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## **ACKNOWLEDGEMENT**

We at Enrich Consultants, Pune, express our sincere gratitude to the management of Rajarshi Shahu College of Pharmacy & Research, Tathawade, Pune for awarding us the assignment of Energy & Green Audit of their Bavdhan Campus for the Year 2016-17.

We are thankful to:

- Prof.-----, Principal.
- Prof Chowdhary, Faculty Member

We are also thankful to other Staff members for helping us during the field measurements.

## **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

**1. Rajarshi Shahu College of Pharmacy & Research, Tathawade, Pune** consumes Energy in the form of Electrical Energy used for various gadgets, Office, laboratories, workshop, hostel, class rooms, passage, staircase, corridors and street lights etc.

**2. PRESENT LEVEL OF ENERGY CONSUMPTION:** The details of Energy Consumption & CO<sub>2</sub> emissions, for the Year: 2016 are as under.

No	Parameter/ Value	Units' consumed, kVA	Maximum Demand, kVA	Power Factor	Bill Amount, Rs
1	Maximum	112266	315	0.967	1151980
2	Minimum	42434	157	0.89	440470
3	Average	81535.58	255.3333	0.91625	857222.4

### 3. ALTERNATE ENERGY INITIATIVES:

It is recommended to install a **Solar PV** System to cater the Demand of Office Load during the Day time. Street light must be replaced by LED solar integrated lamps. On installation of the same the % of Usage of Total Power met by Alternate Energy Sources will increase.

### 4. PERCENTAGE OF LIGHTING POWER REQUIREMENTS MET BY LED BULBS:

It is recommended to replace the existing 383 Nos, T-12 FTL fittings with 20 W LED fittings. On replacement of the same, the % of total Lighting Power met by LEDs will increase.

### 5. WASTE MANAGEMENT:

#### 5.1 ORGANIC WASTE MANAGEMENT:

For disposal of Organic Waste, the College has adopted the route of Composting, wherein the waste is collected in a pit and after the composting the same is used as fertilizer.

#### 5.2. LIQUID WASTE MANAGEMENT:

The waste water generated is collected in a septic tank. The septic tank is cleaned regularly by Municipal sludge collecting vehicle.

#### 5.3 E-WASTE MANAGEMENT:

All the internal communication is through emails and hardly any e-Waste is generated in the Day to Day operation of the College. The College authorities have already contacted Authorized e-Waste management vendor to dispose off any wastage generated.

## 6. RAIN WATER HARVESTING:

The College has already installed **Rainwater Harvesting System** to collect the Rain Water collected at the Terrace & coming from other slopes, which in turn is used to enrich the bore well water source.

## 7. RECOMMENDATIONS:

No	Recommendation	Energy Saving, kWh/Annum	CO <sub>2</sub> reduction, MT/Annum	Monetary Saving, Rs	Investment , Rs	Payback period, Months
1	Replacement of 383 Nos T-12 FTL fittings by 20 W LEDs	35619	28.49	347641	95750	4
2	Installation of 10 kW Solar PV Plant	12000	9.6	117120	600000	62
4	<b>Total</b>	<b>47619</b>	<b>38.09</b>	<b>464761</b>	<b>695750</b>	<b>18</b>

## 8. NOTES & ASSUMPTIONS:

- 1 Unit of Electrical Energy releases **0.8 Kg of CO<sub>2</sub>** into atmosphere
- 1 kWp** Solar PV system generates **4 Units** (kWh) of Energy per Day
- Daily working hours-10 Nos
- Annual working Days-300 Nos
- Average Rate of Electrical Energy : **Rs 9.76/- per kWh**

## ABBREVIATIONS

DP	: Double Pole
CFL	: Compact Fluorescent Lamp
EESL	Energy Efficiency Services Limited
F P	- Feeder Pillar
JSPM	- Jayawantrao Sawant Shikshan Prasarak Mandal
LED	- Light Emitting Diode
MSEDCL	: Maharashtra State Electricity Distribution Company Ltd.
MEDA	- Maharashtra Energy Development Agency
MIDC	- Maharashtra Industrial Development Corporation
V	: Voltage
I	: Current
kW	: kilo-Watt
kVA	: Active Power
kVAr	: Reactive Power
P F	: Power Factor
Kms.	: Kilometers

