

ENERGY AUDIT REPORT

of

**Rajgad Dnyanpeeth's
Shri Chhatrapati Shivajiraje College of Engineering,
Dhangawadi, Tal: Bor, Dist: Pune**



Year: 2020-21

Prepared by

Enrich Consultants

Yashashree, 26, Nirmal Bag Society,
Near Muktangan English School, Parvati, Pune 411009
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MAHARASHTRA ENERGY DEVELOPMENT AGENCY

An ISO 9001 : 2009 Reg. no. : RC 91 / 2482



Maharashtra Energy Development Agency

(Government of Maharashtra Institution)

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ECN/2021-22/CR-14/1577

22nd April, 2021

**CERTIFICATE OF REGISTRATION
FOR CLASS 'A'**

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

Name and Address of the firm : M/s Enrich Consultants
Yushushree, Plot No. 26, Nirmal Bag Society,
Near Muktangan English School, Parvati,
Pune - 411009.

Registration Category : *Empanelled Consultant for Energy Conservation Programme for Class 'A'*

Registration Number : *MEDA/ECN/2021-22/Class A/EA-03*

- Energy Conservation Programme intends to identify areas where wasteful use of energy occurs and to evaluate the scope for Energy Conservation and take concrete steps to achieve the evaluated energy savings.
- MEDA reserves the right to visit at any time without giving prior information to verify quarterly activities performed by the firm and canceling the registration, if the information is found incorrect.
- This empanelment is valid till **21st April, 2023** from the date of registration, to carry out energy audits under the Energy Conservation Programme
- The Director General, MEDA reserves the right to cancel the registration at any time without assigning any reasons thereof.

General Manager (EC)

Enrich Consultants

Yashashree, 26, Nirmal Bag Society,
Near Mukhtangan English School, Parvati, Pune 411 009
Tel: 09890444795 Email: enrichcons@gmail.com

Ref: EC/RDSCSCOE/20-21/01

Date: 30/8/2021

CERTIFICATE

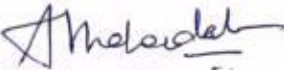
This is to certify that we have conducted Energy Audit at Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhore, Dist: Pune in the year 2020-21.

The College has adopted Energy Efficient practices:

- Usage of Energy Efficient LED Fittings
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of 10 kWp Capacity Roof Top Solar PV Plant
- Installation of 10000 LPD Solar Thermal Water Heating System, at Hostel block.

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

For Enrich Consultants,


A Y Mehendale,
Certified Energy Auditor
EA-8192



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ACKNOWLEDGEMENT

We Enrich Consultants, Pune, express our sincere gratitude to the management of Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhor, Dist: Pune for awarding us the assignment of Energy Audit of their Dhangawadi Campus for the Year: 2020-21.

We are thankful to:

- Prof. Dr. S. B. Patil, Principal
- Mr. S. K. Pawar, HOD, Mechanical Engg Department
- Mr. G. S. Jadhav, HOD, Civil Engg Department
- Mr. Lahu P. Maskepatil, Faculty, Mechanical Engg Department

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

EXECUTIVE SUMMARY

1. Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhore, Dist: Pune consumes Energy in the form of Electrical Energy used for various gadgets, Office & other facilities.

2. Present Energy Consumption & CO₂ Emissions:

No	Value	Energy Consumed, kWh	CO ₂ emissions, MT
1	Total	43198	38.88
2	Maximum	4690	4.22
3	Minimum	2300	2.07
4	Average	3600	3.24

3. Various Majors Adopted for Energy Conservation:

- Usage of Energy Efficient LED fittings
- Installation of 10 kWp Roof top Solar PV Plant
- Installation of 10000 LPD Solar Thermal Water Heating System, at Hostel blocks.

4. Usage of Alternate Energy Source:

- The College has installed Roof top Solar PV Plant of capacity **10 kWp**.
- The College has Solar Thermal Water Heater for Hostel blocks of Capacity **10000 LPD**.
- The Energy purchased from MSEDCL is **43198 kWh**.
- Energy generated by Roof Top Solar PV Plant is **12000 kWh**.
- The percentage of Annual Power requirement met by Renewable Energy Source is **21.74 %**.

5. Percentage of Lighting Power Requirements met by LED Lighting:

- The Total Lighting Load is **21918 kWh**.
- The LED Lighting Load is **2552 kWh**
- The percentage of LED Lighting to annual Lighting Demand is **11.64%**.

6. Notes & Assumptions:

1. 1 Unit of Electrical Energy releases **0.9 Kg of CO₂** into atmosphere
2. **1 kWp** Solar PV system generates **4 kWh** of Electrical Energy per Day
3. Daily working hours-**6 Nos** (For Lighting Calculations)
4. Annual working Days-**100 Nos** (For Lighting Calculations)

7. References:

1. For CO₂ Emissions: www.tatapower.com
2. For Solar PV: www.solarroftop.gov.in

ABBREVIATIONS

LED	:	Light Emitting Diode
MSEDCL	:	Maharashtra State Electricity Distribution Company Limited
kW	:	kilo-Watt
kWh	:	kilo-Watt Hour
kWp	:	Kilo Watt peak
FTL	:	Fluorescent Tube Light
MT	:	Metric Ton
MVL	:	Mercury Vapor Lamp
P C	:	Personal Computer
A C	:	Air conditioner

CHAPTER-I INTRODUCTION

1.1 Objectives:

1. To study present Energy Consumption
2. To Study the present CO₂ emissions
3. To study Scope for usage of Renewable Energy
4. To study usage of LED Lighting

1.2 Table No-1: General Details of College:

No	Head	Particulars
1	Name	Shri Chhatrapati Shivajiraje College of Engineering
2	Address	Dhangawadi, Tal: Bhore, Dist: Pune
3	Year of Establishment	2006
4	Courses Offered	Graduate courses in Engineering disciplines

