May 24, 2025

A REPORT
ON
ENERGY AUDIT IN MARIANI COLLEGE, MARIANI

(From May 2024 to April 2025)

SUBMITTED TO
THE PRINCIPAL
MARIANI COLLEGE
MARIANI-785634, ASSAM

SUBMITTED BY
DEPARTMENT OF PHYSICS
MARIANI COLLEGE, MARIANI

Contents

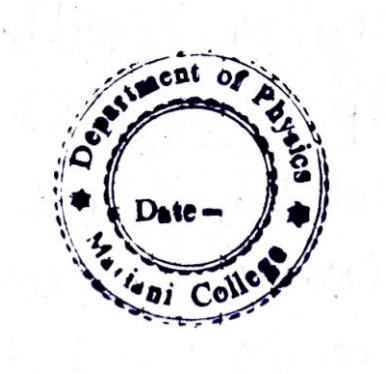
TABLES AND FIGURES:

Acknowledgement:

We are sincerely thankful to the Principal, Mariani College for giving us the opportunity to conduct energy audit.

We are also grateful to Office Staff, Mariani College, for providing necessary documents etc while conducting the audit.

We express our sincere gratitude to all other concerned officials for their support and guidance to bring the report in present format.



For Dept. of Physics:

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1. BACKGROUND:

Energy consumption in various forms has been steadily increasing in practically every sector, including commercial, residential (domestic), transportation, industrial, agriculture and educational institutions. This has led to a greater reliance on electricity and fossil fuels. For energy customers, increasing energy efficiency and potentially reducing energy use become essential goals.

The Government of India enacted the Energy Conservation Act, 2001 in October 2001 and became effective from 1st March, 2002. The Act provides for institutionalizing and strengthening delivery mechanism for energy efficiency programs in the country and provides a framework for the much-needed coordination between various Government entities. Mariani College, an educational institute in Jorhat district of Assam taking initiative for reducing energy intensity in both the college campuses (Arts and Science/Commerce campus) and entrusted Department of Physics of the College for conducting Energy Audit.

2. SCOPE OF WORK:

2.1 Assessment of actual operating load and scope for optimizing the same

- Review of present electrical load in both the campuses.
- Assessment of Building wise electrical load based on electrical fittings.

2.2 Illumination study and energy conservation option in lighting system

- Review of present lighting system, lighting inventories etc. Estimation of lighting load at various locations like different building floors, corridors, rooms etc. outside light and other important locations as mentioned by the management.
- Detail lux level study at various locations and comparison with acceptable standards.
- Study of present lighting system and recommendation for improvement.
- Exploring Energy Conservation options in lighting system.

2.3 Energy Conservation in Air-Conditioning and water pumping system

- Observation and energy conservation.
- Exploring Energy Conservation Option (ENCON) in system.

2.4 Diesel Generator (DG) Sets

- Review of DG set operation
- Performance assessment of DG sets in terms of Specific Fuel Consumption (SFC i.e. Lit/kWh).

3. METHODOLOGY ADOPTED FOR BUILDING AUDIT

Step 1 - Interview with Key Facility Personnel

During the preliminary audit, a meeting is scheduled between the audit team and key operating personnel to start the assignment. The meeting agenda focuses on: audit objectives and scope of work, facility rules and regulations, roles and responsibilities of project team members, and description of scheduled project activities. During this meeting the team enlightened about operating characteristics of the facility, energy system specifications, operating and maintenance procedures.

Step 2 - Facility Tour

After the initial meeting, a tour of the facility is arranged to observe the various operations, focusing on the major energy consuming systems identified during the interview, including the building structure, lighting and power, mechanical energy systems.

Step 3 - Document Review

During the initial visit, available facility documentation is reviewed with facility representatives. This documentation review includes all facility operation and maintenance procedures and logs – sheets/ registers for the previous years.

Step 4 - Facility Inspection

After a thorough review of the construction and operating documentation, the major energy consuming processes in the facility are further investigated. Where appropriate, field measurements are collected to substantiate operating parameters.

Step 5 - Utility Analysis

The utility analysis is a detailed review for the previous months. Data reviewed includes energy usage, energy demand and energy consumption pattern.

Step 6 - Identify/Evaluate Feasible ECMs

Based upon a final review of all information and data gathered about the facility, and based on the measurements final energy conservation measures is developed.

Step 7 - Prepare a Report Summarizing Audit Findings

The results of our findings and recommendations are summarized in this report. The report includes a description of the facilities and their operation, a discussion of all major energy consuming systems, a description of all recommended ECMs with their specific energy impact. The report incorporates a summary of all the activities and effort performed throughout the project with specific conclusions and recommendations and ECMs – Energy Conservation Measures

4. BUILDING DESCRIPTION

The Mariani College consists of multiple buildings (both RCC multi storied and Assam type building). The following Tables show the basic information about the building and the utilities.