## **CHAPTER-I**

### **INTRODUCTION**

#### **1.1 Objectives:**

1. To study present level of Energy Consumption
2. To Study the present CO<sub>2</sub> emissions
3. To assess the various equipment/facilities from Energy efficiency aspect
4. To study Scope for usage of Renewable Energy
5. To study various measures to reduce the Energy Consumption

#### **1.2 Audit Methodology:**

1. Study of connected load
2. Study of various Electrical equipment
3. To prepare the Report with various Encon measures with payback analysis

#### **1.3 General Details of Institute: Table No-1:**

<b>No</b>	<b>Head</b>	<b>Particulars</b>
1	Name	Rajarshi Shahu College of Pharmacy & Research
2	Address	Tathawade, Pune
3	Courses Offered	Degree & Diploma courses in Pharmacy

## CHAPTER-II

### STUDY OF CONNECTED LOAD

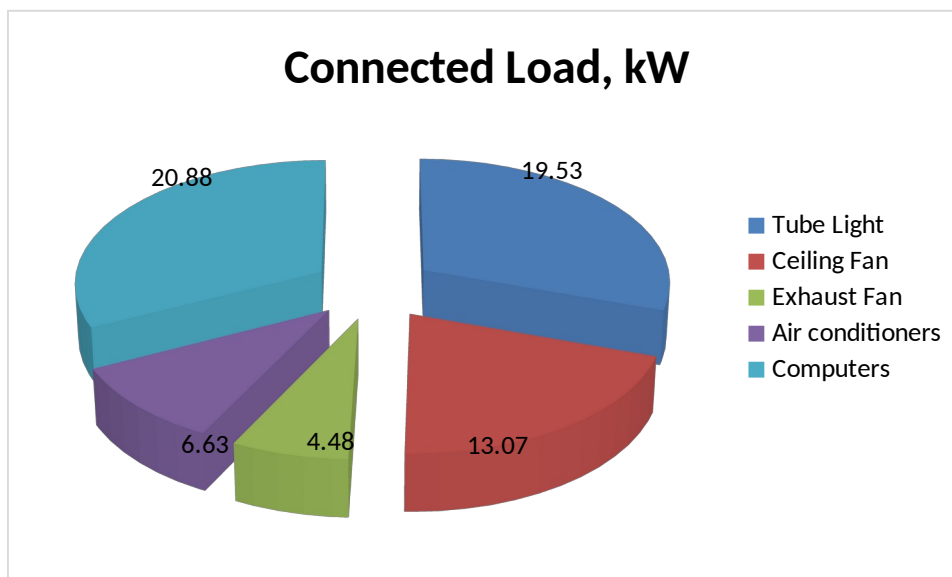
In this chapter, we present the details of various Electrical loads as under

#### 2.1 Details of Overall Connected Load: Table No-2:

No	Equipment	Qty	Load/Unit, W	Load, kW
1	Tube Light	383	51	19.53
2	Ceiling Fan	201	65	13.07
3	Exhaust Fan	12	373	4.48
4	Air conditioners	5	1325	6.63
5	Computers	167	125	20.88
6	<b>Total</b>			<b>64.57</b>

We present the same in a PIE Chart as under:

**Chart No-1: Details of Connected Load:**



**Note:** From the above Table, we observe that out of Total Connected Load of **64.57 kW**, the load due to PCs is **20.88 kW** followed by Lighting of about **19.53 kW**.

