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: 28/08/2022

CERTIFICATE

This is to certify that we have conducted Green Audit at Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar for the year 2021–22.

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

- Installation of Rain Water Harvesting system
- Installation of Bio composting pit
- Installation of **Solar Thermal Hot Water System**
- Usage of Energy Efficient LED
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of Solar PV system of 150kW capacity
- Installation tribid system of 3 kW capacity using Solar, Wind, Battary

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

Report

On

Green Audit

At

Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar

(Year 2021-22)

Prepared by

Nutan Urja Solutions

A 703, Balaji Witefield, Near Sunni's World,

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Acknowledgement

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar for awarding us the assignment of Green Audit of their college premises.

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.

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Executive Summary

Green Audit of Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar is conducted by Nutan Urja Solutions, Pune. Based On the audit field study, following important points can be presented.

1. Present Energy Consumption

Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar 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	18,535	14.8
2	Minimum	2,046	1.6
3	Average	6,210	5.0
4	Total	74,525	59.6

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 college has installed solar PV system of 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battary system. Percentage usage of renewable energy is 75%.

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**

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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

Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar (GECA) is an autonomous engineering Institute in Maharashtra state of India. It is affiliated to the Dr. Babasaheb Ambedkar Marathwada University and was established in 1960. The construction of the college was started in 1957 and was completed in 1960. The institute has been granted autonomous status since 2006.

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

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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-22	16,817	183,236
2	May-22	18,535	198,498
3	Apr-22	14,323	164,755
4	Mar-22	4,408	83,267
5	Feb-22	2,385	63,861
6	Jan-22	2,841	68,238
7	Dec-21	3,471	74,271
8	Nov-21	2,772	67,570
9	Oct-21	2,400	64,004
10	Sep-21	2,219	62,261
11	Aug-21	2,046	60,605
12	Jul-21	2,308	63,132
	Total	**74,525**	**1,153,698**

Variation in energy consumption is as follows,

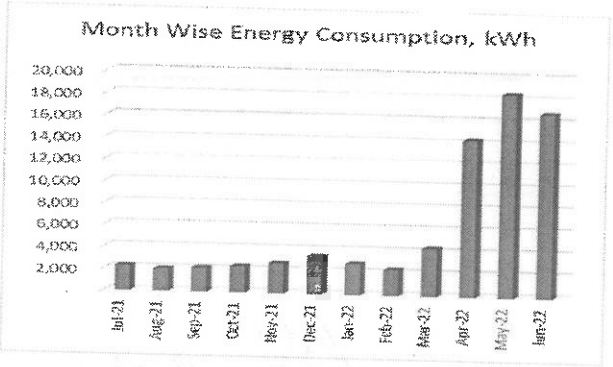

Figure 2.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

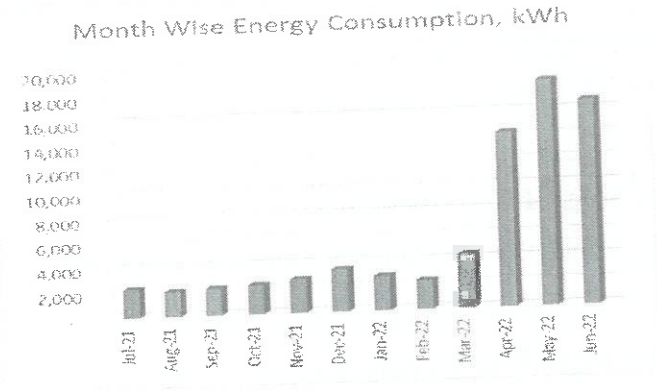

Figure 2.2: Month wise electricity bill

Key observations of electricity bill are as follows,

Table no 2.2: Key observations

Sr no	Parameter	Energy consumed, (Units)	CO2 Emission (MT)
1	Maximum	18,535	14.8
2	Minimum	2,046	1.6
3	Average	6,210	5.0
4	Total	74,525	59.6

