গড়গাঁও মহাবিদ্যালয়

GARGAON COLLEGE

NAAC accredited with 'B' Grade

ENERGY AUDIT

2022-2023

গড়গাঁও মহাবিদ্যালয়
GARGAON COLLEGE
NAAC accredited with 'B' Grade

REPORT
ON
ENERGY AUDIT

Prepared by
Energy Audit Team
Gargaon College, Simaluguri

PREFACE

This report presents the results of an energy audit conducted by the Gargaon College for the academic year 2021-22. The purpose of the audit was to assess the current energy consumption and identify opportunities for energy efficiency and conservation. The audit covered the main campus buildings, facilities, and equipment. The college is in the process of upgrading its existing infrastructure and adding new energy efficient equipment and buildings to the campus. The upgrade is expected to take 3 years, so the college has decided to extend the 2021-22 assessment until the academic session 2023-24.

Energy Audit Team

Sl. No.	*Name*	*Designation*
1	Dr. Dulen Saikia	Principal, Jorhat Kendriya Mahavidyalaya
2	Mr. Rajib Bordoloi	Associate Professor, Jorhat Kendriya Mahavidyalaya
3	Mr. Arup Saikia	Assistant Professor, Jorhat Kendriya Mahavidyalaya
4	Mr. SabikurA Rahman	Assistant Professor, JEC
5	Dr. Dimbeswar Dutta	Sr. Scientist RFRI

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This is to certify that an Energy Audit for Gargaon College, Sibsagar, Assam has been conducted from March-21 to February-22 to assess energy costs, availability and reliability of supply of energy, energy conservations technologies and ways to reduce energy consumption.

23/07/2022

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Chairperson

Dr. Dulen Saikia
Chairperson, E-Audit
JKM Consultancy Service

JKM Consultancy Service

Mr. Arup Saikia
Coordinator

Mr. Arup Saikia
Co-ordinator, E-Audit
JKM Consultancy Service

JKM Consultancy Service

Table of Content

1. INTRODUCTION:

The energy audit at Gargaon College is a step towards the responsibility of energy conservation. The audit was conducted by a team of experts from the ***JKM Consultancy Service*** in collaboration with the college authorities. The objective of the audit was to assess the current energy consumption patterns and identify the potential areas for improvement. The audit covered various aspects of electrical energy use, such as lighting, heating, cooling, ventilation, appliances and computers etc. The audit report provides a detailed analysis of the energy performance of the college and recommends various measures to reduce energy wastage and enhance efficiency.

2. OBJECTIVE:

The primary objectives of the Gargaon College to conduct an energy audit in the campus are:

a) Establish energy consumption in the organization.
b) Estimate the scope for saving.
c) Identify immediate improvements or savings, especially those that are low-cost or no-cost.
d) Set a reference point.

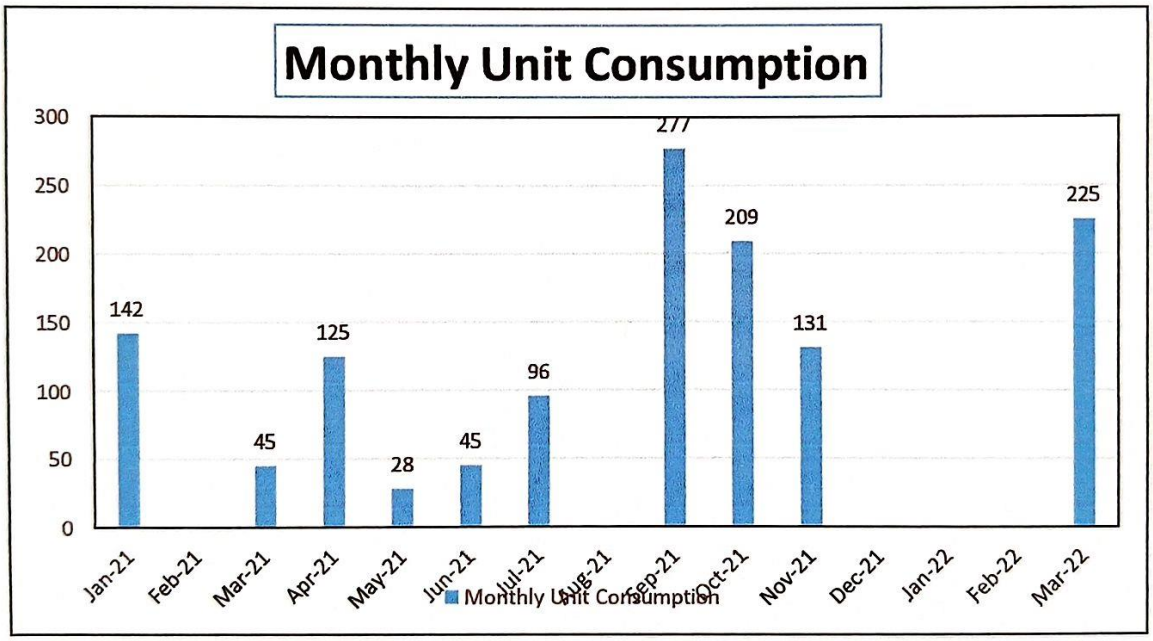
3. LIST OF ELECTRICAL EQUIPMENT AT GARGAON COLLEGE:

Sl. No.	Items	Average Load of Each Quantity (Watt)	Total Load (*averaged*) For Each Item (Watt)
1	Bulb (CFL)	10	6380
2	Bulb (Tube)	20	1300
3	Fan	70	27860
4	Computer	100	10500
5	Printer	100	2700
6	Inverter	1000	4000
7	Stand Fan	65	585
8	Projector	100	800
9	Refrigerator	100	1200
10	Exhaust Fan	60	240
11	Oven	1000	5000

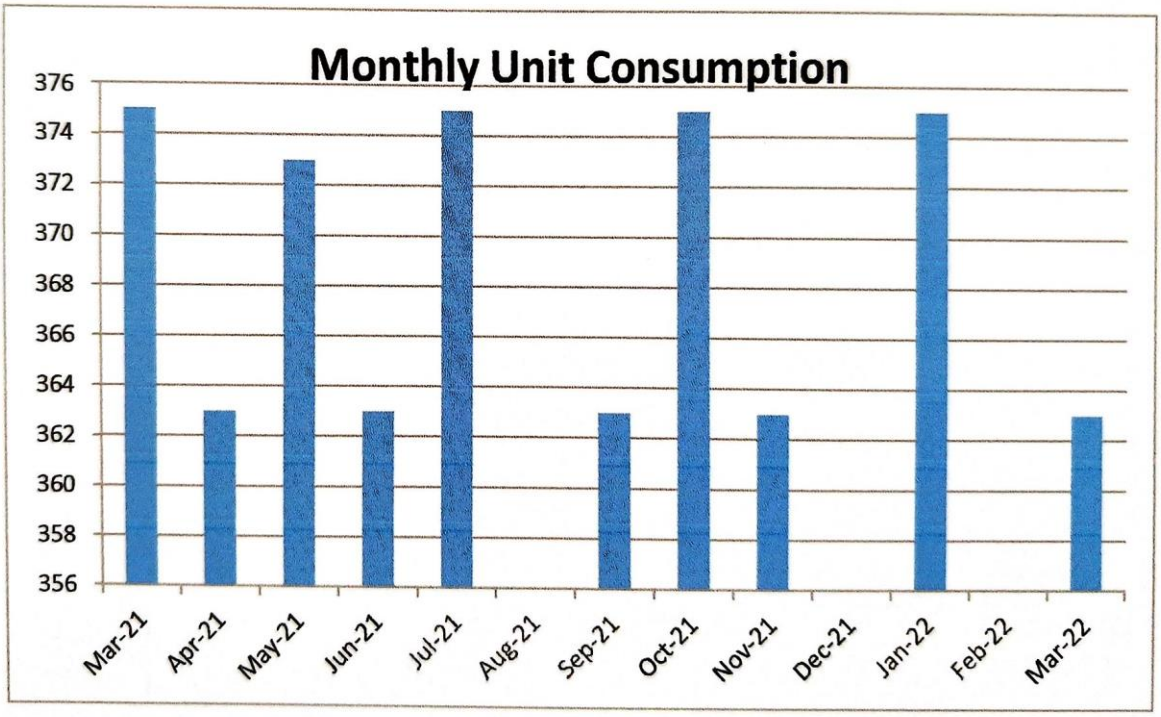
12	**pH Meter**	**100**	**600**
13	**Conductometer**	**100**	**500**
14	**Polarimeter**	**100**	**700**
15	**Magnetic Stirrer**	**100**	**400**
16	**Heating Mantel**	**100**	**300**
17	**Distilled Water Plant**	**100**	**300**
18	**Water Bath**	**100**	**500**
19	**Microscope**	**100**	**800**
20	**Air Conditioner**	**6000**	**48000**
21	**Laminar Air Flow**	**100**	**100**
22	**Centrifuge**	**100**	**200**
23	**UV Transilluminator**	**220**	**220**
24	**Spectrophotometer**	**100**	**100**
25	**PCR**	**100**	**100**
26	**Incubator**	**100**	**300**
27	**FPM Compressor**	**150**	**150**
28	**Double Distillatioin**	**100**	**100**
29	**Muffle Furnace**	**4000**	**4000**
30	**Electric Kattle**	**400**	**800**
31	**Vortex Shaker**	**100**	**400**
32	**Pad Dispenser Machine**	**100**	**300**
33	**Water Pump**	**250**	**2500**
34	**BSNL Router**	**20**	**20**
35	**CCTV DVR**	**100**	**200**
36	**CCTV Camera Displayer**	**60**	**120**
37	**Vacuum Cleaner**	**750**	**750**
38	**XEROX Machine**	**1000**	**4000**
39	**Water Purifier**	**60**	**360**
40	**TV**	**90**	**180**
41	**Online UPS**	**13**	**26**
42	**Flash Light**	**100**	**1200**