Sl. No	Basic Building Data (Arts Campus)	Value
1	A. Connected Load/Contract Demand (For Academic & Administrative Building) Consumer Number: 177000003464	15 kW/17.65 kVA
	B. Connected Load/Contract Demand (For Hostel Building) Consumer Number: 177000030235	5 kW/5.8 kVA
2	Installed capacity of DG set	20 kVA (1 No) Make: Mahindra Powerol Model: 3305GM 15 kVA (1 No) Make: Jaksons Limited Model: JSP-15

3	Annual electricity consumption considering both the consumer number (May'2024 to April'2025)	18076.48 kWh
4	Annual cost of electricity consumption (including fixed charge and electricity duty)	Rs. 1,97,562.70
4.1	Annual cost of electricity consumption through DG set.	Rs. 75,500
4.2	Total cost of electricity (Utility + DG set)	Rs. 2,73,062.70
5	Total Numbers of building covered	7 Nos
5.1	Working hours (Academic and Administration building)	8 Hrs (9 AM to 5PM)
5.2	Working hours (Hostel building)	24 Hr x7 days
5.3	Working Days/week	6 Days
6	Whether sub-metering of electricity consumption for each building	No

Table 1: Basic Building Description (Arts Campus)

Sl. No	**Basic Building Data (Science/Commerce Campus)**	**Value**
1	Connected Load/Contract Demand Consumer Number: 177000000414	19 kW/22.35 kVA
2	Installed capacity of DG set	25 kVA (1 No) Make: Jakson Limited Model: JSP-25
3	Annual electricity consumption (May'2024 to April'2025)	6426.55 kWh
4	Annual cost of electricity consumption (including fixed charge and electricity duty)	Rs. 94,640.03
4.1	Annual cost of electricity consumption through DG set.	Rs. 45000
4.2	Total cost of electricity (Utility + DG set)	Rs. 1,39,640.03

5	Total Numbers of building covered	2 Nos
5.1	Working hours (Academic and Administration building)	8 Hrs (9 AM to 5PM)
5.2	Working hours (Hostel building)	24 Hr x7 days
5.3	Working Days/week	6 Days
6	Whether sub-metering of electricity consumption for each building	No

Table 2: Basic Building Description (Science/Commerce Campus)

5. PRESENT ENERGY SCENARIO

5.1 Review of analysis of electricity bill of Mariani College.

At present the overall energy consumption is mostly catered by the electricity supply from Assam Power Distribution Company Limited and own DG sets. Mariani college has 3 electrical connections from APDCL having different connected load/ sanction load as mentioned in the table no. 1 & 2. Total 3 numbers of DG sets are installed to supply power during load shading hours. (2 numbers are in the Arts campus and 1 number in science and commerce campus) individual capacity of the DG sets are mentioned in the table no.1& 2.

Additionally, 5 nos. of solar powered lights have been installed by a local body, viz., Mariani Municipal Board for illuminating the college premises at night, of which two are in Arts complex and three are in Science and Commerce complex.

5.1.1. Energy Consumption.

The total electricity consumption from May 2024 to April 2025 was 24,503.03 kWh and the total bill paid to distribution companies was Rs. 2,92,202.73

Consumer number wise monthly electricity consumption (kWh) and electricity bill (Rs.) paid from May 2024 to April 2025 have been shown in figures below.

A. Consumer Number: 177000000414 (Science/Commerce Campus)

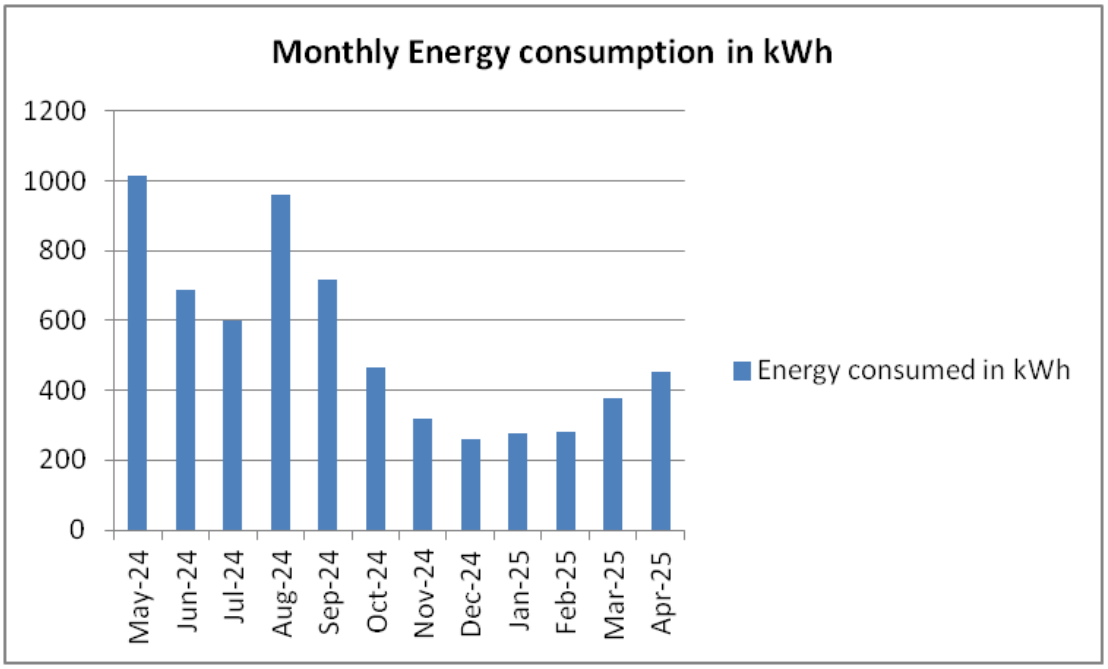

Figure 1: Monthly Electricity Consumption (Consumer Number: 177000000414)

