

ENERGY AUDIT

STUDY PERIOD (TWO YEARS) 2021 - 2022 & 2022 - 2023

Sustainability study

AUDIT REPORT

Studied for

**Acharya Prafulla Chandra Roy
Government College**

Himachal Vihar, Matigara, Siliguri - 734 010, District
Darjeeling (West Bengal), India

Studied in the capacity of

Accredited and Certified
Green Building Professional



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Valid till **31 May 2024**

Disclaimer

The Audit Team has prepared this report for the **Acharya Prafulla Chandra Roy Government College** located at Himachal Vihar, Matigara, Siliguri - 734 010, District Darjeeling (West Bengal), India based on input data submitted by the College analysed by the team to the best of their abilities.

The details have been consolidated and thoroughly studied as per the various guidelines for Green Buildings available in National and International Standards; the report has been generated based on comparative analysis of the existing facilities and the prerequisites formulated by various standards. The inputs derived are a result of the inspection and research. These will further enhance and develop a Healthy and Sustainable Institution.

These can be implemented phase wise or as a whole depending on the decision taken by the Hon'ble Management and College. The warranty or undertaking, expressed or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

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The Report is prepared by the Team of Greenvio Solutions under their brand and department – Sustainable Academe as Consultancy firm with the Project Head - Ar. Nahida Shaikh who is as an Accredited and Certified Green Building Professional-Architect. Green Building consultancy is her forte and she is one of the most sought after names when it comes to providing excellent quality services within the stipulated time frame.

The Study is conducted in capacity of Accredited & Certified Green Building Professional with extensive experience.

Greenvio Solutions

Developing Healthy and Sustainable Environments

We are an Environmental and Architectural Design Consultancy firm

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Acknowledgement

The Audit Assessment Team thanks the **Acharya Prafulla Chandra Roy Government College, West Bengal** for assigning this important work of Energy Audit. We appreciate the cooperation extended to our team during the entire process.

Our special thanks are extended are due to **everyone from the Governing body**.

Our heartfelt thanks are extended to the Chairperson of the entire process **Dr. Mayukh Sarker** (Officer-in-Charge) for the valuable inputs.

We are also thankful to College's Task force the faculty members who have played a major role in data collection – **Ms.Mandira Ghissing** (Assistant Professor) (*Special mention for the excellent coordination*); **Smt. Smriti Singh** (Assistant Professor) and **Dr. Kartick Chandra Dey** (Associate Professor and Coordinator, IQAC).

We highly appreciate the assistance of the **entire Teaching, Non-teaching, and Admin staff** for their support while collecting the data.

Sustainable Academe

Brand of Greenvio Solutions, Palghar District, Maharashtra- 401208

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DETAILED REPORT

1. Introduction

1.1 About the Institution

A.P.C. Roy Govt. College was established on 21st July 2010 to cater to the educational needs of this region. This is the second Govt. College of its kind in Darjeeling district and third in North Bengal.

The College is named after the legendary personality in the field of science Acharya Prafulla Chandra Roy who is hailed as the father of Indian Chemistry, a visionary and a great educationist.

It is hoped in all sincerity that this nascent institution will go a long way in carrying forward the noble vision of this great soul.

1.2 About the statements of the Institute

1.2.1 Vision

The College proposes

- To fulfil the educational aspirations of the region of North Bengal, this is in many ways cut off from the mainstreams of learning.
- A large segment of the population of North Bengal is economically backward and some of the people of the region are well below poverty line with the unfortunate result that quality education is denied to them.
- To recognise the innate potential of students and to enrich these abilities to enable them to meet any challenges in their chosen field.
- To make quality higher education affordable to the less privileged sections of the society with further hope that this college does not become merely a training centre to train students to answer a few selected questions but an institution with a vision committed to the all-round development of the students so that they emerge as good and successful human beings.

1.2.2 Mission

The College adheres and focuses towards:

- To promote capacity-building and all-inclusive development through a quality teaching-learning process.
- Holistic education is one that stresses the importance of knowledge of a specific subject with equal amount of emphasis upon the instilling of moral values.
- To promote equity by empowering and encouraging women students, students from disadvantaged groups and differently abled students.
- To bestow students with human values and social responsibilities this would allow them to become honest and responsible citizens of the country and would be able to meet all kinds of challenges in the future.

