ENERGY AUDIT

STUDY PERIOD (TWO YEARS) 2020-2021 AND 2021-2022

Sustainability study

AUDIT REPORT

Studied for

Maharshi Karve Stree Shikshan Samstha's

Cummins College of Engineering for Women

Karvenagar, Pune – 411052

Studied in the capacity of

An accredited & Certified Green Building Professional

Studied by

Greenvio Solutions

Valid till October 2023

Background reference image Janko Ferlic on pexels

Hereby presents

An Eco-friendly premises

that has executed

more than 90% elements

required for a Green Building

One of India's first technical institute for girl students

Cummins College of Engineering for Women

Affiliated to the Savitribai Phule Pune University

Disclaimer

The Audit Team has prepared this report for the **Maharshi Karve Stree Shikshan Samstha's Cummins College of Engineering for Women** located at *Karvenagar, Pune – 411052* based on input data submitted by the Institute and 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 a 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 Institute. 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.

The audit is a thorough study based on the inspection and investigation of data collected over a while and should not be used for any legal action. This is the property of Greenvio Solutions and should not be copied or regenerated in any form.

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 an Accredited and Certified Green Building Professional-Architect; I.A.(IMS) 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 incapacity of an Accredited & Certified Green Building Professional with extensive experience.

Greenvio Solutions

Developing Healthy and Sustainable Environments

We are an Environmental and Architectural Design Consultancy firm

Sustainable Academe is our department for conducting Audits

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Acknowledgment

The Audit Assessment Team thanks the **Maharshi Karve Stree Shikshan Samstha's Cummins College of Engineering for Women, Pune, Maharashtra** for assigning this important work of Energy Audit. We appreciate the cooperation extended to our team during the entire process.

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Our heartfelt thanks to the Chairperson of the entire process **Dr. Madhuri Khambete,** Principal, for the valuable input.

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Sustainable Academe

Brand of Greenvio Solutions, Palghar District, Maharashtra- 401208

Contents

1. Introduction

1.1 About the Institution

Cummins College of Engineering for Women is the first all women engineering college in India established with the support of Cummins Diesel (India) Foundation. Parent institution of Cummins College is Maharshi Karve Stree Shikshan Samstha (MKSSS). 'Bharat Ratna' Recipient, Maharshi Karve, established MKSSS in 1896 with the mission of women empowerment through education.

The Institute is recognized for its rigor in academics and dedicated faculty, successful alumnae being its outcome. It has a strong association with the industry and is recognized for providing quality recruits for the industry.

1.2 Statements prescribed by the Institute

1.2.1 Vision

The College proposes *"To be a globally renowned institute for imparting quality education and development of women leaders in engineering and technology."*

1.2.2 Mission

The College adheres and focuses *"To develop women professional who are academically and technically competent with strong professional ethics"*

1.2.3 Motto

The College has works towards *"Empowerment of Women through Education."*

The commitment of the Institute is towards continuous improvement and democratic functioning, as is reflected in its vision and mission statements, which in turns become the guiding principles for the governance of the Institute.

1.3 Assessment of the Institute

1.3.1 Affiliations

The Institute is affiliated to **Savitribai Phule Pune University**, one of the premier universities in India, is positioned in the North-western part of Pune city.

1.3.2 Certification

The College has received the following Certifications

- NIRF – Participated in the National Institutional Ranking Framework and has secured position in rank band 200 -250 for the year 2022 and 2021. The institute secured rank 173 in 2020.
- AISHE – The All India Survey of Higher Education code is C-42242.

1.3.3 Accreditation

The following are details of the accreditation awarded by the National Assessment & Accreditation Council (NAAC) to the College.

Cycle	First	Second	Third
CGPA	70-75	3.33	3.16
Grade	B	A	A
Year	2002	2012	2017

Table 1: NAAC Accreditation details of the Institute

The College is due to enter its Fourth cycle of NAAC.

1.3.4 Recognitions

The college is affiliated to Savitribai Phule Pune University, Pune under the UGC scheme for autonomous colleges **for a period of six years w.e.f.2016-2017 to 2021-2022.**

1.3.5 Approval

The technical courses provided by the College are approved by **All India Council for Technical Education (AICTE), New Delhi**.

1.4 Achievements of the Institute

The Institute has a tremendous track record of excellence in Built form and educational services provided, below are some of the achievements of the prestigious Institute.

- **The College ranked 22 in All India Private Engineering Colleges according to 'The Week'.**

- **Best College Award by Savitribai Phule Pune University, 2020-2021.**
- **In local media 'Outlook'**
  - ⇒ 2022 :- Rank 37 in Private colleges
  - ⇒ 2021 :- Rank 42 in Private colleges
  - ⇒ 2020 :- Rank 46 in Private colleges
- **In the local media 'India Today'** among overall Private Engineering College
  - ⇒ 2022 :- Rank 49
  - ⇒ 2021 :- Rank 54
  - ⇒ 2020 :- Rank 68

1.5 Research and Innovation

The College integrates multiple curriculum programs through its unique research and development activities. The goal is *"To develop an integrated R&D environment that will promote and strengthen the research activities in the institute, to meet the immediate as well as futuristic requirements of the Industry and Society and thus improve the quality of various study programs at the College."*

1.6 Facilities

The College is one of India's first Institute of Engineering for girl students. It has an excellent state of the art infrastructure. The College emphasizes on latest technological advancement through its educational initiatives. Some of the key facilities are listed below.

- Auditorium
- Conference halls
- Outdoor sports areas
- Workshop areas
- Break-out spaces in the Indoors of the premises
- Hostel

2. Institution overview

2.1 Populace analysis for the 2020-2022

2.1.1 Students data

The student data (shared by the Institute) shows there were an **approximately 2,500 Girl students** on the premises in both academic years.

