

যাদবপুর বিশ্ববিদ্যালয়
কলকাতা - ৭০০০৩২, ভারত



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Ref. No.

Dated.....

ENERGY AUDIT CERTIFICATE

This is to certify that an Energy Audit for "Gurudas College", 1/1, Suren Sarkar Rd, Jewish Graveyard, Phool Bagan, Narkeldanga, Kolkata, W.B., Pin — 700054 has been conducted in March-April 2023 to assess energy costs, availability and reliability of supply of energy, energy conservation technologies and ways to reduce energy consumption.

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BEE CERTIFIED ENERGY AUDITOR
REG NO: FA-34982/23

Place: Gurudas College, Kolkata
Date: 20th April 2023

July 2022- April 2023 Report on Energy Audit

At

Gurudas College
Kolkata, WB

Prepared For

Gurudas College

1/1, Suren Sarkar Rd, Jewish Graveyard, Phool Bagan,

Narkeldanga, Kolkata, West Bengal 700054

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Executive Summary

In this century energy plays a major role in deciding the cost of products and at the same time detecting the installation and the debt burden. In addition to this energy cost also influences in factors like land and labour. In the present situation with huge need of energy, we all must also take an active role for energy conservation, so that we can meet the demands of shortage of energy when needed, which once again tickle us to take effective measures to consume less energy as much as possible. One of the possible attempts which we can think of is an energy audit to identify all the energy streams in the systems and quantifies energy usages according to its discrete function.

One of the most popular systematic approaches for deciding in the area of energy management is **Energy Audit**. Energy Auditing is a tool for identifying energy efficiency potential and measures. An energy audit is an important tool or method for finding such potentials for energy efficiency measures and for assessing their financial viability, which can be carried out at different levels. It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions.

The energy audit will help for the following points.

- Energy cost reduction.
- Preventive maintenance and quality control programmes which are vital for production and utility activities.
- Keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on an appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. The present report shows the energy audit of Gurudas College, Kolkata campus in terms of pre-audit phase, audit phase and post audit phase.

I.Executive Summary

Project

ENERGY AUDIT

Client

GURUDAS COLLEGE

1/1, Suren Sarkar Rd

Jewish Graveyard, Phool Bagan

Narkeldanga, Kolkata

West Bengal 700054

Site

GURUDAS COLLEGE

1/1, Suren Sarkar Rd

Jewish Graveyard, Phool Bagan

Narkeldanga, Kolkata

West Bengal 700054

Segment

Academic Institute

Consultants

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Mr. Ayandeep Ganguly

(BEE Certified Energy Auditor)

Project Reference

GSC/81/23

Site Details

Gurudas College, established in 1956, is an undergraduate college affiliated to the University of Calcutta. The defining characteristics of the college were formed both by its history and geography. The name commemorates the legacy of Sir Gurudas Banerjee, the first Indian Vice-Chancellor of the University of Calcutta, tireless champion of the spread of education and resident of the historic Narkeldanga neighbourhood. It has been more than 60 years since that time, and the college has grown into a full-fledged institution with a sprawling campus constituting of three buildings (with another under construction) and a well-stocked library with modern equipment. It now offers undergraduate courses in 20 subjects. 18 of these departments offer Honours programmes. Three departments (Bengali, Zoology and Physics) offer Postgraduate programmes. This year, the college has successfully rolled out the Choice Based Credits System (CBCS) in undergraduate studies.

Project

Energy Audit of the facility of **Gurudas College**

Notes

The suggestions / alternatives in the audit report are based on the present operating conditions of equipment's/systems and to the best of our knowledge.

It is recommended to obtain vendor quotations before implementation.

