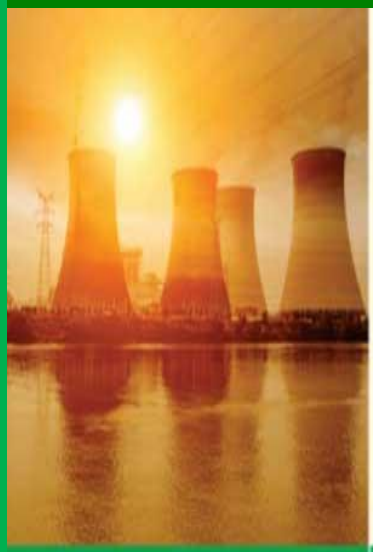
ENERGY AUDIT OF BHILAI MAHILA MAHAVIDYALAYA, BHILAI



Conducted & Prepared By :-

RAJ ENERGY SERVICES,

……dedicated in energy conservation

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An ESCO Empanelled in Bureau of Energy Efficiency, New Delhi

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3. ACKNOWLEDGEMENTS

We express our sincere thanks to Mr. R. K. Sharma, Administrator for his kind support and giving us the assignment to contribute in their effort towards energy conservation initiatives & efficient energy management in Bhilai Mahila Mahavidyalaya, Hospital Sector, Bhilai.

We are highly indebted to Dr. Sandhya Madan Mohan, Principal, Bhilai Mahila Mahavidyalaya, Bhilai for their guidance, intellectual advice and his kind support in completing the project.

Our boundless gratitude to Audit Coordinator , Ms. Neha Srivastava, In-charge Liaisioning & Administrative Officer, all teaching and non-teaching staff associated with this Energy Audit study of Bhilai Mahila Mahavidyalaya, Hospital Sector, Bhilai for extending cooperation during collection of data and field study work.

We trust that the findings of this study will help the college in improving their energy efficiency initiative towards creating awareness for energy conservation and use of renewable energy.

Raj Energy Services, Bhilai

Sanjay Kumar Mishra

Certified Energy Auditor, EA- 8696

4. ENERGY AUDIT CERTIFICATE

RAJ ENERGY SERVICES

dedicated in energy Conservation

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ENERGY AUDIT CERTIFICATE

This is to certify that M/s. Raj Energy Services has conducted Energy Audit of Bhilai Mahila Mahavidyalaya, Sector-9, Bhilai, Durg as per NAAC criteria & Energy Conservation Act 2001.

Name of the Educational Institute	Bhilai Mahila Mahavidyalaya, Hospital sector, Bhilai Nagar, Durg Chhattisgarh ,
Contact Details	0788-2242699, 2210078 E – Mail : bmahila@rediffmail.com Website:https://www.bmmbhilai.com
Name of Director & Principal	Dr. Sandhya Madan Mohan
Details of facilities Audited	Office, All departments, Laboratories, Classrooms, Library, Electrical Systems and complete Installations including Grid connected Solar Power Plant, Diesel Generator Set Etc.
Date of Audit Conducted	15th & 16th November 2021
Name of Certified Energy Auditor	Sanjay Kumar Mishra
Registration Number	EA- 8696

For, Raj Energy Services

Date : November 30, 2021

(Sanjay Kumar Mishra)

Certified Energy Auditor from Bureau of Energy Efficiency,
Ministry of Power, Government of India, New Delhi
EA- 8696

5. INTRODUCTION

Bhilai Mahila Mahavidyalaya**,** Bhilai was established to impart higher education to create knowledge, disseminate knowledge and transfer knowledge and skill to the society for its empowerment. Education is process of empowerment which is to be promoted through the development of knowledge, skills and values.The main aim of the college is to equip the students with essential skill to sail confidently through life's complexity and challenges. Bhilai Mahila Mahavidyalaya is situated at a vantage location in Bhilai.

Bhilai Mahila Mahavidyalaya, a 'B' grade accredited college by NAAC, is established in 1979 and managed by Bhilai Education Trust. BMM, Bhilai is affiliated to Hemchand Yadav Vishwavidyalaya, Durg

Bhilai Mahila Mahavidyalaya**,** Bhilai has following departments:-

- Department of Botany
- Department of Chemistry
- Department of Commerce
- Department of Computer Science
- Department of English
- Department of Hindi
- Department of Education
- Department of Industrial Microbiology & Microbiology
- Department of Biotechnology
- Department of Mathematics
- Department of Zoology
- Department of Physics

Vision of The College -

To be acknowledge as a pro – active institute which strives hard to fulfil the aspiration of students, helps them in developing sound knowledge base, correct skills, attitudes and understanding, to enable them to sail confidently through complexities and challenges of life.

The Goals of BMM's Education –

1. To enable our students to develop their full intellectual potential through a focussed academic experience that is simultaneously rich, extensive and collaborative.
2. To offer the students 'scope for critical thinking and discernment, leading to the development of value based convictions.
3. To help the students develop a degree of self reliance and determination, to respond with courage and sensitivity to personal and social issues.
4. To generate among students an awareness of women's issues, human right and environmental issues, so that they understand and respond constructively to these.
5. In the context of globalization, to foster in students a sense of national identity that is secular and multi-cultural with respect and tolerance of all cultures and religions for humanity at large.

The objective of the college has always been commitment to women, as such education is perceived to be the means of both personal and social transformation and provides upliftment that helps in the all round growth of students.

Library

The BMM library has more than 30,000 books apart from CDs, DVDs, Journals and Magazines The library also has a reference section, reading section and internet section where e- resources can be accessed through the N- List programme of UGC- INFIBNET which provides access to 97,000 e-books and more than 6,000 e-journals.

Computer Lab

The college have the latest version of computers and internet facility. Students derive benefits from these technological advances which connect the world together.

Science Laboratories

The BMM, Bhilai has well equipped labs in all subjects with the latest and standard apparatus and equipments. The students are able to acquire up-to-date practical knowledge not only in the laboratories but also through field trips, educational tours, workshops, seminar and guest lectures.

Sports Infrastructures cum Gymnasium

The BMM, Bhilai is in proud possession of a massive multipurpose gymnasium where various activities are conducted. This huge building has indeed added to the glorious infrastructure of the institution.

NSS Participation

NSS of BMM, Bhilai participates project work , which is organized by the Human Resource Development Mantralaya, Govt. of India,

The students of Bhilai Mahila Mahavidyilai has bagged top positions in the field of education, sports, competitions like quiz competition, speech competition, essay writing competition, Rangoli competition, Debate competition , Mehandi competition in Hemchand Yadav Vishwavidyalaya, Durg.

Also, the students of BMM, Bhilai has raised the flag in the field of sports especially in Volley ball, Badminton, Basket ball & Cricket

6. ENERGY AUDIT

Energy audit is an effective tool in identifying and perusing a comprehensive energy management program. A careful audit of any type will give the organization a plan with which it can effectively manage the organization energy system at minimum energy cost.

