

**GOVERNMENT POST GRADUATE COLLEGE BERINAG,
PITHORAGARH, UTTARAKHAND 262531**

ENERGY AUDIT REPORT

**For Sessions: 2020-2021 &
2021-2022**




**Submitted to:
IQAC
Government Post Graduate College, Berinag
Pithoragarh
Uttarakhand 262531**

ENERGY AUDIT CERTIFICATE


This is to certify that an "Energy Audit" for Government Post Graduate College Berinag, Pithoragarh, Uttarakhand has been conducted in July 2021 and July 2022 to assess energy costs, availability and reliability of supply of energy, energy conservation technologies and ways to reduce energy consumption.


Place: Berinag

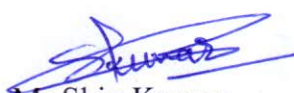
Date: 30th July 2022


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Executive Summary

Energy today has become a key factor in deciding the product cost at micro level as well as in dictating the inflation and the debt burden at the macro level. Energy cost is a significant factor in economic activity at par with factors of production like capital, land and labor. The imperatives of an energy shortage situation calls for energy conservation measure, which essentially mean using less energy for the same level of activity. Energy Audit attempts to balance the total energy inputs with its use and serves to identify all the energy streams in the systems and quantifies energy usages according to its discrete function. Energy Audit helps in energy cost optimization, pollution control, safety aspects and suggests the methods to improve the operating & maintenance practices of the system. It is instrumental in coping with the situation of variation in energy cost availability, reliability of energy supply, decision on appropriate energy mix, decision on using improved energy conservation equipment's Instrumentation and technology.

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. 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 would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on 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 Govt. PG College Campus in terms of pre-audit phase, audit phase and post audit phase.

1. Introduction

In broad sense, Energy Efficiency means economizing on the use of energy without adversely affecting economic growth and development. It includes improving the efficiency of energy extraction, Transmission and Distribution and increasing the productivity of energy use.

Designated consumers

Central Government specifies the following criteria for energy Intensive Industries and other establishments. (As per EC Act 2001, Section 14(e)), for Industries Electrical connected load - 5000 K\W and above Designated Consumers to get energy audit by Accredited energy audit firms

Bureau of Energy Efficiency (BEE)

The Bureau of Energy Efficiency is an agency of the Government of India, under the Ministry of Power created in March 2002 under the provisions of the nation's 2001 Energy Conservation Act. The agency's function is to develop programs which will increase the conservation and efficient use of energy in India

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 phase of Energy Audit

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

Above phase include following stages

A. Data Collection - In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, survey communicating with responsible persons and measurements.

Following steps were taken for data collection:

- The team went to each department, centers. Library, canteen etc.
- Data about the general information was collected by observation and interview.
- The power consumption of appliances was recorded by taking an average value in some cases.

B. Data Analysis - Detailed analysis of data collected include: calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plan provided by the Uttarakhand Power Corporation Limited. Data related to water usages were also analysed using appropriate

methodology.

C. Recommendation - On the basis of results of data analysis and observations, some steps for reducing power and water consumption were recommended. Proper treatments for waste were also suggested. Use of fossil fuels has to be reduced for the sake of community health.

The above target areas particular to the college was evaluated through questionnaire circulated among the students for data collection. Five categories of questionnaires were distributed. The formats of these are given below.

2.1 Pre audit Phase

2.1.1 *Survey Form for data collection*

1. List ways that you use energy in your college. (Electricity, electric stove, kettle, microwave, LPG, firewood, and others).
2. Electricity bill amount for the last five year.
3. Amount paid for LPG cylinders for last one year.
4. Are there any energy saving methods employed in your college? If yes, please specify. If no, suggest some.
5. How much money does your college spend on energy such as electricity, gas, firewood, etc. in a month?
6. How many CFL bulbs are installed? Mention use (Hours used/day for how many days in a month)
7. Energy used by each bulb per month? (For example- 60 watt bulb x 4 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?
11. Mentions use (Hours used/day for how many days in a month)
12. Energy used by each bulb per month? (kwh).
13. How many fans are installed in your college? Mention use (Hours used/day for how many days in

a month).

