

Energy Audit Report

January 2021 To December 2021



Priyadarshini College of Engineering

(Accredited with Grade "A+" by NAAC)

Near CRPF Gate, Digdoh Hills, Hingna Road, Nagpur 440019

ENERGY AUDIT

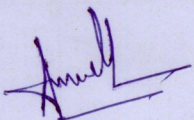
CERTIFICATE

This is to certify that **Priyadarshini College of Engineering, Behind CRPF Campus, Hingna Road Nagpur** has Successfully conducted an “ **Energy Audit** ” on Date **20-21 Jan. 2022**. The Energy Audit was done for the period of **January 2021 to December 2022**. It is found that suitable measures are taken by the college in minimization of energy consumption.

Place: Nagpur

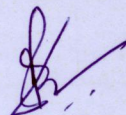
Date: 28 Jan.2022

External Auditor



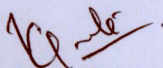
Dr.A.M.Mendhe
HOD, Electrical Engg.Dept
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External Auditor



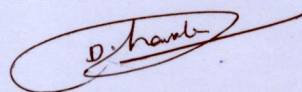
Dr.D.N.Katole
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Internal Auditor



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Mr.D.D.Dhawale
Asst.Professor
PCE, Nagpur
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INDEX

S.N.	Particulars	PageNo.
	Preface,Acknowledgement, Summary, Abbreviations,	
1	Introduction to energy audit	1
2	Institute Details	2
3	Energy Consumption Profile	3
4	Historical Data Analysis	10
5	Actual Measurementsof Power and its Analysis	17
6	Study of Electrical System	30
7	Air Conditioners	33
8	Carbon DiOxide Emission	34
9	Energy Conservation Proposals	36

Preface

Data collection for energy audit of the Priyadarshini College of Engineering, Nagpur was conceded by team for the period of January 2021 to December 2021

This audit was over sighted to inquire about convenience to progress the energy competence of the campus. All data collected from each classroom, laboratory, every room. The work is completed by considering how many tube lights, fan, A.Cs, electronic instruments, etc in each room. How much was participation of each component in total electricity consumption.

We really appreciate the effort put by LTJSS 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 very much thankful to our beloved Principal **Dr. Shrikrushna A. Dhale**, **Priyadarshini College of Engineering, Nagpur** and **Dr. S.S. Shriramwar** IQAC coordinator, **NAAC**. We also would like to thank our management of college. We really wants to give our sincere thanks to the college team for motivating us and giving us the opportunity for energy audit.

We would like to express our sincere thanks to All the Heads of the Department, Internal Energy audit team, all faculty members of PCE, all teaching and nonteaching staff and students those who have taken part in this audit survey for each department, labs, offices etc.

We tried our best to present this energy report as per requirements of college and our expertise work.



Annex Building B

Summary

The objective of the audit is to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods. The salient observations and recommendations are given below.

1. Priyadarshini College of Engineering uses energy in the following forms:

- a. From MSEDCL: 452 KVA
- b. Electricity SOLAR Grid connected solar plant: 376 Kw
- c. High Speed Diesel Generator (HSDG) 1) 140 KVA 2) 125 KVA

Electrical energy is used for various applications, like: Computers, Lighting, Air Conditioning, Fans Other Laboratory Equipment, Printers, Xerox machines, CCTV, UPS, LCD Projector, Router system, Flood light, Pumping motor etc.

2. The average cost of energy required after solar plant instalation is Rs. 39,538/Month.

3. The Specific Energy Consumption (SEC) is the ratio of energy required per square meter. In this case the SEC is evaluated as electrical units consumed per square meter of area. It is calculated as under for (Electricity): 0.1431 kWh/Sq.m

4. After the measurement and analysis, we propose herewith following Energy Efficiency Improvement measures.

Table: Energy Efficiency Improvement

S.N.	Recommendations	Annual Saving Potential (Rs.)	Estimated Investment (Rs.)	Pay Back period (Years)	Remarks (Feasibility)
1	Use of motion sensor in corridors, passage and toilets	14000	20000	1	Mid Term

2	Replacing Tube Lights (FTL) with LED Tube Lights	748535	282200	0.5	Mid/Short Term
3	Replacing Fan with 5 star energysaving Fan or BLDC fan	313600	3972500	10	Long Term
4	Replacing Flood light with smart Radiato ES Ultra Thin LED Street Light SMD (White, Waterproof IP65) by Radiato ES	6546	10000	1	Mid Term
5	Providing Energy Saver Circuit to the Air Conditioners	581440	207000/-	0.5	Mid/Short Term
	Total Amount	1664121	4491700	2.5 Years	

Note: Total savings during the energy audit is estimated at Rs. 1664121. The total energy cost with an overall payback period of 2.5 Years for technical and economical feasibility.

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
SNDL	Spanco Nagpur Distribution Ltd.
MSEDCL	Maharashtra State Electricity Distribution Company Ltd.
MAHADISCO	Maharashtra Electricity Distribution Company

Chapter : 1

Introduction to Energy Audit

General:

The conduction of 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:

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 equipments. The key to such performance evaluation lies in the soundknowledge of performance of equipments 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 focused attention to energy cost and cost involved in achieving higher performance with financial analysis. The best alternative is selected on financial analysis basis.

Energy Audit Methodology: Energy Audit Study is divided into following steps

1. Historical Data Analysis:

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

2. 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.

3. 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.

Chapter : 2

Institute Details

S.N.	Particulars	Details
1	Name of the Institute	Priyadarshini College of Engineering, Nagpur
2	Address	CRPF Gate, Digdoh Hills, Hingna Road, Nagpur
3	Year of Establishment	1990
4	Courses Offered	Mecanical Engineering
		Civil Engineering
		Electrical Engineering
		Aronotical Engineering
		Computer Science Engineering
		Electronics and Telecommunication Engineering
		Information Technology
5	Affiliation	AICTE and RTMNU, Nagpur

Chapter : 3

Energy Consumption Profile

Source of Energy:

Priyadarshini J.L. College of Engineering, uses Energy in following forms:

A. Electricity from MSEDCL :

Consumer No : 430019003960

Consumer Name : M/S PRIYADARSHINI COLLEGE OF ENGINEERING

Address : Near CRPF Gate, Digdoh Hills, Tahsil Hingna, Nagpur 440019

Meter No : 055-X1105982

B. High Speed Diesel Generator (HSDG) : 1) 140 KVA 2) 125 KVA rating (Kirloskar make)

Generator has been installed in college campus to give power whenever there is
Power cut from MSEDCL.

HSDG is used as a power Generator which is run whenever power supply from
MSEDCL is not available.