CHAPTER-II STUDY OF CONNECTED LOAD

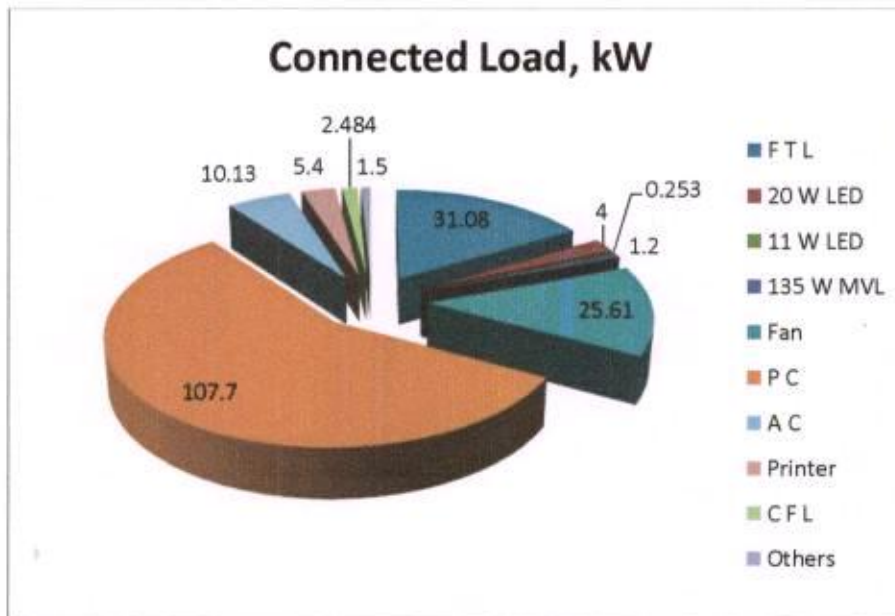
In this chapter, we present the details of various Electrical loads as under

2.1 Table No 2: Equipment wise connected Load:

No	Equipment	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	777	40	31.08
2	LED-20 W	200	20	4
3	LED-11W	23	11	0.253
4	MVL-135 W	8	150	1.2
5	Fan	394	65	25.61
6	P C	1077	100	107.7
7	A C	5	2025	10.13
8	Printer	36	150	5.4
9	Others	15	100	1.5
10	Total			186.87

We present the same in a PIE Chart as under:

Chart No-1: Details of Connected Load:

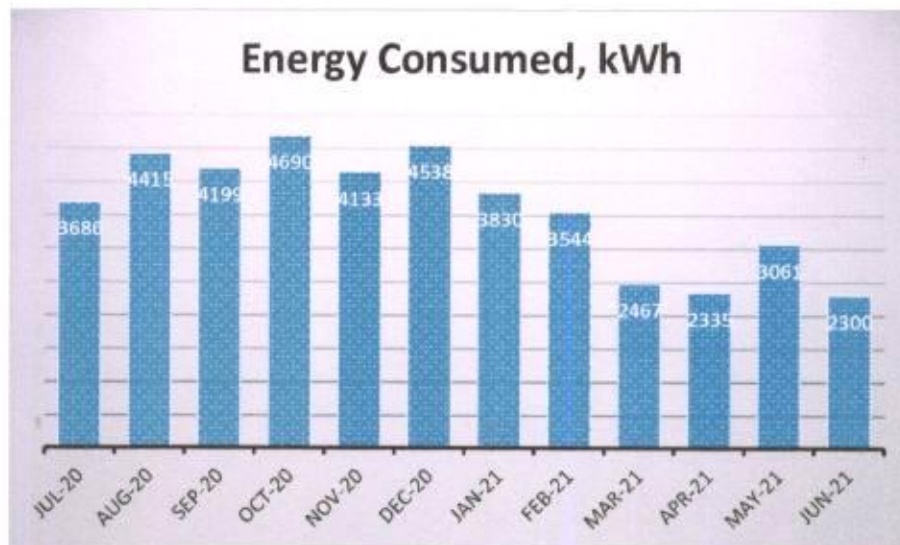


CHAPTER-III STUDY OF PRESENT ENERGY CONSUMPTION

In this chapter, we present the analysis of last year Electricity Bills
Table No 3: Electrical Energy Consumption: 2020-21:

No	Month	Energy Consumed, kWh
1	Jul-20	3686
2	Aug-20	4415
3	Sep-20	4199
4	Oct-20	4690
5	Nov-20	4133
6	Dec-20	4538
7	Jan-21	3830
8	Feb-21	3544
9	Mar-21	2467
10	Apr-21	2335
11	May-21	3061
12	Jun-21	2300
13	Total	43198
14	Maximum	4690
15	Minimum	2300
16	Average	3600

Chart No 2: To study the variation of Month wise Energy Consumed, kWh:



Key observations: Table No 4:

No	Value	Energy Consumed, kWh
1	Total	43198
2	Maximum	4690
3	Minimum	2300
4	Average	3600

CHAPTER-IV CARBON FOOTPRINTING

A Carbon Foot print is defined as the Total Greenhouse Gas emissions, emitted due to various activities.

In this we compute the emissions of Carbon-Di-Oxide, by usage of the various forms of Energy used by the College for performing its day to day activities

The College uses Electrical Energy for various Electrical gadgets.

Basis for computation of CO₂ Emissions:

The basis of Calculation for CO₂ emissions due to LPG & Electrical Energy are as under

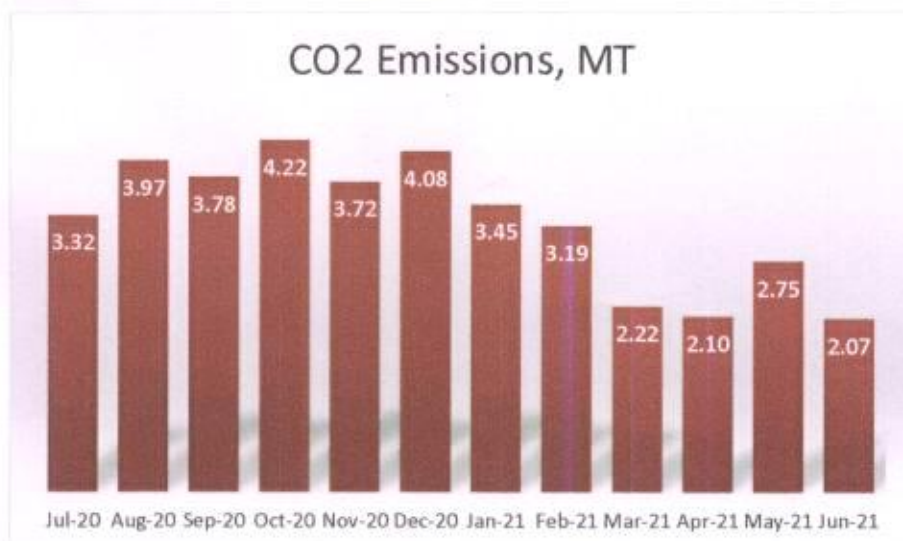
- 1 Unit (kWh) of Electrical Energy releases **0.9 Kg of CO₂** into atmosphere

Based on the above Data we compute the CO₂ emissions which are being released in to the atmosphere by the College due to its Day to Day operations

Table No 5: Month wise CO₂ Emissions:

No	Month	Energy Consumed, kWh	CO ₂ Emissions, MT
1	Jul-20	3686	3.32
2	Aug-20	4415	3.97
3	Sep-20	4199	3.78
4	Oct-20	4690	4.22
5	Nov-20	4133	3.72
6	Dec-20	4538	4.08
7	Jan-21	3830	3.45
8	Feb-21	3544	3.19
9	Mar-21	2467	2.22
10	Apr-21	2335	2.10
11	May-21	3061	2.75
12	Jun-21	2300	2.07
13	Total	43198	38.88
14	Maximum	4690	4.22
15	Minimum	2300	2.07
16	Average	3600	3.24

Representation of Month wise CO₂ emissions: Chart No 3:



Key observations: Table No 6:

No	Value	Energy Consumed, kWh	CO2 emissions, MT
1	Total	43198	38.88
2	Maximum	4690	4.22
3	Minimum	2300	2.07
4	Average	3600	3.24

CHAPTER-V STUDY OF USAGE OF ALTERNATE ENERGY

The College has installed Roof top Solar PV Plant of Capacity **10 kWp**. For Hostel blocks, the Solar Thermal Hot water System is used. The capacity is **10000 LPD**. In this Chapter, we compute the percentage of usage of Alternate (Renewable Energy) to Annual Energy Demand.

Table No 7: Computation of Percentage of Annual Power Requirement met by the Renewable Energy Source:

No	Particulars	Value	Unit
1	Annual Power Requirement of College-As per MSEDCL Bills	43198	kWh/Annum
2	Roof Top Solar PV Plant Capacity	10	kWp
3	Average Daily Energy generated by Solar PV Plant	4	kWh
4	Annual Energy generation Days	300	Nos
5	Energy generated by Roof top Solar PV Plant	12000	kWh/Annum
6	Total Annual Energy requirement= (1) + (5)	55198	kWh/Annum
7	% of Total Power met by Alternate Energy = (5) * 100 / (6)	21.74	%

Note: Due to lockdown, there was no use of Hostel blocks, hence we do not consider the usage of Solar Thermal Water Heating System, in operation, in the Year: 2020-21.

Photograph of 10 kWp Roof top Solar PV Plant:



Photograph of Solar Thermal Water Heating System at Hostel block:



CHAPTER VI STUDY OF USAGE OF LED LIGHTING

In the following Table, we compute the % of total Lighting requirement met by LEDs

Table No 8: Computation of % Lighting Power met by LEDs:

No	Particulars	Value	Unit
1	Number of T-8 FTLs in the campus	777	Nos
2	Load/Unit of T-8 FTL	40	W/Unit
3	Total Lighting Load of T-8 FTL	31.08	kW
4	Number of 20 W LEDs in the campus	200	Nos
5	Load/Unit of 20 W LED	20	W/Unit
6	Total Lighting Load of 20 W LEDs	4	kW
7	Number of 11 W LEDs in the campus	23	Nos
8	Load/Unit of 11 W LED	11	W/Unit
9	Total Lighting Load of 11 W LEDs	0.253	kW
10	Number of 135 W MVLs in the campus	8	Nos
11	Load/Unit of 135 W MVL	150	W/Unit
12	Total Lighting Load of 135 W MVLs	1.2	kW
13	Total Lighting Load= 3+6+9+12	36.53	kW
14	Total LED Lighting Load = 6+9	4.253	kW
15	Daily working hours	6	Hrs/Day
16	Annual Working Days	100	Days/Annum
17	Annual Total Lighting Load = 13*15*16	21918	kWh/Annum
18	Annual Lighting Load met by LED lights = 14*15*16	2552	kWh/Annum
19	% of LEDs to total Lighting Load= (14) *100/ (13)	11.64	%

ENVIRONMENTAL AUDIT REPORT
of
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Shri Chhatrapati Shivajiraje College of Engineering,
Dhangawadi, Tal: Bor, Dist: Pune



Year: 2020-21

Prepared by

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MAHARASHTRA ENERGY DEVELOPMENT AGENCY

An ISO 9001 : 2009 Reg. no. : RC 91 / 2462



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ECN/2021-22/CR-14/1577

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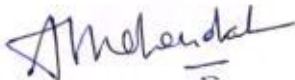
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The College has adopted following Environmentally Friendly practices:

- Usage of Energy Efficient LED Fittings,
- Installation of 10 kWp Roof top Solar PV Plant
- Installation of 10000 LPD Solar Thermal Water Heating System.
- Segregation of Waste at source
- Installation of Biogas plant for conversion of organic waste.
- Installation of Rain Water Harvesting Project
- Provision of Sanitary Waste Incinerator

We appreciate the involvement of the students and faculty members and the cooperation extended by the management, in the process of Energy Conservation and making the campus Green and Environment Friendly.

For Enrich Consultants,



A Y Mehendale,
Certified Energy Auditor
EA-8192



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EXECUTIVE SUMMARY

1. Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhore, Dist: Pune consumes Energy in the form of Electrical Energy used for various gadgets, Office & other facilities.

2. Present Energy Consumption & CO₂ Emissions:

No	Value	Energy Consumed, kWh	CO ₂ emissions, MT
1	Total	90169	72.14
2	Maximum	11748	9.40
3	Minimum	2250	1.8
4	Average	7514.08	6.01

3. Various Pollution caused due to College Activities:

- **Air pollution:** Mainly CO₂ on account of Electricity & LPG Consumption
- **Solid Waste:** Bio degradable Kitchen Waste, Garden Waste, Recyclable Waste and Human Waste
- **Liquid Waste:** Human liquid waste

4. Usage of Renewable Energy Source & CO₂ Emission Reduction:

- The College has installed Roof top Solar PV Plant of capacity **10 kWp**.
- The College has Solar Thermal Water Heater for Hostel blocks of Capacity **10000 LPD**.
- The amount of CO₂ emission reduction in 20-21 is **10.8 MT/Annum**.

5. Indoor Air Quality Parameters:

No	Parameter/Range	A Q I	PM-2.5	PM-10	Temperature, °C	Humidity, %	Lux Level
1	Maximum	190	90	98	25.4	77	983
2	Minimum	91	63	82	22.1	64	60

6. Waste Management:

6.1 Solid Waste Management:

The Waste is segregated at source. The College has installed a Bio gas plant of capacity **1.68 m³** and the bio degradable waste is converted in to Bio gas, which in turn is used in the college mess.

6.2 Liquid Waste Management:

In Campus liquid waste collected from various places like wash basin, urinals, toilets, water cooler etc. through plumbing system and is connected to Septic tank of capacity 240000 litres. The tank is cleaned periodically.