2.1.2 Staff data

The staff data shows the premises had an approximate of **300** Staff Members on the premises in both academic years.

2.2 Total Institute Area & Institute Building Spread Area

The **total site area is 4 acres** and the **total Built-up area of the Institute is 40,870.57 sq. ft.** for **a total of 3,000 footfalls.**

2.3 Institute Infrastructure

2.3.1 Establishment

The Institute was established in 1991.

2.3.2 Spatial Organisation

The overall ambiance of the Institute is warm and inviting. The Architectural style of exposed bricks provides a soothing and contrasting feel to the built-form. The colour palate of earthy colours in the facades helps the building stand out positively.

There are provisions for lifts and a 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.

2.4 Operation and Maintenance of the premises

The interview session was held with the staff regarding the operation and working hours. The schedule is mentioned below.

- **Main Institutional areas** - 7:30 am to 6:00 pm, Monday to Friday and 10:00 am to 2:00 pm on Saturdays for around 250 days (Approximate).
- **Library areas** – 7:30 am to 7:30 pm, Monday to Saturday and 9:00 am to 1 pm on Sundays usually for around 320 days (Approximate).

3. Green Building Study as a Research based technical audit

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 for the following:

Energy Audit

- Analysis of the Lights, Fans, AC, Equipment
- Renewable energy
- Scope for reducing the current energy bills if any
- Improvement in the thermal comfort of the premises

Green Audit

- Green initiatives
- Hygiene audit
- Water Audit - Analysis of the current water consumption of campus; Rainwater harvesting and Wastewater treatment on the premises.
- Waste Audit - Current waste produced, its segregation, and usage; Strategies to be adopted for waste management and awareness

Environmental Audit

- Analysis of the current landscape + hardscape of the premises
- Analysis of the flora and fauna of the premises
- Strategies adopted at present to enhance vegetation
- Measures that can be adopted for ecological improvement of the premises.

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

- 01 August 2022 - Allotment and Initiation by the Institute
- 08 August 2022 - Induction Meeting
- 25 August 2022 - Review Meeting
- 23 September 2022 - Survey of students and staff completed
- 28 September 2022 - Site visit at the Institute
- 20 October 2022 - Submission of the Report

On-site review with the Team

Induction meeting with the Team and inspection of the Universal toilet

Group photo with the Team

4. Energy Audit

4.1 Sources of Energy consumption

The sources of energy consumption in a building comprise Lighting, Refrigeration, Ventilation, Cooling, Computers, Office equipment, cooking, space-eating, water heating, and others. For study purposes, the sources are divided into primary and secondary sources, where the primary is considered for the generation and consumption purposes and secondary sources are additional sources used as an alternative backup. The study emphasizes the consumption patterns, strategies adopted at present, and recommendations that can be implemented to improve the power consumption and utilization pattern. The following mentioned are sources of consumption and production.

4.1.1 Primary sources

- **Electrical (Metered)** – This source studies the elements which are connected through a metered system of electrical consumption. Light, fans, air conditioners, equipment, and pumps are the consumers that comprise this category.
- **Renewable (Solar)** – There are sources of renewable energy available at present in the form of Solar Panels.

4.1.2 Secondary sources

UPS and Batteries– These are utilized in the administrative and academic areas the Institute spend a huge amount towards the same every year.

4.2 Site investigation analysis

The data investigated and collected through interviews are summarised below:

4.2.1 General overview

This analysis is based on the general parameters of the external audit team.

- The **Maintenance Staff, Lab Attendants switches off all equipment** regularly after their appropriate usage.
- All the **computers are shut off after use** and also put on power-saving mode.
- There are **Ultra-violet lights used only in the scientific labs for experiment purposes, apart from these no other harmful lights used** in the premise.

4.2.2 On-site overview

This analysis is based on the specific parameters which were observed during the visit for physical investigation and the induction meeting (offline).

- The computer laboratories use backup systems for power and data.
- **There were no serious discrepancies found in aspects related to energy management.**
- The Institute is located in an urban area; it has no power cuts and the alternative sources of energy which are present are sufficient for current practice.

4.3 Utility bill audit

The admin department had shared the bills for Meter which is connected to all Buildings and is main source of energy supply. The solar panels were installed recently and there has been a positive effect of the same. The details of meter wise unit consumption of the electricity generated are as follows.

S. No	Month	Units consumed	Billing Amount (Rs.)
1	Apr-20	8,800	75,607
2	May-20	9,416	1,68,849
3	Jun-20	15,614	2,43,150
4	Jul-20	16,027	2,47,488
5	Aug-20	17,136	3,07,278
6	Sep-20	11,665	3,40,622
7	Oct-20	17,649	3,04,148
8	Nov-20	20,455	3,38,917
9	Dec-20	41,174	3,09,059
10	Jan-21	19,853	3,22,663
11	Feb-21	20,038	3,03,798

12	Mar-21	21,638	3,64,759
13	Apr-21	20,042	2,53,469
14	May-21	21,932	3,05,957
15	Jun-21	13,280	2,15,610
16	Jul-21	19,001	2,87,505
17	Aug-21	22,719	3,23,655
18	Sep-21	19,530	2,75,636
19	Oct-21	29,004	3,38,577
20	Nov-21	19,544	3,14,226
21	Dec-21	23,823	3,22,963
22	Jan-22	17,915	2,31,367
23	Feb-22	22,266	2,58,391
24	Mar-22	23,429	2,77,971

Table 2: Details of the electricity bills summary

4.3.1 Inferences based on the data

The analysis of actual electrical energy consumption is summarised below.

