

# ENERGY AUDIT

(2021-22)



**BELDA COLLEGE, PASCHIM MEDINIPUR,  
WEST BENGAL**

**CONSULTRAIN MANAGEMENT  
SERVICES, LAKE ROAD, KOLKATA**

**TROPICAL INSTITUTE OF EARTH &  
ENVIRONMENTAL RESEARCH (TIEER),  
MIDNAPORE**



## ENERGY AUDIT : 2021-22

This Audit has been conducted by a Committee constituted by the Experts & Scientists from different reputed Institutes. The Committee developed a questionnaire for audit based on the regulatory & statutory requirements of Central as well State. The basic data was gathered & compiled, which the committee analyzed. By and large, the audit reveals a healthy environment inside the Belda College campus. The committee has suggested short term as well as long-term suggestions for improved environmental conditions about energy efficiency to a higher levels and authorities and all stakeholders of the College conforms that they will give due attention and utilize opportunities for identified improvements. The Committee members are listed below:

### LIST OF EXPERTS AND SCIENTISTS

SL.No.	NAME	DESIGNATION	AREA IN INTEREST
	Dr. Binoy Kr. Chanda	President, TIEER & Former IC, VU	Environment Science & Climatology
	Dr. Pranab Sahoo	Secretary, TIEER & Assistant Professor and HOD, Dept of Geography, S.B. Mahavidyalaya, Kapgari	Climate Change and Environment Management and Biogeography
	Mrs. Sanchita Bhattachariya	ISO-9001,14001 and 50001 Certified Auditor, CO,CSM & Member , TIEER	EIA and Environment Management Services
	Prof. Koushik Chatterjee	Assistant Professor , Dept of Commerce & Management , Sent Xavier's College, Kol	Management service
	Sri Amal Sasmal	Consultant, EIA and EMS	Environmental management
	Dr. Suvendu Ghosh	Assistant Teacher in Geography	Soil Management and Environment Management
	Sri Ananda Das	Assistant Teacher in Physics	Solid state Physics and Mechanical & Electrical low cost model
	Sri Achiransu Sengupta	Electrical Engineer	Machine & Power system
	Sri Sarat Chatterjee	Surveyor	Air quality and carbon footprint measurement

## **Acknowledgements**

*TIEER and CMS are thankful to the Honorable Principal and Administration and IQAC of the Belda College for entrusting processes of Energy auditing with us. We thank all the participants of the auditing team especially, Administrative Officers, Assistant Engineer, HoD, Faculty and Non-Teaching Staff, Students also others Stakeholders who took pain along with us to gather data through survey. We also thank the office staff who helped us during the document verification.*

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## CHAPTER-1 INTRODUCTION

### 1.0 INTRODUCTION

Energy Audit is a process of systematic, documented, periodic and objective evaluation of components of Energy sources with the aim of safeguarding the environment and natural resources in its operations. The process starts with systematic identification, quantification, recording, reporting and analysis of components of Energy sources in the College. Energy auditing is a means of assessing environmental performance (Welford, 2002). It is as systematic, documented, periodic, and objective review by regulated entities of facility operations and practices related to meeting environmental requirements (EPA, 2003).



Aerial Views of Belda College

### 1.2 Objectives and Views of Energy Auditing:

The objectives of Energy Auditing are to assess a resource and fossil fuel utilization aids effective learning and provides a learning Resource management.

- To study of interrelationship between beneficiary and environment in the College campus
- To Establish to provide basis for improved sustainability
- To Recognize the cost saving methods through energy minimizing and managing
- To Financial savings through a reduction in resource use
- To Develop of ownership, personal and social responsibility for the College and its environment and resource

### 1.3 Advantages and favor of Energy Audit:

- To develop to more efficient resource management
- To provide basis for improved sustainability
- To create a GHG free campus