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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-22	16,817	13.45
2	May-22	18,535	14.83
3	Apr-22	14,323	11.46
4	Mar-22	4,408	3.53
5	Feb-22	2,385	1.91
6	Jan-22	2,841	2.27
7	Dec-21	3,471	2.78
8	Nov-21	2,772	2.22
9	Oct-21	2,400	1.92
10	Sep-21	2,219	1.78
11	Aug-21	2,046	1.64
12	Jul-21	2,308	1.85
	Total	**74,525**	**59.62**

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

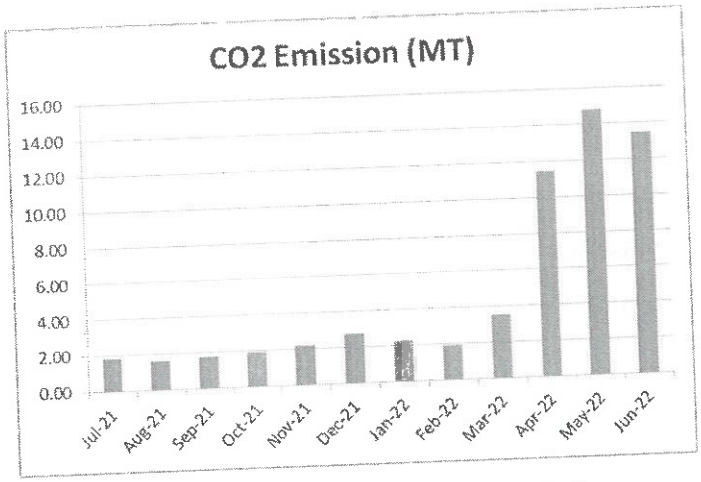


Figure 3.1: Month wise CO2 Emission

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 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battary system.

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

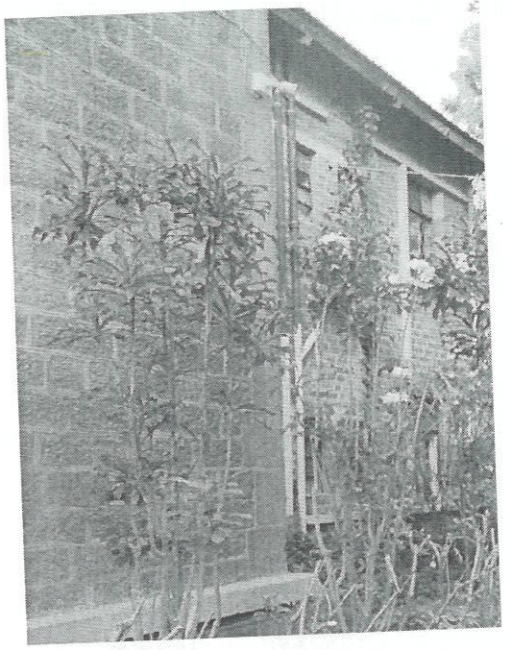
No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	74,525	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	225000	kWh/Annum
3	Total Energy Requirement of College	299,525	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	75	%

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.

6.2 e-Waste Management

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

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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 20% students use own Automobile.

