

**Report
On
Energy Audit
At
Yuvashakti Arts and Science College, Amravati
(Year 2021-22)**



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

Contents

Acknowledgement	2
Executive Summary	3
Abbreviations	5
1. Introduction	6
1.1 Objectives	6
1.2 Audit Methodology:	6
1.3 General Details of College	6
2. Study of connected load	7
3. Study of Electrical Energy Consumption	8
4. Carbon Foot printing	10
5. Study of usage of LED lighting	12
6. Energy conservation proposals	13
6.1 Replacement of Old T-8 FTLs with 20 W LED fittings	13
6.2 Replacement of old fans with STAR Rated fans	14
6.3 Summary of Savings	15

Acknowledgement

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Yuvashakti Arts and Science College, Amravati, for awarding us the assignment of Energy 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 through energy savings. While we have made every attempt to adhere to high quality standards, in both data collection and analysis through the report, we would welcome your suggestions so as to improve upon this report further.

Executive Summary

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the CO₂ 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)	CO ₂ Emission (MT)
1	Maximum	116	0.09
2	Minimum	37	0.03
3	Average	63	0.05
4	Total	751	0.60

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 LED Lighting

The College has various Types of Light fittings, namely: LED, FTL & CFL. The percentage of Annual LED Lighting Usage to Annual Lighting requirement works out to be 12 %.

5. 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 15 Nos T-8 fittings with 20W LED fittings	300	3,300	9,615	35
2	Replacement of 18 Nos Old Ceiling Fans with STAR rating fans	234	2,574	39,132	182
	Total		5,874	48,747	100

6. 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

Yuvashakti Arts & Science College, Amravati established in 2000 by Yuvashakti Samajik and Shaikshanik Sanstha, Amravati and affiliated to Sant Gadge Baba Amravati University, Amravati. The college was started with a vision to provide an opportunity to the students willing to take higher education and to transform their lives by making them self-reliant and responsible citizen of India. The college is situated in the lower middle working class locality. Most of the students admitted from economically backward families. So it becomes challenging task to bring these students in the main stream of higher education. The college strives for all round development of students by offering them opportunity to participate in various co- curricular and extra- curricular activities.

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	Yuvashakti Arts and Science College, Amravati
2	Address	Dastur Nagar Rd, Farshi Stop, Amravati, Maharashtra 444 606.
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

No	Location	FTL (40W)	Fans	LED tube (20W)
1	Principal Cabin		1	1
2	Library	2	1	
3	Office	2	1	
4	Class Room 1	2	2	
5	Class Room 2	2	2	
6	Class Room 3 + Seminar Hall	1	4	1
7	Laboratory 1	1	1	
8	Laboratory 2	1	1	1
9	Laboratory 3	1	1	
10	Laboratory 4	1	1	
11	Girls Common Room		1	1
12	Staff Room	1	2	
13	Toilet	1		
	Total	15	18	4

3. Study of Electrical Energy Consumption

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

Table no 3.1: Summary of electricity bills

No	Month	Energy (kWh)	Bill Amount (Rs)
1	Jun-22	114	2550
2	May-22	116	2200
3	Apr-22	100	1200
4	Mar-22	55	741
5	Feb-22	37	730
6	Jan-22	43	790
7	Dec-21	38	2370
8	Nov-21	53	877
9	Oct-21	42	910
10	Sep-21	48	810
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12	Jul-21	46	800
	Total	751	14,853

