Reports on environment and energy audits (2021-2022)

Report

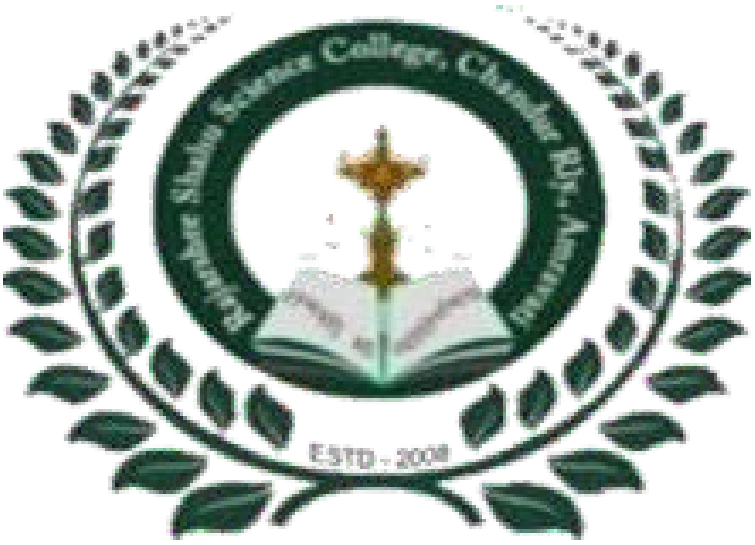
On

Environmental Audit

At

Rajarshee Shahu Science College, Chandur Railway,

District: Amravati



Prepared by

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

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Acknowledgement

We at Nutan Urja Solutions, Pune wish to express our sincere gratitude to the management of Rajarshee Shahu Science College, Chandur Railway, District: Amravati 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.

Rajarshee Shahu Science College, Chandur Railway, District: Amravati 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:

Sr no	Parameter	Energy consumed, (Units)	CO2 Emission (MT)
1	Maximum	1,388	1.11
2	Minimum	329	0.26
3	Average	595	0.48
4	Total	7,134	5.71

3. The various projects already implemented for Environmental Conservation:

- Usage of Energy Efficient BEE STAR Rated ACs
- 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 **10 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 a 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	Rajarshee Shahu Science College, Chandur Railway, District: Amravati
2	Address	Rajarshee Shahu Science College Virul Road, Chandur Railway, Maharashtra 444 904
3	Affiliation	Sant Gadge Baba Amravati University, Amravati

2. Study of Consumption of Various Resources

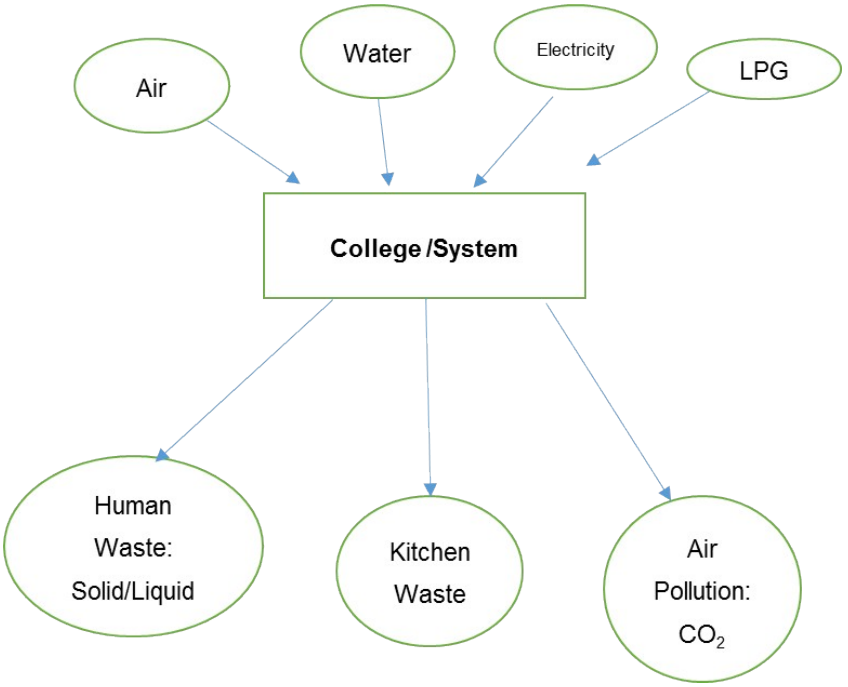
The Institute consumes following basic/derived Resources:

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 (kWh)
1	Jun-22	634
2	May-22	1,032
3	Apr-22	1,388
4	Mar-22	585
5	Feb-22	330
6	Jan-22	352
7	Dec-21	329
8	Nov-21	443
9	Oct-21	458
10	Sep-21	524
11	Aug-21	690
12	Jul-21	369
	Total	**7,134**
	Maximum	1,388
	Minimum	329
	Average	595

2.1 Variation of Monthly Electrical Energy Consumption

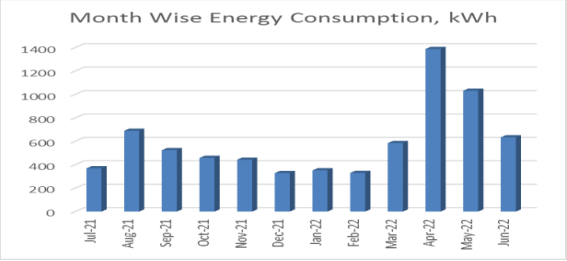


Figure 2.1: Monthly Electrical Energy Consumption

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**	1,388
2	**Minimum**	329
3	**Average**	595
4	**Total**	7,134

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	CO2 Emissions, MT
1	Jun-22	634	0.51
2	May-22	1,032	0.83
3	Apr-22	1,388	1.11
4	Mar-22	585	0.47
5	Feb-22	330	0.26
6	Jan-22	352	0.28
7	Dec-21	329	0.26
8	Nov-21	443	0.35
9	Oct-21	458	0.37
10	Sep-21	524	0.42
11	Aug-21	690	0.55
12	Jul-21	369	0.30
	Total	**7,134**	**5.71**
	Maximum	1,388	1.11
	Minimum	329	0.26
	Average	595	0.48

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

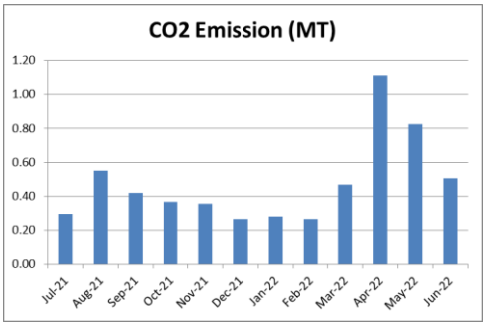


Figure 2.1: CO2 emission due to usage of electrical energy.

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

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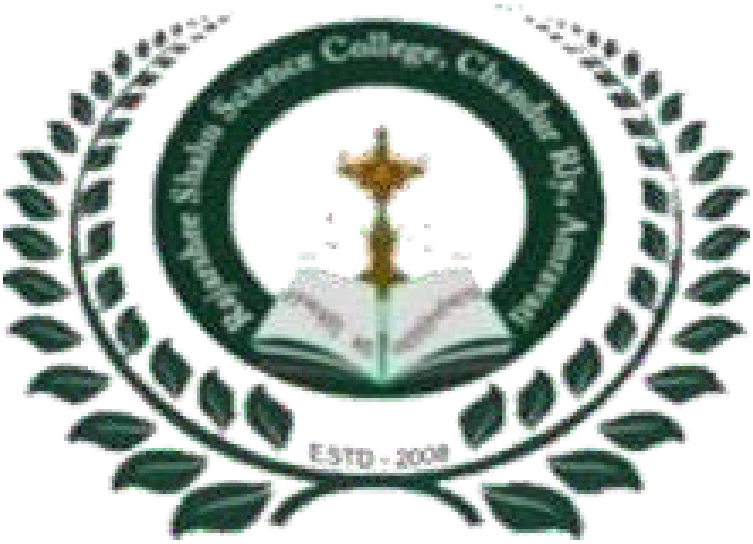