Table-1: List of electrical equipment at Gargaon College

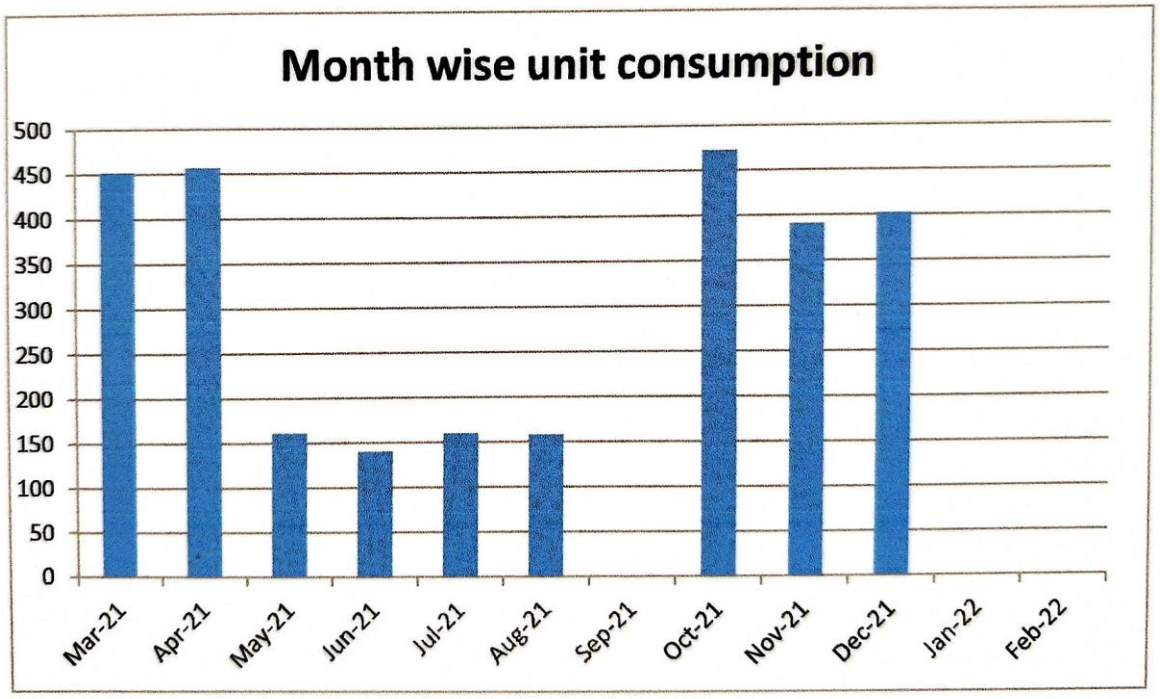
4. MONTHLY ELECTRICITY CONSUMPTION ANALYSIS:



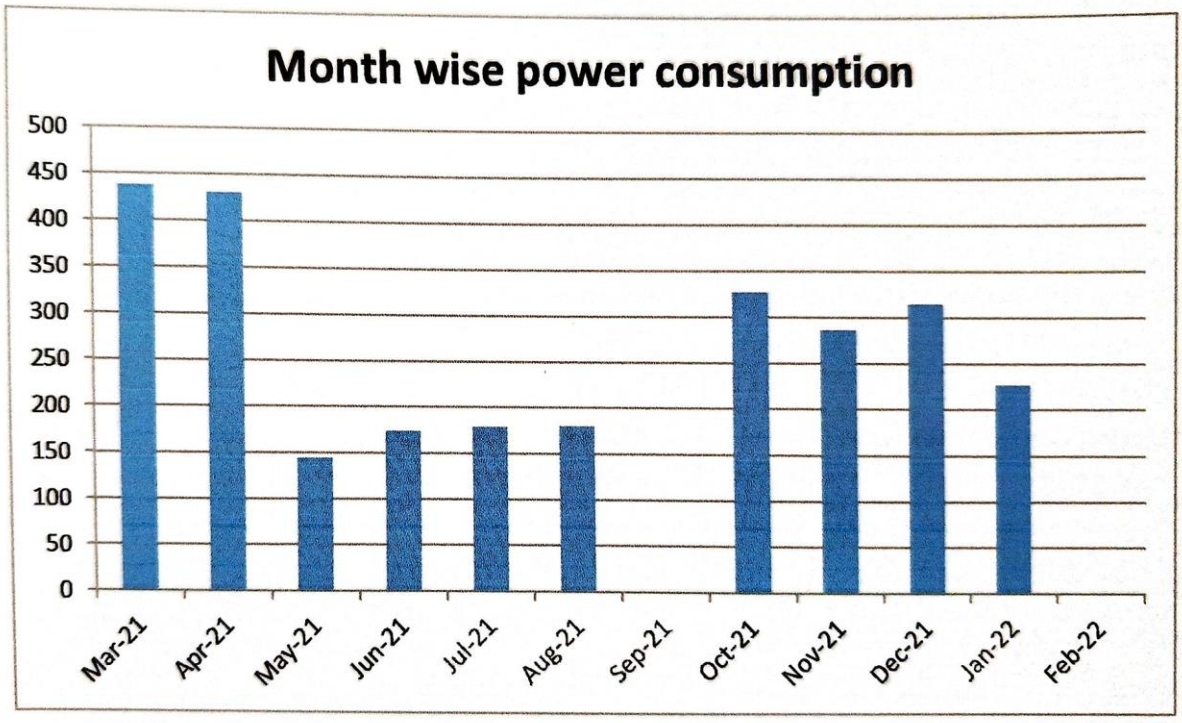
Plot-1: Gargaon College Office; Meter No.-AE043348



Plot-2: Gargaon College Class Room Building; Meter No.-536775



Plot-3: Gargaon College Girls Hostel; Meter No.-AE060628



Plot-4: Gargaon College Girls Hostel; Meter No.-65675

5. SOURCES OF ELECTRICITY IN THE CAMPUS:

The Gargaon College has mainly three sources of electricity, namely-

a) Grid Electricity from Assam Power Distribution Company Limited (APDCL)
b) High Speed Diesel Generator (HSDG)
c) Solar energy.

The campus relies on three sources to fulfil its electricity needs. The main source is the grid electricity, which provides power most of the time. When the grid electricity is unavailable, diesel generators are used as a backup source. As a step towards a clean source solar energy is used in girls common room and light posts in the campus.

6. MERITS/ EXISTING FEATURES FOR ENERGY SAVING AT GARGAON COLLEGE:

The energy audit report highlights a list of features towards energy saving at Gargaon College:

a) Staff vigilance.
b) Computers are connected in LAN.
c) Screen savers facility implemented for every computer.
d) AC's used are of three STARS.
e) Refrigerator's used are of three STARS.
f) Incandescent bulbs are nowhere used.
g) Maximum use of natural light.
h) Cross ventilation is provided in laboratories & class rooms, which reduced number of fans used.
i) Walls are painted with off-white colour to have sufficient brightness.

7. GENERAL RECOMNADATION BY THE AUDTING AGENCY:

The energy audit report also gives few general recommendations to further enhance towards energy saving, few of them are:

a) The comfort/ default air conditioning temperature to be set between 24ºC to 26ºC.
b) Use Automatic Power Factor Correction (APFC) panel for PF improvement.
c) Need to focus on the existing solar panel which is generating below the rated power.
d) Need to use power saver circuit for AC's.
e) Need to replace FTL by smart LED tube.
f) Need to replace ordinary refrigerator by BEE power saver refrigerator if possible.

8. CONCLUSION:

The energy audit at Gargaon College is a commendable initiative that demonstrates the college's commitment to environmental sustainability and social responsibility. The college takes several steps to save and conserve energy, such as using LED bulbs and tube lights, installing rooftop solar panels, equipping solar street lights inside the campus and practicing judicious use of electricity. The college also encourage the stakeholders to increase the use of sustainable energy. The college has a well-lighted and ventilated campus with large windows, doors and high ceiling that receive enough sunlight. The college uses air conditioners only in the offices and computer laboratories. The implementation of the audit recommendations will not only save energy and money, but also reduce greenhouse gas emissions and contribute to the national goal of energy security.

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ENERGY AUDIT REPORT

(2021-22)

OF

GARGAON COLLEGE

Address: Simaluguri ,Sibsagar- 785686, Assam

By

JKM Consultancy Service
Solution For Energy Audit

INDEX

Preface

Data collection for energy audit of the Gargaon college Simaluguri ,Sibsagar was conceded by team for the period of March 2021 to February 2022

This audit was over sighted to inquire about convenience to progress the energy competence of the campus. Energy audit survey was completed by B.Sc. Physics students under the guidance of their faculty members. All data collected from each classroom, laboratory, every room. The work is completed by considering how many tubes, fan, A.C, electronic instruments, etc. in each room. How much was participation of each component in total electricity consumption.

We really appreciate the effort put by college management for creating awareness of Energy Audit, use renewable energy such as solar energy and their significance use for efficient energy saving and our nature among the all of us. We really appreciate Hon. Management of the college for encouraging us by providing this wonderful opportunity to do the energy audit. Through this, we have been cleared the vision of Institution towards the Green campus and save our green nature. We really appreciate to develop good quality weather station in house of the college.

Main Building

Acknowledgement

We are sincerely thankful to the Gargaon College , Simaluguri Sibsagar management for giving us the opportunity to conduct energy audit in Gargaon college campus.

We are also grateful to Dr. Sabyasachi Mahanta , principal , Gargaon college Assam whose valuable comment / feedback , during various reviews have helped us to bring the report in the present format.

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

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Mr. Arup Saikia
Co-ordinator, E-Audit
JKM Consultancy Service
Coordinator

AudiT

JKM Consultancy Service

Energy Audit Assessment Team

(Internal)

- **Dr. Dulen saikia, Principal , M.Sc , M.Phil., Ph.d**
- **Mr. Rajib Bordoloi, Associate Prof. , M.Sc, M.Phil**
- **Mr. Arup saikia, Assistant Prof. M.sc, M.Phil**

23/07/2022
23/07/22

(External)

- **Mr. Sabikur Rahman, Assistant Prof. JEC**
- **Dr. Dandeswar Dutta, Sr. Scientist RFRI**

23/07/2022
22/07/22

Abbreviations

AHU	Air handling unit
APFC	Automatic Power Factor Controller
DG	Diesel generator
ECP	Energy Conservation Proposal
GCV	Gross Calorific Value
HVAC	Heating, Ventilation and Air Conditioning
HSDG	High speed diesel Generator
PF	Power Factor
SEC	Specific Energy Consumption
TR	Tons of Refrigeration
UOM	Unit of Measurement
APDCL	Assam Power Distribution Company Limited

Introduction to Energy Audit

- **General:**

Gargaon College, Simaluguri ,Sibsagar, Assam entrusted the work of conducting a detailed Energy Audit of campus with the main objectives are as bellows:

- ✓ To study the present pattern of energy consumption
- ✓ To identify potential areas for energy optimization
- ✓ To recommend energy conservation proposals with cost benefit analysis.

- **Scope of Work, Methodology and Approach:**

Scope of work and methodology were as per the proposal While undertaking data collection, field trials and their analysis, due care was always taken to avoid abnormal situations so as to generate normal/representative pattern of energy consumption at the facility

- **Approach to Energy Audit:**

We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipment. The key to such performance evaluation lies in the sound knowledge of performance of equipment and system as a whole.

- **Energy Audit:**

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.

There are three phases of energy audit

1. Pre audit phase
2. Audit phase
3. Post audit phase

Above phase include following stages

1. **Data collection**- In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation , survey communicating with responsible persons and measurements.

Following steps were taken for data collection:

a. The team went to each department , centers, library, canteen etc.
b. Data about the general information was collected by observation and interview.
c. The power consumption of appliances was recorded by taking an average value in some cases

2. **Data analysis** – Detailed analysis of data collected include: calculation of energy consumption , analysis of latest electricity bill of campus .
3. **Recommendation** - On the basis of results of data analysis and observations , some steps For reducing power and water consumption were recommended. Proper treatments for waste were also suggested. Used of fossil fuels has to be reduced for the sake of community health

The above target areas particular to the college was evaluated through questionnaire circulated

among the students for data collection. Five categories of questionaries' were distributed. The format of this are given below

1.1 Pre audit phase

1.1.1 Survey form for data collection

1. List ways that you use energy in your college .(Electricity , Electric stove , Kettle, Microwave , LPG , Petrol , Diesel and others).
2. Electricity bill amount for the last five year
3. Amount paid for LPG cylinders for last one year .
4. Weight of firewood used per month and amount of money spent ? Also mention the amount spend for petrol/diesel/others for generators?
5. Are there any energy saving methods employed in your college? If yes ,please specify . If no ,suggest some.
6. How much money does your college spend on energy such as electricity , gas , etc. In a month .(Record monthly for the year 2016).
7. How many CFL bulbs has your college installed ? Mention use (Hours used/ Daily for how many days in a month)
8. Energy used by each bulb per month? (For example- 60 watt bulb x 4 hour x No of bulbs= kwh).
9. How many LED bulbs are used in your college ? Mention the use (Hours used / day for how many days in a month)
10. Energy used by each bulb per month?(kwh) .
11. How many incandescent(tungsten)bulbs have your college installed?
12. Mentions used (Hours used/day for how many days in a month)
13. Energy used by each bulb per month?(kwh).
14. How many fans are installed in your college ? Mention use(Hours used /day for how many days in a month
15. Energy used by each fan per month ? (kwh)
16. How many air conditioners are installed in your college? Mention use(Hours used /day for how many days in a month)
17. Energy used by each air conditioners per month?(kwh)
18. How many electrical equipment including weighing balance are installed in your college ?
19. Mention the use (Hours used /day for how many days in a month)
20. Energy used by electrical equipments per month?(kwh)
21. How many computers are there in your college? Mention the use (Hours used /day for how many days in a month)
22. Energy used by each computer per month?(kwh)
23. How many photocopiers are installed by your college ?Mention use(Hours used /day for how many days in a month)
24. How many cooling apparatus per month are installed in your college ? Mention use(Hours used /day for how many days in a month)
25. Energy used by cooling apparatus per month?(kwh) Mention use(Hours used /day for how many days in a month)

26. Energy used by each photocopier per month?(kwh) Mention use(Hours used /day for how many days in a month)how many inverters your college installed ? Mention use(Hours used /day for how many days in a month)
27. Energy used by each inverter per month?(kwh)
28. How many electrical equipment are used in different labs of your college? Mention use(Hours used /day for how many days in a month)
29. Energy used by each equipment per month?(kwh)
30. How many heaters are used in the canteen of your college? Mention use (Hours used /day for how many days in a month)
31. Energy used by each heater per month (kwh)
32. Number of street lights in your college?
33. Energy used by each street light per month?(kwh)
34. Any other item that uses enegy(Please write the energy used per month) Mention use(Hours used /day for how many days in a month)
35. Are any alternative energy sources /Known conventional energy sources employed / installed in your college?(Photovoltic cell for solar energy, windmill ,energy efficient stoves etc.,)Specify.
36. Do you run "switch off" drills at college?
37. Are your computers and other equipment put on power saving mode?
38. Does your machinery(TV, AC, Computer , weighing balance , printers, etc.)run on standby mode most of the time? If yes , how many hours?
39. What are the energy conservation methods adopted by your college?
40. How many boards displayed for saving energy awareness?
41. How much ash is collected after burning firewood per day in the canteen?
42. Write a note on the methods/ practice / adaptation by which you can reduce the energy used in college campus in future.

2. Audit Phase

In Gargaon college , energy auditing was done with the help of team teaching staff and students. The energy audit began with the teams walking through all the different facilities at the college, determining the different types of appliances and utilities (lights, taps, toilets, fridges, etc.) as well as measuring usage per item (watts indicated on appliances) and identifying the relevant consumption patterns (such as how often an applicant is used) and there impacts. The staff and learners were interviewed to get details of usage, frequency or general characteristics of certain appliances.

2.1 Data collection

Data collection was done in the sector such as sources of energy and energy consumption pattern, college records and documents were verified several times to clarify the data received through survey and discussions. Although whole process was completed from 2021 march to February , 2022 , previous energy patterns were also observed.

2.2 Site Tour

Site inspection was done along with students and staff.

2.3 Review of Documents and Records

Documents such as electricity bill registers of electricity fuel consumption were collected .