- The average consumption varies for each month.
- At present the Institute is spending a huge amount every month on the electricity bills.
- Some appropriate renewable energy planning should be adopted.
- Similarly, a schedule-wise detail documentation of daily energy consumption should be maintained.

4.4 Survey Results

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

4.4.1 Participation

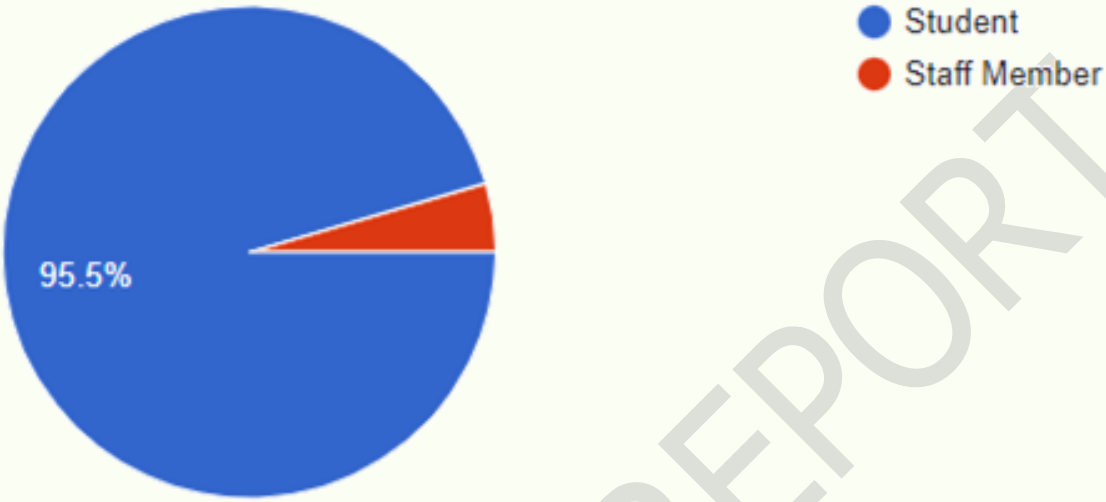


Figure 1: Participation analysis in the survey

A total of **974 responses** were received out of which 96% were students.

4.4.2 Review of the Energy management practices in the premises

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 the graph depict the Number of participant's responses in numerical (Percentage of the participant response) – For example 101 responses (44.5%)

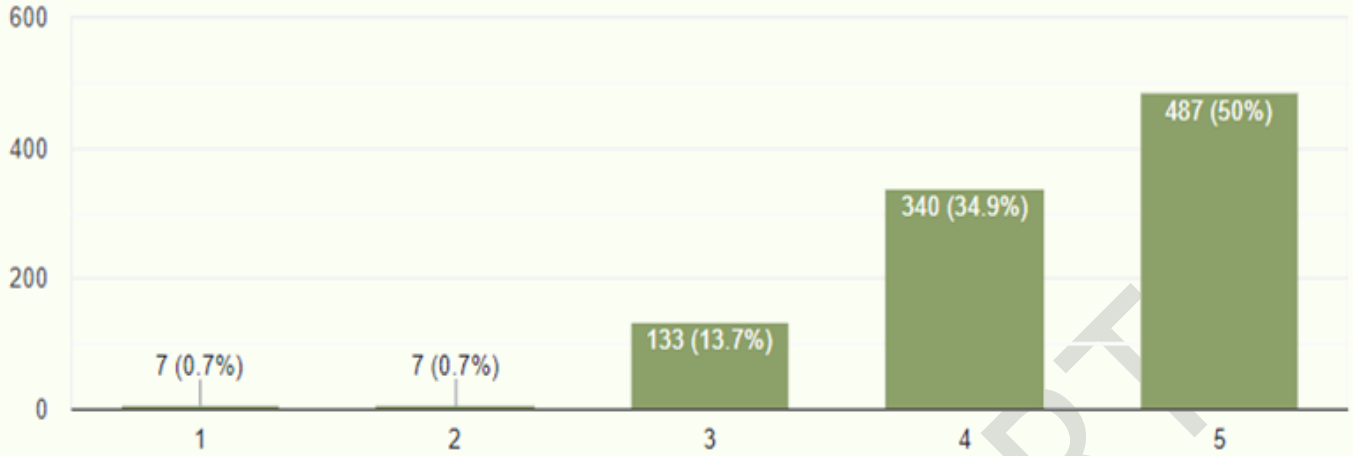


Figure 2: Energy management practices in Institute

Observation: The students and staff *almost 50% of the respondents which are 487 participants* found the practices to be Excellent (Rating of 5); whereas *almost 35% of the respondents which are 340 participants* found the practices to be Very Good (Rating of 4); and *14% of the respondents which is 133 participants found the practices to be Good (Rating of 3).*

Inference: Though the majority responses received is only 50% which has been given to 'Rating of 5' thus given the populace of the Institute this section requires a lot of improvement.

4.5 Calculated Electrical Consumption as per study

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 collection 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 conditioners, and equipment. The inventory and data collection for sources of energy consumed in the premise are summarised in the following sections.

Note: The following analysis is combined for the entire premise taking into consideration the duration before the pandemic to understand the consumption pattern on a regular day.