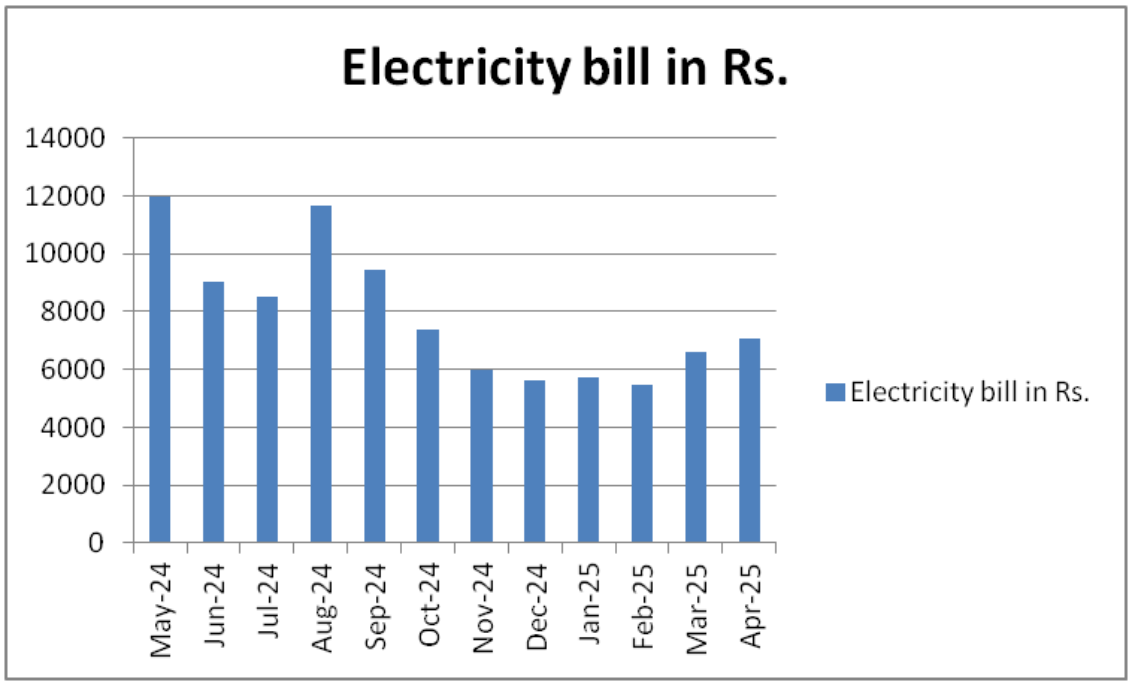

Figure 2: Monthly Electricity Bill (Consumer Number: 177000000414)

B. Consumer Number: 177000030235 (Arts Campus Hostel Building)

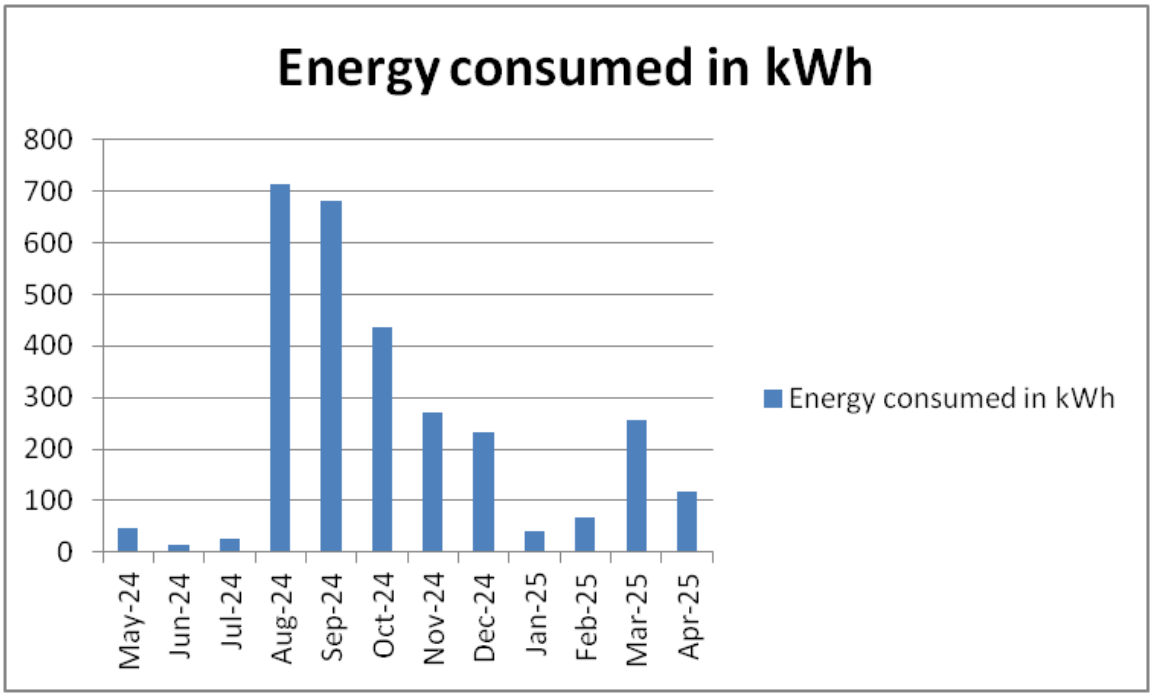

Figure 3: Monthly Electricity Consumption (Consumer Number: 177000030235)