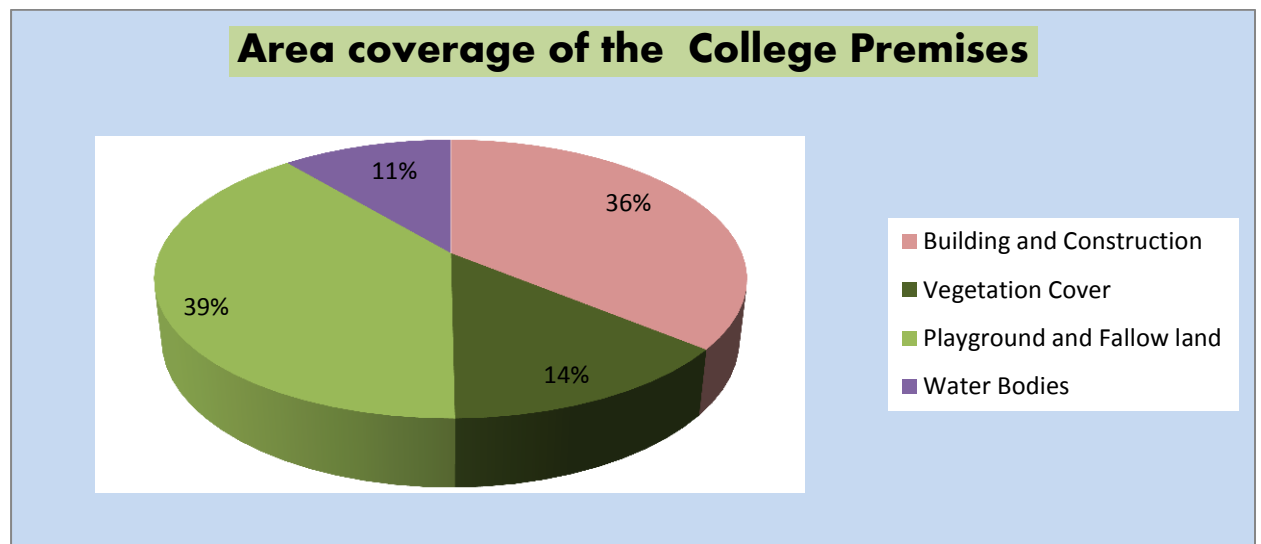
### Campus Area and Infrastructure:

Total area of the college campus – 11 acres,  
Building area: 3.95 acres,  
Green & Vegetated area: 1.53 acres.  
Play Ground & Vacant land area: 4.30 acre

Water Bodies area: 1.22 acre  
 Departments: Post Graduate -6 and Under Graduate-26  
 Laboratories: 20  
 Students: 3860  
 Teaching Faculties: 128  
 Non-teaching staff: 40  
 Others stakeholder: 32  
 Total Stake holders: 4060  
 Total classrooms: 108  
 Auditorium /Seminar hall:02  
 Hostels: 01  
 Hostel students: 14  
 Gymnasium Hall /Smart class rooms: 02

