

**Report**  
**On**  
**Energy Audit**  
**At**  
**Vidarbha Youth Welfare Society's**  
**Prof. Ram Meghe Institute of Technology and Research**  
**Badnera – Amravati**



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## **Acknowledgement**

We at Nutan Urja Solutions, Pune, express our sincere gratitude to the management of Vidarbha Youth Welfare Society's Prof. Ram Meghe Institute of Technology and Research Badnera – Amravati for awarding us the assignment of Energy Audit of their college premises.

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

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

## Executive Summary

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the 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**

Sr no	Parameter	Energy consumed, (Units)	CO <sub>2</sub> Emission (MT)
1	Maximum	29,491	23.59
2	Minimum	14,047	11.24
3	Average	19,790	15.83
4	Total	237,485	189.99

### 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. There are about 1065 Nos old T-8 type fittings which need to be replaced by 18 W LEDs.
5. There are 33 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 9 no of 100W capacity solar PV street lights. The percentage of usage of Alternate Energy to Annual Energy Requirement is 0.6 %.

#### 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 16.5 %.

#### 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 1065 Nos T-8 fittings with 20W LED fittings	21,300	234,300	682,665	35
2	Replacement of 865 Nos Old Ceiling Fans with STAR rating fans	11,245	123,695	1,880,510	182
3	Replacement of 33 Nos Old 1.5 TR Acs with STAR rating Acs	33,000	363,000	1,744,875	58
4	Installation of 100kW grid connected PV panel	150,000	1,650,000	5,000,000	36
	<b>Total</b>	<b>215,545</b>	<b>2,370,995</b>	<b>9,308,050</b>	<b>47</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 Vidarbha Youth Welfare Society's Prof. Ram Meghe Institute of Technology & Research, Badnera-Amravati (Formerly well known as College of Engineering Badnera), is leading technological institute from central India. Established in the year 1983, the institute has a prestigious standing amongst the topmost Technical Institutes of Maharashtra. The Institute is providing an excellent Educational environment, infrastructure, amenities with value-oriented teaching; undoubtedly every student is molded well enough to face challenges of the modern world with the right attitude.

### 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	The Vidarbha Youth Welfare Society's Prof. Ram Meghe Institute of Technology & Research, Badnera-Amravati.
2	Address	New Express Highway, Ram Meghe Square, Badnera, Amravati, Maharashtra 444701
3	Affiliation	Sant Gadge Baba Amravati University, Amravati.

## 2. Study of connected load

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

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

No	Location	FTL (40W)	LED tube (20W)	LED bulb (16W)	Computers (65W)	Fans	1.5TR Star rated AC	1.5TR old Acs
	<b>Mechanical Dept.</b>							
1	HOD	4			2	2	1	
2	Seminar Hall		13	13	1	6		4
3	Robotics lab			10	5	4		
4	Computer lab	10			22	8		
5	Staff room I	5			1	2		
6	Wash Room	1						
7	Staff room II	5			4	2		
8	Library	4			1	3		
9	Mechanical Design lab	9			1	6		
10	Girls common room	1				1		
11	Class room 1	5				6		
12	Class room 2	5				6		
13	Class room 3	4				6		
14	Ladies wash room	2				2		
15	Tutorial room	3			1	2		
16	Class room 4		6			6		
17	Gents wash room	1				1		
18	Class room 5	5				6		
19	Class room 6	4				6		
20	HT lab	2			2	5		
21	Measurement system	7			3	4		



	lab							
22	Staff Canteen	2				1		
23	Passage	14						
24	Automobile lab	16		6		15		1
25	Store	4				2		
26	Zerox room	3				1		
27	FM lab	10		2		12		
28	Non conventional lab							
29	Energy lab	8		6		11		
30	Carpentry shop	10				9		
31	Machine shop	16	2			15		
32	Staff room	2				2		
33	Sports Dept.	2	4			2		
34	Blacksmith	9				4		
35	Welding workshop	6				4		
	<b>Electronic and Tele. Dept.</b>							
36	HOD				2	2	1	
37	Class room 1	4				6		
38	Wash room	2						
39	Class room 2	5				6		
40	Digital signal Process	4			32	5		
41	Digital Communication	6			35	7		
42	Seminar Hall	4			1	14		5
43	Corridor	20		8				
44	Gents wash room	4						
45	Girls wash room	3						
46	Micro computer lab	5			9	4		
47	CPA lab	6			21	4		
48	EDC lab	10				2		