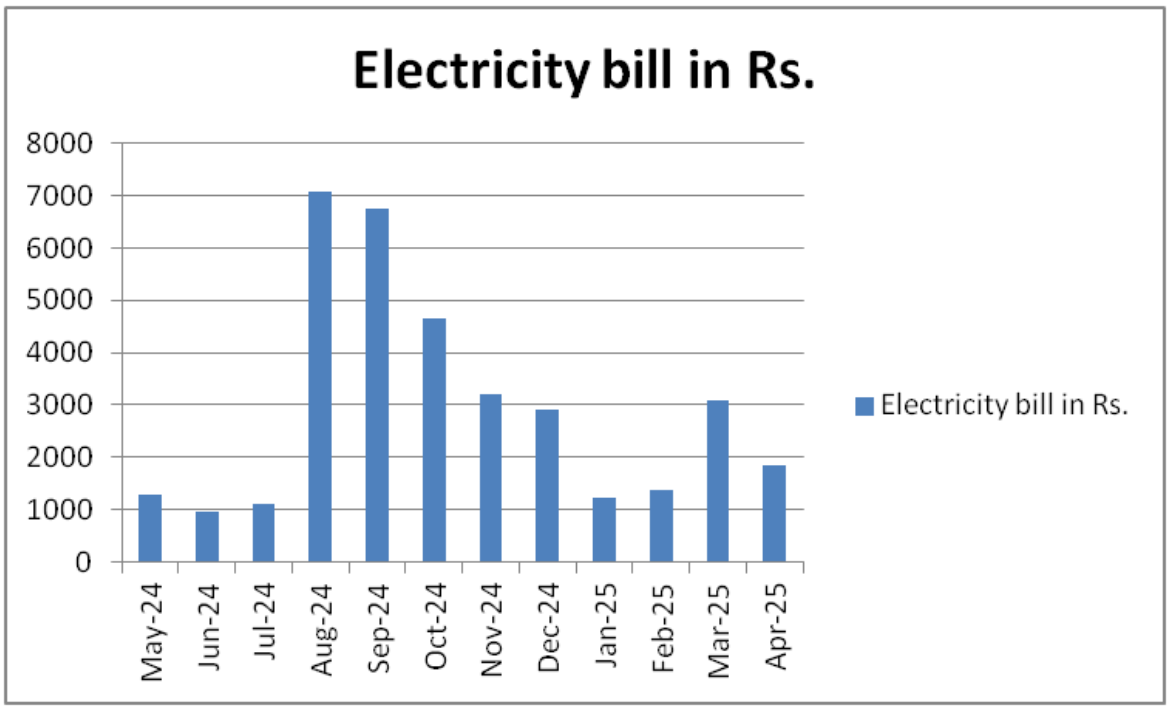

Figure 4: Monthly Electricity Bill (Consumer Number: 177000030235)

C. Consumer Number: 177000003464 (Arts Campus- Academic & Admin Building)

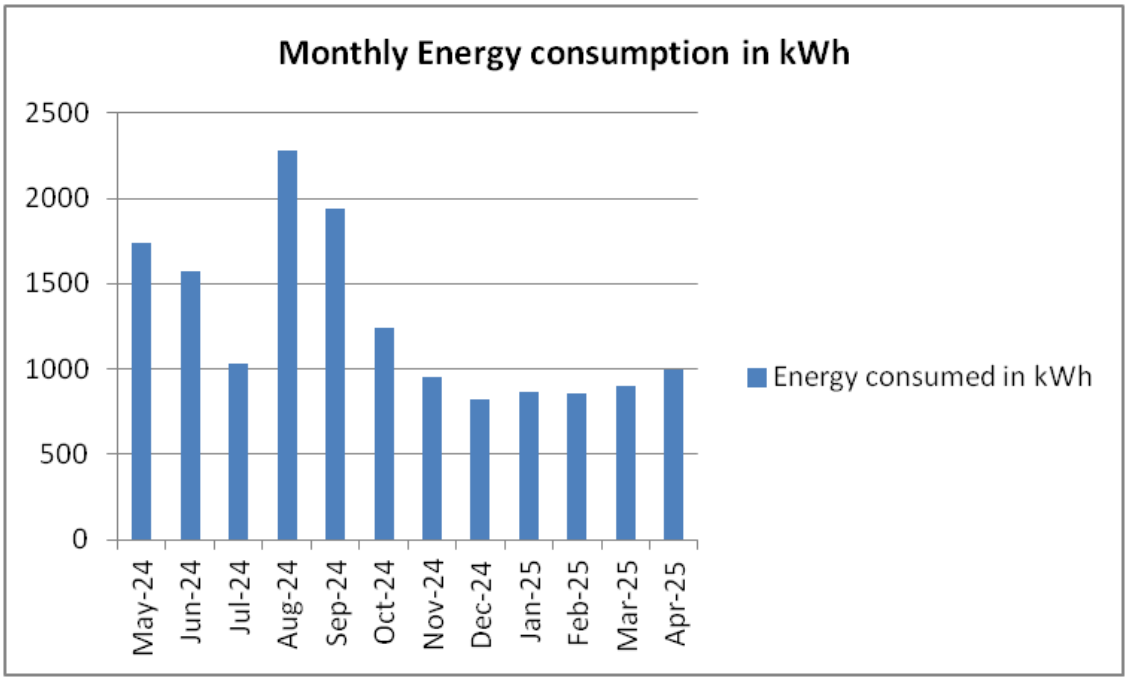

Figure 5: Monthly Electricity Consumption (Consumer Number: 177000003464)

