Miraj Mahavidyalaya Miraj

Maharashtra

Detailed Energy Audit Report

January 2024

Sharad Institute of Technology

College of Engineering, Yadrav.

www.sitcoe.ac.in

Report on

DETAILED ENERGY AUDIT

of

Yashwant Shikshan Sanstha's

Miraj Mahavidyalaya, Miraj

Miraj, Maharashtra

Conducted by

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Certified Energy Auditor (EA-7218)

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January 2024

I. Table of Contents

A. List of Tables

B. List of Figures

C. List of Abbreviations

MMM	: Miraj Mahavidyalaya Miraj
BEE	: Bureau of Energy Efficiency
MEDA	: Maharashtra Energy Development Agency
EB	: Electricity Board
DG	: Diesel Generator
ECM	: Energy Conservation Measures
GCV	: Gross Calorific Value
kWh	: kilo Watt hour
LT	: Low Tension
HT	: High Tension
MT	: Metric Ton
MTOE	: Metric Ton Oil Equivalent
kW	: Kilo Watt
TPA	: Tons per Annum
SEC	: Specific Energy Consumption
SPC	: Specific Power Consumption
TPH	: Tons per Hour
VFD	: Variable Frequency Drive
DOL	: Direct On Line
Yr	: Year
Kg	: Kilo Gram
W	: Watt
°C	: Celsius

II. Acknowledgement

Energy Audit Team of SITCOE expresses our sincere gratitude to management of Miraj Mahavidyalaya, Miraj Maharashtra, for providing us an opportunity to conduct a Energy Audit of their Institute. We are grateful to **Hon. Rajgonda Annasaheb Patil**, Chairman, **Dr. A. R. Jadhav**, Principal **Mr. Manoj Patil**, Office Superintendent and other officials for showing keen interest in the study and for the help and co-operation extended to SITCOE Energy Audit Team during study.

We do hope that you will find the recommendations given in this report useful in helping you save energy. While we have made every attempt to adhere to high quality standards, in both data collection and analysis, as well as in presentation through the report, we should welcome any suggestions from your side as to how we can improve further.

In case of any suggestions or queries:

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III. Introduction

Project	Detailed Energy Audit
Client	Miraj Mahavidyalaya, Miraj
Segment	Education
Contact	**Mr. Manoj Patil**
	Office Suprintendent
Site	Miraj, 416410, Maharashtra.
Consultant	**Dr. Sanjay Khot (EA-7218)**
	Principal, SITCOE, Yadrav
Involved faculty	Dr. M. M. Khade
	Prof. U. S. Patil

Involved from Institute:

Mr. Rajkumar Pandurang Medsinge (Head, Department of Botany)

Mrs. Shubhangi Pradeep Patil (Asst. Prof. Department of Botany)

Mr. Sunil Paradhi (Office Staff)

Mr. Santosh Gaikwad (Lab Attendant)

Duration	January 2024
Project scope	Conducting energy audit at Yashwant Shikshan Sanstha's Miraj Mahavidyalaya Miraj to identify Measures for Energy Conservation.
Report	This document gives recommendations, details of findings and the way forward.
Notes	The suggestions/ alternatives in the audit report are based on the operating conditions of equipment/ systems during the field work and based on information and details collected from site and to the best of our knowledge. It is recommended to obtain vendor quotations before implementation.

IV. Executive Summary

❖ Highlights

Description	Units	Values
Total annual savings	₹	237552
Total investments	₹	748360
Payback period	Years	3.15
Annual electricity consumption	kWh	227819
Annual electricity cost/annum	₹	2497021

❖ Impact of Proposed Energy Conservation Measures

Description	Units	Values
Electricity Saving	kWh/Annum	23661
	%	10.39
Estimated annual cost reduction	₹/annum	237552
Simple Payback period	Years	3.15
Reduction in CO_2 emissions	MT/year	19.40

❖ Summary of Energy Conservation Measures

❖ Table 01: Summary of Energy Conservation Measures

Sr. No.	Energy Conservation Measures	Annual Saving		Investment	Simple payback period	Reduction in CO_2 emissions
		kWh	₹	₹	Years	MT/Year
1	Replace conventional fan with energy efficient fan (187 Nos.)	16052	161163	640360	3.97	13.16
2	Replace conventional tube with energy efficient tube (89 Nos.)	4130	41461	20025	0.48	3.39
3	Replace CFL and Incandescent bulb with LED bulb (05 Nos.)	260	2609	975	0.37	0.21
4	Replace water pump with energy efficient pump (01 Nos.)	3219	32319	87000	2.69	2.64
Total		**23661**	**237552**	**748360**	**3.15**	**19.40**

Table 02: Recommendation for nearly zero energy building

Name of Building	Annual Electricity Consumption kWh	Daily Electricity Consumption kWh	Unit Charge	Solar PV System Required-kW_p	Annual Electricity Generated by Solar kWh	Monetary Saving ₹	Investment @60000/kw_p ₹	Simple Payback
College buildings	22985	62.97	10.04	21	22995	230870	1260000	5.46

1. Energy and Utility System Description

Yashwant Shikshan Sanstha's Miraj Mahavidyalaya Miraj is located in Miraj.

Major utilities in this university are

1. General
2. Electrical

1.1 Brief Description of each Facility

This study is being done under the indicative scope of work for conduct of Energy Audit specified by MEDA (Maharashtra Energy Development Agency) & BEE (Bureau of Energy Efficiency). This study is mainly carried out to identify saving areas in Yashwant Shikshan Sanstha's Miraj Mahavidyalaya Miraj with short term, medium term & long-term investments, yielding significant savings. The study can be mainly divided into following groups.

a. General

Energy Audit focuses on study of correlation of electricity consumption on production. Opportunities for load factor improvement, power factor improvements, etc.

b. Electrical

It includes motor load study of 5 HP & above by measuring input parameters (Voltage, Current, P.F. & kW), performance analysis of water pumps having capacities above 5 HP, performance analysis and identification of energy efficiency opportunities in motors, pumps, air compressors, lighting, etc.

1.2 Instrument Used

Following instruments are used for the study:

a. Three phase power analyzer

b. Lux Meter

c. Anemometer

d. Thermal imager

The site study was carried out from January 2024.

2. Description and Energy Consumption

2.1 About Institute

"In the eastern part of the city of Miraj and Miraj taluka, the former MLA of the Miraj Vidhan Sabha constituency, Mr. Sharad Patil, initiated the establishment of arts, science, and commerce colleges recognized by the government since June 1993. The College with arts, science and Commerce departments began in the premises of the Hindu Dharmashala. In the initial years, although physically inadequate within the building of the Hindu Dharmashala, efforts by enthusiastic and passionate teachers, along with administrative cooperation, rapidly increased the educational quality of the students. Due to these efforts, and with the support of the administration, this college, though briefly, has become renowned. Many youths who have obtained degrees in arts and science from this college are effectively contributing in various fields of society.

The Maharashtra government provided around three acres of land from the Budhgaonkar mala in Miraj city for the college. The institution raised funds and constructed the building, and since 2005, the college has been functioning in its self-owned remarkable building.

After undergoing reevaluation by the NAAC, an organization evaluating academic colleges nationwide, in 2019, the college received a 'B+' grade. The commerce department which initially couldn't commence; but due to student demand, it has been operational since 2016-17 without government financial aid."

2.2 Annual Energy Consumption

2.1.1 Electricity

MMM, is receiving electricity from MSEDCL. A part of the plant electricity is met by open access.

2.1.2 Marginal Energy Cost

Marginal cost of electricity is calculated based on the energy cost of electricity from EB and DG. This marginal cost is considered for the cost benefit analysis of energy conservation measures.

Table 03: Marginal Energy Cost

Description	Units	Value	Value	Value
Name of building	-	Main Building	Jr. College	Hostel
Average monthly EB energy consumption	kWh	1426	324	269
Average basic cost of energy from EB	₹/kWh	5.94	5.94	5.94
% of electricity from EB	%	100	100	100
Marginal cost of electricity	₹/kWh	8.80	5.94	5.94
Actual cost of electricity	₹/kWh	9.19	5.94	5.94

2.1.3 Annual Energy Consumption Breakup

Table 04: Annual Energy Consumption Expenses

Month	Hostel	Main Building	Jr. College	Total bill
Feb-24	2204.57	13265.63	2932.03	18402.23
Jan-24	1792.53	11123	2923.24	15838.77
Dec-23	1664.34	11535.04	2835.39	16034.77
Nov-23	2826.17	16405.35	5363.92	24595.44
Oct-23	2278.7	14709.07	4011.82	20999.59
Sep-23	2682.62	14202.1	4480.69	21365.41
Aug-23	4028.02	11212.31	4311.93	19552.26
Jul-23	3773.01	12663.23	3248.75	19684.99
Jun-23	4335.53	19646.87	2445.25	26427.65
May-23	3157.46	14808.85	2658.08	20624.39
Apr-23	3782.58	12039.45	2495.14	18317.17
Mar-23	3183.16	9413.79	2154.87	14751.82
Total	**35708.69**	**161024.69**	**39861.11**	**236594.5**

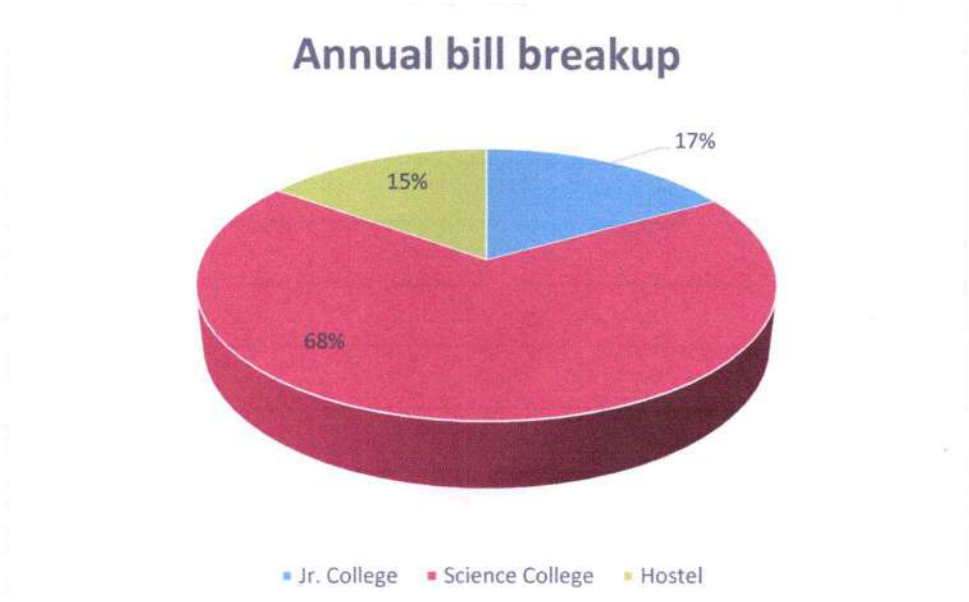

Figure 01: Annual Bill Breakup

3. Energy Scenario

3.1 Electrical Systems

3.1.1 Electrical bill analysis

Miraj Mahavidyalaya Miraj is getting electricity supply from Maharashtra State Electricity Distribution Co. Ltd. Major portion of the energy consumption is used for academics.

The observations made during the study are given in the following sections.

The Tariff Structure

Tariff structure of the facility is given below

Table 05: Tariff structure

Sr. No.	Name of Building	Tariff Code	Connected load kW	Fixed charges ₹/kVA	Unit charge ₹/kWh
1	Main Building	073 /LT-X B I 0-20KW Pub Ser oth	1.3	422	5.94
2	Jr. College		5.9	422	5.94
3	Hostel		1	422	5.94

The analysis of plant electricity consumption from EB is given below. For the electricity consumption analysis, electricity bill for the last twelve months (March-2023 to February 2024) is considered.

Table 06: Electrical Bill Analysis of Main Building

Month	Consumption kWh	Fixed Charges	Energy charges	Wheeling Charges	FAC	Electricity Duty	Tax on sale	Other Charges	Total Bill ₹	Unit Charge ₹/kWh
Feb-24	1393	422	8274.42	1629.81	417.9	2256.27	265.23	0	13265.63	9.52
Jan-24	1159	422	6884.46	1356.03	347.7	1892.14	220.67	0	11123	9.60
Dec-23	1204	422	7151.76	1408.68	361.2	1962.16	229.24	0	11535.04	9.58
Nov-23	1771	422	10519.74	2072.07	265.65	2788.69	337.2	0	16405.35	9.26
Oct-23	1582	422	9397.08	1850.94	237.3	2500.54	301.21	0	14709.07	9.30
Sep-23	1557	422	9248.58	1821.69	0	2413.38	296.45	0	14202.1	9.12
Aug-23	1217	422	7228.98	1423.89	0	1905.72	231.72	0	11212.31	9.21
Jul-23	1382	422	8209.08	1616.94	0	2152.08	263.13	0	12663.23	9.16
Jun-23	2153	422	12788.82	2519.01	0	3303.26	409.93	203.85	19646.87	9.13
May-23	1626	422	9658.44	1902.42	0	2516.4	309.59	0	14808.85	9.11
Apr-23	1371	384	6265.47	1850.85	1233.9	2044.19	261.04	0	12039.45	8.78
Mar-23	1060	384	4844.2	1431	954	1598.77	201.82	0	9413.79	8.88
Min	1060	384	4844.2	1356.03	0	1598.77	201.82	0	9413.79	8.78
Max	2153	422	12788.82	2519.01	1233.9	3303.26	409.93	203.85	19646.87	9.60
Average	1425.77	413.23	8101.17	1710.72	293.67	2225.57	271.47	15.68	13110.65	9.19
Total	16082	4566	92196.6	19253.5	3399.8	25077.3	3062.0	203.9	147759.1	

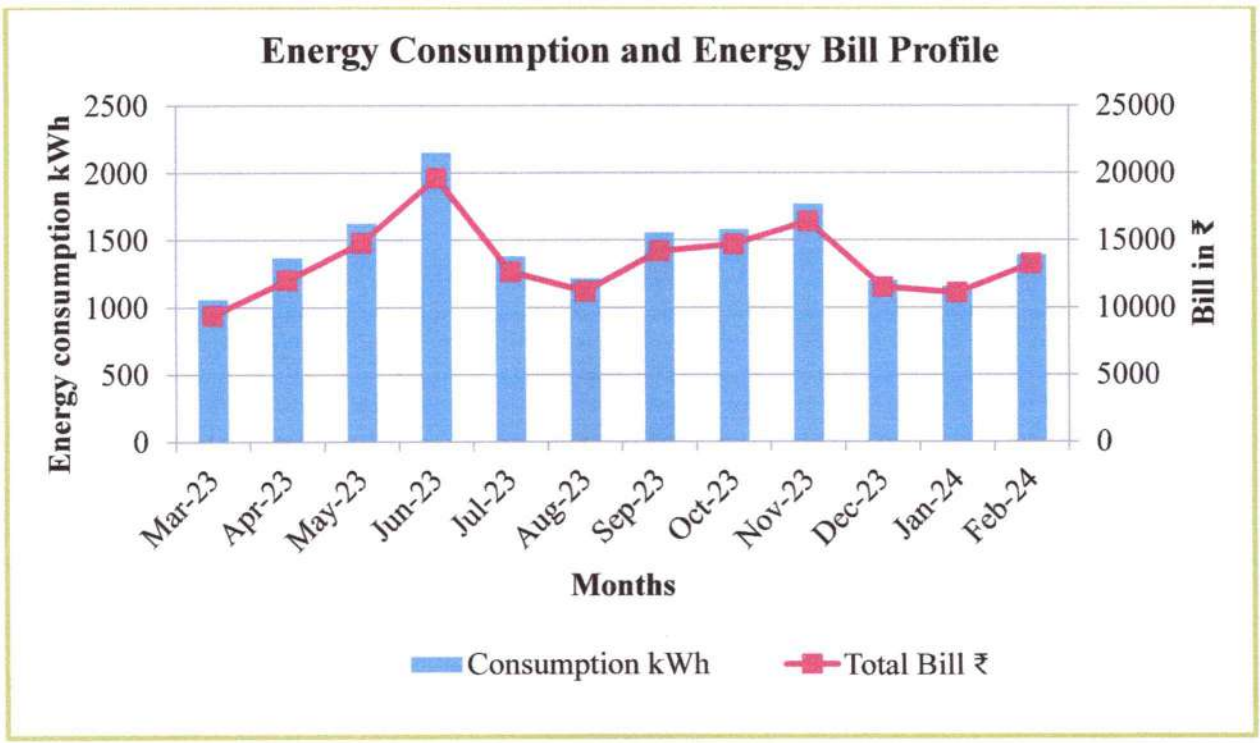

Figure 02: Annual Energy Consumption

Observation:

- The average energy consumption is 16082 kWh.
- The maximum energy consumption was 2153 kWh in the month if June 2023.
- Total bill for energy consumption was ₹147759.

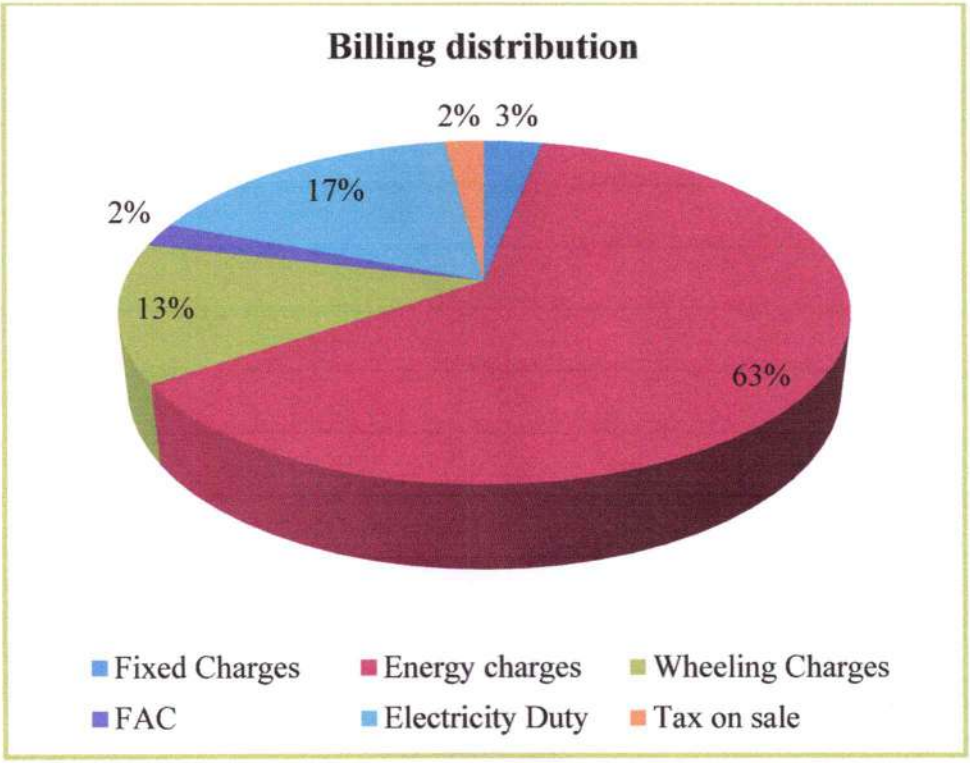

Figure 03: Billing Distribution

Observations

- Energy charges are 63 % of total bill.
- Fixed charges are 3 % of total bill.

Table 07: Electrical Bill Analysis of Jr. College

Month	Consumption kWh	Fixed Charges	Energy charges	Wheeling Charges	FAC	Electricity Duty	Tax on sale	Other Charges	Total Bill ₹	Unit Charge ₹/kWh
Feb-24	278	422	1651.32	325.26	83.4	397.12	52.93	0	2932.03	10.55
Jan-24	277	422	1645.38	324.09	83.1	395.93	52.74	0	2923.24	10.55
Dec-23	267	422	1585.98	312.39	80.1	384.08	50.84	0	2835.39	10.62
Nov-23	566	422	3362.04	662.22	84.9	724.99	107.77	0	5363.92	9.48
Oct-23	409	422	2429.46	478.53	61.35	542.61	77.87	0	4011.82	9.81
Sep-23	473	422	2809.62	553.41	0	605.6	90.06	0	4480.69	9.47
Aug-23	453	422	2690.82	530.01	0	582.85	86.25	0	4311.93	9.52
Jul-23	327	422	1942.38	382.59	0	439.52	62.26	0	3248.75	9.94
Jun-23	227	422	1348.38	265.59	0	325.76	43.22	40.3	2445.25	10.77
May-23	257	422	1526.58	300.69	0	359.88	48.93	0	2658.08	10.34
Apr-23	253	384	1156.21	341.55	227.7	337.51	48.17	0	2495.14	9.86
Mar-23	211	384	964.27	284.85	189.9	291.68	40.17	0	2154.87	10.21
Min	211	384	964.27	265.59	0	291.68	40.17	0	2154.87	9.47
Max	566	422	3362.04	662.22	227.7	724.99	107.77	40.3	5363.92	10.77
Average	323.77	413.23	1852.05	386.67	62.34	436.86	61.64	3.10	3232.00	10.05
Total	3720	4566	21461.1	4435.9	727.1	4990.4	708.3	40.3	36929.1	

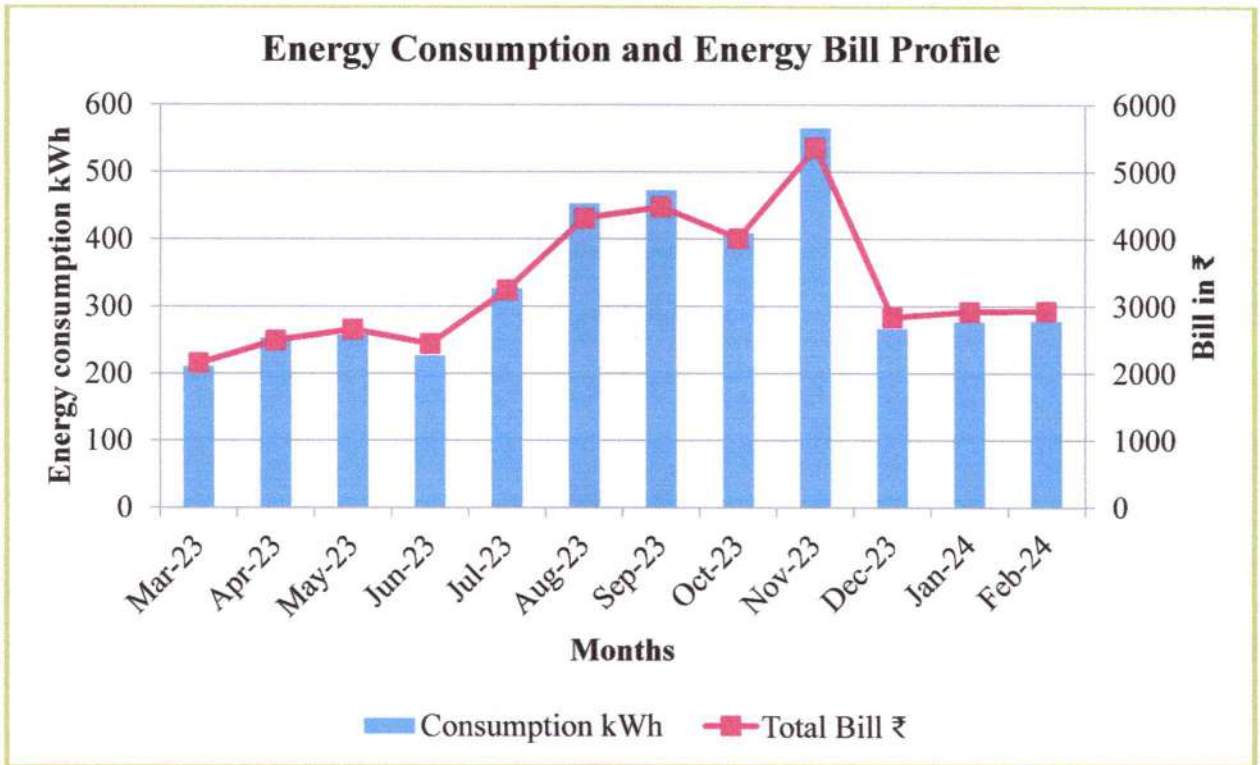

Figure 04: Annual Energy Consumption

Observation:

- The average energy consumption is 323.77 kWh.
- The maximum energy consumption was 566 kWh in the month if November 2023.
- Total bill for energy consumption was ₹ 36929.

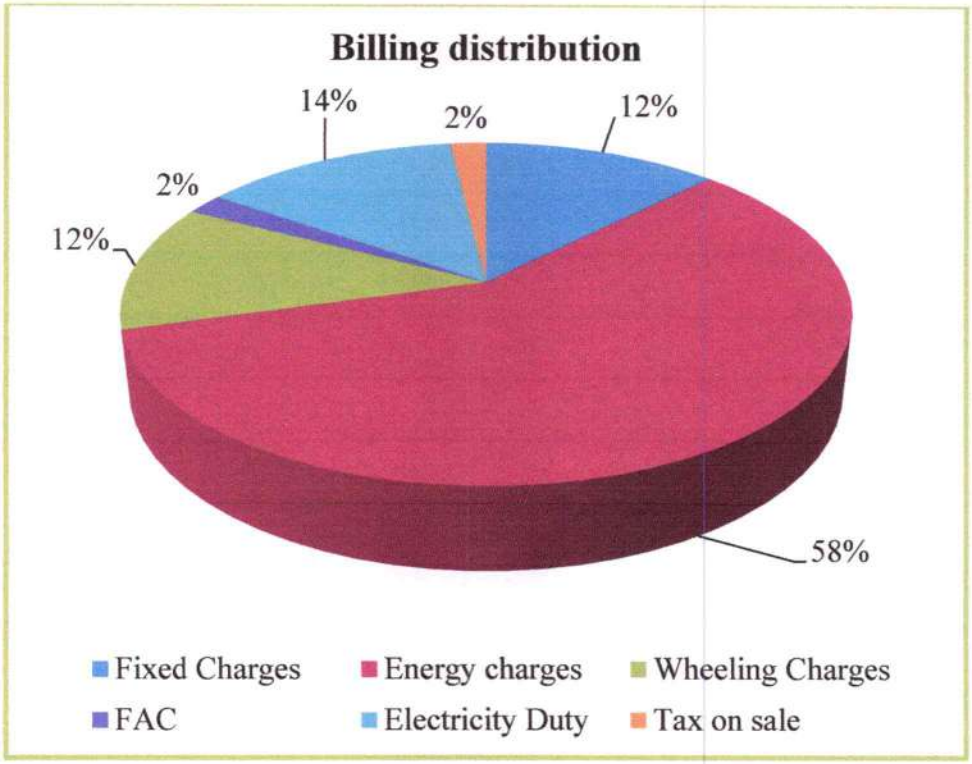

Figure 05: Billing Distribution

Observations

- Energy charges are 58 % of total bill.
- Fixed charges are 12 % of total bill.

Table 08: Electrical Bill Analysis of Hostel

Month	Consumption kWh	Fixed Charges	Energy charges	Wheeling Charges	FAC	Electricity Duty	Tax on sale	Other Charges	Total Bill ₹	Unit Charge ₹/kWh
Feb-24	185	422	1098.9	216.45	55.5	376.5	35.22	0	2204.57	11.92
Jan-24	140	422	831.6	163.8	42	306.47	26.66	0	1792.53	12.80
Dec-23	126	422	748.44	147.42	37.8	284.69	23.99	0	1664.34	13.21
Nov-23	258	422	1532.52	301.86	38.7	481.97	49.12	0	2826.17	10.95
Oct-23	197	422	1170.18	230.49	29.55	388.97	37.51	0	2278.7	11.57
Sep-23	247	422	1467.18	288.99	0	457.42	47.03	0	2682.62	10.86
Aug-23	400	422	2376	468	0	685.86	76.16	0	4028.02	10.07
Jul-23	371	422	2203.74	434.07	0	642.56	70.64	0	3773.01	10.17
Jun-23	428	422	2542.32	500.76	0	727.67	81.49	61.29	4335.53	10.13
May-23	301	422	1787.94	352.17	0	538.04	57.31	0	3157.46	10.49
Apr-23	393	384	1796.01	530.55	353.7	643.49	74.83	0	3782.58	9.62
Mar-23	322	384	1471.54	434.7	289.8	541.81	61.31	0	3183.16	9.89
Min	126	384	748.44	147.42	0	284.69	23.99	0	1664.34	9.62
Max	428	422	2542.32	530.55	353.7	727.67	81.49	61.29	4335.53	13.21
Average	268.77	413.23	1521.14	324.36	65.16	489.24	51.17	4.71	2874.85	10.87
Total	3183	4566	17927.5	3852.8	791.6	5699.0	606.1	61.3	33504.1	

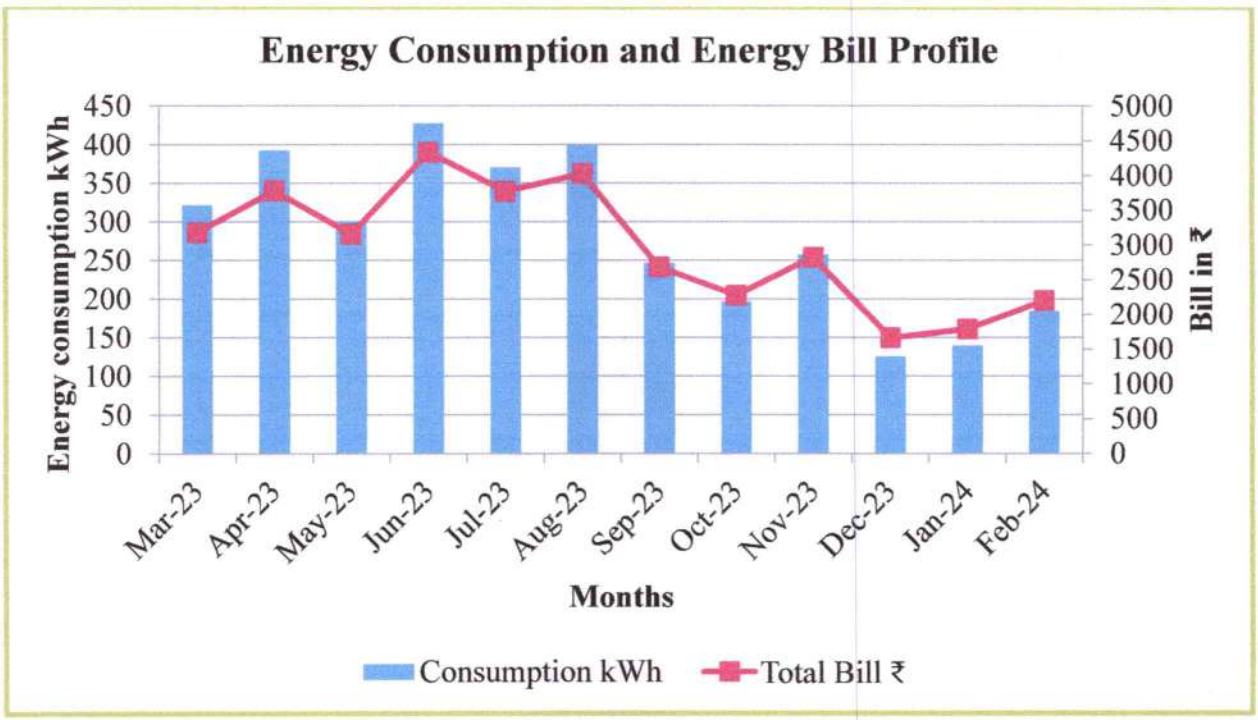

Figure 06: Annual Energy Consumption

Observation:

- The average energy consumption is 268.77 kWh.
- The maximum energy consumption was 428 kWh in the month if June 2023.
- Total bill for energy consumption was ₹ 33504.

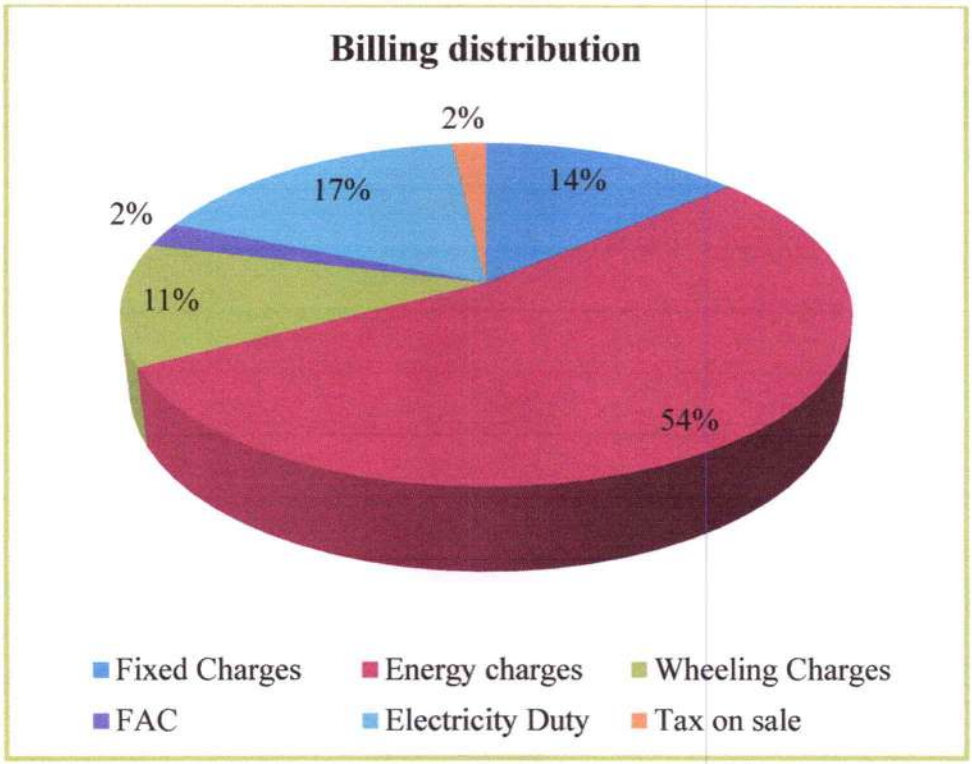

Figure 07: Billing Distribution

Observations

- Energy charges are 54% of total bill.
- Fixed charges are 14 % of total bill.

3.1.2 Transformer Details

In Miraj Mahavidyalay Miraj transformer receive power from MSEDCL Power. Supply voltage to transformer is 11 kV. Following table shows the details of transformer.

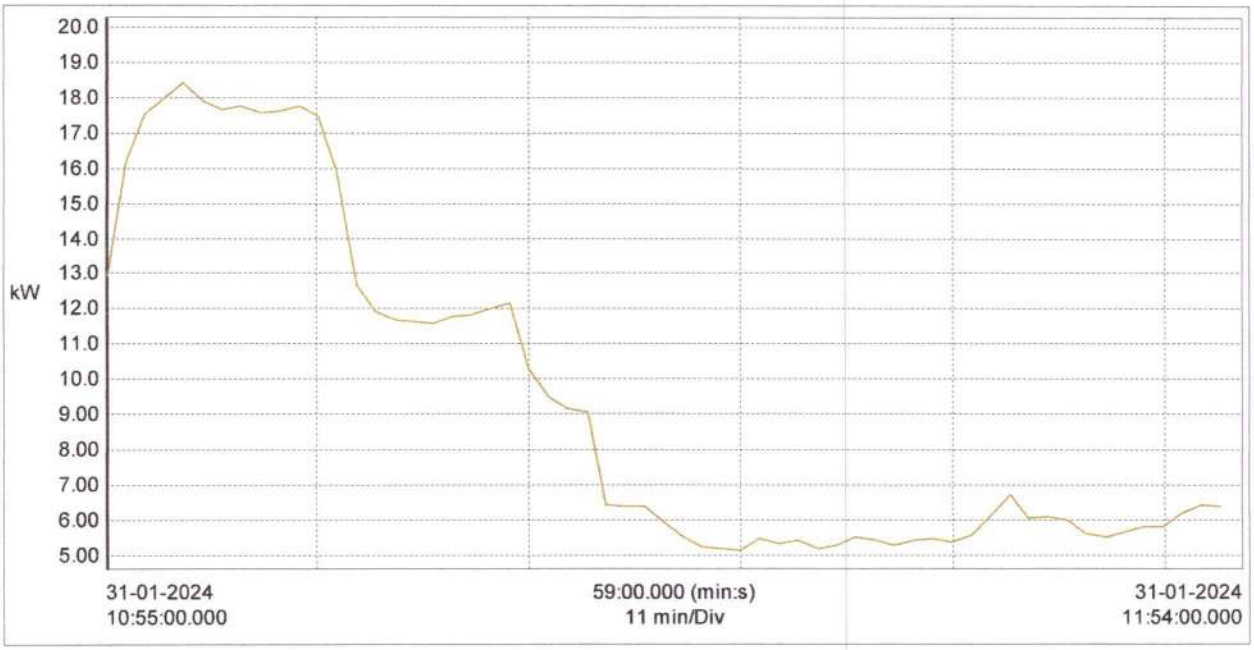

Figure 08: Power Profile of Main Building Main Supply

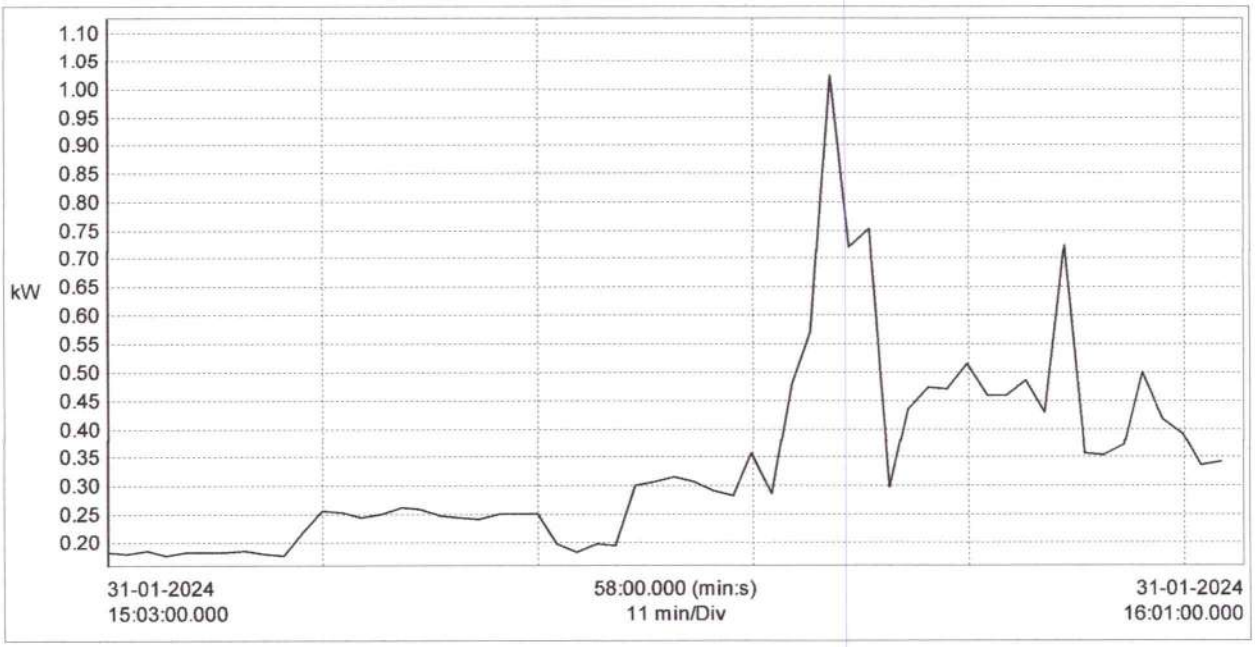

Figure 09: Power Profile of Girls Hostel Main Supply

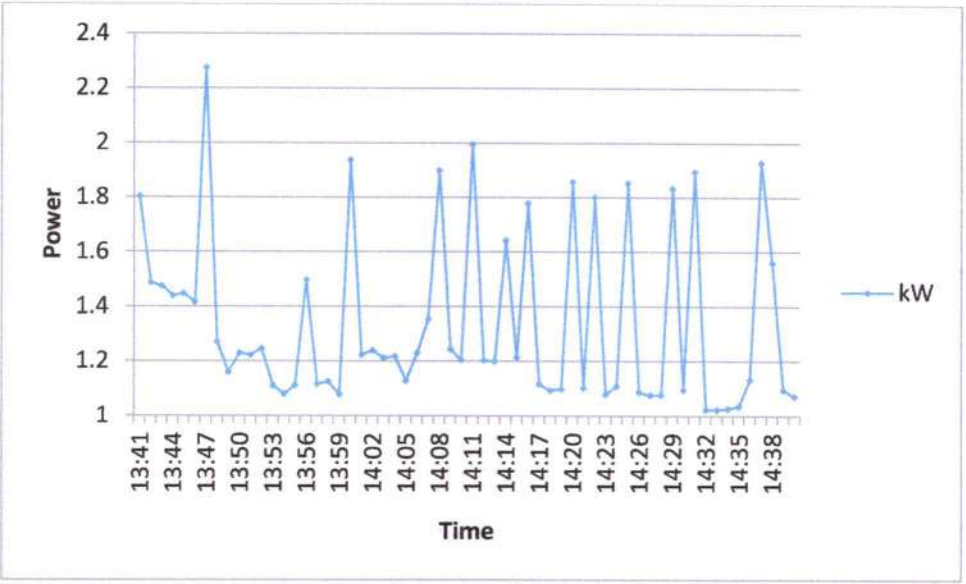

Figure 10: Power Profile of Jr. College Main Supply

3.1.3 Harmonics

Harmonic of a wave is the wave which has frequency as the positive integer multiple of the frequency of the original wave, known as the fundamental frequency.

Electrical loads can be classified as linear and non-linear loads. A linear load is one, which draws a sinusoidal current when subjected to sinusoidal voltage. The current wave may or may not have a phase difference with respect to the voltage. A pure resistance, inductance or capacitance or any combination of these forms a linear load. On the contrary, a non-linear load is one, which draws non-sinusoidal or pulsating current when subjected to sinusoidal voltage.

Any non-sinusoidal current can be mathematically resolved into a series of sinusoidal components (Fourier series). The first component is called as fundamental and the remaining components whose frequencies are integral multiples of the fundamental frequency are known as harmonics. If the fundamental frequency is 50 Hz, then 2nd harmonic will have a frequency of 100Hz and the 3rd will have 150Hz and so on.

Non-linear loads that draw current in abrupt pulses rather than a smooth sinusoidal manner create harmonics. The pulses of current cause distorted current wave shape, which in turn cause harmonic currents to flow back into other parts of the power system.

3.1.3.1 Current Harmonics

In a normal alternating current power system, the current drawn by a linear load will be sinusoidal at the specified frequency. The current wave may or may not have a phase difference

with respect to the voltage. Current harmonics are caused by non-linear loads which draw current that is not necessarily sinusoidal. The current wave form can be distorted and complex depending on the load and the interaction between other components of the system. Using Fourier series, the complex wave form can be resolved into simple sinusoidal waves of multiple frequency for analysis purpose.

Any non-sinusoidal current can be mathematically resolved into a series of sinusoidal components (Fourier series). The first component is called as fundamental and the remaining components whose frequencies are integral multiples of the fundamental frequency are known as harmonics. If the fundamental frequency is 50 Hz, then 2nd harmonic will have a frequency of 100Hz and the 3rd will have 150Hz and so on.

3.1.3.2 Voltage Harmonics

Main reason for voltage harmonics is current harmonics. The voltage wave form from voltage source is distorted by the current harmonics due to source impedance. Larger the source impedance, higher will be the voltage harmonics caused by current harmonics. It is typically the case that voltage harmonics are indeed small compared to current harmonics.

Thus, harmonic voltage can be defined as the product of harmonic current and source impedance at the harmonic frequency.

The source impedance includes the Impedance of the power source (Transformer, Generator, and Grid etc.), Impedance of the Bus bars, Cables, Switchgears and other loads in the network.

Table 09: Details of Individual Phase Harmonics (Main power supply)

Particulars		Main Building		
Phase		R	Y	B
Voltage		412.00	414.50	413.00
Current		166.80	130.60	188.40
kW		30.25	24.47	25.88
PF		0.972	0.974	0.976
$V_{thd\%}$		2.20%	1.80%	1.90%
$I_{thd\%}$		7.30%	8.30%	9.80%
Individual harmonic current in %	2	0.476%	0.499%	0.672%
	3	2.549%	4.012%	6.537%
	4	0.195%	0.138%	0.166%
	5	5.616%	6.381%	6.085%
	6	0.051%	0.005%	0.013%
	7	2.572%	1.757%	1.880%
	8	0.045%	0.049%	0.025%
	9	0.654%	0.686%	0.799%
	10	0.027%	0.014%	0.020%
	11	1.892%	1.855%	1.820%
	12	0.005%	0.000%	0.002%
	13	0.443%	1.172%	1.756%
	14	0.010%	0.006%	0.008%
	15	0.349%	0.095%	0.203%

Observations

The voltage harmonics is 2.20%, 1.80% and 9.80% respectively with R, Y and B phases which are within the limits as specified in the IEEE 519-2014 standard i.e. 8 %.

The current harmonics are 7.30%, 8.30 and 9.80% respectively with R, Y and B phases which is more than the limits as specified in the IEEE 519-2014 standard i.e. 8 %.

3.1.4 Diesel Generator

In Miraj Mahavidyalaya Miraj have one DG set available. Following table shows the details of generators.

Table 10: DG sets details

Sr. No.	Name of DG set	Capacity in kVA	Annual Usage (Lit)
1	Miraj Mahavidyalaya Miraj	25	240

3.2 Water Pump

Daily consumption of Miraj Mahavidyalaya Miraj campus is around 240 liters. The water from bore well is supplied to the campus. There are 2 pumps in campus with a capacity of 7.5 HP for Main Building and 1 HP for girls hostel used to supply water to campus.

3.3 Air Conditioning

In Miraj Mahavidyalaya Miraj split AC are used for auditorium, computer lab & faculty cabin. The list AC is as follows.

Table 11: AC Details with Location

Name of Department	Inverter/Star	Make	Cooling capacity W	Power kW	AC (1.5 ton)	AC (2 ton)
Girls Hostel First floor	3 Star	IFB	5100	1.75	1	
IQAC	Inverter 3 Star	Lloyd	5100	1.71		1
Total					**2**	

3.4 Lighting System

Lighting is provided in commercial buildings, indoor and outdoor for providing comfortable working environment. The primary objective is to provide the required lighting effect for the lowest installed load i.e. highest lighting at lowest power consumption. There are number of buildings in Miraj Mahavidyalaya Miraj Campus. The details of inventories are shown in the table.

Table 12: Inventory Miraj Mahavidyalaya Miraj

Name of Department	Tube T8	LED Tube	Ceiling Fan	Exhaust Fan	Wall Fan	LED Bulb 9W	LED Bulb 15W sq.	LED Bulb 35W	CFL bulb 14 W	Incandescent bulb	Computer	Printer	Xerox	LED Screen	Oven	Projector	Autoclave	Incubator	Refrigerator	AC	Geyser	Micro oven	Pump
Ground Floor Office	1	8	5								8	7	1										
Principal cabin		3	2								1			1									
Pantry						1			1														
Vice Principal cabin		1	1																				
Common facility center		2	1								1	1			1								
Dept. of Chemistry	4	2	2	1																			
Lab 2	4	2	2	1																			
Microbiology Lab Msc		16	5												1		1	1	1				
Microbiology Lab Bsc		11	2												1	1	1	2					
Lab 2		13	1								2	1						1	2				
Staff room		2	2																				
Store	1																						
Class room 3	4		2																				
Class room 2	4		2																				
Class room 1	3	1	2																				
Ladies Common room	2	2																					
Corridor	3	1																					1 (7.5 HP)
First floor Consumer store		1	1								1	1											
Auditorium C.R. 4		8	7													1							
Dept. of Mathematics Comp. lab	2	3	3								20	1											
Class room 5	4		2																				
Class room 6	3	1	2																				
Class room 7	3	1	2																				
Class room 8	4		2																				
Dept. of geography	2		2																				

Name of Department	Tube T8	LED Tube	Ceiling Fan	Exhaust Fan	Wall Fan	LED Bulb 9W	LED Bulb 15W sq.	LED Bulb 35W	CFL bulb 14 W	Incandescent bulb	Computer	Printer	Xerox	LED Screen	Oven	Projector	Autoclave	Incubator	Refrigerator	AC	Geyser	Micro oven	Pump
Class room 9	5	3	4																				
Dept. of English	2		2								10	1											
Dept. of Hindi	2		2								1												
Class room no. 10	5		3																				
Corridor	4		1																				
Second floor Dept. of Marathi	1		1								1												
UPS room		1																					
Dept. of computer science	4	3	4	2							64	4				1							
Physics	5	1	5								1	1											
Jr. Lab	4		4																				
Dept. of zoology	2	3	4								1								1				
Dept. of Botany	5	2	5								1	1			1	1		1	1				
Library		3	1								1	1											
Boys reading room		2	2																				
Girls reading room		8	8								1												
Third floor Dark room	1		1																				
Book issue		8	8								5		1										
Corridor	1	2																					
Terrace		1																					
Girls Hostel Ground floor NSS		15	8																				
Corridor	2	3								1	1	1											1 (1 HP)
First floor		6	4					1			1	1	1							1			
Corridor		7																			1		
Office		6	8								6	4											
Class room 2		4	2																				
Toilet		2																					
Second floor		25	14					1			6	4											

Name of Department	Tube T8	LED Tube	Ceiling Fan	Exhaust Fan	Wall Fan	LED Bulb 9W	LED Bulb 15W sq.	LED Bulb 35W	CFL bulb 14 W	Incandescent bulb	Computer	Printer	Xerox	LED Screen	Oven	Projector	Autoclave	Incubator	Refrigerator	AC	Geyser	Micro oven	Pump
New building Jr. College Groud floor science B5		4	4	1																			
Staff room		4	3																				
lass room 8		4	4																				
Corridor		1								1													
First floor Class room 4		4	4	1																			
Class room 3		6	4																				
Office		3	2								2	1		1									
Class room 1		6	4																				
Class room 2		6	4	1																			
Corridor		1																					
Exam Section Ground floor		2	2							1	1												
Corridor		1																					
First floor P. G. Classroom Geo/MA		2	2																				
Corridor		1																					
MSc 1 PG Class room 2		2	2																				
IQAC			1		1		8				1					1				1			
Canteen		1				1													1			1	
Total	**89**	**231**	**179**	**7**	**1**	**2**	**8**	**2**	**1**	**3**	**141**	**32**	**3**	**2**	**4**	**5**	**2**	**5**	**6**	**2**	**1**	**1**	**2**

3.5 Purpose of the Performance Test

Most interior lighting requirements are for meeting average luminance on a horizontal plane, either throughout the interior, or in specific areas within the interior combined with general lighting of lower value. The purpose of performance test is to calculate the installed efficacy in terms of lux/watt/m² (existing or design) for general lighting installation. The calculated value can be compared with the norms for specific types of interior installations for assessing Improvement options. The installed load efficacy of an existing (or design) lighting installation can be as follows

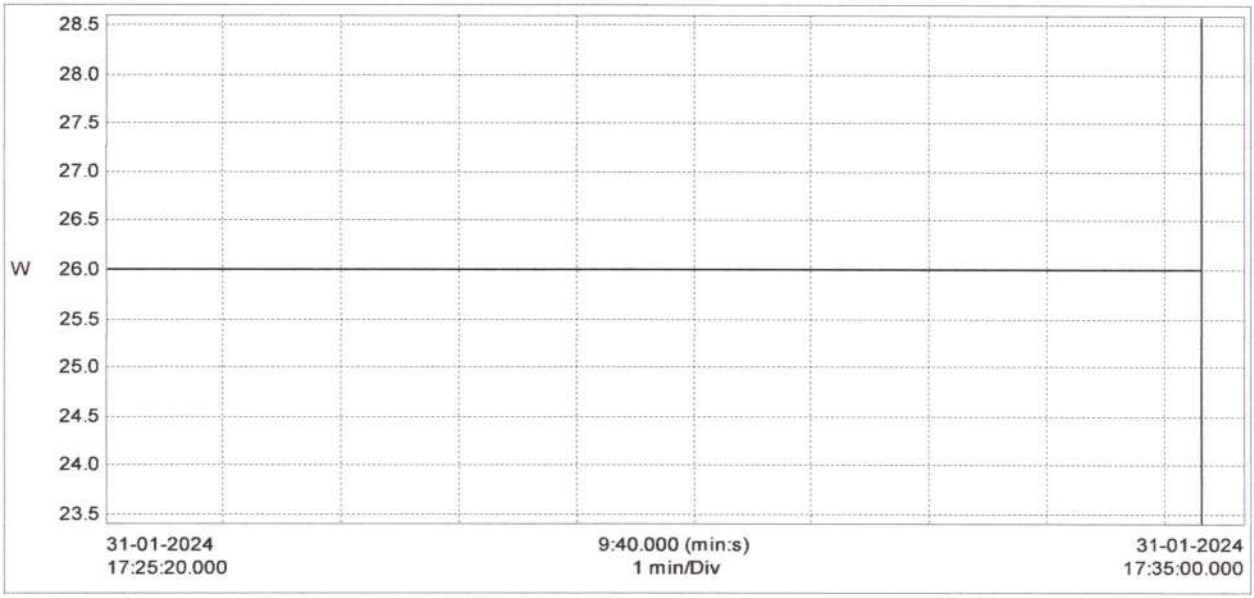

Figure 11: Power profile of 20W LED tube light

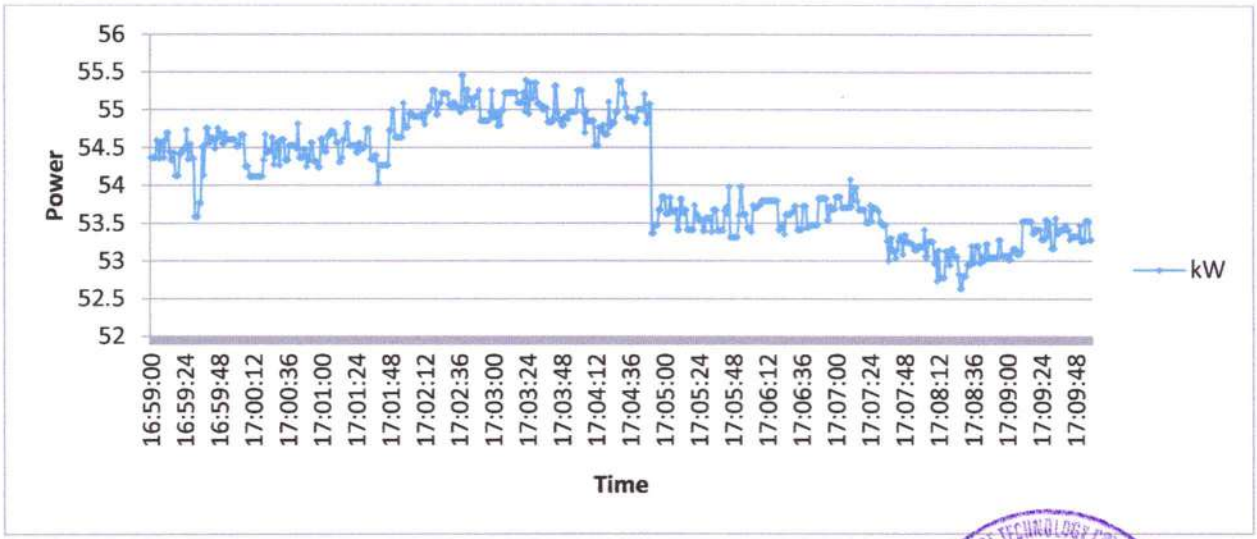

Figure 12: Power profile of 40W T12 tube light

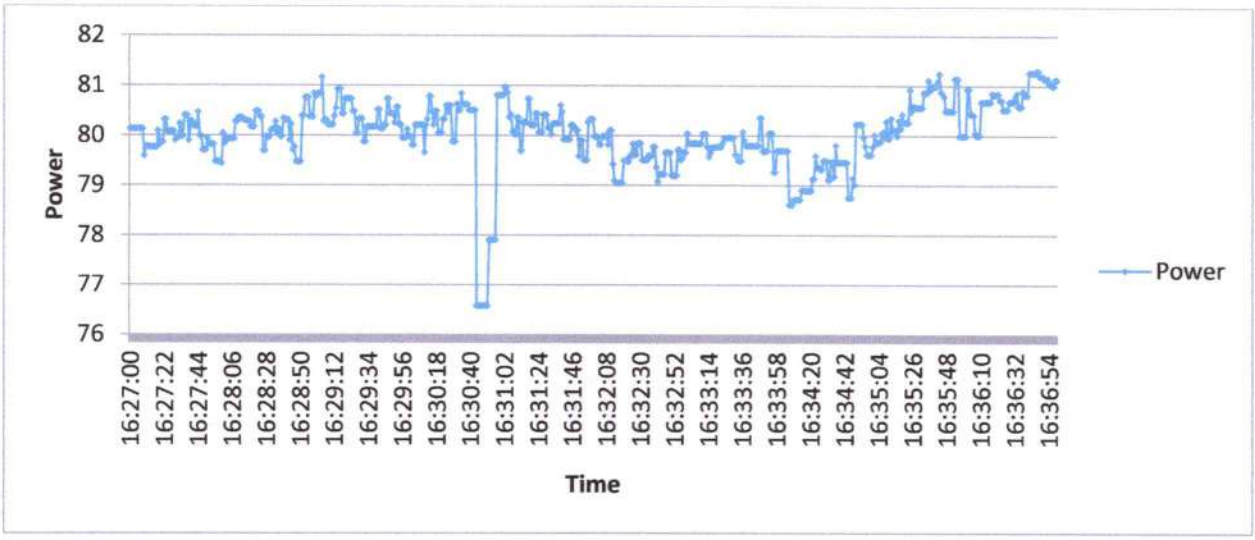

Figure 13: Power profile of fan

3.5.1 Installed load efficacy ratio

ILER Ratios of 0.75 or more may be considered to be satisfactory. Existing installations with ILER ratios is ranging from 1.42 -35.76 considered as satisfactory.

Table 13: ILER calculation

Title	Units	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Name of Lab		**Ground Floor** Office	Dept. of Chemistry	Lab 2	Microbiology Lab Msc	Class room 3	Class room 6	Physics	Boys reading room	Girls reading room	**New bldg. Jr. Coll. G.F. Sci. B5** C.R.8	**First floor** Class room 4
Length of interior	Meter	6.7	10.15	7.6	10.5	7.8	10.3	10.3	15.45	15.45	8.65	8.65
Width of interior	Meter	3.37	9.3	6.75	6.9	7.6	6.9	10.2	4.3	6.1	8.5	8.5
Mounting height	Meter	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Floor area of interior	Meter^2	22.58	94.40	51.30	72.45	59.28	71.07	105.06	66.44	94.25	73.53	73.53
Room Index	No	0.90	1.94	1.43	1.67	1.54	1.65	2.05	1.35	1.75	1.71	1.71
No of light fittings	No	9	6	6	16	4	4	6	2	8	4	4
Total circuit watts	Watt	200	200	200	320	160	140	220	40	160	80	80
Watts per square meter	W/m^2	8.9	2.1	3.9	4.4	2.7	2.0	2.1	0.6	1.7	1.1	1.1
Average maintained luminance	Lux	595.13	155.55	186.60	278.43	322.71	162.89	491.50	499.50	353.50	101.36	844.89
Actual lux per watt per meter square	Lux/W/m^2	67.19	73.41	47.86	63.04	119.57	82.69	234.71	829.61	208.22	93.16	776.51
Target lux/W/m^2 lux for type of the type of interior	Lux/W/m^2	36	45.4	33.76	44.02	43.24	44.2	46	23.2	44.5	44	44.26
Installed load efficiency ratio	ILER	1.87	1.62	1.42	1.43	2.77	1.87	5.10	35.76	4.68	2.12	17.54

4 Energy Conservation Measures

4.1 Water Pumping System

Findings:

The submersible pump is use to supply the water for institute are more 05 years old & power consumption of the pump is more than rated.

Recommendations:

Replace the existing pump with Energy Efficient water pump.

Benefits:

The cost benefit analysis is given below.

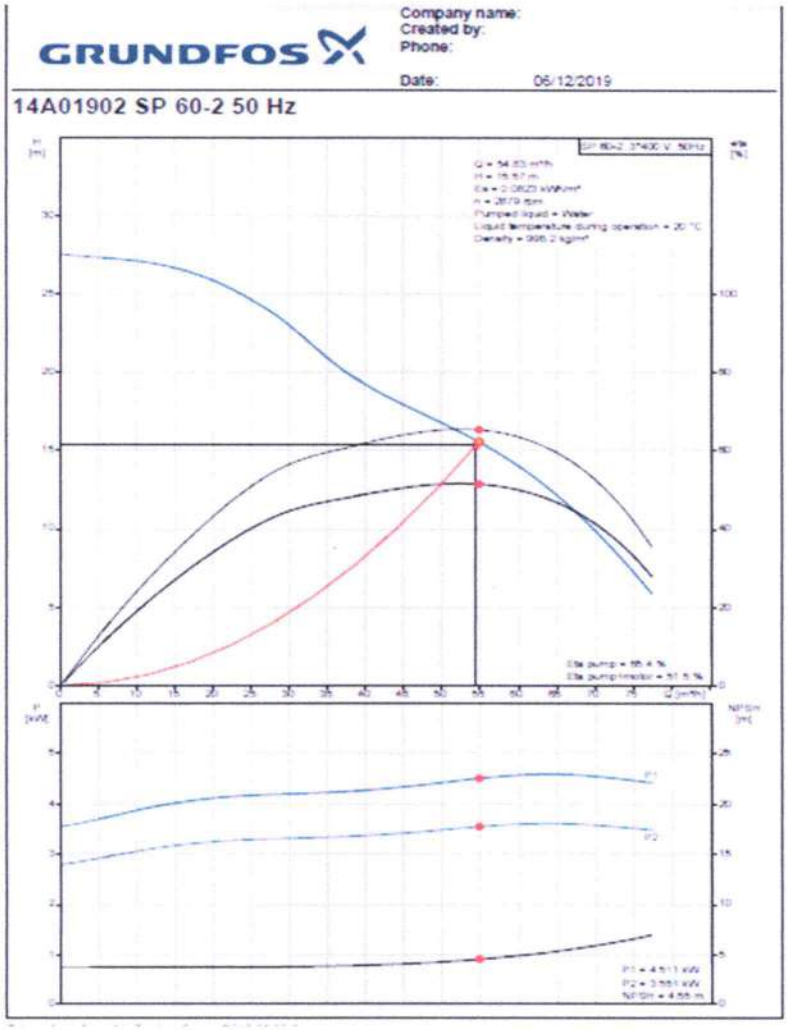

Figure 14: Pump selection for water supply pump

Table 14: Cost benefit analysis of replacing EE water pump

Description	Unit	Overhead Tank 1
Present System		
Make	-	
Power	HP	7.5
	kW	5.55
Type	-	Submersible
Proposed System		
Proposed power	kW	3.7
Daily usage	Hr/day	6
Annual working days	Days/yr	290
Estimated power saving	kWh	1.85
Annual power saving	kWh	3219
Energy tariff	₹/kWh	10.04
Monetary saving	₹	32319
Total investment	₹	87000
Simple payback period	Yr	2.69
Reduction in CO_2 Emission	MT/Yr.	2.64

4.2 Replacing the Conventional fan with energy efficient fan

Findings:

The conventional fan consumes average 65W energy.

Recommendations:

Replace the conventional fan with energy efficient fan which consume less energy.

Benefits:

The cost benefit analysis of replacing conventional fan with energy efficient fan is given below.

Table 15: Cost benefit analysis of replacing the energy efficient fan

Description	Units	Value	Value	Value
Present system				
Type of fan	-	**Ceiling fan**	**Wall fan**	**Exhaust fan**
Number of existing fan	Nos	179	1	7
Wattage /fan	Watt	65	65	65
Usage of fan per day	Hrs	8	8	8
Working days per annum	Days	290	290	290
Annual Energy consumption	kWh	26993	151	1056
Proposed system				
Recommended for replacement	%	100%	100%	100%
Recommended of EE fan	Nos	179	1	7
Wattage of EE fan	Watt	28	28	28
Annual Energy consumption	kWh	11628	65	455
Annual Power saving	kWh	15365	86	601
Energy tariff	₹	10.04	10.04	10.04
Monitory saving	₹	154268.21	861.83	6032.84
Investment/fan	₹	3400	5440	3760
Total investment	₹	608600	5440	26320
Simple Payback period	Years	3.95	6.31	4.36
Reduction in CO_2 emissions	MT/year	12.60	0.07	0.49

4.3 Replacing the florescent tube light with LED tube light

Findings:

The florescent tube light with LED tube light.

Recommendations:

Replace the florescent tube light with LED tube light which consume less energy.

Benefits:

The cost benefit analysis of replacing florescent tube light with LED tube lights is given below.

Table 16: Cost benefit analysis of replacing fluorescent tubes the LED tube lights

Description	Units	Value
Present system		
Type of tube	-	T8
Number of existing tube lights(T12/T8)	Nos	89
wattage /tube	Watt	40
Total wattage	Watt	3560
Daily usage	Hrs/day	8
Annual working days	days/yr	290
Annual Energy consumption	kWh	8259
Proposed system		
Recommended for replacement	%	100%
Recommended of LED tube light	Nos	89
Wattage of LED tube light	Watt	20
Annual Energy consumption	kWh	4130
Annual Power saving	kWh	4130
Energy tariff	₹	10.04
Monitory saving	₹	41461.18
Investment/LED tube light	₹	225
Total investment	₹	20025.00
Simple Payback period	Years	0.48
Reduction in CO_2 emissions	MT/year	3.39

4.4 Replacing the CFL with LED bulb

Findings:

The CFL bulb consumes 24 W which is more than the LED bulb.

Recommendations:

Replace the CFL bulb with LED bulb which consume less energy.

Benefits:

The cost benefit analysis of replacing CFL bulbs with LED bulb is given below.

Table 17: Cost benefit analysis of replacing the CFL bulbs by LED bulb

Description		CFL Bulb (14 W)	Incandescent Bulb (60W)
Name of Block	**Units**	**Value**	**Value**
Present system			
Number of existing CFL bulb	Nos	2	3
wattage /tube	Watt	14	60
Total wattage	Watt	28	180
Daily usage	Hrs/day	8	8
Annual working days	days/yr	290	290
Annual Energy consumption	kWh	65	418
Proposed system			
Recommended for replacement	%	100%	100%
Recommended of LED bulb	Nos	2	3
Wattage of LED bulb	Watt	12	24
Annual Energy consumption	kWh	56	167
Annual Power saving	kWh	9	251
Energy tariff	₹	10.04	10.04
Monitory saving	₹	93.17	2515.62
Investment/LED bulb	₹	150	225
Total investment	₹	300.00	675.00
Simple Payback period	Years	3.22	0.27
Reduction in CO_2 emissions	MT/year	0.01	0.21

4.5 Solar PV system

New Recommendations:

Install solar PV rooftop on Main Building, Jr. College and Hostel building.