6.3 E-Waste Management:

All the internal communication is through emails and hardly any e-Waste is generated in the Day to Day operation of the College. The College authorities have already contacted Authorized e-Waste management vendor to dispose of any wastage generated during the day-to-day operations.

7. Rain Water Harvesting:

The College has installed **Rainwater Harvesting System** to collect the Rain Water collected at the Terrace & coming from other slopes, which in turn is used to enrich the underground water level and water level in the well.

8. Green & Sustainable Practices:

- Maintenance of Good Internal Road & Internal Garden
- Provision of Sanitary Waste Incinerator
- Display of Posters on importance of Resource Conservation

9. Notes & Assumptions:

1. 1 kWh of Electrical Energy releases **0.9 Kg of CO₂** into atmosphere
2. **1 kWp** Solar PV system generates **4 kWh** of Electrical Energy per Day
3. Annual Solar Generation Days: **300 Nos**

10. References:

1. For CO₂ Emission computation: www.tatapower.com
2. For Solar PV Energy Generation: www.solarroftop.gov.in
3. For Various Indoor Air Parameters: www.ishrae.com
4. For AQI & Water Quality Standards: www.cpcb.com

ABBREVIATIONS

CPCB	:	Central Pollution Control Board
ISHARE	:	The Indian Society of Heating & Refrigerating & Air Conditioning Engineers
AQI	:	Air Quality Index
PM2.5	:	Particulate Matter of Size 2.5 microns
PM 10	:	Particulate Matter of Size 10 microns
kWh	:	kilo-Watt Hour
kWp	:	Kilo Watt Peak
Qty	:	Quantity
W	:	Watt
kW	:	Kilo Watt
MT	:	Metric Ton
LPD	:	Litres Per Day

CHAPTER-I 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 College)
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 Audit Methodology:

1. Study of College as System
2. Study of Consumption of various Resources & CO₂ Emission
3. Study of Usage of Renewable Energy & CO₂ emission Reduction
4. Study of Indoor Air Quality Parameters
5. Study of Waste Management
6. Study of Rain Water Harvesting
7. Study of Environment Friendly Initiatives

1.3 General Details of College: Table No: 4

No	Head	Particulars
1	Name	Shri Chhatrapati Shivajiraje College of Engineering
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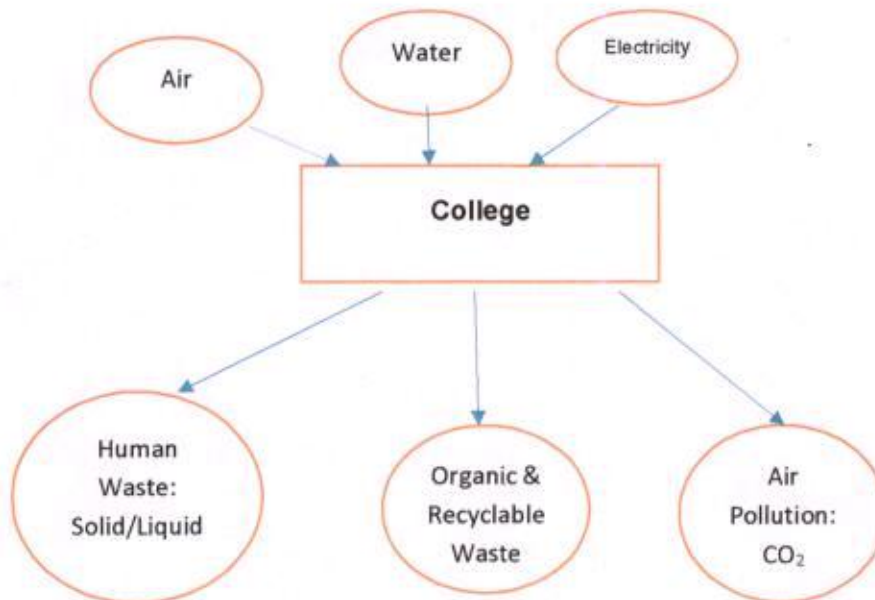
CHAPTER-II STUDY OF CONSUMPTION OF VARIOUS RESOURCES & CO₂ EMISSION

The College consumes following Natural/derived Resources:

1. Air
2. Water
3. Electrical Energy

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

Chart No: 1: Representation of College as System:



Now we study the consumption of Electrical Energy & CO₂ Emission as under.

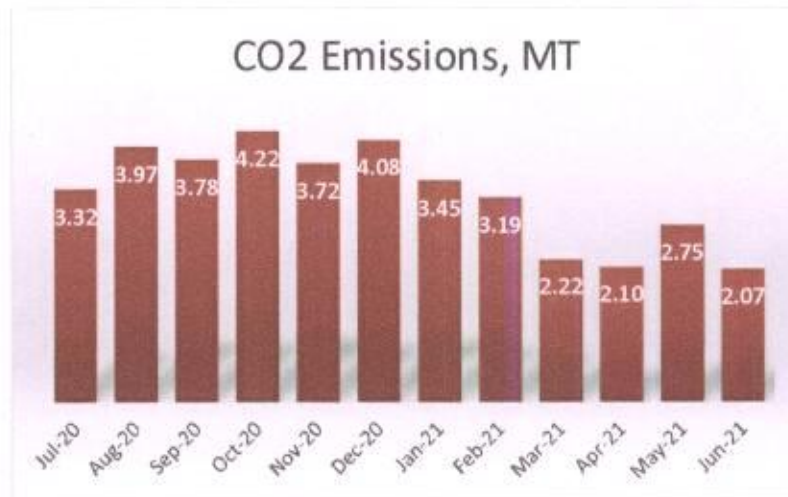
A Carbon Foot print is defined as the Total Greenhouse Gas emissions, emitted due to various activities. The basis of Calculation for CO₂ emissions due to Electrical Energy is: 1 kWh of Electrical Energy releases **0.9 Kg of CO₂** into atmosphere

Table No 5: Energy Consumption & CO₂ Emission: 2020-21:

No	Month	Energy Consumed, kWh	CO ₂ Emissions, MT
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8	Feb-21	3544	3.19
9	Mar-21	2467	2.22
10	Apr-21	2335	2.10
11	May-21	3061	2.75
12	Jun-21	2300	2.07
13	Total	43198	38.88
14	Maximum	4690	4.22
15	Minimum	2300	2.07
16	Average	3600	3.24

To study the variation of Monthly CO₂ Emission: Chart No: 2:



From the above analysis, we present following important parameters:

Table No 6: Variation in Important Parameters:

No	Value	Energy Consumed, kWh	CO ₂ emissions, MT
1	Total	43198	38.88
2	Maximum	4690	4.22
3	Minimum	2300	2.07
4	Average	3600	3.24

CHAPTER-III STUDY OF CO₂ EMISSION REDUCTION

The College has installed Roof top Solar PV Plant of Capacity 10 kWp. For Hostel blocks, the Solar Thermal Hot water System is used. The capacity is 10000 LPD.

