PPS Energy Solutions

PPS Energy Solutions Pvt. Ltd.
Regd. Off: B-403, Bharti Vihar, S.No-78, Bharti Vidyapith Campus, Katraj, Pune – 411046 Ph:+91-20-2523 2858, 6400 0643

Date: 11th January 2023

Certificate of Energy Audit

This is to certify that M/S. PPS Energy Slutions Pvt. Ltd., Pune has conducted Energy Audit at **Govt. Tulsi College Anuppur** in **January 2023** for knowing existing electrical energy consumption, Identification of energy conservation and saving opportunities for environmental protection. Tthis Energy Audit is also carried out to assess impact of Installed renewable energy applications and submitted the Report.

For PPS Energy Solutions Pvt. Ltd, Pune

PPS ENERGY SOLUTIONS PVT. LTD. PPS

Dr. Ravi. G. Deshmukh
Director, PPS Energy Solutions Pvt. Ltd, Pune
Accredited Energy Auditor (AEA – 0243)
Bureau of Energy Efficiency Govt. of India

PRINCIPAL
Govt. Tulsi College Anuppur
Distt. Anuppur (M.P.)

MP Urja Vikas Nigam Ltd.
(M.P. Govt. Undertaking)

Madhya Pradesh Urja Vikas Nigam Limited (MPUVNL)
Government of Madhya Pradesh

ENERGY AUDIT REPORT

GOVT. TULSI COLLEGE, ANUPPUR

Govt. Tulsi Collage, Anuppur, CL

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Govt. Tulsi College Anuppur
Distt. Anuppur (M.P.)

PPS Energy Solutions™
THE POWER OF ENERGY

ENERGY AUDIT REPORT

GOVT. TULSI COLLEGE, ANUPPUR

Govt. Tulsi Collage Anuppur CL

JANUARY 2023

Conducted By

PPS Energy Solutions Pvt. Ltd.

Plot No-18, Girish Housing Society
Warje, Pune – 411058, Maharashtra, India

For MPUVNL

For PPS Energy Solutions Pvt. Ltd, Pune

Dr. Ravi G. Deshmukh
Accredited Energy Auditor, AEA-0243

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Govt. Tulsi College Anuppur
Distt. Anuppur (M.P.)

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This report was prepared for Govt. Tulsi College, Anuppur. The information herein is confidential and shall not be divulged to a third party without the prior written permission of PPS Energy Solutions Pvt. Ltd, Pune, its affiliates and subsidiaries, including PPS Energy Solutions Pvt. Ltd, and their respective officers, employees or agents, individually and collectively, referred to in this clause as 'PPSES'. PPS Energy assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant PPSES entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.

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MPUVNL EMAPANELMENT CERTIFICATE

Madhya Pradesh Urja Vikas Nigam Limited
(MP Govt. Undertaking)

Ref. No. MPUVN/ EA- Empanelment /2017/ 1651 **Date: 21.07.2017**

To,

The Director,
M/s. PPS Energy Solutions,
B-403, Bharti Vihar,
S. No. 78, Bharti Vidyapith Campus, Kartaj,
Pune-411046. (M.H.)

Sub: Your Empanelment as Energy auditor with MPUVN.

Ref: Our letter no. MPUVN/EA-EA/2013/5754, dated 15.02.2013.

With reference to above matter, it is to inform you that we are considering your empanelment as Energy Auditor with MPUVN till new empanelment process is completed.

You are requested to kindly acknowledge the same and submit the status of work done in M.P to MPUVN.

Thanking You,

(Bhuvnesh Kumar Patel)
Chief Engineer

Urja Bhawan, Link Road No. 2, Shivaji Nagar, Bhopal - 462016 (M.P.)
E-mail- cmpuvn@bsnl.in Web-www.mprenewable.nic.in
Phone: 0755- 2553595, 2556246 Fax: 0755-2553122

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ABBREVIATIONS

Table 1Abbrevations:

Abbreviations	Full Form
°C	Degree Centigrade
A	Ampere
AC	Alternating Current
Avg.	Average
CFM	Cubic Feet per Minute
cm.	Centimeter
CMH	Cubic Meter per Hour
DB	Distribution Board
DC	Direct Current
DG	Diesel Generator
Dia.	Diameter
Effn.	Efficiency
FAD	Free Air Delivery
Ft. or ft	Feet
hr.	Hour
A	Current
kCal	Kilo Calories
kg.	Kilogram
kV	Kilo Volt
kVA	Kilo Volt Ampere
kVAr	Kilo Volt Ampere Reactive
kW	Kilo Watts
kWh	Kilo Watt Hour
lit	Liters
Lt	Liters
Ltd.	Limited
M	Meter
Max.	Maximum
m/c	Machine
m^3/hr	Cubic Meter per hour
MD	Maximum Demand
Min.	Minimum
Mm	Millimeter
MTs	Metric Tons
MT	Micro Turners
MW	Mega Watts
No.	Number
p.a.	Per Annum

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Abbreviations	Full Form
PF	Power Factor
Sec.	Second
SEC	Specific Energy Consumption
SHW	Solar Hot Water
THD	Total Harmonics Distortion
TPA	Tons per Annum
TPD	Tons per day
Temp.	Temperature
V	Voltage
VFD	Variable Frequency Drive
Wt.	Weight
yr.	Year

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ACKNOWLEDGEMENT

We at PPS Energy Solutions Pvt. Ltd, Pune wish to express our sincere gratitude to the management of M/s. Govt Tulsi College, Anuppur for assigning the work of Energy Audit of electrical and utility systems to us.

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. Govt. Tulsi College, Anuppur

1. Dr. J.K. Sant, Principal
2. Mrs. Preeti Vaishya, Assistant Professor

MPUVNL

1. Dr. Surendra Vajpai, Superitending Engineer
2. Mr. Pulkit Khosla, Project Officer

&all other staff members who helped us during the Measurements at the field and for giving us the necessary inputs to carry out this vital exercise of Energy Audit.

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EXECUTIVE SUMMARY

A Detailed Energy Auditexercise of M/s.Govt. Tulsi College, Anuppur was entrusted to PPS Energy Solutions Pvt. Ltd, Pune.

In short, Energy Audit was conducted to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods.

The salient observations and recommendations are given below.

1. M/s. Govt. Tulsi College, Anuppur uses energy in the following forms:

Table 2Sources of Energy:

Particulars	Units	Per Unit Cost	Annual Cost
Electricity (kWh)	10769.00	7.05	75896.30
TOTAL			**75896.30**

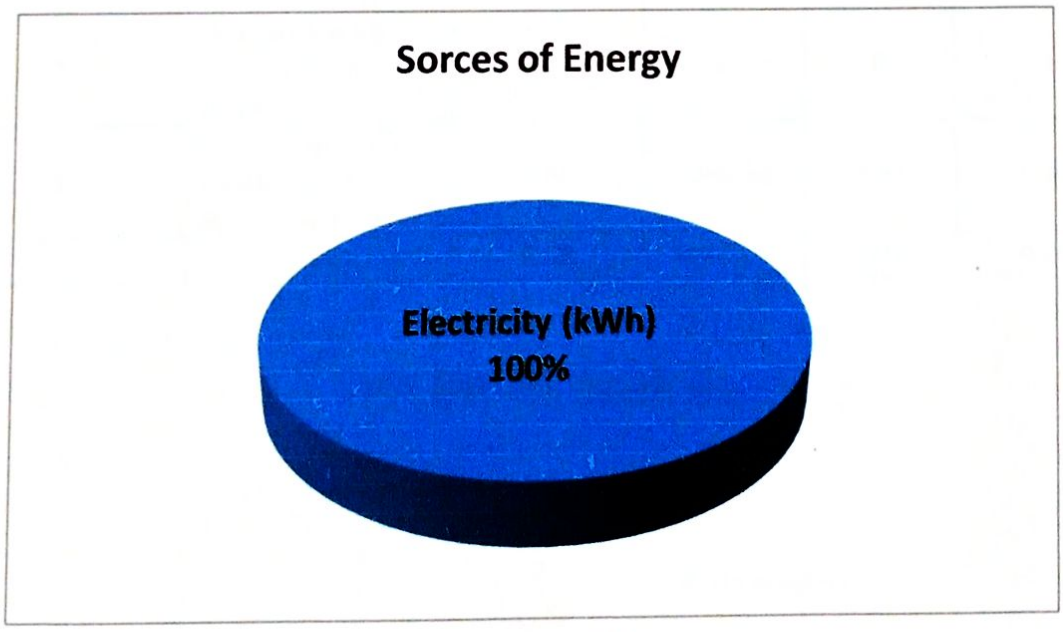

Figure 1Sources of Energy

2. Electrical energy is used for various applications, like:
   - Lighting
   - Ceiling Fans
   - Air Conditioners
   - Other electrical appliances

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3. The Total annual cost of energy is **Rs. 75,896/-**
4. Average monthly kWh units consumed are **897 kWh** equivalent to **Rs.6,324/-**
5. Average electricity charges works out to be **Rs.7.05/-**
6. Total **Connected** Load = **22.13 kW, Quantity of Equipment = 279**
7. **Facility has successfully completed Energy Literacy training program. Completion certificates of participants are enclosed in the Report in Chapter 9.**
8. After the measurement and analysis, we propose here with following Energy Efficiency Improvement measures.

RECOMMENDATIONS AND ACTION PLAN

Summary of Recommendations:

Table 3Summary of Recommendations:

Sr No	Criteria	Estimated Investment (Rs.In Lacs /Year)	Estimated energy saving (KWH)	Estimated saving in tCO2e	Estimated savings (Rs.In Lacs /Year)
1	Zero Investment	0	0	0	0
2	Payback from 6 months to 24 months	0	0	0	0
3	Payback from 25 months to 36 months and above	3.50	3441.00	2.92	0.24
	Total	**3.50**	**3441.00**	**2.92**	**0.24**

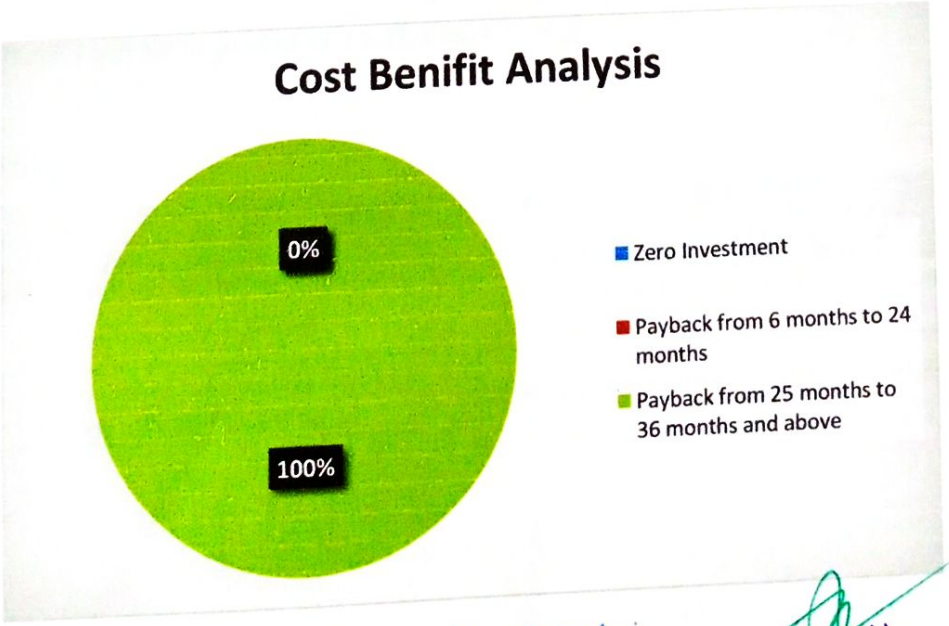

Figure 2Cost Benefit Analysis

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Recommendations:

Table 4Recommendations:

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)	Payback (Months)
2	Lights	Replacement of conventional lights with suitable LEDs	0.36	480.00	0.41	0.03	9.58	114.93
3	Fans	Replacement of existing fans with energy efficient Super fans	3.14	2961.00	2.52	0.21	15.02	180.29
Total			**3.50**	**3441.00**	**2.92**	**0.24**	**14.42**	**173.10**

During the Energy Audit,

- **Total Estimated Investment of Rs. 3,50,000/-**
- **Total Estimated Savings ofRs. 24,000/-**
- **Total Energy Cost of Rs. 75,896-**
- **Total Estimated Savings is 32% of the Total cost of Energy**
- **Overall payback period of 14.42 Years**

Action Plan:

Sr No	Recommendations	Action Required
1	Optimisation of Lighting	Replacement of conventional lights with suitable LEDs
2	Replacement of existing fans with energy efficient Super fans	Install/energy efficient super fans (BLDC Fans)

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1. INTRODUCTION

1.1 Background

The management ofM/s. Govt. Tulsi College, Anuppur entrusted the work of conducting a Detailed Energy Audit exercise of their premises attached to PPS Energy Solutions Pvt. Ltd, Pune.

1.2. About Facility

General Details ofM/s. Govt. Tulsi College, Anuppur

Table 5About M/s. Govt. Tulsi College, Anuppur

Sr. No.	Particulars	Details
1	Name of the Facility	M/s. Govt. Tulsi College Anuppur
2	Address	Govt. Tulsi Collage, Anuppur CL
3	Business Activity	College premises
4	Name of Concern Person and Designation	Mrs Preeti Vaishya, Assistant Professor

1.3. Energy Audit Methodology

Energy Audit Study is divided into following steps

- Historical Set Data Analysis

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

- Actual measurement and data analysis

This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

- Identification and evaluation of Energy Conservation Opportunities

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

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1.4. Instruments Used for conducting Energy Audit

The following instruments were used during the study for measurements.

Table 6 List of Instruments:

Sr. No.	Name of instrument	Make	Purpose
1	Tong Tester	MECO	Instantaneous measurements for Voltage and current
2	Lux Meter	MECO	Measurement of light intensity
3	IR Gun	HTC	Non-contact type measurement of temperatures

1.5. Energy Audit Team:

PPS Energy Solutions Pvt. Ltd. deputed following Team of experts to conduct the study and worked in close association with unit personnel.

Table 7 Energy Audit Team:

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 - Data Analysis, 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	Graduate Electrical Engineer with 2 years of experience in energy efficiency assessment

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2. ENERGY PROFILE

2.1. Sources of Energy

M/s. Govt. Tulsi College, Anuppur uses Energy following forms:

- Electricity from MPPKVVCL: M/s. Govt.Tulsi College, Anuppur receives Electricity through LTline. Further, it is distributed to various electrical panels in the facility.

Table 8Sources of Energy:

Particulars	Units	Per Unit Cost	Annual Cost
Electricity (kWh)	10769.00	7.05	75896.30
TOTAL			**75896.30**

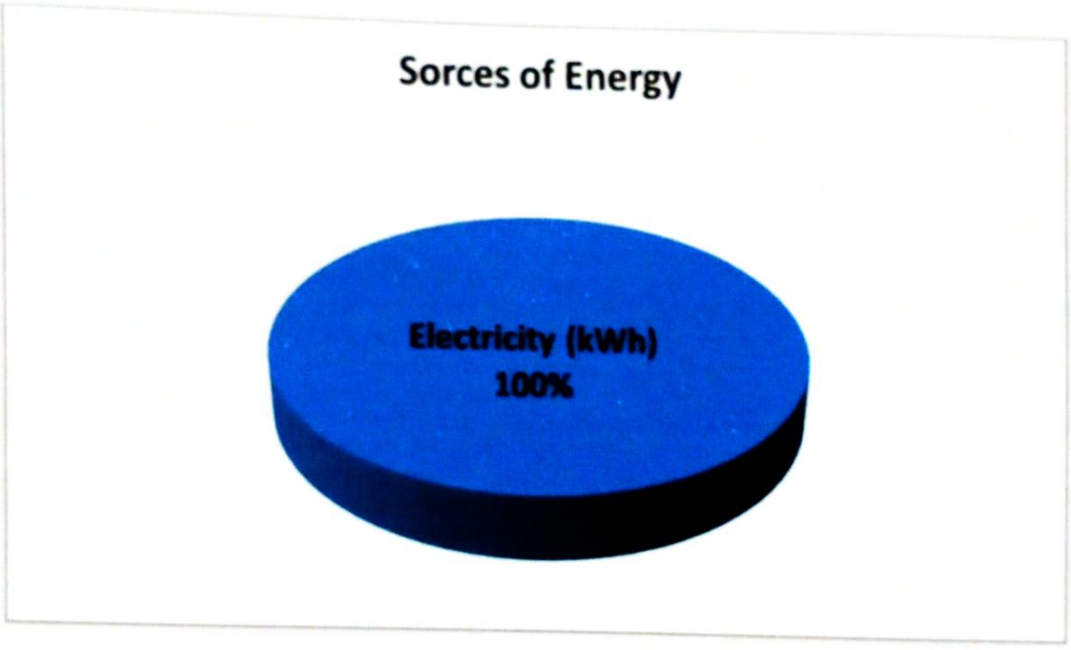

Figure 3Sources of Energy

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2.2. Appliances

I. Electrical Energy is used for various appliances like:

   i. Lighting

   ii. Ceiling Fan

   iii. Air Conditioners

   iv. Other electrical appliances

II. The Totalmonthly cost of energy is **Rs. 75,896/-**

III. Average monthly kWh units consumed are **897 kWh** equivalent to **Rs. 6,324/-**

IV. Average electricity charges works out to be **Rs. 7.05/-**

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3. INPUT ENERGY ANALYSIS

3.1. Bill Analysis

3.1.1. Electricity Bill Analysis

Table 9 Details of Service Number. 1564516-ANT72-41-N1325005716:

Parameter	Details
Service Number	**1564516-ANT72-41-N1325005716**
Name of Customer	PRINCIPAL GOVT TULSI COLLAGE
Address	GOVT TULSI COLLAGE ANUPPUR CL
IVRS	N1325005716
Location Code	1564500-(URBAN)
Division Name	ANUPPUR
Phase Given	THREE
Load Sanctioned (kW)	1.52
Contract Demand(KVA)	1.52
Maximum Demand	0
Tariff	LV2.1

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Table 10Study of Electricity Consumption:

Month	Current Reading		Previous Reading		MF	Meter Consumption (kWh)		Net Units Consumptin (kWh)	Final Units Consumed (kWh)	Billing Units (kWh)
	Import	Export	Import	Export		Import	Export			
Dec-22	95929.00		95929.00		1.00	0.00		867.00	867.00	867
Nov-22	95929.00		95929.00		1.00	0.00		867.00	867.00	867
Oct-22	95929.00		95929.00		1.00	0.00		867.00	867.00	867
Sep-22	89811.00		88945.00		1.00	866.00		866.00	0.00	866
Aug-22	89169.00		88079.00		1.00	1090.00		1090.00	0.00	1090
Jul-22	95929.00		95429.00		1.00	500.00		500.00	0.00	500
Jum-22	86889.00		85896.00		1.00	661.00		661.00	0.00	661
May-22	96309.00		95039.00		1.00	1270.00		1270.00	0.00	1270
Apr-22	95039.00		93769.00		1.00	1270.00		1270.00	0.00	1270
Mar-22	94798.00		93769.00		1.00	1029.00		1029.00	0.00	1029
Feb-22	92740.00		91942.00		1.00	798.00		798.00	0.00	798
Jan-22	91942.00		91258.00		1.00	684.00		684.00	0.00	684
Avg	**93367.75**		**92659.42**		**1.00**	**680.67**		**897.42**	**216.75**	**897.42**
Max	**96309.00**		**95929.00**		**1.00**	**1270.00**		**1270.00**	**867.00**	**1270.00**
Min	**86889.00**		**85896.00**		**1.00**	**0.00**		**500.00**	**0.00**	**500.00**
Sum	**1120413.00**		**1111913.00**		**12.00**	**8168.00**		**10769.00**	**2601.00**	**10769.00**

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Month	Energy Charges (Rs)	Energy FCA Charges (Rs.)	Fixed Charges (Rs)	Current month's bill amountt (Rs)	Total Unit Rate (Rs)
Dec-22	5635.50	173.40	312.00	6120.90	7.06
Nov-22	5635.50	173.40	312.00	6120.90	7.06
Oct-22	5635.50	173.40	312.00	6120.90	7.06
Sep-22	5629.00	173.20	312.00	6114.20	7.06
Aug-22	7085.00	218.00	312.00	7615.00	6.99
Jul-22	3250.00	100.00	312.00	3662.00	7.32
Jum-22	4296.50	132.20	312.00	4740.70	7.17
May-22	8255.00	254.00	312.00	8821.00	6.95
Apr-22	8255.00	254.00	312.00	8821.00	6.95
Mar-22	6688.50	205.80	312.00	7206.30	7.00
Feb-22	5187.00	159.60	312.00	5658.60	7.09
Jan-22	4446.00	136.80	312.00	4894.80	7.16
Avg	**5833.21**	**179.48**	**312.00**	**6324.69**	**7.05**
Max	**8255.00**	**254.00**	**312.00**	**8821.00**	**6.95**
Min	**3250.00**	**100.00**	**312.00**	**3662.00**	**7.32**
Sum	**69998.50**	**2153.80**	**3744.00**	**75896.30**	**7.05**

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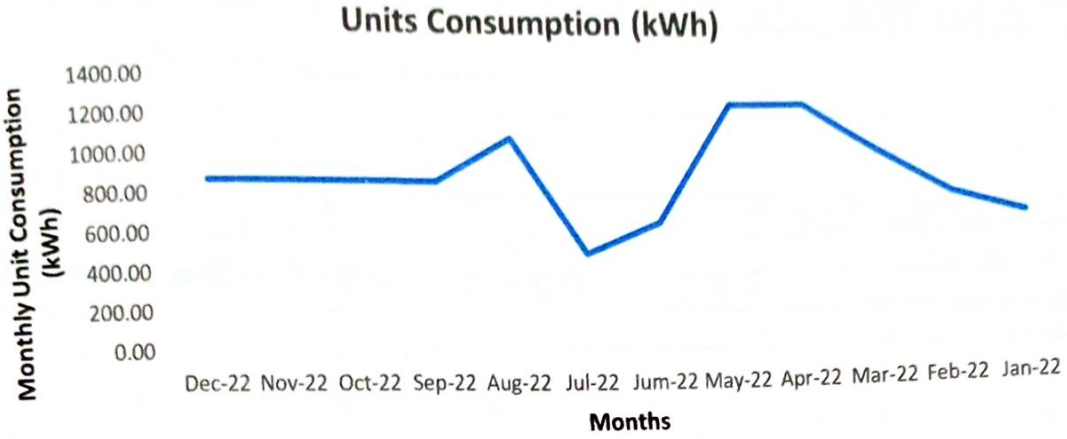

Figure 4 Monthly Unit Consumption (kWh) Variation

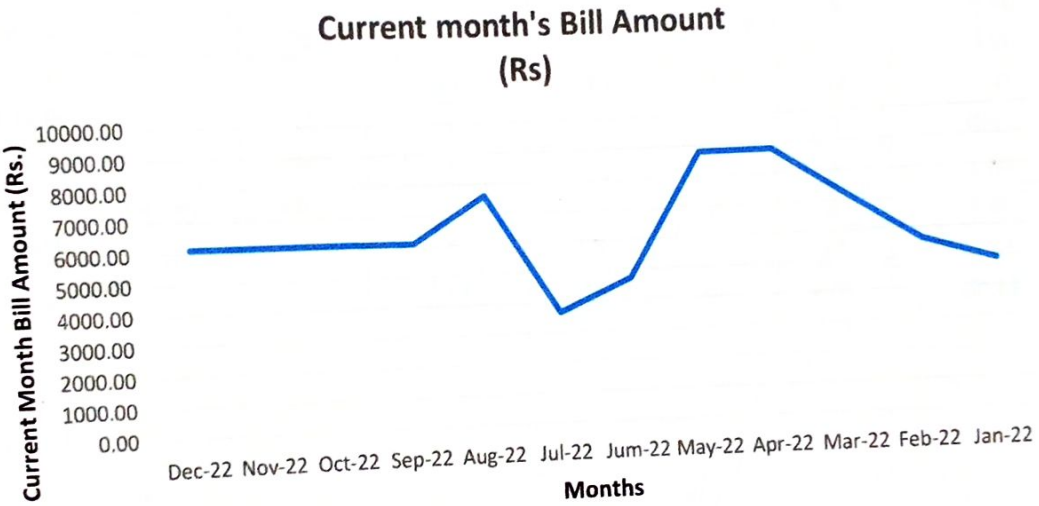

Figure 5Monthly Electricity Bill Variation

Comments:

1. Average monthly kWh units consumed are**897 kWh** equivalent to **Rs. 6,324/-**
2. Average electricity charges works out to be **Rs./kWh = 7.05/-**

3.1.2. Electrical Supply Details:

The electrical supply to M/s. Govt.Tulsi College, Anuppur comes from MPPKVVCL

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4. LOAD ANALYSIS

4.1. Study of Connected Loads:

Table 11List of Connected Electrical Load:

Machines / Equipments / Devices	Wattage	Ground Floor	First Floor	Library	Total Qty	Total Load in kW
Ceiling Fan	75	77	48	16	141	10.58
T-8 Tube Light	40	12	8		20	0.80
LED Tube Light	18	16	23	6	45	0.81
PC	150	11	10		21	3.15
Printer	60	8			8	0.48
Projector	150		3		3	0.45
Exhaust Fan	60		2		2	0.12
LED Screen	150	1	1		2	0.30
Wall Fan	55	1			1	0.06
LED Bulb	15	11	7	9	27	0.41
CFL Bulb	12	4			4	0.05
RO Water cooler	600	3			3	1.80
Submersible pumps	1492			2	2	2.98
LED Bulb	9	7	10		17	0.15
Total		**144**	**102**	**33**	**279**	**22.13**

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Connected Load in kW

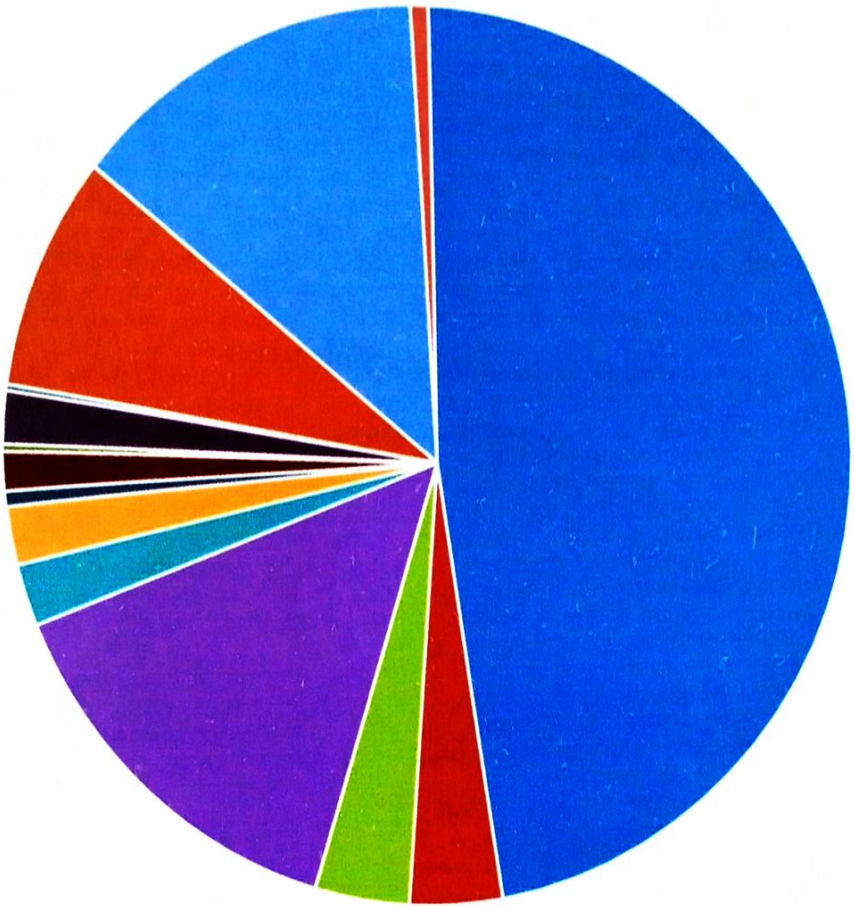

Figure 6Connected Load in kW

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1.3. Study of Lighting System:

Following is the lighting load in the premises

Machines / Equipments / Devices	Wattage	Ground Floor	First Floor	Library	Total Qty	Total Load in kW
T-8 Tube Light	40	12	8		20	0.80
LED Tube Light	18	16	23	6	45	0.81
LED Bulb	15	11	7	9	27	0.41
CFL Bulb	12	4			4	0.05
LED Bulb	9	7	10		17	0.15
Total		**43**	**38**	**15**	**96**	**2.22**

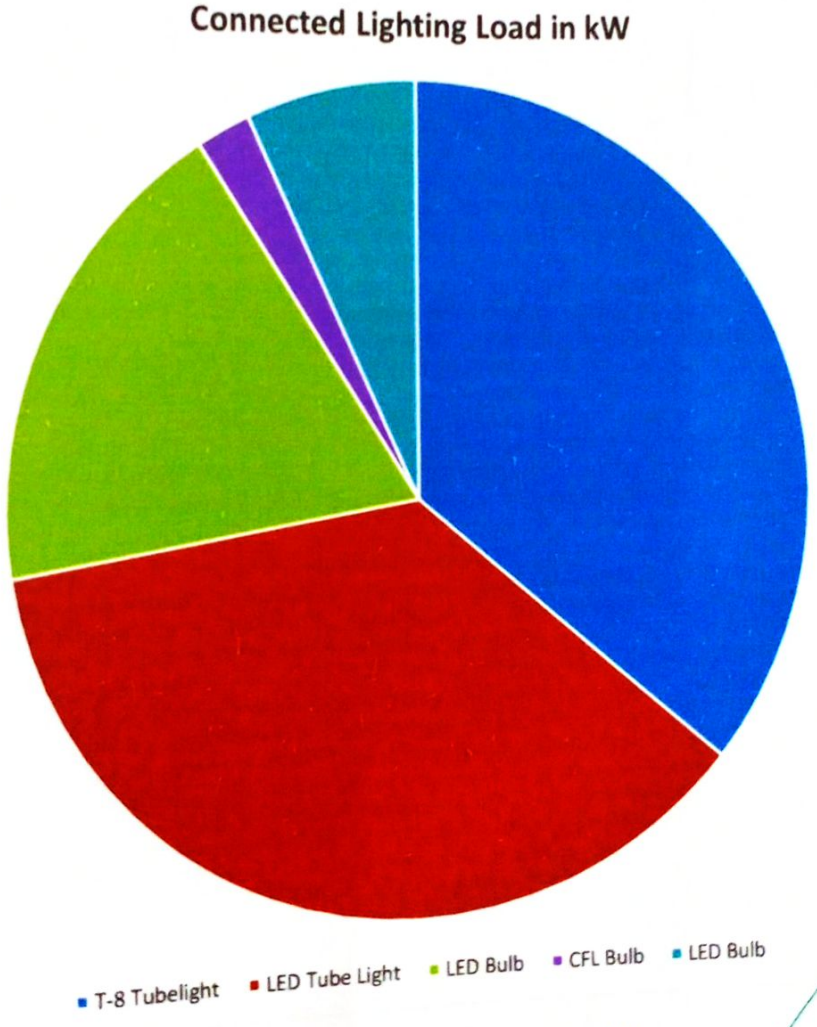

Figure 7Connected Lighting Load in kW

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We have measured lux level at various location in their premises. We are giving details as under –

Lux Measurement	
Location	Lux
Point 1	180
Point 2	164
Point 3	180
Point 4	180
Point 5	125
Point 6	180
Point 7	135
Point 8	180
Point 9	100
Avg Value of Lux	**158**

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5. ENERGY CONSERVATION MEASURES

5.1. ECM 3: Optimization of Lighting

Name	Optimization of Lighting
Location	Entire premises
Estimated Annual Savings	480 kWh/year, Rs. 0.003 Lakhs/year
Estimated investment Cost	Rs. 0.36 Lakhs
Estimated Payback	9.58 Years
Environmental Benefits	Reduced CO_2 emissions from less electricity used @ 0.41 tCO_2e per year
Next Steps	Change conventional tube lights with LED

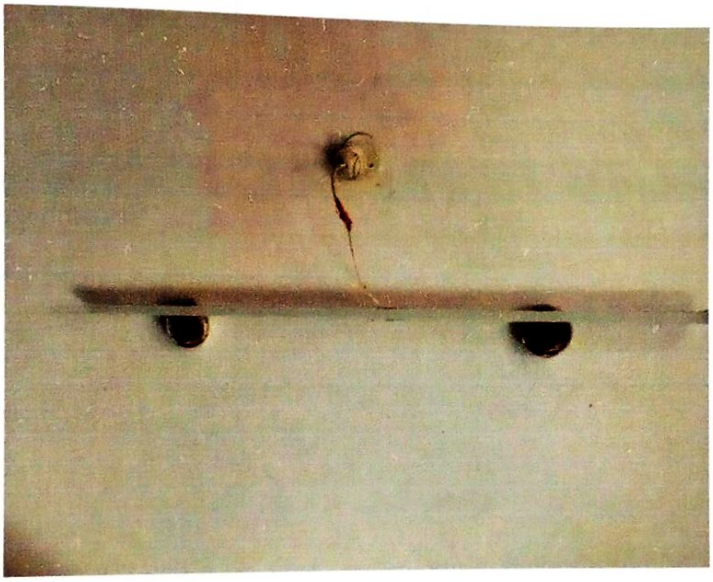

Figure 8Conventional Lights

Observations:

Facility has installed Tube Light of 40 W in their premises

Recommendations:

During energy audit, it is observed that facility has installed Tube Light of 40 Wat some of the places in the facility Also energy team at facility has already replaced some of the CFLs

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with LEDs. The operating hours for these lightings are around 4 hours per day.Tube Light of 40 Wwith 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	0.80
Power consumption of suitable LED light	KW	0.40
Average power saving after replacement with LED light	KW	0.40
Replacement of conventional lights with suitable LEDs	Nos	20
Average working hour per day	Hrs	4
No. of working days in a year	Days	300
Cost Benefit Calculation		
Annual Energy Saving potential	kWh	480
Electricity tariff	Rs/unit	7.05
Annual Cost Saving	Rs. Lakh	0.03
Total investment cost	Rs. Lakh	0.32
Annual Saving	Rs. Lakh	0.03
Simple Payback Period	Years	9.58

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Investment Details

Type of Exisitng 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	40	20	20	2-1-23	926	15	0.32	0.80	0.40	0.40	0.32		
TOTAL		**20**			**926**	**15.00**	**0.32**	**0.80**	**0.40**	**0.40**	**0.32**	**0.04**	**0.36**

CSR no	Description	Material	Labour	Total	Dismantling cost	Quantity	Total Cost
2-1-23	Supplying & erecting LED 20W tube light fitting (4 feet) with aluminium housing, heat sink, integrated HF electronic driver complete.	881	45	926	15	20	32410
	Total						**0.32**
	12% GST on total Investment cost						**0.04**
	Total cost						**0.36**

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5.2. ECM 3: Replacement of existing fans with energy efficient Super fans:

Name	Replacement of existing fans with energy efficient Super fans
Location	Ceiling Fans in entire campus
Estimated Annual Savings	2,961 kWh/year, Rs. 0.21 Lakhs/year
Estimated investment Cost	Rs. 3.14 Lakhs
Estimated Payback	15.02 Years
Environmental Benefits	Reduced CO_2 emissions from less electricity used @ 2..52 tCO_2e per year
Next Steps	Install/energy efficient super fans (BLDC Fans)

Figure 9 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

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Energy Saving Calculations:

Particular	Unit	value
Existing energy consumption of Fan	kWh/year	7931
Wattage of Energy Efficient Super Fan	Watt	35
Energy consumption after replacing with Energy Efficient Super Fan	kWh/year	3701
Operating hrs/day	Hrs/day	3
No. of working days in a year	Days	300
Diversity factor	%	70%
Annual Saving	kWh/year	2961
Unit rate	Rs/kWh	7.05
Annual Saving	Rs. In Lacs	0.21

Category	Nos	Estimated Running kW
Ceiling Fan 75 W	141	10.58
Total	**141**	**10.58**

Investment Details

CSR No	Description	Material	Labour	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	141	5217
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	141	274809
						2.80
	Total					**0.34**
	12% GST on total Investment cost					**3.14**
	Total cost					

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6. SOLAR PV SYSTEM

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, it's maintenance cost is negligible and initial investment per KW is very low.

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3) **Objective**

- Provide reliable, clean, regulated, un-interrupted power on demand to the pre-identified critical loads
- System to provide low life cycle cost and maximize savings to the beneficiaries.
- To save diesel in institutions and other commercial establishments including industry facing huge power cuts especially during daytime.