Table 18: Cost benefit analysis of Solar PV system

Name of Building	Annual Electricity Consumption kWh	Daily Electricity Consumption kWh	Unit Charge	Solar PV System Required- kW_p	Annual Electricity Generated by Solar kWh	Monetary Saving ₹	Investment @60000/kw_p ₹	Simple Payback
College buildings	22985	62.97	10.04	21	22995	230870	1260000	5.46

5. Recommendations

- For main building harmonic values are more compared to IEE 519-2014 standards. Harmonic filters should install to reduce the harmonic levels.
- Safety equipment needs to be maintained such as fire extinguisher, rubber mats, etc.
- Solar PV system need to be installed on main buildings and hostel to make nearly Zero Energy Buildings (nZEB).
- Establish Energy conservation cell.
- Procure only B.E.E star labeled appliances (www.beestarlabel.com).
- Don't use discarded old conventional appliances at other places.
- Use occupancy sensor at appropriate place.
- Display energy conservation poster at every building.
- Steps to follow before renewable energy system-
    1. Conservation of Energy.
    2. Replacement of all energy intensive appliances with energy efficient appliances.
- Finally install the preferred renewable energy system.

6. Annexure

Thermography images of electrical panels.

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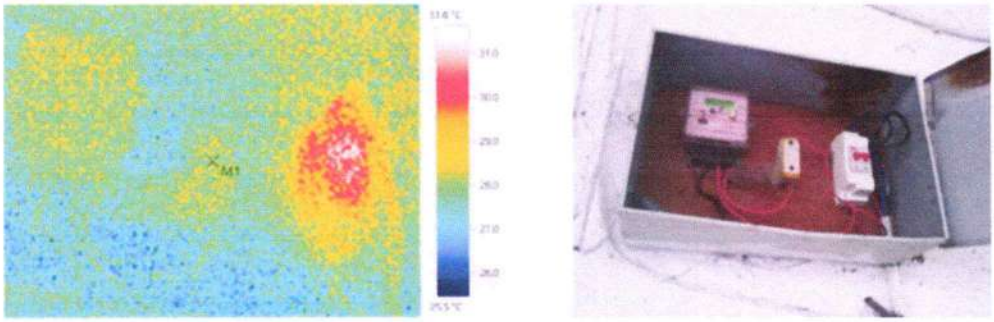

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		Electric power [W]:	

Picture markings:

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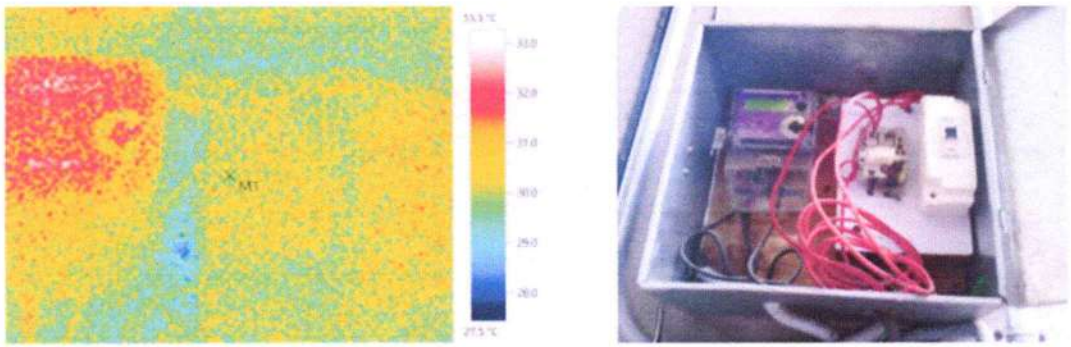

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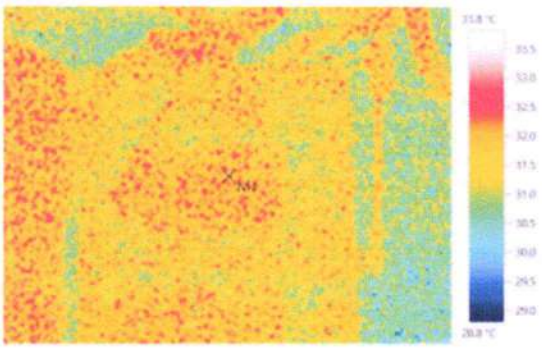

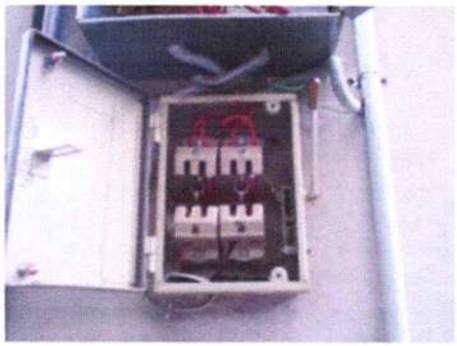

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Refl. temp. [°C]:	20.0	**Electric voltage [V]:**	
		Electric power [W]:	

Picture markings:

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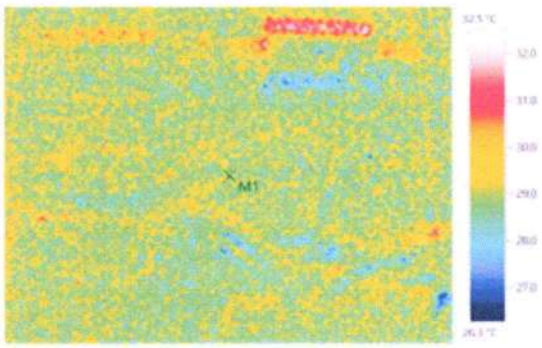

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Refl. temp. [°C]:	20.0	**Electric voltage [V]:**	
		Electric power [W]:	

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
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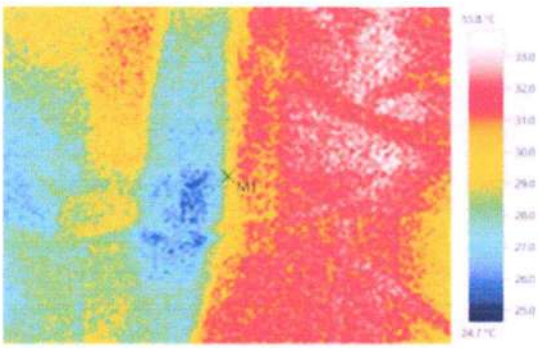

Picture parameters:

Emissivity:	0.95	**Electric current [A]:**	
Refl. temp. [°C]:	20.0	**Electric voltage [V]:**	
		Electric power [W]:	

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	29.4	0.95	20.0	CenterSpot

Table 26: Suppliers of Energy Efficient Appliances/Renewable Energy Product

Sr. No.	Product name	Vendor details
1	LED tube light	**Syska LED** Syska House Plot No. 89-91, Lane No. 4 Sr. No. 232, 1/2, Airport Road, Sakore Nagar, Lohegaon, Pune, Maharashtra 411014 Email : support@syska.co.in Website : https://syska.co.in/
2	Energy Efficient Fan	**ATOMBERG TECHNOLOGIES** Plot No. 130 B, TTC industrial area, Shirawane, Navi-Mumbai, Maharashtra - 400706 Email : sandeepencon@gmail.com Website : https://atomberg.com/
3	Water Pump	**GRUNDFUS** **Vakratund Enterprises** P-12, Shop No. 3/4 SAMK Building, Shiroli, Kolhapur, Maharashtra - 416122 Email: kishor.u@vakratundent.com Mobile : +91 9922959080
4	Solar Water Heater/ Solar PV system	**Photon Energy Systems Limited** Plot 26, Rd Number 10, Krishnapuram Colony Singada Kunta, Banjara Hills, Hyderabad, Telangana - 500034 Email : pradeep@photonsolar.in Website : https://photonsolar.in/ **Jain Irrigation Systems Limited** Jain Plastic Park, N.H.No. 6 Bambhori Jalgaon, Maharashtra - 425001 Email : sandeepencon@gmail.com Website : https://www.jains.com/
5	Air-conditioning	**Neptune Engineers** Ram prasad complex, Miraj road Near Chandani Chowk, Sangli, Maharashtra - 416416 Email : cak@hvacneptune.com Mobile : +91 8308000299
6	Heat Pump	**AO Smith** **Vakratund Enterprises** P-12, Shop No. 3/4 SAMK Building, Shiroli, Kolhapur, Maharashtra - 416122 Email: kishor.u@vakratundent.com Mobile : +91 9922959080
7	Harmonic Filter	**Q Square** 419 A, Galleria Business Tower, DLF Phase-IV, Gurugram 122009 Email: info@qsquareinfra.com

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Dr. S. A. Khot, Principal | Shri. Anil A. Bagane, Executive Director | Dr. Rajendra Patil (Yadravkar), Ex-Minister of State, Govt of Maharashtra, Chairman

Ref No: SITCOE/EA/2023-24/ 824/A Date: - 05/04/2024

Energy Audit Certificate

This is to certify that detailed energy Audit of the Miraj Mahavidyalaya Miraj conducted in month of January 2024. The outcome of implementation of the said audit would results in energy conservation by 10% and reduction in CO_2 emission of 19 MT/annum. This reflects great achievement in terms of energy conservation. The said energy audit is a compilation of the data provided by the organization, MSEDCL and verified by its actual onsite visit verification. The detailed energy audit has been conducted strictly as per the guidelines of the MEDA Pune and BEE New Delhi.

Place: - Yadrav
Date: - 05/04/2024

Dr. Sanjay A. Khot
Certified Energy Auditor (EA-7218)
Principal

SHARAD INSTITUTE OF TECHNOLOGY COLLEGE OF ENGINEERING YADRAV (ICHALKARANJI) DIST. KOLHAPUR

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