Table No 7: Computation of CO₂ Emission reduction by Renewable Energy:

No	Particulars	Value	Unit
1	Annual Energy generated by 10 kWp Roof top Solar PV Plant	12000	kWh/Annum
2	1 kWh of Electrical Energy is equal to	0.9	MT
3	CO ₂ emission reduction on account of usage of Renewable Energy= (1) * (2) /1000	10.8	MT

Note: Due to lockdown, there was no use of Hostel blocks, hence we do not consider the usage of Solar Thermal Water Heating System, in operation.

Photograph of 10 kWp Roof top Solar PV Plant:



4.3 Photograph of Solar Thermal Water Heating System at Hostel block:



CHAPTER IV STUDY OF INDOOR AIR QUALITY PARAMETERS

5.1 Importance of Air Quality:

Air: The common name given to the atmospheric gases used in breathing and photosynthesis.

By volume, Dry Air contains 78.09% Nitrogen, 20.95% Oxygen, 0.93% Argon, 0.039% carbon dioxide, and small amounts of other gases.

On average, a person inhales about **14,000 litres** of air every day. Therefore, poor air quality may affect the quality of life now and for future generations by affecting the health, the environment, the economy and the city's liveability.

Rapid urbanization and industrialization has added other elements/compounds to the pure air and thus caused the increase in pollution. In order to prevent, control and abate air pollution, the Air (Prevention and Control of Pollution) Act was enacted in 1981.

Air quality is a measure of the suitability of air for breathing by people, plants and animals.

According to Section 2(b) of Air (Prevention and control of pollution) Act, 1981 'air pollution' has been defined as 'the presence in the atmosphere of any air pollutant.'

As per Section 2(a) of Air (Prevention and control of pollution) Act, 1981 'air pollutant' has been defined as 'any solid, liquid or gaseous substance [(including noise)] present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment

We present herewith following important Parameters.

1. AQI- Air Quality Index
2. PM 2.5- Particulate Matter of Size 2.5
3. PM 2.5- Particulate Matter of Size 2.5
4. Temperature
5. Humidity
6. Lux Level

Table No 8: Indoor Air Quality Parameters:

No	Location	AQI	PM-2.5	PM-10	Temp	Humidity	Lux
Ground Floor:							
1	CAD Lab	160	87	97	22.1	75	60
2	Admin office	163	78	88	23.2	77	130

3	Embedded Lab	160	70	85	23.7	75	390
4	Civil Dept	190	90	98	23.7	71	170
5	Main Porch	91	68	82	24.8	73	983
6	Hydraulics Lab	130	66	82	25.3	68	430
First Floor:							
1	Passage	160	73	86	25.3	71	490
2	Class Room	146	74	85	25.4	69	190
3	Work shop	93	63	84	25.3	72	222
4	Library	150	66	84	25.1	68	476
5	Reading Hall	110	67	82	25.2	70	104
6	Faculty Room	186	90	96	25.2	64	205
	Maximum	190	90	98	25.4	77	983
	Minimum	91	63	82	22.1	64	60

CHAPTER V STUDY OF WASTE MANAGEMENT PRACTICES

In this Chapter, we study the Waste management Practices of the College.

5.1 Solid Waste Management:

Separate Waste Collection Bins are placed at important locations. The Waste is segregated at source. The Collected Waste is further given for disposal.

Photograph of Waste Collections Bins:



5.2 Organic Waste Management:

In Campus canteen approximately 30 kg /day waste material in the form of leftover food is generated .This waste is collected and utilized for producing biogas using the plant. It takes 24 hours to convert this bio degradable waste into biogas. This biogas plant Specification is Volume of Digester 2.2 m³ and Gas Holding Capacity 1.68 m³. The energy generated from the biogas plant is utilized in institution mess.

Photograph of Biogas Plant:



5.3 Liquid Waste Management:

In Campus liquid waste collected from various places like wash basin, urinals, toilets, water cooler etc. through plumbing system and is connected to Septic tank of capacity 240000 liters. The tank is periodically cleaned, with the help of external agency.

5.4 E-Waste Management:

In campus non-repairable electronic items like computer components, mouse, cables, CDs, chargers, earphones, batteries, non-working switches, electric cables, etc. are stored properly in one place. E-waste bins are placed in the department at various locations. This Collected E- Waste is given to the authorized dealers NGO 'SWaCH' Pune Seva Sahakari Sanstha Ltd. Kothrud-Pune for reuse and disposed. Articles on e-waste management are also frequently displayed on the Notice Boards.

Photograph of E-Waste Collection Bin:



CHAPTER VI STUDY OF RAIN WATER HARVESTING

The College has implemented the Rain Water Harvesting Project. The College has installed Pipes from the terrace and the Rain water falling on the terrace is used to enrich the ground water level.

Photograph of Rain water Harvesting Pipe:



Photograph of Rain water Collection Pit Section:



CHAPTER VII

STUDY OF ENVIRONMENT FRIENDLY INITIATIVES

7.1 Tree Plantation & Internal Garden:

The College has well maintained Garden in the campus. The details of Trees is furnished in the Annexure.

Photograph of Tree plantation in the campus:



7.2 Provision of Sanitary Waste Incinerator:

The College has displayed posters on importance of Resource Conservation, Energy Conservation.

Photograph of Sanitary Waste Incinerator:



7.3 Creation of Awareness about Resource Conservation:

The College has displayed posters on importance of Resource Conservation like Water, Energy, and Ban of Plastic etc.

