

Report
On
Environmental Audit
At
KCE Society's College Of Engineering and Management, Jalgaon
(Year 2021-22)



Prepared by

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Acknowledgement

We at Nutan Urja Solutions, Pune wish to express our sincere gratitude to the management of KCE Society's College Of Engineering and Management, Jalgaon 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.

KCE Society's College Of Engineering and Management, Jalgaon 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	6,141	4.91
2	Minimum	3,098	2.48
3	Average	3,905	3.12
4	Total	46,856	37.48

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 1 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 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 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	KCE Society's College Of Engineering and Management, Jalgaon
2	Address	D.I.C., N.H.6, next to IMR College, Ganesh Colony, Jalgaon, Maharashtra 425001.
3	Affiliation	Dr. Babasaheb Ambedkar Technological University, Lonere.

2. Study of Consumption of Various Resources

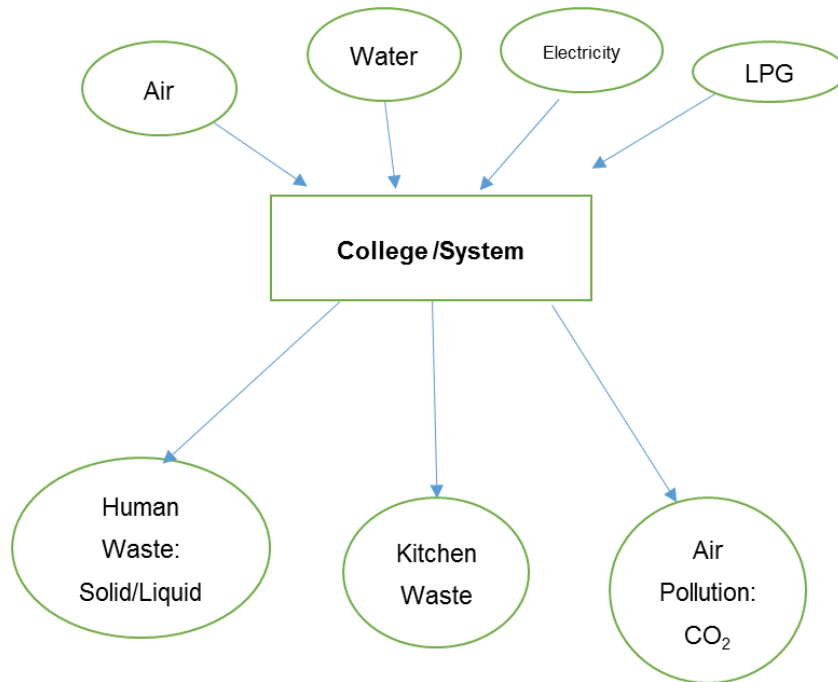
The Institute consumes following basic/derived Resources:

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

Also, college emits following pollutants to environment

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

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



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

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

Table 2.1: Electrical Energy Consumption

No	Month	Energy Consumed, kWh
1	Mar-22	6,141
2	Feb-22	3,614
3	Jan-22	3,098
4	Dec-21	3,757
5	Nov-21	3,749
6	Oct-21	3,922
7	Sep-21	3,637
8	Aug-21	3,614
9	Jul-21	4,272
10	Jun-21	4,605
11	May-21	3,110
12	Apr-21	3,339
	Total	46,856
	Maximum	6140.8
	Minimum	3097.6
	Average	3905

2.1 Variation of Monthly Electrical Energy Consumption

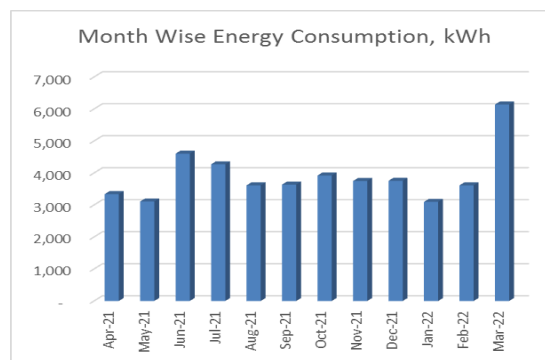


Figure 2.1 : Monthly Electrical Energy Consumption

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	Total	46,856
2	Maximum	6141
3	Minimum	3098
4	Average	3905