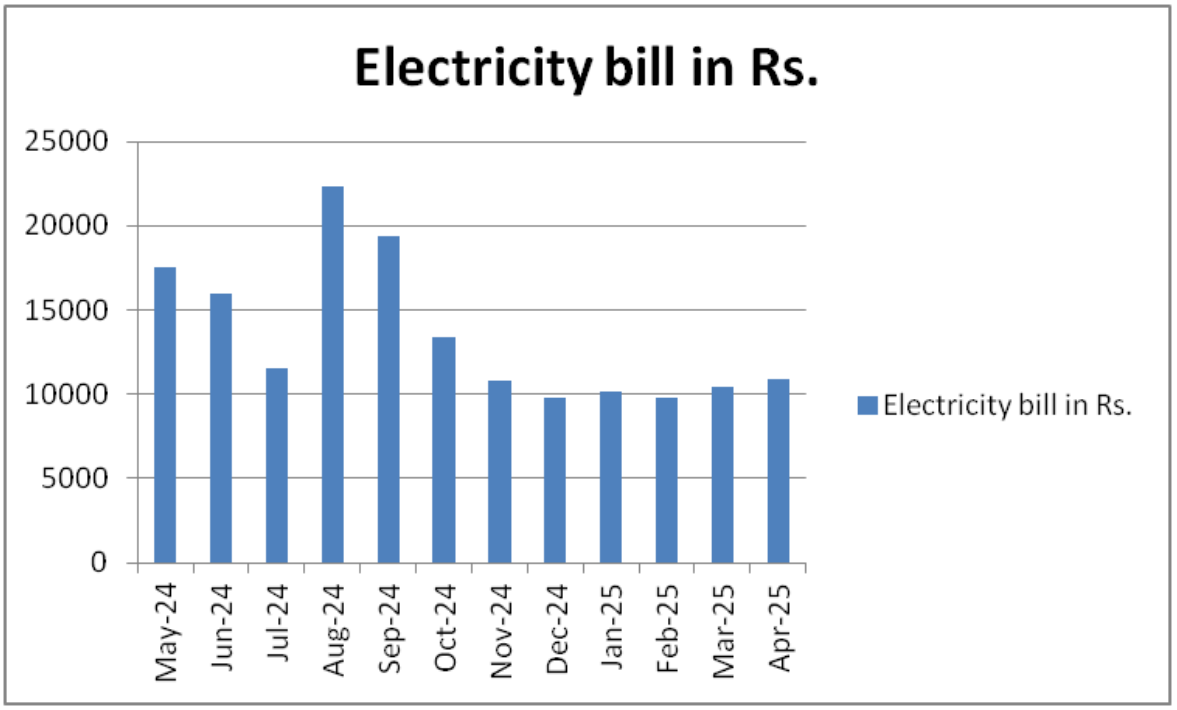

Figure 6: Monthly Electricity Bill (Consumer Number: 177000003464)

Annual expenses incurred due to diesel consumption by all the DG sets (cumulative) was Rs. 120,500.00.

6. PERFORMANCE EVALUATION, OBSERVATION AND ANALYSIS

6.1 ASSESSMENT OF ACTUAL OPERATING LOAD AND SCOPE FOR OPTIMIZING

6.1.1. Energy Consumption in various Loads

The major energy consuming equipment/ utilities available in the building are-

- Lighting Load
- Cooling Load (Fan & Air Conditioner)
- Other Load (Computer/Laptop/projectors and digital classroom equipment)
- Water Pump

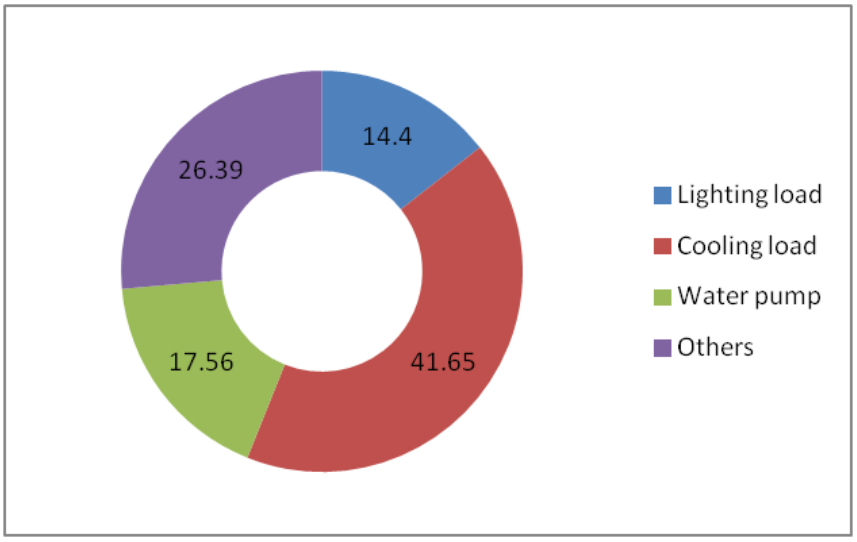

Figure 7: Energy consumption by different load (Arts Building)

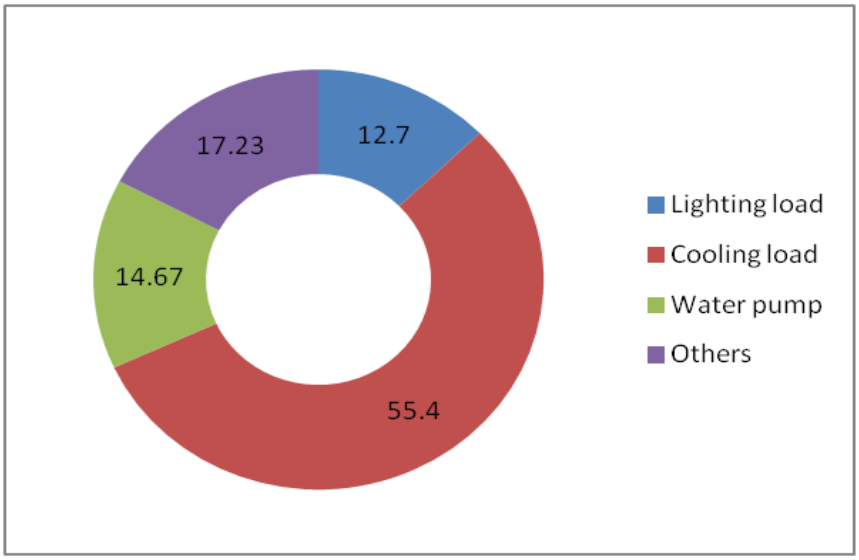

Figure 8:Energy Consumption by different load (Science & Commerce Building)

6.1.2 Building wise estimation of load:

Mariani College consists of multiple buildings comprising various load. A detail assessment was carried out during audit period considering all the loads installed in the buildings. A building wise estimation (as shown in fig.9&10) has been made to understand the load profile which will further help to estimate the electrical energy requirement by the individual buildings for both the campus.

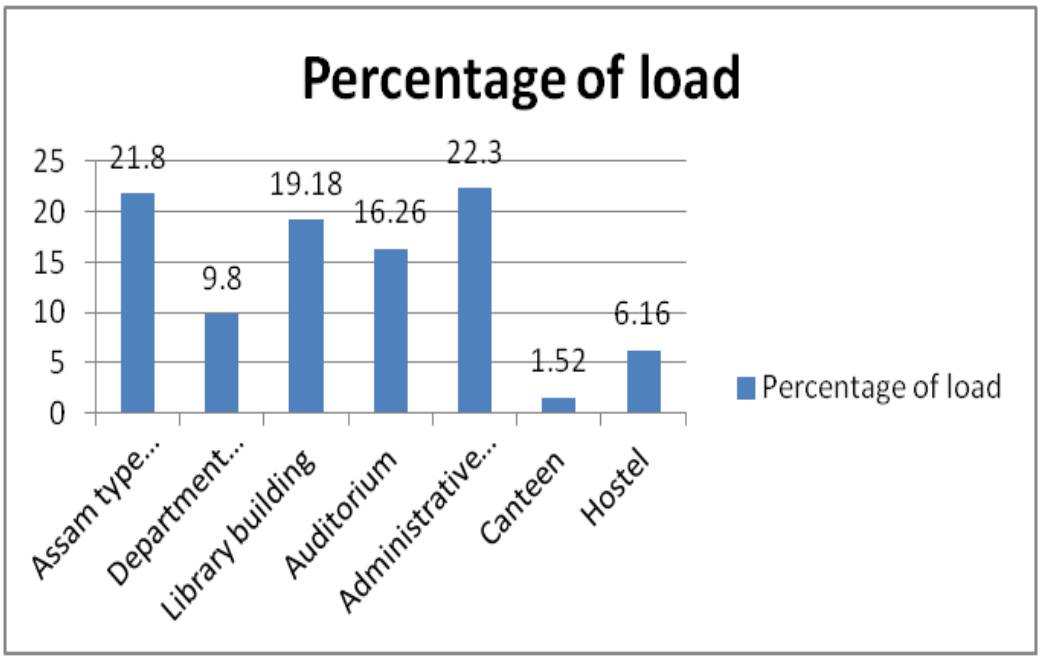

Figure 9: Building wise estimation of Load (Arts Campus)

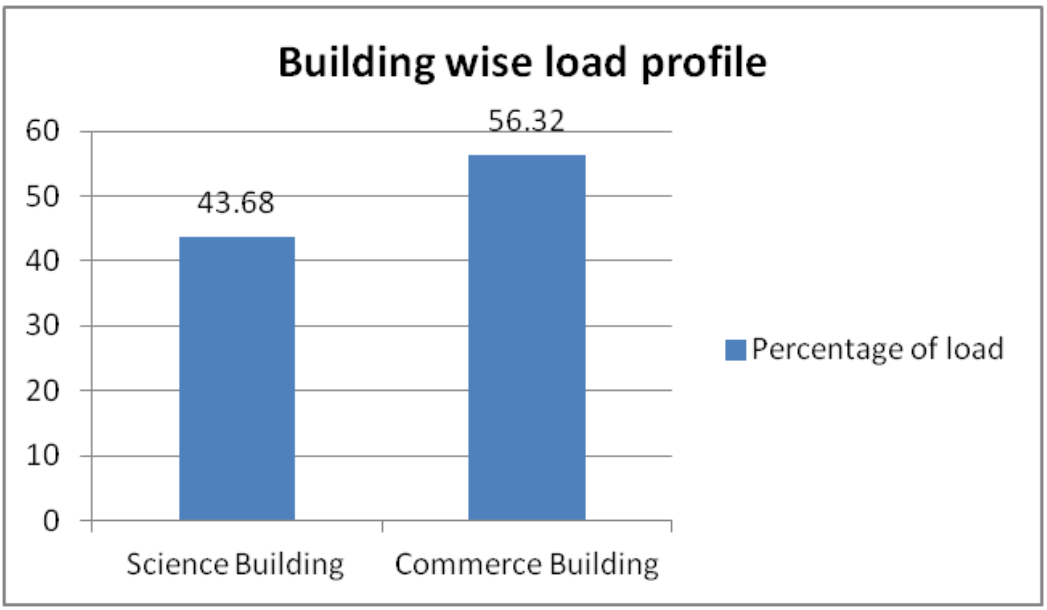

Figure 10: Building wise estimation of Load (Science/Commerce Campus)

