# Nutan Urja Solutions

A 703, Balaji Witefield, Near Sunni's World,
Sus Road, Sus, Pune 411 021
Phone: 83568 18381. Email: nutanurja.solutions@gmail.com

Date: 23/08/2023

**CERTIFICATE**

This is to certify that we have conducted Green Audit at Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner for the year 2022–23.

The College has already adopted **Green** practices like:

- Installation of Rain Water Harvesting system
- Installation of Bio composting pit
- Installation of **2 kW** Roof Top Solar PV Power Plant.
- Usage of Energy Efficient LED
- Usage of Energy Efficient BEE STAR Rated equipment

We appreciate the support of Management, involvement of faculty members and students in the process of making the campus Green.

**Nutan Urja Solutions,**

K G Bhatwadekar,
Certified Energy Auditor,
EA - 22428

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This is to certify that we have conducted Energy Audit at Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner as per the guidelines of Maharashtra Energy Development Agency (www.mahaurja.com) in the year 2022-23.

The College has already adopted **Energy Efficient** practices like:

- Usage of Energy Efficient LED Fittings
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of **2kW** Roof Top Solar PV Power Plant.

We appreciate the support of Management, involvement of faculty members and students in the process of Energy Conservation & making the campus Green.

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The College has already adopted following projects for making the campus **Energy Efficient.**

- Installation of Bio Composting Pit
- Installation of Rain Water Harvesting System
- Installation of **2 kW** Solar PV Power Plant.

We appreciate the support of Management, involvement of faculty members and students in the process of Energy Conservation & making the campus Green.

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# Report

# On

# Environmental Audit

# At

# Gitabai Dattatray Mahajan Arts,

# Shri Keshrmal Rajmal Navlakha Commerce

# and Manoharseth Dhariwal Science College,

# Jamner

# (Year 2022-23)

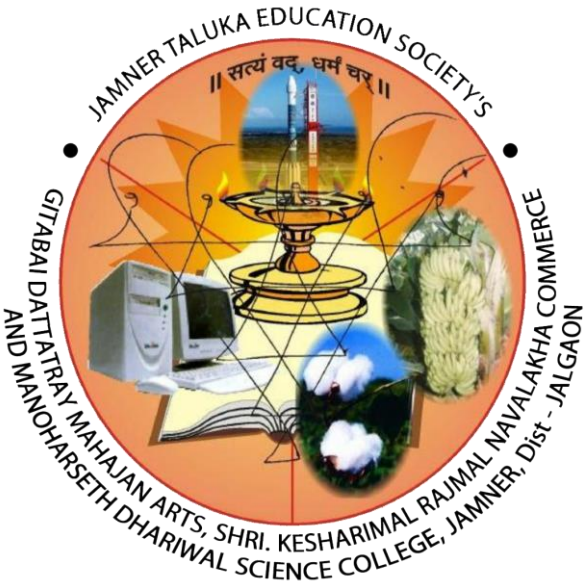


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Table of Contents

## Acknowledgement

We at Nutan Urja Solutions, Pune wish to express our sincere gratitude to the management of Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner for assigning the work of Environmental Audit of college campus.

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

We are also thankful to various Head of Departments & other Staff members for helping us during the field measurements.

We are also thankful to 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.

## Executive Summary

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the dependency on Natural resources & reduce the pollution.

Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner consumes various resources for day to day operations, namely: Air, Water, Electrical Energy & LPG.

**1. Various Pollution due to College Activities:**

- Air pollution: Mainly $CO_2$ on account of Electricity & LPG Consumption
- Solid Waste: Bio degradable Kitchen Waste, Garden Waste
- Liquid Waste: Human liquid waste

**2. Present Level of $CO_2$ Emissions:**

| No | Parameter /Value | Energy, kWh | $CO_2$ Emissions, MT |
|---|---|---|---|
| 1 | Maximum | 2,296 | 1.84 |
| 2 | Minimum | - | - |
| 3 | Average | 1,095 | 0.88 |
| 4 | Total | 13,138 | 10.51 |

**3. The various projects already implemented for Environmental Conservation:**

- Usage of Natural Day light in corridors
- Implementation of Bio Composting pit for disposal of Bio degradable waste
- Implementation of Rain Water Harvesting
- Installation of 2 **kW** Solar PV Power Plant.

**4. Recommendations:**

1. Installation of Bio Gas Generator Plant instead of Bio composting Plant.
2. Installation of Sewage treatment Plant to make campus a Zero Discharge campus

**5. Notes & Assumptions:**

1. **1 kWh** of Electrical Energy releases **0.8 Kg of $CO_2$** into atmosphere
2. 1 kWp Solar PV plant generates 5 kWh/day Electrical Energy for 300 days in an year.

# Abbreviations

| | | |
|---|---|---|
| AC | : | Air conditioner |
| PES | : | Progressive Education Society |
| CFL | : | Compact Fluorescent Lamp |
| FTL | : | Fluorescent Tube Light |
| LED | : | Light Emitting Diode |
| kWh | : | kilo-Watt Hour |
| Qty | : | Quantity |
| W | : | Watt |
| kW | : | Kilo Watt |
| PF | : | Power Factor |
| M D | : | Maximum Demand |
| PC | : | Personal Computer |
| MSEDCL | : | Maharashtra State Electricity Distribution Company Ltd |

# 1. Introduction

## 1.1 Important Definitions:

### 1.1.1 Environment: Definition as per environment Protection Act: 1986

Environment includes water, air and land and the inter-relationship which exists among and between Water, Air, Land and Human beings, other living creatures, plants microorganism and property

### 1.1.2. Environmental Audit: Definition:

An audit which aims at verification and validation to ensure that various environmental laws are compiled with and adequate care has been taken towards environmental protection and preservation

*According to UNEP, 1990, "Environmental audit can be defined as a management tool comprising systematic, documented and periodic evaluation of how well environmental organization management and equipment are performing with an aim of helping to regularize the environment*

**1.1.3. Environmental Pollutant:** means any solid, liquid and gaseous substance present in the concentration as may be, or tend to be, injurious to Environment.

