FEBRUARY 5, 2025

A REPORT
ON
ENERGY AUDIT IN KOKRAJHAR GOVT. COLLEGE, KOKRAJHAR

SUBMITTED TO
THE PRINCIPAL
KOKRAJHAR GOVT. COLLEGE
P.O.: KOKRAJHAR, DIST.: KOKRAJHAR BTC, (ASSAM)

SUBMITTED BY
ADD SQUARE SOLUTIONS
VILL: DEURIPARA (BEHIND DEEO OFFICE, BONGAIGAON),
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Acknowledgement:

We are sincerely thankful to the Kokrajhar Govt. College management for giving us the opportunity to conduct energy audit.

We are also grateful to Dr. Dimacha D. Mwchahary, Principal, Kokrajhar Govt. College, Assam whose valuable comments / feedback, during various reviews have helped us to bring the report in the present format.

We express our sincere gratitude to all other concerned officials for their support and guidance during the conduct of this exercise.

For Add Square Solutions

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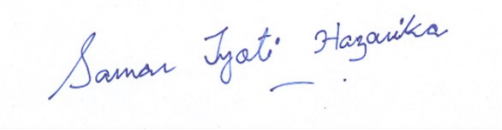

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1. BACKGROUND:

Energy consumption in different forms has been continuously rising almost in all the sectors- agriculture, industry, transport, commercial, residential (domestic) and educational institutions. This has increased the dependency on fossil fuels and electricity. Therefore, energy efficiency improvement and possible energy conservation became a necessary objective for energy consumers. The Government of India enacted the Energy Conservation Act, 2001 in October 2001. The Energy Conservation Act, 2001 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. Kokrajhar Govt. College, an educational institute in Kokrajhar district of Assam taking initiative for reducing energy intensity in the College Campus and entrusted Add Square Solutions for conducting Energy Audit. To conduct the energy audit, the audit team visited the campus on 29th of January 2025 to collect data and to take some measurement for assessment of different energy consuming components.

2. SCOPE OF WORK

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

- Review of present electrical load in the campus
- 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 floor, corridor, 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 ENERGY 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 are 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 Kokrajhar Govt. College campus consisting of multiple buildings. The following Tables show the basic information about the building and the utilities.

Sl. No	Basic Building Data	Value
1	Connected Load	140 kW
	Contract Demand	165 kVA
2	Installed capacity of DG set	20 kVA (1 No) Make: Kirloskar Oil Engine Limited Model: KG1-20WS/20kVA 15 kVA (1 No) Make: Kirloskar Oil Engine Limited Model:KG1-15AS
3	Electricity consumption (July' 2023 to June' 2024)	82,664.93 kWh
4	Cost of electricity consumption (July' 2023 to June' 2024)	Rs. 9,90,422.00
	Annual cost of electricity consumption through DG set.	Rs. 1,06,000.00

	Total cost of electricity (Utility + DG set)	Rs.10,96,422.00
5	Total Numbers of building covered	10 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

5. PRESENT ENERGY SCENARIO

5.1 Review of analysis of electricity bill of Kokrajhar Govt. College.

At present the overall energy consumption is catered by the electricity supply from Assam Power Distribution Company Limited and own DG sets. Total Connected load of Kokrajhar Govt. College is 140 kW and Contracted Demand is 165 kVA. Total 2 numbers of DG sets (20kVA and 15kVA) are used to supply power during load shading hours.

5.1.1. Energy Consumption.

The total energy consumption from July' 2023 to June' 2024 was 82,664.93 kWh and the total bill paid to distribution companies was Rupees 9,90,422.00. The monthly energy consumption and electricity bill paid from July' 2023 to June' 2024 has shown in fig.1 and fig. 2 respectively.

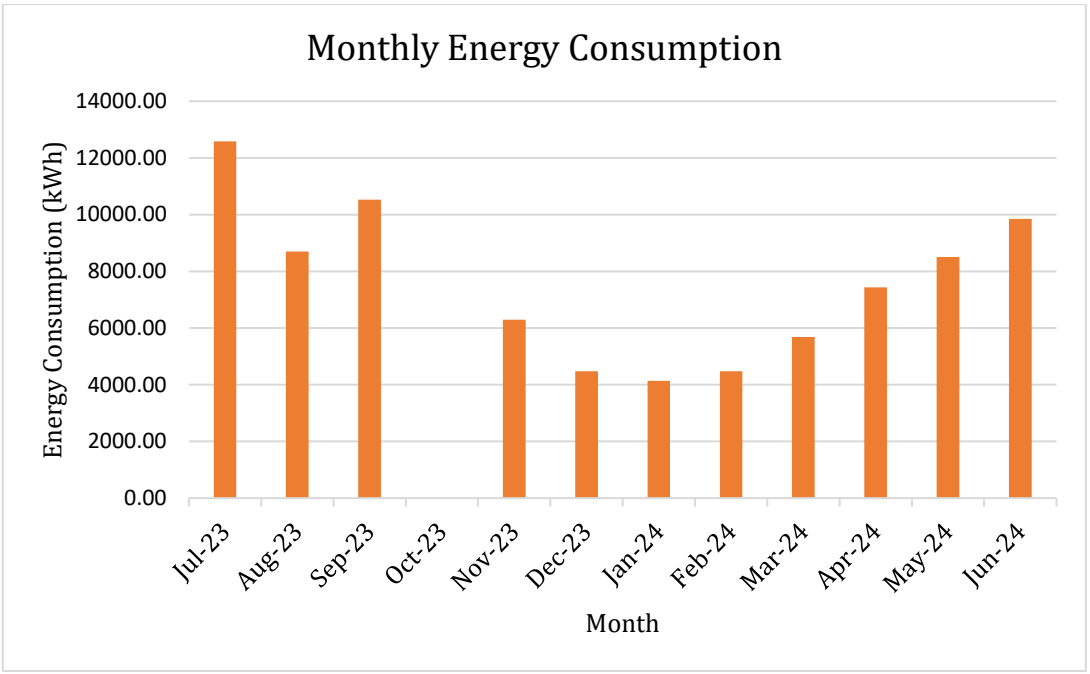

Figure 1: Monthly energy consumption from July' 2023 to June' 2024 (kWh)

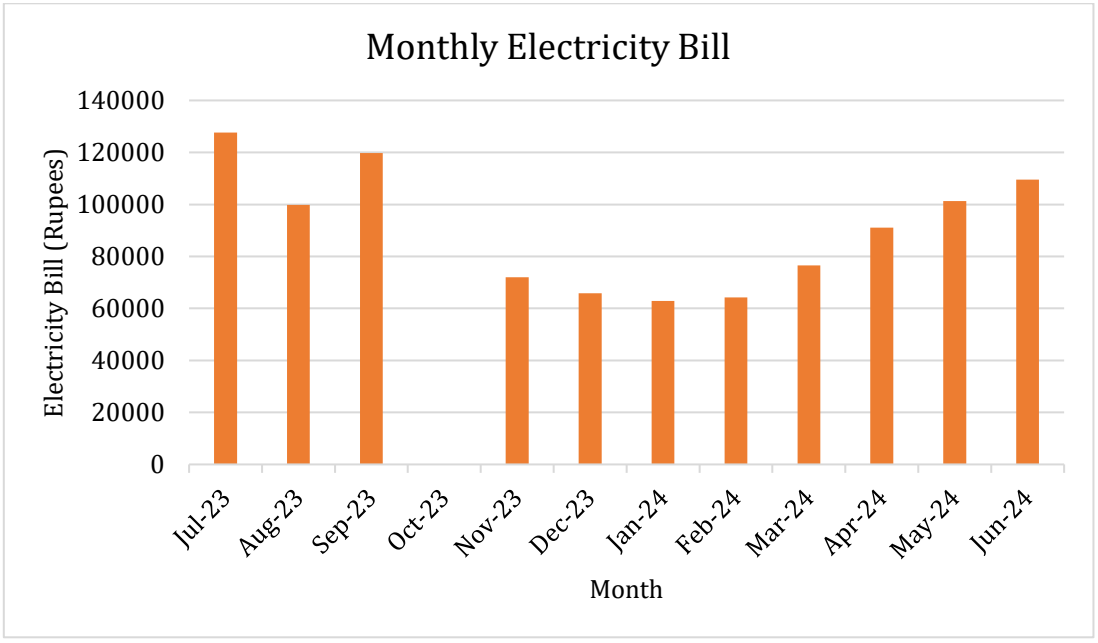

Figure 2: Monthly Electricity Bill (Rupees) from July' 2023 to June' 2024

5.1.2 Power Factor

The power factor indicates how much power is actually being used to perform useful work by a load and how much power get wasted. This wastage typically leads to huge electricity bills for consumers as distribution companies calculate consumption in

terms of apparent power, as such, they end up paying for power which was not used to achieve any "meaningful" work.