II. Energy Scenario

Table. I

| Particulars | Details | | | |
|--|-----------------------------|--------------|-------------|-------------|
| Year | 2022-2023 | | | UNIT |
| Supply Utility | CESC | | | |
| Consumer No. | 28000302830/ 28000072211 | 85000055462 | 28000247621 | |
| Tariff Code | Rate P | Rate G | Rate G | |
| | | | | |
| Contract Demand | 70.4 | 39 | 11.8 | kVA |
| Connected Load | 384.284 | 26.4 | 35.802 | kW |
| Demand Charges | 28 | 28 | 28 | Rs. Per kVA |
| Avg. Energy Charges | 6.63 | 6.745 | 8.878 | Rs. Per kWh |
| Energy Consumption of the Institution for the year from CESC | 70316 | 14746 | 19600 | kWh |
| Cost of Energy received from CESC | 4.66 | 0.995 | 1.74 | Rs. (lakh) |

III. Summary of Energy Savings Proposals

Table II

| Sl. No | Energy Conservation Measures | Annual Savings | Annual Savings | Investment | Payback |
|--------|--|----------------|----------------|------------|---------|
| | | kWh | Rs. Lacs | Rs. Lacs | Months |
| ESM 1 | Replacement of Fan by Energy efficient Fan | 36073 | 2.39 | 6.87 | 34 |

1. Introduction

An energy audit is an inspection survey and an analysis of energy flows of energy conservation in a building. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output.

2. Energy Audit

As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".

There are three phases of Energy Audit

1. Pre-audit phase
2. Audit phase
3. Post audit phase

Above phase includes following stages

1. **Data Collection** – In the primary stage of collection of exhaustive data was mainly implemented using measures such as observation, survey communicating with responsible persons and measurements.

Following steps were taken for data collection:

- A squad went to the respective department, Central Library, Admin Blok, Student hostel, faculty quarters, pump operating stations, canteens, DG unit blocks etc.
 - Data was acquired from the responsible persons through general information observation and interview.
 - In some of the cases average values were considered in case of power consumption of different appliances.
2. **Data Analysis** – Analysis of data collected include:
 - calculation of energy consumption,
 - analysis of latest electricity bill of the campus,
 - Understanding the tariff plan provided by the West Bengal State Electricity Board.
 - Water supply data was also included in the calculation to maintain the accuracy of the calculation as far as possible.
 3. **Recommendation** – Based on the results of the data analysis and observations presented, some recommendations are put forward which will help to reduce power and water consumption. Waste water treatment and as well as utilization of rain water were also suggested for betterment.

The above target areas particular to the college was evaluated through questionnaire circulated among the students for data collection. Some the major points which is included in the questionnaire is given below.

2.1 Pre- Audit Phase

2.1.1 Questionnaire for data Collection-Survey

1. Different ways through which energy is consumed at your college. (Electricity, electric stove, kettle, microwave, LPG, Petrol, diesel and others).
2. Amount of Electricity bill paid for the last five year
3. Amount paid for LPG cylinders for last five year
4. Amount of fuel consumed for DG for the last five years
5. Energy saving methods employed in your college? If yes, please specify. If no, suggest some
6. What is the total number of CFL installed in your college? Mention use (Hours used/day for how many days in a month)
7. Energy used by each bulb per month? (for example- 40-watt bulb x 6 hours x number of bulbs = kwh).
8. How many LED bulbs are used in your college? Mention the use (Hours used/day for how many days in a month)
9. Energy used by each bulb per month? (Kwh).
10. How many incandescent (tungsten) bulbs have your college installed? mentions use (Hours used/day for how many days in a month)
11. Energy used by each bulb per month? (Kwh).
12. How many fans are installed in your college? Mention use (Hours used/day for how many days in a month)
13. Energy used by each fan per month? (kwh)
14. How many air conditioners are installed in your college? Mention use (Hours used/day, for how many days' in a month)
15. Energy used by each air conditioner per month? (Kwh).
16. How many electrical equipment's including weighing balance are installed your college? Mention the use (Hours used/day for how many days in a month)
17. Energy used by each electrical equipment per month? (Kwh).
18. How many computers are there in your college? Mention the use (Hours used/day· for how many days in a month)
19. Energy used by each computer per month? (kwh)
20. How many photocopiers are installed by your college? Mention use (Hours used/day for how many days in a month).
21. How many cooling apparatuses are in installed in your college? Mention use (Hours used/day for how many days in a month)
22. Energy used by each cooling apparatus per month? (kwh)Mention use (Hours used/day for how many days in a month)
23. Energy used by each inverter per month? (kwh)
24. How many electrical equipment are used in different labs of your college? Mention the use (Hours used/day for how many days in a month)
25. How many heaters are used in the canteen of your college? Mention the use (Hours used / day for how many days in a month)
26. Energy used by each heater per month? (kwh)
27. No of street lights in your college?
28. Energy used by each street light per month? (kwh)
29. No of TV in your college and hostels?
30. Energy used by each TV per month? (kwh)
31. Any other item that uses energy (Please write the energy used per month) Mention the use (Hours used/day for how many days in a month)
32. Do you run "switch off' drills at college?
33. Are your computers and other equipment put on power-saving mode?

