ANNUAL ENERGY AUDIT REPORT

April 2022 to March 2023

PRAGJYOTISH COLLEGE

Santipur, Guwahati, Assam -781009.

May -2023

Prepared by

Thunderbolt Energy Consultancy, Pune

Reg. Address- 97/2 Nirmal Apartment, Paud Road, Bhusari Colony,

Kothrud Depot, Pune-411038, Maharashtra, India

Phone: +91 9098 580 420 Email: tecofficeinfo@gmail.com

Website- www.thunderboltenergy.in

Table of Contents

Disclaimer 3
Acknowledgement 4
Why Energy Audit? 5
Energy Audit Team 6
Executive Summary 7
Abbreviations 11
1. Introduction 12
1.1 Objectives 12
1.2 Audit methodology 13
1.3 Historical Data Analysis 13
1.4 Actual measurement and data analysis 13
1.5 Identification and evaluation of Energy Conservation Opportunities 13
1.6 Monitoring and Control 13
1.7 About Thunderbolt Energy Consultancy 14
2. Energy Details 15
3. Study of connected load 16
4. Study of Electrical Energy Consumption 19
5. Carbon Footprint 21
6. Study of utilities 23
6.1 Study of Lighting 23
6.2 Air-conditioners 23
6.3 Ceiling Fans 23
6.4 Office Load 23
6.5 Submersible Pump Load 23
7. Energy conservation proposals 24
7.1 Replacement of 341 Nos Old, FTLs with 18 W LED fittings 24
7.2 Replacement of 39 Nos CFL fitting with 9 W LED fittings 25
7.3 Replacement of 716 Nos Old Fans with STAR Rated Ceiling Fans 26
7.4 Replacement of 34 Nos old ACs with STAR Rated ACs. 27
7.5 Optimize the Temperature Setting of ACs. 28
8. Summary of Savings 29

List of Table

Table 1 The team members of Thunderbolt Energy Consultancy 6
Table 2 Details of energy consumption 7
Table 3 Recommendations for energy savings 9
Table 4 Details of energy consumption 15
Table 5 Location wise study of Electrical fittings in various buildings 16
Table 6 Lighting load percentage in total consumption..... 18
Table 7 Equipment wise Connected Load 18
Table 8 Electricity bills of consumer 006000002737 19
Table 9 Key observations of consumer 006000002737..... 19
Table 10 Month wise Consumption of Energy & CO2 Emissions of consumer 006000002737 . 22
Table 11 Tube light calculation 24
Table 12 CFL light calculation 25
Table 13 Fan calculation..... 26
Table 14 Air Conditioner calculation 27
Table 15 Temperature Setting of ACs calculation..... 28
Table 16 Summary of savings..... 29

List of Figure

Figure 1- Year Wise Net Savings (Rs. Lakh) 9
Figure 2- Block wise connected load in kW 17
Figure 3 Distribution of connected load 18
Figure 4 Month wise energy consumption of consumer 006000002737..... 20
Figure 5 Month wise electricity bill of consumer 006000002737..... 20
Figure 6 Month wise electricity bill of consumer 006000002737..... 21
Figure 7 Month wise CO2 emissions of consumer 006000002737..... 22

Disclaimer

This report was prepared for Pragjyotish College, Guwahati. The information herein is confidential and shall not be divulged to a third party without the prior written permission of Thunderbolt Energy Consultancy, its affiliates and subsidiaries, including Thunderbolt Energy Consultancy, and their respective officers, employees or agents, individually and collectively, referred to in this clause as ' Thunderbolt Energy Consultancy'.

Thunderbolt Energy Consultancy, assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Thunderbolt Energy Consultancy, entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.

All the calculations for energy savings and recommendations to achieve these savings given in this report is fully based on the data shared by the college with Thunderbolt Energy Consultancy.

Acknowledgement

We express our sincere gratitude to the authorities of Pragjyotish College, Guwahati for entrusting and offering the opportunity of energy performance assessment assignment.

- Dr. Manoj Kumar Mahanta - Principal
- Dr. Manjit Kr. Mazumdar - Co-Ordinator (IQAC)

We are thankful to Pragjyotish College, Guwahati for their positive support in undertaking the task of system mapping and energy efficiency assessment of all electrical system, air conditioners, utilities and other equipment. The field studies would not have been completed on time without their interaction and guidance. We are grateful to their cooperation during field studies and providing necessary data for the study.

We are also thankful to all field staff and agencies working with whom we interacted during the field studies for their wholehearted support in undertaking measurements and eagerness to assess the system / equipment performance and saving potential. Also thankful to all concerned staff interacted during the conduct of this exercise for completing official documentations.

Why Energy Audit?

An energy audit determines the amount of energy consumption affiliated with a building and the potential savings associated with that energy consumption. Additionally, an energy audit is designed to understand the specific conditions that are impacting the performance and comfort in your facility to maximize the overall impact of energy-focused building improvements.

An energy audit is a systematic review of the energy consuming installations in a building or premises to ensure that energy is being used sensibly and efficiently. An energy audit usually commences with the collection and analysis of all information that may affect the energy consumption of the building or premises, then follows with reviewing and analyzing the condition and performance of various building services installations and building management, with an aim at identifying areas of inefficiency and suggesting means for improvement.