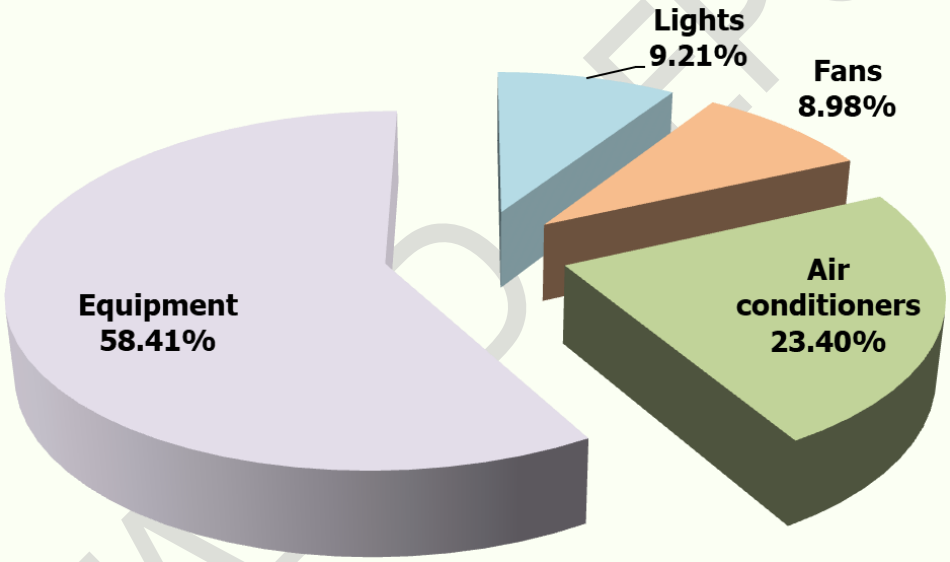


Figure 3: Summary of the calculated electrical consumption as per inventory

The above graph shows that equipment consumes 58.41% followed by air conditioners at 23.40% the lights at 9.21% and the fans consume 8.98% of the total calculated electrical energy.

General point regarding the study

The entire premises are spread in separate blocks. The study has been done for each of these blocks individually and combined in the following sections.

4.6 Electromechanical systems – Lights

4.6.1 Types of lights based on the numbers

There are a total of **2,437 lights on the premises;** the following table shows the various types of lights on the premises.

S. No.	Type	Nos.
1	CFL	52
2	LED	2,385

Table 3: Summary of the types of lights on-premise

4.6.2 Types of lights based on the power consumption

The energy consumption of lights is **93,957 kWh** of energy.

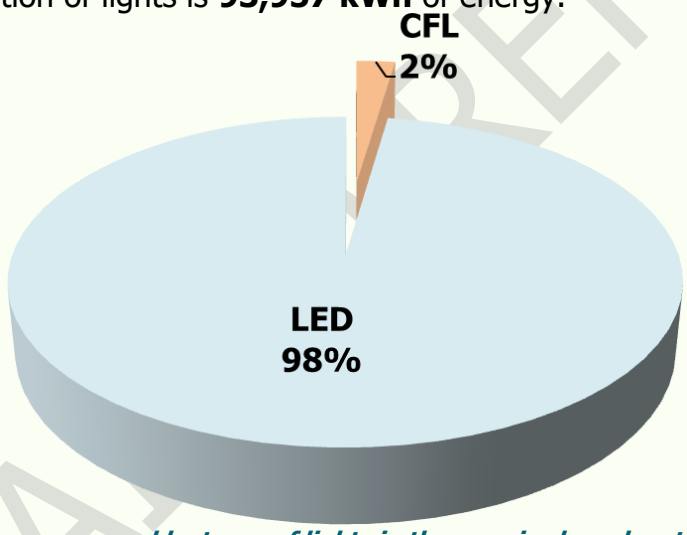


Figure 4: Energy consumed by types of lights in the premise based on the usage study

The analysis of the types of Lights on-premises shows **LED lights consume 98%** followed by **CFL lights consume 2%**

4.6.3 Block-wise consumption analysis

The following list shows Block-wise consumption where the CFL Lights should be replaced.

- Main Building – Few spaces
- Mechanical Building - Conference hall, Student Common Room, CeRIE Lab
- IT Building - Rest room toilet
- Suswad Cafe - Washroom

4.6.4 Requirement of NAAC

4.6.4.1 Alternative energy initiative

Percentage of power requirement met by renewable energy sources It was informed by the College that the installation of solar panels on the College terrace has been carried out, which reduces grid power consumption by the Institute. *On average 35-40% of the power requirement of the College is met by solar energy installed on the premises.*

4.6.4.2 Percentage of lighting power requirement met through LED lights

The premise has LED Lights to contribute to 98% in terms of number and **98% of the power requirement** is met through the same. As per our study, we could conclude that both of these are the highest contributions among all the types of lights.

4.6.5 Site investigation observations

- All lights are in working conditions.
- There was no fuse defect observed.

4.6.6 Section-wise recommendation related to 'lights'

*To be considered as **first priority but first in sequence** for implementation under section wise study*

CFL lights - The current light analysis shows that the College has CFL lights in certain areas, these should be replaced with LED lights which consume on an average 16-20W when in use. Our technical analysis shows that there would be a reduction of an average of **28% reduction** in energy consumption through lights specifically as a part of the electro-mechanical system if all **CFL lights** are replaced on all floors and buildings with an energy-efficient appliance whenever the College undergoes renovation.

4.7 Electromechanical systems – Fans

4.7.1 Types of fans based on the numbers

There are a total of **896 fans** on the premises; the following table shows the various types of fans on the premises.

S. No.	Type	Nos.
1	Ceiling fan	828
2	Pedestal fan	14
3	Wall Mounted Fan	5
4	Small motor exhaust fans	6
5	Medium motor exhaust fans	43

Table 4: Summary of the types of fans in the premises

4.7.2 Types of fans based on the power consumption

The energy consumption of fans is **91,666 kWh** of the energy.