49	Class room 5	5				6		
50	Class room 4	5				6		
51	Class room 3	5				6		
52	Staff room 1	4			4	4		
53	Staff room 2	4			4	4		
54	Staff room 3	4			4	4		
55	Library	4			1	3		
56	Wash Room	2						
57	Class room 6	5				6		
58	Communication lab	5			2	6		
59	Electronic lab	5			5	5		
60	Power electronics lab	2				7		
61	Machine lab	4				4		
62	PV lab	3				2		
63	Girls common room	4				5		
	<b>Civil Dept.</b>							
64	HOD office	7			2	3	1	
65	Wash Room	1						
66	Staff room	7			1	4		
67	Civil library	9				4		
68	Engineering Tech. lab	10			1	5		
69	Surveying room	7	1		1			
70	Computer lab 2	9			24	7		
71	Computer lanb 1	9			26	4		
72	Material testing lab	5			1	4		
73	Transportation lab	7			1	4		
74	Geotechnical Engi.	7	1		1	6		
75	Research lab	3	7	6	1	11		
76	Exam room		6			4		
77	Wash room boys		1					

78	Class room 1	8			1	5		
79	Class room 2	6			1	6		
80	Class room 3	6			1	6		
81	Class room 4	6			1	6		
82	Class room 5	6			1	6		
83	Class room 6	6			1	6		
84	Girls wash room	1						
85	Seminar Hall	11			1	7		
86	Environmental lab	15			2	8		
87	Class room	4				2		
88	Ladies staff roo 1	6			1	4		
89	Ladies staff roo 2	2			1	2		
90	Ladies staff roo 3	1	1		1	1		
91	Structural Engi. Lab	5				2		
92	Computer Science Dept.							
93	HOD	4			2	4		1
94	Class room 1	6				6		
95	Class room 2	6				5		
96	Staff room 1	10			1	9		
97	Passage	16				4		
98	Gents wash room	2						
99	Staff room 2	4				7		
100	Wash room	2						
101	Class room 3	8				6		
102	Class room 4	7				6		
103	Class room 5	8				6		
104	Programming lab	24			43	12		
105	Girls common room	2				2		
106	Girls wash room	1						
107	Staff room 3	3			3	4		

108	Class room 6	8				6		
109	Tutorial room	4				3		
110	Web technology lab	14			54	12		
111	Research lab	8			20	5		
112	Staff room 4	2				5		
113	Simulation lab	14			37	8		
114	Seminar Hall			34	1	22		
115	MBA Department							
116	HOD office	4				3	1	1
117	Staff room	5			2	3		
118	Class room 1	7			2	6		
119	Wash room	1						
120	Staff wash room	1						
121	Library	4			1	3		
122	Conference hall	6			1	3		
123	Girls wash room	2						
124	Class room 2	6				6		
125	Class room 3	6				6		
126	Corridor	5						
127	First Year Dept.							
128	First Year HOD	6			2	3		
129	Dispensary	3				2		
130	Ladies wash room	1						
131	Gents wash room	1						
132	Staff room 1	6			1	3		
133	Library	4				2		
134	Staff room 2	4			2	2		
135	Staff room 3	2			1	2		
136	Computer lab	12			47	10		
137	Eng. Chemistry lab	10				3		

138	Staff room 4	2			2	2		
139	Corridor	5				3		
140	Wash room	1						
141	Boys common room	6				4		
142	Class room 9	6				5		
143	Class room 8	6				5		
144	Engineering Physics Dept.	5				4		
145	Electrical Eng. Lab							
146	Class room 7	6				5		
147	Class room 6	6				5		
148	Electrical Eng. Lab	8				4		
149	Girls common room	1				1		
150	Girls wash room	1						
151	Drawing room	3				2		
152	Class room 1	6				5		
153	Class room 5	6				5		
154	Class room 4	6				5		
155	Class room 3	6				5		
156	Class room 2	6				5		
157	Staff room 4	1	1			2		
158	Staff room 6	1			1	1		
159	Staff room 5	1	1		1	4		
160	Corridor	2	4					
161	Eng. Machine lab	6				4		
162	Library	37			35	37		
	Administrative Building							
163	Hall reception			53		7		
164	Princial office			22		5		2
165	Wash room	1						