Energy Management

This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances etc.. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment.

Bhilai Mahila Mahavidyalaya, Bhilai uses following energy in the campus:-

1) Electricity
2) Diesel for running Diesel Generator Set
3) Liquid Petroleum Gas

6.1 Electricity

The class rooms and labs are well ventilated and also permit enough daylight. Maximum utilization of natural light is done to cut down usage of power in both classrooms and laboratories. Electrical Energy is utilized from these three power generation sources:-

a) Electricity from Distribution Company
b) Electricity from own DG set
c) Electricity from Grid connected Solar Power Plant of 50 KWp capacity

6.1.1 Electricity from Power Distribution Company

Bhilai Mahila Mahavidyalaya, Bhilai Campus having Service number 62/001 and Contract Demand of **56 KW** with Town Services Department, Bhilai Steel Plant, Bhilai. The tariff category is **LT-2**.

The college has also installed a grid connected solar power plant of **50 KWp** on the rooftop. The supply arrangement of Solar Power Plant is such that it will first meet in-house electricity consumption of college, then after it will supply surplus energy to grid, which will be recorded by Import/Export meter. We have analyzed the electricity bills of last one year.


Import- Export Energy Meter of Bhilai Mahila Mahavidyalaya, Bhilai

We have noticed that exported unit to grid is not mentioned in electricity bill. However, Town Services Department should give details of exported unit in electricity bill as per regulation of Chhattisgarh State Electricity Regulatory Commission (GRID INTERACTIVE DISTRIBUTED RENEWABLE ENERGY SOURCES) Regulations, 2019 vide no. 82/CSERC/2019 dated 05 October 2019.

6.1.2 Electricity from Diesel Generator Set

A 125 KVA capacity of DG set of Jackson is installed to provide emergency power during load shedding period. The unit generated by DG set is not recorded by college, also they do not maintain log book to record diesel consumption and operational hours of DG set.

Diesel Consumption of DG Set

Date	**Diesel Consumption in Litre**
2018-19	
20/10/18	82.2
12/2/2019	94.32
Total	**176.52**
2019-20	
30/4/2019	92.74
30/05/2019	92.94
31/05/2019	89.03
2/12/2019	90.93
Total	**365.64**
2020-21	
18/08/2020	81.27
1/9/2020	81.27
10/12/2020	80.83

6/3/2021	73.42
Total	**316.79**
2021-22	
23/06/2021	67.89
18/10/2021	63.37
Total	**131.26**

Table No. 1 : Yearly Diesel consumption of DG set

The readings of KWH meter installed in Diesel Generator set is not recorded. Hence, We have assumed that one litre diesel generates 2.5 Unit of electricity.

Date	Diesel Consumption in Ltr.	Unit Generation in KWH
2018-19		
20/10/18	82.2	
12/2/2019	94.32	
Total	**176.52**	**441**
2019-20		
30/4/2019	92.74	
30/05/2019	92.94	
31/05/2019	89.03	
2/12/2019	90.93	
Total	**365.64**	**914**
2020-21		
18/08/2020	81.27	
1/9/2020	81.27	
10/12/2020	80.83	
6/3/2021	73.42	
Total	**316.79**	**792**

2021-22		
23/06/2021	67.89	
18/10/2021	63.37	
Total	**131.26**	**328**

Table No. 2 : Yearly Unit generation of DG set

Thus, the total unit generated by DG set do 2018 to October 2021 is 2,475 Unit.

6.1.3 Electricity Generation from Grid connected Solar Power Plant of 50 KWp capacity

Electromech Devices Mfg. Co. Raipur has installed a Grid Connected Solar Power Plant of Tata Solar having capacity of 50 KWp and handed over to Bhilai Education Trust on 29th March, 2018.

Total Wattage of one Solar Panel	0.31 Kwp
Total Numbers of Panel	162
Total Wattage	50 kwp

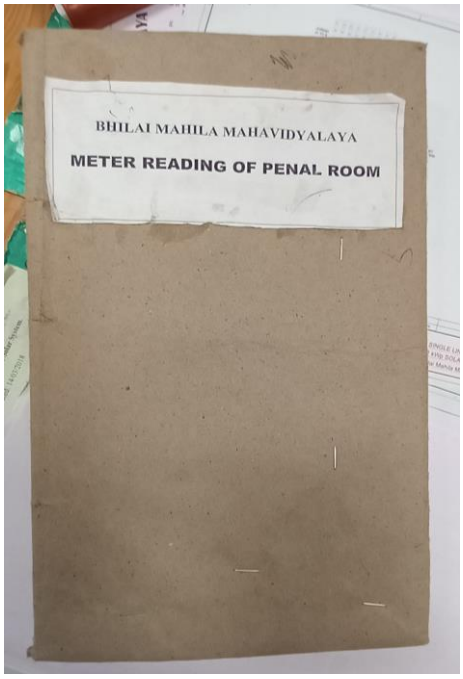
The seller can sell energy maximum up to 49%. The supply arrangement of Solar Power Plant is such that it will first meet in-house electricity consumption of college, then after it will supply surplus energy to grid, which will be recorded by Import/Export meter. The serial. number of Secure make import/export meter is X0480882. The shadow free area of college roof is 12,000 sq. meter.

The solar module efficiency will be about 90% after 10 year and about 80% after 25 years of installation. Module efficiency is 16.55%.

A View of Solar Power Plant

The technical details of electrical parameters of Solar panel is mentioned below :-

Type of Module	Multi	Make & Year	Tata Solar, 2018
Module Efficiency	16.55%	Voltage & Nos.	24 V, 162 Nos.
PCU Make& Rating	Delta, 50 KW	Tilt angle of module	21.D
No. of series & parallel combinations		Series 18 x5, 18 x4 & parallel 9	
AC output & Capacity		230 V, three phase & 50 KWp	



Considering the fact that the Bhilai Mahila Vidya;laya is a non-technical college, there is a significant energy conservation and environmental activity both by faculty and students. The environmental awareness initiatives are substantial. The installation of ongrid solar photo voltaic panels and five star rated equipments are noteworthy. This may lead to the prosperous future in context of Green Campus having energy conservation activities & use of renewable energy and thus sustainable environment and community development.