Variation in energy consumption is as follows,

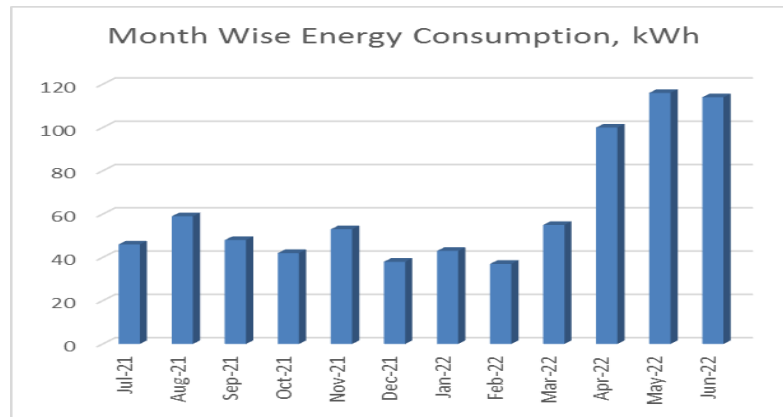


Figure 3.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

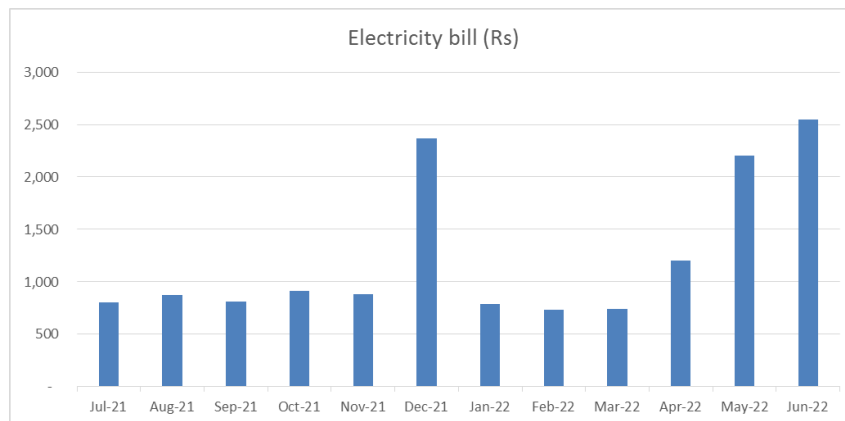


Figure 3.2: Month wise electricity bill

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	116	0.09
2	Minimum	37	0.03
3	Average	63	0.05
4	Total	751	0.60

4. Carbon Foot printing

1. A Carbon Foot print is defined as the Total Greenhouse Gas emissions (CO₂ 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 CO₂ Emissions:

The basis of Calculation for CO₂ emissions due to Electrical Energy is as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 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

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

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

No	Month	Energy Consumed, kWh	CO ₂ Emissions, MT
1	Jun-22	114	0.09
2	May-22	116	0.09
3	Apr-22	100	0.08
4	Mar-22	55	0.04
5	Feb-22	37	0.03
6	Jan-22	43	0.03
7	Dec-21	38	0.03
8	Nov-21	53	0.04
9	Oct-21	42	0.03
10	Sep-21	48	0.04
11	Aug-21	59	0.05
12	Jul-21	46	0.04
	Total	751	0.60

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

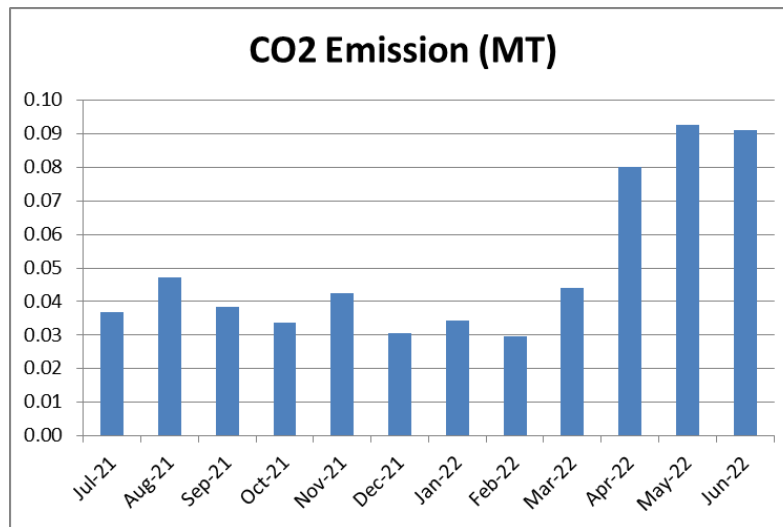


Figure 4.1: Month wise CO2 Emission

5. Study of usage of LED lighting

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

Table 5.1: Total lighting load

No	Particulars	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	15	40	0.6
	LED lighting load	4	20	0.08
	Total LED lighting load			0.08
	Total Lighting load			0.68

It can be seen that out of total lighting load 12% load is LED lighting load.