### 1.1.4. Relevant Environmental Laws in India: Table No-1:

| | |
|---|---|
| 1927 | The Indian Forest Act |
| 1972 | The Wildlife Protection Act |
| 1974 | The Water (Prevention and Control of Pollution) Act |
| 1977 | The Water (Prevention & Control of Pollution) Cess Act |
| 1980 | The Forest (Conservation) Act |
| 1981 | The Air (Prevention and Control of Pollution) Act |
| 1986 | The Environment Protection Act |
| 1991 | The Public Liability Insurance Act |
| 2002 | The Biological Diversity Act |
| 2010 | The National Green Tribunal Act |

### 1.1.5. Some Important Environmental Rules in India: Table No-2:

| | |
|---|---|
| 1989 | Hazardous Waste (Management and Handling) Rules |
| 1989 | Manufacture, Storage and Import of Hazardous Chemical Rules |
| 2000 | Municipal Solid Waste (Management and Handling) Rules |
| 1998 | The Biomedical Waste (Management and Handling) Rules |
| 1999 | The Environment (Siting for Industrial Projects) Rules |
| 2000 | Noise Pollution (Regulation and Control) Rules |
| 2000 | Ozone Depleting Substances (Regulation and Control) Rules |

| | |
|---|---|
| 2011 | E-waste (Management and Handling) Rules |
| 2011 | National Green Tribunal (Practices and Procedure) Rules |
| 2011 | Plastic Waste (Management and Handling) Rules |

### 1.1.6 National Environmental Plans & Policy Documents: Table No-3:

| | |
|---|---|
| 1. | National Forest Policy, 1988 |
| 2. | National Water Policy, 2002 |
| 3. | National Environment Policy or NEP (2006) |
| 4. | National Conservation Strategy and Policy Statement on Environment and Development, 1992 |
| 5. | Policy Statement for Abatement of Pollution (1992) |
| 6. | National Action Plan on Climate Change |
| 7. | Vision Statement on Environment and Human Health |
| 8. | Technology Vision 2030 (The Energy Research Institute) |
| 9. | Addressing Energy Security and Climate Change (MoEF and Bureau of Energy Efficiency |
| 10 | The Road to Copenhagen; India's Position on Climate Change Issues (MoEF) |

## 1.2 Objectives

1. To study present usage of Natural resources the College is consuming
2. To Study the present pollution sources
3. To study various measures to make the campus Self sustainable in respect of Natural resources
4. To suggest the various measures to reduce the pollution: Air, Water, Noise

## 1.3 Audit Methodology:

1. Study of College as System
2. Study of Electrical Energy Consumption
3. Study of CO2 emissions
4. Suggestions on usage of Renewable Energy

## 1.4 General Details of College

| No | Head | Particulars |
|---|---|---|
| 1 | Name of Institution | Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science, Jamner |
| 2 | Address | Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science, Jalgaon Road, Jamner 424 206. |
| 3 | Affiliation | Kaviyitri Bahinabai Chaudhari North Maharashtra University, Jalgaon. |

## 2. Study of Consumption of Various Resources

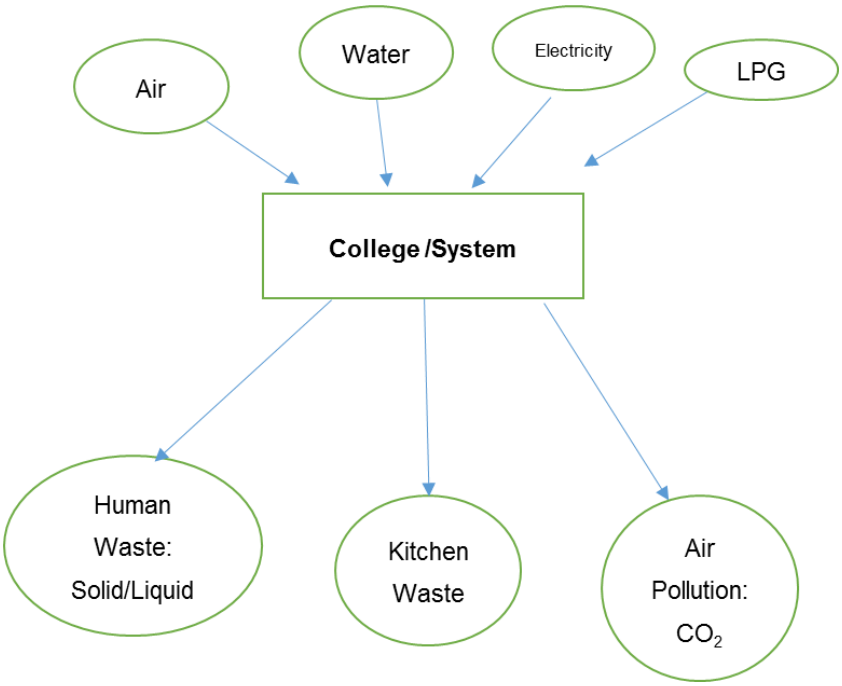
The Institute consumes following basic/derived Resources:

1. Air
2. Water
3. Electrical Energy
4. Liquefied Petroleum Gas

Also, college emits following pollutants to environment

1. Human Waste: Solid/ Liquid
2. Kitchen waste
3. Air pollution

We try to draw a schematic diagram for the College System & Environment as under.




Now we compute the Generation of CO2 on account of consumption of Electrical Energy & LPG as under.

The calculation of electrical energy consumption by college can be given as,

**Table 2.1: Electrical Energy Consumption**

| No | Month | Energy Consumed, kWh |
|---|---|---|
| 1 | Jun-23 | 2008 |
| 2 | May-23 | 2296 |
| 3 | Apr-23 | 1909 |
| 4 | Mar-23 | 1568 |
| 5 | Feb-23 | 713 |
| 6 | Jan-23 | 365 |
| 7 | Dec-22 | 940 |
| 8 | Nov-22 | 679 |
| 9 | Oct-22 | 931 |
| 10 | Sep-22 | 158 |
| 11 | Aug-22 | 0 |
| 12 | Jul-22 | 1571 |
| | **Total** | **13,138** |
| | **Maximum** | 2,296 |
| | **Minimum** | - |
| | **Average** | 1,095 |

## 2.1 Variation of Monthly Electrical Energy Consumption

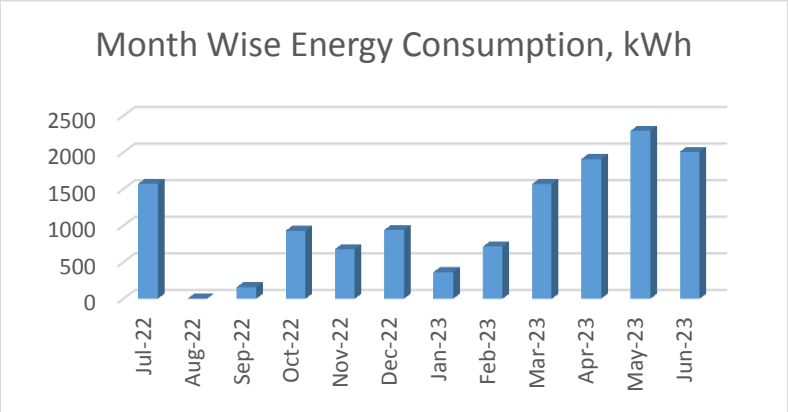



**Figure 2.1 : Monthly Electrical Energy Consumption**

## 2.2 Key Inference drawn

From the above analysis, we present following important parameters:

**Table 2.2: Variation in Important Parameters**

| No | Parameter/ Value | Energy Consumed, kWh |
|---|---|---|
| 1 | **Maximum** | 2,296 |
| 2 | **Minimum** | - |
| 3 | **Average** | 1,095 |
| 4 | **Total** | 13,138 |

# 3. Study of Environmental Pollution

In this Chapter, we present the various types of Pollution as under:

## 3.1 Air Pollution

The College is using two forms of Energies, namely: Thermal in the form of LPG and Electrical Energy used for day to day operations of the College. The major pollutant on account of above Energy forms is the Carbon Di Oxide.

- 1 unit (kWh) of Electrical Energy emits 0.8 Kg of $CO_2$ in the atmosphere
- 1 Kg of LPG emits 3 Kg of $CO_2$ in the atmosphere

In the following Table, we present the $CO_2$ emissions.

**Table 3.1: Month wise Consumption of Electrical Energy & $CO_2$ Emissions:**

| No | Month | Energy Consumed, kWh | $CO_2$ Emissions, MT |
|---|---|---|---|
| 1 | Jun-23 | 2,008 | 1.61 |
| 2 | May-23 | 2,296 | 1.84 |
| 3 | Apr-23 | 1,909 | 1.53 |
| 4 | Mar-23 | 1,568 | 1.25 |
| 5 | Feb-23 | 713 | 0.57 |
| 6 | Jan-23 | 365 | 0.29 |
| 7 | Dec-22 | 940 | 0.75 |
| 8 | Nov-22 | 679 | 0.54 |
| 9 | Oct-22 | 931 | 0.74 |
| 10 | Sep-22 | 158 | 0.13 |
| 11 | Aug-22 | - | 0.00 |
| 12 | Jul-22 | 1,571 | 1.26 |
| | **Total** | **13,138** | **10.51** |
| | **Maximum** | 2,296 | 1.84 |
| | **Minimum** | - | - |
| | **Average** | 1,095 | 0.88 |

In the following Chart we present the CO2 emissions due to usage of Electrical Energy.

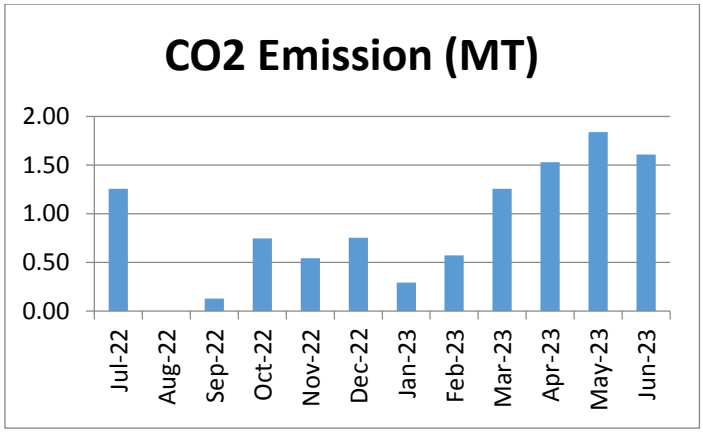



**Figure 2.1: CO2 emission due to usage of electrical energy.**

## 3.2 Study of Solid Waste Generation

The College has already installed a Bio composting Plant, wherein, the bio-degradable waste is composted & is used as fertilizer for the garden.

### 3.2.1 Photograph of Bio Composting Processing Tanks

## 3.3 Study of Liquid Waste Generation

At present the Liquid Waste generated due to day to day operations is drained off to the municipal Corporation through a pipe.

## 3.4 Study of e-Waste Management:

The internal communication is through emails and hence there is hardly any generation of e-Waste in the premises.

## 4. Study of Rain Water Harvesting

The College has already installed Rain Water Harvesting project, wherein the rain water falling on the terrace is collected and through pipes it is fed to underground Water Storage tank. This stored water is then reused for domestic purpose.

**Photograph of Rain Water Harvesting Pipe:**

## 5. Recommendations

In order to reduce the dependency on Natural resources and also in order to reduce the various pollutions arising due to the day to day operations of the College we herewith recommend following recommendations.

- Installation of Bio Gas Generator Plant instead of Bio composting Plant.
- Installation of Sewage treatment Plant to make campus a Zero Discharge campus

# Report

# On

# Green Audit

# At

# Gitabai Dattatray Mahajan Arts,
# Shri Keshrmal Rajmal Navlakha Commerce
# and Manoharseth Dhariwal Science College,
# Jamner

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We are also thankful to various Head of Departments & other Staff members for helping us during the field measurements.

We hope that the recommendations stated in this report will be useful and worthy of discussions to take things forward to help implementation of energy conservation measures and green practices. While we have made every attempt to adhere to high quality standards, in both data collection and analysis through the report, we would welcome your suggestions so as to improve upon this report further.

## Executive Summary

Green Audit of Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner is conducted by Nutan Urja Solutions, Pune. Based On the audit field study, following important points can be presented.

**1. Present Energy Consumption**

Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner uses Electrical Energy as the source of Energy for various equipment in the college campus. In the following Table, we present the details of Energy Consumption.

**Table no 1: Details of energy consumption**

| Sr no | Parameter | Energy consumed, (Units) | CO2 Emission (MT) |
|---|---|---|---|
| 1 | Maximum | 2,296 | 1.84 |
| 2 | Minimum | - | - |
| 3 | Average | 1,095 | 0.88 |
| 4 | Total | 13,138 | 10.51 |

**2. Various Measures Adopted for Energy Conservation**

1. Usage of STAR Rated ACs at new installations
2. Usage of LED lights at some indoor locations
3. Usage of LED Lights for outdoor lighting.

**3. Usage of Renewable Energy**

The collage has installed 2 **kW** Solar PV Power Plant.

**4. Rain Water Harvesting**

The College has installed the Rainwater harvesting project, to reduce dependency on municipal corporation water supply.

**5. Waste Management**

The College has already installed a Bio composting Plant, wherein, the bio-degradable waste is composted & is used as fertilizer for the garden.

The internal communication is through emails and there is hardly any generation of e-Waste in the premises.