34. Does your machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby mode most of the time? If yes, how many hours?
35. What are the energy conservation methods adapted by your college?
36. How many boards displayed for saving energy awareness?
37. How much ash is collected after burning fire wood per day in the canteen?
38. Write a note on the methods/practices/adaptations by which you can reduce the energy use in your college campus in future.

2.2 Audit Phase

Energy auditing was done at Gurudas College, with the help of a team of teaching staff. To begin with the audit, teachers team went through different departments of the college, sorting out the different types of energy consuming equipment and utilities (fan, lights, taps, toilets, heater, pumps, water purifiers, fridges, etc.) and as well as consumption of power by reading the rating plate of the items (voltage, current, watts etc.). They were also engaged in identifying the consumption pattern (how long and how often it is used). The details of the power consumption of the items were noted through rigorous discussion and information exchange among the team and the respective teaching staff of the department. Teaching staffs along with the audit team also visited the admin blocks to identify and monitor the power consuming equipment. Enough checking was done in the calculation portion by the team to maintain the accuracy of the calculation as far as possible.

2.2.1 Data Collection

Energy consumption data was collected and recorded for calculation from college records and sectors where energy is consumed. The documents were verified repeatedly and examined through survey and discussion to maintain the clarity of the data collected. The whole energy audit process was completed from July 2022 to April 2023.

2.2.2 Site Tour

In the energy audit process, the site inspection was done with the audit team and along with some student and administration personnel. Doubts and various questions raised during the site inspection was put as questionnaires, later on the answers of these questions were collected from a general survey and therefore the data were maintained for different calculations of the energy audit.

2.2.3 Review of Documents and Records

Documents such as electricity bills, registers of electricity, fuel consumption were collected and reviewed.

2.2.4 Site Inspection

To gather information and exact data for energy audit the team visited the institute and its premises several times. Total number of grounds, gardens, canteens, library, office rooms and etc. were visited a number of times to accumulate the data. During the site inspection leakage of any water pumps, taps were immediately reported to the college authority.

2.2.5 Energy Sources and Consumption Areas in Gurudas College

At Gurudas College campus there are total 3 blocks, Main Building block, Commerce Building block and Library Building block.

2.2.5.1 Energy sources

One transformer of capacity **400 kVA** (step down to 420V), has been installed at Gurudas College campus for distribution of power after receiving from CESC at 6 kV and to meet different requirements.

Transformer Details

Table III

| Particulars | TR-1 |
|----------------------|--|
| Make | BRENTFORD (Repaired by KVA PROCESS TRANSFORMERS PVT. LTD.) |
| Rating kVA | 400 |
| Voltage Ratio kV/V | 6/420 |
| Current Ratio | 38.5/549.8 |
| Phase | 3 |
| Frequency (Hz) | 50 |
| Cooling | ONAN |
| Sl.No. | 66.119 |
| Percentage Impedance | 4.86% |
| Year of Repair | 08/2020 |

When power cut occurs, Gurudas College supplies power to fulfil demands with help of generator which runs on diesel as fuel

Generator - **45 KVA x 1 Nos.**

Power efficiency of generator is 90%

Diesel Generator Details-

Table IV

| DG | 1 |
|------|-----------|
| Make | KIRLOSKAR |

| | |
|---------------------------|------------------------|
| M/C No. | DS3C013D:168323 |
| Rated kva | 45 |
| Rated Load current | 62.6 |
| Rated voltage | 415 |
| Rated frequency | 50 Hz |
| Rated RPM | 1500 |
| EXC. Amp | 3.4 |
| EXC. Voltage | 42 |