6. Energy conservation proposals

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

In the facility, there are about 15 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	15	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	1.2	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	300	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	3300	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	9615	Rs lump sum
13	Simple Payback period	35	Months

6.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 18 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	18	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	0.936	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	234	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	2574	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	39132	Rs lump sum
13	Simple Payback period	182	Months

6.3 Summary of Savings

No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs.	Investment Required, Rs.	Payback period, Months
1	Replacement of 15 Nos T-8 fittings with 20W LED fittings	300	3,300	9,615	35
2	Replacement of 18 Nos Old Ceiling Fans with STAR rating fans	234	2,574	39,132	182
	Total		5,874	48,747	100

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Table of Contents

Acknowledgement	3
Executive Summary	4
Abbreviations.....	5
1. Introduction.....	6
1.1 Important Definitions:	6
1.2 Objectives.....	7
1.3 Audit Methodology:	7
1.4 General Details of College	7
2. Study of Consumption of Various Resources	8
2.1 Variation of Monthly Electrical Energy Consumption	10
2.2 Key Inference drawn	10
3. Study of Environmental Pollution	11
3.1 Air Pollution.....	11
3.2 Study of Solid Waste Generation	12
3.3 Study of Liquid Waste Generation.....	12
3.4 Study of e-Waste Management:	12
4. Recommendations.....	13

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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.

Yuvashakti Arts and Science College, 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 CO₂ on account of Electricity & LPG Consumption
- Solid Waste: Bio degradable Kitchen Waste, Garden Waste
- Liquid Waste: Human liquid waste

2. Present Level of CO₂ Emissions:

Sr no	Parameter	Energy consumed, (Units)	CO ₂ Emission (MT)
1	Maximum	116	0.09
2	Minimum	37	0.03
3	Average	63	0.05
4	Total	751	0.60

3. The various projects already implemented for Environmental Conservation:

- Usage of Natural Day light in corridors

4. Recommendations:

1. Installation of Rain Water Harvesting.

5. Notes & Assumptions:

1. **1 kWh** of Electrical Energy releases **0.8 Kg of CO₂** into atmosphere
2. 1 kWp Solar PV plant generates 5 kWh/day Electrical Energy for 300 days in an year.

Abbreviations

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

1. Introduction

1.1 Important Definitions:

1.1.1 Environment: Definition as per environment Protection Act: 1986

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

1.1.2. Environmental Audit: Definition:

An audit which aims at verification and validation to ensure that various environmental laws are complied 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	Yuvashakti Arts and Science College, Amravati
2	Address	Dastur Nagar Rd, Farshi Stop, Amravati, Maharashtra 444 606.
3	Affiliation	Sant Gadge Baba Amravati University, Amravati

2. Study of Consumption of Various Resources

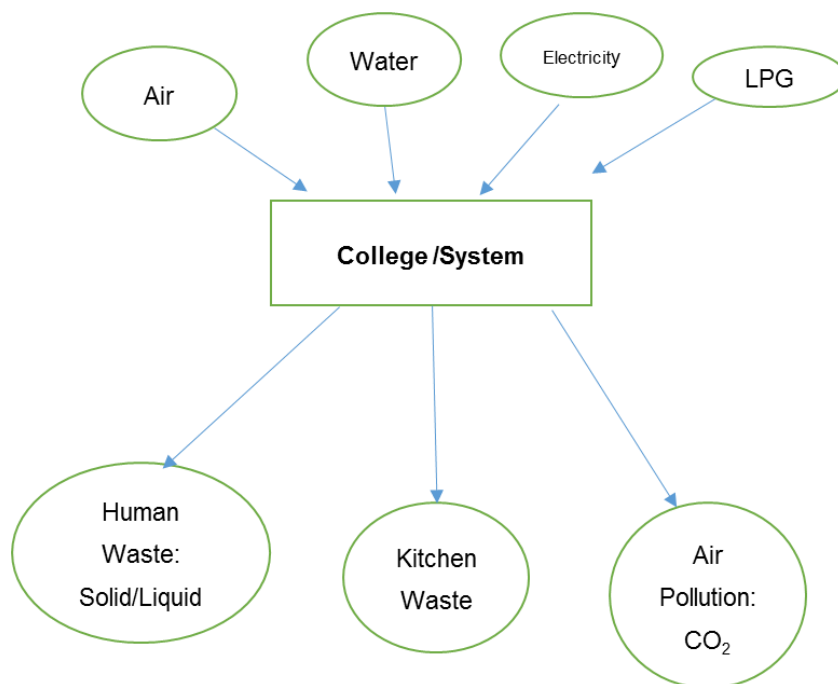
The Institute consumes following basic/derived Resources:

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	114
2	May-22	116
3	Apr-22	100
4	Mar-22	55
5	Feb-22	37
6	Jan-22	43
7	Dec-21	38
8	Nov-21	53
9	Oct-21	42
10	Sep-21	48
11	Aug-21	59
12	Jul-21	46
	Total	751
	Maximum	116
	Minimum	37
	Average	63

2.1 Variation of Monthly Electrical Energy Consumption

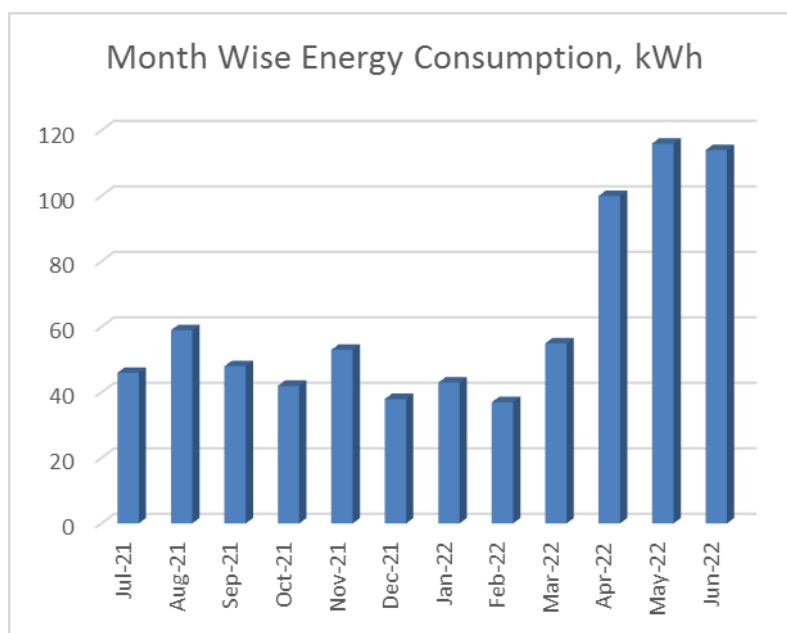


Figure 2.1 : Monthly Electrical Energy Consumption

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	116
2	Minimum	37
3	Average	63
4	Total	751

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 CO₂ in the atmosphere
- 1 Kg of LPG emits 3 Kg of CO₂ in the atmosphere

In the following Table, we present the CO₂ emissions.

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

No	Month	Energy Consumed, kWh	CO2 Emissions, MT
1	Jun-22	114	0.09
2	May-22	116	0.09
3	Apr-22	100	0.08
4	Mar-22	55	0.04
5	Feb-22	37	0.03
6	Jan-22	43	0.03
7	Dec-21	38	0.03
8	Nov-21	53	0.04
9	Oct-21	42	0.03
10	Sep-21	48	0.04
11	Aug-21	59	0.05
12	Jul-21	46	0.04
	Total	751	0.60
	Maximum	116	0.09
	Minimum	37	0.03
	Average	63	0.05

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

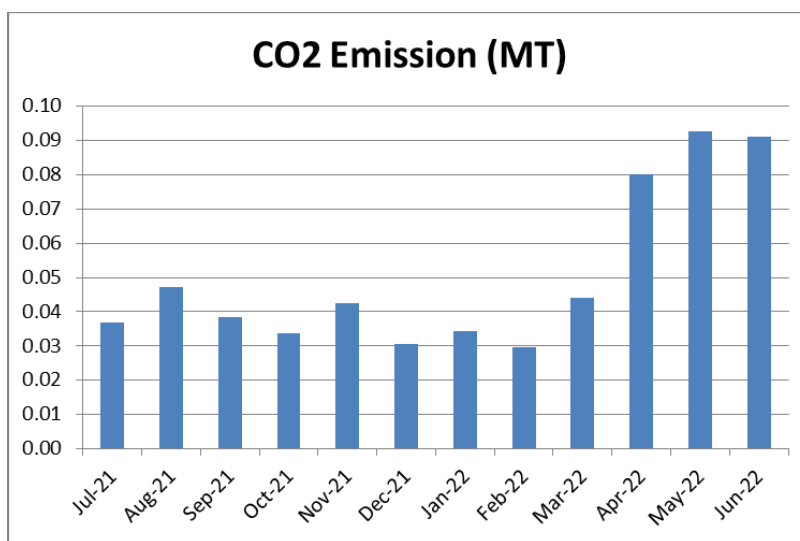


Figure 3.1: CO2 emission due to usage of electrical energy.

3.2 Study of Solid Waste Generation

The solid waste collected in college is bifurcated in dry waste and wet waste. The waste is collected and disposed by corporation.

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 there is hardly any generation of e-Waste in the premises.

4. 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 Rainwater Harvesting

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Acknowledgement	2
Executive Summary	3
Abbreviations	4
1. Introduction.....	5
1.1 Objectives.....	5
1.2 Audit methodology.....	5
2. Study of Electrical Energy Consumption	6
3. Carbon Foot printing.....	8
4. Study of Waste Management	11
4.1 Solid Waste Management.....	11
4.2 e-Waste Management.....	11
5. Study of Green Practices.....	12
5.1 No of students who don't use own Vehicle for coming to Institute.....	12
5.2 Usage of Public Transport.....	12
5.3 Plastic Free Campus	12
5.4 Paperless Office.....	12

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We hope that the recommendations stated in this report will be useful and worthy of discussions to take things forward to help implementation of energy conservation measures 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 Yuvashakti Arts and Science College, Amravati is conducted by Nutan Urja Solutions, Pune. Based On the audit field study, following important points can be presented.

1. Present Energy Consumption

Yuvashakti Arts and Science College, 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	116	0.09
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2. Various Measures Adopted for Energy Conservation

1. Usage of LED lights at some indoor locations

3. Waste Management

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

4. 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

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1.1 Objectives

1. To study present level of Energy Consumption
2. To Study the present CO₂ 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
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2. Study of Electrical Energy Consumption

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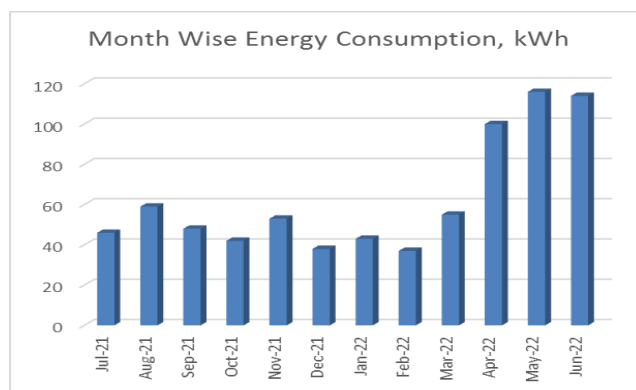