Photograph of Various Posters on Importance of Resource Saving & Ban on Plastic:



ANNEXURE: VARIOUS AIR QUALITY, WATER QUALITY, NOISE & INDOOR COMFORT STANDARDS:

1. Category Wise Air Quality Index Values & Concentration of PM 2.5 & PM10:

No	Category	AQI Value	Concentration Range, PM 2.5	Concentration Range, PM 10
1	Good	0 to 50	0 to 30	0 to 50
2	Satisfactory	51 to 100	31 to 60	51 to 100
3	Moderately Polluted	101 to 200	61 to 90	101 to 250
4	Poor	201 to 300	91 to 120	251 to 350
5	Very Poor	301 to 400	121 to 250	351 to 430
6	Severe	401 to 500	250 +	430 +

2. Recommended Water Quality Standards:

No	Designated Best Use	Criteria
1	Drinking Water Source without conventional Treatment but after disinfection	pH between 6.5 to 8.5 Dissolved Oxygen 6 mg/l or more
2	Drinking water source after conventional treatment and disinfection	pH between 6 to 9 Dissolved Oxygen 4 mg/l or more
3	Outdoor Bathing (Organized)	pH between 6.5 to 8.5 Dissolved Oxygen 5 mg/l or more
4	Controlled Waste Disposal	pH between 6 to 8.5

3. Recommended Noise Level Standards:

No	Location	Noise Level dB
1	Auditoriums	20-25
2	Outdoor Playground	55
3	Occupied Class Room	40-45
4	Un occupied Class Room	35
5	Apartment, Homes	35-40
6	Offices	45-50
7	Libraries	35-40
8	Restaurants	50-55

4. Thermal Comfort Conditions: For Non-conditioned Buildings:

No	Parameter	Value
1	Temperature	Less Than 33 ^o C
2	Humidity	Less Than 70%

GREEN AUDIT REPORT

of

**Rajgad Dnyanpeeth's
Shri Chhatrapati Shivajiraje College of Engineering,
Dhangawadi, Tal: Bor, Dist: Pune**



Year: 2020-21

Prepared by

Enrich Consultants

Yashashree, 26, Nirmal Bag Society,
Near Muktangan English School, Parvati, Pune 411009
Phone: 09890444795 Email: enrichcons@gmail.com



MAHARASHTRA ENERGY DEVELOPMENT AGENCY

An ISO 9001 : 2003 Reg. no. : RQ 91 / 2462



Maharashtra Energy Development Agency

(Government of Maharashtra Institution)

Aundh Road, Opposite Spicer College Road, Near Commissionerate of Animal Husbandary,

Aundh, Pune, Maharashtra 411067

Ph No: 020-35000450

Email: eee@mahaurja.com, Web: www.mahaurja.com

ECN/2021-22/CR-14/1577

22nd April, 2021

**CERTIFICATE OF REGISTRATION
FOR CLASS 'A'**

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

Name and Address of the firm : M/s Enrich Consultants
Yashashree, Plot No. 26, Nirmal Bag Society,
Near Mukangan English School, Parvati,
Pune - 411009.

Registration Category : *Empanelled Consultant for Energy Conservation Programme for Class 'A'*

Registration Number : *MEDA/ECN/2021-22/Class A/EA-03*

- Energy Conservation Programme intends to identify areas where wasteful use of energy occurs and to evaluate the scope for Energy Conservation and take concrete steps to achieve the evaluated energy savings.
- MEDA reserves the right to visit at any time without giving prior information to verify quarterly activities performed by the firm and canceling the registration, if the information is found incorrect.
- This empanelment is valid till **21st April, 2023** from the date of registration, to carry out energy audits under the Energy Conservation Programme
- The Director General, MEDA reserves the right to cancel the registration at any time without assigning any reasons thereof.

General Manager (EC)

Enrich Consultants

Yashashree, 26, Nirmal Bag Society,
Near Mukhtangan English School, Parvati, Pune 411 009
Tel: 09890444795 Email: enrichcons@gmail.com

Ref: EC/ RDSCSCOE/20-21/02

Date: 30/8/2021

CERTIFICATE

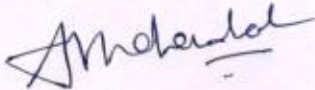
This is to certify that we have conducted Green Audit at Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhore, Dist: Pune in the year 2020-21.

The College has adopted following Energy Efficient and Green practices:

- Usage of Energy Efficient LED Fittings,
- Installation of 10 kWp Roof top Solar PV Plant
- Installation of 10000 LPD Solar Thermal Water Heating System.
- Installation of Rain water harvesting Project
- Segregation of Waste at source
- Installation of Biogas Plant for conversion of Organic Waste
- Maintenance of Good internal roads & internal garden
- Provision of Ramp for Divyangajan
- Provision of Sanitary Waste Incinerator
- Display of posters on importance of resource conservation

We appreciate the involvement of the students and faculty members and the cooperation extended by the management, in the process of Energy Conservation & making the campus Green.

For Enrich Consultants,



A Y Mehendale,
Certified Energy Auditor
EA-8192



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4	Study of Usage of Renewable Energy	14
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ACKNOWLEDGEMENT

We Enrich Consultants, Pune, express our sincere gratitude to the management of Rajgad Dnyanpeeth's Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhore, Dist: Pune for awarding us the assignment of Green Audit of their Dhangawadi Campus for the Year: 2020-21.

We are thankful to:

- Prof. Dr S. B. Patil, Principal
- Mr. S. K. Pawar, HOD, Mechanical Engg Department
- Mr. G. S. Jadhav, HOD, Civil Engg Department
- Mr. Lahu P. Maskepatil, Faculty, Mechanical Engg Department

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

EXECUTIVE SUMMARY

1. **Shri Chhatrapati Shivajiraje College of Engineering, Dhangawadi, Tal: Bhor, Dist: Pune** consumes Energy in the form of **Electrical Energy** used for various gadgets, Office & other facilities.

2. Present Energy Consumption & CO₂ Emissions:

No	Value	Energy Consumed, kWh	CO ₂ emissions, MT
1	Total	43198	38.88
2	Maximum	4690	4.22
3	Minimum	2300	2.07
4	Average	3600	3.24

3. Various Majors Adopted for making the campus Energy Efficient and Green:

- Usage of Energy Efficient LED fittings
- Installation of 10 kWp Roof top Solar PV Plant
- Installation of 10000 LPD Solar Thermal Water Heating System.
- Usage of Biogas Plant
- Usage of Rain water harvesting system

4. Usage of Renewable Energy Source:

- The College has installed Roof top Solar PV Plant of capacity **10 kWp**.
- The College has Solar Thermal Water Heater for Hostel blocks of Capacity **10000 LPD**.
- The amount of CO₂ emission reduced on account of usage of Renewable Energy is **10.8 MT/Annum**.

5. Waste Management:

5.1 Solid Waste Management:

The Waste is segregated at source for further disposal. The College has installed a Bio gas plant of capacity **1.68 m³** and the organic waste is converted in to Bio gas, which in turn is used in the college mess.

5.2 Liquid Waste Management:

In Campus liquid waste collected from various places like wash basin, urinals, toilets, water cooler etc. through plumbing system and is connected to Septic tank of capacity 240000 liters. The tank is cleaned periodically.