2.2.5.2 Energy Users-
a. AC Capacity and Location

Table V

| Sl. No. | Location | Room Name/No | AC | Qty(Window) | Qty(Split) |
|----------------|-----------------|-------------------------|-----------|--------------------|-------------------|
| 1 | Main Building | | | | |
| | 3rd | Math | 1.5TR | 3 | |
| | | Zoology | | 2 | |
| | | Microbiology | | 3 | 1 |
| | 2nd | Zoology Instrument Room | | 2 | |
| | | Biochemical | | 1 | |
| | | Botany | | 1 | |
| | | Zoology | | 1 | |
| | 1st | Physics | | 2 | |
| | | Staff Room | 2TR | | 3 |
| | | IQAC | 2TR | | 1 |
| | | Office | 1.5TR | 2 | |
| | | Cash | 1.5TR | 1 | |
| | | Head Clerk | 1.5TR | 1 | |
| | | Accounts | 1.5TR | 1 | |
| | | Computer Lab | 1.5TR | 2 | |
| | | ICT Classroom | 2TR | | 2 |
| | | Principal's Room | 1.5TR | 2 | |
| | Gr. Floor | G1 | 2TR | | 4 |
| | | Chemistry | 1.5TR | 1 | |
| | | Chemistry Staff Room | 1.5TR | 1 | |
| | | Bengali | 1TR | | 1 |

| | | | | | |
|---|-------------------|------------|-------|---|----|
| 2 | Commerce Building | | | | |
| | Gr. Floor | Union room | 1.5TR | | 1 |
| | 2nd Floor | Staff Room | 1.5TR | 2 | |
| 3 | Library Building | | | | |
| | 1st Floor | Library | 1.5TR | 3 | 13 |
| | Gr. Floor | Media Lab | 2TR | | 1 |

b. Installed Submerged Pump Load

Table VI

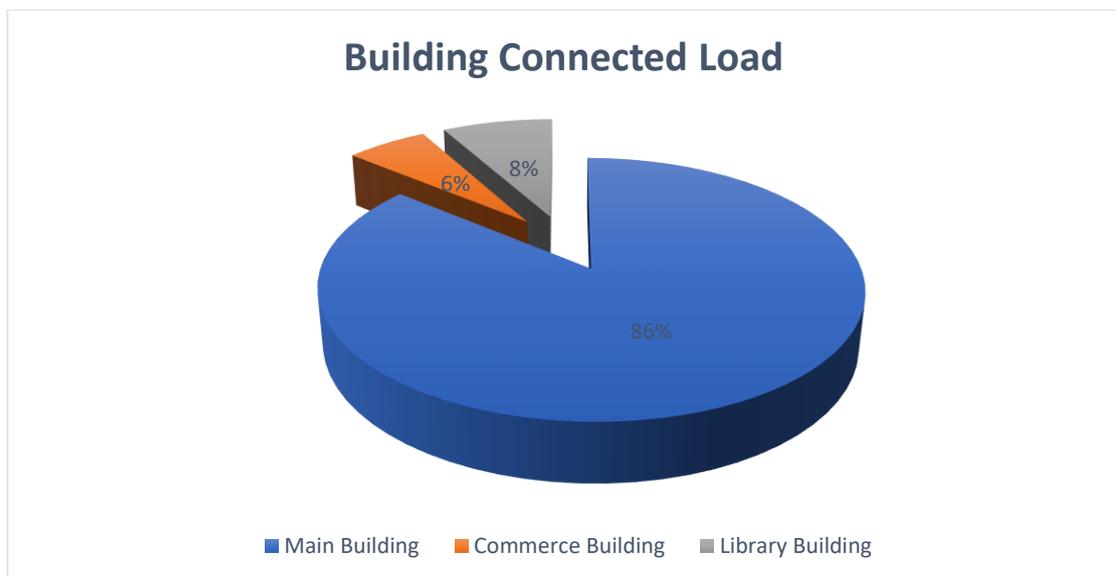
| Sl. No. | Location | HP | Qty |
|---------|-------------------|----------------|-----|
| 1 | Main Building | 3.5 | 1 |
| | | 5 | 1 |
| 2 | Commerce Building | 1 | 1 |
| 3 | Library Building | 1.5 | 1 |
| | Total | 11HP = 8.25 KW | |

c. Total Connected Load (Building)