## CHAPTER-III

### STUDY OF ENERGY CONSUMPTION

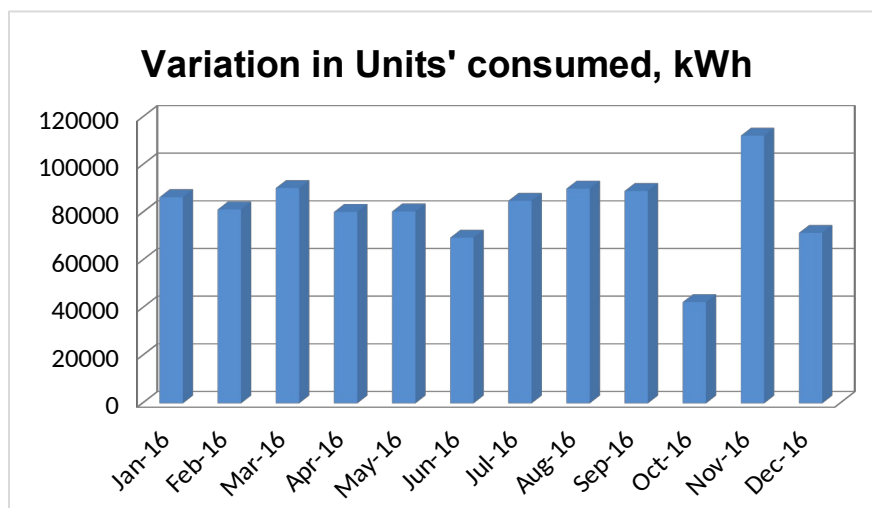
In this chapter, we present the analysis of last year Electricity Bills

#### 3.1.1 To study the variation of Monthly Units' Consumption:

**Table No 3: Electrical Bill Analysis- 2016:**

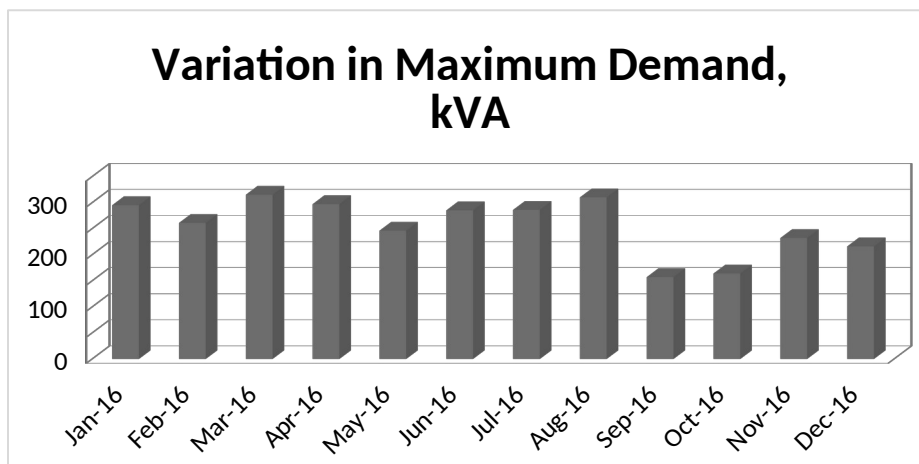
No	Month	Units consumed, kVA	Maximum Demand, kVA	Power Factor	Bill Amount, Rs
1	Jan-16	86472	295	0.9	918675
2	Feb-16	81314	261	0.915	849708
3	Mar-16	90286	315	0.918	958716
4	Apr-16	80266	297	0.913	903490
5	May-16	80466	246	0.916	809750
6	Jun-16	69440	285	0.89	795570
7	Jul-16	84934	286	0.899	899920
8	Aug-16	90006	310	0.908	965070
9	Sep-16	89048	157	0.915	834630
10	Oct-16	42434	164	0.903	440470
11	Nov-16	112266	232	0.967	1151980
12	Dec-16	71495	216	0.951	758690
13	<b>Maximum</b>	<b>112266</b>	<b>315</b>	<b>0.967</b>	<b>1151980</b>
14	<b>Minimum</b>	<b>42434</b>	<b>157</b>	<b>0.89</b>	<b>440470</b>
15	<b>Average</b>	<b>81536</b>	<b>255</b>	<b>0.916</b>	<b>857222</b>