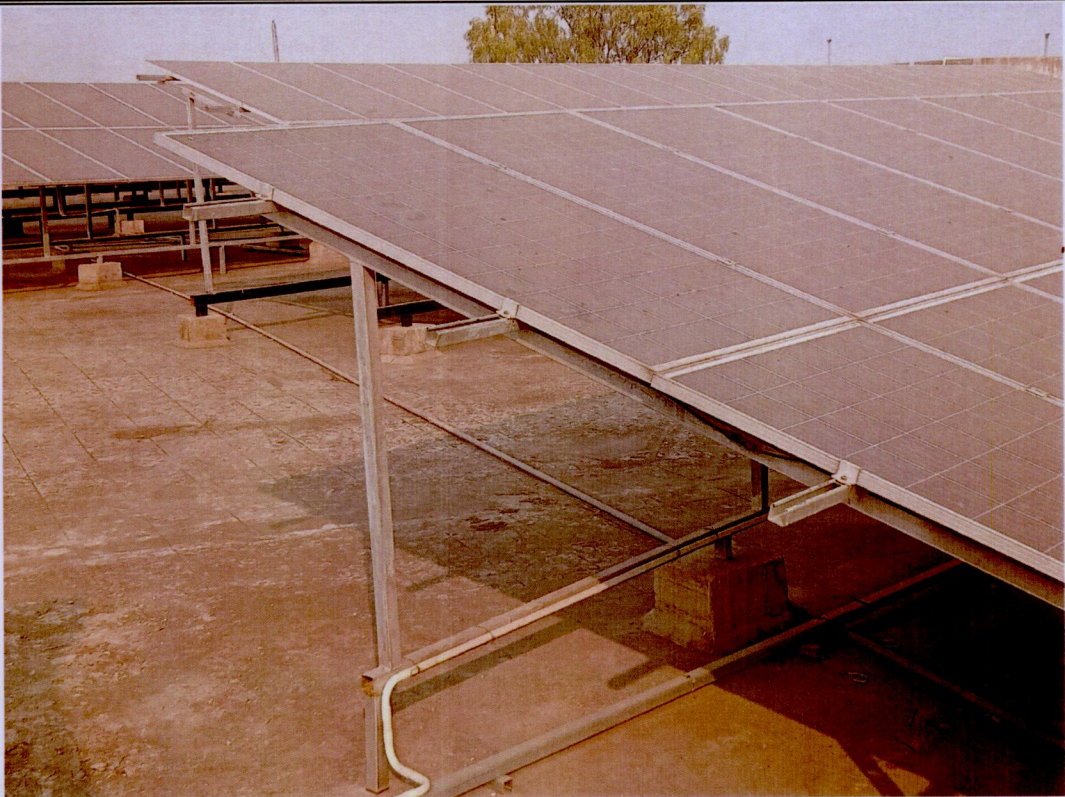
C. Electricity SOLAR Grid connected solar plant: 376 KW

Details : Distribution company :- MSEDCL

Date of commissioning : 18/10/2019

PV Module : Solarium Wp: 325 Quantity: 1142

Inverter : ABB KW: 100, 50, 27 Quantity: 06



Solar Panels

Galaxy Solar Energy Pvt. Ltd.
ON GRID SOLAR ROOF TOP POWER PLANT
Capacity 376kWp

Name of Beneficiary: M/s. Prayadashan Cfg. of Engrs.
Address: Near CRPF Digdoh Tah. Nagpur Dist.
Nagpur - 440016
Size of Plant: 376 kWp
Dt. Of Commissioning: 18-10-2019
Details of Tieup with: MSEDCL
Distribution Co.
Details of Major Components
PV Modules: Make Solarium Wp 325 Quantity 1142
Inverter: Make ABB KW 100,50,27 Quantity 6

Details of EPC
Name of EPC: Galaxy Solar Energy Pvt. Ltd.
Plot No.5A, Crown Society, Jagarath Nagar,
Besa Main Road, Nagpur.
Contact No.: 7721954477 / 7827688785
Email ID: galaxysolarenergyprtltd@gmail.com
Toll Free No.: 18005326677


General Instruction:
• Clean your modules alternative days early in morning or late evening
• Clean your modules with water. Use hand with a suitable brush to allow the stream of water to reach the panels.
• Do not step on solar modules, do not drive or allow any object to fall on solar modules
• Do not switch on/off buttons of inverter, MCB etc.
• Do not touch OR Disturb electrical connections
• Contact authorized engineer from Galaxy Solar Energy Pvt. Ltd. in case of any system related problem.

WARNING

ELECTRICITY

SOLAR PANEL
376KW

2022.02.25 16:39

Solar on Grid Inverter (Detail specification)

Following are the major consumers of electricity in the facility:

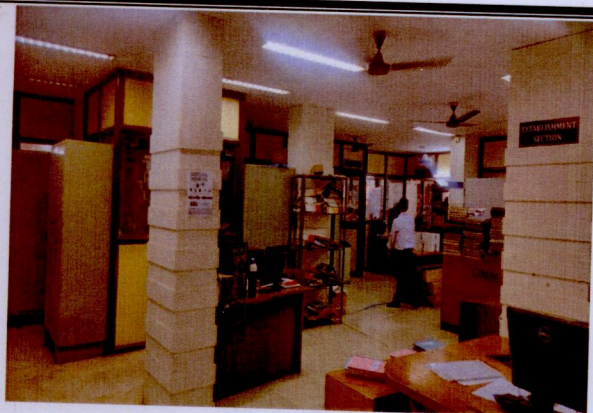
- Principal Office
- Principal Cabin
- Library
- Seminar Hall
- Computer center II
- Reading Room
- Workshop
- Server Room
- Transformer Room
- Xerox Room
- Solar Inverter
- Net meter
- Admin. Office
- Conference Room
- Computer center I
- Computer center III
- Exam Control Room
- Physics Lab
- Generator Room
- Control Room
- Store Room
- Solar Meter
- Net meter Panel



