

**Report**  
**On**  
**Energy Audit**  
**At**  
**Khandesh College Education Society's College Of Education and**  
**Physical Education, Jalgaon**  
**(Year 2022-23)**



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## **Acknowledgement**

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Khandesh College Education Society's College Of Education and Physical Education, Jalgaon, 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>Sr no</b>	<b>Parameter</b>	<b>Energy consumed, (Units)</b>	<b>CO<sub>2</sub> Emission (MT)</b>
1	Maximum	1,802	1.44
2	Minimum	638	0.51
3	Average	960	0.77
4	Total	11,520	9.22

### 2. Energy Conservation Projects already installed

1. Usage of LED lights at some indoor locations
2. Usage of LED Lights for outdoor lighting.
3. 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. There are about 97 Nos old T-8 type fittings which need to be replaced by 18 W LEDs.
5. There are 1 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 20%.

#### 5. Percentage of Usage of LED Lighting

The College has various Types of Light fittings, namely: LED & FTL. The percentage of Annual LED Lighting Usage to Annual Lighting requirement works out to be 22 %.

#### 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 97 Nos T-8 fittings with 20W LED fittings	4,656	51,216	62,177	15
2	Replacement of 81 Nos Old Ceiling Fans with STAR rating fans	2,527	27,799	176,094	76
3	Replacement of 1 Nos Old 1.5 TR Acs with STAR rating Acs	2,400	26,400	52,875	24
4	Installation of 5kW grid connected PV panel	7,500	82,500	250,000	36
	<b>Total</b>	<b>17,083</b>	<b>187,915</b>	<b>541,146</b>	<b>35</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**

Under the Global Visionary Management of Khandesh College Education Society, Jalgaon, the KCES College of Education & Physical Education has started its beginning of training the teachers for tomorrow from the year 1965. The total intake capacity of B.Ed. is 150 students.

The College is bestowed with the status as CTE (College for teacher Education) by the HRD Ministry of Central Government. The Extension Service Centre of the College, which is patron aged by the State Government of Maharashtra, caters to the in service training for secondary school teachers of Jalgaon District. The education in the distant mode is undertaken by the college with the help of IGNOU, YCMOU.

The college is situated in the 26 Acres of beautiful academic campus centrally located in Jalgaon city and district headquarters. The college campus is 2.6 K.M. away from the Jalgaon Railway stations. The College campus is well equipped with the necessary facilities like Gymkhana, spacious play ground, Indoor & Outdoor sports facility, Bank, Canteen, vehicle parking facilities and ultra modern Ladies and Gents Hostels. The College is situated along with Primary School, Secondary School and College buildings in the campus.

### **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	Khandesh College Education Society's College Of Education and Physical Education, Jalgaon
2	Address	MJ College Campus, Chowk, near Bank Of Maharashtra, Prabhat Colony, Jalgaon, Maharashtra 42500.
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)	Computers (65W)	Old fan	1.5TR old Acs
1	Office 1		4	5	4	
2	Principal room		6	2	2	1
3	Store room	1			1	
4	NASC room		4	1	3	
5	Hall	7	3	10	4	
6	Worshop	1	1	1	2	
7	Physic	3	1	2	2	
8	Washing room	2	1			
9	Audio room		8	3	4	
10	Room no 19	8	4		10	
11	Room no 21	4	1		6	
12	Toilet	2				
13	Computer lab	8		20	6	
14	Library	2	6	2	6	
15	Reeding room	3			2	
16	Room 28	3			2	
17	Room 29	3			2	

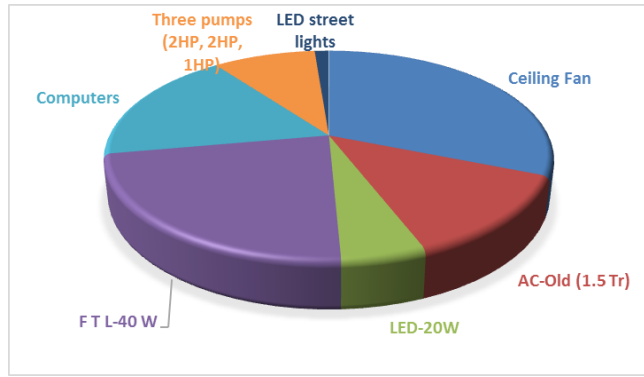
<b>18</b>	Room 30	3			2	
<b>19</b>	Toilet	2				
<b>20</b>	Room 31	1	2		2	
<b>21</b>	Room 26	5			3	
<b>22</b>	Room 25	5			3	
<b>23</b>	Office 2	6			4	
<b>24</b>	Room 24	4	1		3	
<b>25</b>	Hall 2	8	2		8	
<b>26</b>	Toilet	2				
<b>27</b>	Corridor	14				
	<b>Total</b>	<b>97</b>	<b>44</b>	<b>46</b>	<b>81</b>	<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**