2.2.4 Energy Consumption Profile

A. Source of Energy:

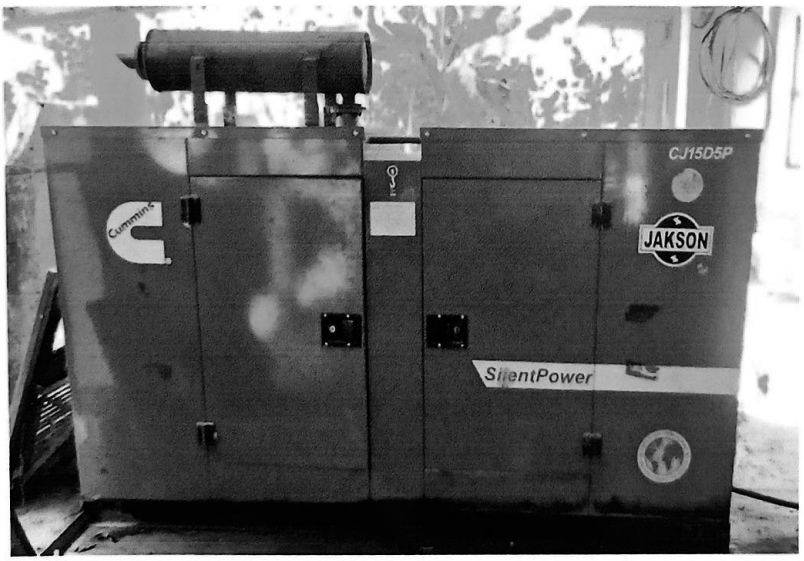
a. Electricity from Assam Power Distribution Company Limited

b. High Speed Diesel Generator (HSDG):

HSD is used as a fuel for Diesel Generator which is run whenever power supply from APDCL is not available.

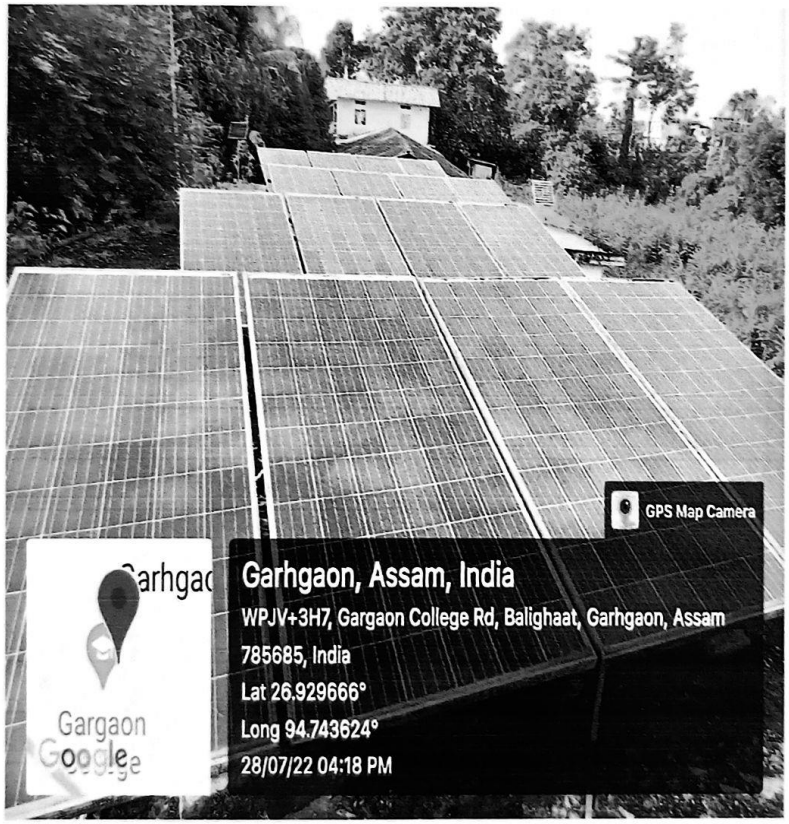
There is two number of DG set which is dedicated to supply power to entire campus. The salient technical specifications are as follows:

Company	JAKSON
Model no	JSPF- 40X(3PH)
Machine no	JSP-40X
KVA	40 KVA
KW	40
Voltage	415v
Current	87amp
Power factor	0.8



c. Solar Energy

There is a Solar Photovoltaic unit for power generation with a capacity of 5 Killowatt.



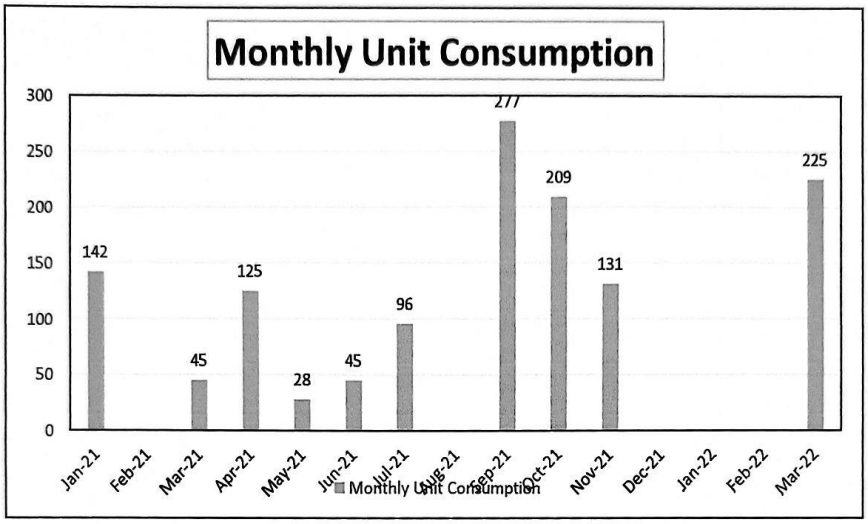
Study of Variation of Monthly Units consumption & Power Factor:

In this Chapter, we study the details of the 12 months Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

I Gargaon college office Meter no AE043348

Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	March 21	45	2180	0.85
2.	April 21	125	2629	0.85
3.	May 21	28	2103	0.85
4.	June 21	45	2112	0.85
5.	July 21	96	4678	0.85
6.	August 21	NA	NA	0.85
7.	September 21	277	3610	0.85
8.	October 21	209	1910	0.85
9.	November 21	131	2668	0.85
10.	December 21	NA	NA	NA
11.	January 22	142	2799	NA
12.	February 22	NA	NA	NA
13.	March 22	225	3275	0.85
	Total Unit (average)	**132.3**	**2796.4**	**0.85**


Monthly Unit Consumption
300
250
200
150
100
50
0
142
45
125
28
45
96
277
209
131
225
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
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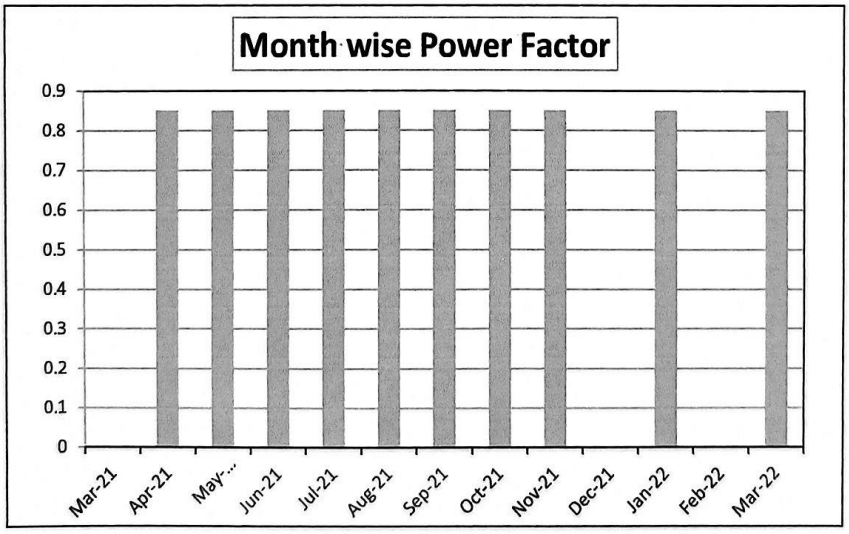
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22
Monthly Unit Consumption


Month wise Power Factor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mar-21
Apr-21
May-...
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22

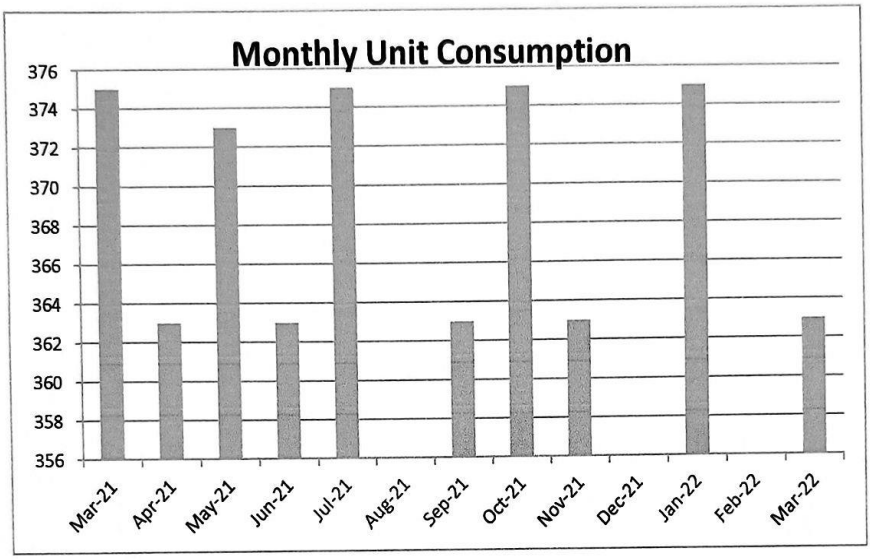
Study of Variation of Monthly Units consumption & Power Factor:

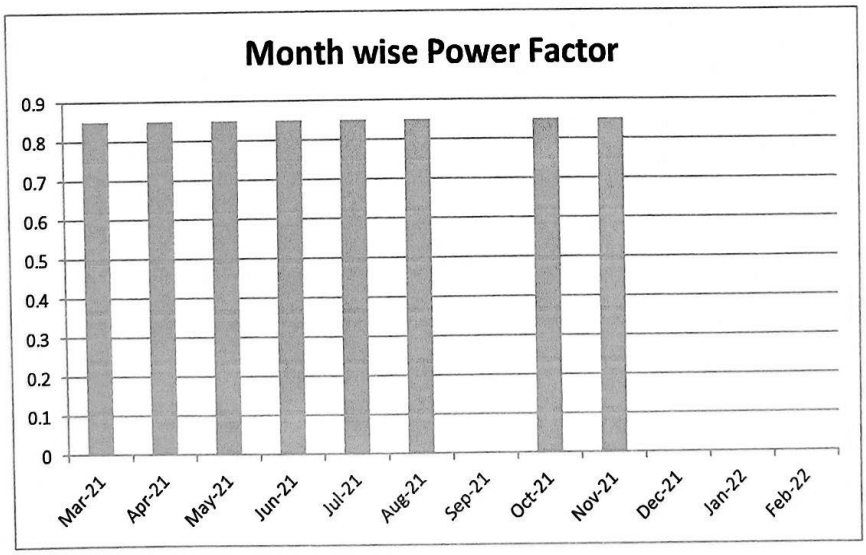
In this Chapter, we study the details of the 12 months Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

II Gargaon college Class room building Meter no:- 536775

Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	March 21	375	2677	0.85
2.	April 21	363	2534	0.85
3.	May 21	373	2656	0.85
4.	June 21	363	2534	0.85
5.	July 21	375	5606	0.85
6.	August 21	NA	NA	0.85
7.	September 21	363	2534	0.85
8.	October 21	375	2618	0.85
9.	November 21	363	2534	0.85
10.	December 21	NA	NA	NA
11.	January 22	375	2618	NA
12.	February 22	NA	NA	NA
13.	March 22	363	2534	0.85
	TotalUnit (average)	**368.8**	**2884.5**	**0.85**


Monthly Unit Consumption
376
374
372
370
368
366
364
362
360
358
356
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22


Month wise Power Factor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22

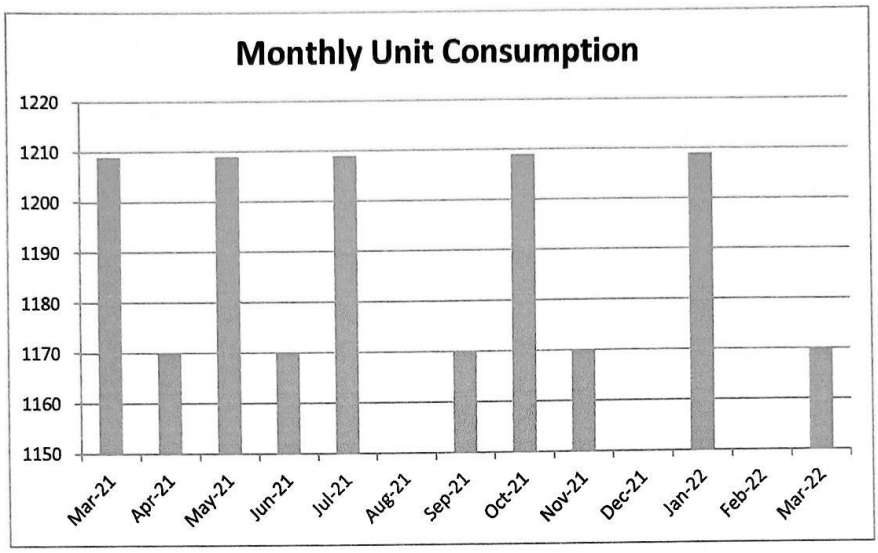
Study of Variation of Monthly Units consumption & Power Factor:

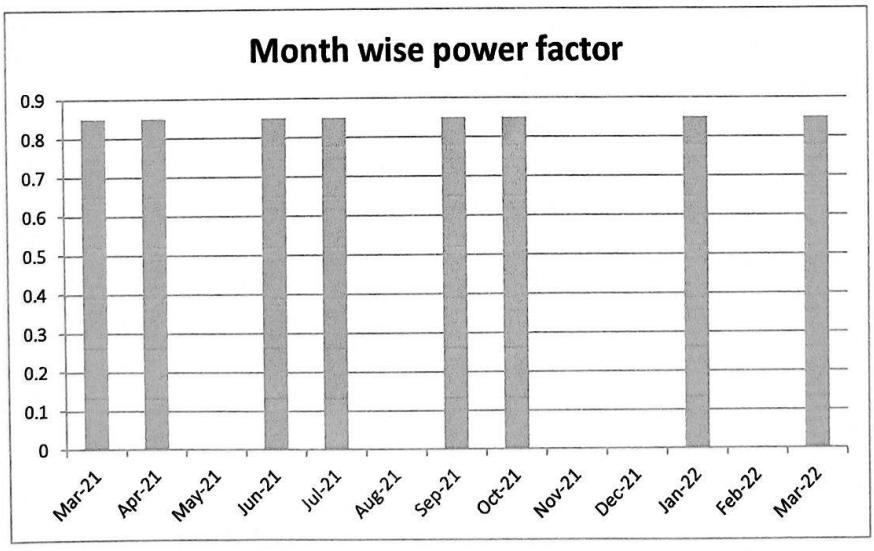
In this Chapter, we study the details of the 12 months Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

II Gargaon college Science building Meter :-no AE051018

Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	March 21	1209	8328	0.85
2.	April 21	1170	7875	0.85
3.	May 21	1209	8256	0.85
4.	June 21	1170	7875	0.85
5.	July 21	1209	15559	0.85
6.	August 21	NA	NA	NA
7.	September 21	1170	7875	0.85
8.	October 21	1209	8138	0.85
9.	November 21	1170	7875	0.85
10.	December 21	NA	NA	NA
11.	January 22	1209	8137	0.85
12.	February 22	NA	NA	NA
13.	March 22	1170	7875	0.85
	TotalUnit (average)	**1189.5**	**8779.3**	**0.85**


Monthly Unit Consumption
1220
1210
1200
1190
1180
1170
1160
1150
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22


Month wise power factor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22

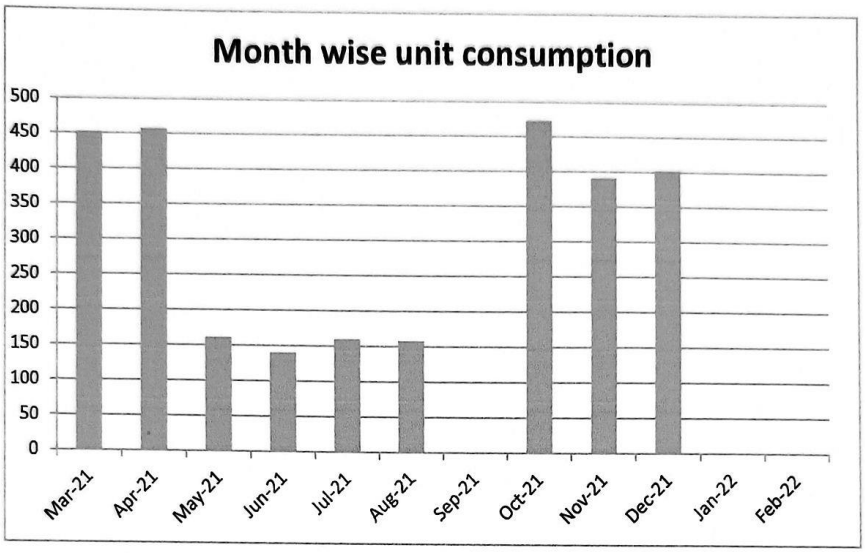
Study of Variation of Monthly Units consumption & Power Factor:

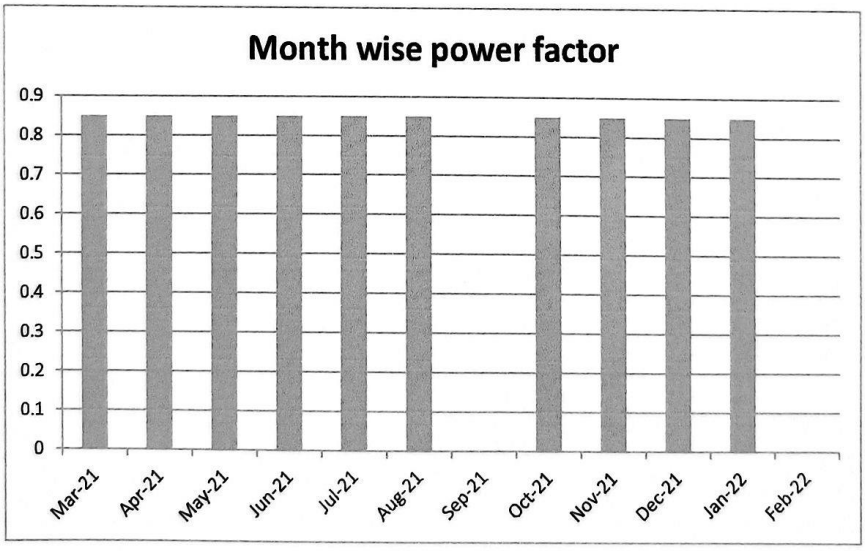
In this Chapter, we study the details of the 12 months Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

II Gargaon college Girls Hostel Meter no:- AE060628

Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	March 21	452	3321	0.85
2.	April 21	457	3271	0.85
3.	May 21	161	1419	0.85
4.	June 21	140	1224	0.85
5.	July 21	160	1382	0.85
6.	August 21	158	1351	NA
7.	September 21	NA	NA	NA
8.	October 21	472	3379	0.85
9.	November 21	391	2845	0.85
10.	December 21	402	3443	0.85
11.	January 22	348	2578	0.85
12.	February 22	NA	NA	NA
	TotalUnit (average)	**314**	**2421**	**0.85**


Month wise unit consumption
500
450
400
350
300
250
200
150
100
50
0
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22


Month wise power factor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22

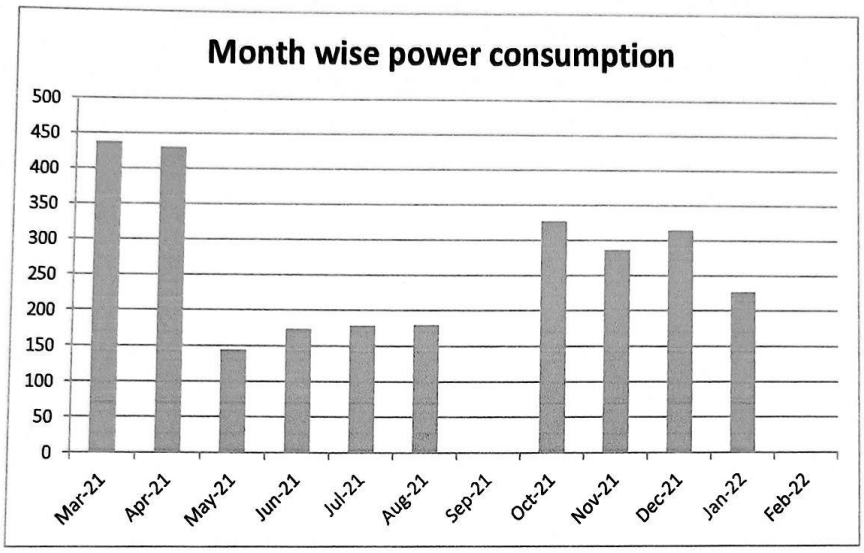
Study of Variation of Monthly Units consumption & Power Factor:

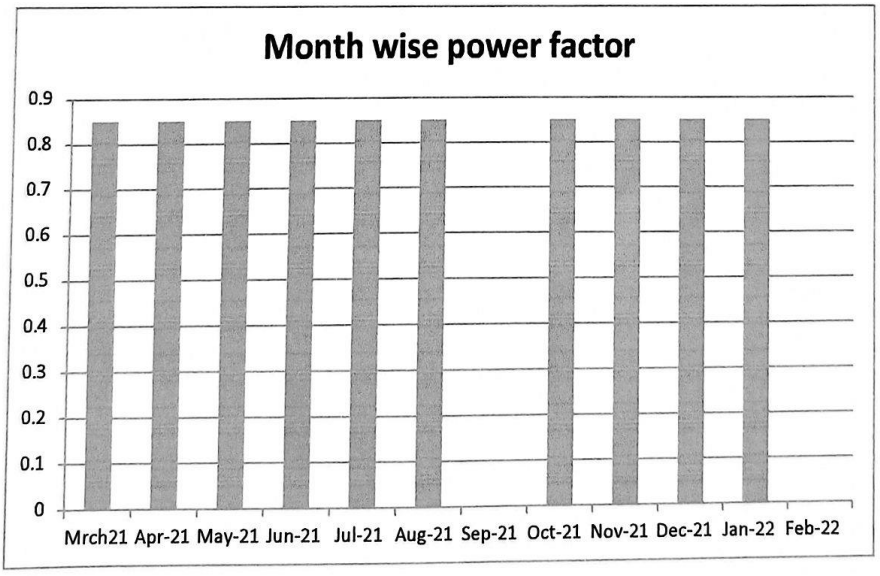
In this Chapter, we study the details of the 12 months Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

II Gargaon college Girls Hostel Meter no:- 65675

Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	March 21	438	4024	0.85
2.	April 21	430	3867	0.85
3.	May 21	144	2115	0.85
4.	June 21	174	2214	0.85
5.	July 21	179	2316	0.85
6.	August 21	180	2289	0.85
7.	September 21	NA	NA	NA
8.	October 21	327	2365	0.85
9.	November 21	286	2937	0.85
10.	December 21	315	3161	0.85
11.	January 22	227	2593	0.85
12.	February 22	NA	NA	NA
	TotalUnit (average)	**270**	**2788**	**0.85**


Month wise power consumption
500
450
400
350
300
250
200
150
100
50
0
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22


Month wise power factor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mrch21 Apr-21 May-21 Jun-21 Jul-21 Aug-21 Sep-21 Oct-21 Nov-21 Dec-21 Jan-22 Feb-22

Study of Variation of Monthly Units consumption & Power Factor:

In this Chapter, we study the details of the 12 months Electricity Bills.

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

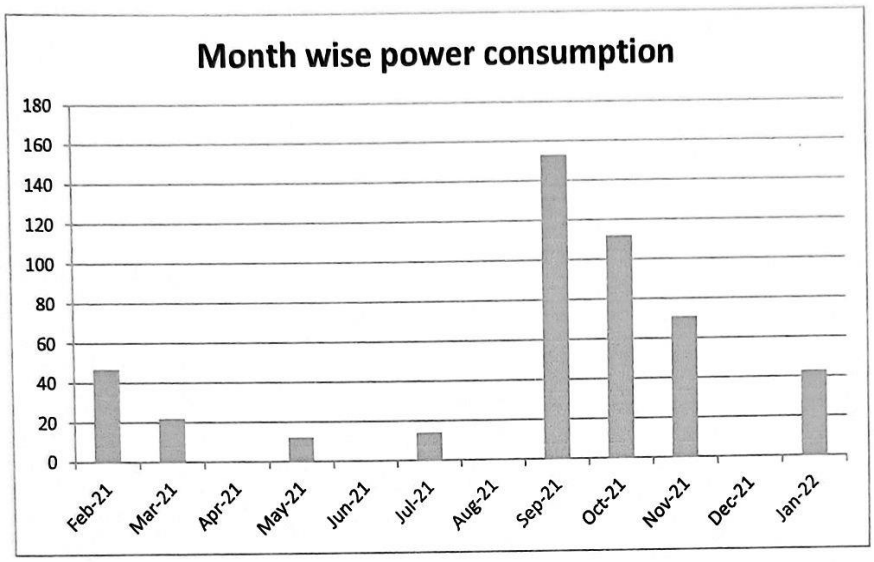
II Gargaon college Boys Hostel Meter no:- 536771

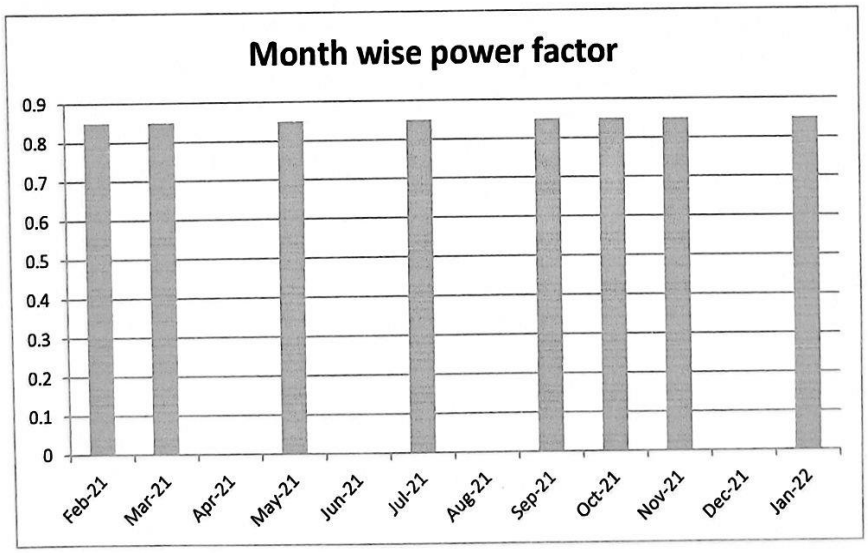
Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	March 21	-	196	0.85
2.	April 21	-	190	0.85
3.	May 21	-	199	0.85
4.	June 21	-	190	0.85
5.	July 21	-	199	0.85
6.	August 21	-	196	0.85
7.	September 21	-	NA	NA
8.	October 21	83	732	0.85
9.	November 21	49	506	0.85
10.	December 21	-	-	-
11.	January 22	-	-	-
12.	February 22	NA	NA	NA
	TotalUnit (average)	-	-	**0.85**