**Table 1. Area Coverage of the College Campus:**

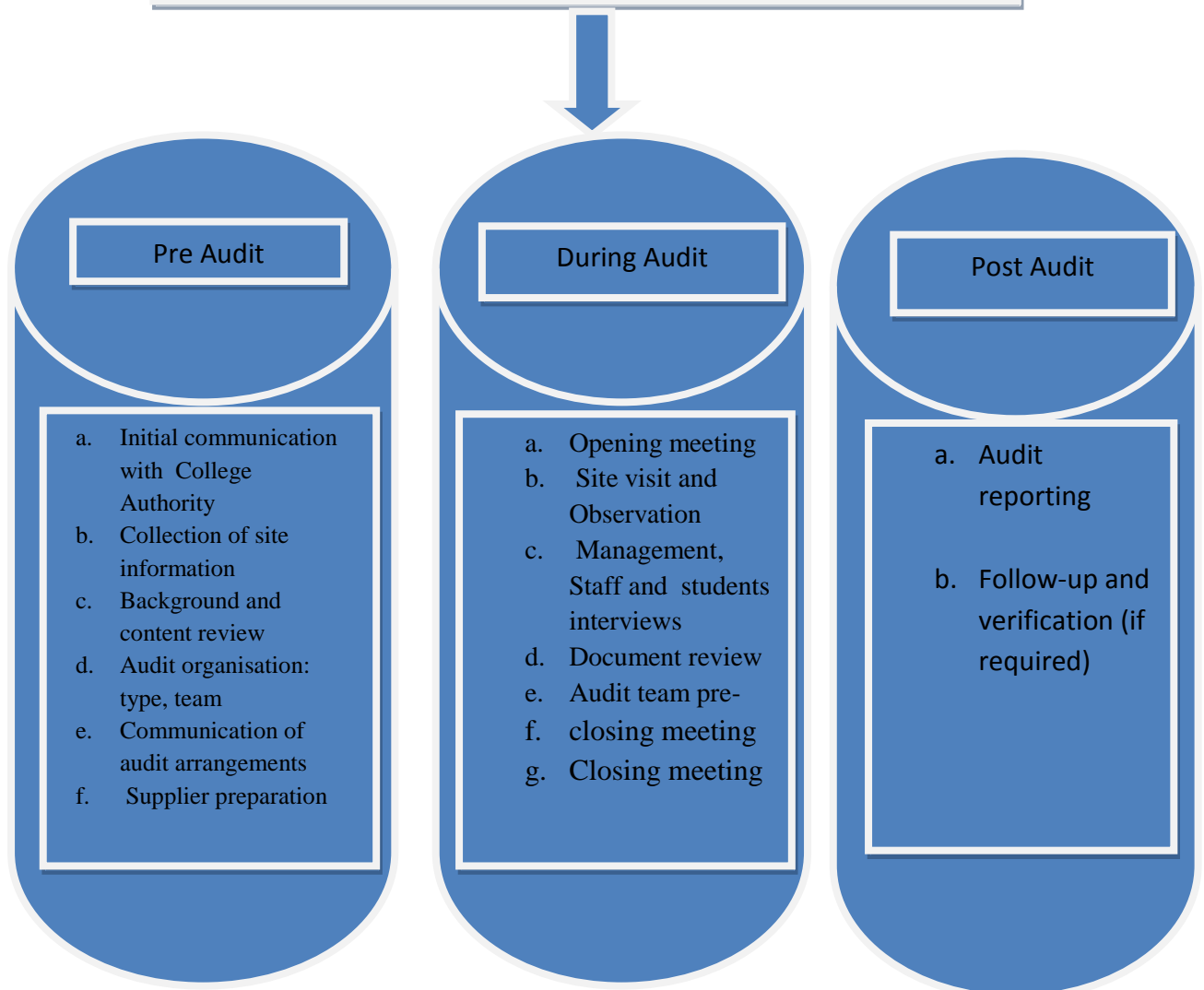
Area Coverage of College Premises:	Area in Percentage
<b>Building and Construction</b>	35.91
<b>Vegetation cover</b>	13.91
<b>Playground and Fallow land</b>	39.09
<b>Water Bodies</b>	11.09



**Fig. 1 Status of Area coverage of the College Premises**

## CHAPTER – 2 METHODOLOGY AND SURVEY SCHEDULES

### Flow Chart of Methodology for Auditing



### 2.1 Advantages of Energy Audit:

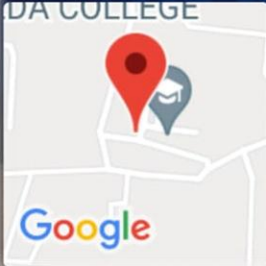
- To develop to more efficient resource management
- To provide basis for improved sustainability
- To create a GHG free campus
- Recognize the cost saving methods through Energy minimizing and Managing
- Energy auditing should become a valuable tool in the management and monitoring of environmental and sustainable development Programs of the College





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Audit Team



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Meeting with Staff

The Audit team started the audit at the College Campus on 10<sup>th</sup> June'2022

SL.NO	PURPOSE	DATE	REMARKS
1.	Communication with College authority	12 <sup>th</sup> May,2022	Discuss about term and condition
2.	Opening Meeting	1 <sup>st</sup> June,2022	Submitted the survey schedule
3.	Collection information about the College	5 <sup>th</sup> May,2022	Introduced to Administrative Officer
4.	Campus visit , site enquiry and department survey & observation	10 <sup>th</sup> June,2022	Outdoor observation with Drown camera& Photo camera, Laboratory enquiry
5.	Review data and Assessment	20 <sup>th</sup> June,2022	Data generate and drown figures
6.	Pre Closing meeting	22 <sup>nd</sup> June,2022	Meeting with IQAC
7.	Closing Meeting	24 <sup>th</sup> June,2022	Pre-submission of the Report
8.	Submit audit report	28 <sup>th</sup> June,2022	Submit of the Report

## 2.2 Site Visit :

College and its premises were visited and analyzed by the audit-teams several times to gather information. Campus trees were counted and identified. Medicinal garden, play grounds, canteen, library, All Department, office rooms, Hostels, Guest House, Staff Quarter and parking grounds were also visited to collect data. Number and type of vehicles used by the stakeholders were counted and fuel consumption for each vehicle was verified with the user. Number of LPG cylinders used in labs, canteen and hostel kitchen were also counted. Leakage of a few water taps and over flow tanks were noticed during the site inspection.