Through implementation of the suggested improvement measures, building owners can get the immediate benefit for paying less for energy bills. On the other hand, lowering of energy consumption in buildings will lead to the chain effect that less fossil fuel will be burnt for electricity generation by the power supply companies and relatively less pollutants and greenhouse gases will be introduced into the atmosphere, thus contributing to conserve the environment and to enhance sustainable development.

Energy Audit Team

Table 1 The team members of Thunderbolt Energy Consultancy

Name	Role	Field of expertise
Mr. Mahesh Khode	Project coordinator, ECM verification, Report verification	Graduate Electrical engineer, BEE Certified Energy Manager, ADIS Safety, Certified First Aider with experience in Energy Efficiency Assessment, Energy Audit, Safety Audit, Firefighting system, Fire Extinguisher, Electrical Safety audit, Green Audit, Green building, ECBC, EHS, OHSA, Environment policy, Environmental Audit, Industrial Utility System, Project Management, Electrical Distribution System, Commercial Buildings and Industrial Maintenance Services.
Mr. Kaustubh Bhatwadekar	Energy Auditor and ECM verification	Graduate Mechanical engineer, M.Tech IIT Bombay, BEE Certified Energy Auditor, Experience In Industrial Energy, distribution system, Energy Efficiency Assessment, Green audit and Environment audit.
Mr. Shantanu Deshmukh	Data tabulation and analysis & report preparation	Graduate in Electrical & Electronics Engineering with experience in field data collection, Data analysis, Green building and Environment assessment.

Executive Summary

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the CO_2 emissions.

Pragjyotish College, Guwahati, consumes Energy in the form of Electrical Energy used for various gadgets, Office & other facilities.

1. Present Energy Consumption

In the following Table, we present the details of Energy Consumption.

Table 2 Details of energy consumption

Sr no	Parameter	College Building	
		Energy consumed, (Units)	Bill Amount (Rs)
1	Maximum	16,442	1,35,964
2	Minimum	5,025	52,626
3	Average	10,184	88,884

2. Energy Conservation Projects already installed

1. Usage of LED lights at some indoor locations.
2. Usage of LED Lights for outdoor lighting.
3. Solar lighting system Installed.
4. Solar Panel system Installed.
5. BEE Star rated air conditioners Installed.

3. Key Observations

1. College has 125 kVA Diesel Generator set for uninterrupted power supply in case of supply failure from APDCL.
2. Presently 100 kVA transformer is installed in college campus and it will extend to 315 kVA in upcoming time.
3. There are about 341 Nos old Tube light fittings which need to be replaced by 18 W LEDs.
4. There are about 39 Nos 18 W CFL light fittings which need to be replaced by 9 W LEDs.
5. There are 716 Nos of ceiling fans which need to be replaced with STAR rated fans.
6. Optimize the temperature setting to 23-25 degree Celsius.
7. There is minimum or practically negligible use of lights during day time as the building structure has possibility of daylight usage.
8. The lighting arrangements are well balanced with arrangements to switch ON and OFF.
9. The policy of college is switch off the lights and other electrical equipment when they are not in use.
10. Cleanliness is well maintained. In- house light fittings are cleaned time to time.
11. Lights are negligibly operated during day time. The lights are operated manually.
12. There is no any sensor-based lighting system.
13. The college is utilizing natural lighting as first preference.
14. Computers, printers and other equipment are switched off at the end of the day.
15. The all the electrical equipment is well operated.
16. The overall electrification system is regularly monitored by a duly qualified electrician.
17. 15 number of solar LED Street lights of capacity 40W each panel and 15W LED's are available in the campus area.
18. 5 kW solar panel Installed on library building with 325W panel capacity.
19. Fire extinguisher is present in campus area.
20. The campus area is well facilitated with CCTVs for security purpose.
21. Water is supplied from bore well to tank and 3 nos. of Pump set has capacity of 1.5 HP.

4. Recommendations

Table 3 Recommendations for energy savings

Sr. No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs Lakh/Annum	Investment Required, Rs/ Lakh/Annum	Payback period, Months
1	Replacement of 341 Nos Tube Light fittings with 18W LED fittings	5,627	0.380	2.217	70
2	Replacement of 39 Nos CFL fittings with 9 W LED fittings	263	0.018	0.084	57
3	Replacement of 716 Nos Old Ceiling Fans with STAR rating fans	21,480	1.450	15.752	130
4	Replacement of 34 Nos Old 1.5 TR ACs with STAR rating ACs	21,675	1.463	17.978	147
5	Optimize the temperature setting to 23-25 degree Celsius	1,224	0.083	NA	NA
	Total	**50,269**	**3.393**	**36.030**	-

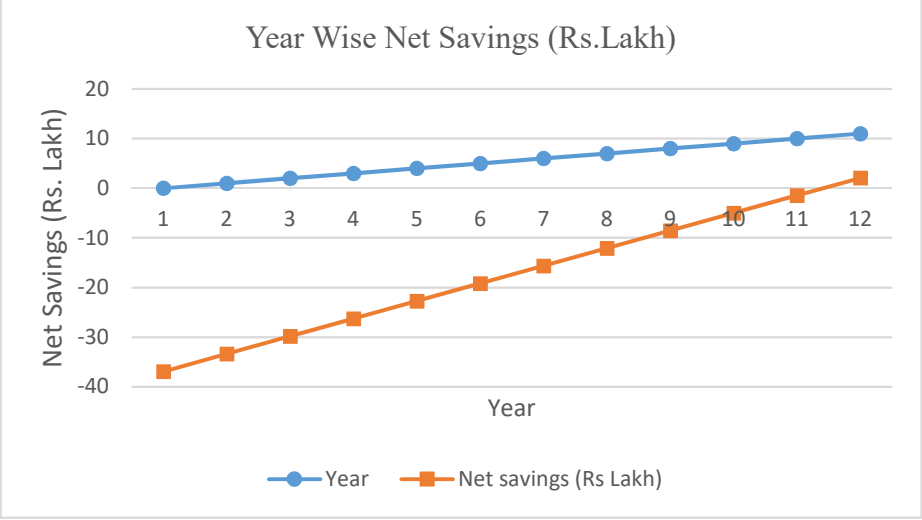

Figure 1 Year Wise Net Savings (Rs. Lakh)