1.2.3 Aim

The College has formulated the following aim to achieve its mission:

Holistic learning - The institution promotes capacity-building and all-inclusive development through a quality teaching-learning process.

1.2.4 Motto

The College channelizes its efforts towards the motto of:

"Culture of knowledge and acquisition of power."

1.2.5 Objectives

The objective of the College is:

- To fulfil the educational aspirations of the economically backward students of this particular region, which is in many ways cut off from the mainstreams of learning and to acknowledge the innate potential of students
- To enrich these abilities to enable them to meet any challenges in their chosen field.

1.3 About the Institute building

The magnificent college building is situated at Himachal Vihar, the foothills of the district offering an unobstructed view of the hills, away from the noise of the city and yet not too far, in an environment that is serene and highly conducive to teaching and learning.

The College building is constructed by **S.J.D.A. (Siliguri Jalpaiguri Development Authority)** funded by the Govt. of West Bengal.

The spacious class rooms are highly lighted and well-furnished and so are the sufficiently equipped laboratories.

Library is the heart of every educational institution. The College library though in its formative stage has adequate number of books to meet the academic needs of teachers as well as students.

1.4 Assessment of the Institute

1.4.1 Affiliations

The Institute is affiliated to **University of North Bengal**, a public state collegiate major research university in North Bengal region of West Bengal, which is located in Raja Rammohanpur, Siliguri, Darjeeling district, in the Indian state of West Bengal

1.4.2 Certification

The College has received AISHE – The All India Survey of Higher Education code is C - 45353.

1.4.3 Recognitions

The College has upgraded in the teaching level – Under graduate to Post graduate in the **section 2(f) (Order No.8-454/2011 (CPP-I/C) dated 12/08/2011) and section 12 (B) (Order No. 8- 386/2015 (CPP-I/C) dated 05/07/2016) of the University Grants Council Act, 1956** Govt. of India, New Delhi.

2. Overview

2.1 Summarised Populace analysis for 2022-2023

2.1.1 Students data

The data (shared by the Institute) shows there were a total of **339 male and 450 female students.**

2.1.2 Staff data

S. No.	Type	Male	Female	Total
1	Teaching staff	27	14	41
2	Non-Teaching staff	08	03	11
Total Staff Members		35	17	52

Table 1: Staff data of the Institution for 2022-2023

The staff data shows the College premises had a total of **52 Staff Members.**

2.2 Summarised Populace analysis for 2021-2022

2.2.1 Students data

The data (shared by the Institute) shows there were a total of **344 male and 434 female students.**

2.2.2 Staff data

S. No.	Type	Male	Female	Total
1	Teaching staff	25	16	41
2	Non-Teaching staff	08	03	11
Total Staff Members		33	19	52

Table 2: Staff data of the Institution for 2021-2022

The staff data shows the College premises had a total of **52 Staff Members.**

2.3 Total College Area & College Building Spread Area

The site area is 2.1 acres and the Built-up area is 86,111.28 sq. ft. for an approximately 841 footfalls.

2.4 Institute Infrastructure

2.4.1 Establishment

The Institute was established in 2010.

2.4.2 Spatial Organisation

There are provisions for staircase for accessibility on the premises, whereas there are amenities such as CCTV, a first aid room, etc.

The Institute is located pretty close to nature and hence has a very fresh environment which is absolutely pollution free and healthy.

The Building is a Reinforced Cement Concrete (RCC) framework building.

3. Research

3.1 About the Green Building Study Audit

It is a systematic study of the aspects which make the Institution sustainable and healthy premises for its inhabitants.

3.2 Analysis of the Green Building Study Audit

The procedure included detailed verification as follows:

- Investigation
- Technical discussion with team
- Observations
- Inferences

3.3 Strategy adopted for Green Building Study Audit

The strategies included data collection from the admin department, actual inventory, investigation to check the operation and maintenance, analysis of the data collection, and preparation of the Report.