## 6. Notes and Assumptions

1. Daily working hours-10 Nos
2. Annual working Days-250 Nos
3. Average Rate of Electrical Energy : **Rs 11/- per kWh**

# Abbreviations

| | | |
|---|---|---|
| CFL | : | Compact Fluorescent Lamp |
| FTL | : | Fluorescent Tube Light |
| LED | : | Light Emitting Diode |
| V | : | Voltage |
| I | : | Current |
| kW | : | Kilo- Watt |
| kWh | : | kilo-Watt Hour |
| kVA | : | Active Power |

# 1. Introduction

Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner. The college is established by Jamner Taluka Education Society in 1971. The college is well equipped with modern research laboratories which are recognized by the university. Wide range of co-curricular, extra-curricular and extension activities are implemented for the personality development of the students. The college is affiliated to Kaviyitri Bahinabai Chaudhari North Maharashtra University.

## 1.1 Objectives

1. To study present level of Energy Consumption
2. To Study the present $CO_2$ emissions
3. To assess the various equipment/facilities from Energy efficiency aspect
4. To measure various Electrical parameters
5. To study Scope for usage of Renewable Energy
6. To study various measures to reduce the Energy Consumption

## 1.2 Audit methodology

1. Study of connected load
2. Study of various Electrical parameters
3. To prepare the Report with various Encon measures with payback analysis

## 2. Study of Electrical Energy Consumption

In this chapter, electricity bills are studied for the analysis of electrical energy consumption.

**Table no 2.1: Summary of electricity bills**

| No | Month | Energy (kWh) | Bill Amount (Rs) |
|---|---|---|---|
| 1 | Jun-23 | 2008 | 18168 |
| 2 | May-23 | 2296 | 20778 |
| 3 | Apr-23 | 1909 | 17297 |
| 4 | Mar-23 | 1568 | 13703 |
| 5 | Feb-23 | 713 | 6484 |
| 6 | Jan-23 | 365 | 3546 |
| 7 | Dec-22 | 940 | 46226 |
| 8 | Nov-22 | 679 | 42964 |
| 9 | Oct-22 | 931 | 8325 |
| 10 | Sep-22 | 158 | 1799 |
| 11 | Aug-22 | 0 | 384 |
| 12 | Jul-22 | 1571 | 13728 |
| | **Total** | **13,138** | **1,93,402** |

Variation in energy consumption is as follows,

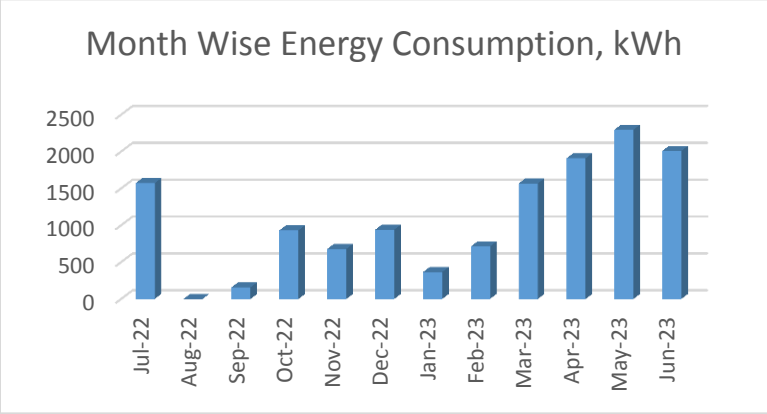


**Figure 2.1: Month wise energy consumption**

Monthly variation in electricity bill is as follows,

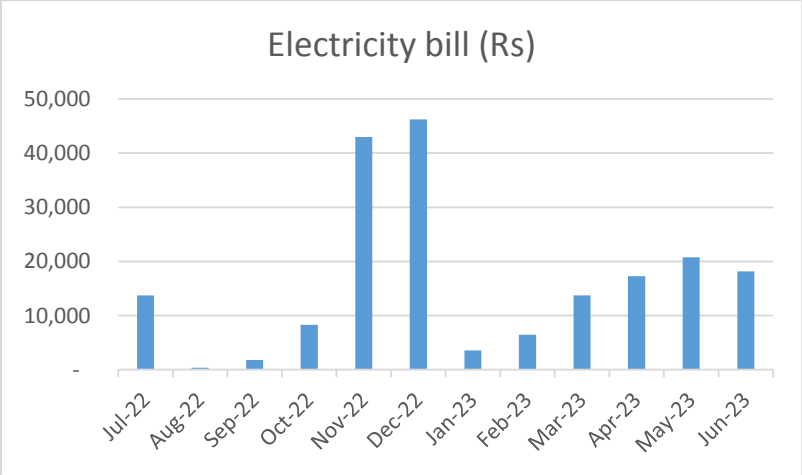


**Figure 2.2: Month wise electricity bill**

Key observations of electricity bill are as follows,

**Table no 2.2: Key observations**

| Sr no | Parameter | Energy consumed, (Units) | CO2 Emmision (MT) |
|---|---|---|---|
| 1 | Maximum | 2,296 | 1.84 |
| 2 | Minimum | - | - |
| 3 | Average | 1,095 | 0.88 |
| 4 | Total | 13,138 | 10.51 |

# 3. Carbon Foot printing

**1. A Carbon Foot print** is defined as the Total Greenhouse Gas emissions ($CO_2$ emissions), emitted due to various activities. In this we compute the emissions of Carbon-Di-Oxide, by usage of the various form of Electrical Energy used by the College for performing its day to day activities

**2. Basis for computation of $CO_2$ Emissions:**

The basis of Calculation for $CO_2$ emissions due to Electrical Energy is as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of $CO_2$** into atmosphere.

Based on the above Data we compute the $CO_2$ emissions which are being released in to the atmosphere by the College due to its Day to Day operations

We herewith furnish the details of various forms of Energy consumption as under

**Table 3.1: Month wise Consumption of Electrical Energy & CO2 Emissions**

| No | Month | Energy Consumed, kWh | CO2 Emissions, MT |
|---|---|---|---|
| 1 | Jun-23 | 2,008 | 1.61 |
| 2 | May-23 | 2,296 | 1.84 |
| 3 | Apr-23 | 1,909 | 1.53 |
| 4 | Mar-23 | 1,568 | 1.25 |
| 5 | Feb-23 | 713 | 0.57 |
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| 8 | Nov-22 | 679 | 0.54 |
| 9 | Oct-22 | 931 | 0.74 |
| 10 | Sep-22 | 158 | 0.13 |
| 11 | Aug-22 | - | 0.00 |
| 12 | Jul-22 | 1,571 | 1.26 |
| | **Total** | **13,138** | **10.51** |

In the following Chart we present the CO2 emissions due to usage of Electrical Energy.

