



**MUKTAINAGAR TALUKA EDUCATION SOCIETY'S**  
**SHRIMATI GODAVARIBAI**  
**GANPATRAO KHADSE COLLEGE,**  
**MUKTAINAGAR**

**TAL-MUKTAINAGAR, DIST- JALGAON**  
**MAHARASHTRA**

**ENERGY AUDIT**  
**(2022-23)**

**Prepared by**

**Nutan Urja Solutions**

**A 703, Balaji Witfield, Near Sunni's World,**

**Sus Road, Sus, Pune 411021**

**Phone: 83568 18381. Email: [nutanurja.solutions@gmail.com](mailto:nutanurja.solutions@gmail.com)**

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## **Acknowledgement**

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Muktainagar Taluka Education Society's Smt. Godawaribai Ganpatrao Khadse College, Muktainagar 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 CO<sub>2</sub> 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**

<b>b</b>	<b>Parameter</b>	<b>Energy consumed, (Units)</b>	<b>CO<sub>2</sub> Emission (MT)</b>
1	Maximum	7,317	5.85
2	Minimum	1,141	0.91
3	Average	2,974	2.38
4	Total	35,693	28.55

### 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.
4. Usage of STAR rated fans at new installations

### 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 a Roof Top Solar thermal hot water system of 1200 liters capacity. Also, college has installed 2 nos. of solar PV street lights.

## 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 3.3 %.

## 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 282 Nos T-8 fittings with 20W LED fittings	5,640	62,040	180,762	35
2	Replacement of 196 Nos Old Ceiling Fans with STAR rating fans	7,840	86,240	426,104	59
3	Installation of 30kW grid connected PV panel	45,000	495,000	1,500,000	36
	<b>Total</b>	<b>58,480</b>	<b>643,280</b>	<b>2,106,866</b>	<b>39</b>

## 7 Notes & Assumptions

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

## Abbreviations

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

## **1. Introduction**

The college Smt. G. G. Khadse Science and Arts College Muktainagar is run by The Muktainagar Taluka Education Society Muktainagar, is located at natural and peaceful surroundings on a hill, on Bhusawal road, near Gajanan Maharaj Temple. The college is permanently affiliated to the North Maharashtra University Jalgaon.

Though the college is situated in rural area, its progress and development is no less than the other of progress. An attempt is always made to retain standard and attain new horizons. In this attempt the management, the principal, the teaching and non-teaching staff of the collage work together hard for the overall development of the rural students. The college has availed advanced academics, sports and other facilities to the student for their social, physical, spiritual, intellectual and spiritual development. The glorious results of the students in the University exams, the medals and prizes in sports, the state and university level awards of N.S.S .etc are an outcome of these efforts.

### **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**

<b>No</b>	<b>Head</b>	<b>Particulars</b>
1	Name of Institution	Muktainagar Taluka Education Society's Smt. Godawaribai Ganpatrao Khadse College, Muktainagar.
2	Address	Muktainagar Taluka Education Societys Smt Godavaribai Ganpatrao Khadse College, Near Gajanan Maharaj Temple, Bhusawal Road, Muktainagar, Dist. Jalgaon – 425 306.
3	Affiliation	Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon.



## 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)	LED tube (20W)	LED bulb (12W)	CFL	Computers (65W)	Fans	1.5TR Star rated AC
1	Principal Cabin	4				2	2	
2	Old Office	5					2	
3	Comp Lab 1	5			1	18	3	
4	Comp Lab 2	5				18	3	
5	Comp Lab 3	4				22	4	
6	Commerce Lab	4				19	4	
7	Store Room	1						
8	History Dept	1					1	
9	Hindi Dept	1					1	
10	Marathi, Psychology, ECD Dept	4					4	
11	Zoology Dept	10				3	7	
12	Math, Political Science Dept	5				3	4	
13	Physics Dept	10					5	
14	NSS, Student Welfare Dept	1				1		
15	Electronics Dept	8			1	4	4	
16	Bot Dept	10				1	4	
17	Carrier Guide and BOT Dept	10				1	4	
18	English Dept	1				9	4	

19	English Dept, Staff Room	2				2		
20	Ladies Toilet			1				
21	Class Room	2					2	
22	Classroom	3			2		3	
23	Classroom	4					4	
24	Classroom, Seminar Hall	4					6	
25	Passage							
26	Chemistry Lab	6						
27	Chemistry Lab	11					1	
28	Research, Physics Lab	9				2	6	
29	Guest Room	2			1		2	
30	Chemistry, Comp Lab	2				5		
31	Passage						4	
32	Gents Toilet							
33	Classroom	3					2	
34	Classroom	2					2	
35	Classroom	2			1		2	
36	Boi Techno Det	6				2	5	1
37	Reading Room	14					5	
38	Central Library	15				2	2	
39	Classroom	3					3	
40	Classroom	2					4	
41	Classroom	2					4	
42	Classroom	2					2	
43	Classroom	2			22		2	
44	Classroom	1			2		1	
45	Store Room	1						
46	Management, Principal,						6	