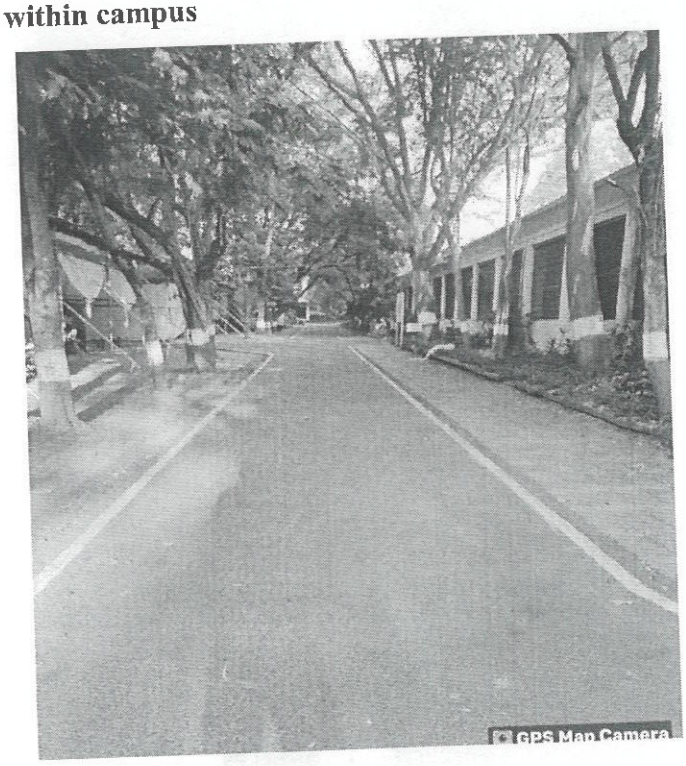
7.2 Usage of Public Transport

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.

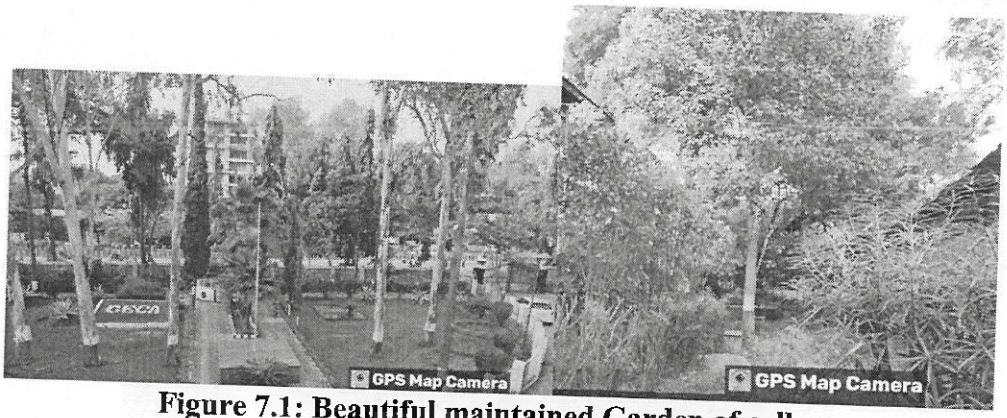


Figure 7.1: Beautiful maintained Garden of college

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Table no 1: Details of energy consumption

Sr no	Parameter	Energy consumed, (Units)	CO2 Emission (MT)
1	Maximum	28,222	22.6
2	Minimum	9,816	7.9
3	Average	16,343	13.1
4	Total	196,113	156.9

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 college has installed solar PV system of 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battary system. Percentage usage of renewable energy is 53%.

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6. Notes and Assumptions

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

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Abbreviations

CFL	:	Compact Fluorescent Lamp
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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	May-23	28,222	406,493
2	Apr-23	24,611	302,441
3	Mar-23	22,102	227,664
4	Feb-23	15,652	173,835
5	Jan-23	9,816	126,543
6	Dec-22	13,166	154,311
7	Nov-22	10,064	130,391
8	Oct-22	13,512	156,537
9	Sep-22	20,868	217,893
10	Aug-22	10,231	129,677
11	Jul-22	11,052	135,671
12	Jun-22	16,817	183,236
	Total	**196,113**	**2,344,692**