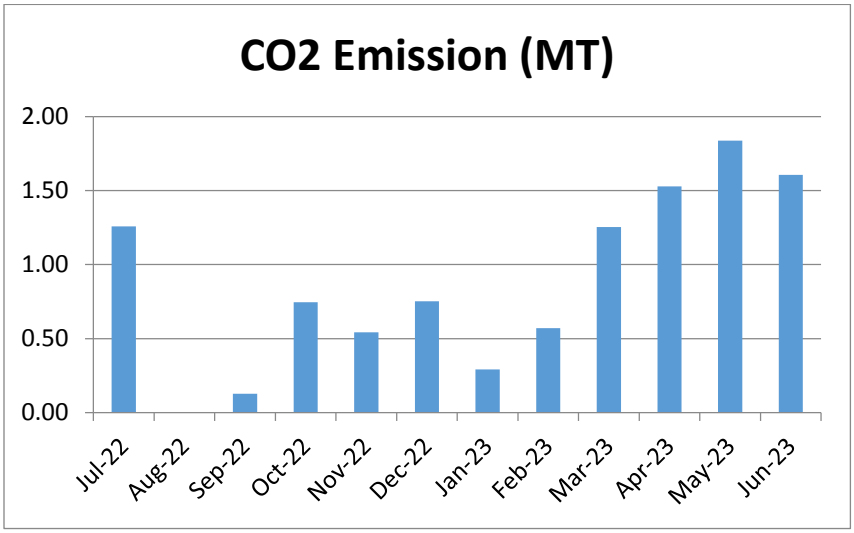


**Figure 3.1: Month wise CO2 Emission**

# 4. Study of Usage of Alternate Energy

In this Chapter, we compute the percentage of Usage of Alternate/Renewable Energy to Annual Energy Requirement of the College. The College has installed Solar PV System of 2kW capacity.

**Table 4.1: Computation of % Usage of Alternate Energy to Annual Energy Requirement**

| No | Particulars | Value | Unit |
|---|---|---|---|
| 1 | Annual Energy Purchased from MSEDCL | 13,138 | kWh/Annum |
| 2 | Energy Generated by Roof Top Solar PV System | 3000 | kWh/Annum |
| 3 | Total Energy Requirement of College | 16,138 | kWh/Annum |
| 4 | % of Usage of Alternate Energy to Annual Energy Requirement = 2*100/3 | 19 | **%** |

**Photograph of Solar PV plant**

## 5. Study of Rain Water Harvesting

The College has already installed Rain Water Harvesting project, wherein the rain water falling on the terrace is collected and through pipes it is fed to underground Water Storage tank. This stored water is then reused for domestic purpose.

**Photograph of Rain Water Harvesting pipe**

# 6. Study of Waste Management

## 6.1 Solid Waste Management

The College has already installed a Bio composting Plant, wherein, the bio-degradable waste is composted & is used as fertilizer for the garden.

**Photographs of Bio Composting Storage Tanks:**

## 6.2 e-Waste Management

The internal communication is through emails and hence there is hardly any generation of e-Waste in the premises.

# 7. Study of Green Practices

## 7.1 No of students who don't use own Vehicle for coming to Institute

Out of total students coming to Institute, about 60% students use own Automobile.

## 7.2 Usage of Public Transport

During the Students transport study, it was revealed that the local students who are residing near areas make use of Public Transport like Municipal Transport local buses, local sharing type auto rickshaws. Some students use bicycles. Institute encourages students to not to use automobiles.

## 7.3 Pedestrian Friendly Roads

The Institute has well defined pedestrian foot paths as to facilitate the easy movement of the students within the campus.

**Photograph of Road within campus**

### 7.4 Plastic Free Campus

The Institute is an active participant in the Government of India's most prestigious project of SWATCHH BHART ABHIYAN. The Institute has displayed boards in the Campus, to make the campus plastic free. Various measures adopted for this purpose are as follows

- Installation of Separate waste bins for Dry waste & wet waste
- Usage of paper tea cups in the Institute canteen
- Display of boards in the campus for Plastic Free campus

### 7.5 Paperless Office

The internal communication of the Institute is through the Internet. There are hardly any day to day operations, where printing is required.

### 7.6 Green Landscaping with Trees and Plants

The Institute has beautiful maintained Garden.

**Figure 7.1: Beautiful maintained Garden of college**

# Report

# On

# Energy Audit

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We hope that the recommendations stated in this report will be useful and worthy of discussions to take things forward to help implementation of energy conservation measures through energy savings. While we have made every attempt to adhere to high quality standards, in both data collection and analysis through the report, we would welcome your suggestions so as to improve upon this report further.

## Executive Summary

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the $CO_2$ emissions. College consumes Energy in the form of Electrical Energy used for various gadgets, Office & other facilities.

**1. Present Energy Consumption**

In the following Table, we present the details of Energy Consumption.

**Table no 2.1: Details of energy consumption**

| Sr no | Parameter | Energy consumed, (kWh) | CO2 Emission (MT) |
|---|---|---|---|
| 1 | Total | 13138 | 10.51 |
| 2 | Maximum | 2,296 | 1.84 |
| 3 | Minimum | - | - |
| 4 | Average | 1,095 | 0.88 |

**2. Energy Conservation Projects already installed**

1. Usage of STAR Rated ACs at new installations
2. Usage of LED lights at some indoor locations
3. Usage of LED Lights for outdoor lighting.

**3. Key Observations**

1. Usage of LED lights.
2. Usage of star rated equipment.
3. Maintained a good power factor.

**4. Percentage of Usage of Alternate Energy**

The College has installed a Roof Top Solar PV Plant. The percentage of usage of Alternate Energy to Annual Energy Requirement is 19 %.

**5. Percentage of Usage of LED Lighting**

The College has various Types of Light fittings. The percentage of Annual LED Lighting Usage to Annual Lighting requirement works out to be 100 %.