14. Energy used by each fan per month? (kwh)
15. How many air conditioners are installed in your college? Mention use (Hours used/day, for how many days in a month)
16. Energy used by each air conditioner per month? (kwh).
17. How many electrical equipment's including weighing balance is installed your college?
18. Mention the use (Hours used/day for how many days in a month)
19. Energy used by each electrical equipment per month? (kwh).
20. How many computers are there in your college? Mention the use (Hours used/day for how many days in a month).
21. Energy used by each computer per month? (kwh).
22. How many photocopiers are installed by your college? Mention use (Hours used/day for how many Days in a month).
23. How many cooling apparatuses are in installed in your college? Mention use (Hours used/day for How many days in a month).
24. Energy used by each cooling apparatus per month? (kwh) Mention use (Hours used day for how many days in a month).
25. Energy used by each photocopier per month? (kwh) Mention the use (Hours used/day for how many days in a month) how many inverters your college installed? Mentions use (Hours used/day for how many days in a month)
26. Energy used by each inverter per month? (kwh)
27. How many electrical types of equipment are used in different labs of your college? Mention the use (Hours used/day for how many days in a month)
28. Energy used by each equipment per month? (kwh)
29. Energy used by each heater per month? (kwh)
30. No of street lights in your college?
31. Energy used by each street light per month? (kwh)
32. No of TV in your college and hostels?
33. Energy used by each TV per month? (kwh).
34. 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).
35. Are any alternative energy sources/nonconventional energy sources employed / installed in your

College? (Photovoltaic cells for solar energy, windmill, energy efficient stoves, etc.,) Specify.

36. Are your computers and other equipment put on power-saving mode?
37. What are the energy conservation methods adapted by your college?
38. How many smart boards displayed for saving energy awareness?
39. 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

In Government Post Graduate College Berinag, Pithoragarh, UK energy auditing was done by faculty members of Physics department. The energy audit began with the teams walking through all the different facilities at the college, determining the different types of appliances and utilities (lights, taps, toilets, fridges, etc.) as well as measuring the usage per item (Watts indicated on the appliance) and identifying the relevant consumption patterns (such as how often an appliance is used) and their impacts. The staff and learners were interviewed to get details of usage, frequency or general characteristics of certain appliances.

2.2.1 Data collection

Data collection was done in the sectors such as sources of Energy and energy consumption pattern, College records and documents were verified several times to clarify the data received through survey and discussions. Although whole process was completed from 15 July 2022 to 25 July 2022. Previous energy patterns were also observed.

2.2.2 Site Tour

Site inspection was done along with students and staff. Questionnaires were answered during the site tour and relevant documents were collected.

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

College and its premises were visited and analyzed by the audit-teams several times to gather information. Campus trees were counted and identified. Academic Block, Admin Block, B. Ed department, Medicinal garden, Staff quarters, play grounds, library, office rooms and parking grounds were also visited to collect data. Number and type of street light were counted and energy consumption for each bulb was

verified. Number of LPG cylinders used in labs, were also counted. Wattage of a water supply motor was noticed during the site inspection.

Table 1: Total Campus Area & College Building Spread Area

Total Cover Area At Ground Floor	4320 square meter
Total Cover Area At First Floor	820 square meter
Road And Open Area	1540 square meter
Ground Coverage	Nil

2.2.5 Energy Sources and Consumption Areas in College:

There are Academic/Admin block, B. Ed block, Geography/Chemistry block, Auditorium block, Music Department and supporting infrastructures like library etc. Analysis implies that hostels in Physics department is relatively more power consuming unit of the college as large power consuming devices are there. Small consumption of auditorium is because of its No use so far. A solar plant of capacity () has been installed in campus for distribution of power to different units. Thought it is installed few months back and its outcome is yet to come.

Energy consumption: Energy consumption is shown in table 2.

Table 2: Energy consumption at Govt. PG College Berinag (July 2021-June 2022)

Month	PF	Total Unit	Cost (Rs. 4.65/unit and 4.75/Unit)
Jul-21	1	599	2785.35
Aug-21	1	1091	5073.15
Sep-21	1	866	4026.9
Oct-21	1	474	2204.1
Nov-21	1	739	3436.35
Dec-21	1	2047	9518.55
Jan-22	1	1386	6583.5
Feb-22	1	1143	5429.25
Mar-22	1	632	3002
Apr-22	1	547	2598.25
May-22	1	892	4237
Jun-22	1	649	3082.75
Total		11065 Units	Rs. 51977.15
Average		922 Units/Month	Rs. 4331/Month

Table 3: Energy consumption at Govt. PG College Berinag (July 2020-June 2021)