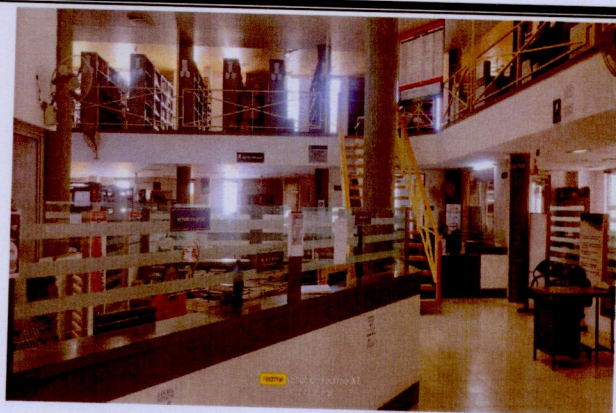
Principal Office



Principal Cabin



Admin. Office



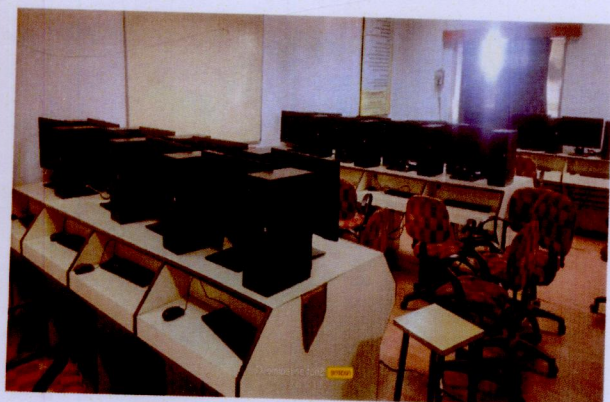
Library



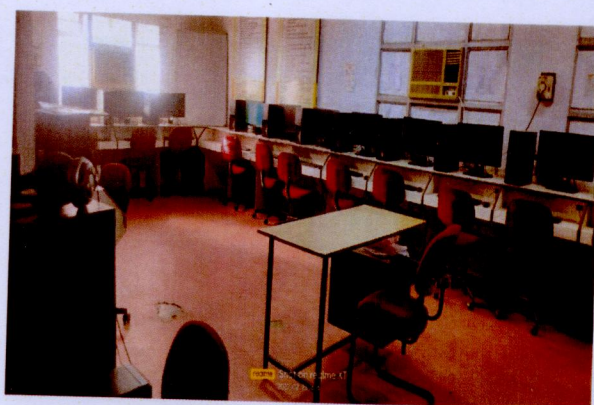
Conference Room



Seminar Hall



Computer center I



Computer center II



Computer Lab III



Reading Room



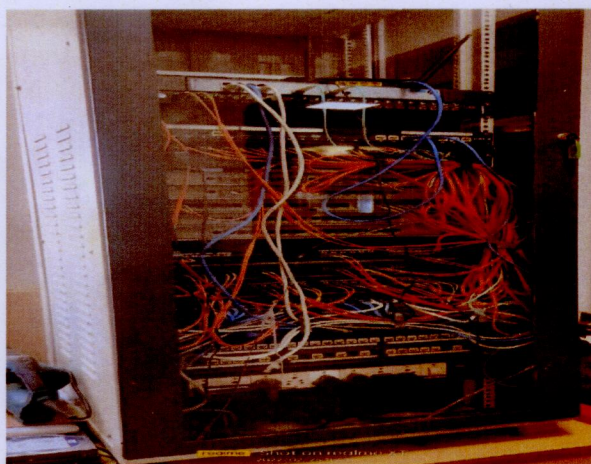
Exam Control Room



Workshop



Physics Department



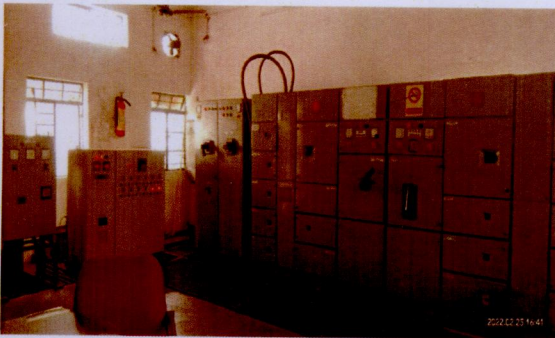
Server Room



Server Room Battery section



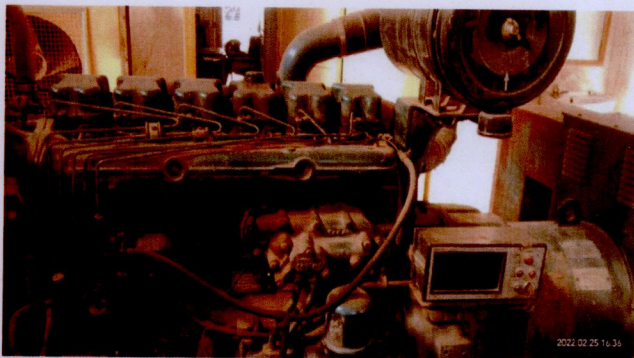
Transformer Room



Control Room



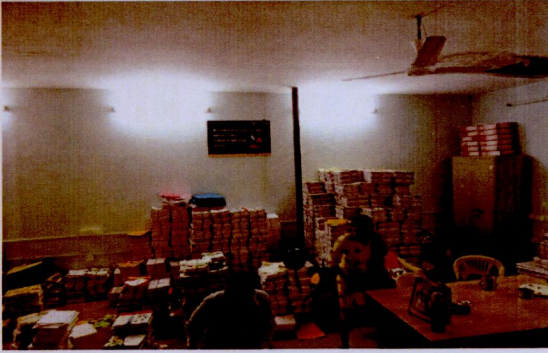
Generator (125 KVA)



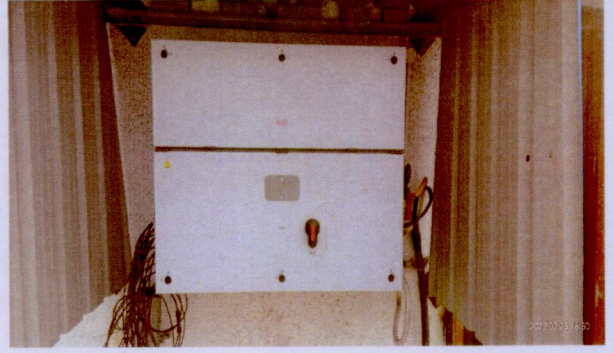
Generator (140 KVA)



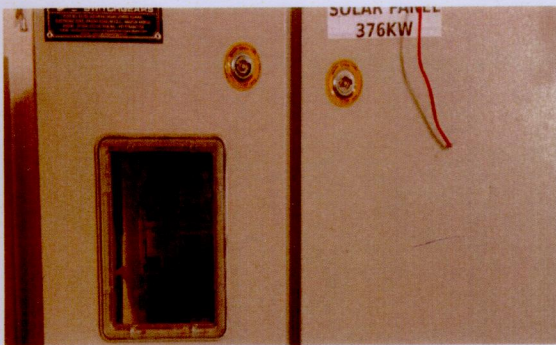
Xerox Room



Store Room



Solar Inverter



Solar Meter



Net Meter



Net Meter Panel



IT Building

Specific Energy Consumption (SEC):

Specific Energy Consumption (SEC) is defined as energy usage per Square meter of area. it is calculated total electrical kWh/total area of the campus. By calculating SEC, we can specifically target the factors of energy efficiency or inefficiency.

Chapter : 4

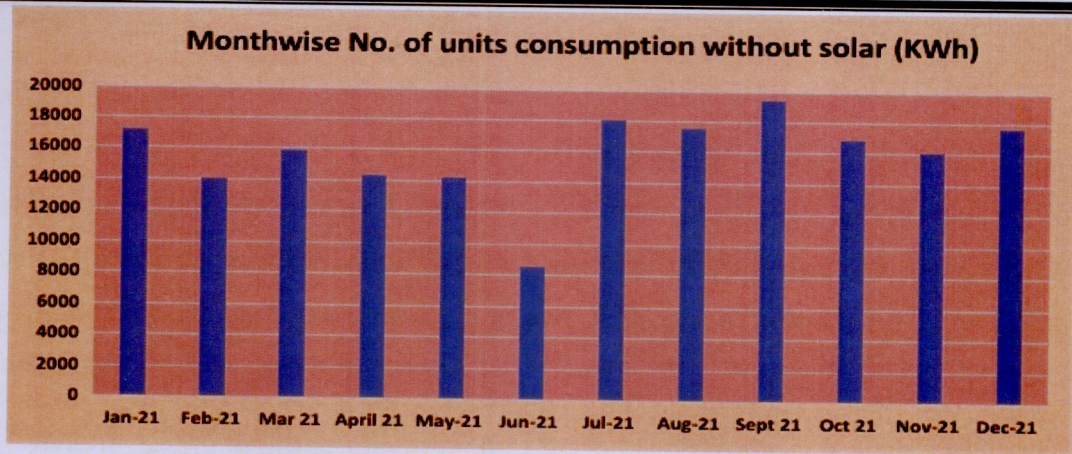
Historical Data Analysis

4.1 : Study of Variation of Monthly Units consumption & Power Factor:

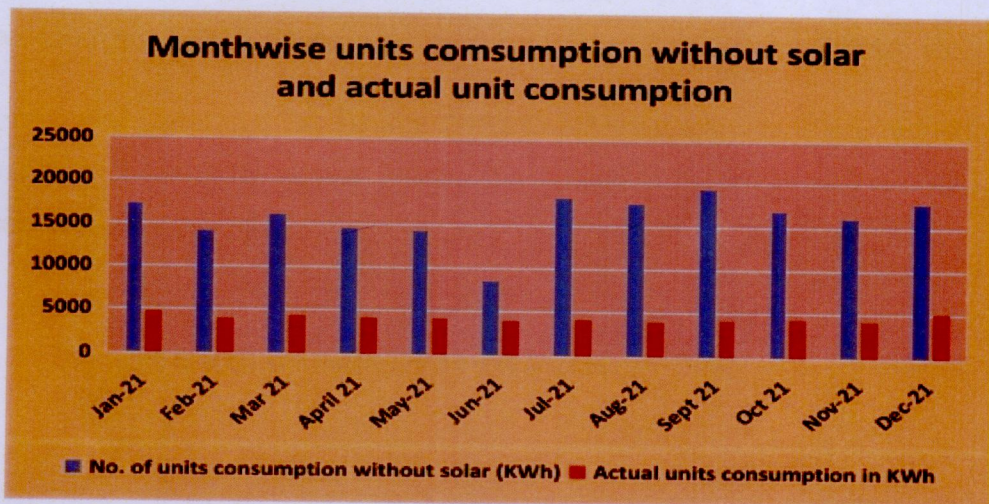
In this Chapter, we study the details of the 12 month Electricity Bills.

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

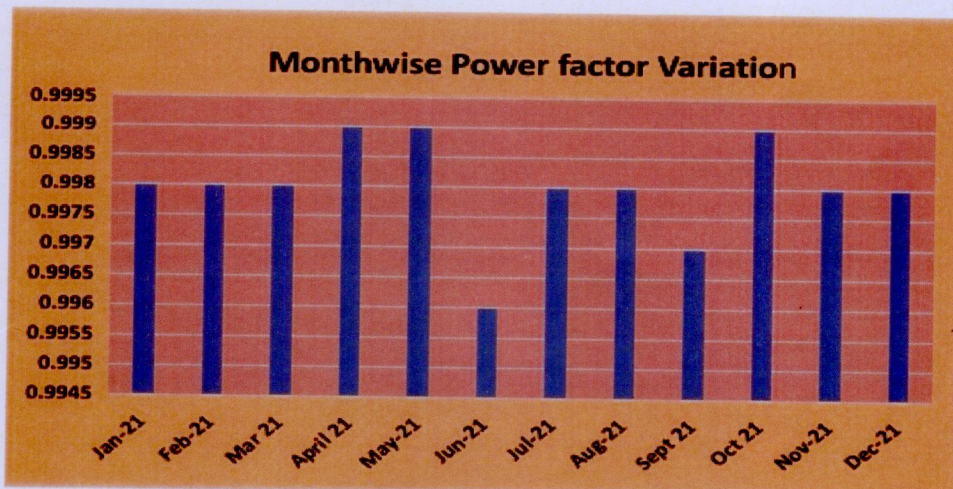
S.N.	Month	No. of units consumption without solar (KWh)	Solar power generation unit (KWh)	Actual units consumption in KWh	Power Factor
1	Jan 21	17152	12368	4785	0.998
2	Feb 21	14070	10149	3921	0.998
3	Mar 21	15925	11486	4439	0.998
4	April 21	14385	10199	4186	0.999
5	May 21	14232	10063	4170	0.999
6	June 21	8595	4537	4058	0.996
7	July 21	18090	13986	4104	0.998
8	Aug 21	17547	13503	4045	0.998
9	Sept 21	19420	15248	4172	0.997
10	Oct 21	16860	16860	4296	0.999
11	Nov 21	16065	11833	4232	0.998
12	Dec 21	17692	12588	5105	0.998
Total no. of units		190033	142820	51513	NA-
Avg. of unit and pf		15836	11902	4293	0.998



Month wise Unit Consumption without Solar



Actual Unit consumption with and without solar



Month wise Power Factor Variation

Conclusion : Variation of PF

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

Whenever the average power factor over a billing cycle or a month, whichever is lower, of a High Tension consumer is below 90%, Penalty charges shall be levied to the consumer at the rate of 2 % 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% reduction in the energy bill and for unity power factor; the effective incentive will amount to 7% reduction in the energy bill.

4.2 Study of Month wise Electricity Bill Variation:

Table No 4.2 Variation in Electricity Bill

Sr. No.	Month	Electricity Bill Amount (Rs.)
1	Jan 21	156780
2	Feb 21	147080
3	Mar 21	151330
4	April 21	163373
5	May 21	163194
6	June 21	174168
7	July 21	196481
8	Aug 21	195693

9	Sept 21	197453
10	Oct 21	198990
11	Nov 21	198390
12	Dec 21	210050
13	Total Bill of a year	21,52,982
14	Avg. Bill	1,79,415

Conclusion :

Monthly Electricity Bill Variation after solar plant installation has been identified.

Roof Top PV Solar System (376 KW) installed on terrace of Annex "B" Building

Before Installation of solar Average Monthly Bill = Rs. 279498/-

After Installation of solar Average Monthly Bill = Rs. 1,79,415/-

Savings in Bill due to Installation (per month) = Rs. 1,00,083/-

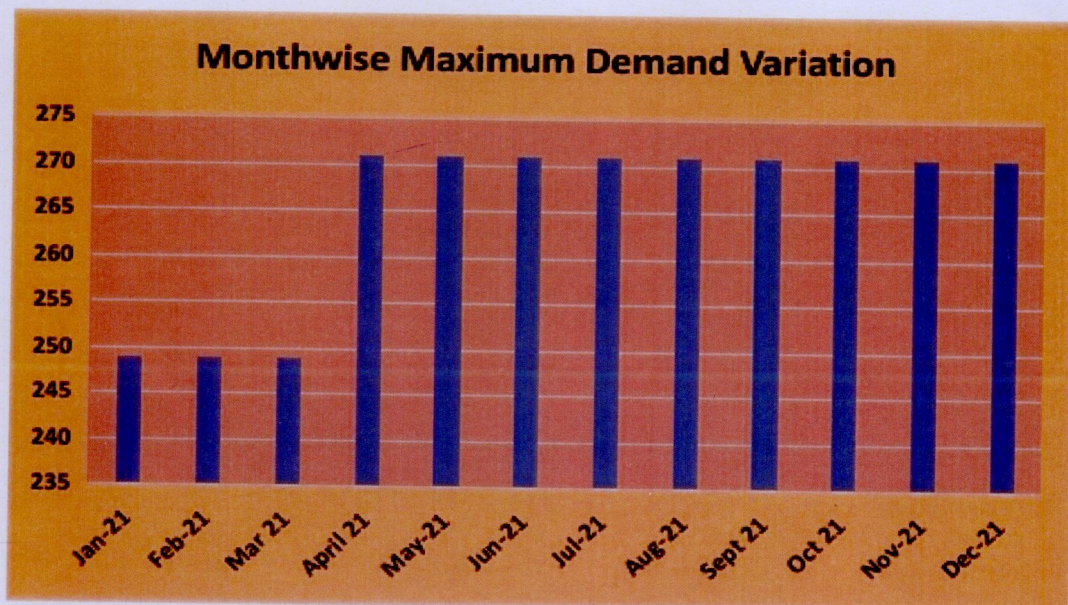
Annual Savings in Bill (One Year) = Rs. 12,00,996/-

4.3: Study of Month wise Maximum Demand Variation:

Table No 4.3 Month wise Maximum Demand Variation

Sr. No.	Month	Max. Demand
1	Jan 21	249
2	Feb 21	249
3	Mar 21	249
4	April 21	271
5	May 21	271
6	June 21	271

7	July 21	271
8	Aug 21	271
9	Sept 21	271
10	Oct 21	271
11	Nov 21	271
12	Dec 21	271



Month wise Maximum Demand Variation

4.4: Study of Month wise Load Factor Variation

Electrical Load factor is a measure of the utilization rate, or efficiency of electrical energy usage. It is the ratio of total energy (KWh) used in the billing period divided by the possible total energy used within the period, if used at the peak demand (KW) during the entire period. Thus,

Load Factor = kWh/ (kW*hours in the period*number of days in the billing cycle)

Example to find Monthly load factor from obtained values.