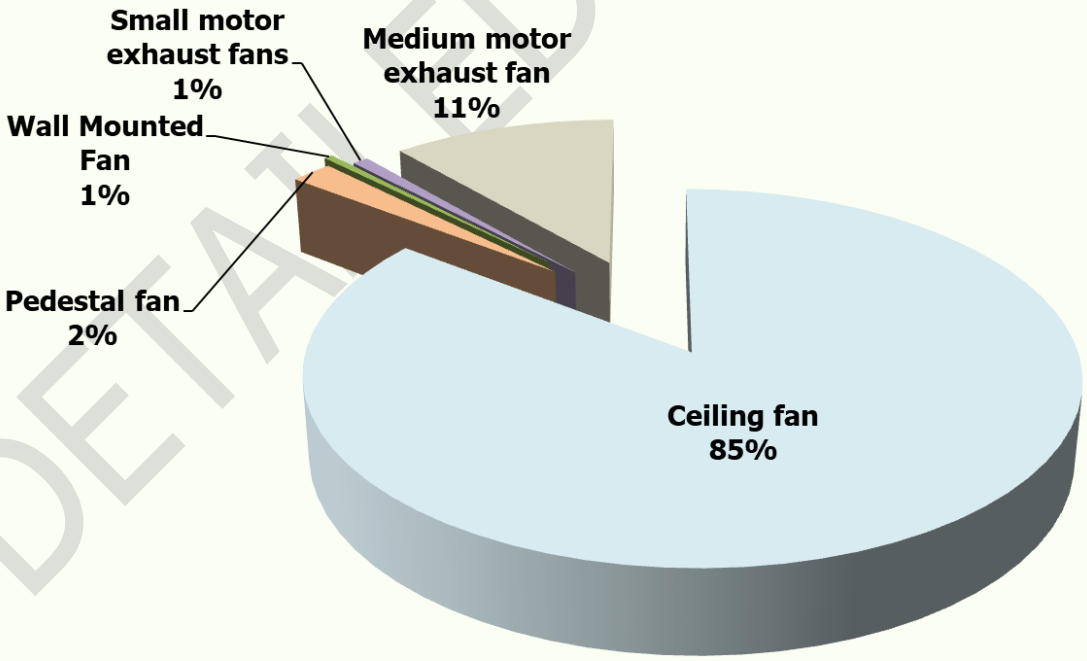


Figure 5: Types of fans based on power consumption

The above analysis shows the **Ceiling fans consume 85%** whereas the **medium motor exhaust fans consume 11%** of power; the **pedestal fans consume 2%** and the **small motor exhaust fans, wall mounted fans consume 1% each** of the total power.

4.7.3 Block-wise consumption analysis

The following graph shows the Block-wise consumption.

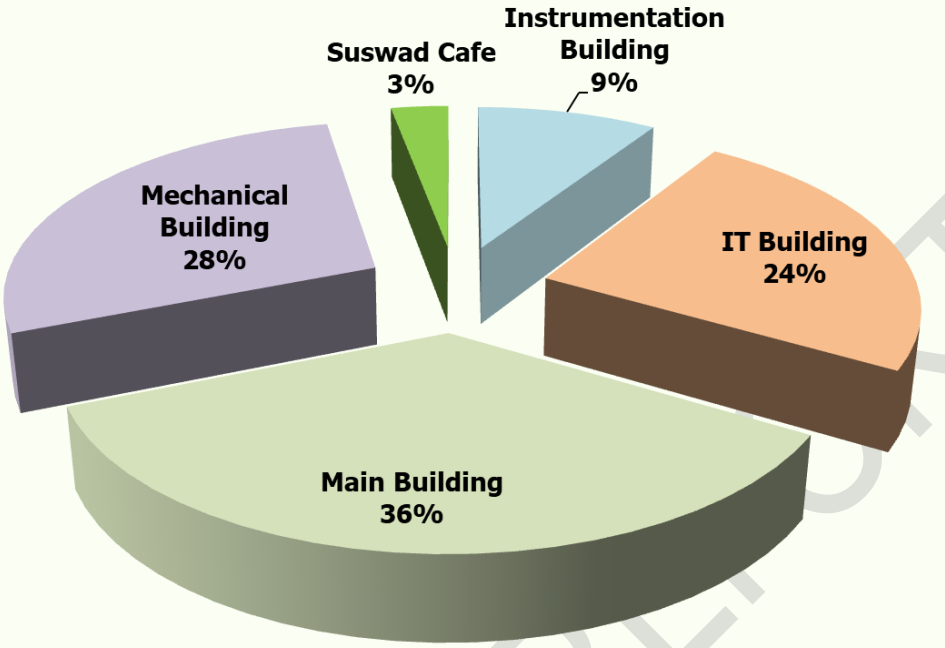


Figure 6: Energy consumed by fans block-wise

The above analysis shows the fans on the **Main building consume 36%; the Mechanical building consumes 28%; the IT building consumes 24% while the Instrumentation building consumes 9%; the Suswad Café consumes 3%** of the total power consumed by fans.

4.7.4 Site investigation observations

- All fans are in working conditions.
- Windows do not have cracks and are caulked appropriately.

4.7.5 Section-wise recommendation related to 'Fans'

*To be considered as **first priority but first in sequence** for implementation under section wise study. It should be noted the premises at present there are 5% energy efficient fans.*

Our detailed study states that is all the **ceiling fans in all Buildings** if replaced with star rated appliance results in a reduction of average of **47% 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.