#### 3.1 To study the variation of Monthly Units' Consumption:

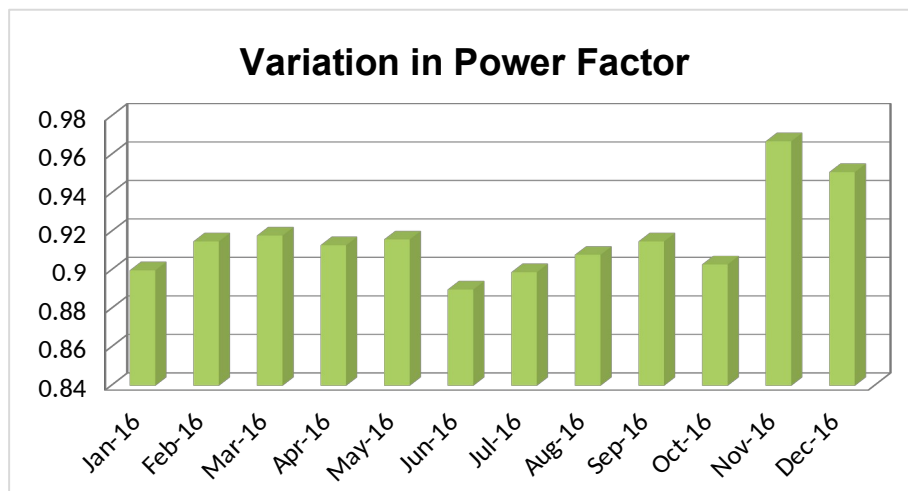




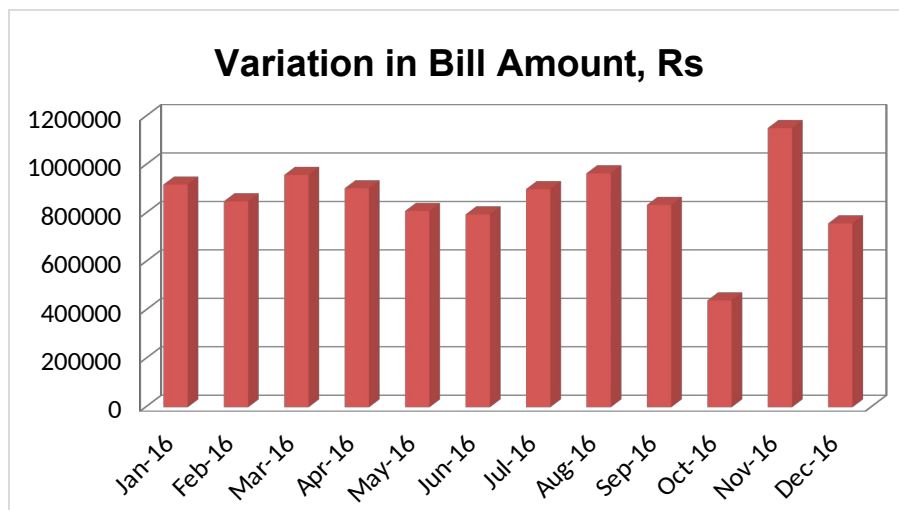
### 3.2 To study the variation of Monthly Maximum Demand, kVA:



### 3.3 To study the variation of Monthly Power Factor:



### 3.4 To study the variation of Monthly Electricity Bill:



**Key Inference drawn:**

From the above analysis, we present following important parameters:

**Table No 6: Various Important Parameters: Table No-5:**

No	Parameter/ Value	Units' consumed, kVA	Maximum Demand, kVA	Power Factor	Bill Amount, Rs
1	Maximum	112266	315	0.967	1151980
2	Minimum	42434	157	0.89	440470
3	Average	81535.58	255.3333	0.91625	857222.4

## CHAPTER-IV

### CARBON FOOTPRINTING

**4.1 A Carbon Foot print** is defined as the Total Greenhouse Gas emissions, emitted due to various activities.

In this we compute the emissions of Carbon-Di-Oxide, by usage of the various forms of Energy used by the College for performing its day to day activities

The College uses two forms of Energy namely:

Electrical Energy for various Electrical gadgets.