166	Admin office	11			15	13		3
167	Wash room	1						
168	Presentation room			34		5		2
169	Conference hall			5		3		2
170	Store office			5	1	1		
171	Strong room	2				1		
172	Dean academics			8	1	1		1
173	Dean Admin			6	1	1		1
174	Pantry	1						
175	Wash room	1						
176	Industry Institute	1						
177	Induction cell		8		1	2		1
178	T&P dept.			18		2		1
179	Interview room			21		5		3
180	IQAC			12		2		1
181	Electronic devices lab	6				6		
182	Language lab	11				7		
183	Corridor	12						
	IT Department							
184	HOD office	8			2	2		
185	Class room 4	8				5		
186	Networking lab	10			14	6		
187	Web technology lab	5			22	6		
188	Class room 1	9				6		
189	Staff room 1	2			3	5		
190	Staff wash room	1						
191	Girls wash room							
192	Boys wash room	1						
193	Class room 2	8				6		
194	Electronic devices lab	3				4		

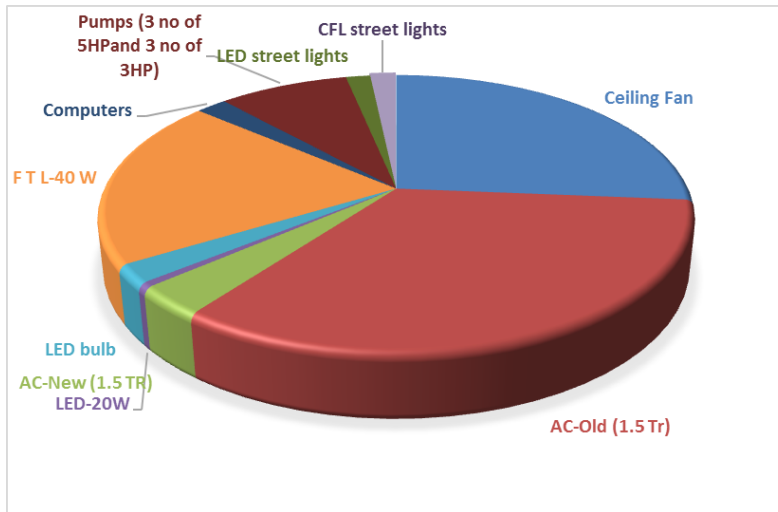
195	Programming lab	22			6	12		2
196	Girls common room	3				1		
197	Staff room 2	2			3	4		
198	Class room 3	6				6		1
199	Project lab	4			13	6		
200	Embedded system lab	10			25	7		
	MCA Department							
201	Passage							
202	HOD			16	1	2		
203	Class room 1	6						
204	MCA lab	15			63	2		
205	Staff room 1	6				5		
206	Class room 2	7				5		
207	Staff room 2	4			1	3		
208	Seminar Hall	13		2		9		
209	Payment counter				3	1		1
210	Wash room	1						
211	Staff room 3	3				2		
	<b>Total</b>	<b>1064</b>	<b>56</b>	<b>287</b>	<b>668</b>	<b>865</b>	<b>4</b>	<b>33</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	865	65	56.2
2	AC-Old (1.5 Tr)	33	2200	72.6
3	AC-New (1.5 TR)	4	1838	7.4
4	LED-20W	56	20	1.1
5	LED bulb	287	16	4.6
6	F T L-40 W	1064	40	42.6
7	Computers	66	65	4.3
8	Pumps (3 no of 5HP and 3 no of 3HP)			18.1
9	LED street lights	34	100	3.4
10	CFL street lights	24	150	3.6
	Total			213.9