3.4 Activities undertaken for the Green Building Study Audit

- Discussion with the Institute
- Allotment and Initiation by the Institute
- Data collection
- Submission of the files

4. Observation

Survey Results

An online survey was conducted to analyse the student and staff views about the Energy management practices adopted in College, following is the result received.

4.1 Participation

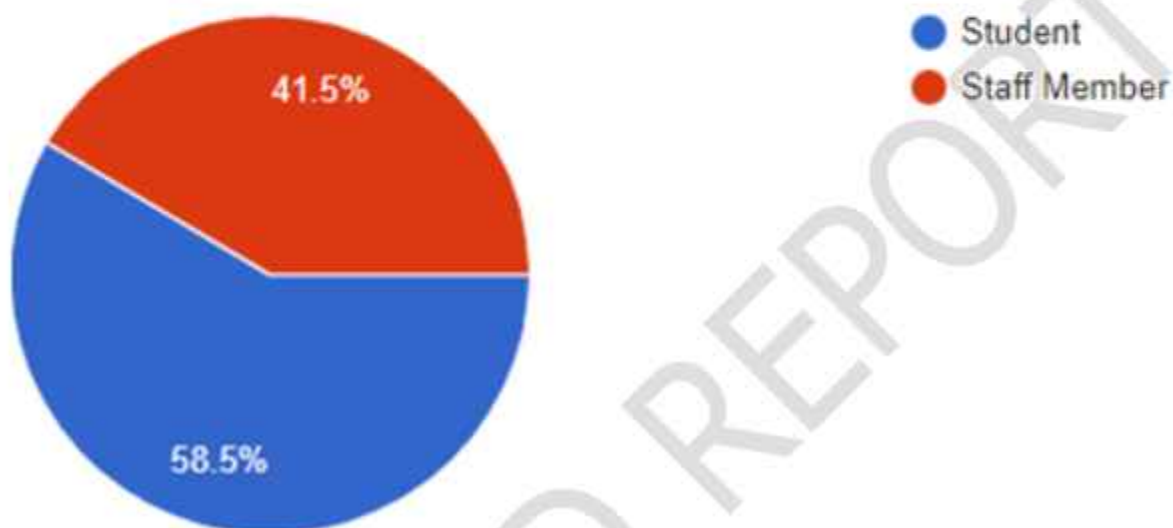


Figure 1: Participation analysis in the survey

A total of **94 responses** were received out of which 59% were students.

Note: The Participants were asked to review the practice on a scale of 1-5 with scale components as follows:

- ➔ Scale 1 – Poor
- ➔ Scale 2 – Satisfactory
- ➔ Scale 3 – Good
- ➔ Scale 4 – Very good
- ➔ Scale 5 – Excellent

The figures in each of the columns of graph depict the Number of participants responses in numerical (Percentage of the participant response) – For example 101 responses (44.5%)