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

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

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

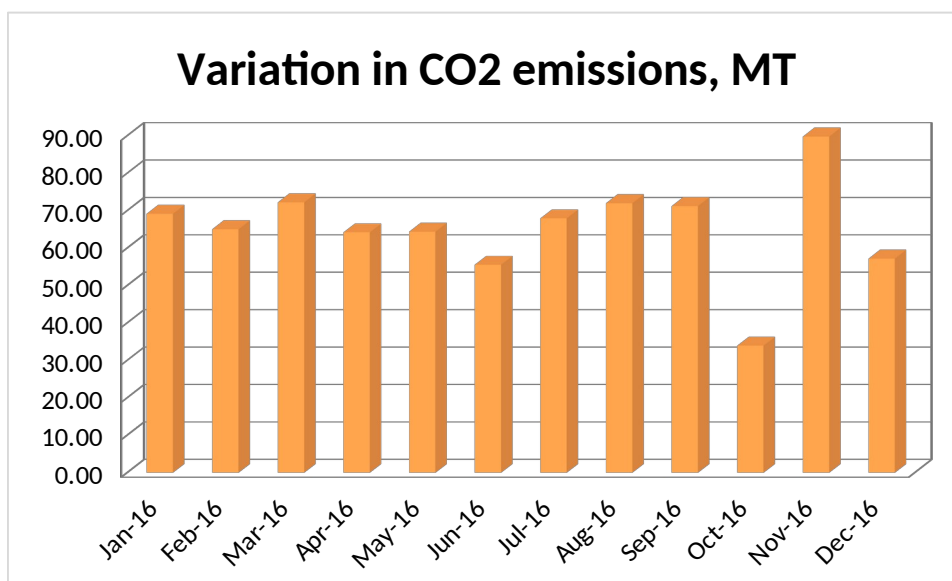
Based on the above Data we compute the CO<sub>2</sub> emissions which are being released in to the atmosphere by the College due to its Day to Day operations

#### 4.3 Table No 5: Month wise CO<sub>2</sub> Emissions:

No	Month	CO <sub>2</sub> emissions, MT
1	Jan-16	69.18
2	Feb-16	65.05
3	Mar-16	72.23
4	Apr-16	64.21
5	May-16	64.37
6	Jun-16	55.55
7	Jul-16	67.95
8	Aug-16	72.00
9	Sep-16	71.24
10	Oct-16	33.95
11	Nov-16	89.81
12	Dec-16	57.20
13	Maximum	89.81
14	Minimum	33.95
15	Average	65.23

#### 4.4 Representation of Month wise CO<sub>2</sub> emissions:

Chart No-2: Month wise CO<sub>2</sub> emissions, MT:



## **CHAPTER-V**

### **USAGE OF ALTERNATE ENERGY SOURCES**

#### **5.1 Installation of Solar PV Power Pack:**

During the Audit, it was revealed that the College has ample space on the Terrace.

During the Electrical Load survey, the Day Electrical Load was found to be about **10 kW**.

#### **5.2 Computation of Daily Units consumed in Day time & Solar PV Plant Capacity:**

In the following Table, we present the Calculations for Solar PV Plant, the Cost involved & Simple Payback Calculations.

<b>Sr.</b>	<b>Particulars</b>	<b>Value</b>	<b>Unit</b>
1	Solar PV Plant Capacity	10	kW
2	Avg Units Gen/kWp of Solar PV Plant	4	kWh/Day
3	Daily Average Units generated	40	kWh/Day
4	Annual units generated	12000	kWh/Annum
5	Annual Saving potential	132000	Rs lump sum
6	Cost of Solar PV Plant	0.60	Lakh/kW
7	Investment Required	600000	Rs lump sum
8	Simple Payback period	55	Months

## **CHAPTER VII**

### **STUDY OF WASTE MANAGEMENT**

In this Chapter, we study the Waste management systems of the College.

#### **7.1 Organic Waste Management:**

For disposal of Organic Waste, the College has adopted the route of Composting, wherein the waste is collected in a pit and after the composting the same is used as fertilizer.

#### **7.2 Liquid Waste Management:**

The waste water generated is collected in a septic tank. The septic tank is cleaned regularly by Municipal sludge collecting vehicle.