We have,

Suppose total kWh = 30864 kWh

Demand = 81kW

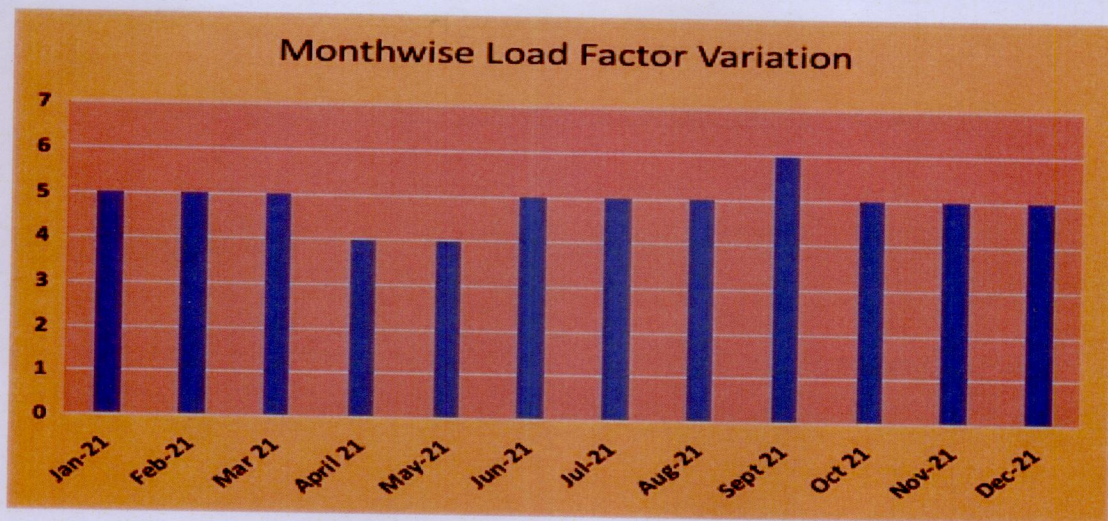
No. of Days = 30 days

Hours per day = 24 hours

Solution : Monthly load factor= $30864/(81*30*24)=0.5292=52.92\%$

Table No 4.4 Month wise Load Factor Variation

Sr. No.	Month	Load Factor
1	Jan 21	5
2	Feb 21	5
3	Mar 21	5
4	April 21	4
5	May 21	4
6	June 21	5
7	July 21	5
8	Aug 21	5
9	Sept 21	6
10	Oct 21	5
11	Nov 21	5
12	Dec 21	5
13	Avg. of Load Factor	4.91



Month wise load factor Variation

Conclusion: Variation in monthly Load Factor

If your load factor ratio is above 0.75, electrical usage is reasonably efficient. If the load factor is below 0.5, you have periods of very high usage (demand) and a low utilization rate. Low load factor customers would benefit from a peak demand control system or from a Battery Energy Storage System to distribute electrical usage out over longer intervals of time and smooth peaks.

Low load factors, such as below 0.4, contribute significantly to the overall monthly electric bill in the form of demand charges. These demand charges are listed on the bill as coincident demand, facilities demand, and summer time related demand.

General Observations based on Electricity Bill:

1. For College Campus the Contract Demand (CD) is **452 kVA** and minimum billing Demand is 60% of the Contract Demand (i.e. **271 kVA**) or the 75% of previous Maximum Demand recorded whichever is higher. Since, the MD recorded is less than 271 kVA.
2. The average electricity cost is Rs. **9.21** considering the last twelve months. (Excluding TOD charges, MD and PF charges)
3. Average monthly Power Factor is maintained near **P.F. 0.998**.
4. Load Factor need to be improved to maximum value. Power factor is affected during June and september month i.e. power factor is 0.996 and 0.997. It has been observed that the power factor is above 0.98 in all other months in the current year. Power factor can further be improved in month june and september by the usage of capacitor bank.

Chapter : 5

Actual Measurements of Power and Its Analysis

College Campus:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	UPS Numeric 6000VA	6KVA, 25A with 20 Batteries	1	6000	6	36000
2	UPS Numeric 600VA	600VA	5	3000	6	18000
3	Ceiling Fan	80	1135	90800	6	544800
4	Wall Fan	75	49	3675	6	22050
5	Exhaust Fan	60	42	2520	6	15120
6	Water Cooler	750	9	6750	3	20250
7	Water Aquagard (RO)	3Kwh/m3	9	27000	1	27000
8	AC (Split Type)	3000	46	138000	4	552000
9	AC (WindowType)	3000	43	129000	4	516000
10	Tube Light Double Fitting	70	132	9240	6	55440
11	Tube Light Single Fitting	40	1279	51160	6	306960
12	LED Tube/Rope light Fitting	20	265	5300	6	31800
13	LED Pannel	20	199	3980	6	23880
14	CFL Light Fitting	20	548	10960	6	65760
15	POP Holder Light	18	16	288	6	1728
16	Air Cooler	250	2	500	6	3000
17	Xerox Machine	650	6	3900	3	11700
18	PC	60	1200	72000	6	432000
19	Printer	Standby mode, 30/50w,	70	21000	1	21000

		printing mode 300/500w				
20	Fax Machine	30	1	30	1	30
21	CCTV camera	50	176	8650	24	207600
22	LED TV	80	3	240	6	1440
23	LCD Projector	285	14	3990	1	3990
24	Internet Box with wifi router W/Hr	85	41	3485	6	20910
25	Charging Socket	25	420	10500	2	21000
26	P.A. System	560	3	1680	1	1680
27	Electric Bell	5	8	40	1	40
28	Refrigerator	2Kwh/day	2	167	24	4000
29	Flood Light	400	7	2800	10	28000
30	Vaccum Cleaner	1400	2	2800	2	5600
31	Lab Equip. For pract	300	20	6000	3	18000
32	Pumping motor	3 HP	3	6714	2	13428
33	Pumping motor	5 HP	1	3730	2	7460
34	Pumping motor	7.5 HP	2	11190	2	22380
35	Pumping motor	12.5 HP	1	9325	2	18650
36	DG Gen Set	140KVA and 125 KVA	1	AS PER USE		AS PER USE
37	Grid connected Solar plant	376 KW	1	376 KW	12	376 KW

It is expected to generate 70 units/day, 2100 units per month. In our case In July only 2396 units are generated through solar. Other months also get affected for optimum power generation.

* This is total load consumption considered approximately. Actual load consumption might be different according to actual use of power for particular time period.