4.2 About the Energy management practices adopted by Institute

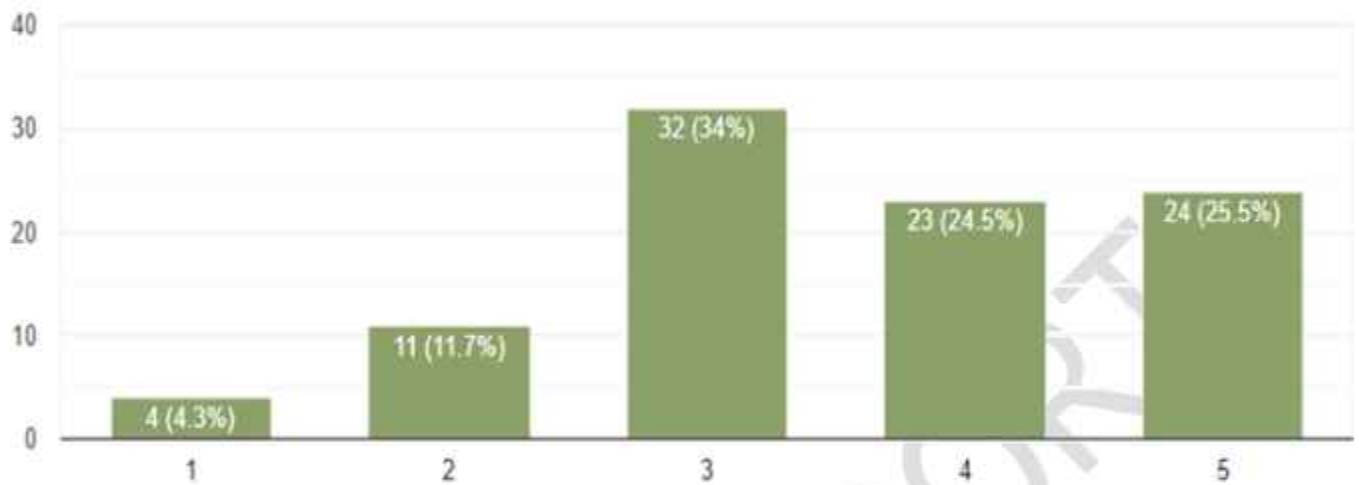


Figure 2: Energy management practices in the Institute

Observation: The students and staff almost 26% of the respondents found practices to be Excellent (Rating of 5); whereas almost 25% of the respondents found practices to be Very Good (Rating of 4); and 34% of the respondents found practices to be Good (Rating of 3).

Inference: Though the majority responses are for 'Excellent – Rating 5' is less than 50% thus this shows that the said section requires improvement.

5. Documentation

The premise uses following sources of energy consumption.

5.1 Primary sources of energy consumption

- **Electrical (Metered)** – Light, Fans, Equipments, Pumps comprise these sources.
- **Renewable energy** – There are no sources to harness solar energy in the premises, although there is availability of a solar street light.

5.2 Secondary sources of energy consumption

The premise uses batteries, inverters & UPS as backup for administrative purposes. The details of the existing sources are documented below:

S. No.	Name	Nos.
1	UPS	17
2	Inverters	10
3	Batteries	10

Table 3: Details of secondary sources of energy consumption

5.3 Actual Electrical Consumption as per Bills

The College spends a substantial amount on electricity bills every month. However, we would like to recommend the use of alternate sources of energy to harness the electrical loads and reduce the monetary expenses.

5.4 Calculated Electrical Consumption as per inventory

The electricity bills provide actual consumption data. The following is the calculated consumption. It is done to understand the percentage of energy usage in the premises by various applications. It is based on the inventory collected and interviews with the staff.

The additional data such as wattage is taken from market research. In terms of electrical consumption, the main sources are lights, fans, air conditioner, and equipment. The inventory and data collection for sources of energy consumed in the premise is summarised in the following sections.

The following documentation is based on the consumption practice of the premises on a regular working day.

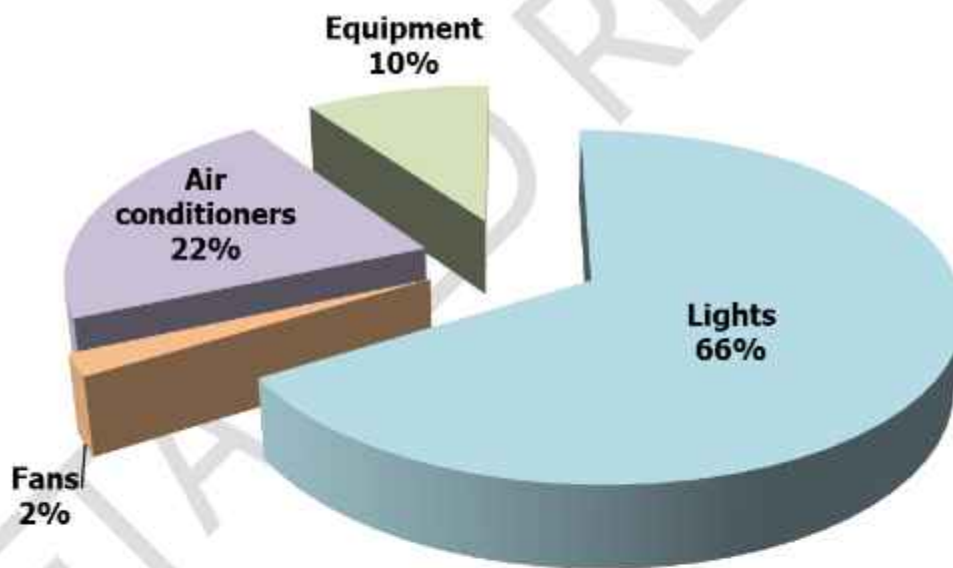


Figure 3: Summary of the calculated electrical consumption as per inventory

The above graph shows that lights consumes 66% whereas the air conditioners consume 22% while the equipment consumes 10% and the fans consume 2% of the total calculated electrical energy.