Month	PF	Total Unit	Cost (Rs. 4.65/unit and 4.75/Unit)
Jul-20	1	632	2938.8
Aug-20	1	1132	5263.8
Sep-20	1	921	4282.65
Oct-20	1	474	2204.1
Nov-20	1	638	2966.7
Dec-20	1	1820	8463
Jan-21	1	1432	6658.8
Feb-21	1	1202	5589.3
Mar-21	1	712	3310.8
Apr-21	1	572	2659.8
May-21	1	720	3348
Jun-21	1	512	2380.8
Total		10767 Units	Rs. 50066.55
Average		897 Units/Month	Rs. 4172/Month

*Because of Covid-19 period power consumption is smaller than from 2021-22

2.2.6 Key Findings and Observations of Energy Usages

The base of energy audit is that its findings are supported by documents and verifiable information. The audit process seeks, on a sampled basis, to track past actions, activities, events, and procedures to ensure that they are carried out according to systems requirements and in the correct manner. Energy audits form a part of a process. Although they are individual events, the real value of energy audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time.

Although audits are carried out using policies, procedures, documented systems and objectives as a test, there is always an element of subjectivity in an audit. The essence of any energy audit is to find out how well energy management equipment is performing. Each of the three components is crucial in ensuring that the organization's energy performance meets the goals set in its energy policy.

- Electricity charges Rs 4331 /month
- Number of Generators =Nil
- Cost of generator fuel = Nil
- Total cost of energy =Rs. 5123 Month

- Total number of CFL bulbs =11 (23 watt/CFL)
- Number of LED lights =126 (85 LED consumes power@9W reaming @7W)
- No of scanners=2 (220 watt)
- Projectors=5 (500 watt)
- Incandescent bulbs =2 (500 watt each)
- Street Light=2 (500 watt each)
- Number of fans =15 (80 watt each)
- Number of Air conditioners =Nil
- Number of Tube lights =21 (36 watt each)
- Sound System (including speakers, amplifiers etc)=2
- Total Electrical Equipment's in Laboratories=110
- Number of room heaters=3 (Power Consumption 1500watt/heater)
- RO=1 (360 watt)
- No of Ovens and other heating appliance=5 (1000 watt each)
- Refrigerator-1 (330 watt)
- Number of Photocopiers =3 150 watt)
- Number of Televisions =1 (120 watt)
- Number of Printers= 6 (80 watt)
- Number of Computers=26 (180 watt/computer)
- Solar street lights=4 (80 watt/)
- Energy generation by solar panels =4.8KW

2.2.7 Already Existing Power Saving Measures:

- We already have Solar Plant installed in Academic Block.
- Turn off electrical equipment's when not in use.
- Resistance regulators being replaced with electronic regulators.
- CFLs are being replaced by more efficient LEDs
- Use computers and electronic equipment's in power saving mode

2.2.8 Recommendations for Better Energy Efficiency

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost analysis of implementation of recommended measures has been performed wherever necessary. Also, a number of general measures for energy efficiency have been listed. Described below are some important recommendations for better energy efficiency:

2.2.8.1 Low /No Investment (Immediate Replacements)

1. **Housekeeping:** 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. **Better Practices for Heater/Fan:**

The College has in total 8 room heater 12 fans which make a very large part of total energy consumption of the college. But, most of the time room heaters/fans are not used with best recommended practices. Even simple things, such as insulation, are not taken care of. Window panes were found broken at many places. These poor practices account for increase in load and thus consumption.

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

- Proper Insulation — Good quality insulation must be maintained in the rooms by keeping all doors and windows closed properly so as to prevent air.
- Operating - The heating appliances should be switched off before leaving the room.

3. **Replacing CFLs with LEDs lamps**

Dominant light source at most places in the college is traditional 23W CFLs As per our date collection, the campus has in total 16 CFLs. If these CFLs are replaced by LEDs 5W-9W power can be saved per CFL.

Cost Analysis of Replacing CFLs with LEDs

- Total No. of CFLs in Campus = 11
- Average Power of CFL = 23 W
- Average Power of LED = 9W
- Power saved per LED = $(23-9)W = 14W$

- Total Power saving = $11 \times 14W = 154W$
- Average Use of CFL per year = $225 \times 2hr = 450hr$
- Total Energy saved per year = $16 \times 154 \times 450 = 110800W = 1108kW$
- Saving in Rs. Per year = $1108 \times 4.65 = Rs. 5152$
- Average Cost of Replacing each CFL = Rs. 80
- Total Cost of Replacing all CFLs = $11 \times 80 = Rs. 880$
- Savings: $5152 - 880 = Rs. 4272$

2.2.8.2 Medium Investment /Short Term Replacements

1. Replacing the LCD monitors with LED monitors

Earlier we had computers with LCD monitors. Later on we replaced these ones by LED monitors. On an average, LCD monitors consume 150W while LED monitors consume only 50W. This saving of 25 W per monitor is very large:

Use of Master Switch outside each Room:

Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.