Variation in energy consumption is as follows,

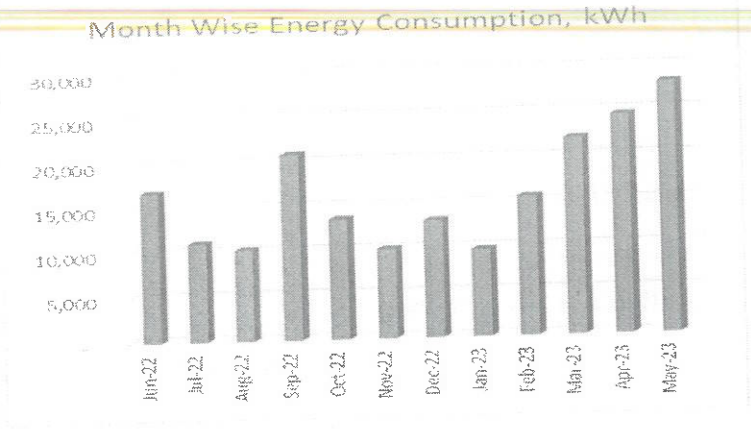

Figure 2.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

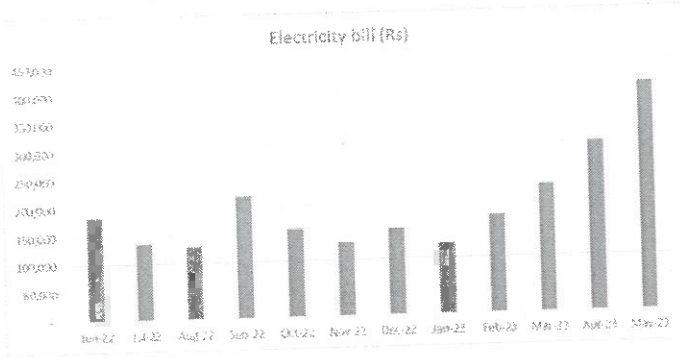

Figure 2.2: Month wise electricity bill

Key observations of electricity bill are as follows,

Table no 2.2: Key observations

Sr no	Parameter	Energy consumed, (Units)	CO2 Emission (MT)
1	Maximum	28,222	22.6
2	Minimum	9,816	7.9
3	Average	16,343	13.1
4	Total	196,113	156.9

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

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3	Mar-23	22,102	17.68
4	Feb-23	15,652	12.52
5	Jan-23	9,816	7.85
6	Dec-22	13,166	10.53
7	Nov-22	10,064	8.05
8	Oct-22	13,512	10.81
9	Sep-22	20,868	16.69
10	Aug-22	10,231	8.18
11	Jul-22	11,052	8.84
12	Jun-22	16,817	13.45
	Total	**196,113**	**156.89**

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

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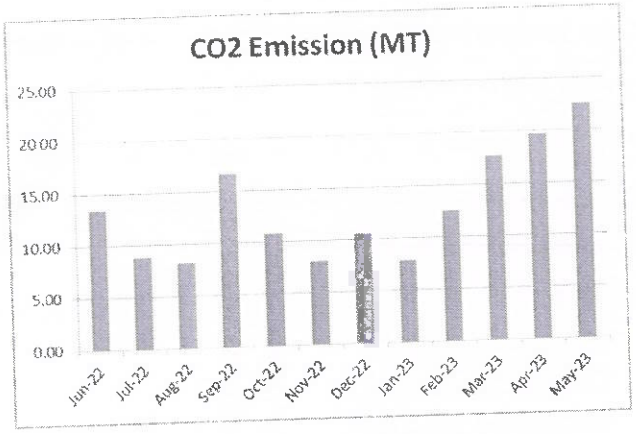

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Table 4.1: Computation of % Usage of Alternate Energy to Annual Energy Requirement

No	Particulars	Value	Unit
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Photograph of Solar PV plant

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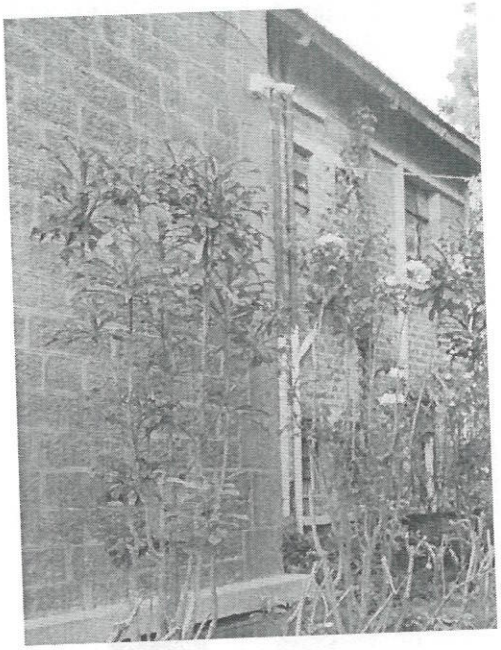