5.5 Lights

5.5.1 Types of lights based on the numbers

There are a total of **568 lights on the premises**; the following table shows the various types of lights on the premises.

S. No.	Type	Nos.
1	CFL lights (Non-Energy efficient appliance)	7
2	Halogen lights (Non-Energy efficient appliance)	26
3	LED lights (Energy efficient appliance)	535

Table 4: Summary of the types of lights on-premise

5.5.2 Types of lights based on the power consumption

The energy consumption of lights is **8,42,932 kWh** of energy.

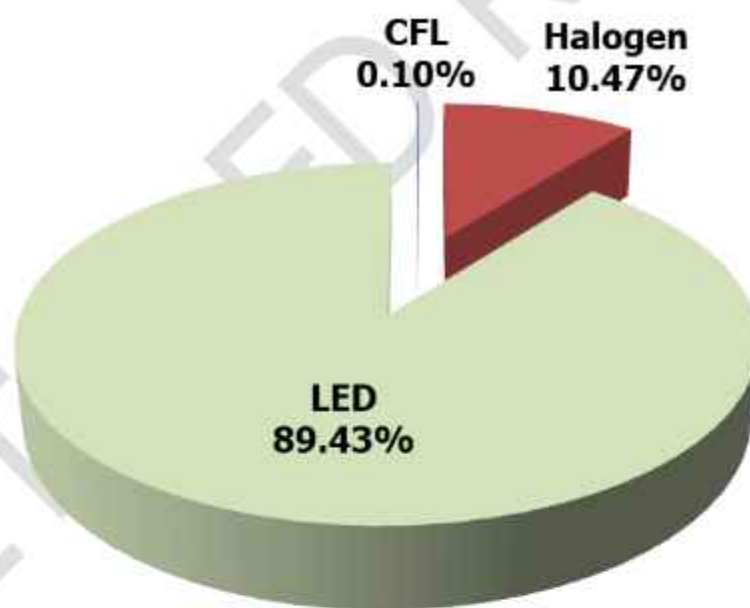


Figure 4: Energy consumed by types of lights in the premise based on the usage study

The analysis of the types of Lights on-premises shows **LED lights consume 89.43%** whereas the **Halogen lights consume 10.47%** and the **CFL lights consume 0.10%** of the total power consumed by lights.

5.6 Fans

5.6.1 Types of fans based on the numbers

There are a total of **381 fans** on the premises as follows:

S. No.	Type	Nos.
1	Ceiling fans	373
2	Pedestal fans	4
3	Small Motor exhaust fan	1
4	Wall mounted fans	3

Table 5: Summary of the types of fans in the premises

5.6.2 Types of fans based on the power consumption

The energy consumption of fans is **26,699 kWh** of the energy.