Table VII

| Sl. No | Connected Load (in KW) | |
|--------|------------------------|---------|
| 1 | Main Building | 384.284 |
| 2 | Commerce Building | 26.4 |
| 3 | Library Building | 35.802 |

Figure I

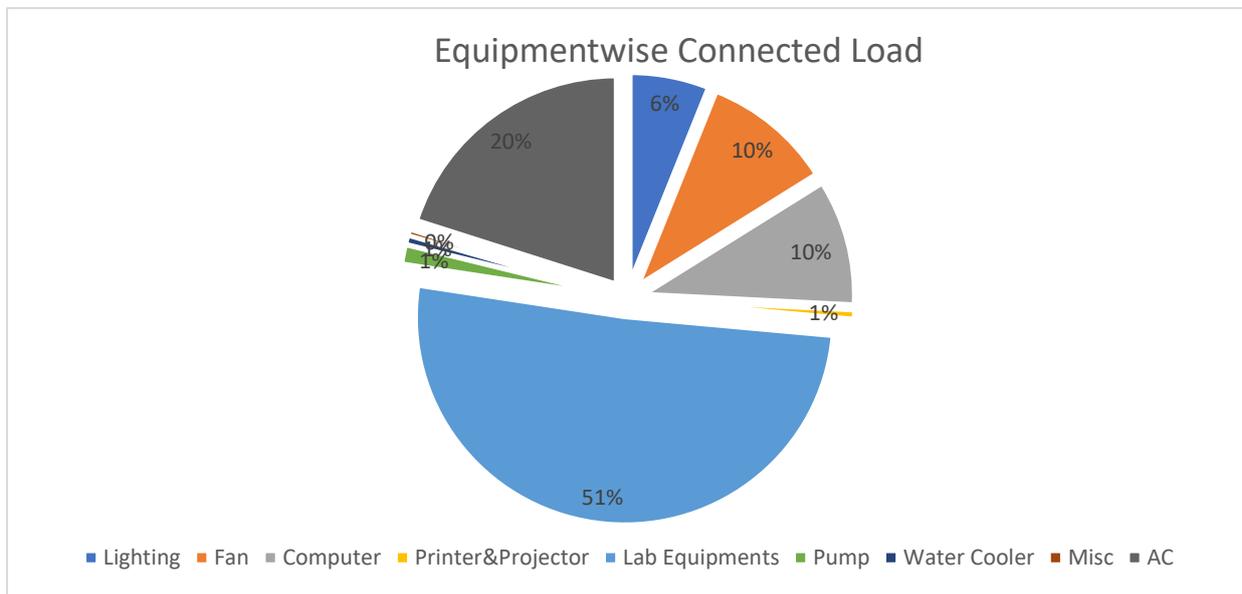


d. Total Connected Load (Equipment)

Table VII

| Sl No | Item | Capacity (KW) |
|-------|--------------------|---------------|
| 1 | Lighting | 34.672 |
| 2 | Fan | 57.5 |
| 3 | Computer | 55.8 |
| 4 | Printer& Projector | 3.7 |
| 6 | Lab Equipment | 292.324 |
| 7 | Pump | 8.25 |
| 8 | Water Cooler | 3.75 |
| 9 | Misc. | 2.47 |
| 10 | AC | 115 |