Department wise load consumption:

A Building:

1) Principal Office/Cabin:

Sr No	Name of Appliance	Power Rating	Quantity	Power Consum ption (watt)	Usage per day in Hrs.	Power consumption/ day (Watt)
1	UPS Numeric 600VA	600VA	1	600	6	3600
2	Ceiling Fan	80	5	400	6	2400
3	Wall Fan	75	2	150	6	900
4	Exhaust Fan	60	1	60	6	360
5	AC (Split Type)	3000	2	6000	4	24000
6	AC (WindowType)	3000	1	3000	4	1200
7	LED Pannel	20	9	180	6	1080
8	PC	60	2	120	6	720
9	Printer	Standby mode, 30/50w, printing mode 300/500w	2	600	2	1200
10	CCTV camera	50	6	300	24	7200
11	LED TV	80	1	80	6	480
12	Internet Box with wifi router W/Hr	85	3	255	6	1530
13	Charging Socket	25	5	125	2	250
14	Electric Bell	5	1	5	1	5

2) Administration Office:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	UPS Numeric 600VA	600VA	1	600	6	3600
2	Ceiling Fan	80	10	800	6	4800
3	Wall Fan	75	1	75	6	450
4	Exhaust Fan	60	1	60	6	360
5	AC (Split Type)	3000	1	3000	4	12000
6	AC (WindowType)	3000	1	3000	4	12000
7	Tube Light Double Fitting	70	12	840	6	5040
8	TubeLight Single Fitting	40	19	760	6	4560
9	Xerox Machine	650	1	650	3	1950
10	PC	60	7	420	6	2520
11	Printer	Standby mode, 30/50w, printing mode 300/500w	5	1500	1	1500
12	Fax Machine	30	1	30	1	30
13	CCTV camera	50	10	500	24	12000
14	LED TV	80	1	80	6	480
15	Internet Box with wifi router W/Hr	85	8	680	6	4080
16	Charging Socket	25	15	375	2	750
17	Refrigerator	2Kwh/day	1	83.33	24	2000

3) Passage (corridor):

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Tube Light Single Fitting	40	120	4800	6	28800
2	CCTV camera	50	20	1000	24	24000
3	Flood Light	400	7	2800	10	28000

4) IQAC Office:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	2	160	6	960
3	Exhaust Fan	60	1	60	6	360
4	AC (Split Type)	3000	1	3000	4	12000
5	Tube Light Double Fitting	70	2	140	6	840
6	Tube Light Single Fitting	40	4	160	6	960
7	PC	60	1	60	6	360
8	Printer	Standby mode, 30/50w, printing mode 300/500w	2	600	1	600
9	LCD Projector	285	1	285	1	285
10	Internet Box with wifi router W/Hr	85	1	85	6	510
11	Charging Socket	25	2	50	2	100

5) Store Room, Sports Room and HV Lab:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	8	640	6	3840
	Exhaust Fan	60	01	60	6	360
2	Tube Light Single Fitting	40	20	800	6	4800

6) Departments of Mechanical Engineering:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	UPS Numeric 600VA	600VA	1	600	6	3600
2	Ceiling Fan	80	200	16000	6	96000
3	Wall Fan	75	17	1275	6	7650
4	Exhaust Fan	60	5	300	6	1800
5	Water Cooler	750	2	1500	3	4500
6	Water Aquagard (RO)	3Kwh/m3	2	6000	1	6000
7	AC (Split Type)	3000	29	87000	4	348000
8	AC (WindowType)	3000	13	39000	4	156000
9	Tube Light Double Fitting	70	72	5040	6	30240
10	Tube Light Single Fitting	40	174	6960	6	41760
11	LED Tube/Rope light Fitting	20	48	960	6	5760
12	LED Pannel	20	125	2500	6	15000
13	CFL Light Fitting	20	30	600	6	3600
14	POP Holder Light	18	16	288	6	1728
15	Xerox Machine	650	1	650	3	1950
16	PC	60	190	11400	6	68400

17	Printer	Standby mode, 30/50w, printing mode 300/500w	12	3600	1	3600
18	CCTV camera	50	25	1250	24	30000
19	LCD Projector	285	2	570	1	570
20	Internet Box with wifi router W/Hr	85	5	425	6	2550
21	Charging Socket	25	50	1250	2	2500
22	P.A. System	560	1	560	1	560
23	Electric Bell	5	1	5	1	5
24	Refrigerator	2Kwh/day	1	83	24	2000
25	Lab Equip. For pract	300	3	900	3	2700

7) Department of Computer Sc. Engineering and Information & Technology:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	UPS Numeric 600VA	600VA	1	600	6	3600
2	UPS Numeric 6000VA	6KVA, 25A with 20 Batteries	1	6000	6	36000
3	Ceiling Fan	80	100	8000	6	48000
4	Exhaust Fan	60	14	840	6	5040
5	Water Cooler	750	2	1500	3	4500
6	Water Aquagard (RO)	3Kwh/m3	2	6000	1	6000
7	AC (Split Type)	3000	4	12000	4	48000
8	AC (WindowType)	3000	9	27000	4	108000
9	Tube Light Single Fitting	40	193	7720	6	46320
10	LED Tube/Rope light Fitting	20	53	1060	6	6360
11	CFL Light Fitting	20	385	7700	6	46200

12	Xerox Machine	650	1	650	3	1950
13	PC	60	190	11400	6	68400
14	Printer	Standby mode, 30/50w, printing mode 300/500w	12	3600	1	3600
15	CCTV camera	50	25	1250	24	30000
16	LCD Projector	285	2	570	1	570
17	Internet Box with wifi router W/Hr	85	5	425	6	2550
18	Charging Socket	25	50	1250	2	2500
19	P.A. System	560	1	560	1	560
20	Electric Bell	5	1	5	1	5

8) Department of Electrical Engineering:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	UPS Numeric 600VA	600VA	1	600	6	3600
2	Ceiling Fan	80	176	14080	6	84480
3	Wall Fan	75	10	750	6	4500
4	Exhaust Fan	60	16	960	6	5760
5	Water Cooler	750	1	750	3	2250
6	Water Aquagard (RO)	3Kwh/m3	1	3000	1	3000
7	AC (Split Type)	3000	1	3000	4	12000
8	AC (WindowType)	3000	8	24000	4	96000
9	Tube Light Double Fitting	70	39	2730	6	1638
10	Tube Light Single Fitting	40	217	8680	6	52080
11	LED Tube/Rope light Fitting	20	36	720	6	4500

12	LED Pannel	20	22	440	6	2640
13	Xerox Machine	650	1	650	3	1950
14	PC	60	190	11400	6	68400
15	Printer	Standby mode, 30/50w, printing mode 300/500w	12	3600	1	3600
16	CCTV camera	50	25	1250	24	30000
17	LCD Projector	285	2	570	1	570
18	Internet Box with wifi router W/Hr	85	5	425	6	2550
19	Charging Socket	25	50	1250	2	2500
20	P.A. System	560	1	560	1	560
21	Electric Bell	5	1	5	1	5
22	Lab Equip. For pract	300	3	900	3	2700

9) Department of Civil Engineering:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consum ption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	263	21040	6	126240
2	Wall Fan	75	5	375	6	2250
3	Water Cooler	750	2	1500	3	4500
4	Water Aquagard (RO)	3Kwh/m3	2	6000	1	6000
5	AC (Split Type)	3000	5	15000	4	60000
6	AC (WindowType)	3000	9	27000	4	108000
7	Tube Light Single Fitting	40	335	13400	6	80400
8	LED Tube/Rope light Fitting	20	33	660	6	3960
9	Xerox Machine	650	1	650	3	1950