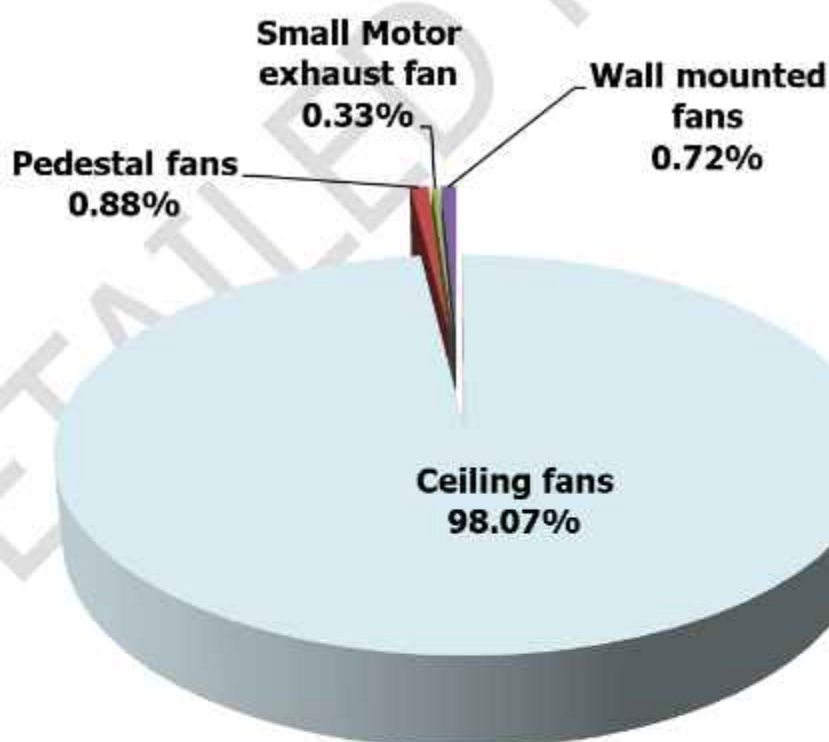


Figure 5: Types of fans based on power consumption

The above analysis shows the **Ceiling fans consume 98.07%** whereas the **pedestal fans consume 0.88%** while the **wall mounted fans consume 0.72%** and the **small motor exhaust fan consumes 0.33%** of the total power consumed by fans.

5.7 Air conditioners

5.7.1 Types of air conditioners based on the numbers

There are **27 air conditioners** on the entire premises.

5.7.2 Building-wise consumption analysis

The energy consumption of air conditioners is **2,77,920 kWh** of energy.

5.7.3 About the replacement of current air conditioners

- The current air conditioners are well maintained.
- Though there is not an immediate requirement for replacement.
- Whenever the College undergoes redevelopment there can be provisions for replacement with energy-efficient appliances or new air conditioners that require less power consumption.

5.8 Equipment

5.8.1 Types of Equipment

There are **99 nos. of equipment** in the Educational sector.

5.8.2 Types of equipment as per their energy contribution

The energy consumption of equipment is **1,23,985 kWh** of energy.