The average monthly power factor from July' 2023 to June' 2024 has shown in table 2.

Billing Month	Average Monthly Power Factor (%)
Jul-23	78.90%
Aug-23	88.00%
Sep-23	96.40%
Oct-23	
Nov-23	95.70%
Dec-23	93.00%
Jan-24	92.10%
Feb-24	93.40%
Mar-24	96.10%
Apr-24	96.10%
May-24	97.10%
Jun-24	98.20%

Table 2: Average monthly Power Factor (P.F)

It has been observed that the monthly average power factor from July' 2023 to June' 2024 was in the range of 76.90% to 98.20%. To avoid the penalty, the average power factor should be maintained above 85%.

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 equipments/ utilities available in the building are-

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

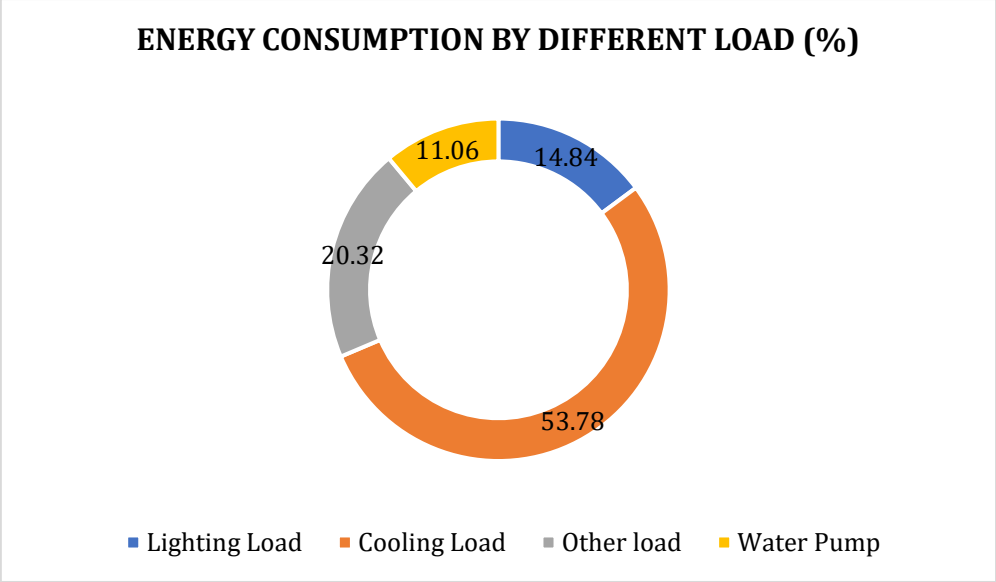

Figure 3: Energy consumption by different load

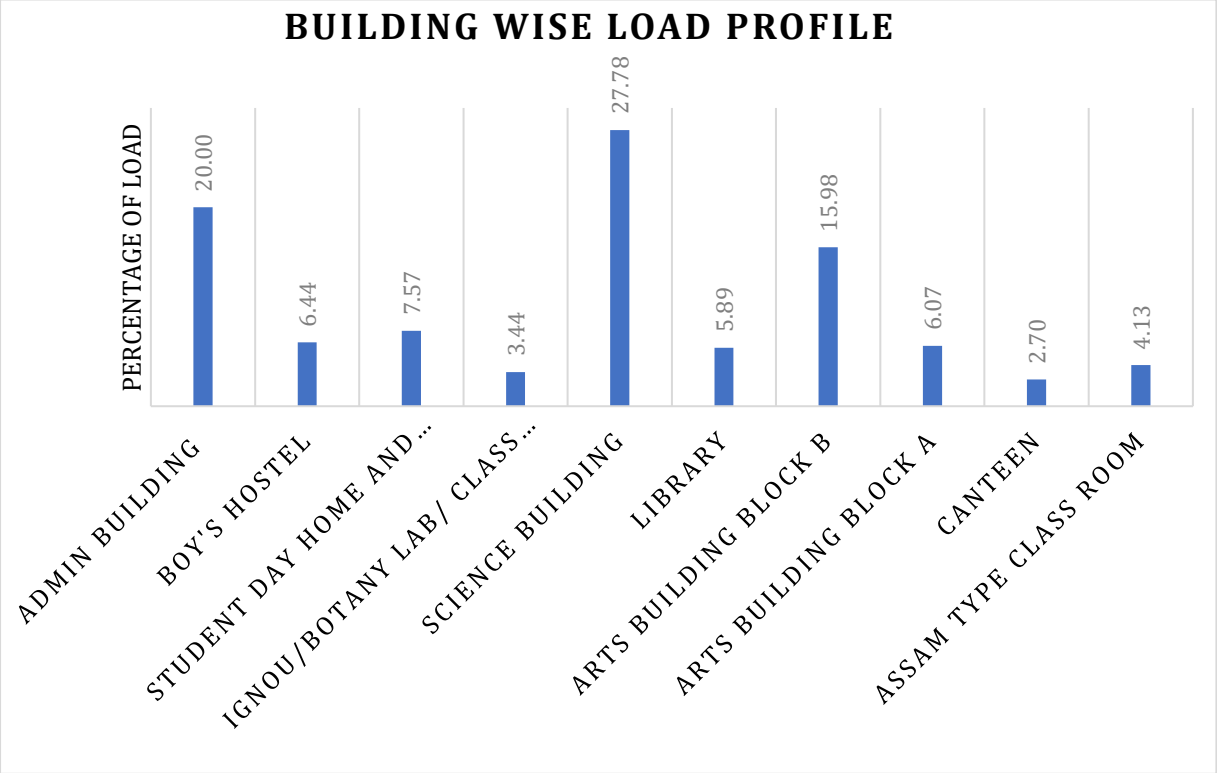

Figure 4: Building wise load profile

6.2 Observation and Recommendation

- It has been observed that the campus has one energy meter to measure the electrical energy consumption from the grid. Since the campus consist of multiple

numbers of buildings with high energy consuming equipment, therefore it is recommended to install separate submeter 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 campus is 95 KW (Approximate) Which include lighting load, Fan load, AC load, motor load etc.
- 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 annexures for reference)

Illumination Study and Energy Conservation in Lighting System:

6.2.1Review of Present Lighting Loads

Lighting contributes about 14.84 % of total load of the campus. The lighting load of the campus is consisting of 9-Watt LED bulb, 20 W LED tube light and 40-Watt Fluorescent Tube Light (FTL) with conventional and electronic ballast to illuminate the workplace.