<b>No</b>	<b>Equipment</b>	<b>Qty</b>	<b>Load, W/Unit</b>	<b>Load, kW</b>
1	Ceiling Fan	81	65	5.3
2	AC-Old (1.5 Tr)	1	2200	2.2
3	LED-20W	44	20	0.9
4	F T L-40 W	97	40	3.9
5	Computers	46	65	3.0
6	pump (2HP)			1.5
7	LED street lights	6	35	0.2
	Total			16.9

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



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

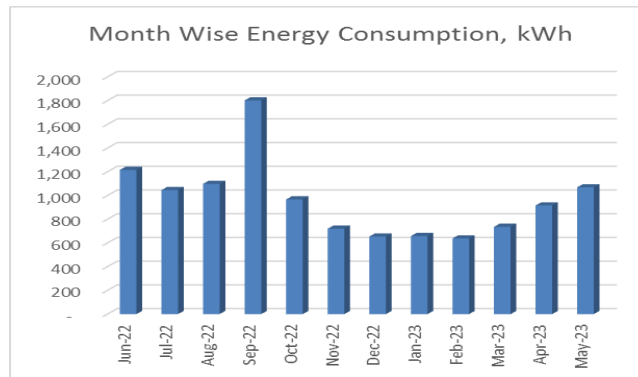
### 3. Study of Electrical Energy Consumption

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

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

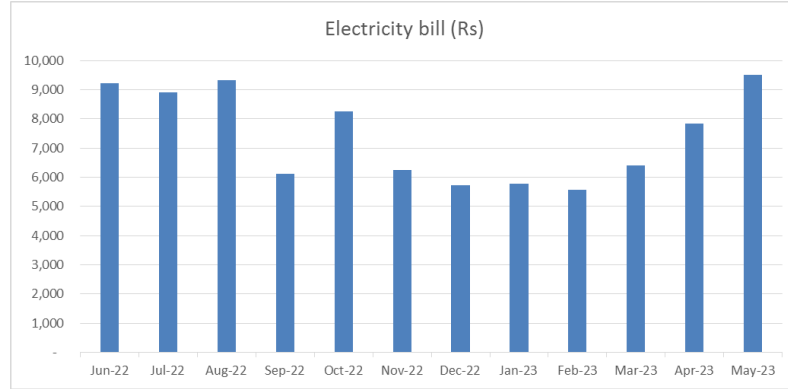
No	Month	Energy (kWh)	Bill Amount (Rs)
1	May-23	1,069	9,500
2	Apr-23	916	7,850
3	Mar-23	736	6,400
4	Feb-23	638	5,580
5	Jan-23	658	5,770
6	Dec-22	654	5,730
7	Nov-22	720	6,260
8	Oct-22	967	8,270
9	Sep-22	1,802	6,130
10	Aug-22	1,098	9,320
11	Jul-22	1,046	8,900
12	Jun-22	1,216	9,220
	<b>Total</b>	<b>11520</b>	<b>88,930</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)	Bill Amount (Rs)
1	Maximum	1,802	9,500
2	Minimum	638	5,580
3	Average	960	7,411

## 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.

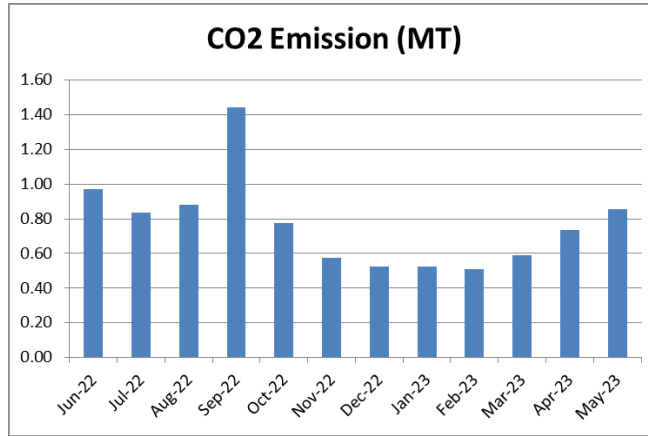
Based on the above Data we compute the CO<sub>2</sub> emissions which are being released in to the atmosphere by the College due to its Day to Day operations