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	Mar-22	6,141	4.91
2	Feb-22	3,614	2.89
3	Jan-22	3,098	2.48
4	Dec-21	3,757	3.01
5	Nov-21	3,749	3.00
6	Oct-21	3,922	3.14
7	Sep-21	3,637	2.91
8	Aug-21	3,614	2.89
9	Jul-21	4,272	3.42
10	Jun-21	4,605	3.68
11	May-21	3,110	2.49
12	Apr-21	3,339	2.67
	Total	46,856	37.48
	Maximum	6,141	4.91
	Minimum	3,098	2.48
	Average	3,905	3.12

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

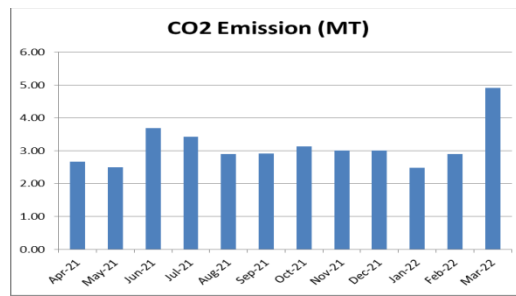


Figure 3.1: CO2 emission due to usage of electrical energy.

3.2 Study of Solid Waste Generation

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

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:

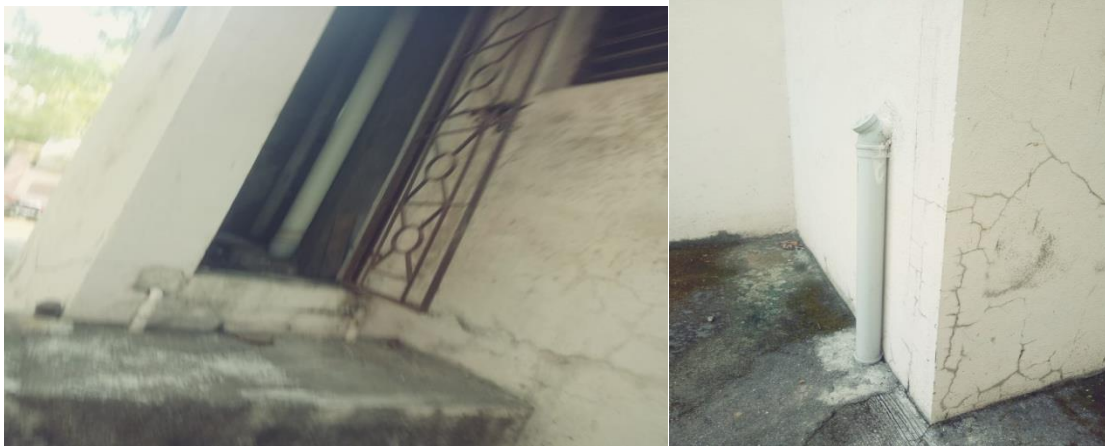
The internal communication is through emails and there is hardly any generation of e-Waste in the premises.

The E-waste generated in all colleges of Khandesh Education Society is collected. Most of the material in waste is reused before disposal.

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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Acknowledgement

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of KCE Society's College Of Engineering and Management, Jalgaon for awarding us the assignment of Green Audit of their college premises.

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

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

Executive Summary

Green Audit of KCE Society's College Of Engineering and Management, Jalgaon is conducted by Nutan Urja Solutions, Pune. Based On the audit field study, following important points can be presented.

1. Present Energy Consumption

KCE Society's College Of Engineering and Management, Jalgaon 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	6,141	4.91
2	Minimum	3,098	2.48
3	Average	3,905	3.12
4	Total	46,856	37.48

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

6. Notes and Assumptions

1. Annual working Days-300 Nos
2. 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

The College of Engineering and Management (CoEM), Jalgaon was established in year 2001 by Khandesh College Education Society, Jalgaon which is one of the most prestigious and oldest education society in the Khandesh area with a vigorous past, a dynamic present, and brilliant future. Institute is located in the heart of Jalgaon city which has population of more than five Lakhs.

Institute offers a world of opportunities to students with modern educational philosophy, state of art infrastructure and experienced faculty members. In addition to regular curricular activities; co-curricular and extra-curricular activities like seminars, workshops, and expert lectures by dignitaries in the respective field are being organized. It provides strong foundation to prepare students with a broad base of technical knowledge, ability to work in team and ethical values like honesty, integrity, professionalism, humanity, etc. More than 7000 successful alumni spread over the globe are witnessing the astonishing consistent progress of the institute.

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
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	Mar-22	6,141	76,806
2	Feb-22	3,614	47,743
3	Jan-22	3,098	41,827
4	Dec-21	3,757	48,218
5	Nov-21	3,749	49,745
6	Oct-21	3,922	51,992
7	Sep-21	3,637	48,330
8	Aug-21	3,614	48,119
9	Jul-21	4,272	57,899
10	Jun-21	4,605	58,970
11	May-21	3,110	42,687
12	Apr-21	3,339	45,073
	Total	46,856	617,408

Variation in energy consumption is as follows,

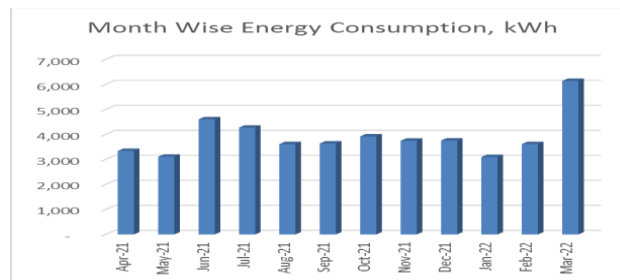


Figure 2.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

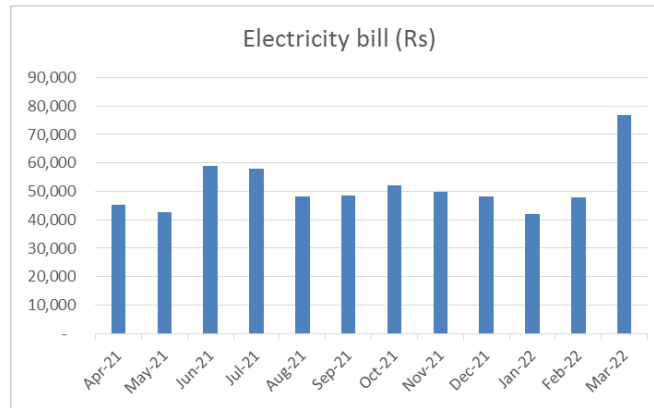


Figure 2.2: Month wise electricity bill

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	6,141	4.91
2	Minimum	3,098	2.48
3	Average	3,905	3.12
4	Total	46,856	37.48

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	Mar-22	6,141	4.91
2	Feb-22	3,614	2.89
3	Jan-22	3,098	2.48
4	Dec-21	3,757	3.01
5	Nov-21	3,749	3.00
6	Oct-21	3,922	3.14
7	Sep-21	3,637	2.91
8	Aug-21	3,614	2.89
9	Jul-21	4,272	3.42
10	Jun-21	4,605	3.68
11	May-21	3,110	2.49
12	Apr-21	3,339	2.67
	Total	46,856	37.48

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

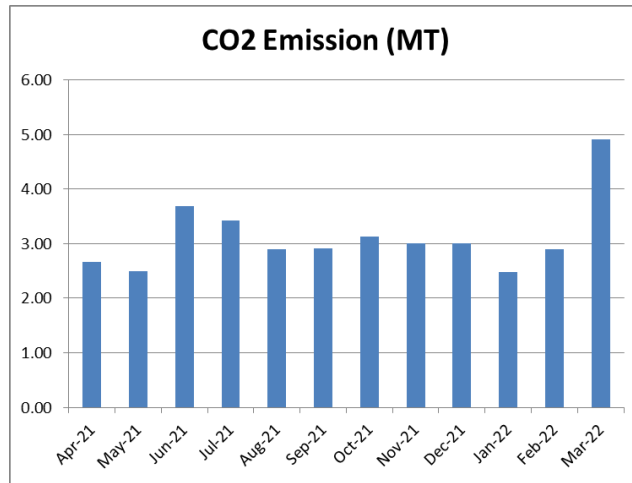


Figure 3.1: Month wise CO2 Emission

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 Roof Top Solar PV System. The Installed Capacity of Solar PV Plant is **1 kWp**.

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

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	46,856	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	1,500	kWh/Annum
3	Total Energy Requirement of College	48,356	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	3.1	%

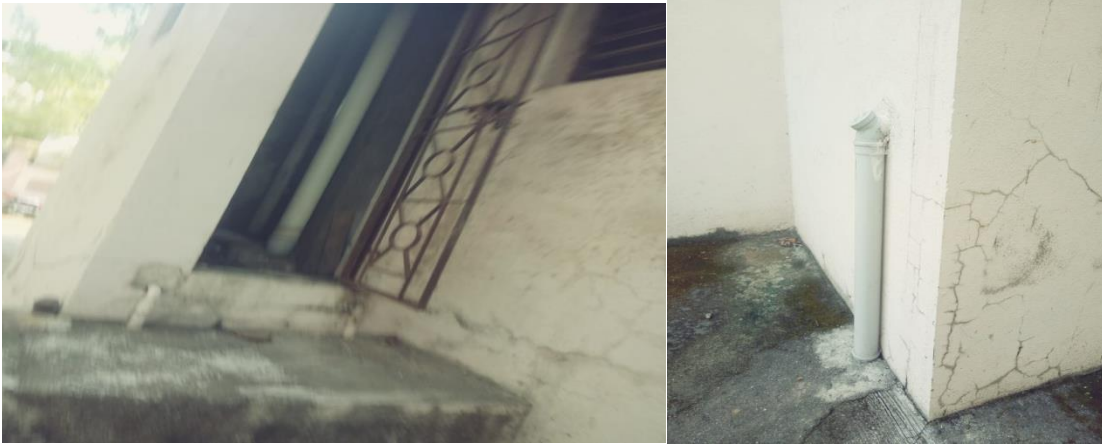
Photograph of Solar PV plant



5. Study of Rain Water Harvesting

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

Photograph of Rain Water Harvesting pipe



6. Study of Waste Management

6.1 Solid Waste Management

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

6.2 e-Waste Management

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

The E-waste generated in all colleges of Khandesh Education Society is collected. Most of the material in waste is reused before disposal.

7. Study of Green Practices

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

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

7.2 Usage of Public Transport

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

7.3 Pedestrian Friendly Roads

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

Photograph of Road within campus



7.4 Plastic Free Campus

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

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

7.5 Paperless Office

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

7.6 Green Landscaping with Trees and Plants

The Institute has beautiful maintained Garden.

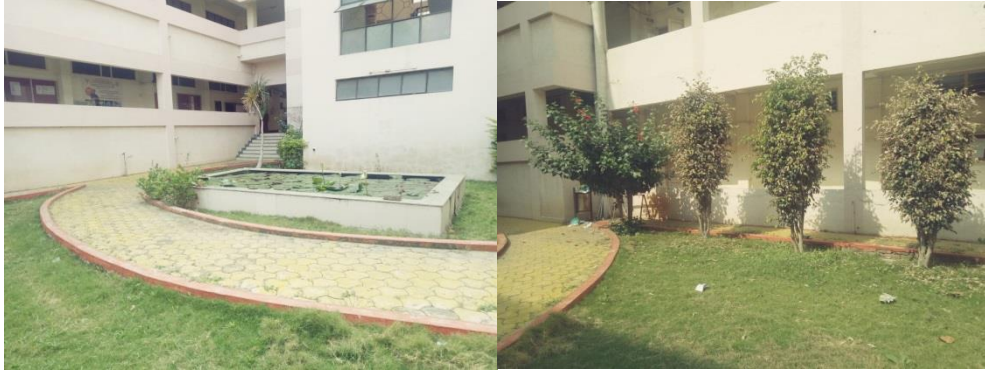


Figure 7.1: Beautiful maintained Garden of college

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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 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)	CO₂ Emission (MT)
1	Maximum	6,141	4.91
2	Minimum	3,098	2.48
3	Average	3,905	3.12
4	Total	46,856	37.48

2. Energy Conservation Projects already installed

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

3. Key Observations

1. Usage of LED lights.
2. Usage of star rated equipment.
3. Maintained a good power factor.
4. There are about 402 Nos old T-8 type fittings which need to be replaced by 20 W LEDs.
5. There are 22 Nos, 1.5 TR Old ACs which need to be replaced with STAR Rated ACs.

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 3.34 %.

5. 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 7.28 %.

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 402 Nos T-8 fittings with 20W LED fittings	8,844	97,284	257,682	32
2	Replacement of 447 Nos Old Ceiling Fans with STAR rating fans	5,811	63,921	971,778	182
3	Replacement of 22 Nos Old 1.5 TR Acs with STAR rating Acs	14,025	154,275	1,163,250	90
4	Installation of 10kW grid connected PV panel	15,000	165,000	500,000	36
	Total	43,680	480,480	2,892,710	72

7 Notes & Assumptions

1. Annual working Days-300 Nos
2. 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

The College of Engineering and Management (CoEM), Jalgaon was established in year 2001 by Khandesh College Education Society, Jalgaon which is one of the most prestigious and oldest education society in the Khandesh area with a vigorous past, a dynamic present, and brilliant future. Institute is located in the heart of Jalgaon city which has population of more than five Lakhs.

Institute offers a world of opportunities to students with modern educational philosophy, state of art infrastructure and experienced faculty members. In addition to regular curricular activities; co-curricular and extra-curricular activities like seminars, workshops, and expert lectures by dignitaries in the respective field are being organized. It provides strong foundation to prepare students with a broad base of technical knowledge, ability to work in team and ethical values like honesty, integrity, professionalism, humanity, etc. More than 7000 successful alumni spread over the globe are witnessing the astonishing consistent progress of the institute.

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	KCE Society's College Of Engineering and Management, Jalgaon
2	Address	D.I.C., N.H.6, next to IMR College, Ganesh Colony, Jalgaon, Maharashtra 425001.
3	Affiliation	Dr. Babasaheb Ambedkar Technological University, Lonere

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)	CFL (24W)	LED tube (20W)	Computers (65W)	Old fan	1.5T R Star rated AC	1.5T R old Acs
1	Parking	14						
2	Security cabin	2				1		
3	Canteen	6				4		
4	Guest room porch	9				3		
5	Reception cabin	1			1	1		
	B1 Building							
	Ground Floor							
6	Ground Floor porch	30				4		
7	Room 23/24		31		2	6	3	
8	Machine room	7			1	5		
9	S/P lab	2			1	1		
10	N/A lab	9				4		
11	Room 19	6				3		
12	Room 18	4				3		
13	office		7	4	9	9		
14	Store room		2			1		
15	PKSDC cabin		8		5	4		

16	Class room 4		2			3		
17	Class room 5		3			4		
18	Class room 6		2			3		
19	Class room 7	2				3		
20	Class room 8	6			1	9		
21	Class room 9	2				4		
22	Class room 10			2		4		
23	Class room 11			4	4	5		
24	Class room 12			4	3	3		1
25	Class room 13			3	5	4		
26	Class room 14			17	14	21		
27	Class room 15			6		7		
28	Class room 16			8		7		
29	Class room 17			2		1		
	First Floor							
30	First Floor porch		30					
31	Room no 101	4			1	2		
32	Room no 102	8			1	6		2
33	Room no 103	2			17	4		
34	Room no 104	3				4		
35	Room no 105	5			2	4		
36	Room no 106	5			1	4		
37	Room no 107	5			1	4		
38	Room no 108	5			14	4	2	
39	Room no 109	5			1	4		
40	Room no 110	3				4		
41	Room no 111	16	16		1	4		1
42	Room no 112	5			2	3		
43	Room no 114	17			14	19		

44	Room no 128	4			2	3		
45	Room no 127	3			1	4		2
46	Room no 126	4			16	4		2
47	Room no 125	5			4	2		1
48	Room no 124	8			32	8		2
49	Room no 123	4			15	6		2
50	Room no 122/ computer lab	6			15	6		2
51	Room no 121	3			4	4		
52	Room no 117	3			1	2		
53	Room no 116			8		7		
54	Room no 115			5		3		
55	Library		39			28		
56	Library 1		5			3		
57	Library 2		5			3		
58	Library 3		2					
59	Library 4		4					
	Second Floor							
60	Second Floor porch		30					
61	Room no 214	9				12		
62	Room no 211	3				4		
63	Room no 212	3				2		
64	Room no 210	3				4		
65	Room no 209	3				4		
66	Room no 208	3				4		
67	Room no 207	5				4		
68	Room no 206	3				4		
69	Room no 205	3				4		
70	Room no 204	5				4		

71	Room no 203	6				4		
72	Room no 202	8				6	4	
73	Room no 201	4			3	4		
74	Room no 229	3			4	2		
75	Room no 228	4			16	3		2
76	Room no 227	3			16	4		1
77	Room no 226	6			14	4		2
78	Room no 225	6			15	6		2
79	Room no 224	6			16	6		
80	Room no 223	6			7	6		
81	Room no 219			3		4		
82	Room no 218			4	24	3		
83	Room no 217			5		4		
84	Room no 216			6		4		
85	W/S	21			1	20		
86	CNC lab	2			1	1		
	B2 Building							
87	Room no 005	5			1	2		
88	Room no 004	6			1	4		
89	Room no 003	6			2	4		
90	Room no 002	6				4		
91	Room no 001	6				4		
92	Room no 105	14			125	8		
93	Room no 104	5			1	3		
94	Room no 103	6			1	4		
95	Room no 102	5				8		
96	Room no 106	3			2	3		
97	Porch	2	4					
	Total	402	190	81	441	447	9	22

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

Table No 2.2: Equipment wise Connected Load

No	Equipment	Qty	Load, W/Unit	Load, kW
1	Ceiling Fan	447	65	29.1
2	AC-Old (1.5 Tr)	22	2200	48.4
3	AC-New (1.5 TR)	9	1838	16.5
5	LED-20W	81	20	1.6
6	CFL	190	24	4.6
7	F T L-40 W	402	40	16.1
8	Computers	441	65	28.7
9	pumps (2HP, 1.5HP)			2.6
	Total			147.6

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

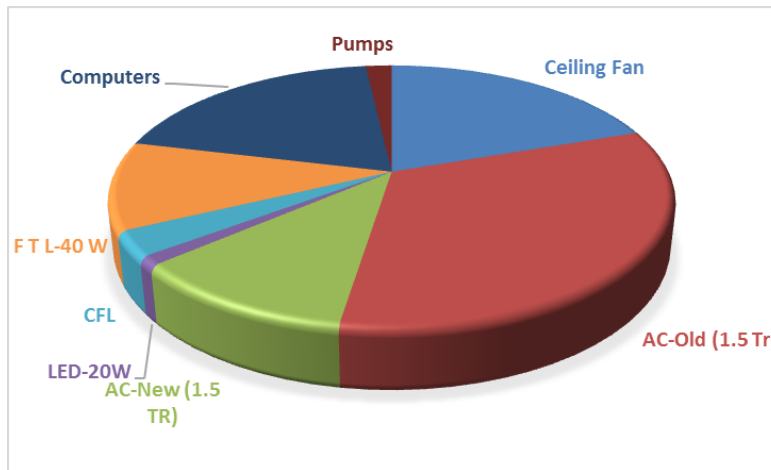


Figure 2.1: Distribution of connected load.

3. Study of Electrical Energy Consumption

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

Table no 3.1: Summary of electricity bills

No	Month	Energy (kWh)	Bill Amount (Rs)
1	Mar-22	6,141	76,806
2	Feb-22	3,614	47,743
3	Jan-22	3,098	41,827
4	Dec-21	3,757	48,218
5	Nov-21	3,749	49,745
6	Oct-21	3,922	51,992
7	Sep-21	3,637	48,330
8	Aug-21	3,614	48,119
9	Jul-21	4,272	57,899
10	Jun-21	4,605	58,970
11	May-21	3,110	42,687
12	Apr-21	3,339	45,073
	Total	46,856	617,408

Variation in energy consumption is as follows,

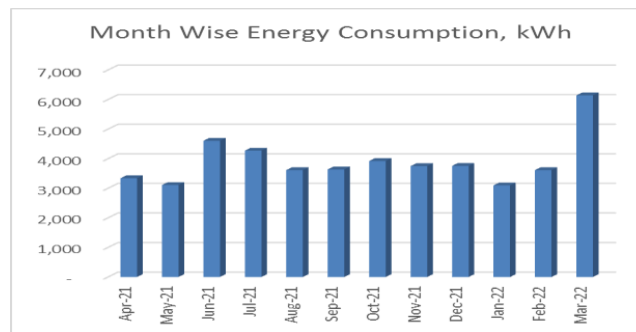


Figure 3.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

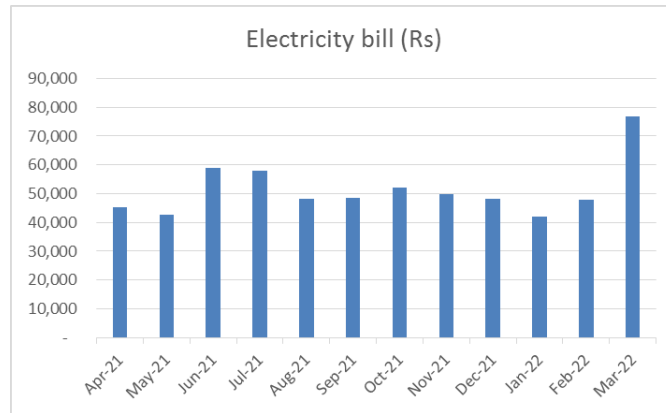


Figure 3.2: Month wise electricity bill

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	6,141	4.91
2	Minimum	3,098	2.48
3	Average	3,905	3.12
4	Total	46,856	37.48

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	Mar-22	6,141	4.91
2	Feb-22	3,614	2.89
3	Jan-22	3,098	2.48
4	Dec-21	3,757	3.01
5	Nov-21	3,749	3.00
6	Oct-21	3,922	3.14
7	Sep-21	3,637	2.91
8	Aug-21	3,614	2.89
9	Jul-21	4,272	3.42
10	Jun-21	4,605	3.68
11	May-21	3,110	2.49
12	Apr-21	3,339	2.67
	Total	46,856	37.48

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

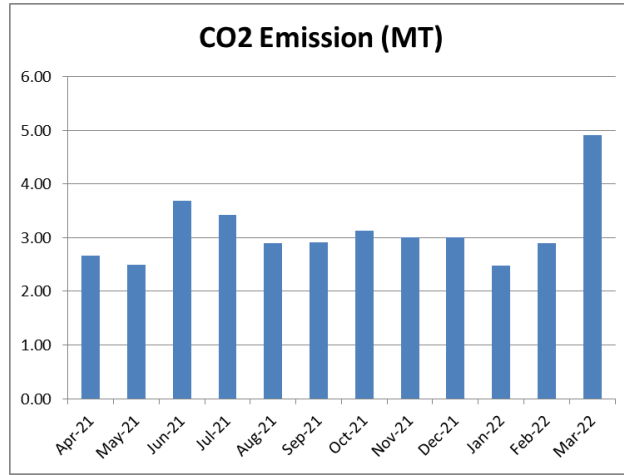


Figure 4.1: Month wise CO2 Emission

5. Study of utilities

5.1 APFC Panel

The Office has already installed the APFC Panel. During the measurements, it was found that the panel is working properly.

5.2 Study of Lighting

In the facility, the lighting system can be divided mainly in to parts, indoor lighting and outdoor lighting. There are 402 FTL fittings with Electronic/ magnetic chokes and 81 LEDs. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings. There are 190 number of CFL lights.

5.3 Air-conditioners

In the facility, there are about 22 Nos. of 1.5 Tr old Air-conditioners. It is recommended to replace these old ACs with BEE STAR Rated ACs. There is 09 nos of star rated new AC of 1.5Tr capacity.

5.4 Ceiling Fans

At building facility, there are about 447 Nos Old Ceiling Fans, which consumed about 65 W of Electrical Energy. It is recommended to replace these old Fans with BEE STAR Rated Ceiling Fans.

5.5 Water Pumps

There are in total 2 Water pumps with 2HP and 1.5HP capacities respectively.

6. Study of usage of alternate energy

In this Chapter, we compute the percentage of Usage of Alternate/Renewable Energy to Annual Energy Requirement of the College. The College has installed Roof Top Solar PV System. The Installed Capacity of Solar PV Plant is **1 kWp**.

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

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	46,856	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	1,500	kWh/Annum
3	Total Energy Requirement of College	48,356	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	3.1	%

Photograph of Solar PV plant



7. Study of usage of LED lighting

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

Table 7.1: Total lighting load

No	Particulars	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	402	40	16.08
2	CFL	190	24	4.56
	LED lighting load			
1	LED tube	81	20	1.62
	Total LED lighting load			1.62
	Total Lighting load			22.26

It can be seen that out of total lighting load 7.3% load is LED lighting load.

8. Energy conservation proposals

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

In the facility, there are about 402 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	402	Nos
2	Energy Demand of T-8 fitting	40	W/Unit
3	Energy Demand of 20 W LED fittin	18	W/Unit
4	Reduction in demad	22	W/Unit
5	Average Daily Usage period	4	Hrs/Day
6	Daily saving in Energy	35	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	8,844	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	97,284	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	257,682	Rs lump sum
13	Simple Payback period	32	Months

8.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 447 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	447	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 demand	13	W/Unit
5	Average Daily Usage period	4	Hrs/Day
6	Daily saving in Energy	23	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	5,811	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	63,921	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2,174	Rs/unit
12	Investment required	971,778	Rs lump sum
13	Simple Payback period	182	Months

8.3 Replacement of 1.5 TR Old ACs with STAR Rated ACs

During the Audit, it was observed that there are 22 Nos, of 1.5 TR old ACs. It is recommended to replace these old ACs with STAR Rated ACs.

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

No	Particulars	Value	Unit
1	Present Qty of 1.5 TR Old ACs	22	Nos
2	Energy Demand of Old 1.5 TR AC	2.00	kW/Unit
3	Energy Demand of New AC	1.15	kW/Unit
4	Reduction in demad	0.85	kW/Unit
5	Average Daily Usage period	3.00	Hrs/Day
6	Daily saving in Energy	56	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	14,025	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	154,275	Rs/Annum
11	Cost of STAR Rated 1.5 TR AC	52,875	Rs/unit
12	Investment required	1,163,250	Rs lump sum
13	Simple Payback period	90	Months

8.4 Summary of Savings

No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs.	Investment Required, Rs.	Payback period, Months
1	Replacement of 402 Nos T-8 fittings with 20W LED fittings	8,844	97,284	257,682	32
2	Replacement of 447 Nos Old Ceiling Fans with STAR rating fans	5,811	63,921	971,778	182
3	Replacement of 22 Nos Old 1.5 TR Acs with STAR rating Acs	14,025	154,275	1,163,250	90
4	Installation of 10kW grid connected PV panel	15,000	165,000	500,000	36
	Total	43,680	480,480	2,892,710	72