Solar Power Plant Generation

Month	**Energy Yield in KWH**
Jun-18	4856
Jul-18	3717
Aug-18	3773
Sep-18	5595
Oct-18	6899
Nov-18	5867
Dec-18	4921
Jan-19	5441
Feb-19	6338
Mar-19	7625
Total Generation	55032
Total Average Generation per month	5503

Table 3 : Solar Power Plant Generation during first year of installation

Month	Energy Yield in KWH
Dec-20	4871
Jan-21	4018
Feb-21	4013
Mar-21	4973
Apr-21	4679
May-21	4866
Jun-21	4264
Jul-21	4023
Aug-21	5393
Sep-21	4696
Oct-21	6278
Total Generation in 11 month	52074
Total Average Generation per month	4,734

Table 4: Solar Power Plant Generation during first year of installation

Life Energy Total	**223.94 MWH**	Run Time	14965 Hours

Table 5 : Electricity generation & Run time hours since installation

6.2 LPG Consumption in Laboratories & Mess

LPG is consumed not only in laboratory but also in hostel mess. Year wise consumption of LPG is mentioned below.

Year	LPG Consumption in KG				Total LPG Consumption in KG
	Biotechnology/Microbiology	Botany	Zoology	Mess	
2016	48	14	14	2850	2912
2017	52	14		2850	2916
2018	56	14		2850	2934
2019	0	14		2850	2864
2020	42	14		0	56

Table 6 : LPG Consumption in Laboratories & Mess

6.3 Alternative Energy Initiative : Percentage of Power requirement met by Renewable Energy Source

Power Requirement met by Solar	50 KWp
Total Power Requirement (Sanctioned Load)	56 KW
Percentage of Power requirement met by Renewable Energy Source	**89.3 %**

Table 7: Alternative Energy Initiative: Percentage of Power requirement met by Renewable Energy Source

Percentage of Power requirement met by Renewable Energy Source is 89.3%.

6.4. Electrical Connected Load :

Segment	Type	Wattage	Quantity	Total Load
Lighting	LED 2x2	32	28	896
	FTL 40	40	572	22880
	LED TL	22	181	3982
	LED 18 W	18	12	216
	LED 200 W	200	8	1600
	LED 12 W	12	20	240
	CFL 32 W	32	1	32
	LED 5 W	5	2	10
	Total			**29856**
HVAC	Fan	70	655	45850
	AC 1.5 T	1700	26	44200
	Big Air Cooler	600	8	4800
	Air Cooler	200	5	1000
	Exhaust Medium	200	11	2200
	Exhaust Small	70	18	1260
	Total			**99310**
Office	Computer	70	68	4760
	Printer/Scanner	500	19	9500
	Printer	300	11	3300
	Photocopy machine	750	1	750
	Total			**18310**
Campus Lighting	LED 150 W	150	2	300
	LED 50 W	50	11	550
	LED 120 W	120	7	840
	LED 200 W	200	3	600
	CFL 85 W	85	2	170
	Total			**2460**
Others	Water Cooler	600	5	3000
	Submersible Pump	750	1	750
	Pump	750	3	2250
	Heater	1000	1	1000
	Induction heater	2000	3	6000
	Refrigerator Big	900	1	900
	Refrigerator Medium	700	3	2100
	Refrigerator small	500	6	3000
	Geyser	2000	5	10000
	Miscellaneous			11000
	Total			**40000**
Total Connected Load in watt				189936
Say				190 KW

Table 8: Connected Load of Bhilai Mahila Mahavidyalaya, Bhilai

The total connected load of St. Thomas, Bhilai Campus is about 121 KW. The maximum share of connected load is in HVAC segment, which is 45% and alone air conditioner has about 13% load share among all the electrical equipment.

Equipment	Connected Load in Watt
Lighting	29856
HVAC	99310
Office	18310
Campus Lighting	2460
Others	40000
Total	189936

Table 9 : Segment wise Connected Load of of Bhilai Mahila Mahavidyalaya, Bhilai

Graphical representation of Connected Load

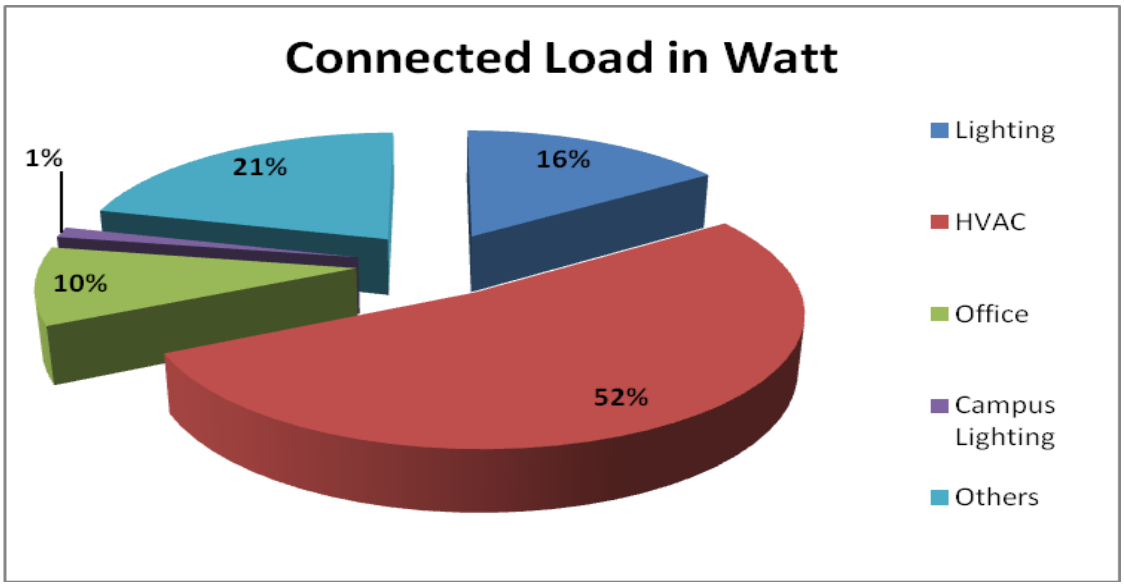


Figure 1 : Graphical representation of connected Load

As per requirement, we have calculated installed load of LED fittings and Conventional light fittings.

Types of Light Fittings	Load in Watt
LED Light Fittings	9234
Conventional Light Fittings	23082

Table 10 : Connected Load of LED light fittings & Conventional fittings at of Bhilai Mahila Mahavidyalaya, Bhilai

6.5 Percentage of Lighting Power requirement met through LED lights

LED Lighting Load in Watt	9234
Total Lighting Load in watt	32316
Percentage of Lighting Power requirement met through LED lights	28.57

Table 11: Percentage of Lighting Power requirement met through LED lights

Thus, total Percentage of Lighting Power requirement met through LED lights is about 29 %.