## 6. Recommendations

**Table no 1: Recommendations for energy savings**

| No | Recommendation | Annual Saving potential, kWh/Annum | Annual Monetary Gain, Rs. | Investment Required, Rs. | Payback period, Months |
|---|---|---|---|---|---|
| 1 | Replacement of 160 Nos Old Ceiling Fans with STAR rating fans | 8,000 | 88,000 | 3,47,840 | 47 |
| 2 | Replacement of 2 Nos Old 1.5 TR Acs with STAR rating Acs | 3,000 | 33,000 | 1,05,750 | 38 |
| 3 | Installation of 5kW grid connected PV panel | 7,500 | 82,500 | 2,50,000 | 36 |
| | **Total** | **18,500** | **2,03,500** | **7,03,590** | **41** |

## 7 Notes & Assumptions

1. Daily working hours-10 Nos
2. Annual working Days-300 Nos
3. Average Rate of Electrical Energy : **Rs 11/- per kWh**

## Abbreviations

| | | |
|---|---|---|
| CFL | : | Compact Fluorescent Lamp |
| FTL | : | Fluorescent Tube Light |
| LED | : | Light Emitting Diode |
| V | : | Voltage |
| I | : | Current |
| kW | : | Kilo- Watt |
| kWh | : | kilo-Watt Hour |
| kVA | : | Active Power |

# 1. Introduction

Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science College, Jamner. The college is established by Jamner Taluka Education Society in 1971. The college is well equipped with modern research laboratories which are recognized by the university. Wide range of co-curricular, extra-curricular and extension activities are implemented for the personality development of the students. The college is affiliated to Kaviyitri Bahinabai Chaudhari North Maharashtra University.

## 1.1 Objectives

1. To study present level of Energy Consumption
2. To Study Electrical Consumption
3. To assess the various equipment/facilities from Energy efficiency aspect
4. To study various measures to reduce the Energy Consumption

## 1.2 Audit Methodology:

1. Study of connected load
2. Study of various Electrical parameters
3. To prepare the Report with various Encon measures with payback analysis

## 1.3 General Details of College

**Table No-1.1: Details of college**

| No | Head | Particulars |
|---|---|---|
| 1 | Name of Institution | Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science, Jamner |
| 2 | Address | Gitabai Dattatray Mahajan Arts, Shri Kesharimal Rajmal Navlakha Commerce and manoharseth Dhariwal Science, Jalgaon Road, Jamner 424 206. |
| 3 | Affiliation | Kaviyitri Bahinabai Chaudhari North Maharashtra University, Jalgaon. |

## 2. Study of connected load

In this chapter, we present details of various connected electrical equipment and electrical load.

**Table No-2.1: Location wise study of Electrical fittings in various buildings**

| No | Location | LED tube (20W) | LED bulb (12W) | Computers (65W) | Fans | 1.5TR old Acs |
|---|---|---|---|---|---|---|
| 1 | Principal Cabin | 4 | | 1 | 3 | 1 |
| 2 | Office | 10 | | 10 | 8 | |
| 3 | O.S. Cabin | 2 | 1 | 1 | 2 | |
| 4 | Staff Room | 2 | | | 6 | |
| 5 | Store Room | 2 | | | 1 | |
| 6 | Library | 6 | | 3 | 8 | |
| 7 | Student Reading Room | 4 | 4 | | 4 | |
| 8 | Exam Strong Room | 2 | | | 2 | |
| 9 | Exam Sensitive Room | 1 | | | 2 | |
| 10 | Girls Common Room | 2 | | | 2 | |
| 11 | N.S. S. Office | 1 | | | 1 | |
| 12 | Computer Lab | 4 | | 18 | 5 | |
| 13 | Class Room 1 | | 2 | | 3 | |
| 14 | Class Room 2 | | 2 | | 3 | |
| 15 | Class Room 3 | 2 | 2 | | 4 | |
| 16 | Class Room 4 | | 2 | | 3 | |
| 17 | Class Room 5 | | 2 | | 4 | |
| 18 | Class Room 6 | | 2 | | 7 | |
| 19 | Class Room 7 | | 2 | | 4 | |
| 20 | Class Room 8 | | 2 | | 7 | |
| 21 | Class Room 9 | | 2 | | 3 | |
| 22 | Class Room 10 | | 2 | | 4 | |
| 23 | Class Room 11 | | 2 | | 3 | |
| 24 | Class Room 12 | | 2 | | 5 | |
| 25 | Class Room 13 | | 2 | | 4 | |
| 26 | Class Room 14 | | 2 | | 3 | |
| 27 | Class Room 15 | | 2 | | 3 | |
| 28 | English Departmen | 1 | 1 | | 1 | |
| 29 | Hindi Departent | 1 | 1 | | 1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | Marati Department | 1 | 1 | | 1 | |
| 31 | Economics Deparment | 1 | 1 | | 1 | |
| 32 | Maths Department | 2 | 1 | 1 | 6 | |
| 33 | Seminar Hall | 2 | | | 6 | |
| 34 | NAAC Room | 2 | | 1 | 2 | 1 |
| 35 | Laboratory 1 Chemistry | 3 | | 1 | 6 | |
| 36 | Laboratory 2 Physics | 15 | 3 | 1 | 14 | |
| 37 | Laboratory 3 Botany | 2 | | | 5 | |
| 38 | Laboratory 4 Zoology | 4 | 6 | | 5 | |
| 39 | Laboratory 5 Geography | 2 | 4 | 1 | 6 | |
| 40 | Gymkhana | 6 | | | 1 | |
| 41 | Corridor | 1 | 9 | | | |
| 42 | Gents Student Wash Room | | 2 | | | |
| 43 | Gents Staff Wash Room | | 2 | | | |
| 44 | Ladies Staff Wash Room | | 2 | | | |
| 45 | Ladies Student Wash Room | | 2 | | | |
| 46 | Suvidha Facility | 2 | | 2 | 1 | |
| | **Total** | **87** | **70** | **40** | **160** | **2** |

Apart from above load, the college has pumps, street lights. Individual fitting wise load is as under.

**Table No 2.2: Equipment wise Connected Load**

| No | Equipment | Qty | Load, W/Unit | Load, kW |
|---|---|---|---|---|
| 1 | LED Tube-20W | 87 | 20 | 1.7 |
| 2 | LED bulb | 70 | 12 | 0.8 |
| 3 | Computers | 40 | 65 | 2.6 |
| 4 | Ceiling Fan | 160 | 65 | 10.4 |
| 5 | AC- (1.5 Tr old) | 2 | 2200 | 4.4 |
| 6 | LED focus Street light | 3 | 35 | 0.1 |
| 7 | Pumps (1 no 3HP) | 1 | | 0.7 |
| | **Total** | | | **15.7** |

Data can be represented in terms of PIE chart as under,

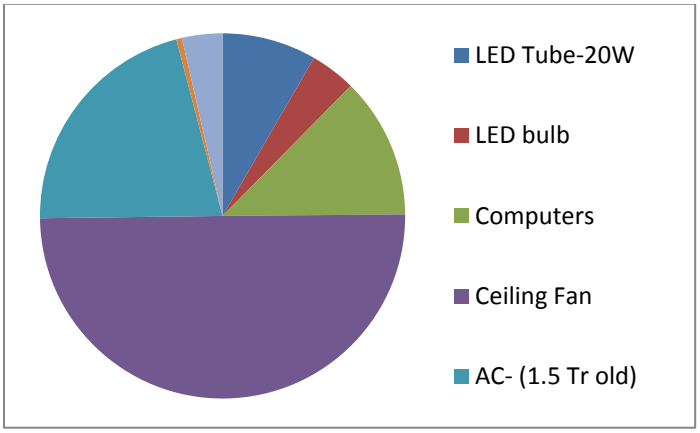


**Figure 2.1: Distribution of connected load.**

# 3. Study of Electrical Energy Consumption

In this chapter, electricity bills are studied for the analysis of electrical energy consumption.

**Table no 3.1: Summary of electricity bills**

| No | Month | Energy (kWh) | Bill Amount (Rs) |
|---|---|---|---|
| 1 | Jun-23 | 2008 | 18168 |
| 2 | May-23 | 2296 | 20778 |
| 3 | Apr-23 | 1909 | 17297 |
| 4 | Mar-23 | 1568 | 13703 |
| 5 | Feb-23 | 713 | 6484 |
| 6 | Jan-23 | 365 | 3546 |
| 7 | Dec-22 | 940 | 46226 |
| 8 | Nov-22 | 679 | 42964 |
| 9 | Oct-22 | 931 | 8325 |
| 10 | Sep-22 | 158 | 1799 |
| 11 | Aug-22 | 0 | 384 |
| 12 | Jul-22 | 1571 | 13728 |
| | **Total** | **13,138** | **1,93,402** |

Variation in energy consumption is as follows,

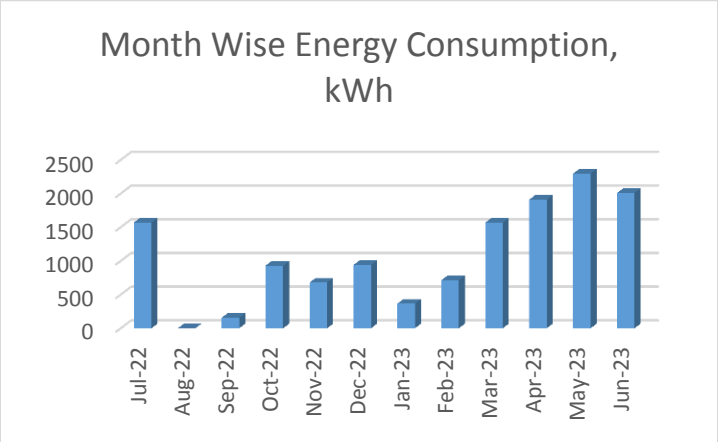


**Figure 3.1: Month wise energy consumption**

Monthly variation in electricity bill is as follows,

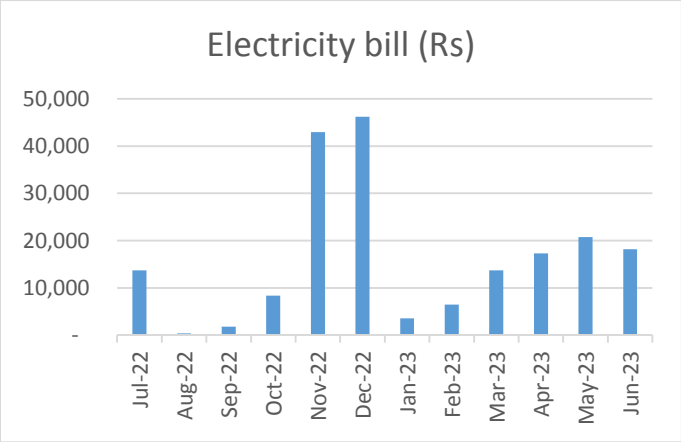


**Figure 3.2: Month wise electricity bill**

Key observations of electricity bill are as follows,

**Table no 3.2: Key observations**

| Sr no | Parameter | Energy consumed, (kWh) | CO2 Emission (MT) |
|---|---|---|---|
| 1 | Total | 13138 | 10.51 |
| 2 | Maximum | 2,296 | 1.84 |
| 3 | Minimum | - | - |
| 4 | Average | 1,095 | 0.88 |

# 4. Carbon Foot printing

**1. A Carbon Foot print** is defined as the Total Greenhouse Gas emissions ($CO_2$ emissions), emitted due to various activities. In this we compute the emissions of Carbon-Di-Oxide, by usage of the various form of Electrical Energy used by the College for performing its day to day activities

**2. Basis for computation of $CO_2$ Emissions:**

The basis of Calculation for $CO_2$ emissions due to Electrical Energy is as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of $CO_2$** into atmosphere.

Based on the above Data we compute the $CO_2$ emissions which are being released in to the atmosphere by the College due to its Day to Day operations

We herewith furnish the details of various forms of Energy consumption as under

**Table 4.1: Month wise Consumption of Electrical Energy & CO2 Emissions**

| No | Month | Energy Consumed, kWh | CO2 Emissions, MT |
|---|---|---|---|
| 1 | Jun-23 | 2,008 | 1.61 |
| 2 | May-23 | 2,296 | 1.84 |
| 3 | Apr-23 | 1,909 | 1.53 |
| 4 | Mar-23 | 1,568 | 1.25 |
| 5 | Feb-23 | 713 | 0.57 |
| 6 | Jan-23 | 365 | 0.29 |
| 7 | Dec-22 | 940 | 0.75 |
| 8 | Nov-22 | 679 | 0.54 |
| 9 | Oct-22 | 931 | 0.74 |
| 10 | Sep-22 | 158 | 0.13 |
| 11 | Aug-22 | - | 0.00 |
| 12 | Jul-22 | 1,571 | 1.26 |
| | **Total** | **13,138** | **10.51** |

In the following Chart we present the CO2 emissions due to usage of Electrical Energy.