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World, Sus Road, Sus, Pune 411 021

Phone: 83568 18381. Email: nutanurja.solutions@gmail.com

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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 Rajarshee Shahu Science College, Chandur Railway, District: Amravati is conducted by Nutan Urja Solutions, Pune. Based On the audit field study, following important points can be presented.

1. Present Energy Consumption

Rajarshee Shahu Science College, Chandur Railway, District: Amravati 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	1,388	1.11
2	Minimum	329	0.26
3	Average	595	0.48
4	Total	7,134	5.71

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 **10 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

Rajarshee Shahu Science College has come up as the premier institution for science education in this area running Science Degree College and also Science & Arts Junior College. Degree Science College is affiliated to the Sant Gadge Baba Amravati University, Amravati.

College is housed in beautiful green campus with sufficient play fields. There are sufficient number of spacious classrooms and independent laboratories for each subject with adequate facilities. College has central library and Wi-Fi facility. Teachers are putting their sincere efforts to create student friendly environment in the campus. They are committed to provide quality education tending to spread the human values & equal opportunities for every student to develop their talent & personalities.

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-22	634	4353
2	May-22	1,032	6,844
3	Apr-22	1,388	9,240
4	Mar-22	585	4,029
5	Feb-22	330	2,435
6	Jan-22	352	2,573
7	Dec-21	329	2,329
8	Nov-21	443	3,141
9	Oct-21	458	3,235
10	Sep-21	524	3,648
11	Aug-21	690	4,685
12	Jul-21	369	2,688
	Total	**7,134**	**49,200**

Variation in energy consumption is as follows,

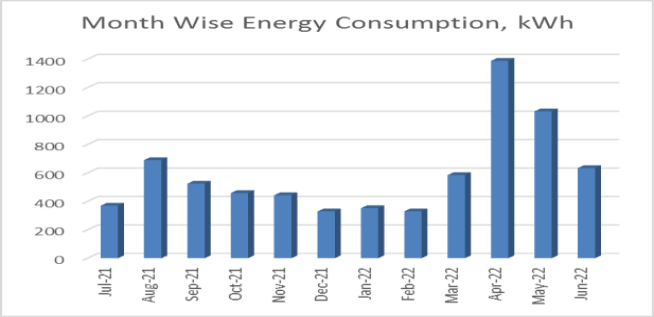

Figure 2.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

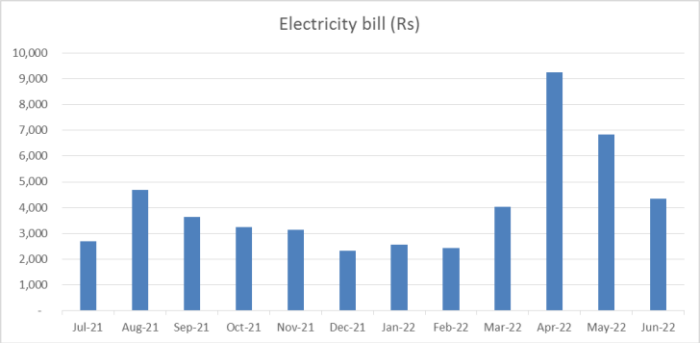

Figure 2.2: Month wise electricity bill

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	1,388	1.11
2	Minimum	329	0.26
3	Average	595	0.48
4	Total	7,134	5.71

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	634	0.51
2	May-22	1,032	0.83
3	Apr-22	1,388	1.11
4	Mar-22	585	0.47
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10	Sep-21	524	0.42
11	Aug-21	690	0.55
12	Jul-21	369	0.30
	Total	**7,134**	**5.71**

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

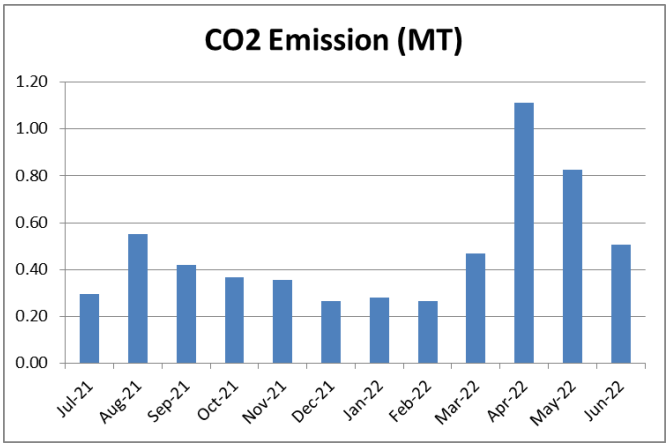

Figure 3.1: Month wise CO2 Emission

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 10kW capacity.

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

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	7,134	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	15,000	kWh/Annum
3	Total Energy Requirement of College	22,134	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	68	**%**

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 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.

8. Green Landscaping with Trees and Plants

The Institute has beautiful maintained Garden.

Figure 8.1: Beautiful maintained Garden of college

List of trees in garden are as follows.

Table 8.1: List of trees

Sr. No.	Common Name of plants	Botanical Name of plants	Plants quantity
1	Kadamba tree	Neolamarckia cadamba	2
2	Bougainvillea	Bougainvillea spectabilis	6
3	Kadu badam (Karanj)	Milletia pinnata	7
4	Kaduneem	Azadirechta indica	43
5	Buddha belly bamboo	Bambusa ventricosa	2
6	Sag	Tectona grandis	7
7	Chafa	Plumeria obtusa	3
8	Tagar mini	Tabernaemontana divaricata	3
9	Pink Ixora	Ixora coccinea	2
10	Travler palm	Ravenala madagascariensis	2
11	Arica Palm	Dypsis lutescens	25
12	Silver Palm	Bismarkiya Palm	1
13	Nilgiri	Eucalyptus globulus	1
14	Euphorbia	Euphorbia milli	2
15	Siseniyam	Siseniyam	2
16	Turmelia	Terminalia metalika	2
17	Bottlebrush	Callistemon citrinus	1
18	Agave	Agave sp.	7
19	Bamboo grass	Bamboo grass	22
20	Baby panda Bamboo Grass	P. Japonica	5
21	Palas	Butea monosperma	5
22	Curry plant	Murraya koenigii	1
23	Pichkari plant	Spathodea campanulata	2

24	Yellow shrub	Pendus sp.	20
25	Bakuli	Mimusops elengi	3
26	Ficus	Ficus benjamina	5
27	Yellow Tecoma	Tecoma stans	5
28	Orange Tecoma	Tecoma capensis	1
29	Madan mast	Artabotrys hexapetalus	2
30	Cuphea	Cuphea hyssopifolia	4
31	Cherry	American cherry	1
32	Bonsai Peepal	Ficus religiosa	1
33	Wad	Ficus benghalensis	1
34	Royal Palm	Roystonea regia	7
35	Shiwaalik Fish tail Palm	Caryota urens	1
36	Coleus	Coleus sp.	6
37	Weliya bamboo	American bamboo	1
38	Haemelia	Haemelia patens	2
39	Fox tail Palm	Wodyetia bifurcata	10
40	Triangular Vidya	Thuja occidentalis	10
41	Dracaena mahatma	Dracaena mahatma	35
42	Jambhul	Syzygium cumini	20
43	Saptparni	Alstonia scholaris	2
44	Red Ixora	Ixora coccinea	2
45	Pencil pine	Mediterranean cypress	6
46	Singhoniyam	Syngonium podophyllum	2
47	Duranta	Duranta erecta	72
48	Green saypras	Cupressus sempervirens	8
49	Mehandi	Lasonia inermis	10
50	Lemon cypress	Cupressus macrocarpa	1
51	Pencil pine	Thuja sp.	6
52	Udumbara	Ficus glomerata	1
53	Bamboo	Phyllostachys aurea	1
54	White sandalwood	Santalum album	3
55	Amla	Phyllanthus emblica	2
56	Babhool	Acacia nilotica	1
57	Kanchan	Bauhinia blackeana	1
58	Buddha belly bamboo	Bambusa ventricosa	50

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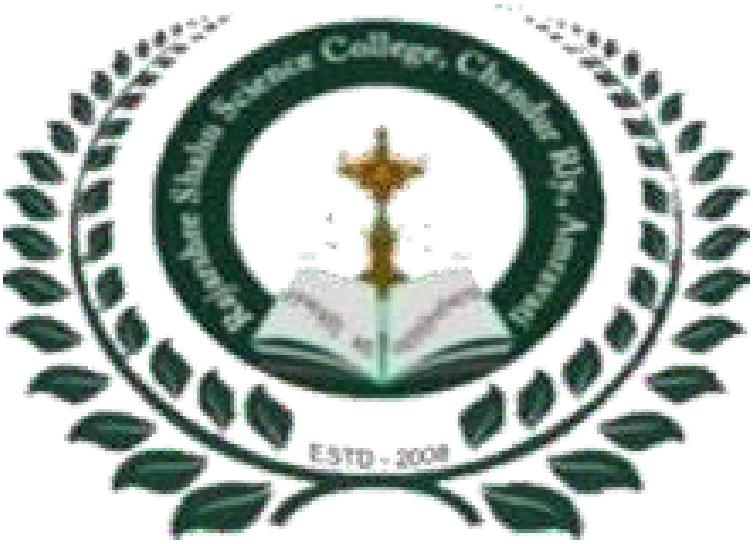

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Executive Summary

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 , (Units)	CO2 Emission (MT)
1	Maximum	1,388	1.11
2	Minimum	329	0.26
3	Average	595	0.48
4	Total	7,134	5.71

2. Energy Conservation Projects already installed

1. Usage of LED lights at some indoor locations
2. 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 68 %.

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 41 %.

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 41 Nos T-8 fittings with 20W LED fittings	820	9,020	26,281	35
2	Replacement of 71 Nos Old Ceiling Fans with STAR rating fans	923	10,153	154,354	182
3	Installation of 4kW grid connected PV panel	6,000	66,000	200,000	36
	Total	**7,743**	**85,173**	**380,635**	**54**

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

Rajarshee Shahu Science College has come up as the premier institution for science education in this area running Science Degree College and also Science & Arts Junior College. Degree Science College is affiliated to the Sant Gadge Baba Amravati University, Amravati.

College is housed in beautiful green campus with sufficient play fields. There are sufficient number of spacious classrooms and independent laboratories for each subject with adequate facilities. College has central library and Wi-Fi facility. Teachers are putting their sincere efforts to create student friendly environment in the campus. They are committed to provide quality education tending to spread the human values & equal opportunities for every student to develop their talent & personalities.

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	Rajarshee Shahu Science College, Chandur Railway, District: Amravati
2	Address	Rajarshee Shahu Science College Virul Road, Chandur Railway, Maharashtra 444 904
3	Affiliation	Sant Gadge Baba Amravati University, Amravati

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

Sr. No	Location	FTL (40W)	CFL	LED tube (20W)	Computers (65W)	Fans
1	G 6 Principal Office			5	2	2
2	G 7		1	2	4	2
3	Toilet Staff		1			
4	G 8 Computer Lab			2	22	2
5	G 9 Electronic Dept.			2	2	2
6	Wash Room Ladies		1			
7	G 10 Hall			14		8
8	Ladies Common Room			2		1
9	G 11 Physics Lab			10		6
10	G12 Chemistry Lab			9		5
	First Floor					
11	F10 Library			6	4	3
12	IQAC			1		1
13	F 11 Class Room			2		4
14	F12 Botny Dept.	10			2	7
15	F 13 Zoology Dept.	10			1	6
16	F 9 N,S.S.	1				1
	Second Floor					
17	S 1 Class Room	3				2
18	S 2 Class Room	3				2
19	S 3 Class Room	3				2
20	S 4 Class Room	3				2
21	S 5 Class Room	3				3
22	S 6 Class Room	3				3
23	S 7 Games & Sports	1				1
24	S 8 NSS Staff Room	1				1
25	Sports Office			1		1
26	Gym			4		4
	Total	**41**	**3**	**60**	**37**	**71**