4.8 Electromechanical systems – Air conditioners

4.8.1 Types of air conditioners based on the numbers

There are **96 air conditioners** on the entire premises**.**

4.8.2 Types of air conditioners based on the power consumption

The energy consumption of air conditioners is **2,38,770 kWh** of energy.

4.8.3 Block-wise consumption analysis

The following graph shows the Block-wise consumption.

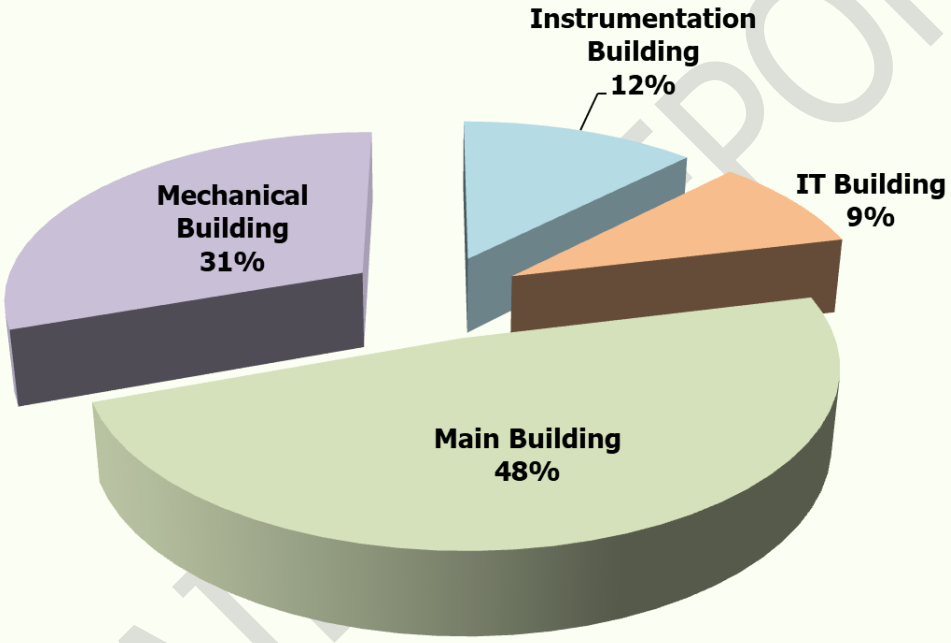


Figure 7: Energy consumed by air conditioners Block-wise

The above analysis shows the air conditioners on the **Main building consume 48%; the Mechanical building consumes 31%; the Instrumentation building consumes 12% and the IT building consumes 9%** of the total power consumed by air conditioners.

4.8.4 Site investigation observations

The Outdoor units are cleaned properly and do not possess dust collection problems.

4.8.5 About the replacement of current air conditioners

Though there is not an immediate requirement for replacement however, whenever the Institute undergoes redevelopment or a new Block is constructed there can be provisions for replacement with energy-efficient appliances that require less power consumption.

4.9 Electromechanical systems – Equipment

The equipment study plays an important role in the analysis of the electrical consumption. These when considered from the Green building perspective are essential to understand their consumption patterns, in order to determine their inputs towards the power generation contribution. As an educational institute, it has general equipment with a regular power contribution pattern. During the visit it was observes that utmost measures are taken for the safety and proper handling of the equipment.

4.9.1 Types of equipment general information

The educational sector was briefly subdivided into 5 major subsectors as follows.

- **Administrative and regular usage** – Air cooler, Barcode scanner, Biometric machine, CCTV Camera, Desktop computer (This appliance is divided as per its space in two sections), Hub, Printer, Server, Xerox machine etc.
- **Infrastructure mandatory usage** – CCTV Camera, Distilled water plant, electric oven (Used in the café), refrigerator, lift motor, PA system, water cooler, Wi-Fi router, and sanitary vending machine.
- **Occasional usage -** Audio system, microwave etc.
- **Usage in Labs, Classrooms, Tutorial Rooms and similar** – All the equipment used in various laboratories; Projector, Desktop computer (This appliance is divided as per its space in two sections)

4.9.2 Types of equipment based on the numbers

There are **2,084 types of equipment in the Educational sector as follows**.

S. No.	Type	Nos.
1	Administrative & regular usage	261
2	Infrastructure mandatory usage	92
3	Occasional usage	27
4	Usage in Labs, Classrooms, Tutorial Rooms and similar	1,704

Table 5: Summary of the types of equipment in the educational sector

The maximum numbers of equipment are present in Specific Educational lecture usage and the Administrative & regular usage sectors based on the numbers of the equipment.

4.9.3 Types of equipment as per their energy contribution

The energy consumption of equipment is **2,38,770 kWh** of energy.