	Vice Principal Cabin							
47	Management Washroom							
48	Geography Dept	2				2	2	
49	Geography Lab 1	2					3	
50	Geography Lab 2	2			1		3	
51	Geography Lab 3	2						
52	Administrative Office 5	2				1	1	
53	Store Room	1					2	
54	Administrative Office 1	4				3	5	
55	Administrative Office 2	2			1		1	
56	Administrative Office 4	2					1	
57	Administrative Office 3	3				1	2	
58	Passage	3						
59	Washroom							
60	Ladies Common Room	2					1	
61	Commerce Classroom	2					2	
62	Commerce Classroom	3					2	
63	Commerce Classroom	3			2		2	
64	Commerce Classroom	3					2	
65	Commerce Classroom	2			4		2	
66	Solar Street Light			2				
67	Girls Hostel	11			1		11	
68	Washroom	2			2			
69	Girls Hostel 1 Floor	12			3		13	
70	Washroom							
71	Passage Ground Floor	3	1				1	
72	Passage First Floor	2		6				
73	Gymkhana	9	4				7	
74	Gym Passage		2	6				
75	Swimming Pool Change	10	2				6	

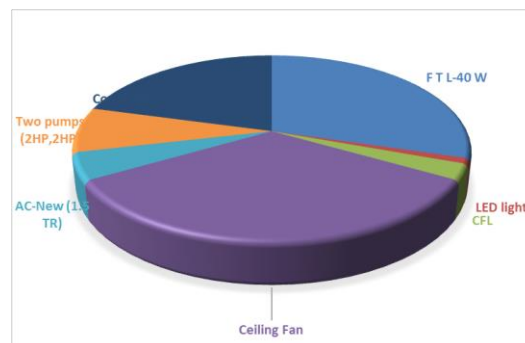
	Room							
76	Gym Watchmen Room		1				1	
77	Gym Guest Room	4					2	
	<b>Total</b>	<b>282</b>	<b>10</b>	<b>15</b>	<b>44</b>	<b>121</b>	<b>196</b>	<b>1</b>

Apart from above load, the school has pumps, LED street lights, CFLs and LED focus street lights on streets and grounds. 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	196	65	12.7
2	AC-New (1.5 TR)	1	1838	1.8
3	LED (12W) bulb	13	12	0.2
4	LED tube-20W	10	20	0.2
5	CFL	44	24	1.1
6	F T L-40 W	282	40	11.3
7	Computers	121	65	7.9
8	Two pumps (2HP, 2HP)			3.0
9	LED street lights	2	35	0.1
	Total			38.2

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



**Figure 2.1: Distribution of connected load.**

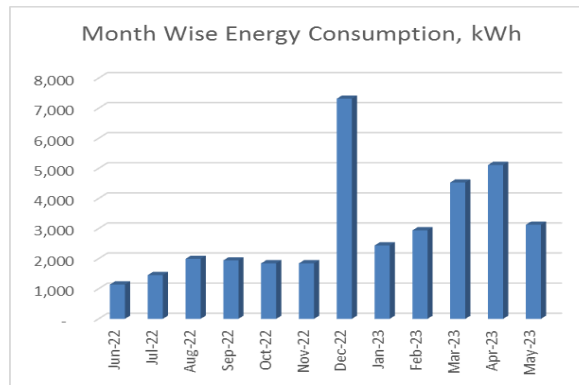
### 3. Study of Electrical Energy Consumption

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

**Table no 3.1: Summary of electricity bills**

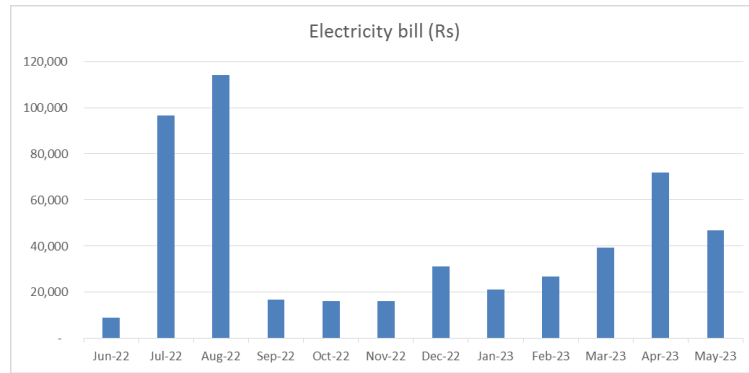
No	Month	Energy (kWh)	Bill Amount (Rs)
1	May-23	3,129	46,709
2	Apr-23	5,116	71,969
3	Mar-23	4,532	39,368
4	Feb-23	2,941	26,600
5	Jan-23	2,439	20,980
6	Dec-22	7,317	31,020
7	Nov-22	1,845	15,990
8	Oct-22	1,845	15,990
9	Sep-22	1,942	16,860
10	Aug-22	1,993	114,010
11	Jul-22	1,453	96,580
12	Jun-22	1,141	9,050
	<b>Total</b>	<b>35,693</b>	<b>505,126</b>

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	7,317	5.85
2	Minimum	1,141	0.91
3	Average	2,974	2.38
4	Total	35,693	28.55

## 4. Carbon Foot printing

1. A **Carbon Foot print** is defined as the Total Greenhouse Gas emissions (CO<sub>2</sub> emissions), emitted due to various activities. In this we compute the emissions of Carbon-Di-Oxide, by usage of the various form of Electrical Energy used by the College for performing its day-to-day activities

### 2. Basis for computation of CO<sub>2</sub> Emissions:

The basis of Calculation for CO<sub>2</sub> emissions due to Electrical Energy is as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of CO<sub>2</sub>** into atmosphere.