5. Renewable Energy Generation in the premises

Table 4 Details of Energy Generated by Stand-Alone Solar Plant

Sr. No.	Particulars	Value	Unit
1	Stand Alone Solar Plant	5	kW
2	Electricity Generation for 1 kW plant	3.50	kWh
3	Daily running hours per day for 5 kW plant	6.00	Hrs
4	Total Working Hours in 250 Days per year for 5 kW plant	1,500	Hrs
5	Total Generation per Year for 5 kW plant	26,250	kWh/Annum
6	Present Annual electrical consumption of premises	112,026	kWh/Annum
7	Renewable Energy to Conventional Energy Consumption	23.43	%

Table 4 Details of Energy Generated by Solar Street Lights

Sr. No.	Particulars	Value	Unit
1	15 Solar Street Light with 40W panel each	0.60	kW
2	Electricity Generation for 0.04 kW plant	0.14	kWh
3	Daily running hours per day for 15 Solar Street Light	6.00	Hrs
4	Total Working Hours in 250 Days per year for 15 Solar Street Light	1,500	Hrs
5	Total Generation per Year for 15 Solar Street Light	126	kWh/Annum
6	Present Annual electrical consumption of premises	112,026	kWh/Annum
7	Renewable Energy to Conventional Energy Consumption	0.11	%

Table 4 Details of Energy Generated by Present Solar System

Sr. No.	Particulars	Value	Unit
1	Stand Alone Solar Plant of 5 kW	26,250	kWh/Annum
2	15 Solar Street Light with 40W panel each	126	kWh/Annum
3	Total	26,376	kWh/Annum
4	Present Annual electrical consumption of premises	112,026	kWh/Annum
5	Renewable Energy to Conventional Energy Consumption	23.54	%

Renewable energy generation in the college premise is 23.54 % as per the Present Annual electrical consumption of premises.

6. Notes & Assumptions

1. Daily working hours-03
2. Annual working days- 250
3. Rate of Electrical Energy- Rs 6.75 /- per kWh.

Abbreviations

CFL	:	Compact Fluorescent Lamp
FTL	:	Fluorescent Tube Light
LED	:	Light Emitting Diode
V	:	Voltage
I	:	Current
kW	:	Kilo- Watt
kWh	:	kilo-Watt Hour
kVA	:	Active Power
PF	:	Power Factor

1. Introduction

Pragjyotish College, established on 1st September 1954, seven years after Independence, became a beacon of learning and a symbol of aspirations for the common people of Assam, raring to build a new nation. Pandit Tirthanath Sarma, eminent scholar and litterateur, responded to and actively participated in the nation building by taking charge as the founder Principal of Pragjyotish College. From its modest inception as an arts college, Pragjyotish College has now developed into one of the premier institutions of higher education in Guwahati. At present, it is a well-known full-fledged under-graduate college imparting higher education in multiple streams.

Situated on the western bank of the Bharalu, a rivulet, in the western part of Guwahati, Pragjyotish College is about 1 kilometer away from its confluence with the mighty Brahmaputra. It is about 4 kilometers from the Guwahati Railway Station and at a distance of about 20 kilometers from the Lokapriya Gopinath Bordoloi International Airport. At the backdrop of the college is a beautiful panoramic view of Nilachal Hills, the famous abode of Mother Goddess Kamakhya.

In the emblem of the college, is ingrained the motto "तेजस्विनावधीतमस्तु" (May our study make us illumined) and a conch shell at the center on an eight-petalled full-blown beautiful-lotus, which symbolizes pure knowledge and the relationship between the teacher and the learner, praying to the Almighty for energy, protection, maintenance that ultimately leads to peace and bliss.

1.1 Objectives

1. To study present level of Energy Consumption.
2. To Study Electrical Consumption.
3. To assess the various equipment/facilities from Energy efficiency aspect.
4. To study various measures to reduce the Energy Consumption.

1.2 Audit methodology

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream. Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on financial analysis basis.

1.3 Historical Data Analysis

The historical data analysis involves establishment of energy consumption pattern to establish base line data on energy consumption and its variation with change in production volumes.

1.4 Actual measurement and data analysis

This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

1.5 Identification and evaluation of Energy Conservation Opportunities

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

1.6 Monitoring and Control

Energy accounting followed by energy monitoring and controlling is the first step of an Energy Management Program. With increasing energy prices, many organizations have incorporated sub-metering system in their plants. Sub metering is essential for monitoring, establishing energy consumption pattern, detailed engineering and energy saving after implementation of energy conservation projects. It is required to identify and monitor parameters for energy consumption per unit of production or services i.e., Specific Energy Consumption (SEC). SEC monitoring is an important tool for monitoring and proving of energy conservation measures.