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.

Building/Block	Specific Area	Type of Luminaries used	Wattage	Average lux level (Lux)
Administrative /Academic Building				
	Accounts Section	LED bulb/LED Tube/FTL	9 W/20W/ 40 W	232

	Conference Hall	LED bulb	9 W	222
	Office Room	FTL	40 W	247
Library				
	Reading Table	LED Tube	20W	262
	Book Rack	LED Tube	20W	98
Science Building				
	Laboratory	FTL	40 W	273
	Computer laboratory	FTL	40 W	239
	Class Room	LED Tube/FTL	20W/40 W	265
Boy's Hostel				
	Hostel Room	LED bulb	9 W	238
	Hostel Kitchen	LED bulb	9 W	189
Arts Building Block A				
	Class Room	LED Tube/FTL	20 W/40 W	243
Arts Building Block B				
	Class Room	LED Tube/FTL	20 W/40W	263

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 depend 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\students 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 2 (Two) numbers of DG sets are installed in the college campus with 20 kVA and 15 kVA capacity. Out of these two, one DG set is used at a time while the other is kept as stand by. The salient technical specifications are as follows:

Make	15 kVA	20 kVA
	Kirloskar Oil Engine Limited	Kirloskar Oil Engine Limited
Model No	KG1-15AS	KG1-20WS
Rated kVA	15	20
Rated kW	12	16
Voltage	230 for 1-Phase & 415 for 3-Phase	230 for 1-Phase & 415 for 3-Phase
Frequency	50 Hz	50 Hz

Table 5: Diesel Generator Set Technical Specification

6.4.2 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	Fuel Consumption(lit/hr)	
	15 kVA	20 kVA
	Kirloskar Oil Engine Limited	Kirloskar Oil Engine Limited
At 100% Load	4	5.1
At 75% Load	3	3.8

At 50% Load	2.2	2.7

Table 6:Fuel Consumption of DG sets (Design Value)

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 ANNEX 1.