Figure II



2.2.5.3 Energy consumption Pattern

Energy consumption is shown in table

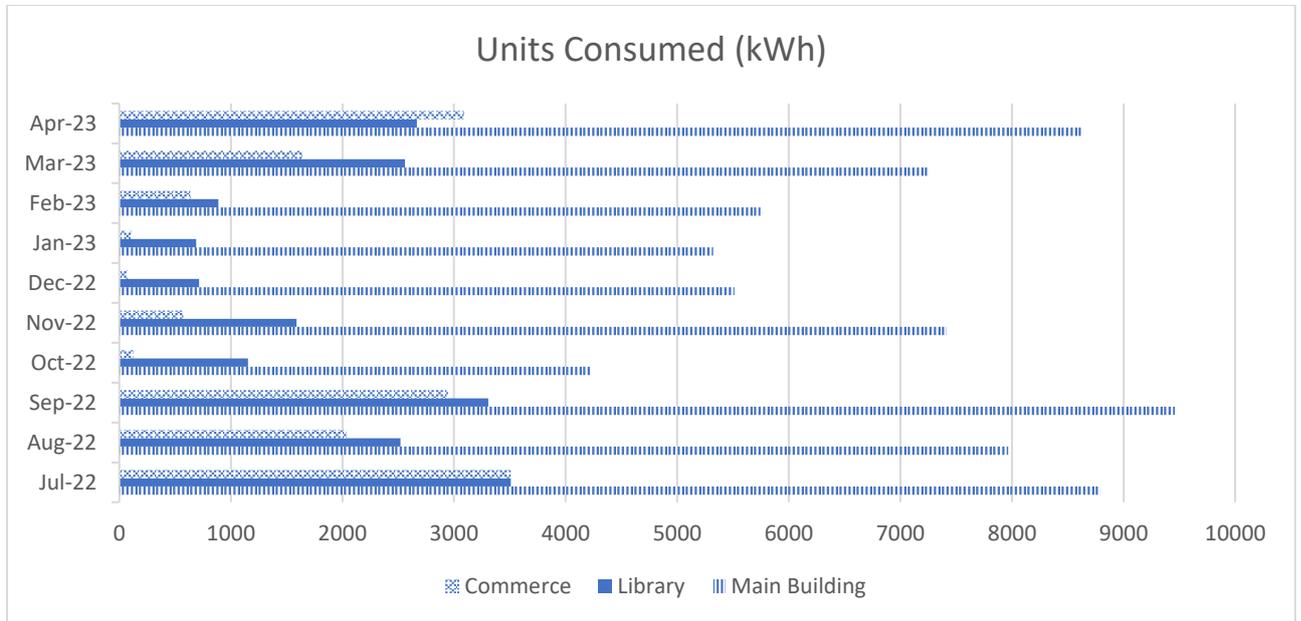
Energy Consumption

Table 1

| Month/Year | Main Building | | Library | | Commerce | |
|------------|---------------------|--------------------------|---------------------|---------------------|---------------------|--------------------|
| | Units Consumed(kWh) | Unit Price @ Rs 6.63/kWh | Units Consumed(kWh) | Unit Price @ Rate G | Units Consumed(kWh) | Unit Price @Rate G |
| Jul-22 | 8788 | 58264.44 | 3508 | 31657.83 | 3508 | 26176.11 |
| Aug-22 | 7965 | 52807.95 | 2520 | 22558.35 | 2036 | 31657.83 |
| Sep-22 | 9458 | 62706.54 | 3308 | 29815.83 | 2948 | 18100.71 |
| Oct-22 | 4222 | 27991.86 | 1154 | 9977.49 | 126 | 1350.15 |
| Nov-22 | 7416 | 49168.08 | 1590 | 13993.05 | 574 | 1030.11 |
| Dec-22 | 5514 | 36557.82 | 716 | 5943.51 | 74 | 543.05 |
| Jan-23 | 5321 | 35278.23 | 688 | 5685.63 | 108 | 10.36 |

| | | | | | | |
|-----------------------|-------|----------|-------------|----------|-------------|----------|
| Feb-23 | 5745 | 38089.35 | 888 | 7527.63 | 640 | 894.65 |
| Mar-23 | 7255 | 48100.65 | 2560 | 22926.75 | 1640 | 5243.55 |
| Apr-23 | 8632 | 57230.16 | 2668 | 23921.43 | 3092 | 14453.55 |
| Total | 70316 | 466195.1 | 19600 | 174007.5 | 14746 | 99460.07 |
| Avg Charges (INR/KWh) | 6.63 | | 8.877933673 | | 6.744884714 | |

