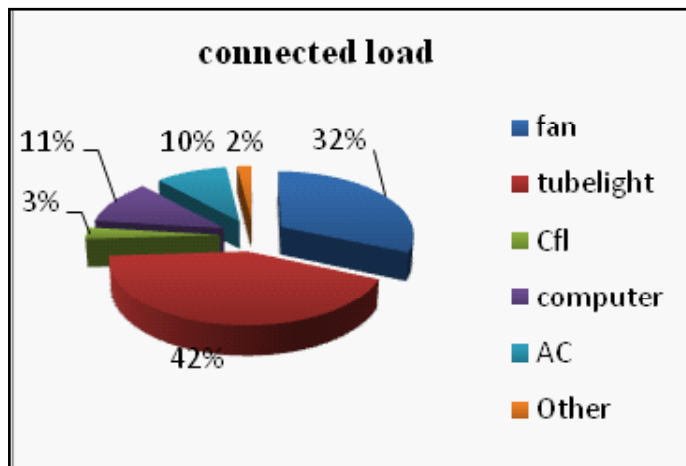


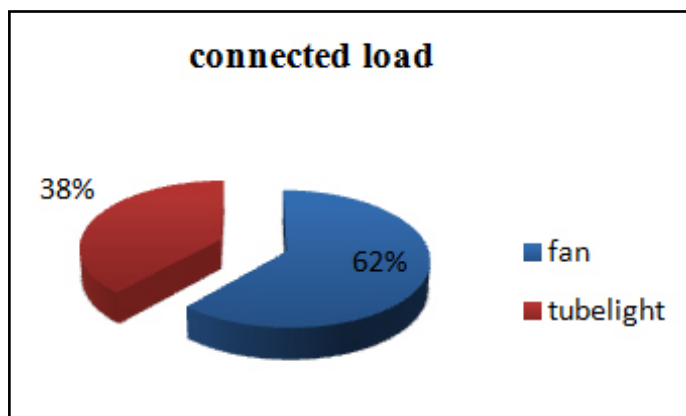
Fig. 1 : show the total connected load of University polytechnic

B. Boy's Hostel

There are 96 rooms of same size in boy's hostel. It has also same the total load and working lumen.

Room no	Room Area	Working Lumen	Total load
-	3.6mx2.7m	L off=51 L on=116	Fan=1 Tube Light=1

Total load of boys hostel (fan + tube light) = 96x80W +96x50W=7680+4800=12480Watt



VI. Energy saving Calculations

A. Energy saving by replacing tube light by CFL

1. Energy saving cost estimation of full load

Total no. Of lamp =236
Actual wattage of tube light with choke =50W
Energy consumed by TL for operating of 10 hours per day =236x50x10 =118000 watt-hours
Energy consumed by TL for operating of 10 hours per month

=118000x24 working days
= 2832000W-h
=2832 kWh
Energy cost per day (1kWh = Rs 5.15)
Monthly energy consumed cost by TL =Rs. 5.15X2832 = Rs14584.8
Yearly energy consumed cost by TL =14584.8x12 =175017.6/-

2. Energy saving by replacing the CFL of equal similarities of tube light

13 watt CFL can give an illumination o/p=800 lumens
40 watt TL can give an illumination o/p=2400 lumens
Therefore no. Of 13 watt CFL required to get The illumination level =3
45 watt of CFL= 50 watt of TL in term of illumination o/p(the actual wattage of 13 watt CFL=15 watt with choke
The power consumption of CFL =15x3 =45 watt
Hence total wattage of TL =236x50 watt =11800 watt
No. Of CFL required to replace all TL at the rate of 13 wattx3, 39 watt CFL= 50 watt TL =11800/39 watt =302
Power saving by CFL replacement =302x11 watt =3322 watt
Energy consumption from CFL for an operated average hour/day for 12 hours =3322wattx12 hours =39864W-h
Daily cost energy consumption by CFL =39.86x5.15 kWh = Rs 205.27/-
Monthly energy cost saving due to CFL =Rs 205.27x24 days =Rs 4926.69/-
Yearly energy cost saving due to CFL =4926.69/- x12 =59120.35/-
Payback period calculation:
Investment on 1 CFL of 13 watt =Rs. 90/-
Total cost of replacement =Rs 302x90 =Rs.27180/-
Payback period =27180x12/59120 = 5 month 16 days

