PPS Energy Solutions

PPS Energy Solutions Pvt. Ltd. Regd. Off: B-403, Bharti Vihar, S. No-78, Bharti Vidyapith Campus, Katraj, Pune –411046

Date: 21/ 03/ 2024

CERTIFICATE

TO WHOMSOEVER IT MAY CONCERN

This is to certify that, we M/s PPS Energy Solutions Pvt. Ltd. Has successfully completed Energy Audit at **NABIRA MAHAVIDYALAYA, KATOL , NAGPUR (MH)** and submitted report for year 2023 -24

For PPS Energy Solutions Pvt. Ltd.

Dr. Ravi G. Deshmukh
Director

PPS Energy Solutions Pvt. Ltd.

DETAILED ENERGY AUDIT REPORT

Nabira Mahavidyalaya, Katol

7HGJ+9JJ, Dhantoli, Katol, Maharashtra 441302

March 2024

Conducted By

PPS Energy Solutions Pvt. Ltd.
Plot No-18, Girish Housing Society
Warje, Pune – 411058, Maharashtra, India.

For PPS Energy Solutions Pvt. Ltd.

Ravi

PPS ENERGY SOLUTIONS PVT. LTD. PPS

Dr. Ravi G. Deshmukh
Energy Auditor Class - A
MEDA/ECN/2023-24/EA-14

PPS Energy Solutions Pvt Ltd PPS

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Dr. Ravi G. Deshmukh
Director

MAHARASHTRA ENERGY DEVELOPMENT AGENCY

Maharashtra Energy Development Agency
(Government of Maharashtra Institution)
Aundh Road, Opposite Spicer College Road, Near Commissionerate of Animal Husbandary,
Aundh, Pune, Maharashtra 411067
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EC N/2023-24/CR-19/228

23rd February, 2024

CERTIFICATE OF REGISTRATION
FOR CLASS 'A'

We hereby certify that, the firm having following particulars is registered with *MAHARASHTRA ENERGY DEVELOPMENT AGENCY (MEDA)* under given category as "Energy Planner & Energy Auditor" in Maharashtra for Energy Conservation Programme of MEDA.

Name and Address of the firm	:	M/s PPS Energy Solutions Pvt. Ltd. B-403, Bharat Vihar, S.No-78, Bharti Vidyapith, Campus, Katraj, Pune-411046.
Registration Category	:	*Empanelled Consultant for Energy Conservation Programme for Class 'A'.*
Registration Number	:	*MEDA/ECN/2023-24/Class A/EA-14*

- Energy Conservation Programme intends to identify areas where wasteful use of energy occurs and to evaluate the scope for Energy Conservation and take concrete steps to achieve the evaluated energy savings.
- MEDA reserves the right to visit at any time without giving prior information to verify quarterly activities performed by the firm and canceling the registration, if the information is found incorrect.
- This empanelment is valid till 22nd **February, 2026** from the date of registration, to carry out energy audits under the Energy Conservation Programme.
- The Director General, MEDA reserves the right to cancel the registration at any time without assigning any reasons thereof.

General Manager (EC)

PPS Energy Solutions Pvt. Ltd.

PREFACE

Energy Audit is a key parameter of systematic approach for decision-making in the area of energy management. It attempts to determine how and where energy is used and to identify methods for energy savings. There is now a universal recognition of the fact that new technologies and much greater use of some that already exists provide the most hopeful prospects for the future. The opportunities lie in the use of existing renewable energy technologies, greater efforts at energy efficiency and the dissemination of these technologies and options.

As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".

Present energy audit is a mare mile marker towards destination of achieving safe, healthy and energy efficient unit. We would like to emphasize that an energy audit is a continuous process. We have compiled a list of possible actions to conserve and efficiently utilize our scarce resources and identified their savings potential. The next step would be to prioritize their implementation. Implementation of recommended measures can help consumes to achieve significant reduction in their energy consumption levels.

WHY ENERGY AUDIT?

An energy audit determines the amount of energy consumption affiliated with a facility and the potential savings associated with that energy consumption. Additionally, an energy audit is designed to understand the specific conditions that are impacting the performance and comfort in your facility to maximize the overall impact of energy-focused building improvements.

An energy audit is a systematic review of the energy consuming installations in a facility to ensure that energy is being used sensibly and efficiently. An energy audit usually commences with the collection and analysis of all information that may affect the energy consumption of the facility, then follows with reviewing and analyzing the condition and performance of various installations and facility management, with an aim at identifying areas of inefficiency and suggesting means for improvement.

Through implementation of the suggested improvement measures, facility owners can get the immediate benefit for paying less energy bills. On the other hand, lowering of energy consumption in facility will lead to the chain effect that the power supply companies will burn less fossil fuel for electricity generation and relatively less pollutants and greenhouse gases will be introduced into the atmosphere, thus contributing to conserve the environment and to enhance sustainable development.

PPS Energy Solutions Pvt. Ltd.

ACKNOWLEDGEMENT

We express our sincere gratitude to the authorities of Nabira Mahavidyalaya, Katol for entrusting and offering the opportunity. It is our immense pleasure to present the detailed energy audit report.

We acknowledge the positive support from management in undertaking the task of Detailed Energy Audit of all electrical system, thermal systems, utilities and other area and for continuous help and support before and during the Detailed Energy Audit.

We are also thankful to all field staff and agencies working with whom we interacted during the field studies for their wholehearted support in undertaking measurements and eagerness to assess the system / equipment performance and saving potential. We admire the help of all concerned staff for their active participation in completing official documentations.

We express our sincere gratitude to the authorities of Nabira Mahavidyalaya, Katol for entrusting PPS Energy Solutions Pvt. Ltd.

We appreciate the co-operation and support extended to our team members during the entire tenure of field study.

We express our thanks to

M/s. Nabira Mahavidyalaya, Katol.

1. Dr. Sunil Kumar Navin, Principal.
2. Dr. Bipinchandra B. Kalbande, HOD- Botany.

For PPS Energy Solutions Pvt. Ltd.

Dr. Ravi G. Deshmukh
Energy Auditor Class - A
MEDA/ECN/2023-24/EA-14

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About PPSES

M/s. PPS Energy Solutions Pvt. Ltd (PPSES) is an ambitious company, established by enterprising engineering professionals in the year 2009. The company offers services pertaining to Energy and Engineering to clients across the globe. Our team is based in Pune, a city known for its Software and Engineering talent in India. We are a rapidly growing company with a team of about 100 people which includes highly trained and experienced Techno-Managers, Analysts, and Engineers & Detailers.

We are presently working in India (Maharashtra, Assam, Madhya Pradesh, Gujarat, Andhra Pradesh, Delhi, Orissa, Chhattisgarh, Bihar, Andhra Pradesh, Telangana and Jharkhand) and Abroad (Bahrain, Stanford)

- We serve in majorly four areas,
  - Energy Audit, Management and System Evaluations
  - Power Distribution System Design, Evaluations and Monitoring
  - MEP Design and Project management
  - Research and Training

PPSES Team Members

Name	Role	Academics and Expertise
Dr. Ravi Deshmukh	ECM verification, Report verification and presentation	Accredited Energy Auditor, PhD, M tech, MBA (Power), Graduate E&TC Engineer with over 18 years of experience in Energy Management, Management of Power System, street light projects, Power Exchange Operations, Power Trading and Analysis, Electrical Automation. Has worked as Expert in Iron & Steel sector and Energy
Mr. Nilesh Saraf	Co-ordination with officers, project status review.	Expert in Energy sector with 16 years of experience in Energy efficiency assessment, Industrial engineering sector & Renewable Energy.
Mr. Vinayak Apte	Energy Audit Expert and Report Preparation	Graduate Electrical Engineer with more than 10 years of experience in various sectors. He handled Energy Audits, Energy Conservation and Energy Efficiency projects in Industries, Commercial and Residential Buildings, Pump House
Mr. Akash Patil	Field study, data tabulation and analysis	Graduate Electrical Engineer with 3 years of experience in energy efficiency assessment

1. EXECUTIVE SUMMARY

Detailed Energy Audit was undertaken in order to evaluate energy performance and identify potential energy conservation measures. Detailed Energy Audit was undertaken in three steps, i.e. document review of data and information initially provided by facility, site visit and preparation of this report.

Energy Audit team conducted the site visit. The site visit includes interaction with staff, electricians of facility, the collection/review of further data and a field inspection of the facility and equipment.

The salient observations and recommendations are given below.

1. The Total Cost of Energy is around **Rs. 4,05,555/-** per Annum
2. Average monthly units consumed are **14,378 kWh** equivalent to **Rs. 1,36,594/-**
3. Average electricity charges work out to be **Rs. 9.5/-**

This brief report has therefore sought to provide a high-level overview of the status of energy efficiency at facility, combined with an illustration of areas where further, previously unidentified savings opportunities may exist.

Our survey has identified further potential opportunities, ranging from "no & low cost" measures, through to those that will require significant capital expenditure.

Note: Investment figures mentioned in are only indicative, further detailed study is recommended.

Summary of Recommended Energy Conservation Measures:

Sr.No.	Equipment Name	ECM Details	Investment (Rs. In Lacs)	Savings (kWh/year)	Carbon credit (Tons of Co2)	Saving (Rs.In Lacs /Year)	Payback (Years)
1	Tube Lights	Replacement of conventional lights with suitable LEDs	3.37	3968.00	3.37	0.38	7.98
2	Fans	Replacement of existing fans with energy efficient Super fans	14.66	7749.84	6.59	0.74	19.91
3	Water Cooler	Optimization of Water Cooler	0.07	756.00	0.64	0.07	0.97
4	Air Conditioner	Optimization of Set Temperature of ACs	0.00	223.76	0.19	0.02	0.00

5	Refrigerator	Optimize the temperature setting of Refrigerators	0.00	50.40	0.05	0.01	0.00
Total			**18.10**	**12748.00**	**10.84**	**1.21**	**14.92**

Note: Estimated savings may base on operating conditions

During the Energy Audit, Total Estimated Investment of Rs. 18,10,000/- yields Total Estimated Savings of Rs. 1,21,000/- which 30% of the Total Energy Cost of Rs. 4,05,555/- with an overall payback period of 15 Years.

Other Recommendations:

A. Regular cleaning and maintenance of equipment's is important to reduce energy losses.

B. Use of star rated equipment's is also strongly recommended specially in case of Fans and Air conditioning.

C. Cleaning of ceiling fan and exhaust fan blades will reduce the drag on the fan and intern will reduce energy loss.

D. Awareness amongst energy users is very essential step to reduce wastage of electricity

E. Energy conservation awareness programs can be conducted once a year. Increasing energy awareness of energy users motivates them to work as a team can lead to reductions in energy consumption and save the money.

Investment (Rs. In Lacs)	Saving (Rs.In Lacs /Year)	Cum Savings (Rs Lakh)	Net savings (Rs Lakh)
-18	0	0	-18
0	1	1	-17
0	1	2	-16
0	1	4	-14
0	1	5	-13
0	1	6	-12
0	1	7	-11
0	1	8	-10
0	1	10	-8
0	1	11	-7
0	1	12	-6
0	1	13	-5
0	1	15	-4
0	1	16	-2
0	1	17	-1
0	1	18	0

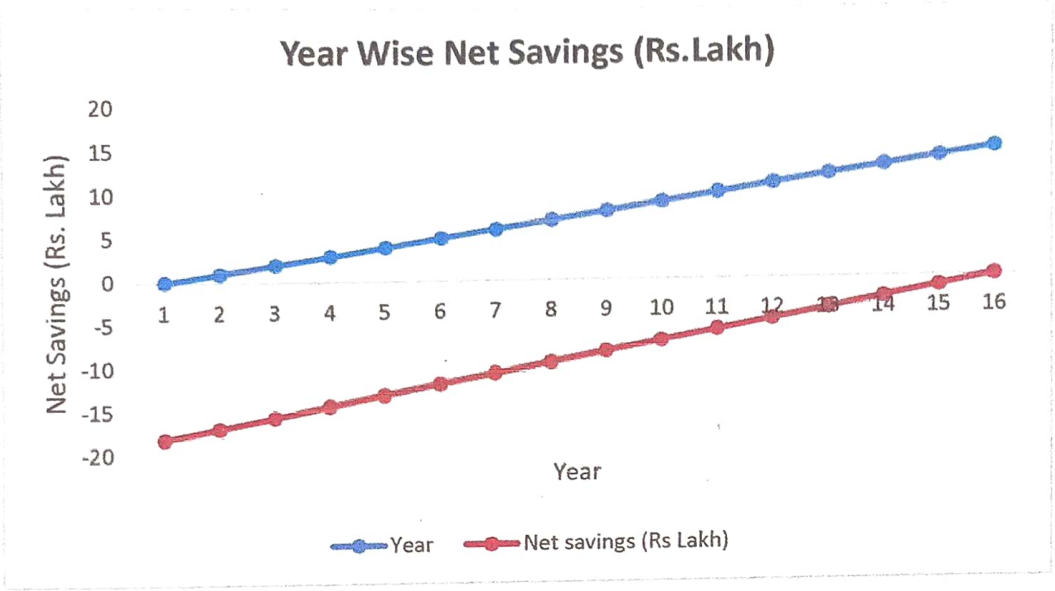

Figure 1 Net Savings (Rs. Lakhs) Vs Year

For PPS Energy Solutions Pvt. Ltd.

Dr. Ravi G. Deshmukh
Energy Auditor Class - A
MEDA/ECN/2023-24/EA-14

2. GENERAL AUDIT REVIEW

Facility can implement faster payback energy conservation measures (ECMs) which have already been considered and for which the ECMs are fully developed.

Other General Points:

1. Energy conservation awareness programs can be conducted once a year. Increasing energy awareness of staff, students and motivating them to work as a team can lead to reductions in energy consumption and save the money. Savings estimates range in the order of 5 to 10%. When implemented effectively these savings can be realized quickly and cost effectively.
2. Most of the fans are of older design and not energy inefficient.
3. Most of the places the tube light installed are energy efficient and fittings are in healthy condition.
4. Natural day light is efficiently used in corridor and few classrooms and labs areas.

It is believed that with the current approach and organization of energy management, energy can be reduced in a systematic, cost-effective manner. We hope that this report will help facility to implement these changes and provide direction to the Energy Management Team.

3. ABOUT ENERGY AUDIT

Objective

The overall objective of the assignment is to quantify energy saving in existing system and achieve reduction in energy consumption pattern.

Hence, the detail objectives are as under,

1. To calculate the energy consumption
2. To evaluate the performance of the equipment
3. To find out the energy saving opportunities
4. To quantify the total energy savings
5. To find out the ways to achieve energy efficiency

3.1. Scope of Work

Following is the scope of work envisaged for this assignment,

Data Collection

To collect the details of various electrical and mechanical system and their ratings, the available drawings and details shall be studied. Detail load list shall be prepared and checked.

A, B, C Analysis

With the details available from load list, analysis shall be carried out depending on the present usage trends. All the power consuming equipment's shall be classified in three categories depending on their ratings, condition and operating time. The area for larger potentials for savings shall be identified.

Field Study

The detail field study on site shall include the following as well as all other measures required for energy audit study,

a. Lay out the system and study of Electrical distribution
b. Study of area wise power distribution and Measurement of power consumption
c. Study of instrumentation provided
d. Measurement of motor currents, voltages, power etc. parameters by energy analyzer and measurement of water flow, pressures etc. parameters of pumps simultaneously and

other measurements as needed to characterize the system and required for calculating efficiency at various combinations

e. Study of air conditioner operations and system requirements

f. Analysis of readings obtained from field with the standard consumption.

3.2. Approach and Methodology

1. Understanding the Scope of Work and Resource Planning

2. Identification of Key Personnel for the assignment/ project

3. Structured Organization Matrix

4. Steps in preparing and implementing energy audit assignment
   a) Discussions with key facility personnel
   b) Site visits and conducting "walk-through audit".
   c) Preliminary Data Collection through questionnaire before audit team's site visit
   d) Steps for conducting the detailed audit
      - Plan the activities of site data collection in coordination with the facility in-charge.
      - Study the existing operations involving energy consumption
      - Collect and collate the energy consumption data with respect to electricity consumption
      - Conduct performance tests to assess the efficiency of the system equipment/ electricity distribution, lighting, and identify energy losses.
      - Discuss with facility personnel about identified energy losses.

5. List proposed efficiency measures
   - Develop a set of potential efficiency improvement proposals
   - Baseline parameters
   - Data presentation
   - System mapping
   - List of potential Energy Savings proposals with cost benefit analysis.
   - Review of current operation & maintenance practices

6. Preparation of the Draft Energy Audit Report

7. Preparation and submission of final Energy Audit Report after discussion with concerned persons

4. ENERGY DETAILS

Maharashtra State Electricity Distribution Company Limited (MSEDCL) provides the electricity supply for facility. Billing is carried out with the help of Three meter according to 73LT-VII B-I Public Service Tariff. Detailed Energy Audit was conducted for the load connected to the mains supply used.

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

1) Ceiling Fans
2) Lighting Load
3) Computer / Desktop
4) Water Cooler
5) Air Conditioner
6) Other Appliances

Based on above it is clear that followings equipment is have highest potential for energy savings

Table 1 Name of Equipment

Sr. No.	Name of the Equipment
1	Lighting Load
2	Ceiling Fan
3	Water Cooler
4	Refrigerator
5	Air Conditioner
6	Other Appliances

4.1. Electricity Bill Analysis

4.1.1. Details of Consumer No.: 426010105461 - MBA Building

Consumer Details

Table 2 Consumer Details

Parameter	Details
Consumer No.	**426010105461**
Consumer Name	THE DIRECTOR DEPT. OF MANAGEMANT STUDIES NABIRA COLLEGE
Address	KATOL, DIST. NAGPUR
Pin Code	441302
Date of Connection	20-10-2004
Sanctioned load (KW)	10.00
Tariff	73LT-VII B-I Public Service
Bu/ Circle No	1945

Consumption Details

Table 3 Billing Data

Month	kWH	Commercial Unit rate (Rs/kWh)	Demand Charges (Rs)	Wheeling Charges (Rs)	Other charges	Energy Charges (Rs)	Total Current Bill (Rs)	Total Unit Rate (INR)	Import	Export	Generation
Mar-23	0	4.57	384	0.00	3.01	0.00	387.0		259.0	752.0	1307.0
Apr-23	0	5.94	422	0.00	0.00	0.00	422.0		628.0	662.0	1468.0
May-23	163	5.94	422	190.71	363.00	968.22	1943.9	11.9	943.0	746.0	1909.0
Jun-23	678	5.94	422	793.26	1229.00	4027.32	6471.6	9.5	899.0	221.0	832.0
Jul-23	715	5.94	422	836.55	1292.00	4247.10	6797.7	9.5	908.0	193.0	794.0
Aug-23	358	5.94	422	418.86	693.00	2126.52	3660.4	10.2	841.0	483.0	1274.0
Sep-23	355	5.94	422	415.35	751.00	2108.70	3697.1	10.4	730.0	375.0	893.0
Oct-23	0	5.94	422	0.00	0.00	0.00	422.0		620.0	647.0	1618.0
Nov-23	0	5.94	422	0.00	0.00	0.00	422.0		257.0	627.0	939.0
Dec-23	0	5.94	422	0.00	0.00	0.00	422.0		303	704	1122
Jan-24	0	5.94	422	0.00	0.00	0.00	422.0		416	416	835
Feb-24	0	5.94	422	0.00	0.00	0.00	422.0		398	597	1285
Avg	**189**	**5.83**	**419**	**221**		**1123**	**2124**	**11**	**600**	**535**	**1190**
Max	**715**	**5.94**	**422**	**837**		**4247**	**6798**	**11.9**	**943.0**	**752.0**	**1909.0**
Min	**0**	**4.57**	**384**	**0**		**0**	**387**	**9.5**	**257.0**	**193.0**	**794.0**
Sum	**2269**		**5026**	**2655**		**13478**	**25490**		**7202.0**	**6423.0**	**14276.0**

PPS Energy Solutions Pvt Ltd

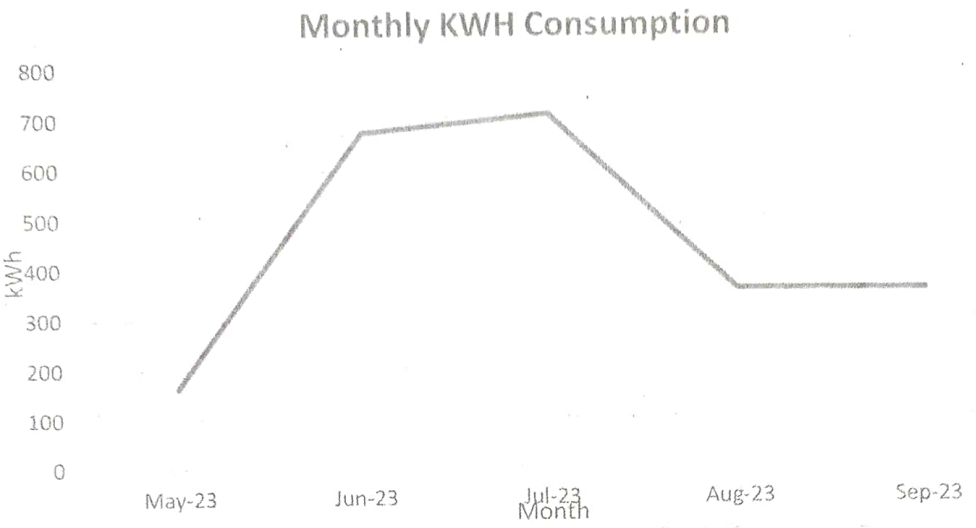

Figure 2 Monthly kWh Consumption

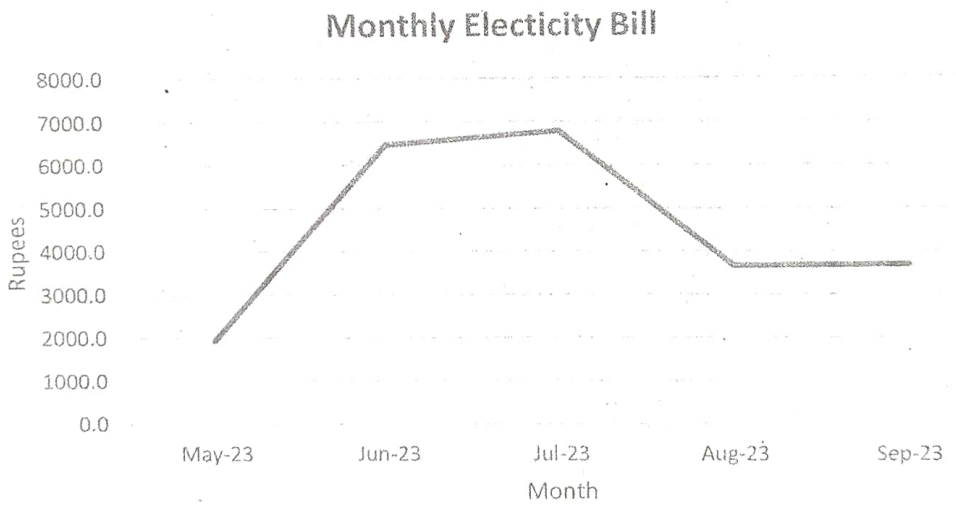

Figure 3 Monthly Electricity Bill

4.1.2. Details of Consumer No.: 426010000171 - Science Building

Consumer Details

Table 4 Consumer Details

Parameter	Details
Consumer No.	**426010000171**
Consumer Name	SHRI NABIRA MAHAVIDYALAYA CHEMISTRY LAB
Address	KATOL, DIST. NAGPUR
Pin Code	441302
Date of Connection	23-03-1968
Sanctioned load KW)	10.00
Tariff	73LT-VII B-I Public Service
Bu/ Circle No	1945

Energy Consumption Details:

Month	kWH	Commercial Unit rate (Rs/kWh)	Demand Charges (Rs)	Wheeling Charges (Rs)	Other charges	Energy Charges (Rs)	Total Current Bill (Rs)	Total Unit Rate (INR)	Import	Export	Generation
Mar-23	1022	4.57	384	1379.70	2658.00	4670.54	9092.2	8.9	1358.0	336.0	1299.0
Apr-23	2069	5.94	422	2420.73	3571.00	12289.86	18703.6	9.0	2320.0	251.0	1470.0
May-23	1996	5.94	422	2335.32	3924.00	11856.24	18537.6	9.3	2276.0	280.0	1790.0
Jun-23	1422	5.94	422	1663.74	2481.00	8446.68	13013.4	9.2	1516.0	94.0	769.0
Jul-23	1654	5.94	422	1935.18	2872.00	9824.76	15053.9	9.1	1814.0	160.0	973.0
Aug-23	2129	5.94	422	2490.93	3672.00	12646.26	19231.2	9.0	2248.0	119.0	1184.0
Sep-23	2057	5.94	422	2406.69	3924.00	12218.58	18971.3	9.2	2304.0	247.0	1057.0
Oct-23	2014	5.94	422	2356.38	3844.00	11963.16	18585.5	9.2	2241.0	227.0	1587.0
Nov-23	125	5.94	422	146.25	343.00	742.50	1653.8	13.2	606.0	481.0	911.0
Dec-23	709	5.94	422	829.53	1538.00	4211.46	7001.0	9.9	1027.0	318.0	1119.0
Jan-24	980	5.94	422	1146.60	2093.00	5821.20	9482.8	9.7	1268.0	288.0	1152.0
Feb-24	1110	5.94	422	1298.70	2359.00	6593.40	10673.1	9.6	1338.0	228.0	1271.0
Avg	**1441**	**5.83**	**419**	**1701**		**8440**	**13333**	**9**	**1693**	**252**	**1215**
Max	**2129**	**5.94**	**422**	**2491**		**12646**	**19231**	**9**	**2320**	**481**	**1790**
Min	**125**	**4.57**	**384**	**146**		**743**	**1654**	**13**	**606**	**94**	**769**
Sum	**17287**		**5026**	**20410**		**101285**	**159999**		**20316**	**3029**	**14582**

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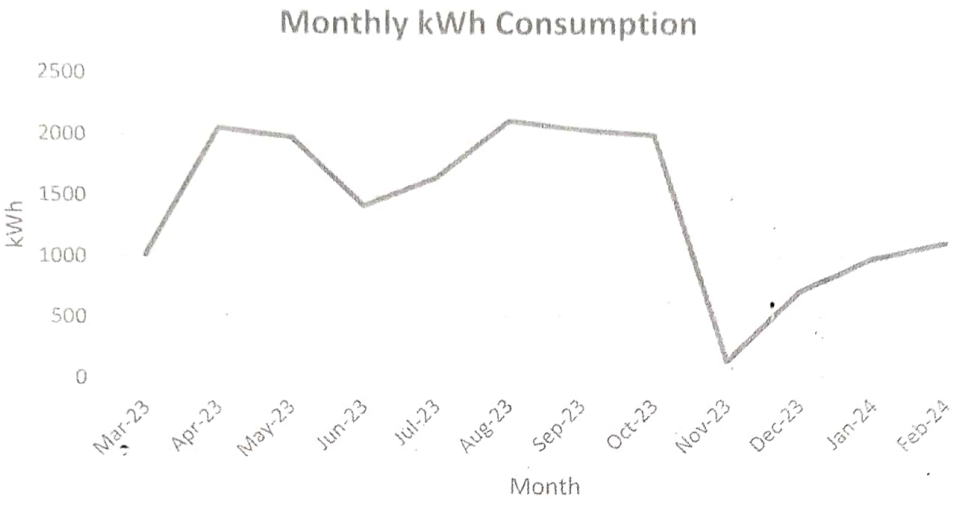

Figure 4 Monthly kWh Consumption

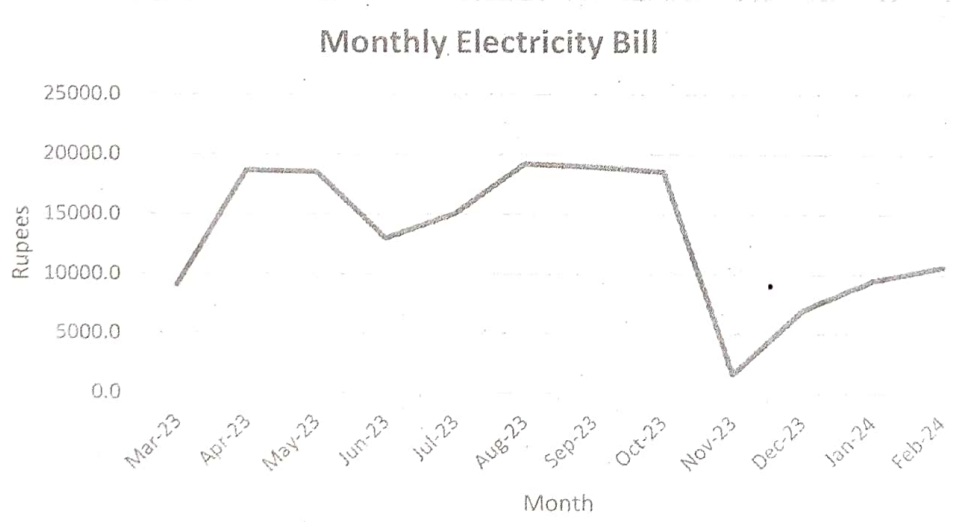

Figure 5 Monthly Electricity Bill

4.1.3. Details of Consumer No.: 426010108541 - Commerce Building

Consumer Details

Table 5 Consumer Details

Parameter	Details
Consumer No.	**426010108541**
Consumer Name	THE PRINCIPAL NABIRA MAHAVIDYALAYA
Address	KATOL, DIST. NAGPUR
Pin Code	441302
Date of Connection	13-11-2006
Sanctioned load (KW)	10.00
Tariff	73LT-VII B-I Public Service
Bu/ Circle No	1945

Energy Consumption Details:

Month	kWH	Commercial Unit rate (Rs/kWh)	Demand Charges (Rs)	Wheeling Charges (Rs)	Other charges	Energy Charges (Rs)	Total Current Bill (Rs)	Total Unit Rate (INR)	Import	Export	Generation
Mar-23	581	4.57	384	784	1546	2655	5370	9.2	1118	412	1296
Apr-23	1558	5.94	422	1823	2711	9255	14210	9.1	1840	282	1475
May-23	1201	5.94	422	1405	2110	7134	11071	9.2	1700	499	1782
Jun-23	1828	5.94	422	2139	3166	10858	16585	9.1	1971	143	918
Jul-23	2070	5.94	422	2422	3573	12296	18713	9.0	2192	122	786
Aug-23	2131	5.94	422	2493	3676	12658	19249	9.0	2344	213	1316
Sep-23	1817	5.94	422	2126	3478	10793	16819	9.3	2016	199	898
Oct-23	1660	5.94	422	1942	3184	9860	15409	9.3	2020	360	1631
Nov-23	0	5.94	422	0	125	0	547		433	643	948
Dec-23	0	5.94	422	0	8	0	430		629	541	1132
Jan-24	0	5.94	422	0	0	0	422		586	549	1140
Feb-24	114	5.94	422	133	322	677	1555	13.6	692	493	1289
Avg	**1080**	**5.83**	**419**	**1272**		**6349**	**10032**	**9**	**1462**	**371**	**1218**
Max	**2131**	**5.94**	**422**	**2493**		**12658**	**19249**		**2344**	**643**	**1782**
Min	**0**	**4.57**	**384**	**0**		**0**	**422**		**433**	**122**	**786**
Sum	**12960**		**5026**	**15268**		**76186**	**120379**		**17541**	**4456**	**14611**

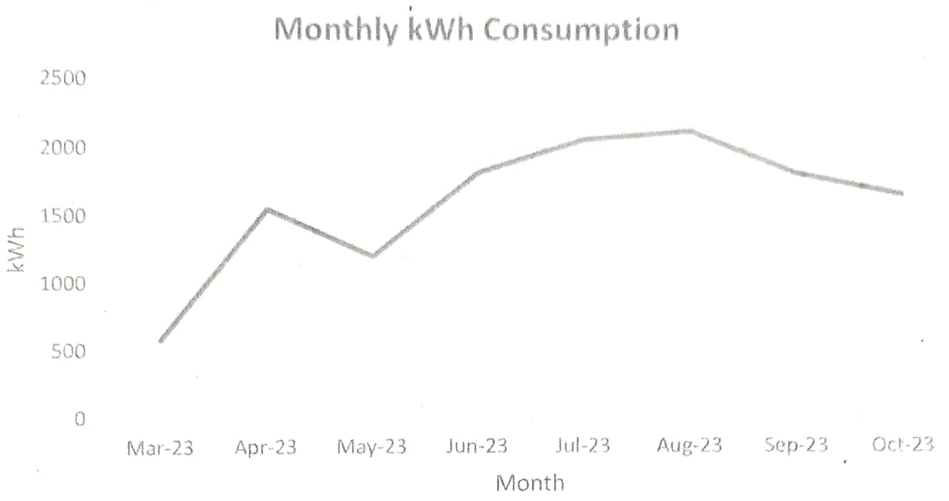

Figure 6 Monthly kWh Consumption

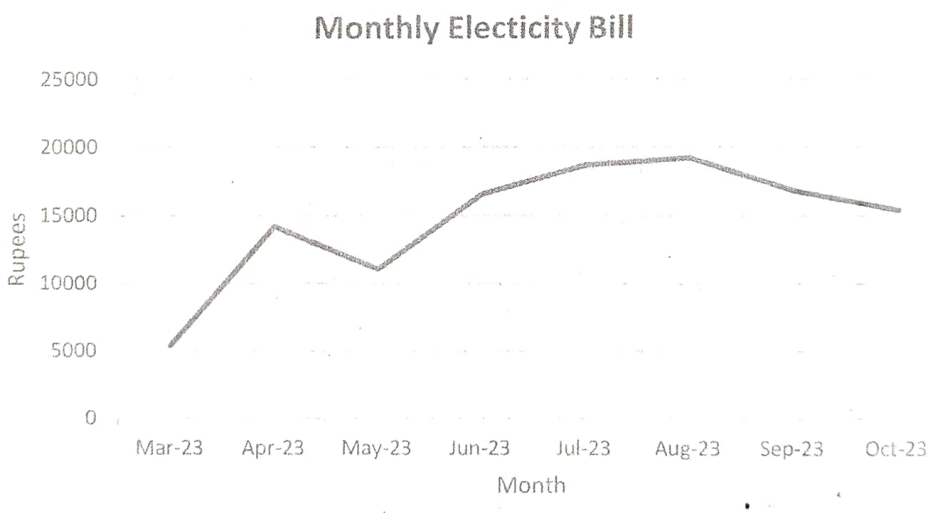

Figure 7 Monthly Electricity Bill

4.2. Connected Load Quantity of Buildings

Table 6 Connected Load of Facility

Fixtures	Wattage	Science Building				MBA Building					Commerce Building		Total	
		Ground Floor	First Floor	Second Floor	Third Floor	BBA	Library	MBA	Pharmacy	Yoga and Gym	Ground Floor	First Floor	Total Qty	Total Connected Load in KW
Ceiling Fan	75	74	78	78	78	46	31	40	26	12	79	117	659	49.43
T-8 Tube light	36	65	25	18	52	22	8	40	17	12	28	23	310	11.16
LED Tube Light	18	40	38	35	56	44	18	20	18	2	48	47	366	6.59
PC's	150	5	57		9	1	20	12	5	1	52	4	166	24.90
Printer	60	4	4		4	1	1	2	2	1	11	2	32	1.92
Projector	150	3	3	6	4			2	1		1	2	22	3.30
Exhaust Fan	60	8	3		4								15	0.90
LED Screen	150									2			2	0.30
RO Water cooler	600				1		1	1	1	1		2	7	4.20
Xerox Machine	800						1				1	2	4	3.20
LED Flood Light	30										2		2	0.06
Refrigerator	700	3			5			2	1		2		13	9.10
Submersible pumps	1492	2											2	2.98
Split A/c 3 *	2250				3			7			7		17	38.25
Microwave	300	1			1								2	0.60
Desert Cooler	350						5	6		2		6	19	6.65
Total													**1638**	**156.89**

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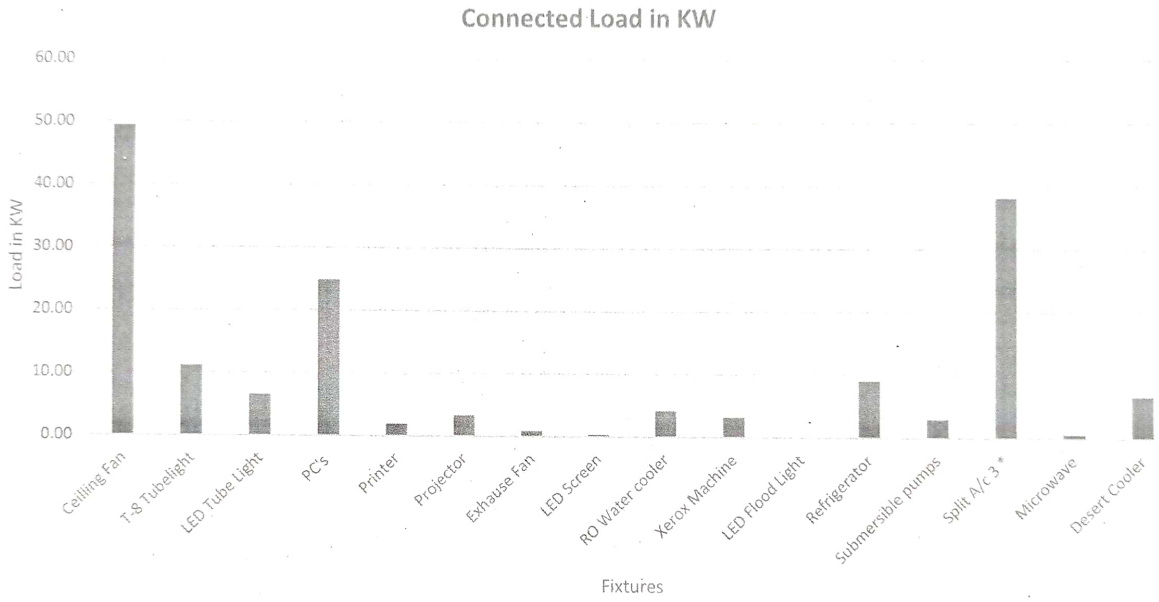

Figure 8 Distribution of Connected Load

5. ENERGY CONSERVATION MEASURES

ECM 1: Replacement of Tube Lights with More Efficient Lights

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving			
			Electricity kWh	Carbon credit (Tons of CO_2)	Estimated Savings Rs. In Lacs	Estimated Payback Years
1	Replacement of conventional lights with suitable LEDs	3.37	3968.00	3.37	0.38	7.98

Figure 9 Lighting Fixture

Observations:

Facility has installed Tube Light of 36 W in their premises

Recommendations:

During energy audit, it is observed that facility has installed Tube Light of 36 W at some of the places in the facility Also management team at facility has already replaced some of the CFLs with LEDs. The operating hours for these lightings are around 4 hours. Tube Light of 36 W with equivalent LED fixture thereby achieving significant reduction in energy consumption. The LEDs could be replaced in such a manner that it has same fixture so there will not be retrofitting cost attached to the replacement. The replacement could be done in a phased manner. LED lights have better efficacy as well as better lifetime than conventional lights

Energy Saving Calculations:

Particular	Unit	Value
Energy Saving Calculation		
Power consumption of existing lights	KW	11.16
Power consumption of suitable LED light	KW	6.20
Average power saving after replacement with LED light	KW	4.96
Replacement of conventional lights with suitable LEDs	Nos	200
Average working hour per day	Hrs	4
No. of working days in a year	Days	200
Cost Benefit Calculation		
Annual Energy Saving potential	kWh	3968
Electricity tariff	Rs/unit	9.5
Annual Cost Saving	Rs. Lakh	0.38
Total investment cost	Rs. Lakh	3.01
Annual Saving	Rs. Lakh	0.38
Simple Payback Period	Years	7.98

Investment Details:

Type of Existing Fitting	Wattage	Qty	Proposed LED W	CSR NO	Price - Rs/Unit	Dismantling cost	TOTAL COST	Existing KW	Proposed KW	Saved kW	Investment Rs Lakh	GST 12%	Total Investment
Tube Light	36	310	20	2-1-23	926	15	3.01	11.16	6.20	4.96	3.01		
TOTAL		**310.00**			**926.00**	**15.00**	**3.01**	**11.16**	**6.20**	**4.96**	**3.01**	**0.36**	**3.37**

Investment Details:

CSR no	Description	Material	Labor	Total	Dismantling cost	Quantity	Total Cost
2-1-23	Supplying & erecting LED 20W tube light fitting (4 feet) with aluminum housing, heat sink, integrated HF electronic driver complete.	881	45	926	15	310	300950
	Total						**3.01**
	12% GST on total Investment cost						**0.36**
	Total cost						**3.37**

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ECM 2: Replacement of Old Fan with Energy Efficient Super Fan

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity kWh	Carbon credit (Tons of CO_2)		
2	Replacement of existing fans with energy efficient Super fans	14.66	7749.84	6.59	0.74	19.91

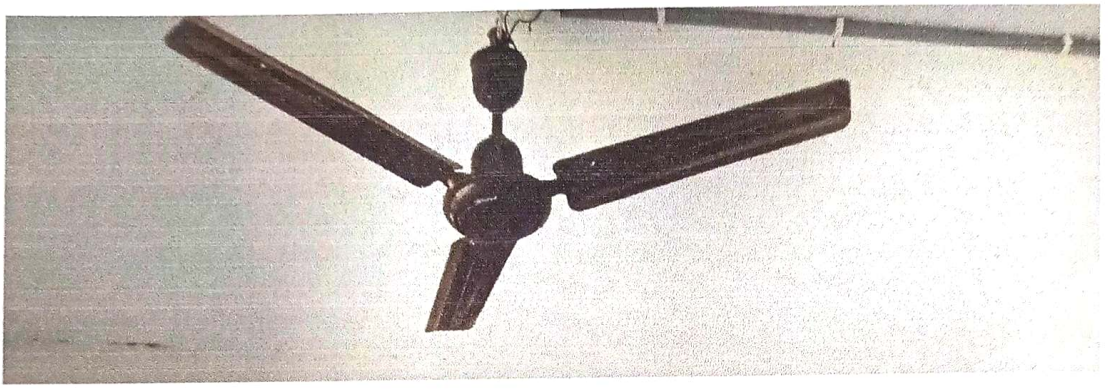

Figure 10 Ceiling Fans

Observations:

During energy audit, it is observed that facility has old 75 W fan and its energy consumption is on higher side.

Recommendations:

During energy audit, it is observed that facility has installed non star rated fan of 75 W so we recommend to replace energy consuming fan with energy efficient super fan.

Energy Saving Calculations:

Particular	Unit	value
Existing energy consumption of Fan	kWh/year	20759
Wattage of Energy Efficient Super Fan	Watt	35
Energy consumption after replacing with Energy Efficient Super Fan	kWh/year	9687
Operating hrs/day	Hrs/day	4
No. of working days in a year	Days	120
Diversity factor	%	70%
Annual Saving	kWh/year	7750
Unit rate	Rs/kWh	9.5
Annual Saving	Rs. In Lacs	0.74

Fixture Details:

AC category	Nos	Estimated Running kW
Ceiling Fan 75 W	659	49.43
Total	**659**	**49.43**

Investment Details:

CSR No	Description	Material	Labor	Total	Quantity	Total Cost
2-14-4	Dismantling the existing ceiling fan /exhaust fan / cabin fan / bracket fan complete with accessories, G.I. down rod, frame etc. and making the site clear.	0	37	37	659	24383
2-12-21.	Supplying and erecting five star rated energy saving Ceiling fan 230 V A.C. 50 cycles 1200 mm complete erected in position as per specification no. FG-FN/CF	1858	91	1949	659	1284391
	Total					**13.09**
	12% GST on total Investment cost					**1.57**
	Total cost					**14.66**

ECM 3: Optimization of Water Cooler

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated Saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity kWh	Carbon credit (Tons of CO_2)		
3	Optimisation of Water Cooler	0.07	756.00	0.64	0.07	0.97

Figure 11 Water Cooler

Observations:

Facility has 7 nos. of Water Cooler of 600 W and power of Water coolers is continuously ON for 4 hours per day.

Recommendation:

It is recommended to install Temperature control circuit which will turn on power of Water cooler at 21 deg C and turn off power when temperature of water reaches to 16 Deg C. Calculations are done for Energy saving considering automatic power ON of water cooler for 2 hours per day.

Energy Saving Calculations:

Particular	Unit	Value
Energy Saving Calculation		
Power consumption of RO and Water Cooler	KW	4.20
Supply Water Temperature	Deg C	26.00
Inlet Temperature T1	Deg C	21.00
Outlet Temperature T2	Deg C	16.00
Average working hour per day	Hrs	4
No. of working days in a year	Days	90
Existing consumption of Water cooler without automation	kWh/year	1512.00
Energy consumption of of water cooler with control circuit	kWh/year	756.00
Cost Benefit Calculation		
Annual Energy Saving potential	kWh/year	756
Electricity tariff	Rs/unit	9.5
Annual Cost Saving	Rs. Lakh	0.07
Total investment cost	Rs. Lakh	0.07
Annual Saving	Rs. Lakh	0.07
Simple Payback Period	Years	0.97

Fixture Details:

Name of Equipment	Wattage	Qty	Existing KW
Water Cooler (150Ltr)	600	7	4.20
TOTAL		**7**	**4.20**

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ECM 4: Optimize the temperature setting to 23-25 degree Celsius of Air Conditioners.

ECM No.	Energy efficiency improvement measures	Investment Rs. In Lakh	Estimated saving		Estimated Savings Rs. In Lacs	Estimated Payback Years
			Electricity kWh	Carbon credit (Tons of CO_2)		
4	Optimization of Set Temperature of ACs	0.00	223.76	0.19	0.02	0.00

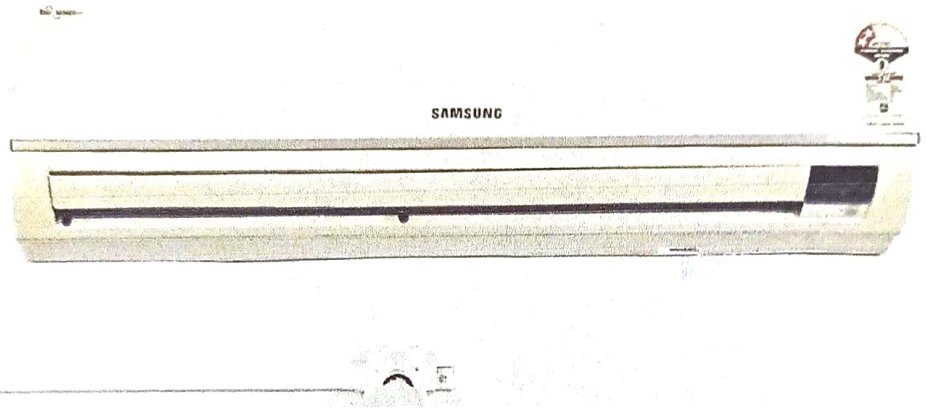

Figure 12 Air Conditioner

Observations:

During energy audit, it is observed that Air Conditioner temperature settings are very low.

Recommendations:

During Detailed Energy Audit study at facility, it was observed that temperature settings of ACs in the range of 20₀ C to 22₀ C. It is known that a 1°C raise in AC temperature can help to save almost 3 % on power consumption (this can also be verified in BEE guideline: Chapter 4. HVAC and Refrigeration System)

Hence it was recommended that temperature setting of outlets will be changed from present 23 °C to 25 °C and keeping inlet temperature unaltered M/S Nabira Mahavidyalaya, Katol will further study the overall effect on the facility and may further tune the temperature settings.
Based on the recommended change of AC temperature settings, calculation for energy saving was completed and this has been elaborated in ECM calculation sheet (Annexure)

Energy Saving Calculations:

Particular	Unit	Value
Estimated Energy Consumption of ACs	kWh/hr	38.25
Estimated Annual Energy Consumption of ACs	kWh/year	7458.75
Estimated Saving	%	3%
Operating Hrs per day	hrs/day	3
Operating days per year	Days/year	65
Estimated Saving	kWh/year	224
Unit Rate	Rs/kWh	9.5
Annual Saving	Rs Lakh/year	2125.74375

Fixture Details:

Sr No	Type	Wattage	Qty	Annual Consumption
1	Air Conditioner (Split) (3*)	2250	17	38.25
Total				**38.25**

ECM 5: Optimization Temperature setting of Refrigerator.

Sl. No.	Energy efficiency improvement measures	Investment Rs. In Lacs	Estimated Saving		Savings Rs. In Lacs	Payback Year
			Electricity kWh	Carbon credit (Tons of Co2)		
5	Optimize the temperature setting of Refrigerators	0.00	50.40	0.05	0.01	0.00

Figure 13 Refrigerator

Observations:

It was observed that all refrigerators were running with set temperatures quite below the standard set temperatures given by WHO. It is known that a 1°C raise in temperature can help to save almost 3% on power consumption (this can also be verified in BEE guideline: Chapter 4. HVAC and Refrigeration System).

The TR capacity of the same HVAC systems will also increase with the increase in evaporator temperature (Refrigerator set points), as given in Table below:

Effect of variation in Evaporator Temperature on Compressor Power Consumption			
Evaporator temperature (0 C)	Refrigeration Capacity* (tons)	Specific Power Consumption	Increase in kW/ton (%)
5	67.58	0.81	-
0	56.07	0.94	16
-5	45.98	1.08	33
-10	37.2	1.25	54
-20	23.12	1.67	106

* *Condenser temperature 40°C*

Recommendations:

It was recommended to increase the set point for all refrigerators by 1°C to achieve energy gain of 3% as per guideline of BEE.
Also, to avoid formation of ice on evaporator, plan for quarterly maintenance of all the refrigerators.

Facility will further study the overall effect on the facility and may further tune the temperature settings.

Based on the recommended change of Refrigerator temperature settings, calculation for energy saving was completed and this has been elaborated in ECM calculation sheet (Annexure).

Energy Saving Calculations:

Sr No	Name of Equipment	Wattage	Qty	Increase set Temperature by 1 Deg C	Per Deg C Temperature Saving	Running Load (kW)	Avg. Running Hours/Day	Avg. Operating Days/Year	Present Energy Consumption (kWh/Year	Percentage Saving (%)	Estimated Annual Energy Saving (kWh/Year)	Unit Rate (Rs. /kWh)	Total Annual Saving (Rs. Lacs /Year)
1	Domestic Refrigerator	700	13	1	3	0.42	16	250	1680	3	50	12.86	0.01
	Total		**13**			**0.420**	**16**	**250**	**1680**		**50**		**0.01**

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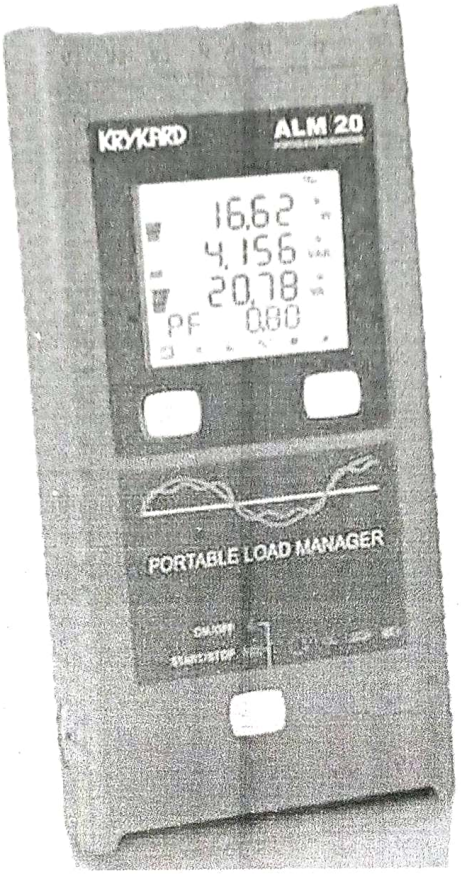
6. List of Instruments

POWER ANALYSER



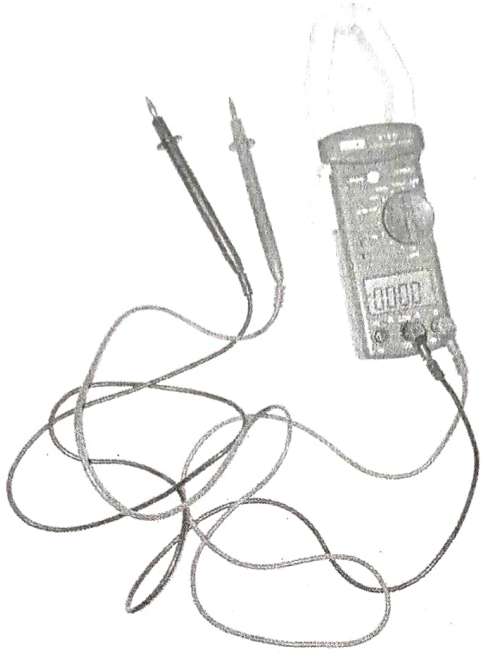
Picture 1 ALM 20 Power Analyzer

ALM 20 Power Analyzer is designed for Measuring power network parameters

TECHNICAL SPECIFICATIONS

Number of channels	3U/3I
Voltage (TRMS AC + DC)	100V to 2000V ph-ph /50V to 1000V ph-N
Voltage ratio	Up to 650 kV
Current (TRMS AC + DC)	5mA to 10,000 Aac / 50 mA to 5,000 Adc (depending on Clamp)
Current ratio	Up to 25 kA
Frequency	42.5 - 69 Hz, 340 - 460Hz
Power values	W, VA, VAr, VAD, PF, DPF, cos ø, tanø
Energy values	Wh, VAh, VArh
Harmonics, THD	on V, U, I & In up to 50th order
Electrical safety	IEC 61010, 1000V CAT III / 600V CAT IV
Protection	IP54

DIGITAL CLAMP METER



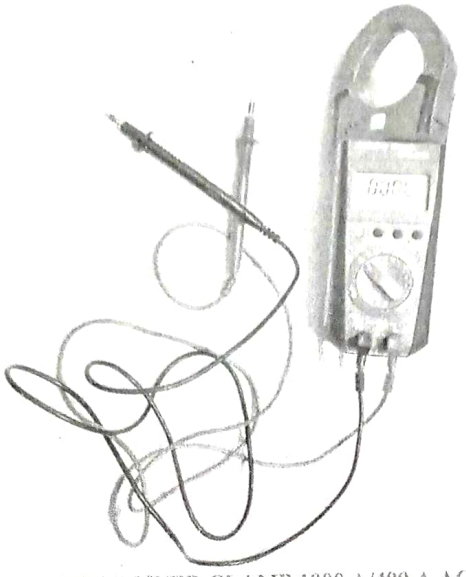
Picture 2 MECO 3150 DIGITAL CLAMP METER

Power Clamp meter is a Portable Digital multi-functional measuring instrument. Designed for Measuring selected power network parameters, AC/DC Voltage, AC/DC current, Resistance, Continuity, Diode and Frequency.

TECHNICAL SPECIFICATIONS

DC VOLTAGE (Auto Ranging)	
Ranges	4V, 40V, 400V, 1000V
Overload Protection	1200V DC/800V AC
AC VOLTAGE (Auto Ranging) 40-500Hz	
Range	4V, 40V, 400V, 750V
Overload Protection	1200V DC/800V AC
RESISTANCE (Auto Ranging)	
Range	400Ω, 4KΩ, 40KΩ, 400KΩ, 4MΩ, 40MΩ
Test Current	0.7mA on 400Ω, 0.1mA on 4KΩ
Diode Test	
Measurement Current	1.0 ± 0.6 mA Approx
Open Circuit Voltage	0.4V Approx
Overload Protection	500V DC / AC
Frequency (Auto Ranging)	
Range	10.00Hz, 50.00Hz, 500.0Hz, 5.000kHz, 50.00kHz, 500.0kHz
Sensitivity	3V
Overvoltage Protection	200V DC or AC peak

DIGITAL CLAMP METER



Picture 3 RISH POWER CLAMP 1000 A/400 A AC-DC

Power Clamp meter is a Portable Digital multi-functional measuring instrument. Designed for Measuring selected power network parameters, AC/DC Voltage, AC/DC current, Resistance, Continuity, Diode and Frequency.