Figure III



2.2.6 Key findings and Observations of Energy Usages

The findings of energy audit are verified and supported by documentation and authentic information. The audit procedure pursues, on experimented basis, to keep a track of past schedules, events, dealings and processes to confirm that they are carried out as per the organization necessities and in the accurate method. Energy audit is actually a sum of different events. Since these are individual events but can change over time. Hence, these events are carried out at definite and regular intervals. Analysis and calculations of the audit is done to illustrate the present situation and so as to take necessary steps to change and improve over time. Although necessary precautions are taken during policies, documentations and systems adopted in an energy audit, there will be always an element of biasness. The principle of any energy audit is to track out how well energy management equipment is acting. All of these components are essential in confirming that the energy performance of Gurudas College is actually satisfying the objective set in its energy policy management.

2.2.7 Already existing Power Saving Measures

- When not in use electrical equipment are turned OFF.
- False ceilings in maintaining optimum room temperature in some research and project labs.
- Electronics regulators are in use instead of resistance regulators.

- Fluorescent lamps are being replaced by more efficient LEDs
 - 5kW existing solar power plant.

2.2.8 Recommendations for better Energy Efficiency

After analysing the data presented for power consumption, some recommendations are put forward for improving energy efficiency of the Gurudas College campus. Whatever recommendations are given, to visualize a tentative cost calculation is given to implement which ever necessary. Some of the measures for energy efficiency have been listed.

Defined below are some vital recommendations for improved energy efficiency:

2.2.8.1 *Immediate Replacements*

1. Better practice for AC

The institute has in total 31 window type ACs and 27 split type ACs which takes up huge energy and hence consumes a large part of total energy consumption of the campus. But, at many places it was found that AC is not used with best recommended practices. Some places the insulation level is not taken care of. Curtains are to be used in AC rooms. Some of these practices increases the AC load and hence increase power consumption.

Summarized below are some guidelines for most efficient use of ACs:

- Proper Insulation - Good quality insulation must be maintained in the air- conditioned rooms by keeping all doors and windows closed properly so as to prevent cool air go out and hot air come in.
- Operating - The ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room.

2. House keeping

Curtains - Always keep curtains on windows to prevent direct sunlight inside the room to avoid heating of cooled air. This reduces AC load significantly.

2.2.8.2 *Medium / short term Replacements*

Replacement of fan by energy efficient fan

| Particulars | Unit | Value | Value |
|---------------------------------|-------|--------|--------|
| No. of Fan in Operation | no. | 387 | 71 |
| No. of Fan Suggested to rplace | | | 71 |
| Running Hour More than 6 hour | No. | 387 | |
| Wattage of Existing Fan | Watt | 100 | 200 |
| Wattage of Energy Efficient Fan | Watt | 53 | 53 |
| Savings of Power Per Fan | Watt | 47 | 147 |
| Total Savings in Power | Watt | 18189 | 10437 |
| Total Savings in Power | kW | 18.19 | 10.44 |
| Working Hour Per Day | Hour | 6 | 6 |
| Annual Working Days | Days | 210 | 210 |
| Annual Working Hours | Hours | 1260 | 1260 |
| Savings of Electricity | kWh | 22919 | 13154 |
| Savings of Money @6.63 Per Unit | Rs. | 151953 | 87211 |
| Investment @ Rs.1500/Fan | Rs. | 580500 | 106500 |
| Pay Back Period | Month | 34 | |

2.2.9 Consolidation / Coupling of audit Findings

The communication process for awareness in relation to energy conservation is found adequate.

- Data recording and electrical load calculation has been done by then college.
- Month wise electric usage of college is not very high.
- Preventive measures taken in reducing energy consumption for water and fuel consumption are sufficient
- Old energy consuming equipments have been replaced to some extent but more are required to be replaced by Energy efficient equipment.
- Monitoring of high voltage equipment are regularly done and any problem regarding it is immediately taken care of.

2.3 Post Audit Phase

Follow up and action

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a “bench-mark” for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization. Hence, energy audit is an ongoing process. Effective initiative must be taken to design and upgrade the implementation every year in the college campus to make the environment sustainable.