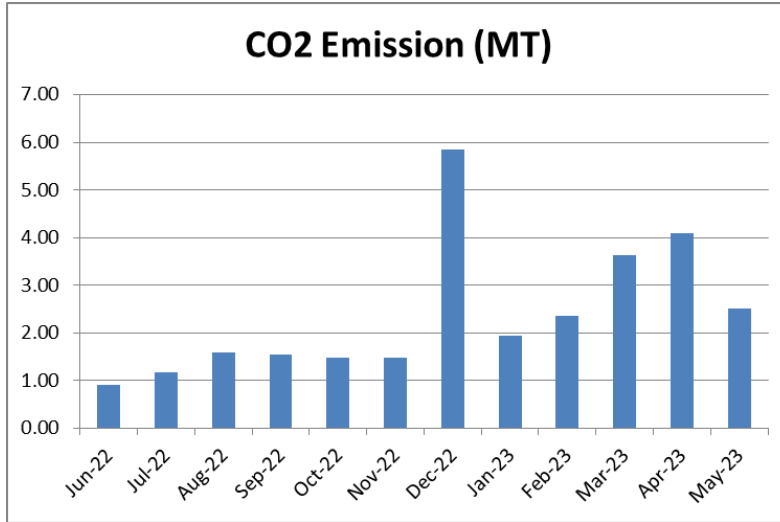
Based on the above Data we compute the CO<sub>2</sub> emissions which are being released in to the atmosphere by the College due to its Day-to-Day operations

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

**Table 4.1: Month wise Consumption of Electrical Energy & CO<sub>2</sub> Emissions**

No	Month	Energy Consumed, kWh	CO <sub>2</sub> Emissions, MT
1	Jun-22	4,503	3.60
2	May-22	2,453	1.96
3	Apr-22	3,795	3.04
4	Mar-22	2,443	1.95
5	Feb-22	1,851	1.48
6	Jan-22	2,414	1.93
7	Dec-21	1,736	1.39
8	Nov-21	2,942	2.35
9	Oct-21	2,164	1.73
10	Sep-21	1,451	1.16
11	Aug-21	2,769	2.22
12	Jul-21	3,959	3.17
	<b>Total</b>	<b>32,480</b>	<b>25.98</b>

In the following Chart we present the CO<sub>2</sub> emissions due to usage of Electrical Energy.



**Figure 4.1: Month wise CO<sub>2</sub> Emission**



## **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 282 nos. of FTL fittings with electronic/ magnetic chokes, 10 LED tubes, 15 nos. of LED bulbs, 44 nos. of CFLs and 2 nos. of LED street lights. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings.

### **5.2 Air-conditioners**

There is 1 no of star rated new AC of 1.5Tr capacity.

### **5.3 Ceiling Fans**

At building facility, there are about 196 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 2 nos. of Water pumps with 2HP capacities respectively.

## 6. Study of usage of alternate energy

The College has installed a Solar thermal hot water system of 1200 liters capacity on hostel terrace. Also, college has installed 2 nos. of solar PV street lights.

### Photograph of Solar Thermal Water Heaters



## 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	282	40	11.3
2	CFL	44	24	1.06
	<b>LED lighting load</b>			
1	LED tube	10	20	0.2
2	LED bulbs	13	12	0.16
3	LED street lights	2	35	0.07
	<b>Total LED lighting load</b>			<b>0.43</b>
	<b>Total Lighting load</b>			<b>12.8</b>

It can be seen that out of total lighting load 3.3% 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 282 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	282	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	22.56	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	5640	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	62040	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	180762	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 196 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	196	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	45	W/Unit
4	Reduction in demad	20	W/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	31.36	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	7840	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	86240	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	426104	Rs lump sum
13	Simple Payback period	59	Months

### 8.3 Installation of Solar PV panel

It is recommended to install 15 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	30	kW
2	Energy saving	45000	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetary savings	495000	Rs/ Annum
5	Investment required	1500000	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 282 Nos T-8 fittings with 20W LED fittings	5,640	62,040	180,762	35
2	Replacement of 196 Nos Old Ceiling Fans with STAR rating fans	7,840	86,240	426,104	59
3	Installation of 30kW grid connected PV panel	45,000	495,000	1,500,000	36
	<b>Total</b>	<b>58,480</b>	<b>643,280</b>	<b>2,106,866</b>	<b>39</b>