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



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



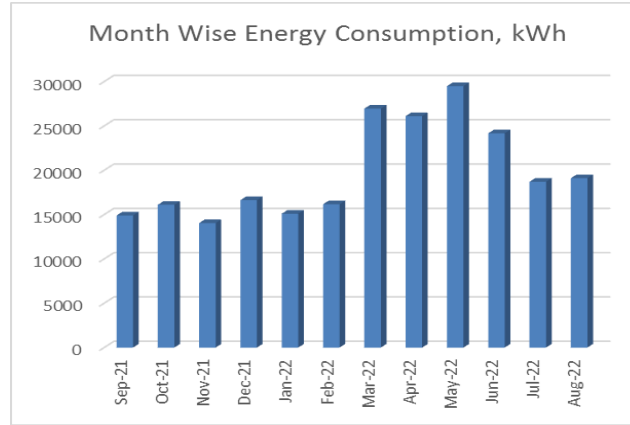
### 3. Study of Electrical Energy Consumption

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

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

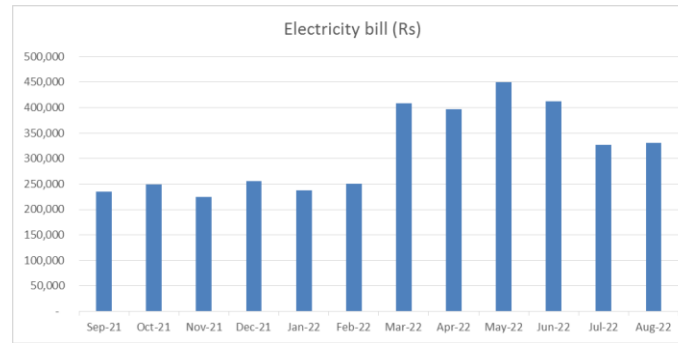
<b>No</b>	<b>Month</b>	<b>Energy (kWh)</b>	<b>Bill Amount (Rs)</b>
1	Aug-22	19107	331,193
2	Jul-22	18705	326,529
3	Jun-22	24167	412,429
4	May-22	29491	449,464
5	Apr-22	26107	397,160
6	Mar-22	26955	408,311
7	Feb-22	16169	250,621
8	Jan-22	15099	236,970
9	Dec-21	16631	255,813
10	Nov-21	14047	224,561
11	Oct-21	16107	249,523
12	Sep-21	14900	235,242
	<b>Total</b>	<b>237,485</b>	<b>3777816</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	29,491	23.59
2	Minimum	14,047	11.24
3	Average	19,790	15.83
4	Total	237,485	189.99

## 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.

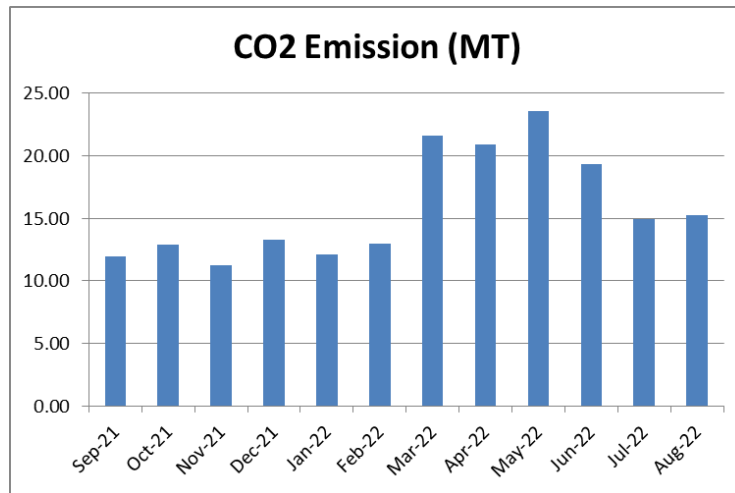
Based on the above Data we compute the CO<sub>2</sub> emissions which are being released in to the atmosphere by the College due to its Day to Day operations

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	Aug-22	19,107	15.3
2	Jul-22	18,705	15.0
3	Jun-22	24,167	19.3
4	May-22	29,491	23.6
5	Apr-22	26,107	20.9
6	Mar-22	26,955	21.6
7	Feb-22	16,169	12.9
8	Jan-22	15,099	12.1
9	Dec-21	16,631	13.3
10	Nov-21	14,047	11.2
11	Oct-21	16,107	12.9
12	Sep-21	14,900	11.9
	<b>Total</b>	<b>237,485</b>	<b>190.0</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 1064 FTL fittings with Electronic/ magnetic chokes and 287 LED bulbs 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 24 number of 150W CFL street lights. There are 34 No of LED street lights.

### **5.2 Air-conditioners**

In the facility, there are about 33 Nos. of 1.5 Tr old Air-conditioners. It is recommended to replace these Old ACs with BEE STAR Rated ACs. There is 4 star rated new AC of 1.5Tr capacity.

### **5.3 Ceiling Fans**

At building facility, there are about 865 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 6 Water pumps, 3 no of pumps with 5HP, 3 no of pumps with 3HP 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. 9 no of 100W capacity solar PV street lights are installed in college.

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

<b>No</b>	<b>Particulars</b>	<b>Value</b>	<b>Unit</b>
1	Annual Energy Purchased from MSEDCL	237,485	kWh/Annum
2	Energy Generated by Roof Top Solar PV System	1350	kWh/Annum
3	Total Energy Requirement of College	238,835	kWh/Annum
4	% of Usage of Alternate Energy to Annual Energy Requirement	0.6	%

## 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	1064	40	42.6
2	CFL street lights	24	150	3.6
	<b>LED lighting load</b>			
1	LED tube	56	20	1.1
2	LED bulbs	<b>287</b>	<b>16</b>	4.6
3	LED street lights	<b>34</b>	<b>100</b>	3.4
	<b>Total LED lighting load</b>			<b>9.1</b>
	<b>Total Lighting load</b>			<b>55.3</b>

It can be seen that out of total lighting load 16.5% 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 1064 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	1065	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	85.2	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	21300	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	234300	Rs/Annum
11	Cost of 20 W LED Tube	641	Rs/Unit
12	Investment required	682665	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 865 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	865	Nos
2	Energy Demand of Old Ceiling Fan fitting	65	W/Unit
3	Energy Demand of STAR Rated Fan	52	W/Unit
4	Reduction in demad	13	W/Unit
5	Average Daily Usage period	4	Hrs/Day
6	Daily saving in Energy	44.98	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	11245	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	123695	Rs/Annum
11	Cost of STAR Rated Ceiling Fan	2174	Rs/unit
12	Investment required	1880510	Rs lump sum
13	Simple Payback period	182	Months

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

During the Audit, it was observed that there are 33 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	33	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	4	Hrs/Day
6	Daily saving in Energy	132	kWh/Day
7	Annual Working Days	250	Nos
8	Annual Energy Saving possible	33000	kWh/Annum
9	Rate of Electrical Energy	11	Rs/kWh
10	Annual Monetary saving	363000	Rs/Annum
11	Cost of STAR Rated 1.5 TR AC	52875	Rs/unit
12	Investment required	1744875	Rs lump sum
13	Simple Payback period	58	Months

#### 8.4 Installation of 100kW Solar PV panel

It is recommended to install 200 kW solar PV panel. In the following Table, we present the savings, investment required & payback analysis.

<b>No</b>	<b>Particulars</b>	<b>Value</b>	<b>Unit</b>
1	Installation of 20kW PV unit	100	kW
2	Energy saving	150000	kWh/Annum
3	Rate of electrical energy	11	Rs
4	Annual monetary savings	1650000	Rs/ Annum
5	Investment required	5000000	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 1065 Nos T-8 fittings with 20W LED fittings	21,300	234,300	682,665	35
2	Replacement of 865 Nos Old Ceiling Fans with STAR rating fans	11,245	123,695	1,880,510	182
3	Replacement of 33 Nos Old 1.5 TR Acs with STAR rating Acs	33,000	363,000	1,744,875	58
4	Installation of 100kW grid connected PV panel	150,000	1,650,000	5,000,000	36
	<b>Total</b>	<b>215,545</b>	<b>2,370,995</b>	<b>9,308,050</b>	<b>47</b>