10	PC	60	190	11400	6	68400
11	Printer	Standby mode, 30/50w, printing mode 300/500w	12	3600	1	3600
12	CCTV camera	50	25	1250	24	30000
13	LCD Projector	285	2	570	1	570
14	Internet Box with wifi router W/Hr	85	5	425	6	2550
15	Charging Socket	25	50	1250	2	2500
16	P.A. System	560	1	560	1	560
17	Electric Bell	5	1	5	1	5
18	Lab Equip. For pract	300	3	900	3	2700

10) Department of Aronautical Engineering:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	282	22560	6	135360
2	Wall Fan	75	11	825	6	4950
3	Water Cooler	750	1	750	3	2250
4	Water Aquagard (RO)	3Kwh/m3	1	3000	1	3000
5	AC (WindowType)	3000	2	6000	4	24000
6	Tube Light Single Fitting	40	260	10400	6	62400
7	LED Tube/Rope light Fitting	20	21	420	6	2520
8	Xerox Machine	650	1	650	3	1950
9	PC	60	190	11400	6	68400
10	Printer	Standby mode, 30/50w, printing mode 300/500w	12	3600	1	3600

11	CCTV camera	50	25	1250	24	30000
12	LCD Projector	285	2	570	1	570
13	Internet Box with wifi router W/Hr	85	5	425	6	2550
14	Charging Socket	25	50	1250	2	2500
15	P.A. System	560	1	560	1	560
16	Electric Bell	5	1	5	1	5
17	Lab Equip. For pract	300	3	900	3	2700

11) College Library:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumtion (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	50	4000	6	24000
2	AC (WindowType)	3000	2	6000	4	24000
3	Tube Light Single Fitting	40	22	880	6	5280
4	LED Tube/Rope light Fitting	20	7	140	6	840
5	CFL Light Fitting	20	133	2660	6	15960
6	PC	60	4	240	6	1440
7	Printer	Standby mode, 30/50w, printing mode 300/500w	1	300	1	300
8	CCTV camera	50	5	250	24	6000
9	Internet Box with wifi router W/Hr	85	2	170	6	1020
10	Charging Socket	25	5	125	2	250

12) IT Chamber, Conference Room :

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumtion (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	1	80	6	
2	Exhaust Fan	60	3		6	
3	AC (Split Type)	3000	7	21000	4	84000
4	LED Tube/Rope light Fitting	20	67	1340	6	8040
5	LED Pannel	20	52	1040	6	6240
6	PC	60	1	60	6	360
7	Printer	Standby mode, 30/50w, printing mode 300/500w	1	300	1	300
8	CCTV camera	50	5	250	24	6000
9	LCD Projector	285	1	285	1	285
10	Internet Box with wifi router W/Hr	85	2	170	6	1020
11	Charging Socket	25	5	125	2	250

13) Workshop Wing , College Canteen and Power House:

Sr. No	Name of Appliance	Power Rating	Quantity	Power Consumtion (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Ceiling Fan	80	49	3920	6	23520
2	Exhaust Fan	60	3	180	6	1080
3	Water Cooler	750	1	750	3	2250
4	Water Aquagard (RO)	3Kwh/m3	1	3000	1	3000

5	Tube Light Double Fitting	70	21	1470	6	8820
6	Tube Light Single Fitting	40	58	2320	6	13920
7	CCTV camera	50	5	250	24	6000
8	Lab Equip. For pract	300	3	900	3	2700

14) College Campus:

S. N.	Name of Appliance	Power Rating	Quantity	Power Consumption (watt)	Usage per day in Hrs.	Power consumption/day (Watt)
1	Pumping motor	3 HP	3	6714	2	13428
2	Pumping motor	5 HP	1	3730	2	7460
3	Pumping motor	7.5 HP	2	11190	2	22380
4	Pumping motor	12.5 HP	1	9325	2	18650
5	DG Gen Set	140KVA and 125 KVA	1	AS PER USE		AS PER USE

Remarks:

It has been observed that in Main and Annex building majority of electrical power consumption is through light load such as fan, FTL and power load such as refrigerator, PC, Water cooler, Air cooler, 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 loadmanagement techniques along with optimum utilization of resources.

Chapter: 6

Study of Electrical Systems

6.1 : Electrical Supply Details:

Power Supply comes from MSEDCL supply at 11 kV, which is stepped down to 415 V by step down transformer.

6.1.2 Study of Electrical Demand:

There is a single meters installed in the premises. The details of meters are as under

Table No 6.1: Meter Details:

Sr. No.	Details of Electricity Demand	Tariff	LT-X B II(88)
1	Consumer No.	430019003960	
2	Meter No:	055 X1105982	
3	Sanctioned Load	654	KW
4	Contract Demand	452	kVA
5	Recorded Maximum Demand	271	kVA

Thus we observe that:

Total Sanctioned Demand is **654 kVA** while the recorded Maximum Demand is **271 kVA**.

Electrical Energy Cost Analysis

The electrical bills from MSEDCL for 12 months from Jan. 2021 to Dec. 2021 have been studied.

TOD Charges

For all LT consumers the Time of Day (TOD) tariff is applicable in Maharashtra for above 20HP. For this purpose the day has been divided into 4 different time Zones as given in table.

Zone	Consumption during following Hr of the day	Rate of Consumption	Units consumed	Energy Charge (Rs./Unit)
A	2200 – 0600 Hrs-	(01.50 rate in addition to actual rate)	0+0+0+0+0+0+0 +0+0+0+0+0	0+0+0+0+0+0+0 +0+0+0+0
B	0600 – 0900Hrs & 1200 – 1800Hrs	(0 i.e same rate)	0+0+0+0+0+0+0 +0+0+0+0+0	0+0+0+0+0+0+0 +0+0+0+0
C	0900 – 1200 Hrs	(0.80 rate in addition to actual rate)	0+0+0+0+0+0+0 +0+0+0+0+0	0+0+0+0+0+0+0 +0+0+0+0
D	1800 – 2200 Hrs	(0.1.10 rate in addition to actual rate)	4795+3931+444 9+4192+4174+4 074+4113+4053 +4186+4302+42 41+5115=51,625	5274+4324+4894+ 4611+4591+4481+ 4524+4458+4604+ 4732+4665+5626= 56,784

In addition to base tariff of Rs. 9.21 per unit consumed, TOD tariff as indicated is levied depending on time zone during which the unit has been consumed.

PF Incentive :

As per the MSEDCL tariff, whenever average power factor in a month is more than 0.95, following incentives are offered:

For every 0.01 improvement of average PF above 0.95, an incentive of 1% of the amount of monthly energy bill, (excluding RLC, Demand Charges, FOCA, and Electricity Duty) is offered.

For PF of 0.99 the effective incentive will amount to 5% of the energy charges, and for unity PF the effective incentive will amount to 7% of the energy charges.

PF Penalty:

As per the MSEDCL tariff, whenever average power factor in a month is less than 0.95, following incentives are offered:

For every 0.01 decreases of average PF below 0.95, penalty of 1% of the amount of

monthly energy bill, (excluding RLC, Demand Charges, FOCA, and Electricity Duty) is offered. Similarly it would be changes by 1 % for further decrement of PF.