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	May-23	1,069	0.86
2	Apr-23	916	0.73
3	Mar-23	736	0.59
4	Feb-23	638	0.51
5	Jan-23	658	0.53
6	Dec-22	654	0.52
7	Nov-22	720	0.58
8	Oct-22	967	0.77
9	Sep-22	1,802	1.44
10	Aug-22	1,098	0.88
11	Jul-22	1,046	0.84
12	Jun-22	1,216	0.97
	<b>Total</b>	<b>11,520</b>	<b>9.22</b>

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 Study of Lighting**

In the facility, the lighting system can be divided mainly in to parts, indoor lighting and outdoor lighting. There are 97 FTL fittings with Electronic/ magnetic chokes and 44 LEDs in indoor lightings. It is recommended to install the 20 W LED Tube light fittings in place of these old T-8 fittings. There are 06 No of LED street lights.

### **5.2 Air-conditioners**

In the facility, there are about 01 Nos. of 1.5 Tr old Air-conditioners. It is recommended to replace these Old ACs with BEE STAR Rated ACs.

### **5.3 Ceiling Fans**

At building facility, there are about 81 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 1 Water pumps with 2HP capacity.



## 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 **1.8 kWp**.

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

No	Particulars	Value	Unit
1	Annual Energy Purchased from MSEDCL	11,520	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	2,700	kWh/Annum
3	Total Energy Requirement of College	14,220	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	<b>19</b>	<b>%</b>

### 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	97	40	3.88
	<b>LED lighting load</b>			
1	LED tube	44	20	0.88
2	LED street lights	6	35	0.21
	<b>Total LED lighting load</b>			<b>1.09</b>
	<b>Total Lighting load</b>			<b>4.97</b>

It can be seen that out of total lighting load 22% 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 97 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	97	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	8	Hrs/Day
6	Daily saving in Energy	15.52	kWh/Day
7	Annual Working Days	300	Nos
8	Annual Energy Saving possible	4656	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	51216	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	62177	Rs lump sum
13	Simple Payback period	15	Months

## 8.2 Replacement of old fans with STAR Rated fans

During the Audit, it was observed that there are 81 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	81	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	52	W/Unit
4	Reduction in demad	13	W/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	8.424	kWh/Day
7	Annual Working Days	300	Nos
8	Annual Energy Saving possible	2527.2	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	27799.2	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	176094	Rs lump sum
13	Simple Payback period	76	Months

### 8.3 Replacement of 1.5 TR Old ACs with STAR Rated ACs

During the Audit, it was observed that there are 01 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	1	Nos
2	Energy Demand of Old 1.5 TR AC	2.15	kW/Unit
3	Energy Demand of New AC	1.15	kW/Unit
4	Reduction in demad	1	kW/Unit
5	Average Daily Usage period	8	Hrs/Day
6	Daily saving in Energy	8	kWh/Day
7	Annual Working Days	300	Nos
8	Annual Energy Saving possible	2400	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	26400	Rs/Annum
11	Cost of STAR Rated 1.5 TR AC	52875	Rs/unit
12	Investment required	52875	Rs lump sum
13	Simple Payback period	24	Months

#### 8.4 Installation of PV panel

It is recommended to install PV panels of 5 kW capacity. In the following Table, we present the savings, investment required & payback analysis.

No	Particulars	Value	Unit
1	Installation of 20kW PV unit	5	kW
2	Energy saving	7500	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetary savings	82500	Rs/ Annum
5	Investment required	250000	Rs lump sum
6	Simple payback period	36	Months

### 8.5 Summary of Savings

No	Recommendation	Annual Saving potential, kWh/Annum	Annual Monetary Gain, Rs.	Investment Required, Rs.	Payback period, Months
1	Replacement of 97 Nos T-8 fittings with 20W LED fittings	4,656	51,216	62,177	15
2	Replacement of 81 Nos Old Ceiling Fans with STAR rating fans	2,527	27,799	176,094	76
3	Replacement of 1 Nos Old 1.5 TR Acs with STAR rating Acs	2,400	26,400	52,875	24
4	Installation of 5kW grid connected PV panel	7,500	82,500	250,000	36
	<b>Total</b>	<b>17,083</b>	<b>187,915</b>	<b>541,146</b>	<b>35</b>