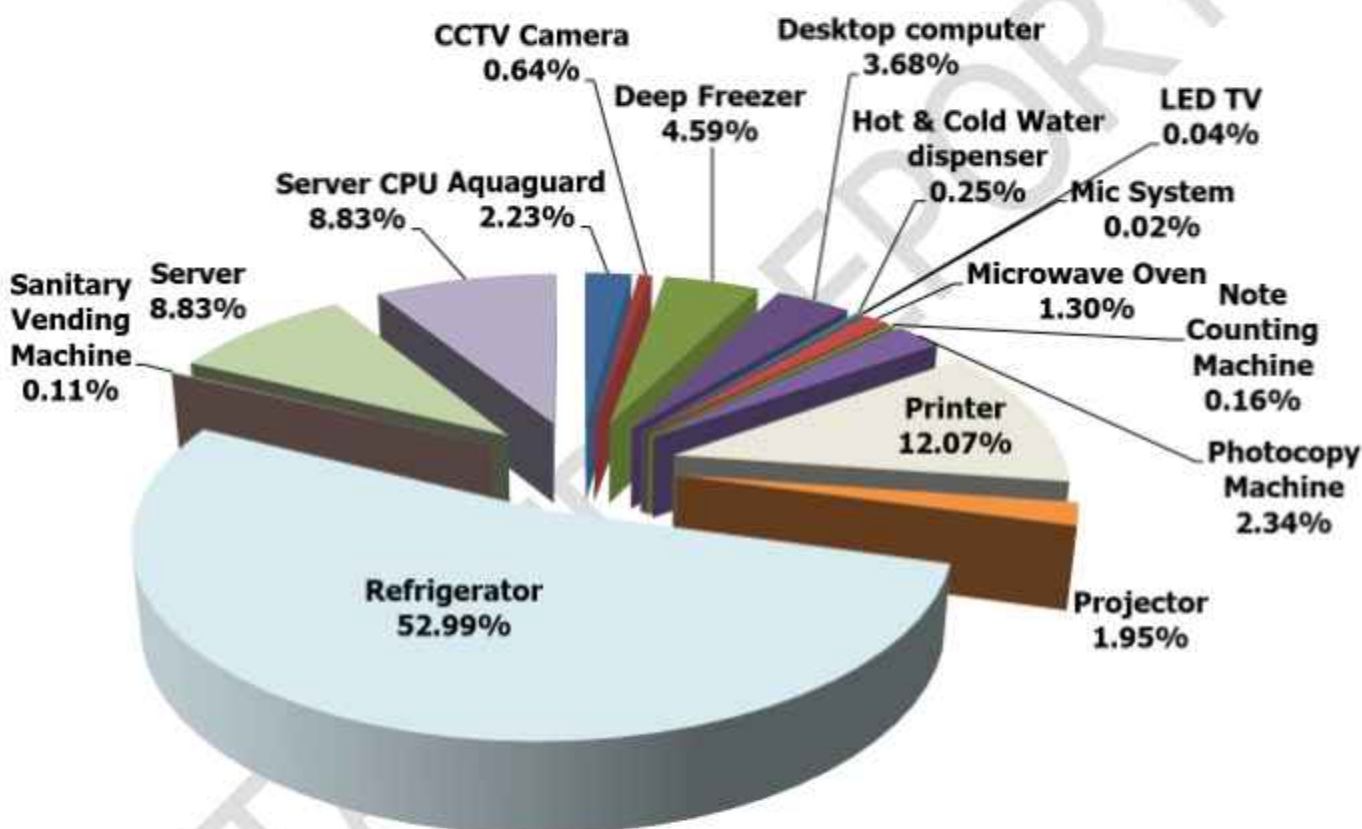


Figure 6: Energy consumed by types of equipment in the educational sector based on the usage study

The above summary shows that the **refrigerator consumes more energy at 52.99%** while the **printer consumes 12.07%** the **server CPU and server consume 8.83% each** and the **deep freezer consumes 4.59%** these are the maximum consumers as compared to other equipment.

6. Suggestion

6.1 Section-wise suggestions

The following suggestions are to be considered as a **first priority** for implementation. These **should be executed within the next 1.5 to 2.5 years from the date of the Report submission**. The Institute can execute a plan after discussion with Project Head.

6.1.1 Electromechanical systems - Electrical and Lighting

Section 1 - Non-LED lights

The current light analysis shows that Non-LED lights consume anywhere between 50W to 54W and even more when in use; these should be replaced with LED lights which consume on an average 12-16W when in use.

Our technical research shows that there would be a reduction of an average of **67% reduction** in energy consumption through lights specifically as a part of the electro - mechanical system if all **Non-LED lights on all floors** are replaced with an energy efficient appliance whenever the College undergoes renovation.

Section 2 - Ceiling fans

The current Fans are in proper working conditions and maintained well. The ceiling fans are in more quantity and consume at least 45W when in use. These should be replaced with energy efficient fans consuming 14W when in use.

Our technical research states that is all the **ceiling fans on all floors** if replaced with star rated appliance results in a reduction of average of **69% reduction** in energy consumption if replaced with energy efficient appliance. It will be suggested to either replace these now if College can have certain plans else the replacement can be done when fans get damaged or are not in working condition.

6.2 General suggestions

The following details are consolidated study recommendations related to 'entire Institute' and should be considered as **second priority** for implementation, once the section wise recommendations are implemented. The following recommendations should be **implemented within 2.5 to 3.5 years from the date of the Report submission.**

6.2.1 Alternatives to increase renewable energy

6.2.1.1 Solar farms

This option can be explored with due discussion with the surrounding and adjacent farmland owners. This will serve as a noble project and will provide dual benefits to farm land and University w.r.t to electricity bill power reduction.



Plate 1: Solar farm concept for the Institute (For reference purpose only)

Image source: Zsuzsa Bóka from Pixabay

6.2.1.2 Solar parking

The College can turn its existing parking areas into solar panel powered parking areas. This will provide shade and renewable energy benefit to the College.