Graphical representation of Percentage of Lighting Power requirement met through LED lights

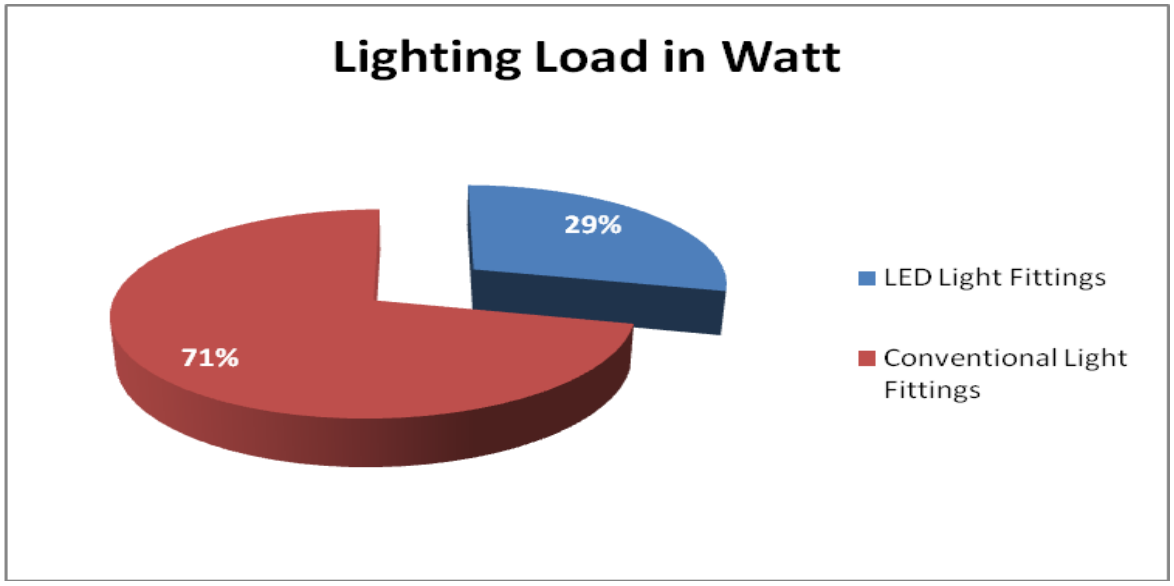


Figure 2 : Graphical representation of Percentage of Lighting Power requirement met through LED lights

6.6 Electricity Bill Analysis

We have analyzed the electricity bills of last six years i.e. 2015-16,2016-17,2017-18,2018-19,2019-20 & 2020-21

1. **2015-16**

Month	Unit Consumption
Apr-15	5000
May-15	25577
Jun-15	5000
Jul-15	15466
Aug-15	5000
Sep-15	23745
Oct-15	5000
Nov-15	19300
Dec-15	5000
Jan-16	13280
Feb-16	5000
Mar-16	18775
Total	146143

Table 12 : Electricity Consumption for the year 2015-16

2. **2016-17**

Month	Unit Consumption
Apr-16	5000
May-16	23089
Jun-16	5000
Jul-16	18182
Aug-16	5000
Sep-16	28377
Oct-16	5000
Nov-16	22327
Dec-16	5000
Jan-17	18214
Feb-17	5000
Mar-17	15061
Total	**155250**

Table 13 : Electricity Consumption for the year 2016-17

3. **2017-18**

Month	Unit Consumption
Apr-17	5000
May-17	29881
Jun-17	5000
Jul-17	15161
Aug-17	5000
Sep-17	26387
Oct-17	5000
Nov-17	20528
Dec-17	5000
Jan-18	5000
Feb-18	5000
Mar-18	5000
Total	131957

Table 14 : Electricity Consumption for the year 2017-18

4. **2018-19**

Month	Unit Consumption
Apr-18	5000
May-18	5000
Jun-18	5000
Jul-18	5000
Aug-18	5000
Sep-18	89084
Oct-18	14400

Nov-18	4600
Dec-18	6440
Jan-19	5400
Feb-19	7640
Mar-19	5000
Total	157564

Table 15 : Electricity Consumption for the year 2018-19

5. **2019-20**

Month	Unit Consumption
Apr-19	16040
May-19	5000
Jun-19	5000
Jul-19	5000
Aug-19	5000
Sep-19	42640
Oct-19	13320
Nov-19	7680
Dec-19	4200
Jan-20	5000
Feb-20	22680
Mar-20	5000
Total	136560

Table 16 : Electricity Consumption for the year 2019-20

6. **2020-21**

Month	Unit Consumption
Apr-20	5000
May-20	5000
Jun-20	13120
Jul-20	6040
Aug-20	5000
Sep-20	4800
Oct-20	6080
Nov-20	2960
Dec-20	3320
Jan-21	3360
Feb-21	3480
Mar-21	2800
Total	60960

Table 17 : Electricity Consumption for the year 2020-21

The yearly electricity consumption of last six years is summarized below :-

Sl. No.	Year	Unit Consumption
1	2015-16	146143
2	2016-17	155250
3	2017-18	131957
4	2018-19	157564
5	2019-20	136560
6	2020-21	60960

Table 18 : Summary of Electricity Consumption for last six years

Graphical representation of Unit consumption of last six years

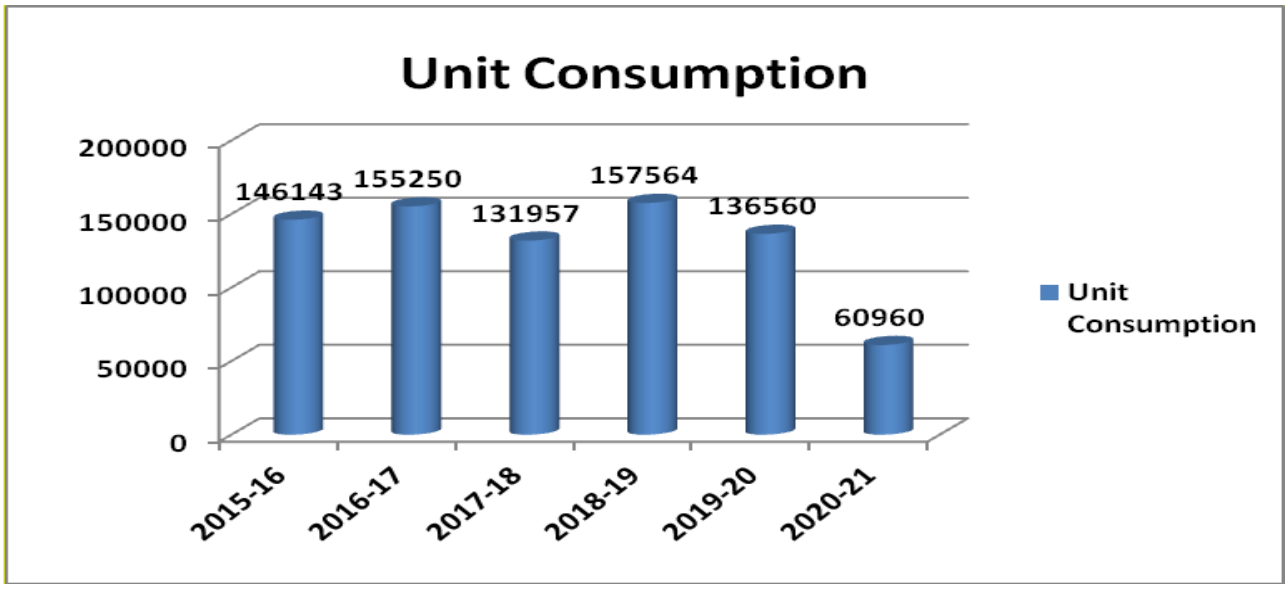


Figure 3: Graphical representation of Unit consumption of last six years.

