ANNUAL ENERGY AUDIT REPORT

April 2022 to March 2023

HABRAGHAT MAHAVIDYALAYA

VILL + P.O + P.S: KRISHNAI DIST: GOALPARA
STATE: ASSAM-783126

April -2023

Prepared by

Thunderbolt Energy Consultancy

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Disclaimer

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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 Habraghat Mahavidyalaya for entrusting and offering the opportunity of energy performance assessment assignment.

- Dr. Mantu Kr. Das – Principal
- Dr. Ibrahim Ali Bhuyan - Co-Ordinator

We are thankful to Habraghat Mahavidyalaya 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, Electrical distribution system, Industrial Safety, Green building, ECBC, EHS, OHSA, Environment policy, Firefighting system, Fire Extinguisher and Project Management.
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. Prashant Yadev	Data tabulation and analysis & report preparation	Graduate in Electrical & Electronics Engineering, M.Tech 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.

Habraghat Mahavidyalaya 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	PRICIPAL HABRAGHAT COLLEGE	
		Energy consumed, (Units)	Bill Amount (Rs)
1	Maximum	1,882	24,920
2	Minimum	1,012	10,510
3	Average	1,360	13,854

2. Energy Conservation Projects already installed

1. Usage of LED lights at some indoor locations.
2. Usage of LED Lights for outdoor lighting.
3. Usage of Energy Efficient LED.
4. Usage of Energy Efficient BEE STAR Rated equipment.

3. Key Observations

1. College has 5 nos Inverter set for uninterrupted power supply in case of supply failure from APDCL.
2. There is minimum or practically negligible use of lights during day time as the building structure has possibility of daylight usage.
3. The lighting arrangements are well balanced with arrangements to switch ON and OFF.
4. The policy of college is switch off the lights and other electrical equipment when they are not in use.
5. Cleanliness is well maintained. In- house light fittings are cleaned time to time.
6. Lights are negligibly operated during day time. The lights are operated manually.
7. There is no any sensor-based lighting system.
8. The college is utilizing natural lighting as first preference.
9. Computers, printers and other equipment are switched off at the end of the day.
10. The all the electrical equipment is well operated.
11. The overall electrification system is regularly monitored by a duly qualified electrician.
12. Fire extinguisher is present in campus area.
13. The campus area is well facilitated with CCTVs for security purpose.
14. Water is supplied from bore well to tank and 6 nos. of Pump set has capacity of 1 HP.

4. Recommendations

1. It is recommended to Install solar High Mast at Play Ground area for night activates.
2. Provide solar lights at entry gate and boundary wall.
3. It is recommended to Install solar PV System to reduce dependency on APDCL supply.
4. Provide 2 nos of CO_2 of 4.5 Kg Fire extinguisher in Electrical room.
5. It is recommended to do Solar Panel Cleaning once in a month.
6. Install energy efficient equipment instead of local equipment.
7. Provide 2 nos of DCP of 6 Kg Fire extinguisher in college campus.
8. There are about 54 Nos old Tube light fittings which need to be replaced by 18 W LEDs.
9. There are 254 Nos of ceiling fans which need to be replaced with STAR rated fans.
10. Optimize the temperature setting to 23-25 degree Celsius.

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 54 Nos Tube Light fittings with 18W LED fittings	891	0.057	0.135	28
2	Replacement of 254 Nos Old Ceiling Fans with STAR rating fans	7,620	0.491	5.588	136
3	Replacement of 2 Nos Old 1.5 TR Acs with STAR rating Acs	1,275	0.082	1.058	154
4	To reduce billed contract demand from 23.53 kVA to 10 kVA	NA	0.146	NA	NA
5	Optimize the temperature setting to 23-25 degree Celsius	72	0.005	NA	NA
	Total	**9,858**	**0.782**	**6.781**	-