## 2.3 Questionnaire for Energy Audit:

Survey Form for data collection

1. List ways that you use energy in your College. (Electricity, electric stove, kettle, microwave, LPG, firewood, Petrol, diesel and others).
2. Electricity bill amount for the last three year
3. Amount paid for LPG cylinders for last one year
4. Also mention the amount spent for petrol/diesel/ others for generators?
5. Are there any energy saving methods employed in your College? If yes, please specify. If no, suggest some.
6. How much money does your College spend on energy such as electricity, gas, etc. in a month.

7. How many CFL bulbs has your College installed? Mention use (Hours used/day for how many days in a month)
8. Energy used by each bulb per month? (for example- 60 watt bulb x 4 hours x number of bulbs = kwh).
9. How many LED bulbs are used in your College ? Mention the use (Hours used/day for how many days in a month)
10. Energy used by each bulb per month? (kwh).
11. How many incandescent (tungsten) bulbs have your College installed?
12. Mentions use (Hours used/day for how many days in a month)
13. Energy used by each bulb per month? (kwh).
14. How many fans are installed in your College ? Mention use (Hours used/day for how many days in a month)
15. Energy used by each fan per month? (kwh)
16. How many air conditioners are installed in your College? Mention use (Hours used/day, for how many day in a month)
17. Energy used by each air conditioner per month? (kwh).
18. How much electrical equipment including weighing balance are installed your College?
19. Mention the use (Hours used/day for how many days in a month)
20. Energy used by each electrical equipment per month? (kwh).
21. How many computers are there in your College? Mention the use (Hours used/day for how many days in a month)
22. Energy used by each computer per month? (kwh)
23. How many photocopiers are installed by your College? Mention use (Hours used/day for how many days in a month).
24. How many cooling apparatuses are in installed in your College? Mention use(Hours used day for how many days in a month)
25. Energy used by each cooling apparatus per month? (kwh)Mention use (Hours used/day for how many days in a month)
26. Energy used by each photocopier per month? (kwh) Mention the use(l-hours used/day for how many days in a rmonth)how many inverters your College installed? Mentions use (Hours used/day for how many days in a month)
27. Energy used by each inverter per month? (kwh)
28. 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)
29. Energy used by each equipment per month? (kwh)
30. How many heaters are used in the canteen of your College? Mention the use (hours used per day for how many days in a month)
31. Energy used by each TV per month? (kwh)
32. Any other item that uses energy (Please write the energy used per month) Mention the use (Hours used per day for how many days in a month)

33. Are any alternative energy sources/nonconventional energy sources employed / installed in your College? ( photovoltaic cells for solar energy, windmill, energy efficient stoves, etc.,) Specify.
34. Do you run switch off drills at College?
35. Are your computers and other equipment put on power-saving mode?
36. Does your machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby mode most of the time? If yes, how many hours?
37. What are the energy conservation methods adapted by your College?
38. How many boards displayed for saving energy awareness?



## Chapter 3.0 : AUDIT STAGE

### 3.1 Campus Observation and Enquiry

Energy audit forms part of a resource management 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. Eco-campus concept mainly focuses on the efficient use of energy, pollution and also economic efficiency. All these indicators are assessed in process of Energy Auditing of educational institute". Eco-campus focuses on the reduction of contribution to emissions, procure a cost effective and secure supply of energy, encourage and enhance energy use conservation, promotes personal action, reduce the institute's energy and integrate environmental considerations into all contracts and services considered to have significant environmental impacts.

The Audit covered the following major areas:

1. Sources of Energy
2. Consumption of Energy
3. Cost of Energy
4. Measurement of Emission of GHGs
5. Energy Efficiency and Energy Management

### 3.2 Grouping and Strategy

The following groups were formed with specific target areas and end users assigned.

**Group 1:** Lighting and fans in Main building, Library and staff canteen

**Group 2:** Lighting and fans in Departments (all departments, offices, class rooms and labs)

**Group 3:** Lighting common area – Covering Street lights, corridors, grounds

**Group 4:** Lighting and fans in boys Hostels

**Group 7:** Energy use in Canteen

**Group 8:** Total room air conditioners in Administrative building, departments and labs.

**Group 9:** Total Energy audit of Central library and Computer Lab.

**Group 10:** Enquiry of total energy cost from Power Office

**Group 11:** Water Pumps in the entire campus

**Group 12:** Benchmarking of electricity consumption

The groups are allowed the use of various measuring instruments to assist in the auditing activity. Also, cooperation of the Electrical Maintenance Section was sought to collect past data and for taking measurements.