5.3 E-Waste Management:

All the internal communication is through emails and hardly any e-Waste is generated in the Day to Day operation of the College. The College authorities have already contacted

Authorized e-Waste management vendor to dispose of any wastage generated during the day-to-day operations.

6. Rain Water Harvesting:

The College has installed Rainwater Harvesting Project to collect the Rain Water collected at the Terrace & coming from other slopes, which in turn is used to enrich the underground water level.

7. Green & Sustainable Practices:

- Maintenance of Good Internal Road & Internal Garden
- Provision of Ramp for Divyangajan
- Provision of Sanitary Waste Incinerator
- Display of Posters on importance of Resource Conservation

8. Notes & Assumptions:

1. 1 Unit of Electrical Energy releases **0.9 Kg of CO₂** into atmosphere
2. **1 kWp** Solar PV system generates **4 kWh** of Electrical Energy per Day
3. Annual Solar Energy Generation Days: **300 Nos**

9. References:

1. For CO₂ Emissions: www.tatapower.com
2. For Solar PV: www.solarroftop.gov.in

ABBREVIATIONS

LED	: Light Emitting Diode
kW	: kilo-Watt
kWh	: kilo-Watt Hour
LPD	: Liters per Day
kWp	: Kilo Watt peak
MT	: Metric Ton

CHAPTER-I INTRODUCTION

1.1 Objectives:

1. To study present Energy Consumption
2. To Study the present CO₂ Emissions
3. To study usage of Renewable Energy
4. To study Waste Management: Solid, Liquid and E-waste
5. To study Rain Water Harvesting
6. To study Green & Sustainable Practices.

1.2 Table No-1: General Details of College:

No	Head	Particulars
1	Name	Shri Chhatrapati Shivajiraje College of Engineering
2	Address	Dhangawadi, Tal: Bhore, Dist: Pune
3	Year of Establishment	2006
4	Courses Offered	Graduate courses in Engineering disciplines

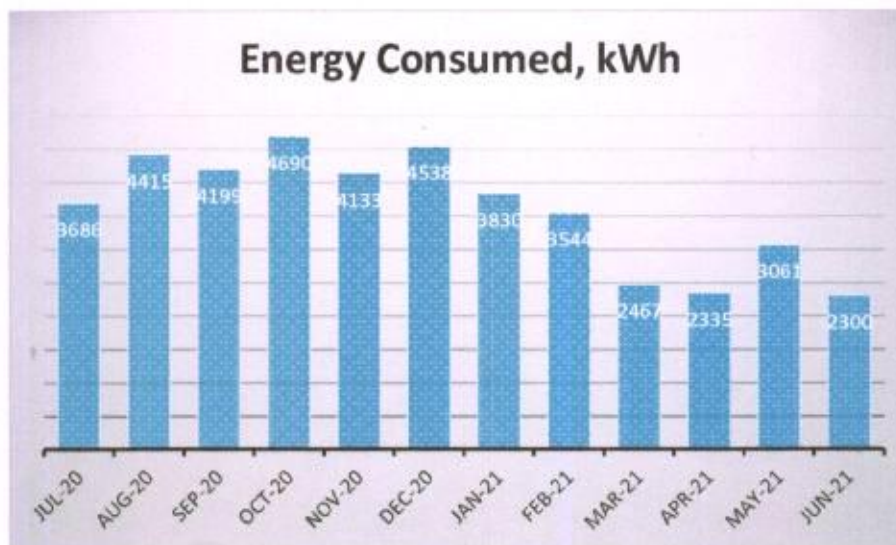
CHAPTER-II STUDY OF PRESENT ENERGY CONSUMPTION

In this chapter, we present the analysis of last year Electricity Bills

Table No 2: Electrical Energy Consumption: 2020-21:

No	Month	Energy Consumed, kWh
1	Jul-20	3686
2	Aug-20	4415
3	Sep-20	4199
4	Oct-20	4690
5	Nov-20	4133
6	Dec-20	4538
7	Jan-21	3830
8	Feb-21	3544
9	Mar-21	2467
10	Apr-21	2335
11	May-21	3061
12	Jun-21	2300
13	Total	43198
14	Maximum	4690
15	Minimum	2300
16	Average	3600

Chart No 1: To study the variation of Month wise Energy Consumed, kWh:



Key observations: Table No 3:

No	Value	Energy Consumed, kWh
1	Total	43198
2	Maximum	4690
3	Minimum	2300
4	Average	3600

CHAPTER-III STUDY OF CARBON FOOTPRINTING

A Carbon Foot print is defined as the Total Greenhouse Gas emissions, emitted due to various activities.

In this we compute the emissions of Carbon-Di-Oxide, by usage of the various forms of Energy used by the College for performing its day to day activities

The College uses Electrical Energy for various Electrical gadgets.

Basis for computation of CO₂ Emissions:

The basis of Calculation for CO₂ emissions due to LPG & Electrical Energy are as under

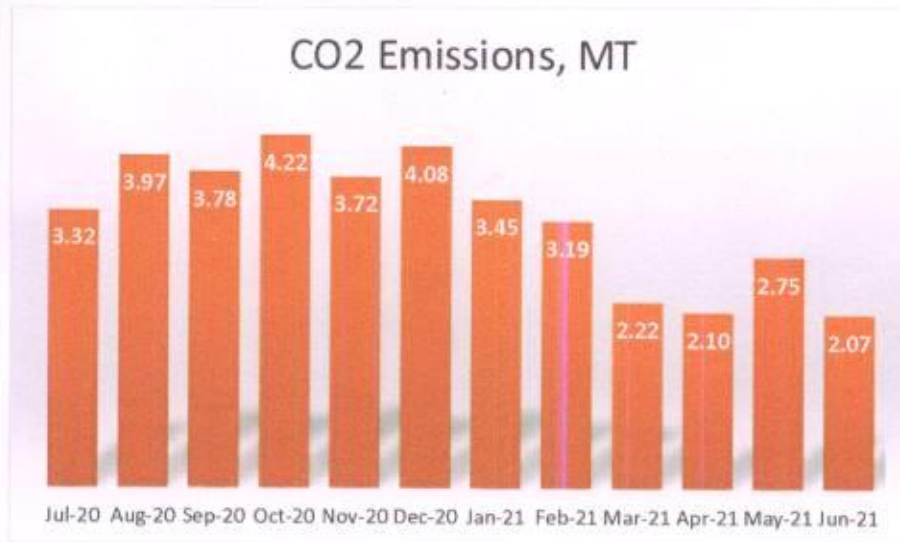
- 1 Unit (kWh) of Electrical Energy releases 0.9 Kg of CO₂ into atmosphere