Figure 2.1: Month wise energy consumption

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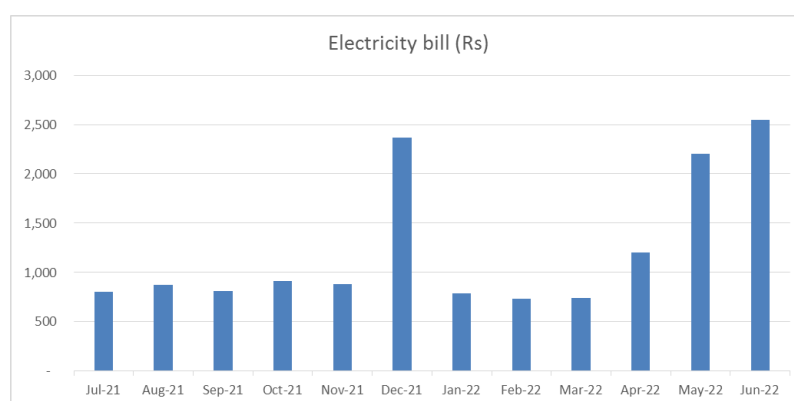


Figure 2.2: Month wise electricity bill

Key observations of electricity bill are as follows,

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3. Carbon Foot printing

1. A Carbon Foot print is defined as the Total Greenhouse Gas emissions (CO₂ 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 CO₂ Emissions:

The basis of Calculation for CO₂ emissions due to Electrical Energy is as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 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

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	CO ₂ Emissions, MT
1	Jun-22	114	0.09
2	May-22	116	0.09
3	Apr-22	100	0.08
4	Mar-22	55	0.04
5	Feb-22	37	0.03
6	Jan-22	43	0.03
7	Dec-21	38	0.03
8	Nov-21	53	0.04
9	Oct-21	42	0.03
10	Sep-21	48	0.04
11	Aug-21	59	0.05
12	Jul-21	46	0.04
	Total	751	0.60

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

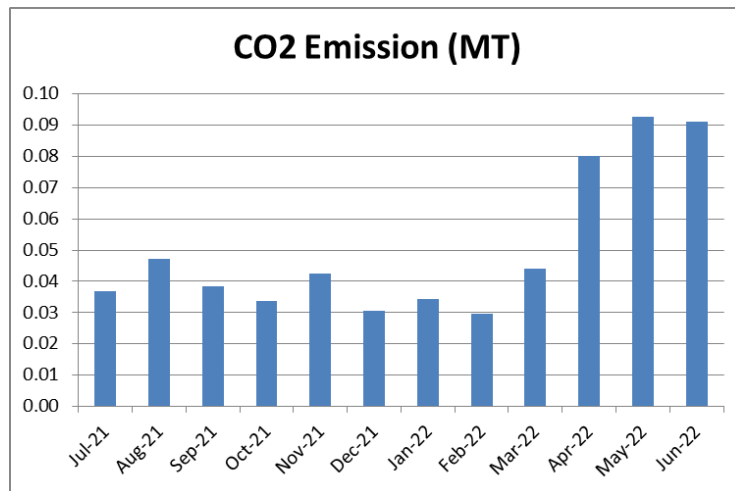


Figure 3.1: Month wise CO2 Emission

4. Study of Waste Management

4.1 Solid Waste Management

The solid waste collected in college is bifurcated in dry waste and wet waste. The waste is collected and disposed by corporation.

4.2 e-Waste Management

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

5. Study of Green Practices

5.1 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.

5.2 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. The average number of students is approximately 40 %. Institute encourages students to not to use automobiles.

5.3 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

5.4 Paperless Office

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