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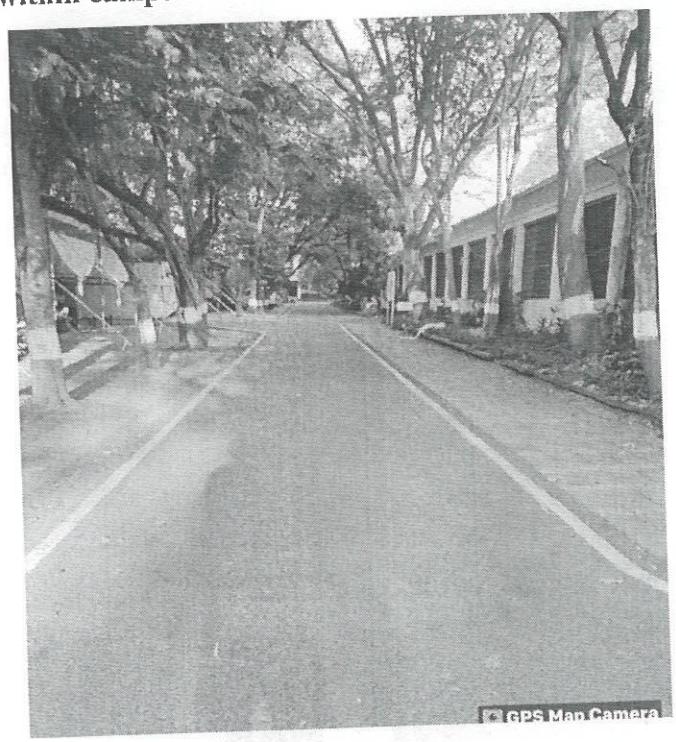

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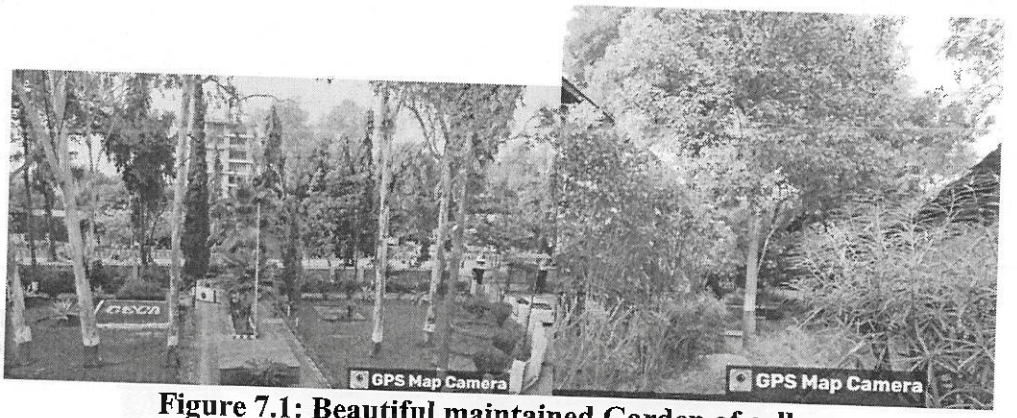

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2	Minimum	12,503	10.0
3	Average	24,531	19.6
4	Total	294,367	235.5

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 college has installed solar PV system of 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battary system. Percentage usage of renewable energy is 43%.

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

Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar (GECA) is an autonomous engineering Institute in Maharashtra state of India. It is affiliated to the Dr. Babasaheb Ambedkar Marathwada University and was established in 1960. The construction of the college was started in 1957 and was completed in 1960. The institute has been granted autonomous status since 2006.