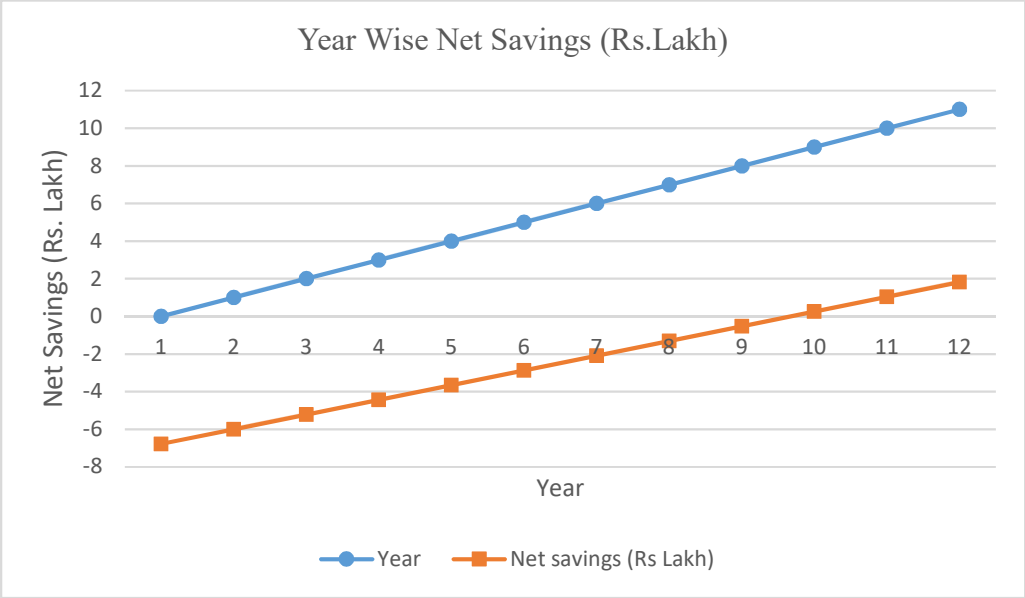

Figure 1 Year Wise Net Savings (Rs. Lakh)

5. Notes & Assumptions

1. Daily working hours-03
2. Annual working days- 250
3. Rate of Electrical Energy- Rs 6.45 /- 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
APDCL	:	Assam Power Distribution Company Limited

1. Introduction

Habraghat College, known as HABRAGHAT MAHAVIDYALAYA dedicated to the glorious memory of "Habraghat Pargana" a revenue village of the erstwhile Bijni Raj State , was formally inaugurated on the auspicious day of 29th August, 1979 with 61 Students in-Pre University Class under the aegis of a Sponsoring & Governing Body with a view to catering to the need of higher education of vast rural backward area bordering Meghalaya state centering round Krishnai pre-dominantly inhabited by people belonging to S.C., ST, O.B.C., M.O.B.C. and minority communities of alarming socio-economic condition.

The college situated in 36 Dudhnoi S.T. Constituency and located in the vicinity of Krishnai just 1 K.M. South from the N.H.37 was affiliated to Gauhati University in 1983 and was placed under deficit system of Grants-in-Aid w.e.f. 01-02-1986. The college has got permanent affiliation and has been registered under 2 (f) & 12 (B) of UGC act 1956 w.e.f March, 2006.
The college has been offering Two Year Higher Secondary Course and Three year Under Graduate Course in the faculty of Arts with Major in Assamese, Arabic, English, Economics, Education, Political Science, History and Mathematics. But I have the pleasure to inform you that with a view to creating capacity building and job opportunities among the students we are going to introduce Certificate Course in Computer Applications from this academic session.

With the help and co-operation of all alike, it is therefore, earnestly hoped that the beloved Alma-Mater of ours would be ever flourishing in the days to come with all its dignity for the noble cause of higher education a process of human empowerment & enlightenment for achievement of a better and higher quality of life.

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 4 years and our vision is to deliver everlasting performance through our services.

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 Habraghat Mahavidyalaya is provided by Assam Power Distribution Company Limited. The Energy consumed by Habraghat Mahavidyalaya falls under LT Category.

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.
PRICIPALHABRAGHAT COLLEGE	LT VB GENERAL PURPOSE Supply	037010060160

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

1) Lighting's load
2) Water Pump
3) Fan load
4) Office equipment
5) Other Load

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	Total number	Load, kW
1	LED Lighting	LED Bulb	9	425	3.83
2	LED Lighting	LED Tube Light	18	50	0.90
3	LED Lighting	Led Flood Light	18	12	0.22
4	LED Lighting	Tube old (General)	40	54	2.16
5	Fan Load	Celling Fan	70	254	17.78
6	Fan Load	Exhaust Fan	50	30	1.50
7	Fan Load	Stand Fan	50	2	0.10
8	Air Conditioner	A.C. 3 Star	1500	2	3.00
9	Office Load	Computer	250	88	22.00
10	Office Load	Refrigerator	1000	2	2.00
11	Office Load	Xerox Machine	1000	2	2.00
12	Office Load	Printer	500	8	4.00
13	Office Load	T.V.	300	2	0.60
14	Office Load	Water Cooler	500	2	1.00
15	Office Load	Water Filter	500	2	1.00
16	Office Load	Scanner	500	1	0.50
17	Office Load	Air Cooler	500	1	0.50
18	Office Load	Projector	500	6	3.00
19	Submersible Pump	Water Pump	750	6	4.50
Total Load kW				**949**	**70.58**