Performance in power factor is appreciable as the PF is maintained average 0.998 in annual power consumption.

Similarly there is scope for further improvement of power factor at particular case. Power factor is affected during June 2021 i.e. its power factor is 0.996. It has been observed that the power factor is above 0.998 in all other months in the current year. Power factor can further be improved in the month of June by the usage of capacitor bank. If we give more focus on average power factor, we will get the incentives instead of penalty.

Hence we have to more focus on **power factor correction and its improvement using capacitor bank Or APFC panel.**

Lighting System

Observations and suggestions:

It is found that FTL, Bulbs, CFLs has been 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.

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, Ceiling Fan

Exhaust Fan, Projectors, TVs players etc.

Chapter : 7

Study of Air Conditioners

In the college campus, for air conditioning there is no centralized system with AHU (air handling unit), but mostly split air conditioners are installed.

Load of ACs are as follows:

Item	Rated Power(KW)	Qty	Voltage	Current (Amp)	Actual Power(KW)
AC	3.5	46	440	8.2	3.0

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.

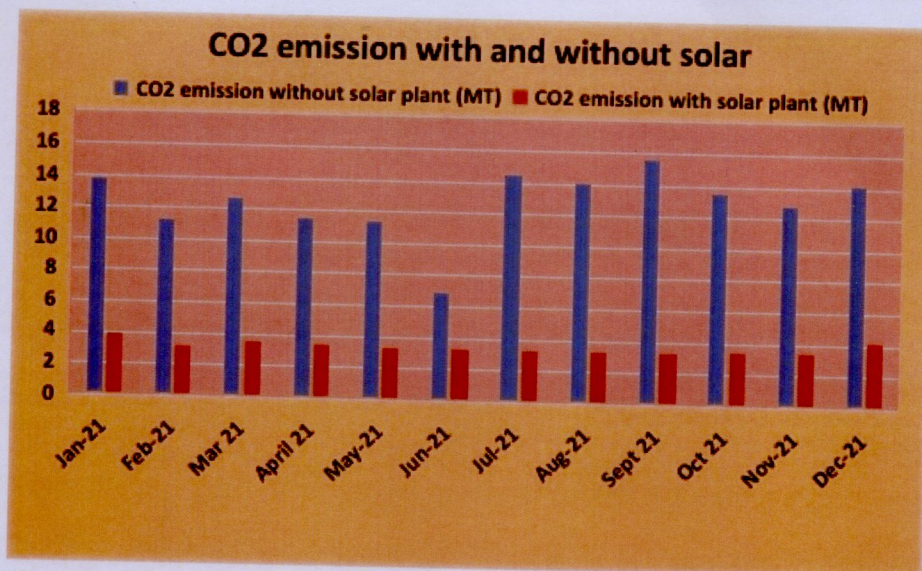
Chapter : 8

Carbon DiOxide Emission

In this Chapter we compute the CO₂ emissions. For consumption of 1 Unit (1 KWh) of Electricity, the CO₂ emitted is 0.8 Kg. OR the Emission is 0.8 Kg/kWh. In the following Table we presented the total energy units requirement without solar, units generation through solar, actual units consumed and CO₂ emission without and with solar as under:

Table 8.1: CO₂ Emission:

S.N	Month	No. Of Kwh required	No. Of Kwh generation through solar	Actual consumption of load	CO ₂ emission without solar plant (MT)	CO ₂ emission with solar plant (MT)
1	Jan 21	17152	12368	4785	13.721	3.828
2	Feb 21	14070	10149	3921	11.256	3.136
3	Mar 21	15925	11486	4439	12.74	3.551
4	April 21	14385	10199	4186	11.508	3.348
5	May 21	14232	10063	4170	11.385	3.336
6	June 21	8595	4537	4058	6.876	3.246
7	July 21	18090	13986	4104	14.472	3.283
8	Aug 21	17547	13503	4045	14.037	3.236
9	Sept 21	19420	15248	4172	15.536	3.337
10	Oct 21	16860	16860	4296	13.488	3.436
11	Nov 21	16065	11833	4232	12.852	3.385
12	Dec 21	17692	12588	5105	14.153	4.084
13	Avg	15836	11902	4293	12.668	3.433



CO2 emission with and without solar

Coclusion : It has been observed that the average reduction in CO2 emission with solar instalation is **9.235 MT**

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 where Billing Rate in normal.
12. Walls are painted with off white colour to have sufficient brightness.
13. Solar powered utilization in college primises.
14. LED flash light is used in Seminar hall.
15. PV solar system (376KW) is installed which is expected to generate 397 Unit/day. This saves Rs. 12,00,996/ Year.

Chapter: 9

Energy Conservation Proposals

9.1 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.

There are total 46 split type air conditioners. It is Recommended that the old air conditioners are being replaced with new energy efficient BEE STAR labeled (3 Star and above) air conditioners in a phased manner.

SN	Particulars	Calculation
1	Considering the average compressor ON Time	= 5 h/day
2	Power consumption by 2 TR compressor	= 6.1 kW
3	Average daily consumption	= $6.1 \times 5 = 30.5$
4	kWh/day/ air conditioner Yearly operating days	= 300 days/year/ air conditioner
5	Yearly electricity consumption	= 9150 kWh/year/ air conditioner
6	Considering a saving of 15%, total annual savings	= $15\% \times 9150$ = 1372.5 kWh/year/ air conditioner
7	Cost of electricity	Rs. 9.21/ KWh
8	Yearly savings	= 9.21×1372.5 = Rs. 12640/year/ air conditioner
9	Total number of Air Conditioners	= 46

Summary :

- ✓ Total yearly Saving = $46 \times 12640/\text{year} = \text{Rs. } 5,81,440/\text{year}$
- ✓ Total Cost of energy saver circuits = $\text{Rs. } 4500 \times 46 = \text{Rs. } 2,07,000/-$

9.2 Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights

The 40 W FTLs can be replaced with the LED tube lights of 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:

SN	Particulars	Calculation
1	Power consumption by 36 W FTL with conventional choke	= 40 W/ Tube Light
2	Equivalent LED tube light	= 16 W/ Tube Light
3	Savings in power	= 24 W/ Tube Light
4	Operating hours	= 8 h/day $\times$ 300 = 2400 h/year
5	Tube Light Yearly savings	= $2400 \times 24 \text{ W} = 57.6 \text{ kWh/year/Tube Light}$
6	Average Cost of electricity	= Rs. 9.21/ kWh
7	Saving	= $57.6 \text{ kWh} \times 9.21 = \text{Rs.} 530.5 / \text{year/ Tube light}$
8	Approximate investment on single LED Tube lights	= Rs. 200
9	Number of Tube Lights to be replaced	= $132+1279=1411$

Summary:

- ✓ Total Yearly Saving = $1411 \times 530.5 = \text{Rs. } 7,48,535.5/\text{year}$
- ✓ Total Investment = $1411 \times \text{Rs. } 200 = \text{Rs. } 2,82,200.00$

9.3 General Recommendations

All Class Rooms and labs should have **Display Messages** regarding optimum use of electrical appliances in the classroom 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.

Trying to get the benefit of -01.50 rate in addition to actual rate for per unit consumption of **electric motor pumping during 2200 – 0600 Hrs.**

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 after 10 minutes/30 minutes.

The comfort/Default air conditioning temperature to be set between 24°C to 26°C.

Lights in toilet area may be kept OFF during daytime

It is recommended to Use AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement.