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Date: 11/08/2024

CERTIFICATE

This is to certify that we have conducted Energy Audit at Government College of Engineering Aurangabad, Chhatrapati Sambhajnagar as per the guidelines of Maharashtra Energy Development Agency (www.mahaurja.com) in the year 2023-24.

The College has already adopted **Energy Efficient** practices like:

- Usage of Energy Efficient LED Fittings
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of Solar Thermal Hot Water System
- Installation of Solar PV system of 150kW capacity
- Installation tribid system of 3 kW capacity using Solar, Wind, Battery

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

Nutan Urja Solutions,



K G Bhatwadekar,

Certified Energy Auditor,

EA - 22428





Report
On
Energy Audit
At
Government College of Engineering Aurangabad, Chhatrapati
Sambhajinagar
(Year 2023-24)



Prepared by

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B. Jambhale



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Acknowledgement

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar for awarding us the assignment of 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)	CO2 Emission (MT)
1	Maximum	36,351	29.1
2	Minimum	12,503	10.0
3	Average	24,531	19.6
4	Total	294,367	235.5

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. Usage of Alternate Energy

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



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 57 %.

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 641 Nos T-8 fittings with 20W LED fittings	12,820	141,020	410,881	35
2	Replacement of 1020 Nos Old Ceiling Fans with STAR rating fans	51,000	561,000	2,217,480	47
3	Installation of 150kW grid connected PV panel	225,000	2,475,000	7,500,000	36
	Total	63,820	702,020	2,628,361	45

7 Notes & Assumptions

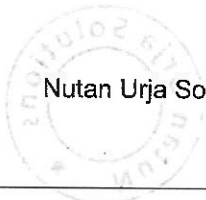
1. Daily working hours-10 Nos
2. Annual working Days-300 Nos
3. Average Rate of Electrical Energy : Rs 11/- per kWh

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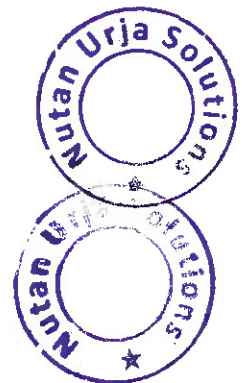
Abbreviations

CFL	:	Compact Fluorescent Lamp
FTL	:	Fluorescent Tube Light
LED	:	Light Emitting Diode
V	:	Voltage
I	:	Current
kW	:	Kilo- Watt
kWh	:	kilo-Watt Hour
kVA	:	Active Power



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1. Introduction

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

1.1 Objectives

1. To study present level of Energy Consumption
2. To Study 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	Government College of Engineering Aurangabad, Chhatrapati Sambhajanagar (GECA)
2	Address	Bhanudas Sabhahgrah Railway Station Rd, Rachanakar Colony, New Usmanpura, Chhatrapati Sambhaji Nagar, Maharashtra 431 005
3	Affiliation	Dr. Babasaheb Ambedkar Marathwada University

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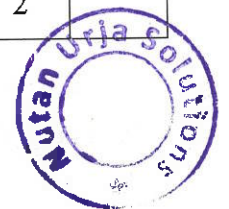
2. Study of connected load

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	LED tube (20W)	LED bulb (12W)	Computer s (65W)	Fans	1.5 TR ACs
	Electrical Engi. Dept.							
1	Cabin 1	2	1	2		1	1	
2	Corridor	12			16			1
3	Cabin 2	6	1			1	5	
4	Cabin	2				1	2	
5	Network Lab	5					5	
6	Cabin 3	2			1	1	1	
7	Class room no 5		5	2	6		5	
8	Electrical Machine Lab	8			1		12	
9	Class room no 6	6					3	
10	High Voltage lab	4					2	
11	Power electronics & Drive lab	6				1	8	
12	Gear and Protection Lab	10				1	4	
13	Electrical Measurement Lab	12				2	4	
14	Computer Center	31				51	12	8
15	Ladies Room						1	
16	Room no 7	6					2	
17	EESA council						2	

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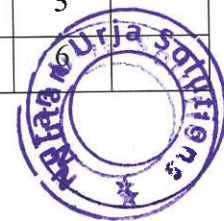


	Control Measurement							
18	Lab	6					2	
19	Control Lab			1		1	2	
20	Cabin 4			1		1	1	
21	Microprocessor Lab	4					1	
22	Cabin 5	2				1	1	1
23	Cabin 6	2				1	2	1
24	Toilet	2						
25	T&P cell	14			10		3	2
	Mechanical Engi. Lab						1	
26	Staff Room 1			1	2	2	1	
27	Cabin 1			1	1	1	1	
28	Cabin 2			2			2	
29	Staff Room 2			2		1	1	
30	Cabin 3			2		1	1	
31	Class Room no 3			9			3	
32	Cabin 4	6			2	2	2	1
33	Class Room 2	9		1				
34	Corridor				4			
35	Tutorial Room				6		4	
36	Cabin 5			1	2	1	1	
37	Cabin 6				1	1	3	
38	IC Engine Lab	2		7	16			
39	Toilet			1				
40	Corridor	2						
41	HT Lab	6		2	7	3	2	
42	Staff Room No 4	1			2			
43	PG Class Room				6		1	
44	Security Cabin				1	1	1	
	Office							

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45	research Lab	10			6	3		2
46	Seminar Hall	14			22		7	2
47	CAD Lab				24	8	5	
48	Robotics Lab				21	2	2	
49	Small Tutorial Room				1	2	2	
50	Corridor	1			10			
51	Tutorial Room				5		4	
52	Tutorial Room				8			
53	Student Section				45	4	12	
54	Account Section				36	6	9	1
55	Graphical lab				4	1	1	
56	Principal Office	8		1	9	1		2
57	Chairman office				6	1		
58	Corridor	2		6	2			
59	Toilet				3			
60	Boys Hostel	3	21	128			106	
	IT Department							
61	Class Room 1			10			6	
62	Class Room 2			11			6	
63	Class Room 3			8			6	
64	Class Room 4			9			6	
65	Class Room 5			11			6	
66	Class Room 6			10			6	
67	Exam Cell			30		13	14	2
68	cabin 1			2		2	1	
69	cabin 2			4		3	2	
70	It project lab			19		60	14	
71	Cabin 3			2		1	1	
72	Cabin 4					1	3	
73	IT Lab 1			15				



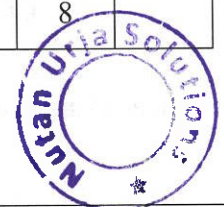
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74	IT Lab 2			15			6	
75	training Room	9				53	6	2
76	Faculty Room	25				5	11	
77	OBMS Lab	24		10		68	14	
78	Toilet			12				
79	HOD Cabin					2	12	1
80	Corridor			35				
81	Seminar Hall		21				13	
82	Toilet			12			12	
	Electronic Engineering Dept.							
83	Office							
84	Room no 8			11			4	
85	Electronics and Circuit Lab			9		5	5	
86	Cabin 1			3		1		
87	Corridor				7			
88	Digital and Computer lab			16		55	12	2
89	Gents Lab			2			1	
90	Ladies Lab			2			1	
91	Electronic Seminar Hall				20	31	10	4
92	Head Office			8	10	6	4	1
93	PG Lab				12	1	3	
94	Communication Engi. Lab			14		28	10	
95	Instrmentation Lab			8		11	12	
96	Street Light	12						
	Computer Engi.							

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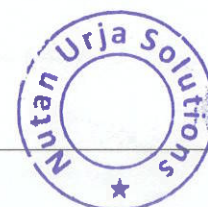
	Department							
97	Office							
98	Computer Facility				84	79	12	
99	Crridor				12			
100	Faculty Room				24	3	3	
101	PG Lab				24	21	4	
102	Cabin 1				6	1	3	
103	Cabin 2	3			18			
104	Data Center				18	4	1	2
105	CSE Lybrary				18	2	4	
106	HOD Cabin				27	3	2	1
107	Class Room 11				27		7	
108	Class Room 12				27		7	
109	Class Room 13				24		7	
110	Language Lab			12	44	4	10	
111	Cabin 3			5		5	5	
112	research Lab	11				44	6	4
113	MCA Dept.	26		28	40	100	50	14
114	Workshop				71	7	10	
115	Boys Hostel	79	1	44		1	20	
116	Library			87		9	32	
117	Canteen			30			9	
118	New Hostel	19		456	86		189	
119	Old Hostel	3		107	32	2	44	
	Civil Engineering Dept.							
120	Computer Aided Lab					12		
121	Drawing hall	24					16	
122	HOD						4	
123	Concrete Lab	18				1	8	

B. Sambhakar



124	Staff Room	6				3	4	2
125	Transportation Lab	8				4	6	
126	SOM lab	10				2	10	
127	Solid Engi. Lab	10					5	
128	Class room 11	6					4	
129	Class Room 10	6					4	
130	Survey Lab	4				2	5	
131	Envi. Engi. Lab	10				2	8	
132	Room no 15	4					5	
133	Civil Drawing Hall	10					6	
134	Computer Lab	6				10	4	
135	Civil HOD Cabin	5				2	2	
136	PG Class Room	6				2	4	
137	Civil dept. lab	4				1	1	
138	APM Dept, Lab	6				4	2	
139	APM class room	5				1	5	
140	Class room 2	6				2	6	
141	Civil seminar hall	10				2	4	4
142	Drawing hall	24					16	
143	Toilet 2	16						
144	Coirridor	20						
	Total	641	50	1227	917	785	1020	60

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



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Table No 2.2: Equipment wise Connected Load

No	Equipment	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	641	40	25.6
2	CFL	50	24	1.2
3	LED Tube-20W	1227	20	24.5
4	LED bulb	917	12	11.0
5	Computers	785	65	51.0
6	Ceiling Fan	1020	65	66.3
7	AC (1.5Tr)	60	1838	110.3
8	Pumps (3 nos 5HP)			11.2
	Total			187.8

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

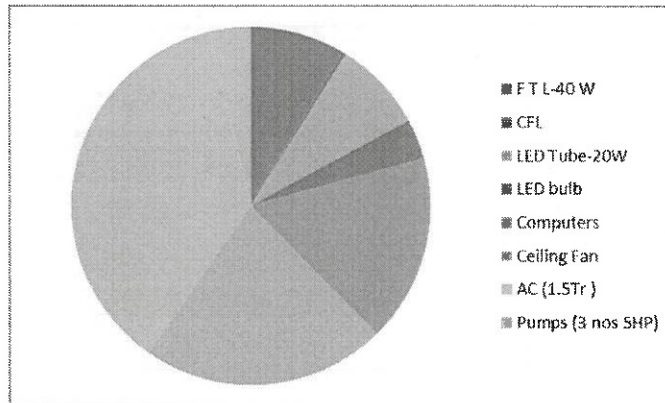
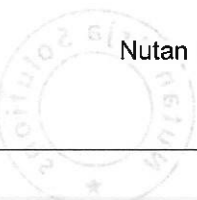


Figure 2.1: Distribution of connected load.

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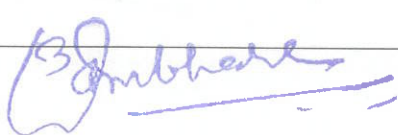
3. Study of Electrical Energy Consumption

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

Variation in energy consumption is as follows,

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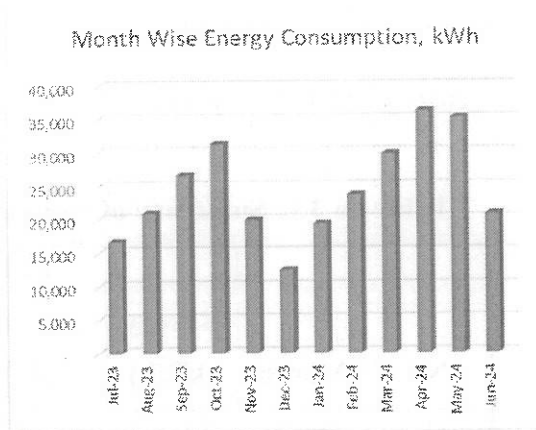


Figure 3.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

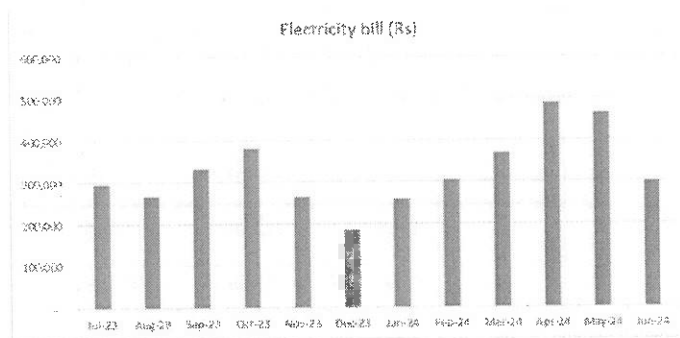


Figure 3.2: Month wise electricity bill

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	36,351	29.1
2	Minimum	12,503	10.0
3	Average	24,531	19.6
4	Total	294,367	235.5



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

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

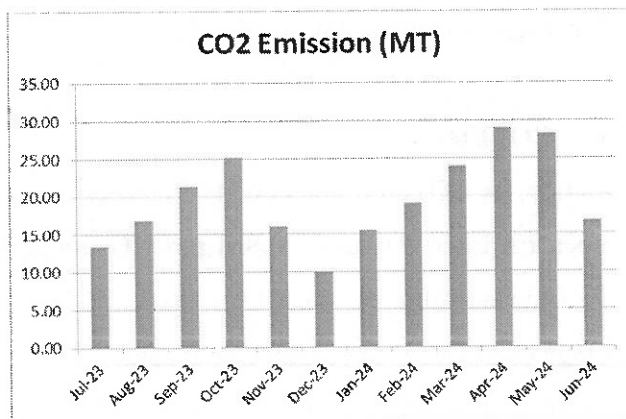
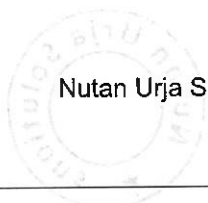


Figure 4.1: Month wise CO2 Emission

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5. Study of utilities

5.1 Study of Lighting

In the facility, the lighting system can be divided mainly in to parts, indoor lighting and outdoor lighting. There are 641 FTL fittings with Electronic/ magnetic chokes , 50 nos of CFLs, 1272 nos of LED tubes, 917 nos of LED bulbs. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings.

5.2 Air-conditioners

In the facility, there are about 60Nos. of 1.5 Tr Air-conditioners.

5.3 Ceiling Fans

At building facility, there are about 1020 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.

5.4 Water Pumps

There are in total 3 Water pumps with 5HP capacities respectively.



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

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

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

Photograph of Solar PV plant



(Signature)

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	641	40	25.6
2	CFL	50	24	1.2
	LED lighting load			
1	LED tube	1227	20	24.5
2	LED bulbs	917	12	11.0
	Total LED lighting load			35.5
	Total Lighting load			62.4

It can be seen that out of total lighting load 57% 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 641 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	641	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	51.28	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	12820	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	141020	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	410881	Rs lump sum
13	Simple Payback period	35	Months





8.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 1020 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	1020	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	40	W/Unit
4	Reduction in demad	25	W/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	204	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	51000	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	561000	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	2217480	Rs lump sum
13	Simple Payback period	47	Months

8.3 Installation of Solar PV panel

It is recommended to install 150 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	150	kW
2	Energy saving	225000	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetary savings	2475000	Rs/ Annum
5	Investment required	7500000	Rs lump sum
6	Simple payback period	36	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 641 Nos T-8 fittings with 20W LED fittings	12,820	141,020	410,881	35
2	Replacement of 1020 Nos Old Ceiling Fans with STAR rating fans	51,000	561,000	2,217,480	47
3	Installation of 150kW grid connected PV panel	225,000	2,475,000	7,500,000	36
	Total	63,820	702,020	2,628,361	45

(Signature)





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Date: 22/08/2023

CERTIFICATE

This is to certify that we have conducted Energy Audit at Government College of Engineering Aurangabad, Chhatrapati Sambhajnagar as per the guidelines of Maharashtra Energy Development Agency (www.mahaurja.com) in the year 2022-23.

The College has already adopted **Energy Efficient** practices like:

- Usage of Energy Efficient LED Fittings
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of Solar Thermal Hot Water System
- Installation of Solar PV system of 150kW capacity
- Installation tribid system of 3 kW capacity using Solar, Wind, Battery

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

Nutan Urja Solutions,



K G Bhatwadekar,

Certified Energy Auditor,

EA - 22428







Report
On
Energy Audit
At
Government College of Engineering Aurangabad, Chhatrapati
Sambhajinagar
(Year 2022-23)



Prepared by

Nutan Urja Solutions

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B. Ambhore



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Acknowledgement

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Government College of Engineering Aurangabad, Chhatrapati Sambhajnagar 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.

B. Ambhore



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	28,222	22.6
2	Minimum	9,816	7.9
3	Average	16,343	13.1
4	Total	196,113	156.9

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. Usage of Alternate Energy

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

B. Sambhade



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 57 %.

6. Recommendations

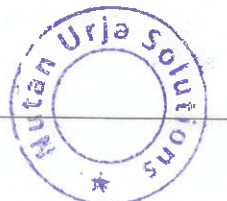
Table no 1: Recommendations for energy savings

No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs.	Investment Required, Rs.	Payback period, Months
1	Replacement of 641 Nos T-8 fittings with 20W LED fittings	12,820	141,020	410,881	35
2	Replacement of 1020 Nos Old Ceiling Fans with STAR rating fans	51,000	561,000	2,217,480	47
3	Installation of 150kW grid connected PV panel	225,000	2,475,000	7,500,000	36
	Total	63,820	702,020	2,628,361	45

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

B. Ambekar



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

B. J. Ambhede



1. Introduction

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

1.1 Objectives

1. To study present level of Energy Consumption
2. To Study 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

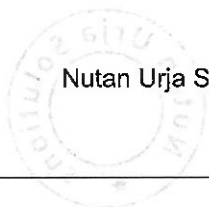
No	Head	Particulars
1	Name of Institution	Government College of Engineering Aurangabad, Chhatrapati Sambhajanagar (GECA)
2	Address	Bhanudas Sabhahgrah Railway Station Rd, Rachanakar Colony, New Usmanpura, Chhatrapati Sambhaji Nagar, Maharashtra 431 005
3	Affiliation	Dr. Babasaheb Ambedkar Marathwada University

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	LED tube (20W)	LED bulb (12W)	Computer s (65W)	Fans	1.5 TR ACs
	Electrical Engi. Dept.							
1	Cabin 1	2	1	2		1	1	
2	Corridor	12			16			1
3	Cabin 2	6	1			1	5	
4	Cabin	2				1	2	
5	Network Lab	5					5	
6	Cabin 3	2			1	1	1	
7	Class room no 5		5	2	6		5	
8	Electrical Machine Lab	8			1		12	
9	Class room no 6	6					3	
10	High Voltage lab	4					2	
11	Power electronics & Drive lab	6				1	8	
12	Gear and Protection Lab	10				1	4	
13	Electrical Measurement Lab	12				2	4	
14	Computer Center	31				51	12	8
15	Ladies Room						1	
16	Room no 7	6					2	
17	EESA council						2	



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	Control Measurement							
18	Lab	6					2	
19	Control Lab			1		1	2	
20	Cabin 4			1		1	1	
21	Microprocessor Lab	4					1	
22	Cabin 5	2				1	1	1
23	Cabin 6	2				1	2	1
24	Toilet	2						
25	T&P cell	14			10		3	2
	Mechanical Engi. Lab						1	
26	Staff Room 1			1	2	2	1	
27	Cabin 1			1	1	1	1	
28	Cabin 2			2			2	
29	Staff Room 2			2		1	1	
30	Cabin 3			2		1	1	
31	Class Room no 3			9			3	
32	Cabin 4	6			2	2	2	1
33	Class Room 2	9		1				
34	Corridor				4			
35	Tutorial Room				6		4	
36	Cabin 5			1	2	1	1	
37	Cabin 6				1	1	3	
38	IC Engine Lab	2		7	16			
39	Toilet			1				
40	Corridor	2						
41	HT Lab	6		2	7	3	2	
42	Staff Room No 4	1			2			
43	PG Class Room				6		1	
44	Security Cabin				1	1	1	
	Office							

B. Sambhare



45	research Lab	10			6	3		2
46	Seminar Hall	14			22		7	2
47	CAD Lab				24	8	5	
48	Robotics Lab				21	2	2	
49	Small Tutorial Room				1	2	2	
50	Corridor	1			10			
51	Tutorial Room				5		4	
52	Tutorial Room				8			
53	Student Section				45	4	12	
54	Account Section				36	6	9	1
55	Graphical lab				4	1	1	
56	Principal Office	8		1	9	1		2
57	Chairman office				6	1		
58	Corridor	2		6	2			
59	Toilet				3			
60	Boys Hostel	3	21	128			106	
	IT Department							
61	Class Room 1			10			6	
62	Class Room 2			11			6	
63	Class Room 3			8			6	
64	Class Room 4			9			6	
65	Class Room 5			11			6	
66	Class Room 6			10			6	
67	Exam Cell			30		13	14	2
68	cabin 1			2		2	1	
69	cabin 2			4		3	2	
70	It project lab			19		60	14	
71	Cabin 3			2		1	1	
72	Cabin 4					1	3	
73	IT Lab 1			15				

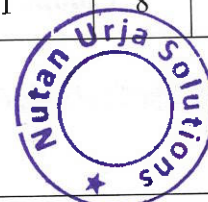
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74	IT Lab 2			15			6	
75	training Room	9				53	6	2
76	Faculty Room	25				5	11	
77	OBMS Lab	24		10		68	14	
78	Toilet			12				
79	HOD Cabin					2	12	1
80	Corridor			35				
81	Seminar Hall		21				13	
82	Toilet			12			12	
	Electronic Engineering Dept.							
83	Office							
84	Room no 8			11			4	
85	Electronics and Circuit Lab			9		5	5	
86	Cabin 1			3		1		
87	Corridor				7			
88	Digital and Computer lab			16		55	12	2
89	Gents Lab			2			1	
90	Ladies Lab			2			1	
91	Electronic Seminar Hall				20	31	10	4
92	Head Office			8	10	6	4	1
93	PG Lab				12	1	3	
94	Communication Engi. Lab			14		28	10	
95	Instrmentation Lab			8		11	12	
96	Street Light	12						
	Computer Engi.							

	Department							
97	Office							
98	Computer Facility				84	79	12	
99	Crridor				12			
100	Faculty Room				24	3	3	
101	PG Lab				24	21	4	
102	Cabin 1				6	1	3	
103	Cabin 2	3			18			
104	Data Center				18	4	1	2
105	CSE Lybrary				18	2	4	
106	HOD Cabin				27	3	2	1
107	Class Room 11				27		7	
108	Class Room 12				27		7	
109	Class Room 13				24		7	
110	Language Lab			12	44	4	10	
111	Cabin 3			5		5	5	
112	research Lab	11				44	6	4
113	MCA Dept.	26		28	40	100	50	14
114	Workshop				71	7	10	
115	Boys Hostel	79	1	44		1	20	
116	Library			87		9	32	
117	Canteen			30			9	
118	New Hostel	19		456	86		189	
119	Old Hostel	3		107	32	2	44	
	Civil Engineering Dept.							
120	Computer Aided Lab					12		
121	Drawing hall	24					16	
122	HOD						4	
123	Concrete Lab	18				1	8	

B. Sambhede



124	Staff Room	6				3	4	2
125	Transportation Lab	8				4	6	
126	SOM lab	10				2	10	
127	Solid Engi. Lab	10					5	
128	Class room 11	6					4	
129	Class Room 10	6					4	
130	Survey Lab	4				2	5	
131	Envi. Engi. Lab	10				2	8	
132	Room no 15	4					5	
133	Civil Drawing Hall	10					6	
134	Computer Lab	6				10	4	
135	Civil HOD Cabin	5				2	2	
136	PG Class Room	6				2	4	
137	Civil dept. lab	4				1	1	
138	APM Dept, Lab	6				4	2	
139	APM class room	5				1	5	
140	Class room 2	6				2	6	
141	Civil seminar hall	10				2	4	4
142	Drawing hall	24					16	
143	Toilet 2	16						
144	Coirridor	20						
	Total	641	50	1227	917	785	1020	60

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

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Table No 2.2: Equipment wise Connected Load

No	Equipment	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	641	40	25.6
2	CFL	50	24	1.2
3	LED Tube-20W	1227	20	24.5
4	LED bulb	917	12	11.0
5	Computers	785	65	51.0
6	Ceiling Fan	1020	65	66.3
7	AC (1.5Tr)	60	1838	110.3
8	Pumps (3 nos 5HP)			11.2
	Total			187.8

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

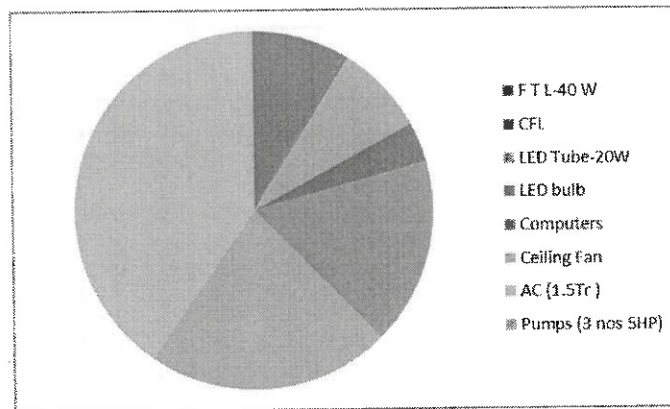


Figure 2.1: Distribution of connected load.

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

Variation in energy consumption is as follows,

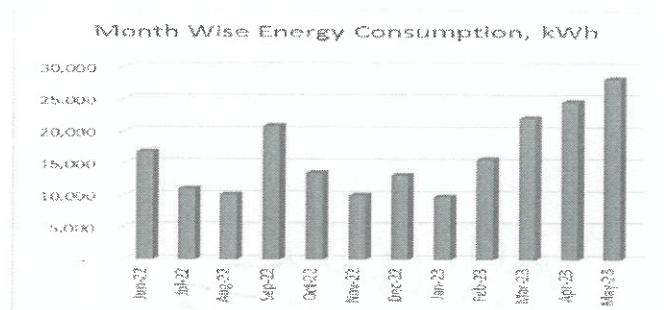


Figure 3.1: Month wise energy consumption

Monthly variation in electricity bill is as follows,

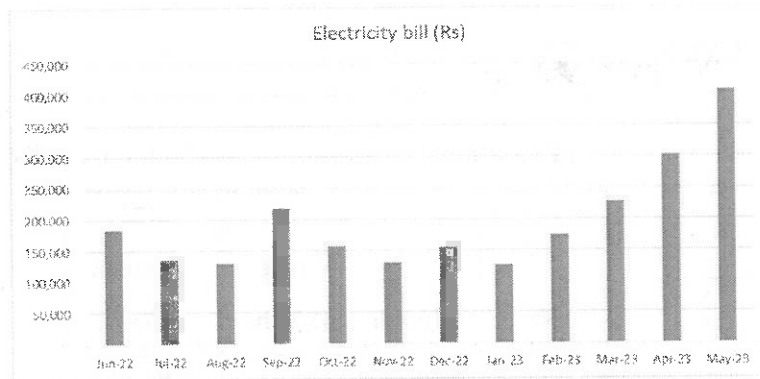


Figure 3.2: Month wise electricity bill

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	28,222	22.6
2	Minimum	9,816	7.9
3	Average	16,343	13.1
4	Total	196,113	156.9

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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	May-23	28,222	22.58
2	Apr-23	24,611	19.69
3	Mar-23	22,102	17.68
4	Feb-23	15,652	12.52
5	Jan-23	9,816	7.85
6	Dec-22	13,166	10.53
7	Nov-22	10,064	8.05
8	Oct-22	13,512	10.81
9	Sep-22	20,868	16.69
10	Aug-22	10,231	8.18
11	Jul-22	11,052	8.84
12	Jun-22	16,817	13.45
	Total	196,113	156.89

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

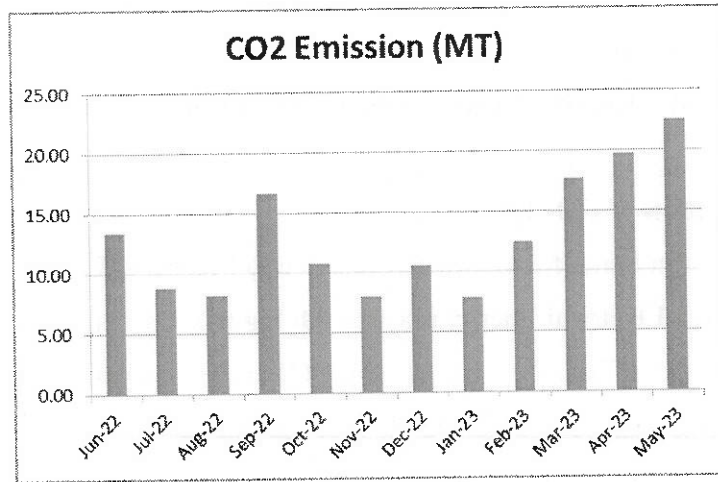


Figure 4.1: Month wise CO2 Emission

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5. Study of utilities

5.1 Study of Lighting

In the facility, the lighting system can be divided mainly in to parts, indoor lighting and outdoor lighting. There are 641 FTL fittings with Electronic/ magnetic chokes , 50 nos of CFLs, 1272 nos of LED tubes, 917 nos of LED bulbs. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings.

5.2 Air-conditioners

In the facility, there are about 60Nos. of 1.5 Tr Air-conditioners.

5.3 Ceiling Fans

At building facility, there are about 1020 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.

5.4 Water Pumps

There are in total 3 Water pumps with 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 solar PV system of 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battery system.

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

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	196,113	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	225000	kWh/Annum
3	Total Energy Requirement of College	421,113	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	53	%

Photograph of Solar PV plant



B. Sambhade



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.

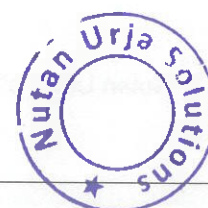
Table 7.1: Total lighting load

No	Particulars	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	641	40	25.6
2	CFL	50	24	1.2
	LED lighting load			
1	LED tube	1227	20	24.5
2	LED bulbs	917	12	11.0
	Total LED lighting load			35.5
	Total Lighting load			62.4

It can be seen that out of total lighting load 57% load is LED lighting load.



B. Sambhade



8. Energy conservation proposals

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

In the facility, there are about 641 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	641	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	51.28	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	12820	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	141020	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	410881	Rs lump sum
13	Simple Payback period	35	Months

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8.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 1020 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	1020	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	40	W/Unit
4	Reduction in demad	25	W/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	204	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	51000	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	561000	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	2217480	Rs lump sum
13	Simple Payback period	47	Months

8.3 Installation of Solar PV panel

It is recommended to install 150 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	150	kW
2	Energy saving	225000	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetary savings	2475000	Rs/ Annum
5	Investment required	7500000	Rs lump sum
6	Simple payback period	36	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 641 Nos T-8 fittings with 20W LED fittings	12,820	141,020	410,881	35
2	Replacement of 1020 Nos Old Ceiling Fans with STAR rating fans	51,000	561,000	2,217,480	47
3	Installation of 150kW grid connected PV panel	225,000	2,475,000	7,500,000	36
	Total	63,820	702,020	2,628,361	45

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Date: 28/08/2022

CERTIFICATE

This is to certify that we have conducted Energy Audit at Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar as per the guidelines of Maharashtra Energy Development Agency (www.mahaurja.com) in the year 2021-22.

The College has already adopted **Energy Efficient** practices like:

- Usage of Energy Efficient LED Fittings
- Usage of Energy Efficient BEE STAR Rated equipment
- Installation of Solar Thermal Hot Water System
- Installation of Solar PV system of 150kW capacity
- Installation tribid system of 3 kW capacity using Solar, Wind, Battery

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

Nutan Urja Solutions,



K G Bhatwadekar,

Certified Energy Auditor,

EA - 22428







Report
On
Energy Audit
At
Government College of Engineering Aurangabad, Chhatrapati
Sambhajinagar
(Year 2021-22)



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Acknowledgement

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Government College of Engineering Aurangabad, Chhatrapati Sambhajnagar 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)	CO2 Emission (MT)
1	Maximum	18,535	14.8
2	Minimum	2,046	1.6
3	Average	6,210	5.0
4	Total	74,525	59.6

2. Energy Conservation Projects already installed

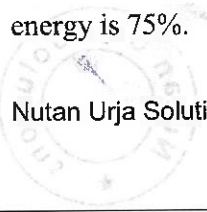
1. Usage of STAR Rated ACs at new installations
2. Usage of LED lights at some indoor locations
3. Usage of LED Lights for outdoor lighting.

3. Key Observations

1. Usage of LED lights.
2. Usage of star rated equipment.
3. Maintained a good power factor.

4. Usage of Alternate Energy

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



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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 57 %.

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 641 Nos T-8 fittings with 20W LED fittings	12,820	141,020	410,881	35
2	Replacement of 1020 Nos Old Ceiling Fans with STAR rating fans	51,000	561,000	2,217,480	47
3	Installation of 150kW grid connected PV panel	225,000	2,475,000	7,500,000	36
	Total	63,820	702,020	2,628,361	45

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



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Abbreviations

CFL	:	Compact Fluorescent Lamp
FTL	:	Fluorescent Tube Light
LED	:	Light Emitting Diode
V	:	Voltage
I	:	Current
kW	:	Kilo- Watt
kWh	:	kilo-Watt Hour
kVA	:	Active Power



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1. Introduction

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

1.1 Objectives

1. To study present level of Energy Consumption
2. To Study 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	Government College of Engineering Aurangabad, Chhatrapati Sambhajnagar (GECA)
2	Address	Bhanudas Sabhahgrah Railway Station Rd, Rachanakar Colony, New Usmanpura, Chhatrapati Sambhaji Nagar, Maharashtra 431 005
3	Affiliation	Dr. Babasaheb Ambedkar Marathwada University



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2. Study of connected load

In this chapter, we present details of various connected electrical equipment and electrical load.

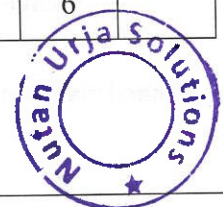
Table No-2.1: Location wise study of Electrical fittings in various buildings

No	Location	FTL (40W)	CFL	LED tube (20W)	LED bulb (12W)	Computer s (65W)	Fans	1.5 TR ACs
	Electrical Engi. Dept.							
1	Cabin 1	2	1	2		1	1	
2	Corridor	12			16			1
3	Cabin 2	6	1			1	5	
4	Cabin	2				1	2	
5	Network Lab	5					5	
6	Cabin 3	2			1	1	1	
7	Class room no 5		5	2	6		5	
8	Electrical Machine Lab	8			1		12	
9	Class room no 6	6					3	
10	High Voltage lab	4					2	
11	Power electronics & Drive lab	6				1	8	
12	Gear and Protection Lab	10				1	4	
13	Electrical Measurement Lab	12				2	4	
14	Computer Center	31				51	12	8
15	Ladies Room						1	
16	Room no 7	6					2	
17	EESA council						2	

	Control Measurement						
18	Lab	6					2
19	Control Lab			1		1	2
20	Cabin 4			1		1	1
21	Microprocessor Lab	4					1
22	Cabin 5	2				1	1 1
23	Cabin 6	2				1	2 1
24	Toilet	2					
25	T&P cell	14			10		3 2
	Mechanical Engi. Lab						1
26	Staff Room 1			1	2	2	1
27	Cabin 1			1	1	1	1
28	Cabin 2			2			2
29	Staff Room 2			2		1	1
30	Cabin 3			2		1	1
31	Class Room no 3			9			3
32	Cabin 4	6			2	2	2 1
33	Class Room 2	9		1			
34	Corridor				4		
35	Tutorial Room				6		4
36	Cabin 5			1	2	1	1
37	Cabin 6				1	1	3
38	IC Engine Lab	2		7	16		
39	Toilet			1			
40	Corridor	2					
41	HT Lab	6		2	7	3	2
42	Staff Room No 4	1			2		
43	PG Class Room				6		1
44	Security Cabin				1	1	1
	Office						

45	research Lab	10			6	3		2
46	Seminar Hall	14			22		7	2
47	CAD Lab				24	8	5	
48	Robotics Lab				21	2	2	
49	Small Tutorial Room				1	2	2	
50	Corridor	1			10			
51	Tutorial Room				5		4	
52	Tutorial Room				8			
53	Student Section				45	4	12	
54	Account Section				36	6	9	1
55	Graphical lab				4	1	1	
56	Principal Office	8		1	9	1		2
57	Chairman office				6	1		
58	Corridor	2		6	2			
59	Toilet				3			
60	Boys Hostel	3	21	128			106	
	IT Department							
61	Class Room 1			10			6	
62	Class Room 2			11			6	
63	Class Room 3			8			6	
64	Class Room 4			9			6	
65	Class Room 5			11			6	
66	Class Room 6			10			6	
67	Exam Cell			30		13	14	2
68	cabin 1			2		2	1	
69	cabin 2			4		3	2	
70	It project lab			19		60	14	
71	Cabin 3			2		1	1	
72	Cabin 4					1	3	
73	IT Lab 1			15			6	

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74	IT Lab 2			15			6	
75	training Room	9				53	6	2
76	Faculty Room	25				5	11	
77	OBMS Lab	24		10		68	14	
78	Toilet			12				
79	HOD Cabin					2	12	1
80	Corridor			35				
81	Seminar Hall		21				13	
82	Toilet			12			12	
	Electronic Engineering Dept.							
83	Office							
84	Room no 8			11			4	
85	Electronics and Circuit Lab			9		5	5	
86	Cabin 1			3		1		
87	Corridor				7			
88	Digital and Computer lab			16		55	12	2
89	Gents Lab			2			1	
90	Ladies Lab			2			1	
91	Electronic Seminar Hall				20	31	10	4
92	Head Office			8	10	6	4	1
93	PG Lab				12	1	3	
94	Communication Engi. Lab			14		28	10	
95	Instrmentation Lab			8		11	12	
96	Street Light	12						
	Computer Engi.							

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	Department							
97	Office							
98	Computer Facility				84	79	12	
99	Crridor				12			
100	Faculty Room				24	3	3	
101	PG Lab				24	21	4	
102	Cabin 1				6	1	3	
103	Cabin 2	3			18			
104	Data Center				18	4	1	2
105	CSE Lybrary				18	2	4	
106	HOD Cabin				27	3	2	1
107	Class Room 11				27		7	
108	Class Room 12				27		7	
109	Class Room 13				24		7	
110	Language Lab			12	44	4	10	
111	Cabin 3			5		5	5	
112	research Lab	11				44	6	4
113	MCA Dept.	26		28	40	100	50	14
114	Workshop				71	7	10	
115	Boys Hostel	79	1	44		1	20	
116	Library			87		9	32	
117	Canteen			30			9	
118	New Hostel	19		456	86		189	
119	Old Hostel	3		107	32	2	44	
	Civil Engineering Dept.							
120	Computer Aided Lab					12		
121	Drawing hall	24					16	
122	HOD						4	
123	Concrete Lab	18				1	8	



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124	Staff Room	6				3	4	2
125	Transportation Lab	8				4	6	
126	SOM lab	10				2	10	
127	Solid Engi. Lab	10					5	
128	Class room 11	6					4	
129	Class Room 10	6					4	
130	Survey Lab	4				2	5	
131	Envi. Engi. Lab	10				2	8	
132	Room no 15	4					5	
133	Civil Drawing Hall	10					6	
134	Computer Lab	6				10	4	
135	Civil HOD Cabin	5				2	2	
136	PG Class Room	6				2	4	
137	Civil dept. lab	4				1	1	
138	APM Dept, Lab	6				4	2	
139	APM class room	5				1	5	
140	Class room 2	6				2	6	
141	Civil seminar hall	10				2	4	4
142	Drawing hall	24					16	
143	Toilet 2	16						
144	Coirridor	20						
	Total	641	50	1227	917	785	1020	60

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



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Table No 2.2: Equipment wise Connected Load

No	Equipment	Qty	Load, W/Unit	Load, kW
1	F T L-40 W	641	40	25.6
2	CFL	50	24	1.2
3	LED Tube-20W	1227	20	24.5
4	LED bulb	917	12	11.0
5	Computers	785	65	51.0
6	Ceiling Fan	1020	65	66.3
7	AC (1.5Tr)	60	1838	110.3
8	Pumps (3 nos 5HP)			11.2
	Total			187.8

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

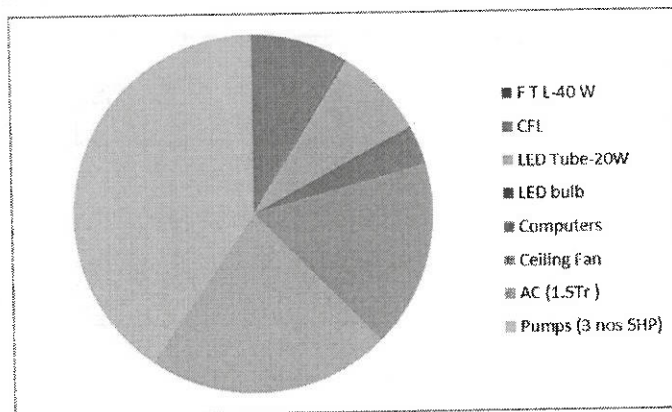


Figure 2.1: Distribution of connected load.

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

Variation in energy consumption is as follows,

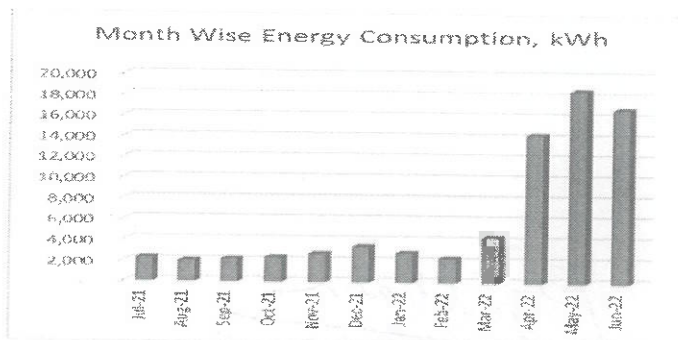


Figure 3.1: Month wise energy consumption



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Monthly variation in electricity bill is as follows,

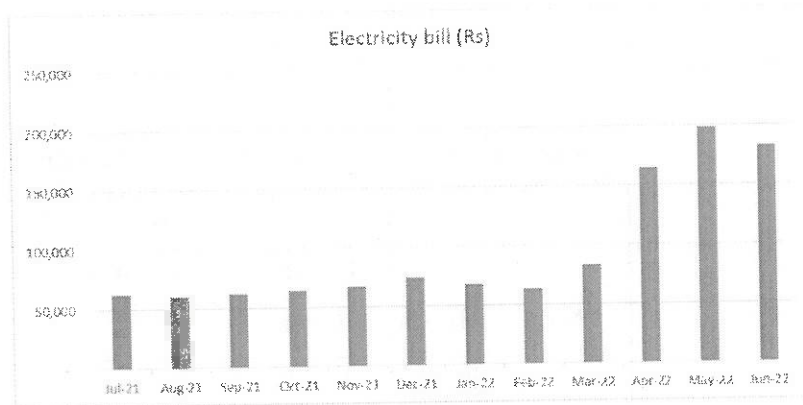


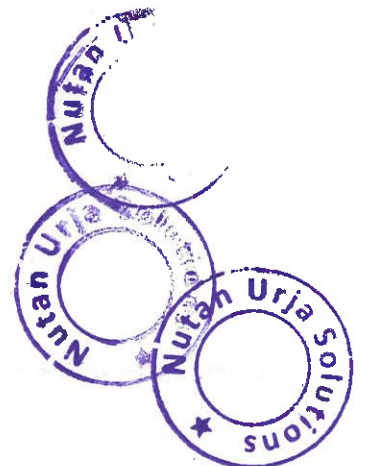
Figure 3.2: Month wise electricity bill

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	18,535	14.8
2	Minimum	2,046	1.6
3	Average	6,210	5.0
4	Total	74,525	59.6

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

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

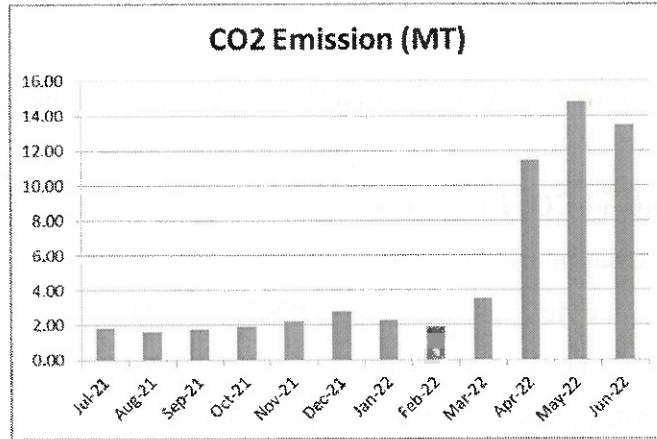


Figure 4.1: Month wise CO2 Emission

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5. Study of utilities

5.1 Study of Lighting

In the facility, the lighting system can be divided mainly in to parts, indoor lighting and outdoor lighting. There are 641 FTL fittings with Electronic/ magnetic chokes , 50 nos of CFLs, 1272 nos of LED tubes, 917 nos of LED bulbs. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings.

5.2 Air-conditioners

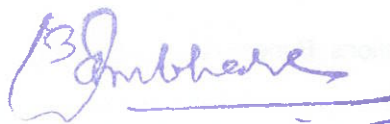
In the facility, there are about 60Nos. of 1.5 Tr Air-conditioners.

5.3 Ceiling Fans

At building facility, there are about 1020 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.

5.4 Water Pumps

There are in total 3 Water pumps with 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 solar PV system of 150 kW capacity. The College has installed a Roof Top Solar Thermal Hot Water system on hostel terrace. Also, college has installed tribid system of 3 kW capacity using Solar, Wind, Battery system.

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

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

Photograph of Solar PV plant



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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	641	40	25.6
2	CFL	50	24	1.2
	LED lighting load			
1	LED tube	1227	20	24.5
2	LED bulbs	917	12	11.0
	Total LED lighting load			35.5
	Total Lighting load			62.4

It can be seen that out of total lighting load 57% 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 641 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	641	Nos
2	Energy Demand of T-8 fitting	40	W/Unit
3	Energy Demand of 20 W LED fitting	20	W/Unit
4	Reduction in demand	20	W/Unit
5	Average Daily Usage period	4	Hrs/Day
6	Daily saving in Energy	51.28	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	12820	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	141020	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	410881	Rs lump sum
13	Simple Payback period	35	Months

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8.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 1020 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.

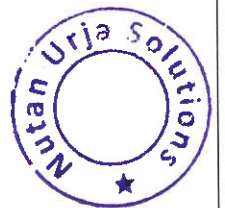
No	Particulars	Value	Unit
1	Present Qty of Old Ceiling Fan fittings	1020	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	40	W/Unit
4	Reduction in demad	25	W/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	204	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	51000	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	561000	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	2217480	Rs lump sum
13	Simple Payback period	47	Months

8.3 Installation of Solar PV panel

It is recommended to install 150 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	150	kW
2	Energy saving	225000	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetary savings	2475000	Rs/ Annum
5	Investment required	7500000	Rs lump sum
6	Simple payback period	36	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 641 Nos T-8 fittings with 20W LED fittings	12,820	141,020	410,881	35
2	Replacement of 1020 Nos Old Ceiling Fans with STAR rating fans	51,000	561,000	2,217,480	47
3	Installation of 150kW grid connected PV panel	225,000	2,475,000	7,500,000	36
	Total	63,820	702,020	2,628,361	45

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