TECHNICAL SPECIFICATIONS

Measuring function	Measuring range
kWh	9.999 kWh
	99.99 kWh
	999.9 kWh
	9999 kWh
Ahr	999.9 Ahr
Phase angle	0.0°....360.0°
Power Factor	-1...0...1
Harmonics (RMS & %)	1...13
	14...49
THD	0...99.9%
Crest Factor	1.0...2.9
	3.0...5.0
Power Clamp 1000A peak	1400 A/ 1400 V
Power Clamp 400A peak	100 A
	560 A/ 1000 V
Power Clamp 1000A INRUSH	999.9 A
Power Clamp 400A INRUSH	99.99 A
	400 A
Resistance	9999 Ohm
Continuity	Below 40 Ohm

THERMAL IMAGER

Picture 4 FLIR TG 167 Thermal imager

FLIR TG 167Thermal imager is designed to easily find unseen hot and cold spots in electrical cabinets or switch boxes, giving you quality image detail on even small connectors and wires.

TECHNICAL SPECIFICATIONS

Accuracy	±1.5% or 1.5°C (2.7°F)
Detector Type	Focal plane array (FPA), uncooled micro bolometer
IR Resolution	80 × 60 pixels
Laser	Dual diverging lasers indicate the temperature measurement area, activated by pulling the trigger
Memory Type	Micro SD card
Object Temperature Range	-25°C to 380°C (-13°F to 716°F)
Thermal Sensitivity/NETD	<150 mK
Display	2.0 in TFT LCD

INFRARED THERMOMETER

Picture 5 HTC IRX 64 Infrared thermometer

HTC IRX 64 infrared thermometer is useful instrument to measure the surface temperature. Infrared thermometers are ideal for taking temperatures need to be tested from a distance. They provide accurate temperatures without ever having to touch the object you're measuring (and even if your subject is in motion).

TECHNICAL SPECIFICATIONS

Specification	Range
IR	-50°C~1050 °C
Contact	-50°C~1370 °C
IR Temp. Resolution	0.1°C
Basic Accuracy	+/- 1.5% of reading
Emissivity	Adjustable 0.10 ~ 1.0
Optical resolution	30 : 1

LUX METER

Picture 6 Nishant NE 1010 Lux meter

Nishant NE 1010 Lux meter is used to measure the lux levels.

TECHNICAL SPECIFICATIONS

Measuring range	0 Lux ~200, 000 Lux/0 Fc~185, 806 Fc
Accuracy	± 3% rdg ± 0.5% f.s.(<10,000 Lux)
	± 4% rdg ± 10% f.s.(>10,000 Lux)
Digital Updates	2 times/s
Photometric sensor	Silicon diode
Battery life	18 hours (continuous operation)
Operating temperature and humidity	0°C ~ 40°C, 10% RH ~ 90% RH
Storage temperature and humidity	-20°C ~ 50°C, 10% RH ~ 90% RH
Power	9V battery
Unit Size	52.5 x 52.5 x 166 mm
Auto power off	After 5 minutes

7. Solar PV System

Facility (Nabira Mahavidyalaya, Katol) has installed grid tied Solar PV System of 10 kWP Solar Rooftop Power Plant for MBA Building, 10 kWp Solar Rooftop plant for Science Building and 10 kWP solar Rooftop plant for Commerce Building. The Facility (NMK) has installed grid tied Solar PV System of total **30 kWP Solar Rooftop Power Plant** for generating Green Energy.

Figure 14 Solar PV System

Solar Recommendation:

1) Introduction

The solar energy has a great potential as future source of energy. With its availability in large quantity almost in every corner of the country, solar power has the distinctive advantage of generating power at local and decentralized levels and being one of the prime factors for empowering people at grassroots level. The solar mission, which is part of the National Action Plan on Climate change has been set up to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar energy competitive with fossil-based energy options. The solar photovoltaic device systems for power generation had been deployed in the various parts in the country for electrification where the grid connectivity is either not feasible or not cost effective as also some times in conjunction with diesel based generating stations in isolated places, communication

transmitters at remote locations. With the downward trend in the cost of solar energy and appreciation for the need for development of solar power, solar power projects have recently been implemented. A significant part of the large potential of solar energy in the country could be developed by promoting solar photovoltaic power systems of varying sizes as per the need and affordability coupled with ensuring adequate return on investment.

2) Benefits of Solar Energy

a. Power from the sun is clean, silent, limitless and free.

b. Photovoltaic process releases no CO2, SO2, or NO2 gases which are normally associated with burning finite fossil fuel reserves and don't contribute to global warming.

c. Photovoltaic are now a proven technology which is inherently safe as opposed to other fossil fuel-based electricity generating technologies.

d. Solar power shall augment the needs of peak power needs.

e. provides a potential revenue source in a diverse energy portfolio

f. Assists in meeting renewable portfolio standards goals.

This proposal is prepared for design, engineering, procurement / manufacture and installation of solar power generating system. The grid-tie solar photovoltaic power generation system is mainly composed of PV array, String Inverter, and PV mounting structure.

It also consists of supporting devices like AC / DC switchgears, Lighting Arrestor, Earth Electrodes, AC / DC cables. As there is no any battery, its maintenance cost is negligible and initial investment per KW is very low.

3) Capacity Evaluation

Calculation for Required Solar Capacity plant to fulfill In-house Requirement

Calculation to Fulfil Building Total Load Requirement			
Sr. No.	Details	Value	Unit
1	Total electrical consumption per year	17287	KWh
2	Units generated per day per KWp	4.5	KWh/KWp/day
3	Units generated per Year per KWp (300 days / Year)	10800	KWh/KWp/Year
4	Solar KW capacity for 10800 KWh consumption / year	8	KWp

As per electrical consumption (Building Load), capacity of Solar Power Plant required is 8 KWp. As per shadow free space available on college building more plant can be installed which is more than the actual requirement of full Electrical Load. As per MSEDCL bill total Sanctioned load is 10 kW + 8 kW = 18 kW for Science Building MSEDCL Meter.

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It is suggested to install Solar Plant of Capacity 8 KWp, by increasing sanctioned load of Science Building Meter from 10 kW to 18 kW, which can be installed & it covers all required load.

The SPV power plant with proposed capacity of 8 KWp would be connected to the main electrical distribution panel. The system would meet full load requirement of the connected load during the day. Advance control mechanism in the Power Conditioning Unit will ensure that the maximum power generated by PV modules will be utilized first and the balance requirement of power will be met by either grid or DG set

The 8 KWp SPV Power Plant is estimated to afford annual energy feed of 10800 KWh/year (After considering all losses) considering efficiency of the solar module as 15.16%, Power Conditioning Unit (PCU) efficiency as 98.3% and losses in the DC and AC system as 3%.

4) Budgetary Estimation of the Project

Details	Value	Unit
Shadow free space required for approx. 1 KWp Solar Plant	80	Sq.Ft
Shadow free space available at Facility		Sq.Ft.
Solar Plant capacity to be Installed at Facility		KWp
Solar Plant Requirement as per actual consumption	8	KWp
Installation Cost Per KW for 1 KWp Solar Plant	0.65	Rs. In Lakh
Gross Estimated System cost (For 8 KWp Grid Connected Solar Plant)	5.2	Rs. In Lakh
Unit generated per day per kWp	4.5	KWh
Electricity generation per day for 30 KWp Grid Connected Solar Plant	36	KWh/day
Electricity generation per year for 30 KWp Grid Connected Solar Plant (300 days/year)	10800	KWh/year
Average Electricity Unit Cost	7.5	Rs./KWh
Electricity cost saved per year	0.81	Rs. In Lakh
Simple payback period	6.4	Years

For PPS Energy Solutions Pvt. Ltd.

Dr. Ravi G. Deshmukh
Energy Auditor Class - A
MEDA/ECN/2023-24/EA-14

8. Site Photos

Figure 15 Site Photos

PPS Energy Solutions

PPS Energy Solutions Pvt. Ltd. Regd. Off: B-403, Bharti Vihar, S. No-78, Bharti Vidyapith Campus, Katraj, Pune –411046

Date : 25th Mar.'2024

To,

The Principal,
Nabira mahavidyalaya, Katol
Dist. Nagpur Maharashtra.

Sub :- Receipt for Payment against Energy Audit assignment

Dear Sir,

We have received Cash Payment of Rs. 10,000/- against Energy Audit assignment for year 2023-24

For PPS Energy Solutions Pvt. Ltd. Pune

Authorized Signatory

PPS Energy Solutions Pvt. Ltd. -PS-