Table No 4.1 Variation in Units Consumption & Power Factor (PF)

II Gargaon college Qtr. No1 Meter no. GE183961

Sr. No.	Month	No. Units kWh	Amount	Power Factor
1.	February 21	47	261	0.85
2.	March 21	22	0.00	0.85
3.	April 21	NA	NA	NA
4.	May 21	12	280	0.85
5.	June 21	NA	NA	NA
6.	July 21	14	706	0.85
7.	August 21	NA	NA	NA
8.	September 21	153	781	0.85
9.	October 21	112	530	0.85
10.	November 21	71	365	0.85
11.	December 21	NA	NA	NA
12.	January 22	43	252	0.85
	TotalUnit (average)	**57.4**	**380.7**	**0.85**


Month wise power consumption
180
160
140
120
100
80
60
40
20
0
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22


Month wise power factor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22

Conclusion: Variation of PF

The Power Factor to reduce the utility power bill. Most utility bills are influenced by KVAR usage. A good Power Factor provides a better voltage. Reducing the pressure on electrical distribution network. Reducing cable heating, cable over loading and cable losses. Reducing over loadings of control gears and switch-gears etc.

Whenever the average power factor over a billing cycle or a month, whichever is lower, of a higher tension consumer is below 90%, Penal charges shall be levied to the consumer at the rate of 2 % (two %) of the amount of monthly energy bill (excluding of Demand Charges, FOCA, Electricity Duty and Regulatory Liability Charge etc.)

For power factor of 0.99, the effective incentive will amount to 5% (five percent) reduction in the energy bill and for unity power factor; the effective incentive will amount to7% (seven percent) reduction in the energy bill

General Observations based on Electricity Bill:

1. The average electricity cost is Rs. 6.80 considering the last twelve months.
2. Average monthly Power Factor is maintained near **P.F. 0.85**
3. Load Factor need to be improved to maximum value.
4. Power factor is affected during May and July 2021 is 0.85 and 0.85 and need to improvepower factor up to 0.9

Actual Measurements and its Analysis

1. PHYSICS DEPARTMENT

SL. No.	ITEMS	Power rating (watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	8	80
2	Fan	70	8	560
3	Computer	100	4	400
4	Printer	100	1	100
5	Projector	100	1	100
6	Refrigerator	100	1	100
				Total :-1.34KW

2. CHEMISTRY DEPARTMENT

SL. No.	ITEMS	Power rating (watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	11	110
2	Bulb (Tube)	20	4	80
3	Fan	70	8	560
4	Computer	100	4	400
5	Printer	100	1	100
6	Refrigerator	100	2	200
7	Exhaust Fan	60	4	240
8	Oven	1000	2	2000
9	pH Meter	100	5	500
10	Conductometer	100	5	500
11	Polarimeter	100	7	700
12	Magnetic Stirrer	100	4	400
13	Heating Mantel	100	3	300
14	Distilled Water Plant	100	2	200
15	Water Bath	100	1	100
16	Centrifuge	100	1	100
				Total 5.99KW

3.ZOOLOGY DEPARTMENT

Sl. No.	Items	Power rating (watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	6	60
2	Fan	70	7	490
3	Computer	100	1	100
4	Printer	100	1	100
5	Refrigerator	100	1	100
6	Oven	1000	1	1000
7	pH Meter	100	1	100
8	Distilled Water Plant	100	1	100
9	Water Bath	100	1	100
10	Microscope	100	1	100

4. BOTANY DEPARTMENT

Sl. No.	Items	Power rating (watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	17	170
2	Fan	70	16	1120
3	Computer	100	5	500
4	Refrigerator	100	4	400
5	Oven	1000	2	2000
6	Water Bath	100	3	300
7	Microscope	100	3	300
8	Air Conditioner	6000	1	6000
9	Laminar Air Flow	100	1	100
10	Centrifuge	100	1	100
11	UV Trans illuminator	220	1	220
12	Spectrophotometer	100	1	100
13	PCR	100	1	100
14	Incubator	100	3	300
15	FPM Compressor	150	1	150
16	Double Distillatioin	100	1	100
17	Muffle Furnace	4000	1	4000
18	Electric Kettle	400	1	400
19	Online UPS	13	2	26
				Total 16.386KW

5. GEOLOGY DEPARTMENT

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	22	220
2	Fan	70	22	1540
3	Computer	100	1	100
4	Printer	100	1	100
5	Inverter	1000	2	2000
6	Stand Fan	65	4	260
7	Projector	100	2	200
8	Refrigerator	100	1	100
9	Microscope	100	4	400
				Total = 4.92KW

6. GEOGRAPHY DEPARTMENT

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	9	90
2	Fan	40	13	910
3	Computer	100	10	1000
4	Printer	100	1	100
5	Stand Fan	65	4	260
				Total = 2.36KW

7. MATHEMATICS DEPARTMENT

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	14	140
2	Fan	70	10	700
3	Computer	100	17	1700
4	Printer	100	2	200
5	Projector	100	1	100
				Total = 2.84KW

8. STATISTICS DEPARTMENT

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)		1	10
2	Fan		2	140
				Total= 0.15KW

9. EDUCATION DEPARTMENT

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	5	50
2	Fan	70	8	560
3	Computer	100	1	100
4	Printer	100	1	100
				Total = 0.81KW

10. Pol. Science Department

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	3	30
2	Bulb (Tube)	20	3	60
3	Fan	70	9	630
4	Computer	100	1	100
5	Printer	100	1	100
6	Projector	100	1	100
				Total = 1.02KW

11. HISTORY DEPARTMENT

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	6	60
2	Bulb (Tube)	20	1	20
3	Fan	70	8	560
4	Computer	100	1	100
				Total =0.74KW

12. English department

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	6	60
2	Bulb (Tube)	20	1	20
3	Fan	70	10	700
4	Computer	100	1	100
				Total=0.88KW

13. Assamese department

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	4	40
2	Bulb (Tube)	20	3	60
3	Fan	70	6	420
4	Computer	100	1	100
5	Printer	100	1	100
6	Inverter	1000	1	1000
				Total=1.72KW

14. Economics department

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	12	120
2	Bulb (Tube)	20	10	200
3	Fan	70	1	70
4	Computer	100	1	100
				Total= 0.49KW

15. Sociology department

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	8	80
3	Fan	70	12	840
4	Computer	100	1	100
				Total=0.58KW

16. Commerce department

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	8	80
3	Fan	70	12	840
4	Computer	100	1	100
5	Electric kettle	400	1	400
				Total=1.42KW

17. Commerce Lab

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	12	120
2	Fan	70	2	140
3	Computer	100	3	300
4	TV	90	1	90
5	Flash Light	100	1	100
				Total=0.75KW

18. Rural Development

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	1	10
3	Fan	70	1	70
				Total=0.08KW

19.College Office

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	8	80
2	Bulb (Tube)	20	6	120
4	Computer	100	8	800
5	Printer	100	8	800
39	Water Purifier	60	1	60
				Total=1.86KW

20. Principal Office

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	9	90
3	Fan	70	2	140
4	Computer	100	1	100
5	Printer	100	1	100
33	Water Pump	750	3	2250
				Total=8.68KW

21. VP Office

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	1	10
2	Bulb (Tube)	20	1	20
3	Fan	70	2	140
				Total=0.17KW

22. Central Library

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	58	580
2	Bulb (Tube)	20	13	260
3	Fan	80	40	2800
4	Computer	100	24	2400
5	Printer	100	4	400
6	Inverter	1000	1	1000
7	Projector	100	1	100
8	Air Conditioner	6000	1	6000
9	Water Pump	250	1	250
10	BSNL Router	20	1	20
11	CCTV DVR	100	2	200
12	CCTV Camera Displayer	60	2	120
13	Vacuum Cleaner	750	1	750
14	XEROX Machine	1000	2	2000
15	Water Purifier	60	1	60
				Total=16.94KW

23. RUSA Building

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	36	360
2	Bulb (Tube)	20	18	360
				Total=0.72KW