1.7 About Thunderbolt Energy Consultancy

We are pleased to introduce ourselves as **Thunderbolt Energy Consultancy**. We are a team of young Energy professionals, working to help Businesses and facilities become Energy efficient and promote green and clean Energy.

Our highly competent team of Certified Energy Managers, Energy Auditors, Safety Auditors, Analyst, Engineers and Experts having experience in variety of sectors and we are one of the leading engineering services and solutions providing company.

Our company was established in 2020 pioneering in quality and customer satisfaction. We have been a beacon of performance for the last 3 years and our vision is to deliver everlasting performance through our services.

Thunderbolt Energy Consultancy is extremely proud to announce that we have achieved ISO 9001:2015, ISO 14001:2015, ISO 50001:2018 and ISO/IEC 17020:2012 certification. Assessment for certification was done by QRO (Quality Research Organization) Certification LLP accredited by several bodies like, Egyptian Accreditation Council (EGAC) and UKAF (United Kingdom Akkreditation Forum). This certification not only anticipates the demands of our customers, but also reveals our commitment to providing quality services to all our existing and prospective customers.

We are providing services in various areas like

- Energy Audit, Electrical Audit, Electrical Survey
- Green Audit & Environmental Audit for all Entities
- Safety Audit, Electrical safety audit, Safety survey
- Industrial Maintenance Services
- Project Management Consultancy
- Third-Party Audit

2. Energy Details

The electricity supply for Pragjyotish College, Guwahati is provided by Assam Power Distribution Company Limited. The energy consumed by Pragjyotish College, Guwahati falls under HT Category. The facility also has 1 DG sets of 125 KVA. The DG set is mainly used for power failure from APDCL.

The energy efficiency assessment was conducted for the load connected to the mains supply of college building.

Consumer details:

Table 4 Details of energy consumption

Name of Consumer	Tariff Category	Consumer Account No.
Pragjyotish College, Guwahati	HT IV Bulk Supply (Govt. Education)	006000002737

Mainly energy is used on this facility for the following purposes:

1) Lighting's load
2) Air conditioners
3) Fan load
4) Office equipment

3. Study of connected load

In this chapter, we present details of various connected electrical equipment and electrical load.

Table 5 Location wise study of Electrical fittings in various buildings

Sr. No	Type	Equipment	Wattage	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Total number	Load, kW
1	LED Lighting	LED (5 Watt)	5	4															4	0.02
2	LED Lighting	LED (9 Watt)	9	5	3	1		27	1	21								30	88	0.79
3	LED Lighting	LED (18 Watt)	18	64	14	4	8	30	51	61	11	1		1		2			247	4.45
4	LED Lighting	LED (28 Watt)	28		9					1	2			111					123	3.44
5	LED Lighting	LED (50 Watt)	50	1	2			1											4	0.20
7	LED Lighting	Tube Light (LED)	18	25	91		74	78	10	74		27			5	1	2		387	4.52
8	Non LED Lighting	Tube old (General)	40	79	19	22	10	19	33	37	37	14	4	14	5	4	1	43	341	19.08
9	CFL	CFL 18 Watt	18		5	2	5		3		4	4						16	39	0.70
10	Fan Load	Ceiling Fan	70	93	92	19	48	82	74	112	40	42	9	47	12	4		42	716	50.12
11	Fan Load	Wall Fan	50	11	10	2	8		4	4	6			2					47	2.35
12	Fan Load	Stand Fan	50	2	1		1		2	1									7	0.35
13	Fan Load	Stand Fan	100	12	7	4	4	2	2	11	2			1			4	5	54	5.40
14	Air Conditioner	A.C. 2 Star	2000	9	2	2	2	1	2			2		14					34	68.00
15	Air Conditioner	A.C. 3 Star	1500	2		1	3					1							7	10.50
16	Office Load	Computer	250	31	4	28	5	12		13	6	7		10					116	29.00
17	Office Load	Aqua guard	500	2	2	2			1									2	9	4.50
18	Office Load	Refrigerator	1000	1	1		1	1					2					1	7	7.00
19	Office Load	CCTV Monitor	200	3	2	1				2									8	1.60
20	Office Load	Xerox Machine	1000	2	4								1	2					9	9.00
21	Office Load	Printer	500	13	4	2	3	1	1	6	1	2		3					36	18.00
22	Office Load	T.V	300	2	6									2					10	3.00
23	Office Load	Water Cooler	500	2	2									2				1	7	3.50
24	Submersible Pump	Water Pump	1119	2														1	3	3.36
Total Load kW																				**248**

Table 5 Details of various buildings

Name of the Building
A Block (Geology or Main Building)
B Block (opposite to Main Building)
C Block (Statistics Building)
D Block (Zoology Building)
E Block (Chemistry Building)
F Block (Commerce Building)
G Block (Art Building)
H Block (Boys common Room)
I Block (Gym Sub Room Building)
J Block (Canteen Building)
K Block (Library Building)
L Block (Auditorium Building)
M Block (NCC Building)
N Block (Boys toilet Building)
O Block (Girls hostel Building)

Based on data collected from all buildings present in campus. The connected load in kW of all buildings is shown below:

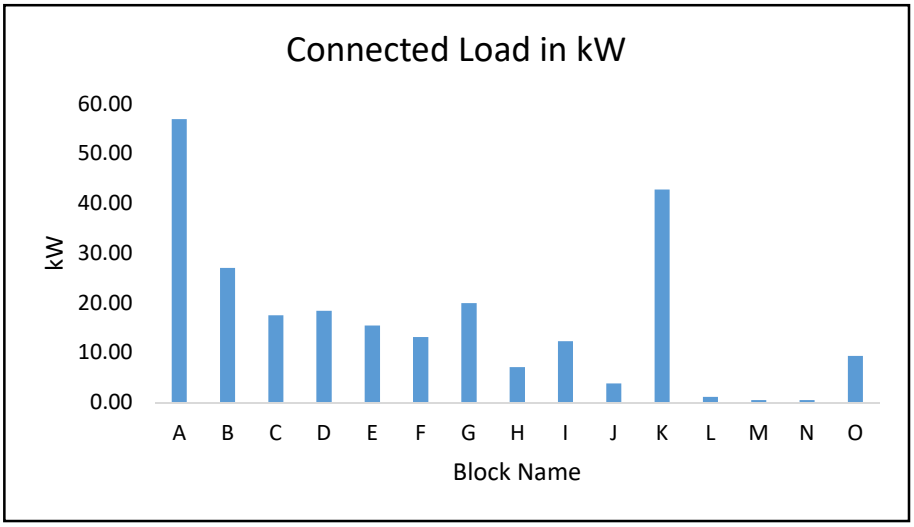

Figure 2- Block wise connected load in kW

Table 6 Lighting load percentage in total consumption

Particulars		Total Lighting requirement	Lighting met Through LED Bulb	Lighting met through other type lamp
(A)	Load in kW	30.21	15.87	14.34
	Percentage %	100	52.53	47.47
(B)	Energy in kWh per year	22,658	11,901	10,757
	Percentage %	100	52.53	47.47

Note- Above calculation is based on 3 hours working and 250 days per annum.

Apart from above load, the college has Fan load, street lights. Individual fitting wise load is as under

Table 7 Equipment wise Connected Load

Sr. No.	Equipment	Qty	Load, kW
1	LED Lighting	853	16
2	Non-LED Lighting	380	14
3	Fan Load	824	58
4	Office Load	195	72
5	Air Conditioner	41	79
6	Other Load	10	7

Data can be represented in terms of PIE chart as under,

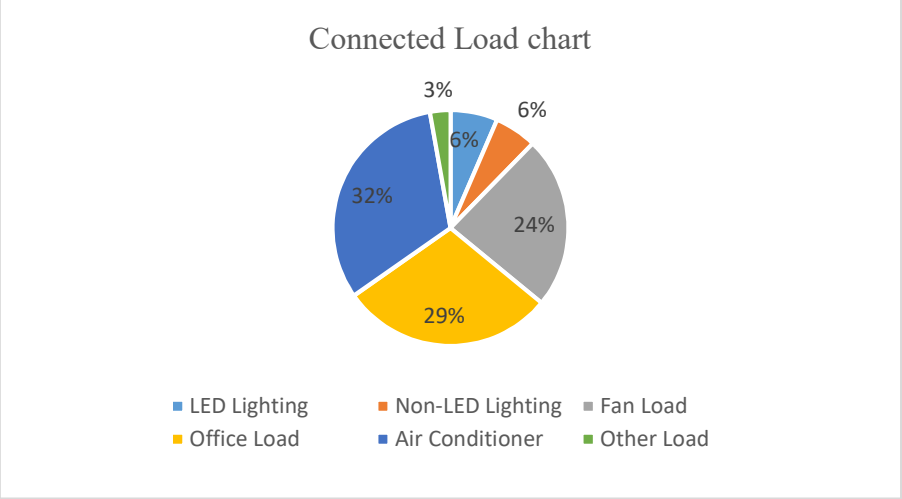

Figure 3 Distribution of connected load

4. Study of Electrical Energy Consumption

Consumer Name- Pragjyotish College, Guwahati

Consumer Number- 006000002737

In this chapter, electricity bills are studied for the analysis of electrical energy consumption.

Table 8 Electricity bills of consumer 006000002737

Sr. No.	Month	Energy (kWh)	Bill Amount (Rs)	Max. Demand (kVA)
1	Apr-22			
2	May-22	10,336	88,089	19.8
3	Jun-22	10,774	89,638	63.94
4	Jul-22	13,029	1,06,186	81.88
5	Aug-22	15,106	1,26,093	89.17
6	Sep-22	16,442	1,35,964	89.57
7	Oct-22	9,448	84,449	64.57
8	Nov-22	9,254	82,396	51.43
9	Dec-22	6,884	65,351	27.31
10	Jan-23	5,025	52,626	24.81
11	Feb-23	6,423	61,827	30.22
12	Mar-23	9,305	85,101	53.12
	Total	**1,12,026**	**9,77,720**	**596**

Key observations of electricity bill are as follows,

Table 9 Key observations of consumer 006000002737

Sr no	Parameter	Energy consumed, (Units)	Bill Amount (Rs)	Max. Demand (kVA)
1	Maximum	16,442	1,35,964	89.57
2	Minimum	5,025	52,626	19.80
3	Average	10,184	88,884	54.17