2.2.8.3 High Investment / Long Term Replacement

1. Energy substitution (electrical energy to solar energy)

As we know in our campus there is a huge consumption of electrical energy which is not economical so instead of using electrical energy we switch to alternate energy source which is solar energy.

The major energy consumption unit is Admin/Academic block, so we have shown the calculation for the no. of solar panels for Admin/Academic block only.

Cost analysis of solar panel for Admin/Academic block:

- Solar Power production per day- 4.8KW
- Total watt hour per day provided by module- 4.8kW
- Size of PV panel=
- Total watt peak rating- 320 watt/panel
- No. of PV panel for system- 15
- Cost of PV panels- Rs. 345000 (with installation charge)
- KWH saved per month-up to the end of this year we will be able to calculate.
- Annual savings in Rs. —output is yet to come as plant installed recently
- Payback period- Lifetime*

2.2.9 Consolidation of Audit Findings

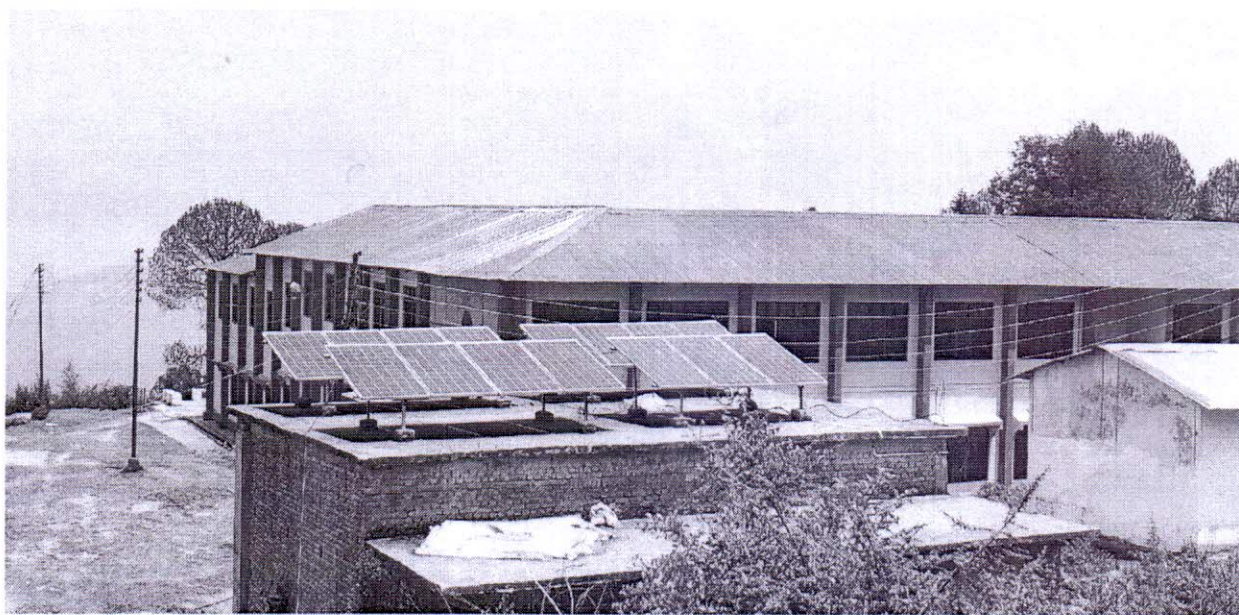
- The communication process for awareness in relation to energy conservation is found adequate.
- Average power factor of 1 is maintained
- Assessment of electrical load calculation has been done by the college.
- Monthly use of electricity in the college is not very high.
- Objectives for reducing energy, water and fuel consumption are sufficient.
- Energy efficient equipments are being used by replacing the old non-energy efficient fans.
- Regular monitoring of equipment's and immediate rectification of any problems is being done.