6.2 OBSERVATION AND RECOMMENDATION

- Since the campus consist of multiple numbers of buildings with high energy consuming equipment, therefore it is recommended to install separate sub meter for each building to identify and energy consumption of each building. This will help the management to take energy conservation measures as well as it will help to do the performance assessment of electrical uses.
- Presently the total installed load of the arts and science/commerce campuses are approximately 34 KW and 15 kW respectively, which include lighting load, Fan load, AC load, motor load etc. Out of these loads, most of the loads are used on occasional basis, except some areas where energy uses are in regular basis. Total installed load found in hostel is 2.25 kW.
- There is no evidence of recording data of energy generation and consumption by DG set. Management may take initiative to record in the log book for future performance assessment of energy profile of the systems as well as preventive and regular maintenance work. (Please refer annexure for reference).

ILLUMINATION STUDY AND ENERGY CONSERVATION IN LIGHTING SYSTEM:

6.2.1 Review of Present Lighting Loads

Lighting contributes about 14.40 % and 12.70% of total load in Arts campus and Science/Commerce campus respectively. The lighting load of the campus is consisting of 9-Watt LED bulb and 20 W LED tubes. It has also been observed that, almost all the luminaries have already been converted to energy efficient LED lighting except few CFL and FTL in some locations. The College authority intend to comply energy efficient measures by converting remaining lighting systems to LED lighting.

6.2.2 Lux Level Survey

The building wise and floor wise lux level is measured by the portable lux meter (Make: Fluke, Model: Fluke 941). For building energy audit the parking area is normally excluded. Location/Floor/ Room/ area wise Lux level was measured and the details are as follows:

It has been observed that most of the area surveyed receives a good amount of day light if all windows and curtains are open, which implies lesser use of artificial lighting.

Major Working Area	Luminaries used	Wattage	Avg. lux level (Lux)
Assam Type Building (Class Room)	LED Bulb/LED Tube	9W/20W	210
English Department	LED Bulb/LED Tube	9W/20W	176
Assamese Department	LED Bulb/LED Tube	9W/20W	188
Seminar Hall	LED Bulb/LED Tube	9W/20W	196
Girls Common Room	LED Bulb/LED Tube	9W/20W	166
Economics Department	LED Bulb/LED Tube	9W/20W	213
Education Department	LED Bulb/LED Tube	9W/20W	290
Library	LED Bulb/LED Tube/CFL	9W/20W/20W	112
Library Reading Room	LED Bulb/LED Tube	9W/20W	290
Digital Class Room	LED Bulb/LED Tube	9W/20W	276
Auditorium	LED Bulb/LED Tube/CFL	9W/20W/20W	226
Office Working Area	LED Bulb/LED Tube	9W/20W	253
Hostel	LED Bulb	20W	198
Class Room (Commerce Building)	LED Tube	20W	216
Teacher's Common Room (Commerce Building)	LED Tube	20W	203
Class Room (Science Building)	LED Tube	20W	211
Mathematics Department	LED Tube	20W	202
Chemistry Department Laboratory	LED Tube	20W	211
Botany Department Laboratory	LED Bulb	9W	131
Zoology Department Laboratory	LED Tube	20W	226
Physics Laboratory	LED Tube	20W	212

Table 3:Illumination level of different working areas

OBSERVATIONS

- Since educational institutes are working mainly on day time, therefore illumination study was carried out during day time only and it is observed that if all windows are open and curtains are keep open, the working area or the study area covers adequate illumination level.
- It is also observed that, some part of the study area in Library, class room and laboratories, there is not adequate day lighting which leads to dependence on artificial lighting. This will increase the use of energy and operating cost to meet up the standard illumination level.

RECOMMENDATION

- Inculcate discipline and sense of participation in the energy conservation movement, any unnecessary lighting during day period should be avoided through awareness programmes.
- Intensive monitoring/inspection in order to ensure the minimum use of artificial light.
- It is recommended that all luminaries should be converted to energy efficient LED as an energy conservation measures.
- Area specific use of task lighting specifically where the back ground illumination is not required.
- Installation of master switch outside in each room which will help to switch off all electrical appliances during non-working hour.
- Tubular daylight devices to maximize the use of daylight which will reduce the energy consumption.
- Installation of occupancy sensors so that the lighting systems are controlled by this smart occupancy sensor.

It is recommended to use standard practice of illumination level as follows (As per IES standard)

Type of interior/activity	Standard illumination Level (Lux)
Libraries	
Shelves, book stacks	150
Reading table	300
Staff rooms, student rooms\student's hostels etc	
Gymnasium	300
Assembly halls general	300
Teaching spaces general	300
INDOOR SPORTS AND RECREATIONAL BUILDING MULTIPURPOSE SPORTS HALLS	
Athletics, basketball, bowls, judo	300
Hockey	700
BADMINTON COURTS	300
PUBLIC AND EDUCATIONAL BUILDING ASSEMBLY AND CONCERT HALLS	
Theatre and concert halls	100
Multipurpose	500
FURTHER EDUCATION ESTABLISHMENT	
Lecture theatres general	500
Chalkboard	500
Demonstration benches	500
Examination halls, seminar rooms, teaching spaces	500
Laboratories	500

Table 4: Standard Illumination Level

6.3 Diesel Generator (DG) Set

6.3.1 Review of present Diesel Generator (DG) Set:

Total 3 (Three) numbers (2 nos are in Arts campus and 1 no is in Science/Commerce Campus) of DG sets are installed in different location within the college campus and covers all the loads of academic blocks, administrative building, library, canteen, auditorium and hostel.