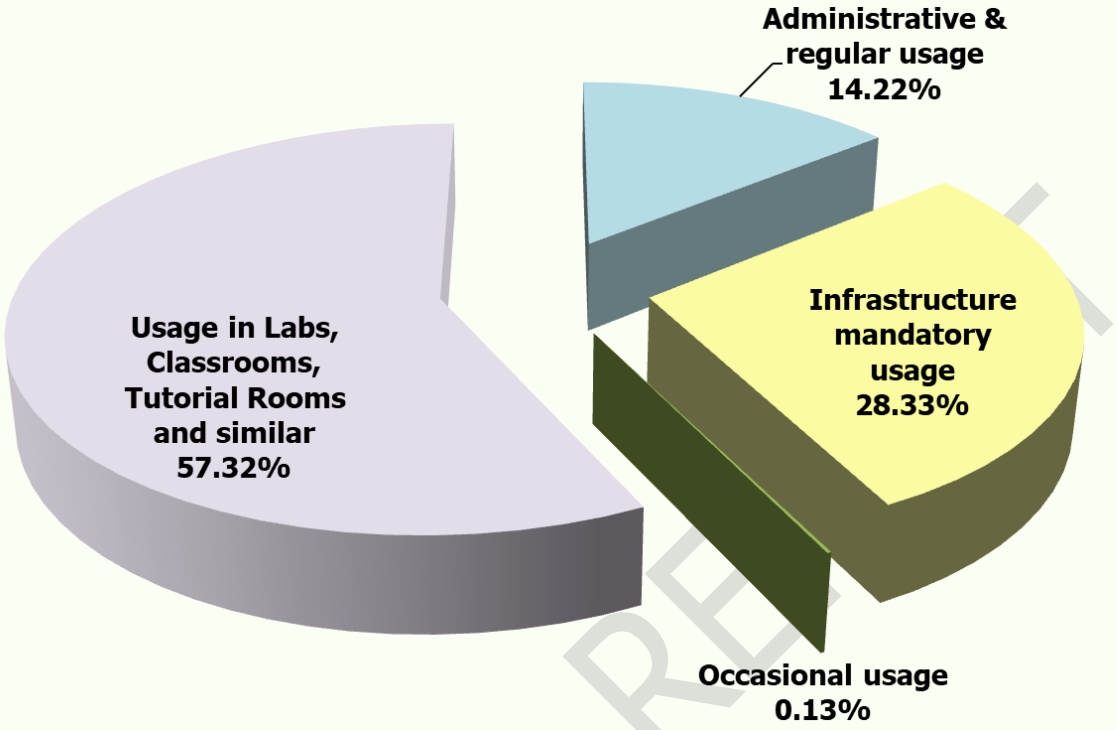


Figure 8: Energy consumed by types of equipment in the educational sector based on the usage study

The analysis of the types of equipment shows that the **Specific Educational lecture usage consumes 54.98%** whereas the **Infrastructure mandatory usage consumes 28.33%;** the **Administrative & regular usage consumes 14.22%;** the **scientific usage consumes 2.34%** and the **Occasional usage** consumes 0.13%

4.9.4 Site investigation observations

Some of the points noticed are as follows:

1. No unnecessary electronic devices are plugged in.
2. During vacations all electrical devices unplugged.
3. All types of equipment are in working conditions and daily monitoring and check are done by the maintenance staff and admin staff skilfully.
4. No defect was found in any equipment of electrical consumption.

4.9.5 Section-wise recommendation related to 'Equipment'

*To be considered as **first priority but first in sequence** for implementation under section wise study*

a) Desktop computers to laptops

Among all equipment, it suggested replacing the desktop computers with laptops as this would be energy efficient. A normal desktop computer consumes an average of 250W and it is to be connected all time when it has to be used. On the contrary, a laptop consumes 40W and has a battery backup that lasts up to 4 hours.

There is **an average 84% reduction** in energy consumption if replaced with an energy-efficient appliance which is a laptop in all the areas. This replacement is however dependent on a variety of factors as follows.

- **Some of the senior staff** members may be more convenient with computers; replacement with a laptop might result in a change of the working patterns and hours which may affect the productivity.
- **Laptops** in case are not handled with care such as if dropped unintentionally might result in data imbalance.
- **Students who are not day scholars** can use a laptop at their convenience; whereas in common areas there can monitor of the usage hours hence computers may be a preferable option then laptops in certain spaces.
- **Depending on the recent pandemic situation** in case it might be possible due to irregular usage the device might have issues while functioning.

Thus the Institute should analyze the above points and then devise a strategy for the replacement, when the devices get damaged or are not in working condition.

b) Other equipment

The following recommendations are for the other equipment in the premises.

- Replace the Non-LED (Regular) TV Monitors with LED equipment.
- Backup computer files during vacations.
- Refrigerators and all electronic equipments should be cleaned out completely including system check up with AMC during vacations, this should be a periodic activity and the same should be documented every year.

4.10 Consolidated study recommendations related to 'entire Institute'

*To be considered as **first priority but second in sequence** for implementation, once the section wise recommendations are implemented.*

Over time energy-efficient appliances have been a boon not only to the energy-saving parameters they adhere to but also to the eco-friendly habits it helps to inculcate. An institution such as Schools and Institutes is the best way to implement these initiatives. It creates awareness among the students at a young age. The Institutions also act as a symbol and representative of being an energy-efficient premise.

The following recommendations should be ***implemented within the prescribed tenure as follows from the date of the Report submission.***

- **Energy efficient premises** (Section wise recommendations) – Within 1 year
- **Nearly Zero Energy premises** – Within 2 years
- **Net Zero/ Positive Energy premises** – Within 3 years
- **Smart premises** – Within 5 years

1) General suggestions

The following suggestions are applicable to all parts of the premises.

- **New buildings** – Use light colour walls, floor and ceiling for all the new buildings that may be constructed in future.
- **Task lighting** – Focus lamps can be installed in admin, staff rooms, library and reading areas.

2) Building management systems (Smart premises)

The College has extreme potential to become 100% energy efficient premises. In addition to provisions in the electromechanical system some facilities can be introduced towards building management systems as well. These can be undertaken equally for educational and residential sections.

- Set the BMS time of day schedules to suit the minimum occupancy periods of the areas served and implement optimum start stop incorporating a night purge cycle,

session and holiday scheduling.

- Space temperature Setback - A temperature setback is a simple strategy to help save utility cost by reducing how often your heating or cooling system operates. (morrisseyengineering)
- Timer control of air conditioners.

3) Facility management systems, controls (Smart premises)

(Includes electromechanical systems – Electrical, Water)

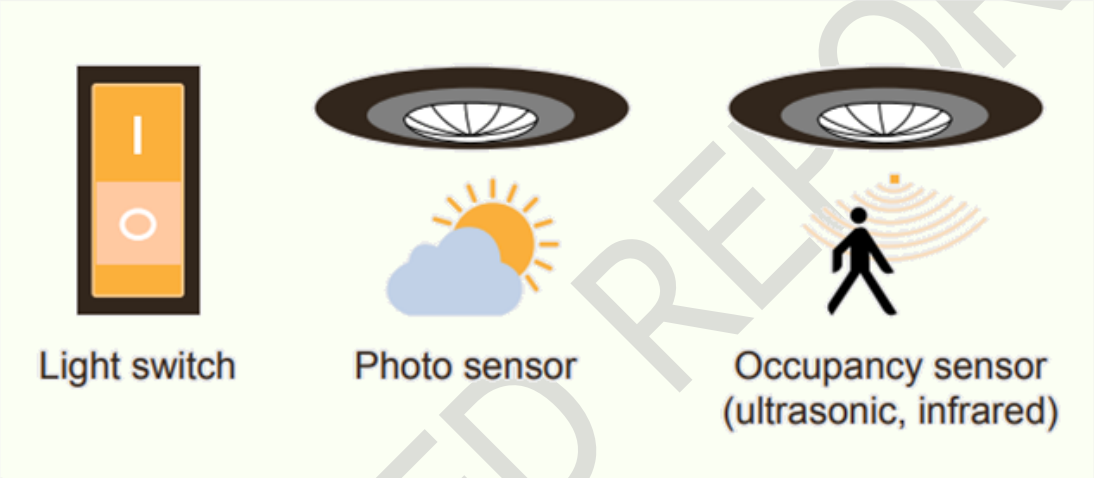


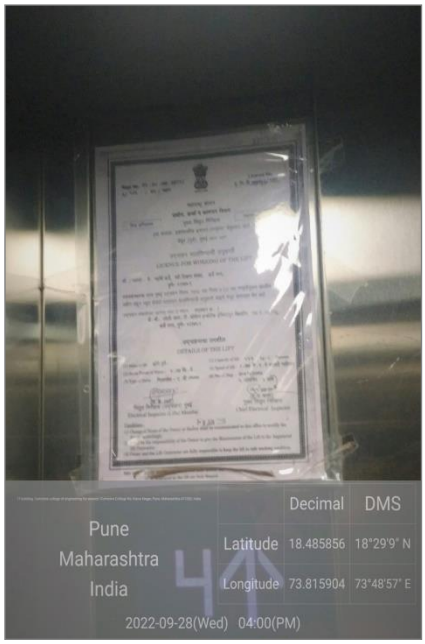
Plate 1: Understanding the lighting concepts

Source: https://seors.unfccc.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 fare as lighting systems are considered. The suggesting 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 audible alarms on the laboratory doors to ensure doors remain closed at all times.
- Install Power Electronics control of the Foyer notice board lighting.
- Use of photo sensor switch for street light controlling helps in conserving the lighting energy.

Solar panels on the roof tops



Electro-mechanical systems in the premises

5. Inferences as Consolidated study

These are to be considered as ***second priority*** for implementation, once the section wise recommendations are implemented. The following recommendations should be ***implemented within the next 2.5 years from the date of the Report submission.***

- **Signing of a MoU for improvement w.r.t. to Green Building aspects of premises**
- **Articles and Documentation** – The premises has multiple features which add to the beauty of the nature and improve the environment in the premises, it is thus suggested to have an article written every month as guided by the Team based on the MoU.
- **Carbon sequestration study** – This study will have to under taken in two phases; one for the dense forest in the premises and the second phase will be for all the plants in the premises.
- **Scope for executing multiple dense forests (Green zones) in the premises based on the prototype** – This can be executed after the Carbon sequestration study has been completed. The Miyawaki technique can be undertaken for this purpose.
- **Determination of Plastic (orange) zones** – The study and execution can be undertaken through a pilot project where the waste plastic can be collected through areas within 5 km of the premises and a product can be developed.
- **Net zero carbon reduction projects –** This is a pilot project where each student will plant at least 6 projects.

6. Towards a Healthy & Sustainable Institution

To be considered as ***last priority*** for implementation, once the section wise (first priority) and the consolidated study (second priority) recommendations are implemented.

The following recommendations are researched strategies for a Healthy and Sustainable Institution practices. These should be ***implemented within the next 3.5 years from the date of the Report submission.***

a) **Environment Certificate Courses –** The College could begin courses such as Bachelors, Diploma, or Certificate courses with National and International Collaboration related to Environment as part of the courses provided. Though, this is not a requirement or compulsion.

b) **Terrace farming -** There can be the provision of terrace farming in a designated area of the open space this would enhance the biodiversity and be useful in training students and staff about the healthy practices and food grown which would be used in Canteen. It helps in smaller steps are taken have huge impacts when each student would adopt these practices in their homes or societies and grow kitchen garden, and terrace garden there will be a long term benefit for the environment as a whole.

c) **Signages –** In addition to the signages being in regular language there can be additional signages in braille language for the specially-abled students.

d) **Clubs –** There can be additional provisions for an Eco-club (For surrounding beautification projects); Hygiene club (For joint activities with local Municipal Corporation to undertake specific hygiene related activities in public areas); Nature/ Adventure club (For outdoor recreational activities); Non-teaching members club (For environment related activities). These are a few suggestions for the increased number of clubs in the Institute. Depending on the curriculum and extra-curricular activities appropriate steps can be undertaken.

7. References

The study is based on the data collected, analysed, 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 analyse 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