6.4 Water Pumping System:

The campus has total Ten (10) numbers of water pumps. Detail specification along with installed location are given below-

Sl. No	Location	Capacity	Quantity	Type	Make/Model
1	Hostel	1 HP	2	Surface	V-Guard Industries Limited
2	Student Day Home	1 HP	2	Surface	USHA
		1 HP	1	Submersible	Kirloskar Brothers Limited
3	Science Building	1 HP	2	Surface	
4	Library	1 HP	1	Surface	
5	Office	1 HP	1	Surface	
6	Canteen	1 HP	1	Surface	

Table 7: Detail of water pump location

OBSERVATION

The percentage of loading for the 1 HP motor is 85% which is acceptable as per the energy conservation measure.

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 as 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 took the initiative to convert all inefficient luminaries to energy efficient LED tube lights and LED bulbs.

7.1.3 Air-Conditioning System

The Kokrajhar Govt. College campus has very less number of air conditioning units as cooling load. It has been observed that the installed air conditioning units are 2 star and 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.

8. INTEGRATION OF RENEWABLE ENERGY IN COLLEGE CAMPUS:

8.1 INITIATIVE ALREADY TAKEN

To minimize the dependency on electrical energy consumption from conventional energy sources, energy generation and utilization from the renewable energy sources has been adopted. Initially the college has installed solar street light to replace the conventional street light in the campus.

Detail specification of Solar Street Light has been listed below-

Luminaries:	30 Watt
Battery:	12.8V 24AH Lithium Battery
Solar PV Module:	70Wp Solar PV Module (Poly crystalline)
Pole:	6M GI Pole with Light Arm, Panel Stand and Accessories

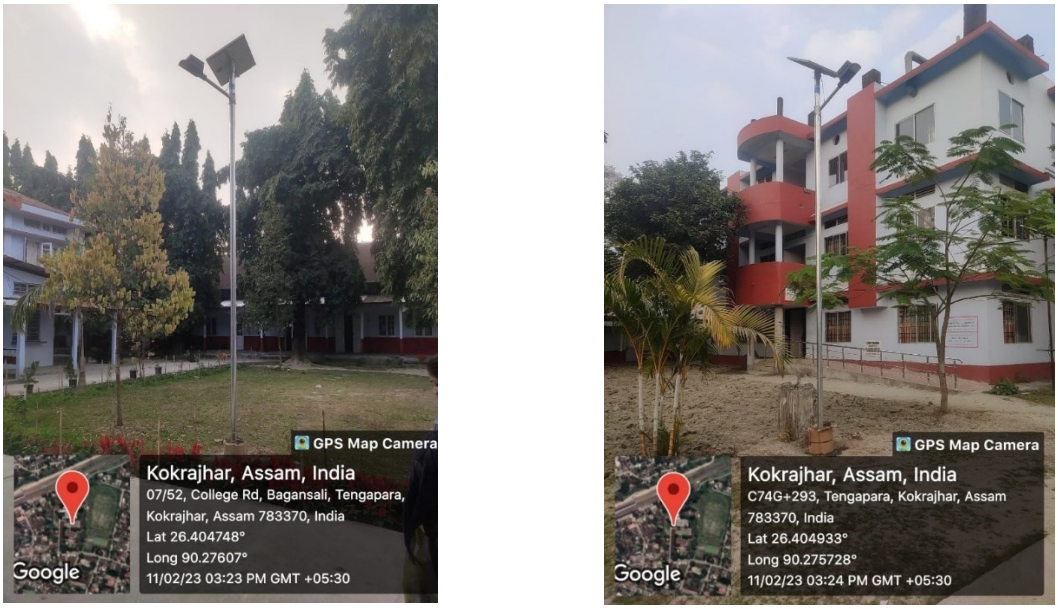

Figure 5: 30-Watt Solar Street Light Installed in the Campus

ANNEX 1

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

DATA LOGGING FORMAT FOR PERIODIC MAINTENANCE.

ANNEX 2

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