### 3.3 Enquiry of different sources of Energy :

#### 1. Energy Efficiency and Energy Management

<b>a</b>	Energy sources	Sources of Energy: Conventional Electricity, LPG Gases, Diesel, Petrol, Wooden fuels and Non -conventional Solar energy
<b>b.</b>	Energy consumption	The useable energy is Conventional and Non-Conventional energy. The used Electricity energy is 36718 units which costing is Rs.131094.3. About 5% energy is Non-conventional energy which is contributed from Solar Power. The Maximum energy is consumed for Light & Fan amounting to 45% of total consumption.
<b>c.</b>	Usage of LPG	It has been observed that LPG gas cylinders are used in Hostel, Canteen, & Laboratories (15PC/year) for cooking and other purpose. There are Green generators used in the premises.

Table 2. Source of Energy in Percentage

Source of energy	In Percentage
Conventional	95
Non -Conventional	5

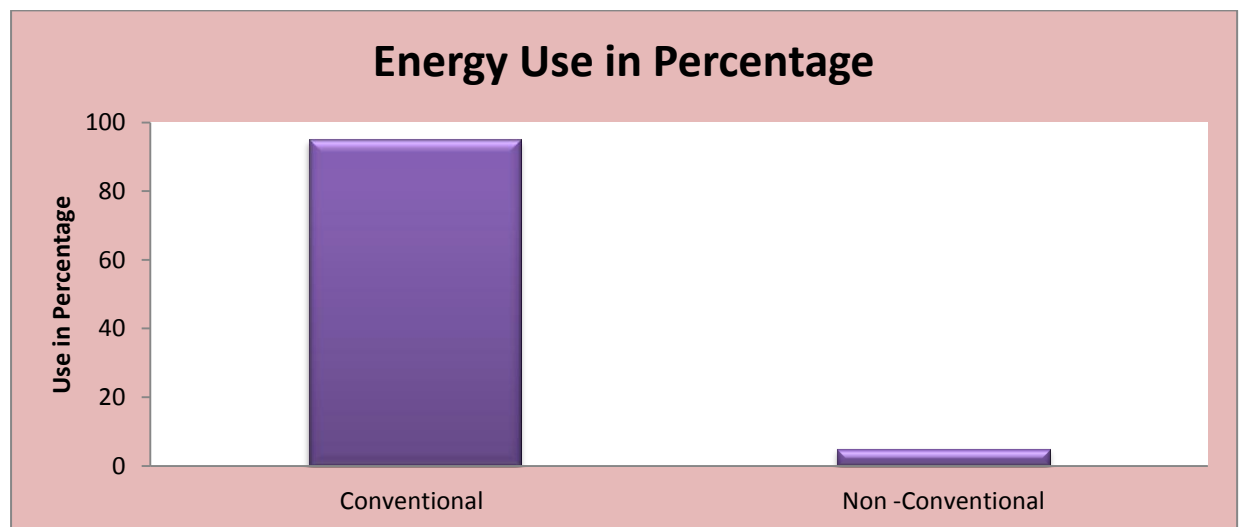


Fig. 2 - Source of Energy



Source of Non-Conventional Energy in College Premises (Solar Energy)

Table 3. Energy Consumption in different Purpose in Percentage:

Energy Consumption in different Purpose	Consumption in Percentage
light and fans	45
AC	15
Pump	3.8
Computer and Laboratory	28
Others	8.2