4) **Design Assumptions**

General

a. The Solar Radiation Data's are based on standard books & simulation software as NASA and Metronome. The Mean Hourly Radiation Data is considered.

b. The module rating considered is tentative. The exact module sizing and rating will depend on the availability of cell grade and site suitability.

c. Solar Panels are roof/ground mounted in one location. Environmentally protected, closed, ventilated, inverter room at minimum distance from PV modules.

d. Application: Self consumption, captive grid or NET metering.

e. Emergency Backup: Generator or any other source in absence of Grid.

5) **System Description:**

Solar Power Plant comprises of the main equipment and components listed below:

1. Solar PV Modules
2. String Inverter with MPPT
3. Module mounting system
4. Monitoring system
5. Cables & connectors

Each of the sub systems has been described for the functionality and operation modes. The physical construction of the system follows a modular approach, which is field-tested and is regularly used for delivery of power systems.

1.2 5.1 Solar PV Module (Electrical Features)

The PV modules convert the light reaching them into DC power. The amount of power they produce is roughly proportional to the intensity and the angle of the light reaching them. They are therefore required to be positioned to take maximum advantage of available sunlight within sitting constraints.

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1.3 5.2 Solar PV Module (Mechanical Features)

Solar Module design will conform to following Mechanical requirements:

- Toughened,
- low iron content,
- High transmissivity from glass.
- Anodized Aluminum Frame.
- Ethyl Vinyl Acetate (EVA) encapsulating.
- Tedlar/Polyester trilaminate back surface.
- ABS plastic terminal box for the module output termination with gasket to prevent water & moisture.
- Resistant to water, abrasion hail impact, humidity & other environment of actors for the worst situation at site.

1.4 5.3 Module Mounting Structure

The structure shall be designed to allow easy replacement of any module and shall be in line with site requirement. Structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site. The array structure shall have tilt arrangement to adjust the plane of the solar array for optimum tilt.

1.5 5.4 Junction Box

The junction boxes shall be dust, vermin and waterproof and made of FRP/ABS Plastic with IP65 protection. The terminals shall be connected to copper bus bar arrangement of proper sizes. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable marking shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification

1.6 5.5 String Inverter

The STRING INVERTER is A combination of Solar Charger (MPPT), Inverter and synchronization unit for two different AC supplies, all housed in a single unit. Maximum power point tracker (MPPT) shall be integrated into it to maximize energy drawn from the solar array. The Inverter converts the DC available from the array into an AC output. The output of the inverter is filtered to reduce the harmonics to an acceptable level (less than 5%). MPPT shall be microprocessor/micro controller based to minimize power losses and maximize energy utilization. The efficiency of MPPT shall not be less than 90% and shall be designed to meet the solar PV Array capacity.

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1.7 5.6 AC /DC Cables

We use DC & AC cables of Lap, Apar, Polycab, Havels, Finolex or equivalent make to ensure minimum losses in transmission.

In order to complete the energy study that leads to the construction of a photovoltaic installation, hourly series of global horizontal irradiation values for a complete year are used, which resume the irradiation and other meteorological parameters behavior over a long term. We use PV. SYST. Software to workout optimum power production at site with minimum loses.

1.8 5.7 Grounding and Lighting Protection

- A protective earth (PE) connection ensures that all exposed conductive surfaces are at the same electrical potential as the surface of the Earth, to avoid the risk of electrical shock. It ensures that in the case of an insulation fault (a "short circuit"), a very high current flows, which will trigger an over current protection device as fuses and circuit breakers that disconnects the power supply.
- A functional earth connection serves a purpose other than providing protection against electrical shock. In contrast to a protective earth connection, a functional earth connection may carry a current during the normal operation of a device.
- Lightning protection is a very specialized form of grounding used in an attempt to divert the huge currents from lightning strikes. A ground conductor on a lightning arrester system is used to dissipate the strike into the earth.
- Lightning ground conductors must carry heavy currents for a short period of time. To limit inductance and the resulting voltage due to the fast pulse nature of lightning currents, lightning ground conductors may be wide flat strips of metal, usually run as directly as possible to electrodes in contact with the earth.
- In proposal, the entire system is fully provided with the required lighting and grounding protection.

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6) Solar PV Locations

Area Considered for Solar Power Installation

Location is to be identified.

Details of Facility:

Total Unit Consumption / year of facility is**10,769kWh** (Ref. 12 months Electricity Bills)

Sr. No.	Area	Length (ft.)	Width (ft.)	Area (Sq. ft.)	Plant Installed (kW)
1	Area 1	100	20	2000	25
2	Area 2	100	20	2000	25
Total				**4000**	**50**

7) Capacity Evaluation and Verification

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

Calculation to Fulfill Building Total Load Requirement			
Sr. No.	Details	Value	Unit
1	Total electrical consumption per year	10769	KWh
2	Units generated per day per KWp	4.5	KWh/KWp/day
3	Units generated per Year per KWp (330 days / Year)	1485	KWh/KWp/Year
4	Solar KW capacity For 10769 KWh consumption / year	7.3	KWp

As per electrical consumption (Building Load), capacity of Solar Power Plant required is 6.3 KWp.

It is suggested to insta;; grid tie Solar PV plant of 7 kW to fulfill energy requirement of facility.

The SPV power plant with proposed capacity of 7 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 7 KWp SPV Power Plant is estimated to afford annual energy feed of 10769 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%.

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8) Payback Period Calculations

Details	Value	Unit
Shadow free space required for approx. 1 KWp Solar Plant	80	Sq.Ft
Shadow free space available at Facility	4000	Sq.Ft.
Solar Plant capacity to be Installed at Facility	50.00	KWp
Solar Plant Requirement as per actual consumption	7	KWp
Installation Cost Per KW for 1 KWp Solar Plant	0.57	Rs. In Lakh
Gross Estimated System cost (For 4 KWp Grid Connected Solar Plant)	4	Rs. In Lakh
Unit generated per day per kWp	4.5	KWh
Electricity generation per day for 4 KWp Grid Connected Solar Plant	33	KWh/day
Electricity generation per year for 4 KWp Grid Connected Solar Plant (330 days/year)	10769	KWh/year
Average Electricity Unit Cost	7.05	Rs./KWh
Electricity cost saved per year	0.76	Rs. In Lakh
Simple payback period	5.44	Years

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7. RECOMMENDATIONS AND ACTION PLAN

7.1. Recommendations:

Summary of Recommendations:

Table 12Summary of Recommendations:

Sr No	Criteria	Estimated Investment (Rs.In Lacs /Year)	Estimated energy saving (KWH)	Estimated saving in tCO2e	Estimated savings (Rs.In Lacs /Year)
1	Zero Investment	0	0	0	0
2	Payback from 6 months to 24 months	0	0	0	0
3	Payback from 25 months to 36 months and above	3.50	3441.00	2.92	0.24
	Total	**3.50**	**3441.00**	**2.92**	**0.24**

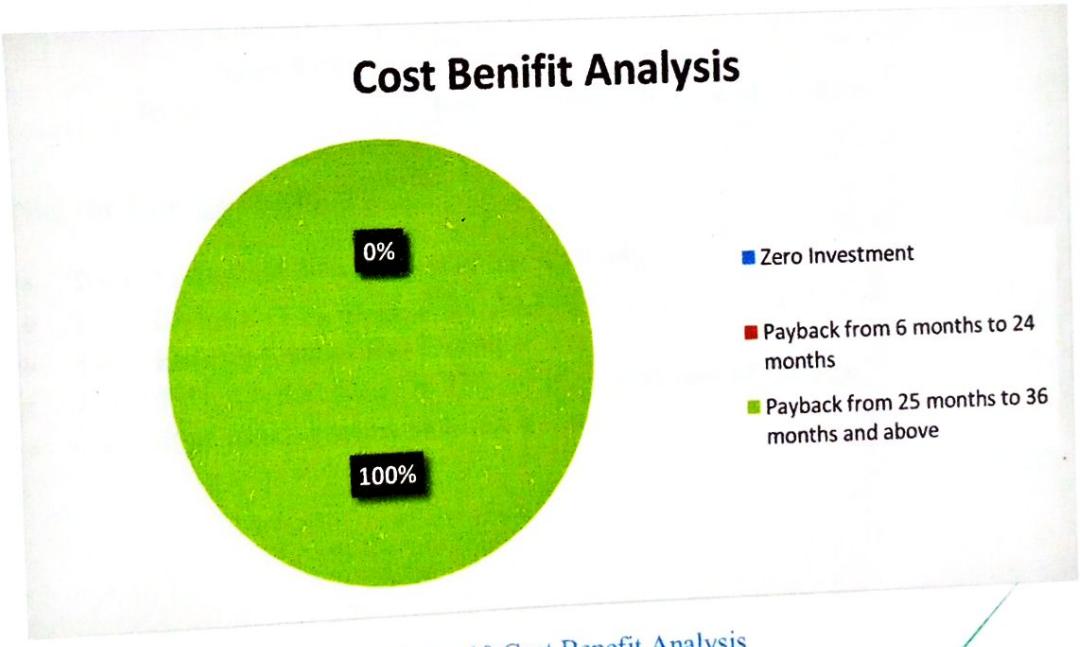

Figure 10 Cost Benefit Analysis

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Recommendations:

Table 13Recommendations:

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)	Payback (Months)
2	Lights	Replacement of conventional lights with suitable LEDs	0.36	480.00	0.41	0.03	9.58	114.93
3	Fans	Replacement of existing fans with energy efficient Super fans	3.14	2961.00	2.52	0.21	15.02	180.29
Total			**3.50**	**3441.00**	**2.92**	**0.24**	**14.42**	**173.10**

During the Energy Audit,

- **Total Estimated Investment of Rs. 3,50,000/-**
- **Total Estimated Savings of Rs. 24,000/-**
- **Total Energy Cost of Rs. 75,896/-**
- **Total Estimated Savings is 32% of the Total cost of Energy**
- **Overall payback period of 14.42 Years**

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Sr No	Recommendations	Action Required
1	Optimisation of Lighting	Replacement of conventional lights with suitable LEDs
2	Replacement of existing fans with energy efficient Super fans	Install/energy efficient super fans (BLDC Fans)

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8. LIST OF INSTRUMENTS

DIGITAL CLAMP METER

Picture 1 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

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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
Thermal Sensitivity/NETD	<150 mK
Display	2.0 in TFT LCD

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INFRARED THERMOMETER

Picture 2 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

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LUX METER

Picture 3 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

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9. COMPLETION OF ENERGY LITERACY TRAINING

कार्यालय प्राचार्य शासकीय तुलसी अग्रणी महाविद्यालय
जिला–अनूपपुर (म0प्र0)

Azadi ka Amrit Mahotsav

e-mail: hegtdcano@mp.gov.in 9425844318

क्रमांक / 112 / स्था. / 2023 अनूपपुर दिनांक 14-01-2023

प्रति,

नोडल अधिकारी
ऊर्जा साक्षरता अभियान,
मध्यप्रदेश ऊर्जा विकास निगम लिमिटेड, भोपाल लिंक रोड-2, शिवाजी नगर, भोपाल

विषय:- कॉलेज में "ऊर्जा साक्षरता अभियान" के सफल क्रियान्वयन बाबत्।

विषयांतर्गत लेख है कि, मध्यप्रदेश शासन के अनुठे अभियान "ऊर्जा साक्षरता अभियान" की हम सराहना करते हैं।

इस अभियान का सफल क्रियान्वयन हमारे कॉलेज द्वारा किया जा रहा है एवं विद्यार्थीयों को ऊर्जा, ऊर्जा के व्यय - अपव्यय, अक्षय ऊर्जा एवं ऊर्जा की बचत के संदर्भ में अति महत्वपूर्ण जानकारी मिल सकी है, जिससे ऊर्जा प्रबंधन के प्रति उनके दृष्टिकोण में सकारात्मक बदलाव परिलक्षित हो रहा है।

दिनांक 14-01-2023 तक हमारे कॉलेज से अभियान में जुड़ने वाले स्टाफ / टीचर्स / विद्यार्थीयों की संख्या निम्नानुसार हैं:-

स.क्र.		कुल संख्या	अभियान में पंजीकृत संख्या	अभियान में सर्टिफिकेशन की संख्या	टीप
1.	टीचिंग स्टाफ	36	23	23	
2.	नॉन टीचिंग स्टाफ	15	00	00	
3.	छात्र / छात्राएं	2660	1400	1230	

हम इस अभियान से अपने कॉलेज के स्टाफ एवं छात्र /छात्राओं को शत-प्रतिशत जुड़ने हेतु प्रेरित कर रहे है।

प्राचार्य
शास0 तुलसी महावि0 अनूपपुर
जिला–अनूपपुर (म0प्र0)
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10. ANNEXURES

10.1. Annexure 1: Site Photographs

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