24. Computer Centre

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	12	120
3	Fan	70	12	840
4	Computer	100	15	1500
5	Printer	100	1	100
20	Air Conditioner	6000	3	18000
				Total=20.56KW

25. Girls Common Room

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	5	50
2	Bulb (Tube)	20	2	40
3	Fan	70	5	350
4	Pad Dispenser Machine	100	2	200
5	Water Purifier	60	1	60
				Total=0.7KW

26. Girls Hostel

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	240	2400
2	Fan	70	65	4550
3	Refrigerator	100	2	200
4	Vortex Shaker	100	4	400
5	Pad Dispenser Machine	100	1	100
6	Water Purifier	60	1	60
				Total=7.71KW

27. Boys Hostel

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	29	290
2	Fan	70	8	560
3	Refrigerator	100	1	100
4	TV	90	1	90
5	Flash Light	100	1	100
				Total=1.14KW

28. Canteen.

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	6	60
2	Fan	70	6	420
3	Water Purifier	60	1	60
				Total=0.54KW

29. Benudhar Mohan Auditorium

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	7	70
2	Fan	70	26	1820
				Total=1.89KW

30. ICM

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	2	20
2	Bulb (Tube)	20	3	60
3	Fan	70	4	280
4	Stand Fan	65	1	65
				Total=0.425KW

31. Indoor Stadium

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Flash Light	100	10	1000
				Total= 1KW

32. IQAC Office

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	4	40
2	Fan	70	2	140
3	Computer	100	2	200
4	Printer	100	1	100
				Total=0.48KW

33. Class Room (No. 3-12)

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	33	330
2	Fan	70	44	3080
				Total=3.41KW

34. Conference Hall (Golden Gbl.)

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	10	100
2	Fan	70	6	420
3	Projector	100	1	100
4	Air Conditioner	6000	2	12000
				Total=12.62KW

35. Academic Gallery

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	22	220
2	Fan	70	24	1680
3	Projector	100	1	100
				Total=2KW

36. Examination Branch

Sl. No.	Items	Power rating(watt)	Quantity	Power consumption(watt per hr)
1	Bulb (CFL)	10	7	70
2	Fan	70	5	350
3	Computer	100	2	200
4	Printer	100	1	100
5	XEROX Machine	1000	2	2000
				Total=2.72KW

Remarks:

- It has been observed that in old and new building majority of electrical power consumption is through light load such as fan, FTL and power load such as refrigerator, ups, etc. unnecessary use of electrical equipment must be avoided.
- As per individual dept. level load consumption, we understand the scope for improvement of energy saving. Hence our electricity bill will be reduced by proper load management techniques along with optimum utilization of resources.

Lighting System

Observations and suggestions:

- It is found that FTL, Bulbs, CFLs is installed in the facility.
- It is recommended that some tube lights in this area be switched off when sufficient daylight is available.
- Presently there are no reflectors installed for tube lights.
- Every light or electric gadget left on when not needed is wasting energy and money and is causing pollution that is totally unnecessary.
- **Stand-by power can use up to 8% of a household's total electricity.**

For most homes a 10% reduction in electricity consumption can save $200 a more a year off our electricity bill and nearly ¾ of a tone of CO^2 pollution. A 20% reduction on average consumption will save over $400 and over 1.5 tons of CO^2.

Don't forget to power down these things when not in use:

- Lights
- Heaters and fans (or air-conditioning)
- Printers and scanners
- Battery and phone chargers
- Computers
- Gaming consoles
- TVs, DVD players
- Stereos
- Kitchen gadgets such as blenders, kettles, toasters etc.

2.2.5 Study of Air Conditioners

In the facility for air conditioning there is no centralizedsystem with AHU (air handling unit), but mostly spilt air conditioners are installed.

a. **Load of ACs was as follows:**

Item	Rated Power (kW)	Qty	Voltage	Current Amp	Actual Power (kW)
ACs	2	8	240	8.3	1.9

Observations and suggestions:

1. Normal air conditioning temperature should be kept as high as possible (i.e.,24 d.cel.). By thumb rule, increase in 3 degrees in indoor air temperatures can save 1% of electricity.

2. The ventilation in area can be provided with installation of natural ventilation. Natural ventilation will also minimize the requirement of exhaust fans.

2.2.6 Carbon Di-Oxide Emission

In this Chapter we compute the CO_2 emissions. For consumption of 1 Unit (1 kWh) ofElectricity, the CO_2 emitted is 0.8 Kg. OR the Emission is 0.8 Kg/kWh. In the following Table we present the total units consumed and CO_2 emitted as under:

Table 8.1: CO_2 Emission:

Sr. No.	Month	kWh	CO_2 Emitted in MT
1	March-21	2541	2
2	April-21	2545	2
3	May-21	1927	1.54
4	June-21	1892	1.5
5	July-21	2033	1.62
6	August-21	NA	NA
7	Septembe-21r	1963	1.57
8	October-21	2704	2.16
9	November-21	2412	1.93
10	December-21	NA	NA
11	January-22	2354	1.88
12	February-22	NA	NA
	Total		**Avg. Emission = 1.8**

Merits/Existing Features for Energy Savings.

1. Staff vigilance
2. Computers are connected in LAN.
3. Printers are shared in LAN.
4. Screen savers facility implemented for every computer.
5. AC's used are of three STARS.
6. Refrigerator's are of three STARS.
7. Incandescent Bulbs are nowhere used.
8. They are replaced by CFL tubes with electronic choke.
9. Maximum use of natural light.
10. Cross Ventilation is provided in laboratory & class rooms,which reduced number of fans.
11. Most of the practical's are scheduled in noon time when Billing Rate in normal.
12. Walls are painted with off white colour to have sufficient brightness.
13. LED flash light is used in Seminar hall.

2.2.7 Energy Conservation Proposals

Providing Energy Saver Circuit to the Air Conditioners:

The **energy saver circuits for the air conditioners, intelligently reduces the operating hours** of the compressors either by timing or temperature difference logic without affecting the human comfort. This can save around 15% to 30% of the electricity depending on the weather conditions and temperature settings.

Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights

The 638 FTLs can be replaced with the LED tube lights 16 W. These changes can be made at the places where the life is higher. Usually minimum of 3 years warranty is given and approximate burning hours is 40 000. (15 years considering 8 hours per day running)

Following calculations are done for 8 hours working:

- Power consumption by 36w FTL with conventional choke = 40 W/ Tube Light
- Equivalent LED tube light = 16 W/ Tube Light
- Savings in power = 24 W/ Tube Light
- Operating hours = 8 h/day x 300 = 2400 h/year
- Tube Light Yearly savings = 2400 x 24 W = 57.6 kWh/year/Tube Light
- Average Cost of electricity = Rs.6.80/ kWh
- Saving = 57.6 kWh x 6.80 = Rs.391.68 / year/ Tube light
- Approximate investment on single LED Tube lights = Rs. 200
- Number of Tube Lights to be replaced = 638

Summary:

- ✓ **Total Yearly Saving =638 x 391.16 = Rs. 249560/year**
- ✓ **Total Investment = 638 x Rs. 200 = Rs. 127600/-**

General Recommendations

- All Class Rooms and labs to have **Display Messages** regarding optimum use of electrical appliances in the room like, lights, fans, computers and projectors. Save electricity. **Display the stickers of save electricity**, save nature everywhere in the campus. So that all stakeholders encouraged to save the electricity.
- Most of the time, all the tube lights in a class room are kept ON, even though, there is sufficient light level near the window opening. In such cases, the light row near the window may be kept OFF.
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers to have power saving settings to turn off monitors and hard discs, say after10 minutes/30 minutes.
- The comfort/Default air conditioning temperature to be set between 24˚C to26˚C.
- Lights in toilet area may be kept OFF during daytime
- Use AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement.

- Need to focus on existing solar plant which is generating power below the rated power
- Need to use power saver circuits for AC.
- Need to replace FTL by smart LED Tube
- Need to replace ordinary bulb by LED bulb.
- Need to replace ordinary CRT monitor by LED.
- Need to replace ordinary refrigerator by BEE power saver refrigerator if possible.
- Out of total electricity bill paid, 53 percentage are actual energy utilized charges and remaining expense belongs to additional taxes on energy consumption

Executive Recommendations:

1. **There has to be Institute level student community that keeps track of the energy consumption Parameters of the various departments, class rooms, halls, areas, meters, etc.**
2. **Energy auditing inside the campus has to be done on a regular basis and report should be made public to generate awareness.**
3. **Need to Create energy efficiency/ renewable energy awareness among the college campus i.e. solar, wind, Biogas energy. College should take initiative to arrange seminars, lectures, paper presentation competition among students and staff for general awareness.**

2.3 Post audit phase

Follow up and action plans

Energy audits form a part of an on-going process. Innovative energy saving initiatives has to be designed and implemented every year to make the college environmentally sustainable. Follow of programs of energy auditing recommendations should be done meticulously before the next audit.

Photograph

Conference Hall

Computer lab

Central Library

Commerce Laboratory

Chemistry Laboratory

Library