Individual fitting wise load is as under.

Table No 2.2: Equipment wise Connected Load

No	Equipment	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	41	40	1.6
2	CFL	3	24	0.1
3	LED Tube-20W	60	20	1.2
4	Computers	37	65	2.4
5	Ceiling Fan	71	65	4.6
6	Pumps (2 nos 2HP)			1.5
	Total			**6.1**

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

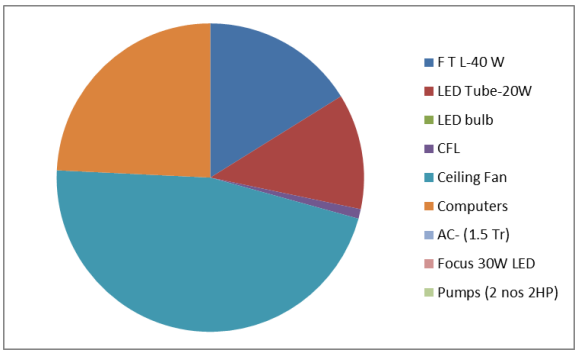

Figure 2.1: Distribution of connected load.

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

Sr. No	Month	Energy (kWh)	Bill Amount (Rs)
1	Jun-22	634	4,353
2	May-22	1,032	6,844
3	Apr-22	1,388	9,240
4	Mar-22	585	4,029
5	Feb-22	330	2,435
6	Jan-22	352	2,573
7	Dec-21	329	2,329
8	Nov-21	443	3,141
9	Oct-21	458	3,235
10	Sep-21	524	3,648
11	Aug-21	690	4,685
12	Jul-21	369	2,688
	Total	**7,134**	**49,200**

Variation in energy consumption is as follows,

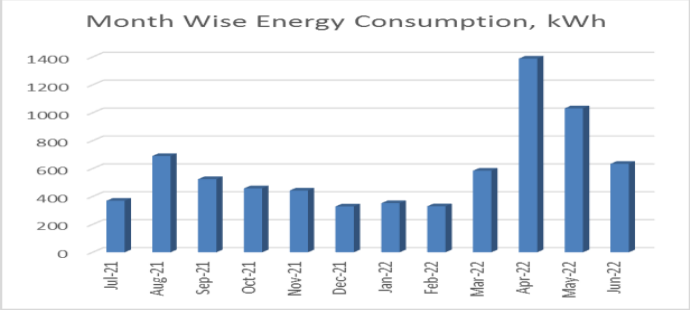

Figure 3.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

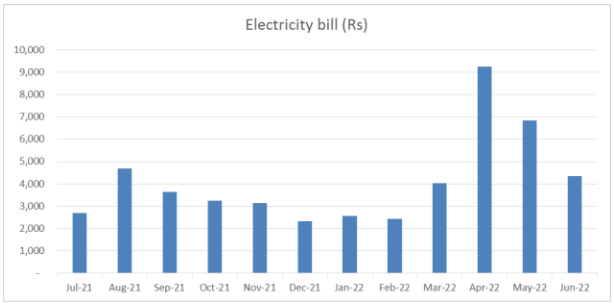

Figure 3.2: Month wise electricity bill

Key observations of electricity bill are as follows,

Table no 3.2: Key observations

Sr no	Parameter	Energy consumed, (Units)	CO2 Emission (MT)
1	Maximum	1,388	1.11
2	Minimum	329	0.26
3	Average	595	0.48
4	Total	7,134	5.71