6.7 Annual Electricity Consumption

On the basis of operational hours, we have calculated annual unit consumption:-

Segment	Type	Wattage	Quantity	No. of Hours	Nos. of Days	Diversity Factor	Total Annual Unit Consumption
Lighting	LED 2x2	32	28	6	220	0.8	946
	FTL 40	40	572	6	220	0.8	24161
	LED TL	22	181	6	220	0.5	2628
	LED 18 W	18	12	6	220	1	285
	LED 200 W	200	8	6	30	0.8	230
	LED 12 W	12	20	6	220	1	316
	CFL 32 W	32	1	6	220	1	42
	LED 5 W	5	2	6	220	1	13
	Total						28621
HVAC	Fan	70	655	6	220	0.7	42365
	AC 1.5 T	1700	26	6	100	0.8	21216

	Big Air Cooler	600	8	6	20	0.8	461
	Air Cooler	200	5	6	180	0.5	540
	Exhaust Medium	200	11	6	180	0.5	1188
	Exhaust Small	70	18	6	180	0.5	680
	Total						66450
Office	Computer	70	68	6	270	0.6	4627
	Printer/Scanner	500	19	1	270	0.4	1026
	Printer	300	11	1	270	0.4	356
	Photocopy machine	750	1	6	270	0.7	851
	Total						6860
Campus Lighting	LED 150 W	150	2	11	365	1	1205
	LED 50 W	50	11	11	365	1	208
	LED 120 W	120	7	11	365	1	3373
	LED 200 W	200	3	11	365	1	2409
	CFL 85 W	85	2	11	365	1	683
	Total						7878
Water Supply	Submersible Pump	750	1	5	365	0.8	1095
	Pump	750	3	5	365	1	4106
							5201
Others	Water Cooler	575	5	8	365	0.8	6716
	Heater	1000	1	1	180	1	180
	Induction heater	2000	3	1	270	0.8	1296
	Refrigerator Big						500
	Refrigerator Medium						400
	Refrigerator small						300
	Geyser	2000	5	3	90	1	2700
	Miscellaneous						5000
	Total						17092
	Grand Total						1,32,102

Table 19 : Annual Electricity Consumption

Segment wise Unit Consumption

Lighting	28621
HVAC	66450
Office	6860
Campus Lighting	7878
Water Supply	5201
Others	17092

Table 20 : Segment wise Unit Consumption

Graphical Representation of Unit Consumption

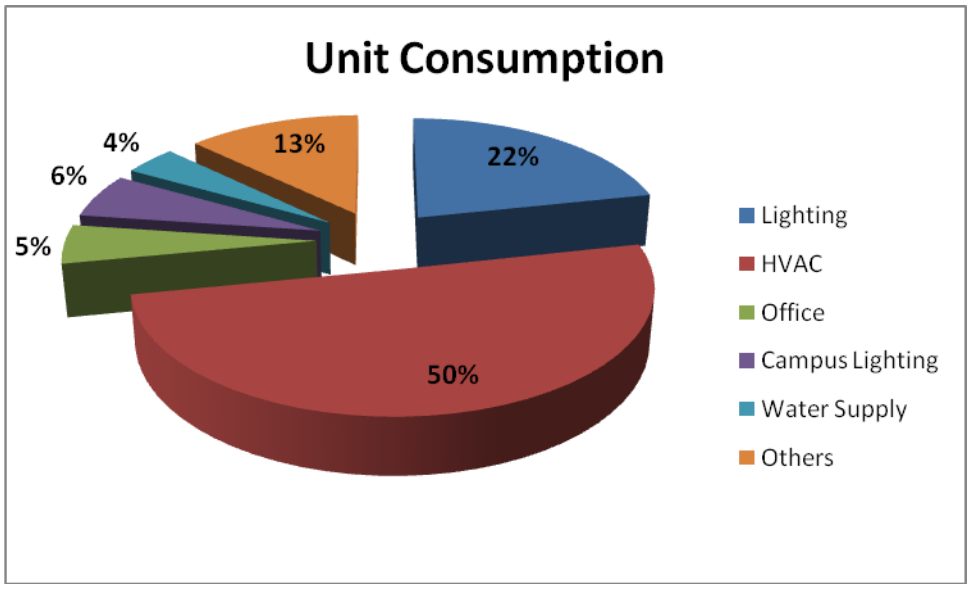


Figure 4 : Graphical Representation of Unit Consumption

Thus, we may say that the maximum share of electricity consumption is in HVAC

7. ILLUMINATION

Sl. No.	Name of Office/ Room	Lux measured	Remarks
1	Management Office (Sharma Sir)	339	Ok
2	Management Office (Neha Madam, Big table)	130	Ok but advised to increase lux.
3	Management Office (Neha Madam, Computer table)	134	Ok but advised to increase lux.
4	Accounts Section	212	Ok
5	Establishment Section	256	Ok
6	Data Entry Section	224	Ok
7	Students Counter	180	Ok
8	Principal Madam	250	Ok
9	Library (Card)	63	Insufficient light and advised to increase lux.
10	Library (Issue/return)	32	Insufficient light and advised to increase lux.
11	Students Table	115	Insufficient light and advised to increase lux.
12	Test book Section table	100	Insufficient light and advised to increase lux.
13	Referrence Section	160	Ok

Table 21: Illumination measurement

The lux levels in different department is found good, except library. In college, 572 numbers of conventional tube lights are installed, which should be replaced by LED tube light.

It is advised to use maximum day light during working hours. All the place where reading and writing work is performed, The lux level at library should be improved, which shall be achieved by installation of energy efficient LED lighting or proper orientation of lighting fixtures.

8. CARBON FOOTPRINT

A carbon footprint is the amount of greenhouse gases—primarily carbon dioxide— released into the atmosphere by an individual, event, organization, service, or product, expressed as carbon dioxide equivalent. In addition to the water, waste, energy and biodiversity audits we can also determine what our carbon footprint is, based on the amount of carbon emissions created. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions.

An important aspect of doing an audit is to be able to measure our impact so that we can determine better ways to manage the impact. In addition to the water, waste, energy and biodiversity audits we can also determine what our carbon footprint is, based on the amount of carbon emissions created.

8.1 Total Emission of Carbon dioxide

The following activity/utility is responsible for carbon emission:-

- Electricity purchased from Distribution companies.
- Diesel used in DG set
- Burning of wood / LPG

Average Annual Energy Consumption of Last Three Years

Sl. No.	Types of Energy	Year	Consumption	Average	Emission Factor	Total CO_2 eq. emission
1	**Electricity in KWH**	2018-19	157564	118361	0.82	97056
		2019-20	136560			
		2020-21	60960			
2	**Diesel in Litre**	2018-19	441	716	0.59	422
		2019-20	914			
		2020-21	792			
3	**LPG in KG**	2018-19	2934	1951	0.2983	582
		2019-20	2864			
		2020-21	56			
4	**Total Annual Average CO_2 equivalent emission**					98060

Table 22 : Total Carbon dioxide emission at Energy Consumption in BMM, Bhilai

8.2 Total Reduction of Carbon dioxide emission

Reduction of Carbon Emission by Solar Power Plant

Total Unit Generation in 41 months	223940
Average Annual Unit generation	65543

The solar power plant has generated 63,622 unit from renewable sources in the year 2019-2020 . If it is not generated from solar then it would be purchased from electricity distribution companies which would be produced from burning of coals in thermal power plant, which causes carbon dioxide emission.

Parameter	**Emission Factor**	**Unit in KWH**	**Total reduction of CO_2 emission**
Solar Power Plant	0.82	65,543	53,745

Table 23: Reduction of Carbon Emission by Solar Power Plant

Thus, solar power plant has reduced 53,745 KG of CO_2eq. Per year.

9. ENERGY CONSERVATION MEASURES ADOPTED BY BMM, BHILAI

9.1) Installation of Energy Efficient LED light

The college has replaced nearly all conventional light fittings in campus with energy efficient LED lights. At present, the use of LED lights in campus is about 29% by load and the use of LED lights in campus is about 32% by quantity.

The details are explained below:-

Details of LED fittings

Type	Wattage	Quantity	Total Wattage
LED 2x2	32	28	896
LED TL	22	181	3982
LED 18 W	18	12	216
LED 200 W	200	8	1600
LED 12 W	12	20	240
LED 5 W	5	2	10
LED 150 W	150	2	300
LED 50 W	50	11	550
LED 120 W	120	7	840
LED 200 W	200	3	600
Total		274	9234

Table 24 : Details of LED fittings

Details of Conventional light fittings

Type	Wattage	Quantity	Total wattage
FTL 40	40	572	22880
CFL 32 W	32	1	32
CFL 85 W	85	2	170
Total		575	23082

Table 25 : Details of conventional light fittings

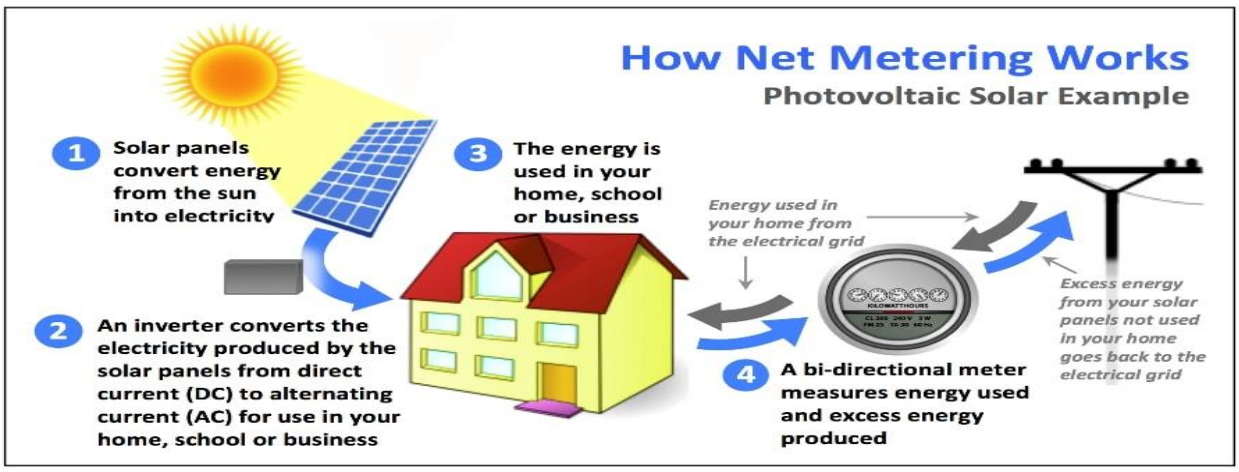
Connected Load of LED Lights	9234 watt
Connected Load of Conventional Light	23082 watt
% Share of connected load of LED Lights in total lighting load	29%

Quantity of LED Lights	274 Nos.
Quantity of Conventional Light	575 Nos.
% Share of quantity of LED Lights in total quantity of light fittings	32%

9.2) Installation of Solar Power Plant

In last couple of years, Solar energy has been one of the most affordable, dependable, and financially viable source of energy. The 'green' environmental benefits are the ones we are more aware of, but there are other well-known financial rewards to replacing traditional coal- powered electricity with solar electricity as well.

Solar power system produces maximum power during the middle of the day (peak sunshine hours) This way, "Net Metering" help us to keep the complete track record of what solar system generates .In grid connected rooftop or small SPV system, the DC power generated from SPV panel is converted to AC power using power conditioning unit and is fed to the grid 440 Volt three phase line. These systems generate power during the day time which is utilized fully by powering captive loads and feed excess power to the grid as long as grid is available. In case, where solar power is not sufficient due to cloud cover etc., the captive loads are served by drawing power from the grid.

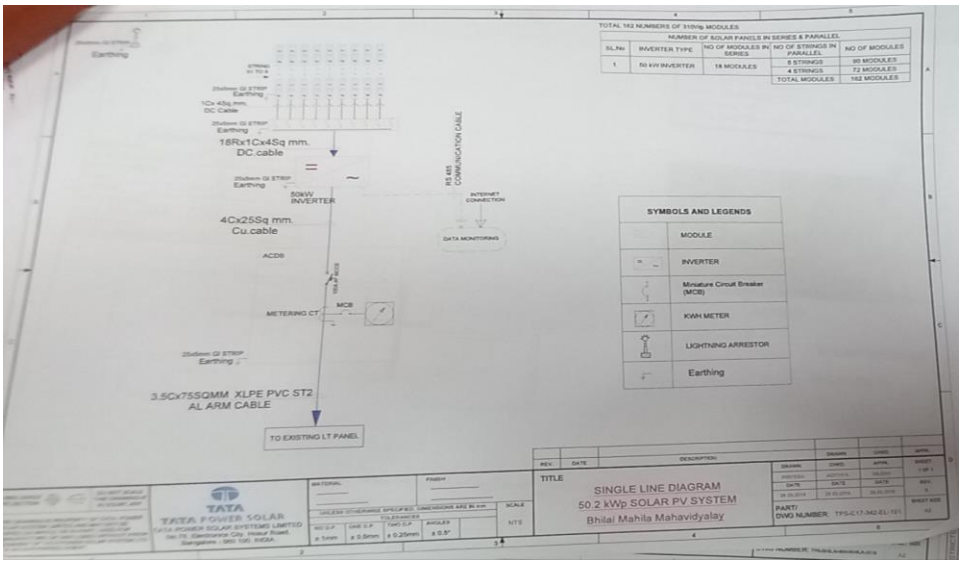


Advantages of Grid-Connected Rooftop Solar System

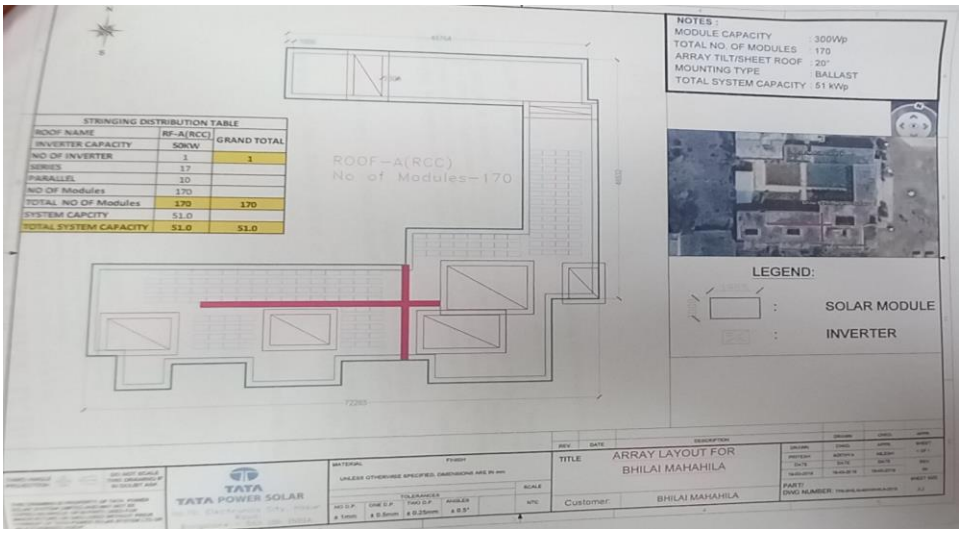
- Electricity generation at the consumption center and hence Savings in transmission and distribution losses
- Low gestation time
- No requirement of additional land
- Improvement of tail-end grid voltages and reduction in system congestion with higher self-consumption of solar electricity
- Local employment generation

Single Line Diagram of Solar PV System

Single line diagram of Solar Power Plant is shown below:-



Array Layout



9.3 Use of Energy Efficient equipment

We have noted that college has adopted the use of energy efficient star rated equipments. In principal office, there are two numbers of five star rated air conditioners.

A star rating system depicts the energy efficiency of an electrical appliance. The higher the number of stars, the more efficient it is. The star rating system was devised by the Bureau of Energy Efficiency (BEE) India, with a range of 1 to 5 stars..

We have also noticed that energy efficient 2 x2 LED light fittings are also installed at Principal and management office.

There are many rooms, where LED light fittings are installed. College management is also replacing all fluorescent tube lights with LED fittings with phase wise.

9.4 Awareness among students & staff.

The teachers of the college discuss about energy conservation to college and also, some posters related to energy conservation are displayed to increase awareness among students & staff of college.

10. RECOMMENDATIONS

1) Formation of ENCON Club:

We recommend to formation of the ENCON Club in Bhilai Mahila Mahavidyalaya, Hospital Sector, Bhilai for spreading awareness on the importance of energy conservation. ENCON Club will participate in all energy conservation activities and organize program with the support of Chhattisgarh State Renewable Energy Development Agency, (CREDA) Raipur and Bureau of Energy Efficiency,(BEE) New Delhi.

Every year, India observes National Energy Conservation on December 14. The day is organized by the Bureau of Energy Efficiency (BEE) – which operates under the Ministry of Power, aiming to present India's stellar achievements in cost-efficient energy production and resource conservation.

ENCON Club will celebrate "Energy Conservation Day" on 14Th December, each year. Further plans for the future may be discussed on this day, targeting holistic development as the main goal towards mitigation of climate change. It would not only help in imparting knowledge on energy efficiency but also in its implementation in households and institutions.

Objective of ENCON Club

The objective of the club is to create awareness among the students, staff and teachers and equip them for efficient management of all forms of energy, to promote energy efficiency and energy conservation. The club will keen to spread "Energy Conservation Messages" in the society by conducting awareness programmes to students and public.

2) Replacement of all conventional tube light will replaced by energy efficient LED tube light:

Bhilai Mahila Mahavidyalaya, Bhilai management shall enhance energy efficiency of the college and replace all conventional tube light with LED light fittings , It should be continue till all conventional tube light will replaced by energy efficient LED tube light. It will not only save in electricity consumption but also to save CO_2 emission directly and indirectly.

Wattage including choke	50
Wattage of LED tube light	22
Saving in wattage	28

Quantity	572
Operating hours	6
No. of days in operation	220
Annual saving in unit consumption	21141.12
Energy Cost in Rs. Per unit	7.5
Total annual monitory saving in Rs.	158558.4
Price of one LED 22 Watt tube light	350
Total Investment	200200
Simple Payback period	15.15152

Table 26 : Replacement of all conventional tube light will replaced by energy efficient LED tube light

The total investment is about Rs. 2,00,200 and simple payback period is about 16 months

1) Replacement of all conventional fans by 28 watt energy efficient fans.

In college, conventional fans are installed. We have recommended to use Energy Efficient Fan in college building. All 655 conventional fans (70 W) shall be replaced by 28 watt energy efficient fans. The total saving of this energy conservation measure is about 3.04 lakh per annum and total investment is about 20.96 lakh. The simple payback period is 83 months.

Wattage of conventional fan	75
Wattage of Energy Efficient Gorilla Fan	28
Saving in wattage	47
Quantity	655
Operating hours	6
No. of days in operation	220
Annual saving in unit consumption	40636
Energy Cost in Rs. Per unit	7.5
Total annual monitory saving in Rs.	3,04,772
Price of one LED 22 Watt tube light	3200
Total Investment	20,96,000
Simple Payback period	83 months

Table 27 : Replacement of all conventional fans by 28 watt energy efficient fans

Technical Description

Energy Efficient Gorilla Fan/ Super fan

Every energy efficient Gorilla/Super fan uses BLDC (Brushless Direct Current) motor. BLDC motor has no mechanical brush for commutation of the windings. Commutation is deployed with the help of smart electronics. As a result the fan runs internally at 24V and consumes just 28 W at full speed.