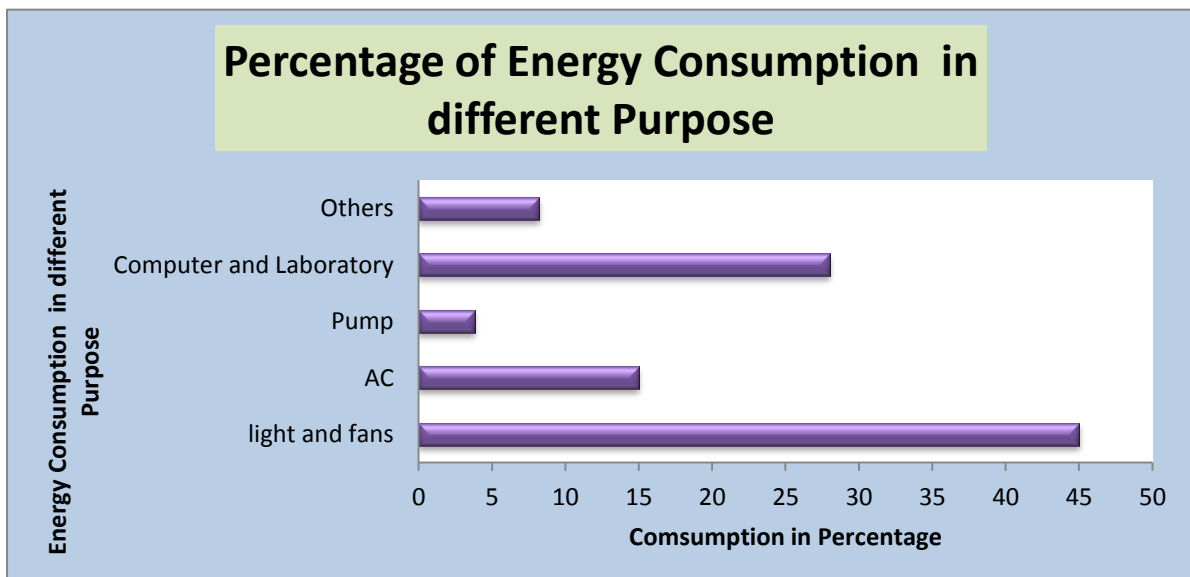


Fig. – Energy Consumption in Different Sectors

## Recommendations:

- I. a) Installation of automatic lights with sensors can be considered.
- II. b) Standard Operation Procedures (SOPs) should be prepared and followed for green purchasing wherein equipment's with star rating; those using eco-friendly materials; those with safe disposal policy or return to supplier after unused, can be considered.
- III. c) Notices/ signage can be put up/ displayed near switches and on notice boards, informing students and staff to switch off all Departments & Sectors when not in use.
- IV. d) Use of large percentage renewable energy should be considered.

### 3.4 Energy Consumption :

**Table 4. Power consumption ( Kwh) of particulars**

Sl.no	Particulars	Power consumption per hour
1.	Air Conditionar	1.5kw
2.	Computer	300w
3.	Xerox Machine/Network printer	500w
4.	Inkjet printer	50w
5.	Dot matrix printer	50w
6.	Tube light	40w
7.	Fans	50w
8.	LCD Projector	500w
9.	Water Coolar	200w
10	Chimni for cooking	850w
11	Spot light(CFL)	25w
12	Electric kettle	850w
13	Refregerator	500w
14	Water pump	1kw

### Energy Consumption of different items(Kwh/day)

**Table 5. Energy Consumption of different items (Kwh/day)**

Electrical Items	Numbers	Use of energy(Kwh/day)
Computers	140	126
Printers	49	1.2
Fans	546	109.25



Light	701	90.02
AC	26	195
Laptop	12	1.8

## 4.0 POST AUDIT STAGE

### 4.1 Energy Cost Summary

#### Energy-

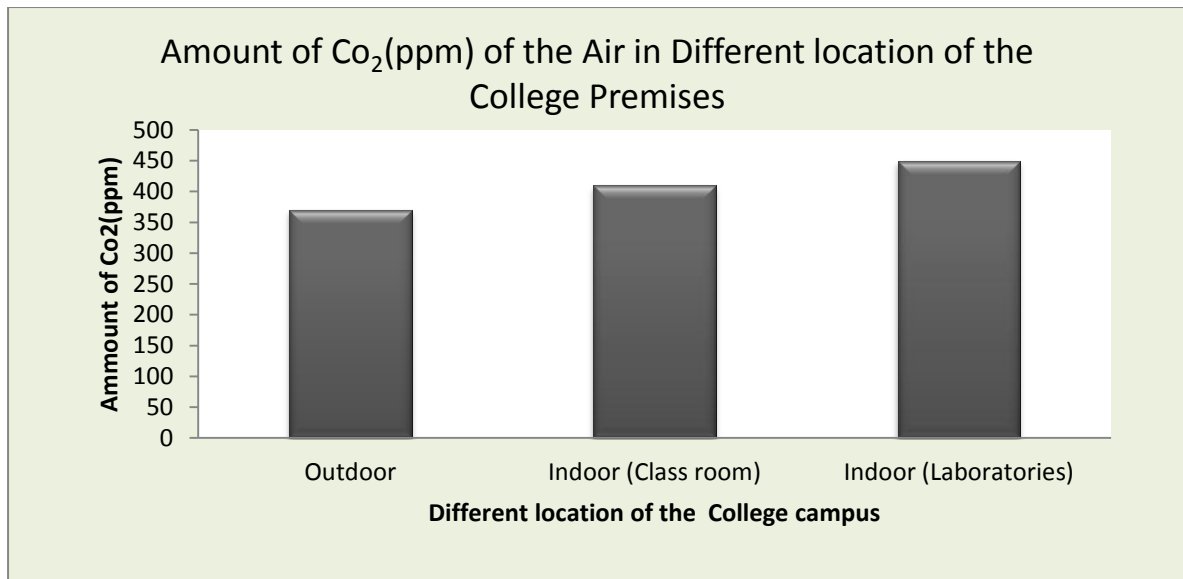
- ❖ Electricity Consumption – 38553.9 Unit (Conventional). Rs.- 375900.52/- Per Year
  - a) Conventional energy- 36718 Unit
  - b) Nonconventional energy-1835.9 Unit. Cost.-Rs. 17,900.02/- Per Year
  - c) Payable cost of electricity – Rs.358000.5/- Per Year
- ❖ Fossil fuel consumption per Year:
  - a. Number of Gas cylinders used for cooking purpose( Hostels& Canteen) – 12 PC
  - b. Number of Gas cylinders used in Chemistry Laboratory - 3PC
  - c. Diesel used for green Generator- 30 liter
- ❖ Number of Green Generators - 2 Unit
- ❖ Cost of fuel for Generator – Rs. 2700/-Month

**Table 6. No of different Electrical items**

Electrical Items	Numbers
Computers	140
Printers	49
Fans	546
Light	701
AC	26
Laptop	12

**Table 7. Amount of CO<sub>2</sub> (ppm) in different places**

Amount of CO <sub>2</sub> (ppm) in the Air in Different places of the College Premises	Amount of CO <sub>2</sub> (ppm)
Outdoor	370
Indoor (Class room)	410
Indoor (Laboratories)	450



**Fig. 4 Amount of Co<sub>2</sub>(ppm) of the Air in Different location of the College Premises**

#### 4.2 Results and Findings

Sl. No.	Object and Parameter	Observation and Finding
1	Source of energy ( conventional)	95%
2	Source of energy ( Non-conventional)	Solar- 5%(1835.9 unit)
3	Total consumption of Electric Power	36718 unit
4	The maximum use of Electric Power	Conventional - 95%
5	Maximum energy consumption in the purpose	Light and fans – 16523.1unit AC-5507.7 unit
6	Energy Consumption in Computer & Lab.	10281.04unit
7	No. of LPG Gas cylinder for coking purpose	10
8	No. of LPG Gas cylinder used in Laboratories	3
9	Amount of diesel used for green generator	30 liter
10	No. of Computers and use of energy	140 ( 1.8 Kwh/Day)
11	No. of AC and use of energy	26( 195 Kwh/Day)

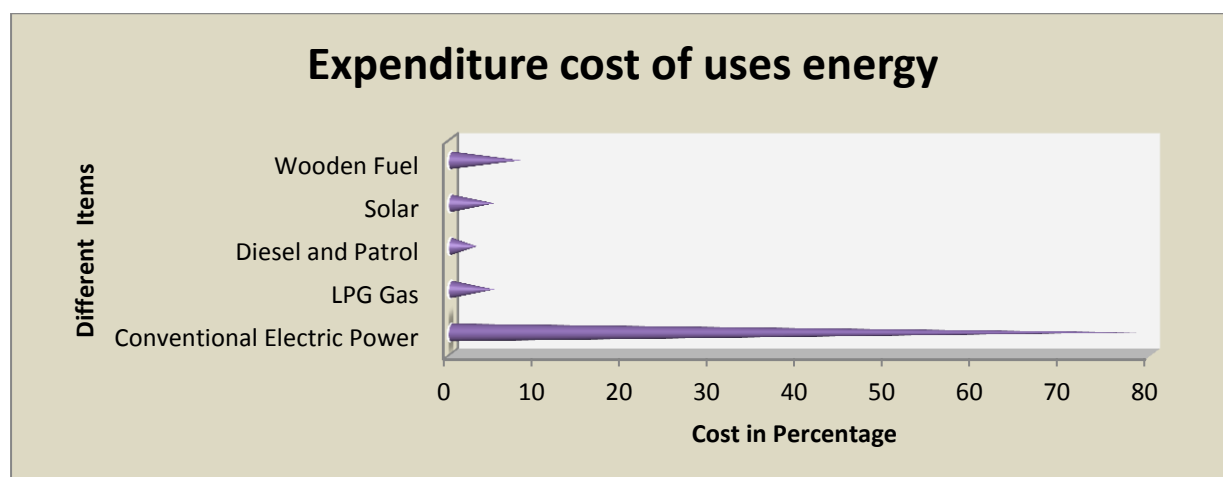
#### 4.3. Energy Cost:

##### Energy-

- ❖ Electricity Consumption – 38553.9 Unit (Conventional). Rs.- 375900.52/- Per Year
  - d) Conventional energy- 36718 Unit
  - e) Nonconventional energy-1835.9 Unit Cost.-Rs. 17,900.02/- Per Year
  - f) Payable cost of electricity – Rs.358000.5/- Per Year
- ❖ Fossil fuel consumption per Year:
  - d. Number of Gas cylinders used for cooking purpose( Hostels& Canteen) – 12 PC
  - e. Number of Gas cylinders used in Chemistry Laboratory - 3PC
  - f. Diesel used for green Generator- 30 liter
- ❖ Number of Green Generators - 2 Unit
- ❖ Cost of fuel for Generator – Rs. 2700/-Month

**Table 9. Expenditure cost of uses energy**

Expenditure cost of uses energy	Cost in Percentage
Conventional Electric Power	79
LPG Gas	5
Diesel and Patrol	3
Solar	5
Wooden Fuel	8



**Fig. 5 Expenditure cost of uses energy**

**Table 10. Energy consumption in different purpose**

Energy consumption in different purpose , 2021-22		
1	Lights & Fans	16523.1 unit
2	Air Condition	5507.7unit
3	Lifting of water( HP pump)	1395.28unit
4	Computer & Dept. Lab	10281.04unit
5	Others( CCTV,TV, water cooler & others)	3010.88unit

### **Routine of Energy Save Practices**

- Non Motor vehicles Day,
- World Environment Day – June 5,
- Ozone Day – September 16
- Awareness seminars are organized on various environmental problems.

Major Audit Observations		
Sl. No	Sectors/Indicators	weightage
1	Applied of NCE	L
2	Step to LED and CFL Bulb use	M
3	Reduce of AC User	L
4	Awareness	M
5	Management of GHGs	M

\* H denote- Taken management policy level above 60%

\*\* M denote- Taken management policy level 40%-60%

\*\*\* L denote-Taken management policy level below 40%

## 5.0 CONCLUSION AND RECOMMENDATIONS

- Most of the time, all the tube lights in a class room are kept **ON**, even though, there is sufficient light level near the window opening.
- In such cases, the light row near the window may be kept **OFF**.
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers to have power saving settings to turn **Off** monitors and hard discs, say after 10 minutes/30 minutes.
- All Class Rooms and labs to have Display Messages regarding optimum use of electrical appliances in the room like lights, fans, computers and projectors.
- Installation of more solar panels and other renewable energy sources.
- Conduct more save energy awareness programs for students and staff.
- Replace old computers and LED monitors.
- More energy efficient fans, tubes and bulb should be replaced.
- Observe a power saving day every year.
- Automatic power switch off systems may be introduced.

## 6.0 ENERGY CONSERVATION PROPOSALS

Providing Energy Saver Circuit to the Air Conditioners: The energy saver circuits for the air conditioners, intelligently reduces the operating hours of the compressors either by timing or temperature difference logic without affecting the human comfort. This can save around 15% to 30% of the electricity depending on the weather conditions and temperature settings. There are total 7 split type air conditioners. It is Recommended that the old air conditioners are being replaced with new energy efficient BEE STAR labeled (3 Star and above) air conditioners in a phased manner. Considering the average compressor ON Time, 5h/day

### Proposal for Reduce of Using time of Air Conditioners:

- kWh/day/ air conditioner Yearly operating days = 160 days/year/ air conditioner
- Yearly electricity consumption = 195 kWh/Year/ air conditioner



- Considering a saving of 15%, total annual savings =  $15\% \times 1852.5(160\text{Day}) = \text{Rs. } 44460/-$  Per Year.

**Proposal for Replacement of Tube Light:**

Power consumption by 36 W FTL with conventional choke = 40 W/ Tube Light

- Equivalent LED tube light = 16 W/ Tube Light
- Savings in power = 24 W/ Tube Light
- Operating hours = 8 h/day x 250x240 days
- Saving = Rs. 112320/per year

\*\*\*\*\*