



OFFICE, PRINCIPAL GOVERNMENT TULSI COLLEGE, ANUPPUR

Affiliated to Awadhesh Pratap Singh University Rewa (MP)

Registered Under Section 2 (F) & 12 (B) of UGC Act

E-mail: hegtdcano@mp.gov.in

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Energy Audit report 2022-23

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

Ravi



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

[Signature]
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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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ENERGY AUDIT REPORT



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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

Ravi



Dr. Ravi G. Deshmukh

Accredited Energy Auditor, AEA-0243

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MPUVNL EMPANELMENT CERTIFICATE



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

Ref. No. MPUVN/EA- Empanelment /2017/ 65/

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- 2583895, 266246 Fax: 0756- 2583122

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ABBREVIATIONS

Table 1 Abbreviations:

| 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 Audit exercise 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 2 Sources of Energy:

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

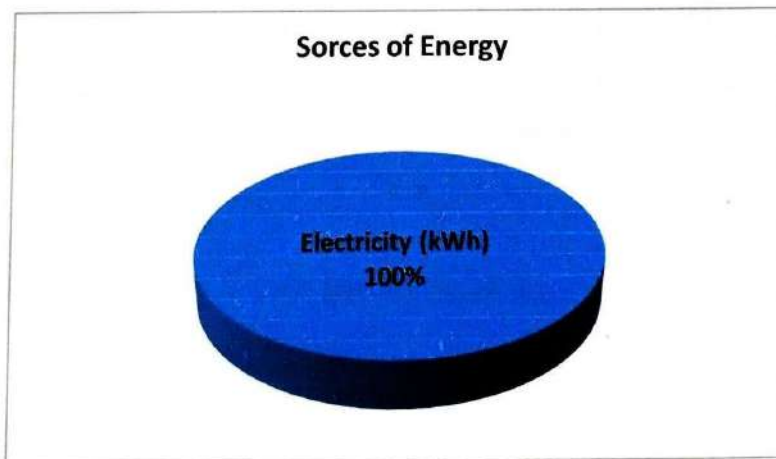


Figure 1 Sources of Energy

2. Electrical energy is used for various applications, like:

- Lighting
- Ceiling Fans
- Air Conditioners
- Other electrical appliances


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

RECOMMENDATIONS AND ACTION PLAN

Summary of Recommendations:

Table 3 Summary 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 |

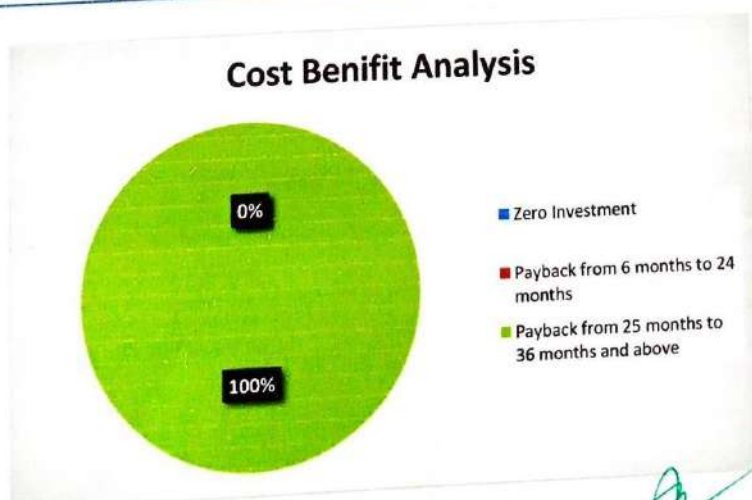


Figure 2 Cost Benifit Analysis

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Recommendations:

Table 4 Recommendations:

| 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

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 of M/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 of M/s. Govt. Tulsi College, Anuppur

Table 5 About 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 8 Sources of Energy:

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

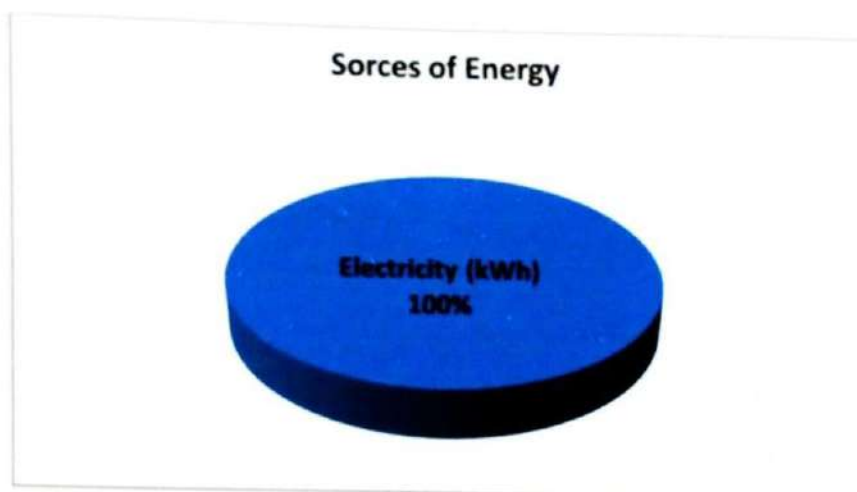


Figure 3 Sources of Energy

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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 Total monthly 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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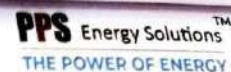


Table 10 Study of Electricity Consumption:

| 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 |
| Jun-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 | | | Current month's bill amountt (Rs) | Total Unit Rate (Rs) |
|--------|---------------------|-------------------|--------------------|-----------------------------------|----------------------|
| | Energy Charges (Rs) | FCA Charges (Rs.) | Fixed Charges (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 |
| Jun-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

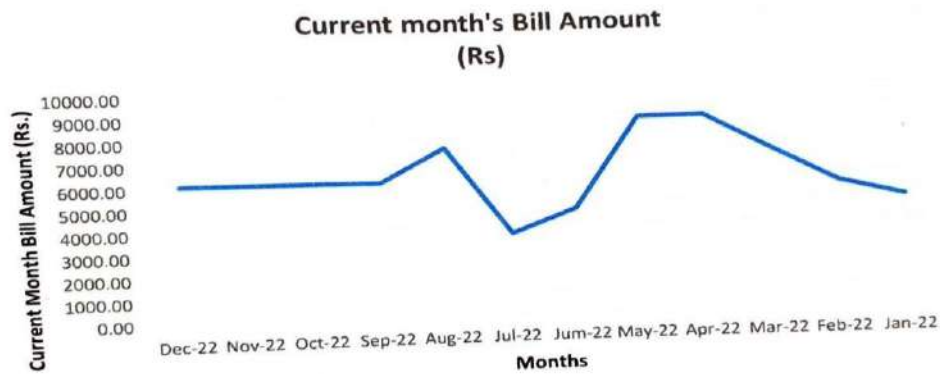


Figure 5 Monthly Electricity Bill Variation

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 MPPKVCL

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4. LOAD ANALYSIS

4.1. Study of Connected Loads:

Table 1 | List 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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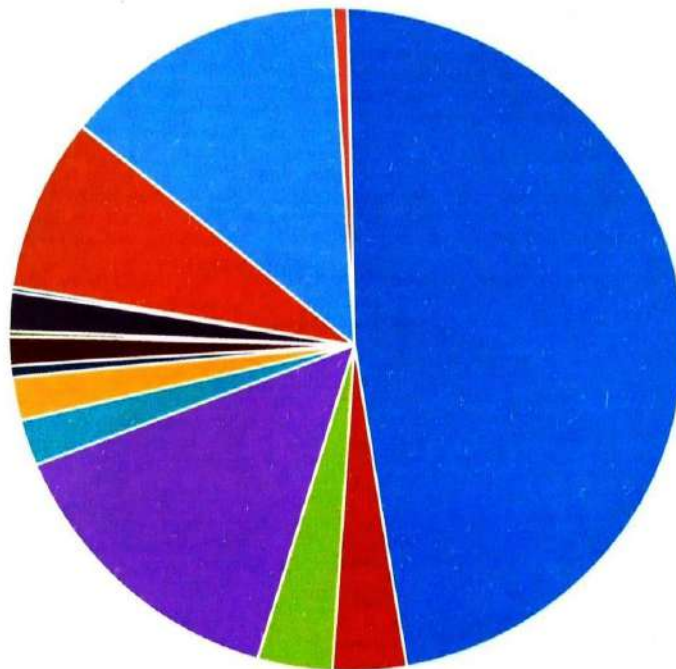
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Connected Load in kW



- | | |
|---------------------|-------------------|
| ■ Ceiling Fan | ■ T-8 Tubelight |
| ■ LED Tube Light | ■ PC |
| ■ Printer | ■ Projector |
| ■ Exhaust Fan | ■ LED Screen |
| ■ Wall Fan | ■ LED Bulb |
| ■ CFL Bulb | ■ RO Water cooler |
| ■ Submersible pumps | ■ LED Bulb |