Key features of BLDC design:

- Extremely low heat & associated power loss

- Better flexibility over controlling motor speed
- Smart motor tuning algorithm
- No spark and minimal electrical noise
- Sensor less design
- A BLDC fan takes in AC voltage and internally converts it into DC using SMPS.
- The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period of time, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use.

Figure 71 : BLDC motor of Energy Efficient fan

- To explain, BLDC technology in simpler terms, BLDC uses a combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance it delivers. A BLDC fan composes of 3 main components:
- 1.Stator

  2.Rotor

  3. Electronics.

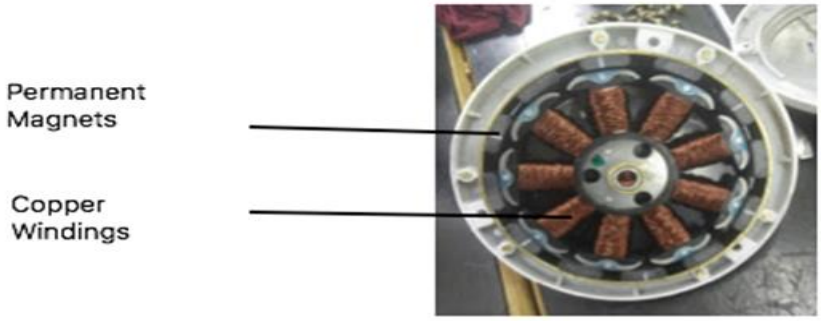


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Figure 16: Inside view of BLDC motor

- The electronics contains a driving algorithm which drives the BLDC motor. As discussed earlier in a BLDC motor the position of magnets in the fan is sensed by electronics that either uses a Hall effect sensor or back EMF. Modern BLDC motors use Back EMF for commutation due to proven disadvantages of hall effect sensor over period of time.
- To explain it in easier terms, we can take an example of a donkey who has a carrot fixed over his head as per shown in the picture below:
- Consider the Stator to be the Carrot and the donkey to be the Magnets. The polarity of the stator will keep changing, due to attraction the magnets will create rotational moment, just like how the donkey tries hard to reach the carrot in the picture.
- 
- Permanent magnets used in rotor are responsible for mass reduction in power consumption compared to windings used in the stator in an ordinary induction fan. One added advantage in a BLDC fans due to use of an electronic circuit is that you can add several additional features to increase convenience, few example of the same are sleep mode, timer mode also it is compatible with Home automation systems. Most of the BLDC Ceiling fans are operated by remote unlike traditional regulator reducing the purchase cost of regulator.
- Compared to regular induction fan, a BLDC fan can save up to Rs 1000-1500/ Year/fan. And because there is no heating of the motor, the life of a BLDC fan is also expected to be much higher than ordinary fans.

2) Electricity generation and Diesel Consumption of DG set

It is suggested to record KWH generation of DG set.At present, only consumption of diesel is recorded. A logbook shall be maintained with the following format.

Date	DG set on Time	DG set Off Time	Total running time in minute	Initial KWH reading	Final KWH reading	Total Unit Generated	Diesel Filled in Litre

Table 28 : Format for DG log book.

3) Dust cleaning on Solar Photo Voltaic Modules Surface

The degree of efficiency deterioration depends on the specific mass and size of dust particles deposition on PV module surface. As the mass of dust deposition increases, power output and the efficiency of the module decrease, and as the size becomes smaller, power output decreases as smaller particles block more radiation on PV module surface. The different pollutant depositions may include red soil, ash, sand, calcium carbonate, silica, etc. The presence of air pollution may significantly deteriorate the energy yield of PV panels; even after a short period of the panels' outdoor exposure (e.g., 2 months) without cleaning, it may cause a decrement of 6.5% in energy production approximately

4) Enhancement of Energy Efficacy of light fittings:

Cleaning of tube-lights/bulbs to be done periodically, to remove dust over It.. It affects on lamp efficacy (lm/watt).

5) General Recommendation for Energy Saving in Office Equipment

Equipment	Wattage	Comments
CRT Monitor	100 - 120W (during operating condition)	CRT monitors consume a lot of power, much of which is wasted as heat, and represent the largest power consumption component in a typical desktop computer. Emit potentially harmful radiation. Fortunately, most CRT monitors these days are legacy equipment as new computers are generally supplied with LCD monitors. Unfortunately, most CRT monitors end up in landfill.

Desktop Computer	150W (during operating condition)	Power consumption will differ significantly depending on whether a CRT or LCD monitor is used. In home and office situations where it is necessary to run multiple desktop computers, it may be possible to make significant power savings by running a single terminal server computer with several LCD monitors and keyboards attached. Terminal server computers can also greatly simplify network management, software upgrades, etc
Photo copier	7-30W (Sl. Mode) 40-300W (Standby) 200-1300W (op. cond)	Most of the energy used in a photocopier is consumed by the hot rollers, which are usually kept hot on stand-bay, consuming from 40-300W. Significant energy savings (40% to 60%) can be made by ensuring that photocopiers are switched off at night and on weekends. Some photocopiers consume up to 30 watts even when switched off, so photo copiers should be switched off at the power outlet to ensure they are really "off".
LCD Monitor	30-50W (during operating condition)	LCD monitors typically require about 30% of the power required for a CRT monitor with the same screen area. In addition, the amount of heat generated by an LCD monitor is considerably less than a CRT monitor, resulting in a lower load on ACs. Building cooling needs may be decreased by up to 20%.
Inkjet Printer	120W (during operating condition)	Inkjet printers use relatively little power in comparison to laser printers. From an energy consumption point of view, inkjets are preferable to lasers. Unfortunately, they typically cost more to un on a cost -Per -print basis and sometimes produce less than optimum results
Laser Printer	25-80W (Standby) 150-1100W (during operating condition)	Laser printers consume significant amounts of power even when in standby mode. Over the course of an 8 -10 hr working day, a laser printer could consume around 1kWh of energy. On the other hand, laser printers are cheaper to run on a cost-per page basis and generally produce better results. Both the number of laser printers used, and the number of hours the are operated for, should be minimized. As with printing of any kind, office procedures should be developed which minimize the need for printing to paper
Laptop Computer	15-40 W (during operating condition)	Laptop computer power consumption is typically 10% to 25% of that of a desktop computer. In situations such as an office or home office, where computers may operate for 8 to 10 hours a day, this difference is significant and could represent an energy saving of up to 1kWh per day.

Table 29 : General Recommendation for Energy Saving in Office Equipment