#### **7.3 e-Waste Management:**

The College communication is through Internet within the staff. There are hardly any floppies or CDs used for day to day operations. Hence as far as the e-waste is concerned hardly any waste is generated during the day to day operations. In addition to this the College authorities have already finalized Authorized e-Waste management agency to dispose of the old equipment

***Pl mention about Hazardous Waste Management***

## **CHAPTER-VIII**

### **STUDY OF RAIN WATER HARVESTING**

In institute premises, to achieve rain water harvesting (RWH) the pipes are laid down from the roof of all the buildings to collect convey and recharge by disposing of in dry bore well. After recharge rise in ground water table, increases water level in well. Ground water then utilized from well for the various purposes such as drinking, gardening etc. in the campus.

Also to account conservation and preservation of natural resource, drip and sprinkler irrigation system is used for gardening.

## **CHAPTER-IX**

## STUDY OF GREEN PRACTICES

The institute is having pollution free location surrounded with greenery and mountains.

1. College provides bus facilities to the students and staffs with an aim to avoid the use of individual vehicles and initiatives are taken to sensitize students and staff members in utilizing the public transport system in order to reduce the carbon emission. The institute actively promotes an idea of vehicle pooling to both staff and students.
2. NSS actively organized and conducted "Plastic Kachara Nirmulan" under Yuva Mahotsav to participate and support Swacha Bharat Abhiyan.
3. Institute has implemented MOODLE for the academics and other activities to reduce paper waste.
4. Tree plantation is carried out during monsoon period every year to make the campus as green as possible. The activities are performed by gardeners and NSS students.



## CHAPTER X

### ENERGY CONSERVATION PROPOSALS

#### ECP-1: Replacement of 383 Nos T-12 Fittings with 20 W LEDs:

During the audit, it was revealed that, in the Class rooms, office section, Library section, **T-12** type tube light fittings are used. It is recommended to replace all these fittings with **20 W LED** Fittings.

In the following Table, we present the saving calculations

Sr	Particulars	Unit/ quantity	Unit
1	Present Quantity of T-12 FTL Fittings	383	Nos
2	Consumption of T-12 FTL fitting	51	W/unit
3	Consumption of 20 W LED fitting	20	W/unit
4	Total saving potential	31	W/unit
5	Average Daily period of Usage	10	Hrs/Day
6	Average saving potential	118.73	kWh/Day
7	Annual Operating Days	300	Days/Annum
8	Annual saving potential	35619	kWh/Annum
9	Present Energy Charges	9.76	Rs/kWh
10	Annual monetary Gain	347641	Rs/Annum
12	Annual CO <sub>2</sub> emissions reduction	28.49	MT/Annum
13	Investment required	95750	Rs lump sum
14	Simple Payback period	4	Months

### ECP-2: Installation of 10 kWp Solar PV Plant:

It is recommended to install 10 kWp Roof top Solar PV Plant.

In the following Table, we present the saving potential.

Sr	Particulars	Unit/quantity	Unit
1	Design Load	10	kW
2	Avg Units Gen/kWp of Solar PV Plant	4	kWh/Day
3	Daily Average Units generated	40	kWh/Day
4	Annual units generated	12000	kWh/Annum
5	Reduction in Co2 emissions	9.6	MT/Annum
6	Annual Saving potential	117120	Rs lump sum
7	Cost of Solar PV Plant	0.60	Lakh/kW
8	Investment Required	600000	Rs lump sum
9	Simple Payback period	62	Months

### Summary of Recommendations:

No	Recommendation	Energy Saving, kWh/Annum	CO <sub>2</sub> reduction, MT/Annum	Monetary Saving, Rs	Investment , Rs	Payback period, Months
1	Replacement of 383 Nos T-12 FTL fittings by 20 W LEDs	35619	28.49	347641	95750	4
2	Installation of 10 kW Solar PV Plant	12000	9.6	117120	600000	62
4	<b>Total</b>	<b>47619</b>	<b>38.09</b>	<b>464761</b>	<b>695750</b>	<b>18</b>