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

Sr. No	Month	Energy Consumed, kWh	CO2 Emissions, MT
1	Jun-22	634	0.51
2	May-22	1,032	0.83
3	Apr-22	1,388	1.11
4	Mar-22	585	0.47
5	Feb-22	330	0.26
6	Jan-22	352	0.28
7	Dec-21	329	0.26
8	Nov-21	443	0.35
9	Oct-21	458	0.37
10	Sep-21	524	0.42
11	Aug-21	690	0.55
12	Jul-21	369	0.30
	Total	**7,134**	**5.71**

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

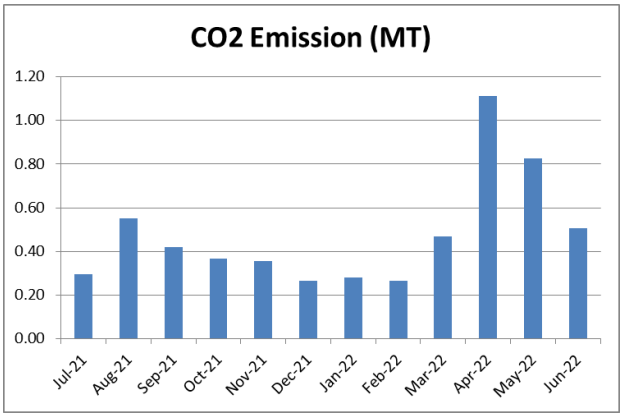

Figure 4.1: Month wise CO2 Emission

5. Study of 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 **10 kWp**.

Table 5.1: Computation of % Usage of Alternate Energy to Annual Energy Requirement

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	7,134	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	15,000	kWh/Annum
3	Total Energy Requirement of College	22,134	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	68	**%**

Photograph of Solar PV plant

6. 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
1	F T L-40 W	41	40	1.64
2	CFL	3	24	0.07
	LED lighting load			
1	LED tube	60	20	1.20
	Total LED lighting load			**1.20**
	Total Lighting load			**2.91**

It can be seen that out of total lighting load 41% load is LED lighting load.

7. Energy conservation proposals

7.1 Replacement of Old T-8 FTLs with 20 W LED fittings

In the facility, there are about 41 Nos, T-8, FTL fittings with electronic/magnetic chokes. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings. In the following Table, we present the savings, investment required & payback analysis.

No	Particulars	Value	Unit
1	Present Qty of T-8 fittings	41	Nos
2	Energy Demand of T-8 fitting	40	W/Unit
3	Energy Demand of 20 W LED fittin	20	W/Unit
4	Reduction in demad	20	W/Unit
5	Average Daily Usage period	4	Hrs/Day
6	Daily saving in Energy	3.28	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	820	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	9020	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	26281	Rs lumpsum
13	Simple Payback period	35	Months

7.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 71 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	71	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	52	W/Unit
4	Reduction in demad	13	W/Unit
5	Average Daily Usage period	4	Hrs/Day
6	Daily saving in Energy	3.692	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	923	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	10153	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	154354	Rs lumpsum
13	Simple Payback period	182	Months

7.3 Installation of Solar PV panel

It is recommended to install 4 kW solar PV panel. In the following Table, we present the savings, investment required & payback analysis.

No	Particulars	Value	Unit
1	Installation of PV unit	4	kW
2	Energy saving	6000	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetory savings	66000	Rs/ Annum
5	Investment required	200000	Rs lump sum
6	Simple payback period	36	Months

7.4 Summary of Savings

No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs.	Investment Required, Rs.	Payback period, Months
1	Replacement of 41 Nos T-8 fittings with 20W LED fittings	820	9,020	26,281	35
2	Replacement of 71 Nos Old Ceiling Fans with STAR rating fans	923	10,153	154,354	182
3	Installation of 4kW grid connected PV panel	6,000	66,000	200,000	36
	Total	**7,743**	**85,173**	**380,635**	**54**