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	7.10	4.94	2.16
	Percentage %	100	69.58	30.42
(B)	Energy in kWh per year	5,326	3,706	1,620
	Percentage %	100	69.58	30.42

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	487	4.94
2	Non-LED Lighting	54	2.16
3	Fan Load	286	19.38
4	Office Load	114	36.60
5	Pump Load	6	4.50
6	Air Conditioner Load	2	3.00

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

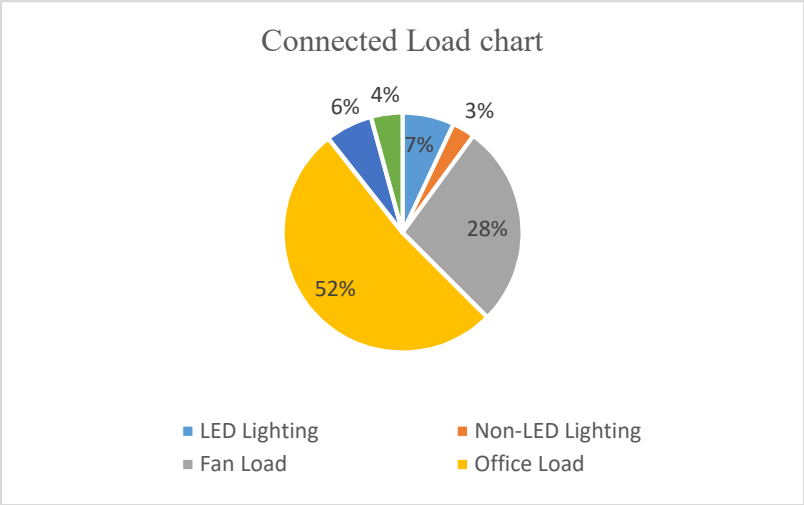

Figure 2 Distribution of connected load

4. Study of Electrical Energy Consumption

Consumer Name- PRICIPAL HABRAGHAT COLLEGE.
Consumer Number- 037010060160

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

Table 8 Summary of electricity bills of consumer 037010060160

Sr. No	Month	Energy (kWh)	Bill Amount (Rs)
1	Apr-22	1,360	11,809
2	May-22	1,172	11,174
3	Jun-22	1,484	24,920
4	Jul-22	1,397	13,123
5	Aug-22	1,882	16,776
6	Sep-22	1,670	16,034
7	Oct-22	1,558	15,379
8	Nov-22	1,240	12,380
9	Dec-22	1,210	12,189
10	Jan-23	1,012	10,510
11	Feb-23	1,074	11,066
12	Mar-23	1,262	10,889
	Total	**16,321**	**1,66,249**

Key observations of electricity bill are as follows,

Table 9 Key observations of consumer 037010060160

Sr no	Parameter	Energy consumed, (Units)	Bill Amount (Rs)
1	Maximum	1,882	24,920
2	Minimum	1,012	10,510
3	Average	1,360	13,854

Variation in Energy consumption is as follows,

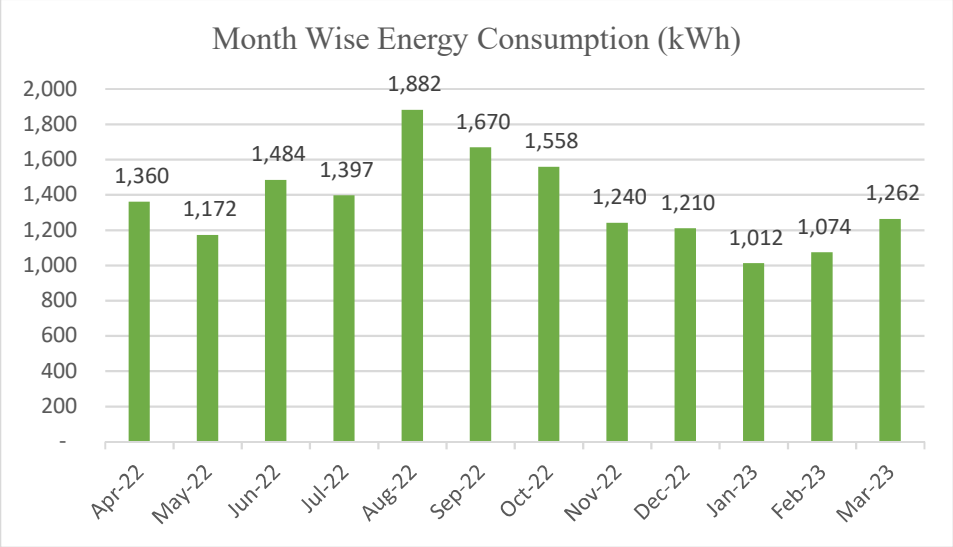

Figure 3 Month wise Energy consumption of consumer 037010060160

Monthly variation in electricity bill is as follows,

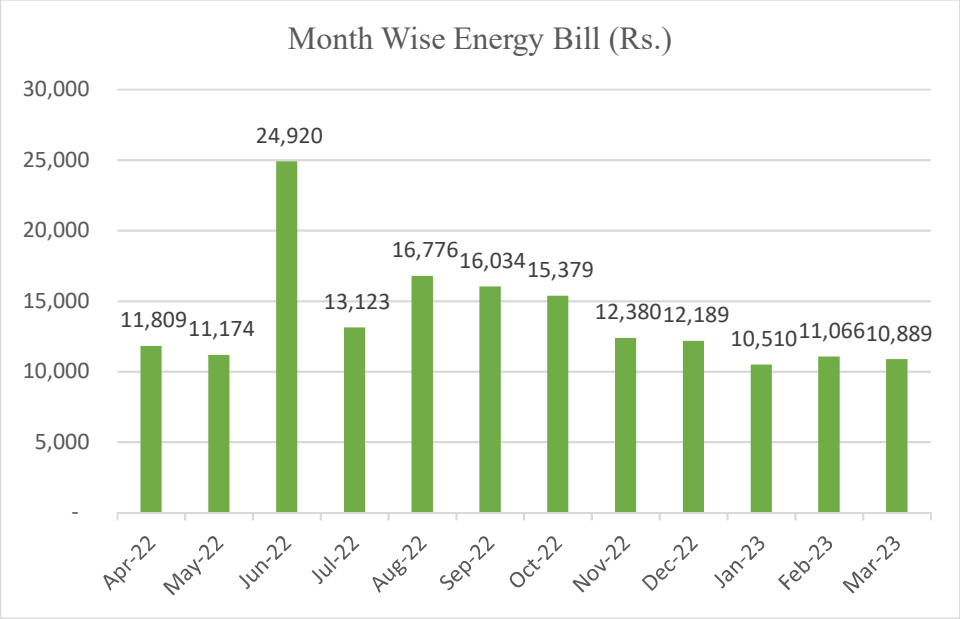

Figure 4 Month wise electricity bill of consumer 037010060160

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

Figure 5 Source of CO2 Emissions

Consumer Name- PRICIPAL HABRAGHAT COLLEGE

Consumer Number- 037010060160

Table 10 Month wise Consumption of Energy & CO2 Emissions of consumer 037010060160

Sr. No	Month	Energy Consumed, kWh	CO2 Emissions, MT
1	Apr-22	1,360	1.16
2	May-22	1,172	1.00
3	Jun-22	1,484	1.26
4	Jul-22	1,397	1.19
5	Aug-22	1,882	1.60
6	Sep-22	1,670	1.42
7	Oct-22	1,558	1.32
8	Nov-22	1,240	1.05
9	Dec-22	1,210	1.03
10	Jan-23	1,012	0.86
11	Feb-23	1,074	0.91
12	Mar-23	1,262	1.07
	Total	**16,321**	**13.06**

In the following Chart we present the CO_2 emissions due to usage of Electrical Energy.

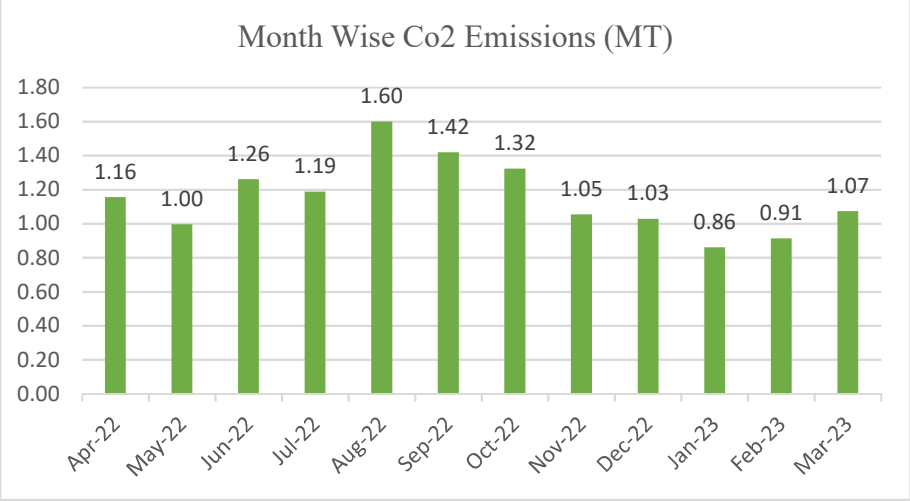

Figure 6 Month wise CO2 emissions of consumer 037010060160

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 54 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.

6.2 Air-conditioners

It is suggested to Install all ACs with BEE STAR Rated ACs and maintain temperature setting between 23-25 degree Celsius.

6.3 Ceiling Fans

At building facility, there are about 254 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 88 nos of computer, Photocopier machine, printer and Invertor system for office use.

6.5 Submersible Pump Load

Drinking water purpose premise having 6 nos of water bore well pump. Water is supplied from bore well to tank and Pump set has capacity of 1 HP.

7. Energy conservation proposals

7.1 Replacement of 54 Nos Old, FTLs with 18 W LED fittings

In the facility, there are about 54 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	54	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	4	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	891	kWh/Annum
9	Rate of Electrical Energy	6.45	Rs/kWh
10	Annual Monetary saving	0.057	Rs. In Lakh/Annum
11	Cost of 18 W LED Tube	250	Rs/Unit
12	Investment required	0.135	Rs. In Lakh/Annum
13	Simple Payback period	28	Months

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

7.2 Replacement of 254 Nos Old Fans with STAR Rated Ceiling Fans

During the Audit, it was observed that there are 254 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 12 Fan calculation

Sr. No	Particulars	Value	Unit
1	Present Qty of Old Fan fittings	254	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	30	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving potential	7,620	kWh/Annum
9	Rate of Electrical Energy	6.45	Rs/kWh
10	Annual Monetary saving	0.491	Rs. In Lakh/Annum
11	Cost of STAR Rated Ceiling Fan	2,200	Rs/unit
12	Investment required	5.588	Rs. In Lakh/Annum
13	Simple Payback period	136	Months

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

7.3 Replacement of 2 Nos old ACs with STAR Rated ACs.

During the field visit it is observed that 2 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 13 Air Conditioner calculation

No	Particulars	Value	Unit
1	Present Qty of 1.5 TR Old ACs	2	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	5	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	1,275	kWh/Annum
9	Rate of Electrical Energy	6.45	Rs/kWh
10	Annual Monetary saving	0.082	Rs. In Lakh/Annum
11	Cost of STAR Rated 1.5 TR AC	52,875	Rs/unit
12	Investment required	1.058	Rs. In Lakh/Annum
13	Simple Payback period	154	Months

It is recommended to change ACs in a phase manner.

7.4 Reduce Contract demand from 23.53 kVA to 10 kVA.

During the Bill Analysis, it was observed that average maximum demand in 2022-2023 is 6.73 kVA and Contracted Demand is 23.53 kVA.

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

Table 14 Contract demand calculation

No	Particulars	Value	Unit
1	Current contract billed demand	23.53	kVA
2	Current highest maximum demand	6.73	kVA
3	Recommended contract billed demand	10	kVA
4	Reduction in billed demand	14	kVA
5	Per unit charges for billed demand	90	Rs/ kW/ month
6	Monthly Monetary savings	1,218	Rs/month
7	Annual monetary savings	0.146	Rs/year

It is suggested to reduce contract demand from 23.53 kVA to 10 kVA.

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	2	Nos
2	Energy Demand of Old 1.5 TR AC	2.00	kW/Unit
3	Estimated consumption of Acs	12	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	72	kWh/Annum
8	Unit Rate	6.45	Rs/kWh
9	Annual Saving	0.005	Rs. In Lakh/Annum
10	Investment required	-	Rs. In Lakh/Annum
11	Simple Payback period	-	Months

Hence it was recommended that temperature setting of outlets 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 54 Nos Tube Light fittings with 18W LED fittings	891	0.057	0.135	28
2	Replacement of 254 Nos Old Ceiling Fans with STAR rating fans	7,620	0.491	5.588	136
3	Replacement of 2 Nos Old 1.5 TR Acs with STAR rating Acs	1,275	0.082	1.058	154
4	To reduce billed contract demand from 23.53 kVA to 10 kVA	NA	0.146	NA	NA
5	Optimize the temperature setting to 23-25 degree Celsius	72	0.005	NA	NA
Total		**9,858**	**0.782**	**6.781**	-