2.3 Post Audit Phase:

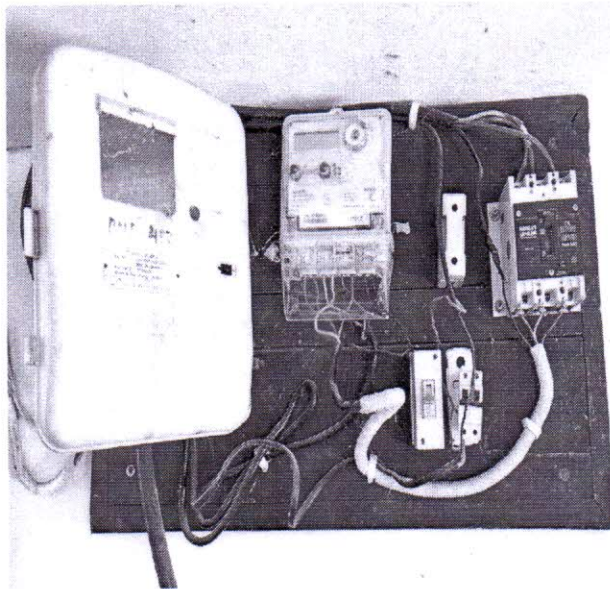
Follow up and Action Plans

Energy audits form a part of an on-going process. Innovative energy saving initiatives has to be designed and implemented every year to make the college environmentally sustainable. Follow' up programs of energy auditing recommendations should be done meticulously before the next audit.

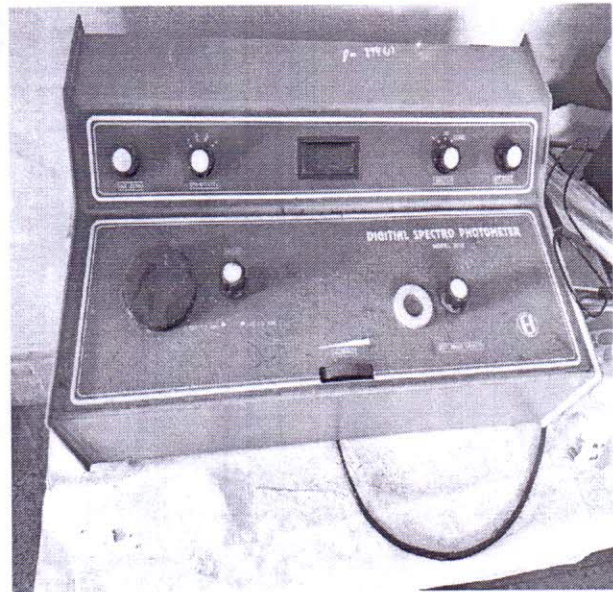
Photographs:



Solar Panels (Govt. PG College Berinag, Pithoragarh)



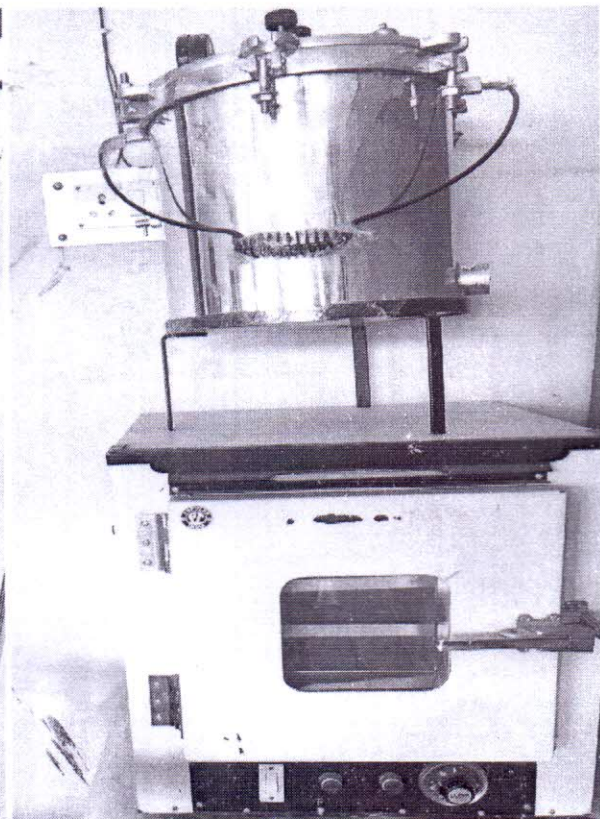
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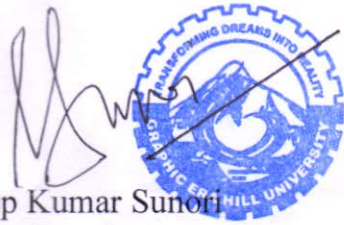


(c)



(d)

Several Electrical Appliances (More Power consuming device)



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