Variation in energy consumption is as follows,

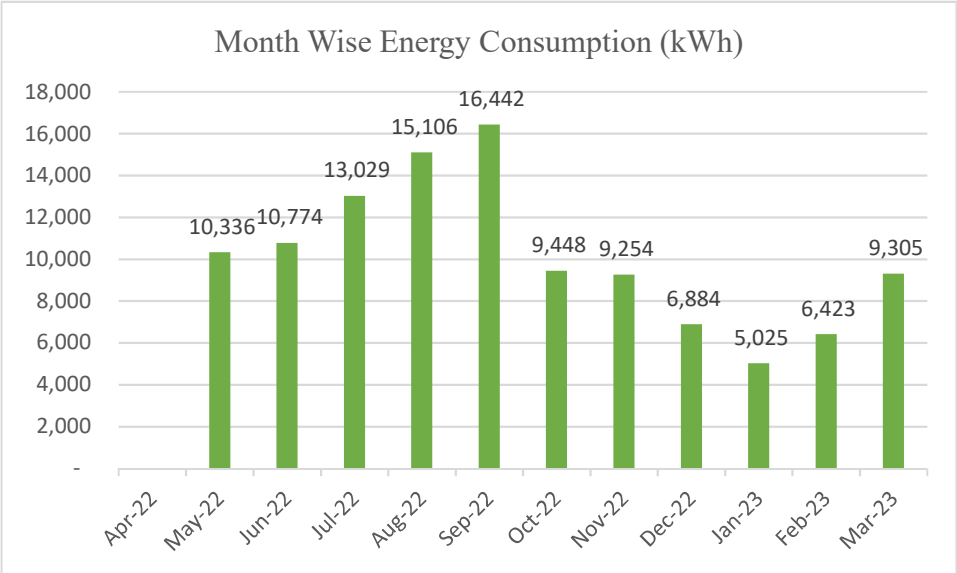

Figure 4 Month wise energy consumption of consumer 006000002737

Monthly variation in electricity bill is as follows,

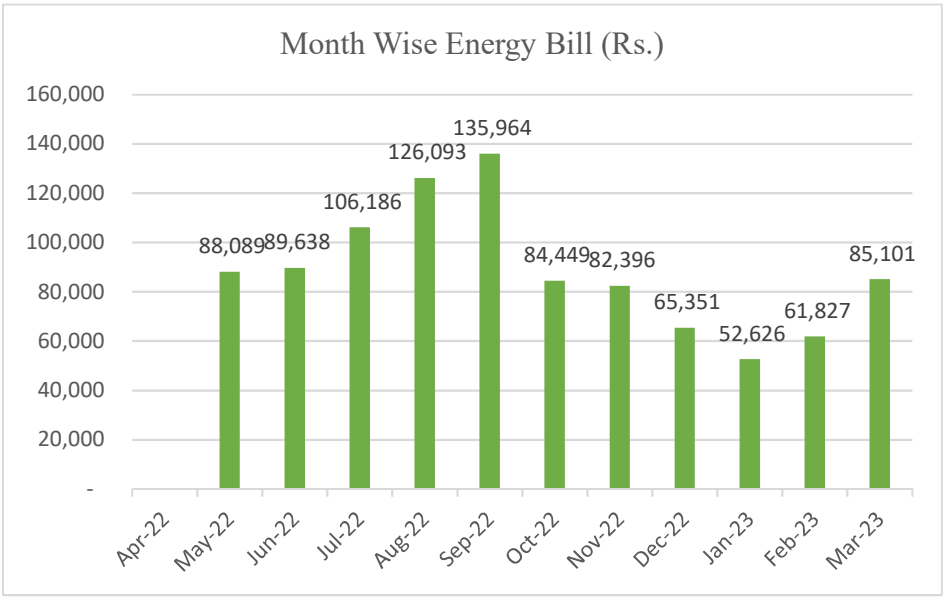

Figure 5 Month wise electricity bill of consumer 006000002737

Monthly variation in Maximum demand is as follows,

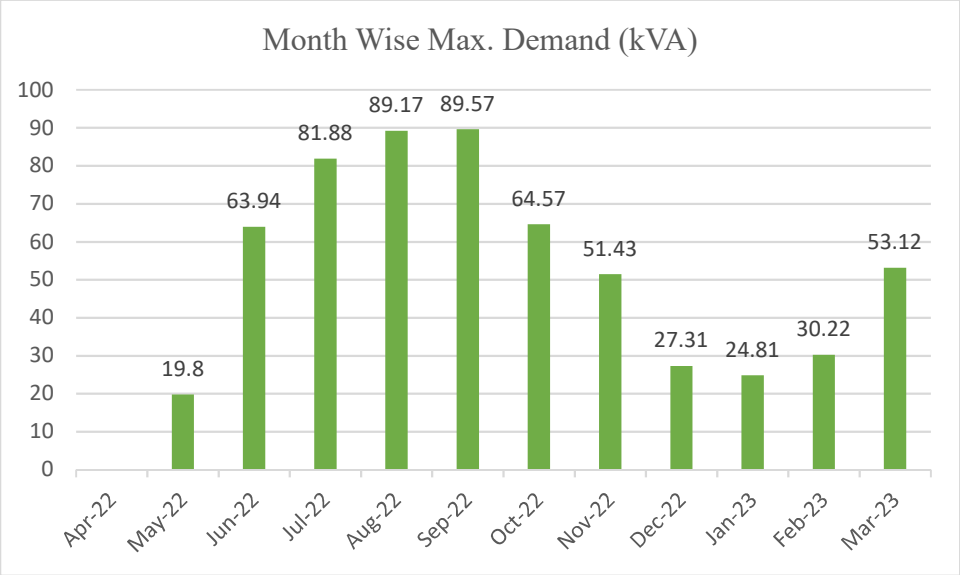

Figure 6 Month wise electricity bill of consumer 006000002737

5. Carbon Footprint

1. **A Carbon Foot print** is defined as the Total Greenhouse Gas emissions (CO_2 emissions), emitted due to various activities. In this we compute the emissions of Carbon-Di-Oxide, by usage of the various form of Electrical Energy used by the College for performing its day-to-day activities
2. **Basis for computation of CO_2 Emissions:**

   The basis of Calculation for CO_2 emissions due to Electrical Energy is as under

1 Unit (kWh) of Electrical Energy releases **0.85 Kg of CO_2** into atmosphere.

Based on the above Data we compute the CO_2 emissions which are being released in to the atmosphere by the College due to its Day-to-Day operations.

We herewith furnish the details of various forms of Energy consumption as under

Consumer Name- Pragjyotish College, Guwahati

Consumer Number- 006000002737

Table 10 Month wise Consumption of Energy & CO2 Emissions of consumer 006000002737

No	Month	Energy Consumed, kWh	CO2 Emissions, MT
1	Apr-22		
2	May-22	10,336	8.79
3	Jun-22	10,774	9.16
4	Jul-22	13,029	11.07
5	Aug-22	15,106	12.84
6	Sep-22	16,442	13.98
7	Oct-22	9,448	8.03
8	Nov-22	9,254	7.87
9	Dec-22	6,884	5.85
10	Jan-23	5,025	4.27
11	Feb-23	6,423	5.46
12	Mar-23	9,305	7.91
	Total	**1,12,026**	**89.62**

In the following Chart we present the CO2 emissions due to usage of Electrical Energy.

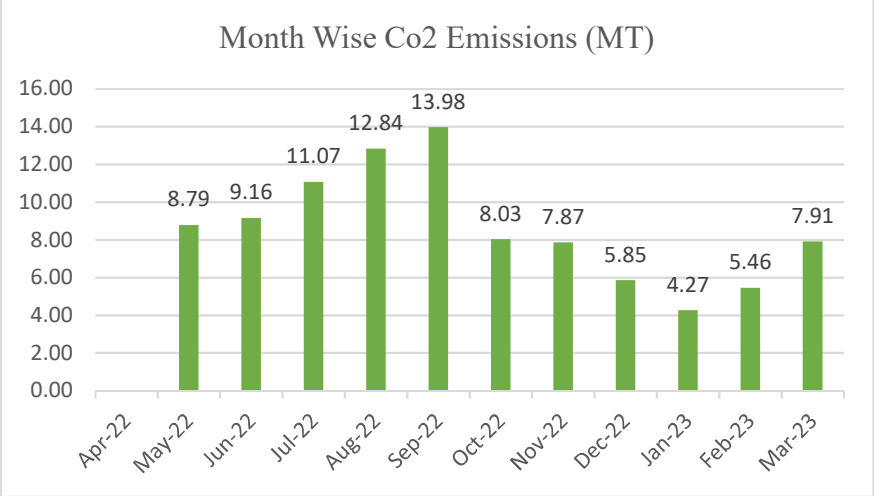

Figure 7 Month wise CO2 emissions of consumer 006000002737

6. Study of utilities

6.1 Study of Lighting

In the facility, the lighting system can be divided mainly in two parts, indoor lighting and outdoor lighting. There are 341 FTL fittings with electronic/ magnetic chokes and It is recommended to install the 18 W LED Tube light fittings in place of these old Tube light fittings. There are 39 CFL fittings are observed and It is recommended to install the 9 W LED fittings in place of these CFL fittings.

6.2 Air-conditioners

In the facility, there are about 41 Nos. of 1.5 Tr Air-conditioners. It is found that all ACs with BEE STAR Rated ACs.

6.3 Ceiling Fans

At building facility, there are about 716 Nos Old Ceiling Fans, which consumed about 70 W of Electrical Energy. It is recommended to replace these old Fans with BEE STAR Rated Ceiling Fans.

6.4 Office Load

In Office load facility have 116 nos of computer, Photocopier machine and Invertor system for office use.

6.5 Submersible Pump Load

Drinking water purpose premise having 3 nos of water bore well pump. Water is supplied from bore well to tank and Pump set has capacity of 1.5 HP.

7. Energy conservation proposals

7.1 Replacement of 341 Nos Old, FTLs with 18 W LED fittings

In the facility, there are about 341 Nos, FTL fittings with electronic/magnetic chokes. It is recommended to the install 18 W LED Tube light fittings in place of these old fittings. In the following Table, we present the savings, investment required & payback analysis.

Table 11 Tube light calculation

Sr. No	Particulars	Value	Unit
1	Present Qty of Tube light fittings	341	Nos
2	Energy Demand of Tube light fitting	40	W/Unit
3	Energy Demand of 18 W LED fitting	18	W/Unit
4	Reduction in demand	22	W/Unit
5	Average Daily Usage period	3	Hrs/Day
6	Daily saving in Energy	23	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	5,627	kWh/Annum
9	Rate of Electrical Energy	6.75	Rs/kWh
10	Annual Monetary saving	0.380	Rs. In Lakh/Annum
11	Cost of 18 W LED Tube	650	Rs/Unit
12	Investment required	2.217	Rs. In Lakh/Annum
13	Simple Payback period	70	Months

It is recommended to change lighting system in a phase manner.

7.2 Replacement of 39 Nos CFL fitting with 9 W LED fittings

In the facility, there are about 39 No fittings. It is recommended to the install 9 W LED light fittings in place of these old fittings. In the following Table, we present the savings, investment required & payback analysis.

Table 12 CFL light calculation

Sr. No	Particulars	Value	Unit
1	Present Qty of CFL light fittings	39	Nos
2	Energy Demand of CFL light fitting	18	W/Unit
3	Energy Demand of 9 W LED fitting	9	W/Unit
4	Reduction in demand	9	W/Unit
5	Average Daily Usage period	3	Hrs/Day
6	Daily saving in Energy	1.05	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	263	kWh/Annum
9	Rate of Electrical Energy	6.75	Rs/kWh
10	Annual Monetary saving	0.018	Rs. In Lakh/Annum
11	Cost of 18 W LED Tube	215	Rs/Unit
12	Investment required	0.084	Rs. In Lakh/Annum
13	Simple Payback period	57	Months

It is recommended to change lighting system in a phase manner.

7.3 Replacement of 716 Nos Old Fans with STAR Rated Ceiling Fans

During the Audit, it was observed that there are 716 Nos, old fans. It is recommended to replace these old fans with 5 STAR Rated Fans.

In the following Table, we present the savings, investment required & payback analysis.

Table 13 Fan calculation

Sr. No	Particulars	Value	Unit
1	Present Qty of Old Fan fittings	716	Nos
2	Energy Demand of Old Ceiling Fan fitting	70	W/Unit
3	Energy Demand of STAR Rated Fan	30	W/Unit
4	Reduction in demand	40	W/Unit
5	Average Daily Usage period	3	Hrs/Day
6	Daily saving in Energy	86	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving potential	21,480	kWh/Annum
9	Rate of Electrical Energy	6.75	Rs/kWh
10	Annual Monetary saving	1.450	Rs. In Lakh/Annum
11	Cost of STAR Rated Ceiling Fan	2,200	Rs/unit
12	Investment required	15.752	Rs. In Lakh/Annum
13	Simple Payback period	130	Months

It is recommended to replace fan with energy efficient fan accordingly.

7.4 Replacement of 34 Nos old ACs with STAR Rated ACs.

During the field visit it is observed that 34 nos of 2 and 3 star ACs found. It is recommended to replace these old ACs with 5 STAR Rated ACs.

In the following Table, we present the savings, investment required & payback analysis.

Table 14 Air Conditioner calculation

No	Particulars	Value	Unit
1	Present Qty of 1.5 TR Old ACs	34	Nos
2	Energy Demand of Old 1.5 TR AC	2.00	kW/Unit
3	Energy Demand of New AC	1.15	kW/Unit
4	Reduction in demand	0.85	kW/Unit
5	Average Daily Usage period	3	Hrs/Day
6	Daily saving in Energy	87	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	21,675	kWh/Annum
9	Rate of Electrical Energy	6.75	Rs/kWh
10	Annual Monetary saving	1.463	Rs. In Lakh/Annum
11	Cost of STAR Rated 1.5 TR AC	52,875	Rs/unit
12	Investment required	17.978	Rs. In Lakh/Annum
13	Simple Payback period	147	Months

It is recommended to change ACs in a phase manner.

7.5 **Optimize the Temperature Setting of ACs.**

During the field visit it is observed that Temperature settings are very low**.**

During EEA study at facility it was observed that temperature settings of AC in office & meeting rooms were in the range of 17^0 C to 22^0 C.

It is known that a 1°C raise in AC temperature can help to save almost 6 % on power consumption (this can also be verified in BEE guideline).

Table 15 Temperature Setting of ACs calculation

No	Particulars	Value	Unit
1	Present Qty of 1.5 TR ACs	34	Nos
2	Energy Demand of Old 1.5 TR AC	2.00	kW/Unit
3	Estimated consumption of Acs	204	kWh/hr
4	Estimated Saving	6	%
5	Operating Hrs per day	3	hrs/day
6	Operating days per year	250	Days/Annum
7	Annual Estimated Saving	1,224	kWh/Annum
8	Unit Rate	6.75	Rs/kWh
9	Annual Saving	0.083	Rs. In Lakh/Annum
10	Investment required	-	Rs. In Lakh/Annum
11	Simple Payback period	-	Months

Hence it was recommended that temperature setting of outlet will be changed from present 23 ^{0}C to 25 ^{0} C and keeping inlet temperature unaltered.

8. Summary of Savings

Table 16 Summary of savings

Sr. No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs. Lakh/Annum	Investment Required, Rs. Lakh/Annum	Payback period, Months
1	Replacement of 341 Nos Tube Light fittings with 18W LED fittings	5,627	0.380	2.217	70
2	Replacement of 39 Nos CFL fittings with 9 W LED fittings	263	0.018	0.084	57
3	Replacement of 716 Nos Old Ceiling Fans with STAR rating fans	21,480	1.450	15.752	130
4	Replacement of 34 Nos Old 1.5 TR ACs with STAR rating ACs	21,675	1.463	17.978	147
5	Optimize the temperature setting to 23-25 degree Celsius	1,224	0.083	NA	NA
Total		**50,269**	**3.393**	**36.030**	-