Plate 2: Solar parking concept for the Institute (For reference purpose only)

Source: Image by <https://solarpowerproject.in/solar-panels-for-parking-lots.php>

6.2.2 Alternatives towards Smart premises mechanisms

6.2.2.1 Facility management systems, controls

(Includes electromechanical systems – Electrical, Water)

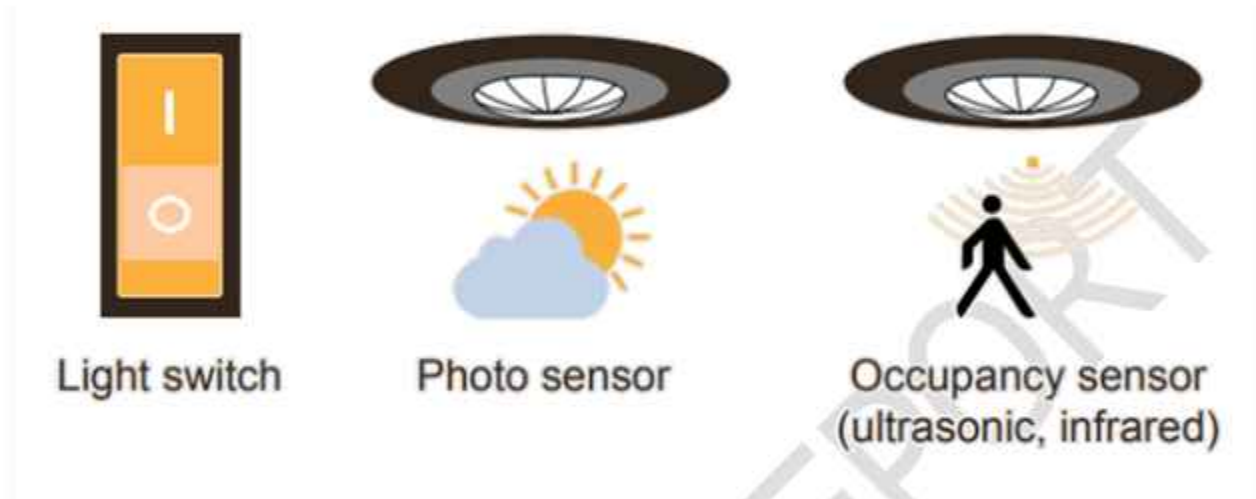


Plate 3: Understanding the lighting concepts

Source: https://seors.unfcc.int/applications/seors/attachments/get_attachment?code=NG125PFE4WHMWSYAK8TCAKIHMWX0F4QD

The above diagram provides a detailed study of how the system controls should be incorporated in the premises as far as lighting systems are considered. The suggestions for this sub-section are listed below.

- Install PIR control of the lighting in the toilet areas.
- Install low flow taps with automatic shut off in the toilets.
- Install push button timer control in all rooms lighting and ceiling fans.
- Install Power Electronics control of the Foyer notice board lighting.
- Installation of intelligent lighting controller will help in controlling the lighting energy.
- Use of photo sensor switch for street light controlling helps in conserving the lighting energy.



Investigative parameters – Energy Management – Solar street light and sources of energy consumption



Investigative parameters – Ecological Management – Plantations, covered parking and ramp



Investigative parameters – Water Management – Water sources and proposed rain water harvesting system



Investigative parameters – Waste Management – Sanitary vending machine, dustbins and cleanliness in premises

7. Compilation

The study is based on the data collected, analyzed, rechecked, and confirmed through multiple modes. For the quality study, some standards/ notes have been referred to. These are listed and noted below. However, no direct references have been used anywhere. These are used as a base to analyze and study the data collected.

Specific references for study related to energy

- <https://www.energy.gov/eere/buildings/zero-energy-buildings>
- <https://www.dsaarch.com/zero-net-positive-energy>
- U.S. Energy Information Administration
- <https://www.happysprout.com/inspiration/what-is-smart-gardening/>
- <https://housing.com/news/smart-gardening/>
- Inference study reference image - Zsuzsa Bóka from Pixabay
- Inference study reference image - <https://solarpowerproject.in/solar-panels-for-parking-lots.php>