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-24	20,913	301,499
2	May-24	35,318	464,898
3	Apr-24	36,351	488,319
4	Mar-24	29,910	368,768
5	Feb-24	23,832	304,439
6	Jan-24	19,464	258,629
7	Dec-23	12,503	184,897
8	Nov-23	20,064	264,981
9	Oct-23	31,439	381,234
10	Sep-23	26,748	333,170
11	Aug-23	21,059	266,298
12	Jul-23	16,766	295,956
	Total	**294,367**	**3,913,088**

Variation in energy consumption is as follows,

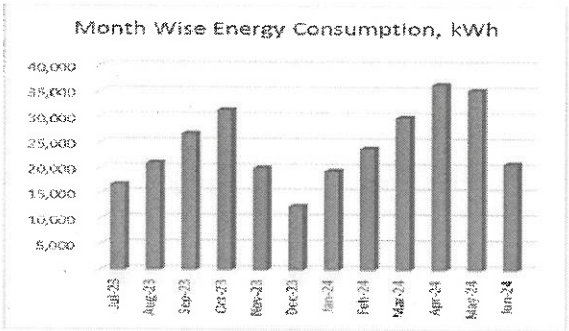


Figure 2.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

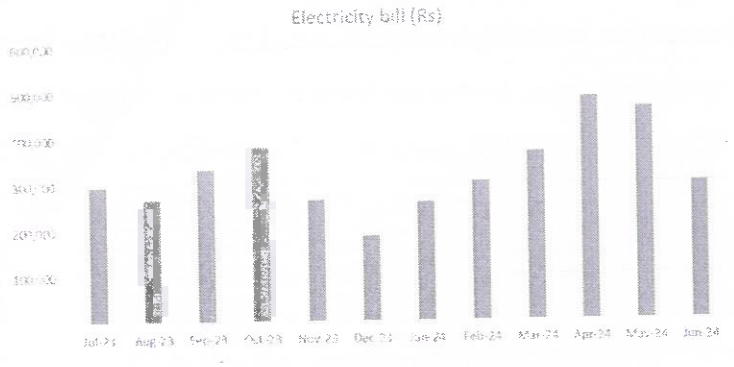


Figure 2.2: Month wise electricity bill

Key observations of electricity bill are as follows,

Table no 2.2: Key observations

Sr no	Parameter	Energy consumed, (Units)	CO2 Emission (MT)
1	Maximum	36,351	29.1
2	Minimum	12,503	10.0
3	Average	24,531	19.6
4	Total	294,367	235.5

Nutan Urja Solutions

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-24	20,913	16.73
2	May-24	35,318	28.25
3	Apr-24	36,351	29.08
4	Mar-24	29,910	23.93
5	Feb-24	23,832	19.07
6	Jan-24	19,464	15.57
7	Dec-23	12,503	10.00
8	Nov-23	20,064	16.05
9	Oct-23	31,439	25.15
10	Sep-23	26,748	21.40
11	Aug-23	21,059	16.85
12	Jul-23	16,766	13.41
	Total	**294,367**	**235.49**

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

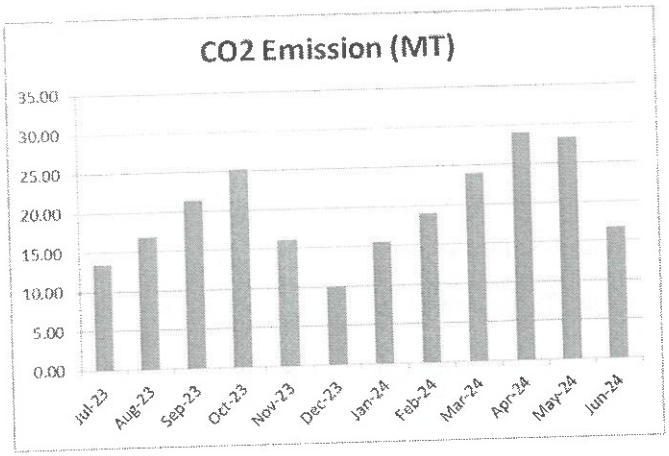


Figure 3.1: Month wise CO2 Emission

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 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battary system.