Figure 6 Connected 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 |

Connected Lighting Load in kW

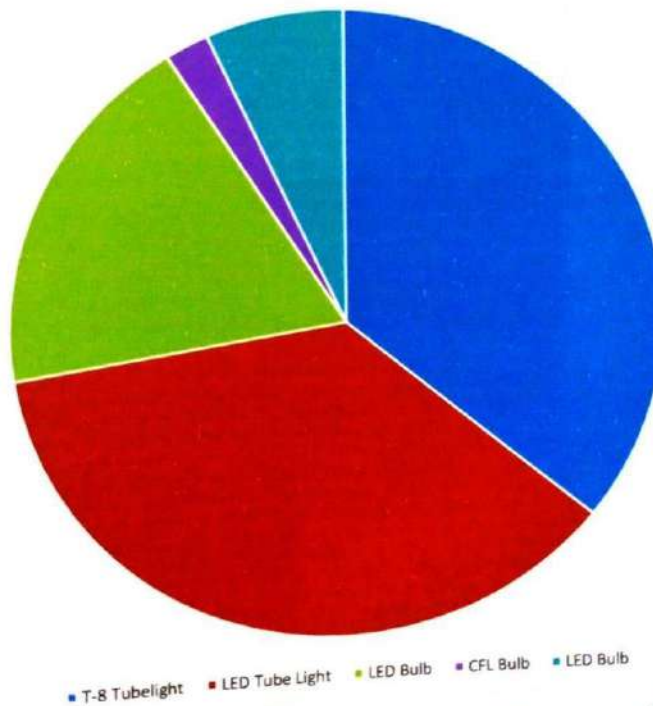


Figure 7 Connected Lighting Load in kW

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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 ₂ e per year |
| Next Steps | Change conventional tube lights with LED |

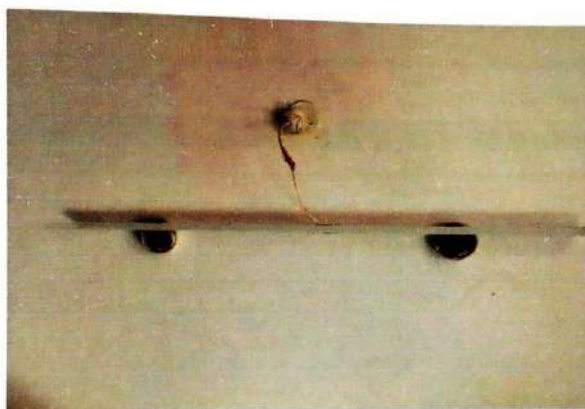


Figure 8 Conventional Lights

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 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 | 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 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 | 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 ₂ e 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:

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| 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 |
| | Total | | | | | 2.80 |
| | 12% GST on total investment cost | | | | | 0.34 |
| | Total cost | | | | | 3.14 |

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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

- Power from the sun is clean, silent, limitless and free.
- 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.
- Photovoltaic are now a proven technology which is inherently safe as opposed to other fossil fuel based electricity generating technologies.
- Solar power shall augment the needs of peak power needs.
- provides a potential revenue source in a diverse energy portfolio
- 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 losses.

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 install 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 12 Summary 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 |

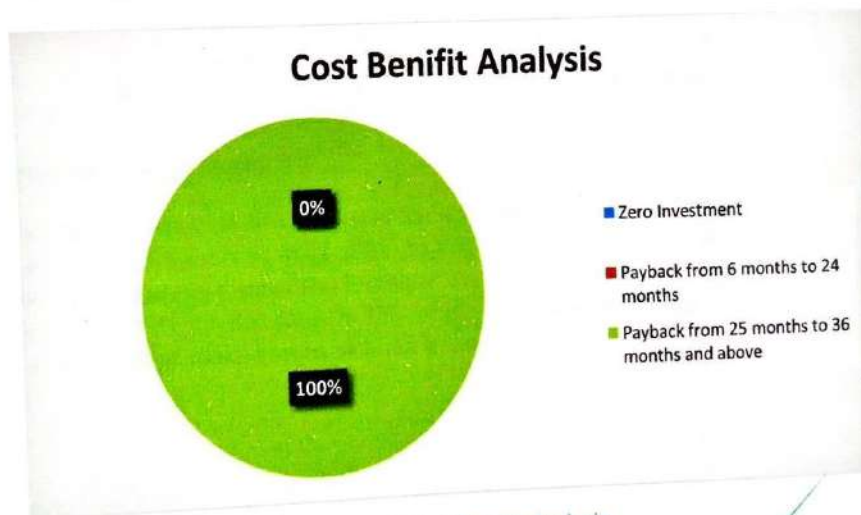


Figure 10 Cost Benefit Analysis

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Recommendations:

Table 13 Recommendations:

| 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) |

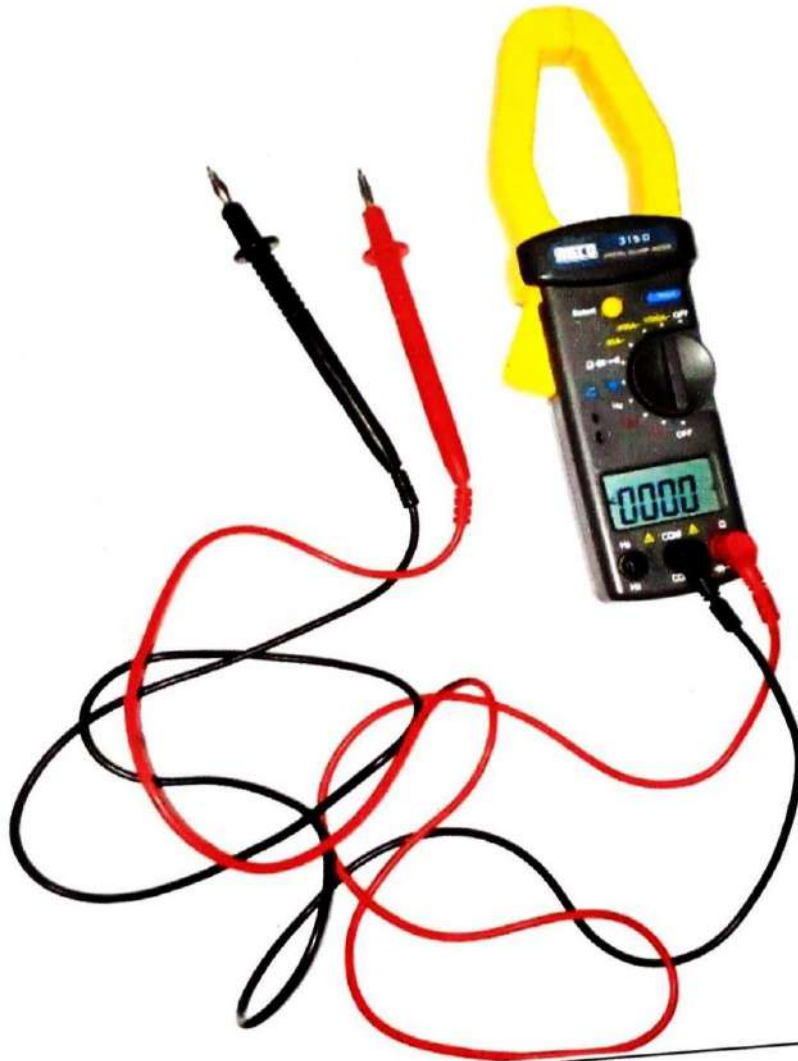

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8. LIST OF INSTRUMENTS

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

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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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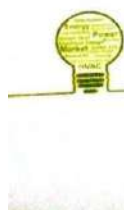


Picture 3 Nishant NE 1010 Lux meter

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

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जिला-अनूपपुर (मध्य प्रदेश)

E-mail: hegtldcano@mp.gov.in 9425844318

उपनांक / 112 / स्था / 2023 अनूपपुर दिनांक 14-01-2023

प्रति,
मैट्रल अधिकारी
ऊर्जा साक्षरता अभियान,
समन्वयक ऊर्जा विकास निगम लिमिटेड, भोपाल लिंक रोड-2, सिवाजी नगर, भोपाल

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

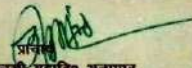
विनयाचनात्मक लेख है कि, मध्यप्रदेश शासन के अग्रणी अभियान "ऊर्जा साक्षरता अभियान" की हम सफलता करते हैं।

इस अभियान का सफल क्रियान्वयन हमारे कॉलेज द्वारा किया जा रहा है एवं विद्यार्थियों 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 / विद्यार्थियों की संख्या निम्नानुसार है:-

| 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 हैं।


प्राचार्य
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10. ANNEXURES

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10.1. Annexure 1: Site Photographs



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