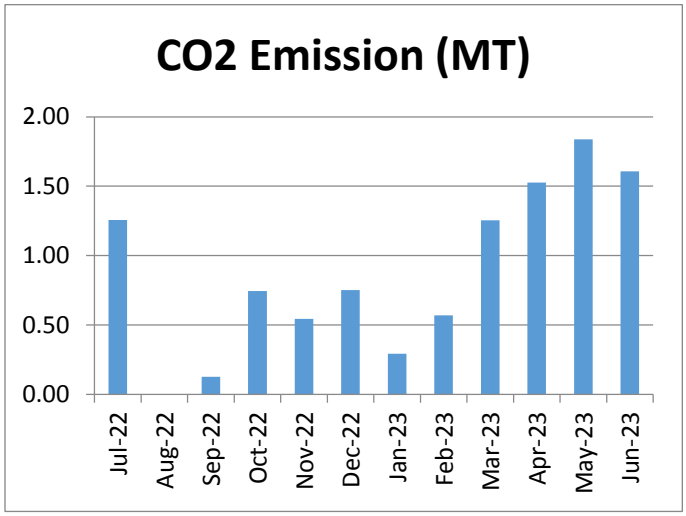


**Figure 4.1: Month wise CO2 Emission**

# 5. Study of utilities

## 5.1 Study of Lighting

In the facility, the lighting system can be divided mainly in to parts, indoor lighting and outdoor lighting. 87 nos of LED tubes, 70 nos of LED bulbs There are 3 No of LED street lights.

## 5.2 Air-conditioners

In the facility, there are about 02 Nos. of 1.5 Tr old Air-conditioners. It is recommended to replace these Old ACs with BEE STAR Rated ACs.

## 5.3 Ceiling Fans

At building facility, there are about 160 Nos Old Ceiling Fans, which consumed about 65 W of Electrical Energy. It is recommended to replace these old Fans with BEE STAR Rated Ceiling Fans.

## 5.4 Water Pumps

There are in total 1 Water pumps with 3HP capacity.

## 6. Study of usage of alternate energy

In this Chapter, we compute the percentage of Usage of Alternate/Renewable Energy to Annual Energy Requirement of the College. The College has installed Roof Top Solar PV System. The Installed Capacity of Solar PV Plant is **2 kWp**.

**Table 6.1: Computation of % Usage of Alternate Energy to Annual Energy Requirement**

| No | Particulars | Value | Unit |
|---|---|---|---|
| 1 | Annual Energy Purchased from MSEDCL | 13,138 | kWh/Annum |
| 2 | Energy Generated by Roof Top Solar PV System | 3000 | kWh/Annum |
| 3 | Total Energy Requirement of College | 16,138 | kWh/Annum |
| 4 | % of Usage of Alternate Energy to Annual Energy Requirement | 19 | **%** |

**Photograph of Solar PV plant**

# 7. Study of usage of LED lighting

In this chapter we study the lighting system of college and compute the percentage of total load catered by LED lighting.

**Table 7.1: Total lighting load**

| No | Particulars | Qty | Load, W/Unit | Load, kW |
|---|---|---|---|---|
| | **LED lighting load** | | | |
| 1 | LED tube | 87 | 20 | 1.7 |
| 2 | LED bulbs | 70 | 12 | 0.8 |
| 3 | LED street lights | 3 | 35 | 0.1 |
| | **Total LED lighting load** | | | **2.7** |
| | **Total Lighting load** | | | **2.7** |

It can be seen that out of total lighting load 100% load is LED lighting load.

# 8. Energy conservation proposals

## 8.1 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 160 no of fans. It is recommended to replace these old fans with STAR Rated fans.

In the following Table, we present the savings, investment required & payback analysis.

| No | Particulars | Value | Unit |
|---|---|---|---|
| 1 | Present Qty of Old Ceiling Fan fittings | 160 | Nos |
| 2 | Energy Demand of Old Ceiling Fan fitting | 65 | W/Unit |
| 3 | Energy Demand of STAR Rated Fan | 40 | W/Unit |
| 4 | Reduction in demad | 25 | W/Unit |
| 5 | Average Daily Usage period | 8 | Hrs/Day |
| 6 | Daily saving in Energy | 32 | kWh/Day |
| 7 | Annual Working Days | 250 | Nos |
| 8 | Annual Energy Saving possible | 8000 | kWh/Annum |
| 9 | Rate of Electrical Energy | 11 | Rs/kWh |
| 10 | Annual Monetary saving | 88000 | Rs/Annum |
| 11 | Cost of STAR Rated Ceiling Fan | 2174 | Rs/unit |
| 12 | Investment required | 347840 | Rs lump sum |
| 13 | Simple Payback period | 47 | Months |

## 8.2 Replacement of 1.5 TR Old ACs with STAR Rated ACs

During the Audit, it was observed that there are 2 Nos, of 1.5 TR old ACs. It is recommended to replace these old ACs with STAR Rated ACs.

In the following Table, we present the savings, investment required & payback analysis.

| No | Particulars | Value | Unit |
|---|---|---|---|
| 1 | Present Qty of 1.5 TR Old ACs | 2 | Nos |
| 2 | Energy Demand of Old 1.5 TR AC | 2.15 | kW/Unit |
| 3 | Energy Demand of New AC | 1.15 | kW/Unit |
| 4 | Reduction in demad | 1 | kW/Unit |
| 5 | Average Daily Usage period | 6 | Hrs/Day |
| 6 | Daily saving in Energy | 12 | kWh/Day |
| 7 | Annual Working Days | 250 | Nos |
| 8 | Annual Energy Saving possible | 3000 | kWh/Annum |
| 9 | Rate of Electrical Energy | 11 | Rs/kWh |
| 10 | Annual Monetary saving | 33000 | Rs/Annum |
| 11 | Cost of STAR Rated 1.5 TR AC | 52875 | Rs/unit |
| 12 | Investment required | 105750 | Rs lump sum |
| 13 | Simple Payback period | 38 | Months |

### 8.3 Installation of Solar PV panel

It is recommended to install 5 kW solar PV panel. In the following Table, we present the savings, investment required & payback analysis.

| No | Particulars | Value | Unit |
|---|---|---|---|
| 1 | Installation of 5kW PV unit | 5 | kW |
| 2 | Energy saving | 7500 | kWh/Annum |
| 3 | Rate of electrical energy | 11 | Rs |
| 4 | Annual monetory savings | 82500 | Rs/ Annum |
| 5 | Investment required | 250000 | Rs lump sum |
| 6 | Simple payback period | 36 | Months |

### 8.4 Summary of Savings

| No | Recommendation | Annual Saving potential, kWh/Annum | Annual Monetary Gain, Rs. | Investment Required, Rs. | Payback period, Months |
|---|---|---|---|---|---|
| 1 | Replacement of 160 Nos Old Ceiling Fans with STAR rating fans | 8,000 | 88,000 | 3,47,840 | 47 |
| 2 | Replacement of 2 Nos Old 1.5 TR Acs with STAR rating Acs | 3,000 | 33,000 | 1,05,750 | 38 |
| 3 | Installation of 5kW grid connected PV panel | 7,500 | 82,500 | 2,50,000 | 36 |
| | **Total** | **18,500** | **2,03,500** | **7,03,590** | **41** |