The salient technical specifications are as follows:

Sl. No	Make	Model	MFG Date /SR No	Rated kVA	Rated kW	Voltage (V)	Frequency (Hz)	Phase
1	Mahindra	3305GM	October 2012	20	16	415	50	3 ϕ
2	Jakson Limited	JSP-15	25/05/2010	15	12	415	50	3 ϕ
3	Jakson Limited	JSP-25	24/09/2012	25	20	415	50	3 ϕ

Table 5: Diesel Generator Set Technical Specification

6.3.2 Performance assessment of the Diesel Generator sets:

For the performance assessment of the DG sets its need to study specific fuel consumption [SFC= Total fuel consumed (litres)/ total power generated (kW)]. For which at least Twelve (12) months data of monthly fuel consumption and monthly energy generated by the DG set is required to analyze the specific fuel consumption. As monthly energy generation data is not available, therefore the performance assessment of DG sets is not able to conduct.

Although the design value of fuel consumption/hr are Shown below-

Load Condition	Specific Fuel Consumption		
	Mahindra 3305GM 20 kVA	Jakson Ltd. JSP-15 15 kVA	Jakson Ltd. JSP-25 25 kVA
At 100% Load	165 (gm/hp/hr)	2.49 (Ltr/hr)	2.49 (Ltr/hr)
At 75% Load		2.04 (Ltr/hr)	2.04 (Ltr/hr)

Table 6: Design value of Specific Fuel Consumption of DG sets

Recommendation:

It is strongly recommended the data recording or data logging of monthly fuel consumption and monthly energy generation practices for the DG set. A typical data logging format is given as ANNEXURE I.

6.4 Water Pumping System:

The arts campus of Mariani College has total 6 numbers of water pumps. Out of which 5 numbers are surface water pump and 1 submersible water pump. Similarly, the Science and commerce campus has 2 surface water pumps. The capacity of all the water pumps is of 1 HP each.

If any changes and new installation is required to be done management may take initiative to purchase energy efficient motor (EEM) only.

7. GOOD ENGINEERING PRACTICES

7.1 Guidelines for Energy Management in Buildings

7.1.1 Illumination:

Natural light should be used as far as possible to meet the required illumination level. Especially requirement of artificial light is less during daytime. While using the artificial lights care should be taken so that the lights in each area can be switched off partially when not in use. (e.g. The illumination level required for working on computers is 150 - 300 lux, but when the area is not used for work illumination level of 110 lux is sufficient. (This can be achieved by switching off some of the lights.) Also proper naming or numbering of the switches will facilitate the use of them by occupants or staff.

7.1.2 Use of Efficient Lighting Technology

The college campus has already taken the initiative to convert all inefficient luminaries to energy efficient LED tube lights and LED bulbs.

7.1.3 Air-Conditioning System

The Mariani College campus has a very smaller number of air conditioning units as cooling load. It has been observed that some of the installed air conditioning units are 3 star rating, therefore it is recommended to use 5 star rating air conditioning unit.

7.1.4 Preventive Maintenance

Inspect & monitor equipment operations. Maintain regular operation & maintenance log for major equipment. Fix minor problems before they result in major repairs. For this regular inspection of all equipment by trained staff is necessary. If necessary maintenance shutdown should be taken at least once in 6 months. During this wiring, contacts & other components should be thoroughly inspected for voltage imbalance,

loose connections or self heating. If major repairs are required, evaluate the economic benefit of replacing the old equipment with more efficient and compact equipment before doing the repairs. Such study should be done well in advance, so that in case of breakdown a decision can be taken quickly. Adjust schedules to keep all equipment on only when necessary. Adjust temperature & humidity set points for AC within comfort zones seasonally.

7.1.5 Training & Awareness

Maintenance & operating staff should be trained / informed about the energy management issues & procedures. To implement an effective preventive maintenance program, the operational staff must be given comprehensive training on each type of equipment, regarding system fundamentals, use of reference material & manuals, maintenance procedures, service guidelines & warranty information. Proper maintenance schedules could be supplied to them for different equipment.

7.1.6 Other Savings

New computers available in the market offer built in power saving modes. These monitors are called as Energy Star compliant monitors. However, it was found that most of the users are not aware of this facility. Therefore, steps should be taken to inform every one of this & any such future options. Switches for computers should be made more accessible, so that employee can turn off their terminals when not in use.

7.1.7 Integration of Renewable Energy in the campus

- It has been observed that a total 5 numbers of 30-Watt solar street lights are installed in the campus to illuminate some specific areas.
- **Since the College campus consist of multiple buildings with enough roof space available, therefore the college authority can install and generate solar energy which will reduce the annual energy cost incurred by the College.**

❖ DATA LOGGING FORMAT FOR PERIODIC MAINTENANCE.:

ANNEX URE: I

Month/Year:……../……..					Generator Operator Name:……					
Date	Generator Name	Capacity Location	Time		Meter Reading		Fuel Added	Total Running Hrs	Total Meter Reading	Signature of Operator
			Start	End	Start	End				

ANNEX URE: II

Month/Year:……../……..			Generator Operator Name:……			
Date	Lub oil Level	Coolant Level	Fuel Filter	Lub Oil Filter	Battery Water Level	Coolant Filter

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