B. Energy saving by replacing desktop of CRT monitor with LCD monitor

Computer with CRT monitor of 400 watt
Total no. Of system = 60
Total power consumption = 60x400 =24000 watt =24 kW
Total energy consumption= power consumption x operating hours/day =24x8 kWh =192 kWh
Energy cost /day =192x5.15 =Rs.988.8/-
Total annual energy cost=energy cost/day x no. Of days

=Rs. 988.8x288
= Rs.284774.4/-
Computer with LCD monitor of 250 watt
Total power consumption = 60 x 250
= 15000 watt
=15 kW
Total energy consumption / day =15 x 8 hours
=120 kWh
Energy cost/day =120 x 5.15
=Rs.618/-
Total annual energy cost =Rs 618 x 288 days
=Rs 177984/-
Annual cost saving = Rs (284774.4-177984)
=Rs 106790.4/-

C. Energy saving by changing the location of classroom

Second and third floor classroom are better balance of more light and airs.
Number of classes to be relocated= 7
Total no. Of operating hours / week =6 hours x 6 days =36 hours
Energy consumption/ week /classroom=hours x lights x watts
= 36 x 8 x50
= 14400Wh
Energy consumption /week for 7 classrooms
= 7 x 14400Wh
=100800Wh
Total annual energy consumption from lighting for 7 classrooms=weekly consumption x no. Of weeks
=100800 x 42 weeks
= 4233600Wh
= 4233.6kWh
Saving cost from lighting = 4233.6 x Rs 5.15
=Rs 21803/-
Energy consumption by fan load/week/classrooms =36x6x80
(Assume 1 fan=80 watt) = 17280Wh
Energy consumption by fan /week for 7 classrooms =7x17280Wh
=120960Wh
Total annual energy consumption from fan load for 7 classrooms =120960x42 weeks
= 5080320Wh
=5080.32kWh
Saving cost from fan load=5080.32x5.15
=Rs 26163.64/-
Total annual energy cost saving from lighting and fan load =21803+26163.64
=Rs. 47966.64/-

D. Energy saving by remote controlled fans

1. Remote controlled fan verses conventionally controlled fan

Energy saving by controlled fan and conventionally controlled fans=80w x operating hours (per day per fan) =80w x 8 hours/day
= 640Wh/ day/fan
Energy cost /day/fan = 0.64x5.15
= Rs.3.296/-

Cost of energy consumption for 192 fan /day
=3.296/- x 192
=Rs 632.83/-
Annual cost of energy consumption by regular controlled fans =Rs 632.83 x 288 days
=Rs 182255.6/-

6.4.1) Remote controlled fan can be operating based on user requirement may reduce the operating time

Let us operate the fan on need basis as remote control is available. It will reduce the operating hours (Assume that the wattage is same)

= 80w x 6 hours
= 480Wh/day
= 0.48kWh/day
= 0.48 x Rs 5.15
= Rs 2.472/-/day
Annual energy consumption by remote controlled fan = 2.472 x 192 x288
= Rs 136691.7/-
Cost saving =182255.6-136691.7
=Rs 45563.9/-
Total cost of additional unit remote operating switch = Rs 400/- x 192
=Rs 76800/-
Payback period =76800x12/45563.9
=1 year 8 month 6 days

VII. Summary of Energy Disbursement Based On Monthly And Annual Substitute Bills

Way of energy saving	Saving cost in Rs.	Investment cost in Rs.	Payback period
Replacing Tube Light by CFL	27180	59120	5 months 16 days
Replacing CRT desktop with LCD monitor	106790.4	284774.4	4 months 15 days
Changing the location of classroom	47966.64	NIL	NIL
Using remote controlled fan	45563.9	76800	1year 8months 6 days

VIII. Conclusion

After the survey of RGPV (Polytechnic and boys hostel) we have observed that some department has unnecessary electricity is used. After the audit we compare the standard data to the measuring data. This data are used to save energy. Energy wastage can be reduced by simply human behavior change such as switching off light and other equipment when not used. Because a famous quote "Energy saved is energy generated". Due to increasing of population electricity demand is increased and that case putting stress on power system. The data provided in this paper shows that how we can save electrical energy by change efficient.

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