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

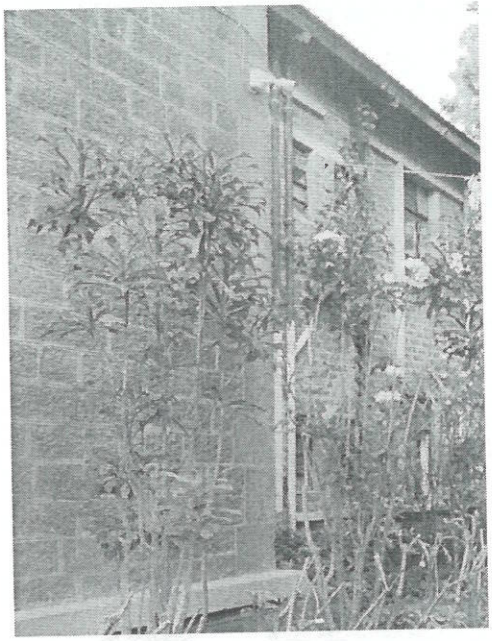
No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	294,367	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	225000	kWh/Annum
3	Total Energy Requirement of College	519,367	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	43	%

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.

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 20% students use own Automobile.

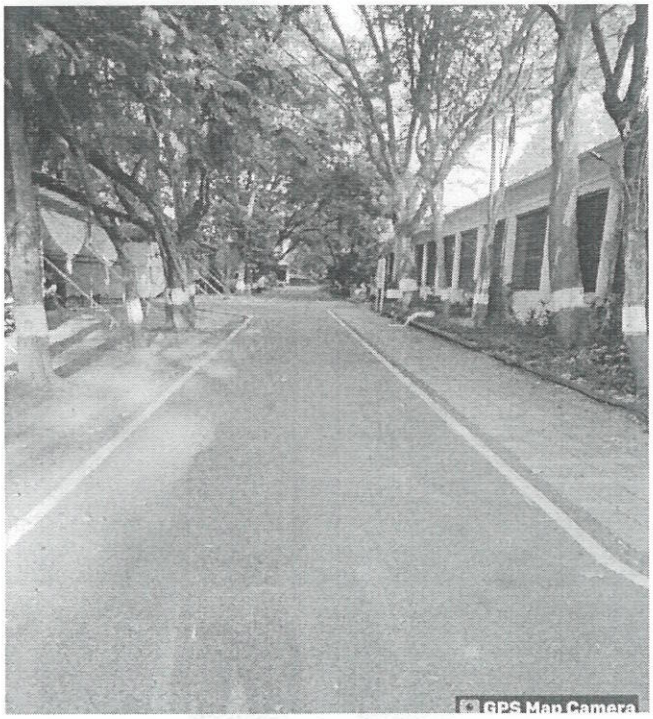
7.2 Usage of Public Transport

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.

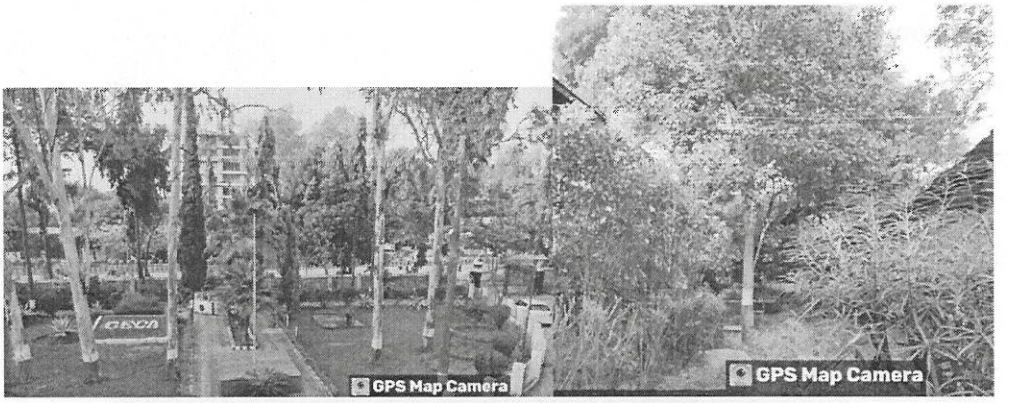


Figure 7.1: Beautiful maintained Garden of college