Based on the above Data we compute the CO₂ emissions which are being released in to the atmosphere by the College due to its Day to Day operations

Table No 4: Month wise CO₂ Emissions:

No	Month	Energy Consumed, kWh	CO ₂ Emissions, MT
1	Jul-20	3686	3.32
2	Aug-20	4415	3.97
3	Sep-20	4199	3.78
4	Oct-20	4690	4.22
5	Nov-20	4133	3.72
6	Dec-20	4538	4.08
7	Jan-21	3830	3.45
8	Feb-21	3544	3.19
9	Mar-21	2467	2.22
10	Apr-21	2335	2.10
11	May-21	3061	2.75
12	Jun-21	2300	2.07
13	Total	43198	38.88
14	Maximum	4690	4.22
15	Minimum	2300	2.07
16	Average	3600	3.24

Representation of Month wise CO₂ emissions: Chart No 2:



Key observations: Table No 5:

No	Value	Energy Consumed, kWh	CO2 emissions, MT
1	Total	43198	38.88
2	Maximum	4690	4.22
3	Minimum	2300	2.07
4	Average	3600	3.24

CHAPTER-IV STUDY OF USAGE OF RENEWABLE ENERGY

The College has installed Roof top Solar PV Plant of Capacity 10 kWp. For Hostel blocks, the Solar Thermal Hot water System is used. The capacity is 10000 LPD.

Table No 6: Computation of CO₂ emission reduction by usage of Renewable Energy:

No	Particulars	Value	Unit
1	Annual Energy generated by 10 kWp Roof top Solar PV Plant	12000	kWh/Annum
2	1 kWh of Electrical Energy is equal to	0.9	MT
3	CO ₂ emission reduction on account of usage of Renewable Energy= (1) * (2) /1000	10.8	MT

Note: Due to lockdown, there was no use of Hostel blocks, hence we do not consider the usage of Solar Thermal Water Heating System, in operation.

Photograph of 10 kWp Roof top Solar PV Plant:



Photograph of Solar Thermal Water Heating System at Hostel block:



CHAPTER V STUDY OF WASTE MANAGEMENT

In this Chapter, we study the Waste management Practices of the College.

5.1 Solid Waste Management:

Separate Waste Collection Bins are placed at important locations. The Waste is segregated at source. The Collected Waste is further given for disposal.

Photograph of Waste Collections Bins:



5.2 Organic Waste Management:

In Campus canteen approximately 30 kg /day waste material in the form of leftover food is generated .This waste is collected and utilized for producing biogas using the plant. It takes 24 hours to convert this bio degradable waste into biogas. This biogas plant Specification is Volume of Digester 2.2 m³ and Gas Holding Capacity 1.68 m³. The energy generated from the biogas plant is utilized in institution mess.

Photograph of Biogas Plant:



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In Campus liquid waste collected from various places like wash basin, urinals, toilets, water cooler etc. through plumbing system and is connected to Septic tank of capacity 240000 liters. The tank is periodically cleaned, with the help of external agency.

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In campus non-repairable electronic items like computer components, mouse, cables, CDs, chargers, earphones, batteries, non-working switches, electric cables, etc. are stored properly in one place. E-waste bins are placed in the department at various locations. This Collected E- Waste is given to the authorized dealers NGO 'SWaCH' Pune Seva Sahakari Sanstha Ltd. Kothrud-Pune for reuse and disposed. Articles on e-waste management are also frequently displayed on the Notice Boards.

Photograph of E-Waste Collection Bin:



CHAPTER VI STUDY OF RAIN WATER HARVESTING

The College has implemented the Rain Water Harvesting Project. The College has installed Pipes from the terrace and the Rain water falling on the terrace is used to enrich the ground water level.

Photograph of Rain water Harvesting Pipe:



Photograph of Rain water Collection Pit Section:



CHAPTER VII

STUDY OF GREEN & SUSTAINABLE PRACTICES

7.1 Pedestrian Friendly Roads:

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

Photograph of internal road in the campus:



7.2 Tree Plantation & Internal Garden:

The College has well maintained Garden in the campus. The details of Trees is furnished in the Annexure.

Photograph of Tree plantation in the campus:



7.3 Ramp for Divyangajan:

The College has made provision of Ramp for easy movement of Divyangajan.

Photograph of Ramp:



7.4 Provision of Sanitary Waste Incinerator:

The College has displayed posters on importance of Resource Conservation, Energy Conservation.

Photograph of Sanitary Waste Incinerator:



7.5 Creation of Awareness about Resource Conservation:

The College has displayed posters on importance of Resource Conservation like Water, Energy, and Ban of Plastic etc.

Photograph of Poster on Importance of Energy Saving, Water Saving:



Photograph Poster showing Ban on use of Plastic & Green Campus:



ANNEXURE
LIST OF TREES IN THE CAMPUS

List of Trees:

No	Common Name	Quantity
1	Nim	5
2	Karanj	1
3	Umbar	1
4	Tantanee	1
5	Chandan	1
6	Rui	1
7	Sag	2
8	Gulmohar	3
9	Shisav	4
10	Supari	4
11	Vad	2
12	Mango	3
13	Bottol Palm	23
14	Rose	2
15	Jasmine	3
16	Mango	2
17	Tikoma	1
18	Shisav	27
19	Karanj	3
20	Gulmohar	1
21	Kashiya	4
22	Shisav	50
23	Nilgiri	23
24	Karanj	3
25	Savar	3
26	Bor	1
27	Pangara	1
28	Jambhul	3
29	Bakul	1
30	Silver Oke	1
31	Mango	1
32	Gulmohar	1
33	Subhabul	1
34	Tikoma	1

35	Umbar	1
36	Rui	1
37	Shisav	28
38	Subhabul	1
39	Mango	7
40	Bhabul	2
41	Vad	5
42	Gulmohar	27
43	Jambhul	1
44	Sag	1
45	Pangara	1
46	Nim	1
47	Karanj	3
48	Duranda	409
49	Rui	2
50	Naral	3
51	Junikeras	1
52	Rose	4
53	Jasmine	3
54	Aboli	1
55	X - Mas Tree	1
56	Duranda	14
57	Hemiliya Pentas	114
58	Areca Palm	4
59	X - Mas Tree	1
60	Duranda	17
61	Hemiliya Pentas	135
62	Areca Palm	4
63	X - Mas Tree	1
64	Duranda	92
65	Hemiliya Pentas	40
66	Areca Palm	3
67	Acalyfa	5