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- ➢ Sau. Kanta Balaso Maskare, Treasurer
- ➢ Shri. Ashokshet Shankarrao Kale, Parent representative
- ➢ Shri. Anil Moreshawar Joglekar, Trustee
- ➢ Shri. Adv. Avinash Vitthalrao Thorve, Trustee
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We are also thankful to all the technical staff and office staff for helping during the visit and providing necessary information.

EXECUTIVE SUMMARY

After the Field measurements & analysis, we present herewith important observations made and various measures to reduce the Energy Consumption & mitigate the CO_2 emissions

1. Shri Shiv Chhatrapati College consumes electrical Energy in majority used for various gadgets & office operations.

2. The various projects already implemented by the College are

- Solar roof top plant of capacity 15kW sanctioned by BoD, SPPU, Pune.
- Usage of natural day lights and natural air circulation
- Usage of Natural Day light in corridors specifically
- Natural site location of the college will be very useful for Rain water harvesting.
- Usage of LED lighting for Admin & outdoor lighting
- Disposal of Chemistry laboratory waste and chemical effectively by doing dilution process.
- The institution has taken a very good initiative to install sanitary napkin disposal machine at the different location in the college campus.
- Fire extinguishers are installed and maintained for fire safety in the college campus.

3. Important Parameters: Electrical Energy:

Electricity is used for different purposes and at different sections in the college campus. These sections where the electrical meters and distribution is taking place is as follows.

Sr. No.	Consumer No.	Electrical Meter No.	Payee
1	174212780691	06506472855	Shri Shiv Chhatrapati College
2	174212978475	7513496324	Shri Shiv Chhatrapati College
3	175700190727	7506469535	Shri Shiv Chhatrapati College
4	174970157733	6506468052	Shri Shiv Chhatrapati College

The important parameters of electrical consumption as per Consumer no. in the campus are mentioned as below.

Sr. No	Consumer No.	Parameter	Max	Min	Average
1	174212780691	Units consumed, kWh	2102	1180	1739
		Electricity Bill amount	53170	21630	32643
3	174212978475	Units consumed, kWh	197	95	152
		Electricity Bill amount	14850	1170	3713
4	175700190727	Units consumed, kWh	627	331	473

		Electricity Bill amount	22900	5340	9700
5	174970157733	Units consumed, kWh	1357	1357	1357
		Electricity Bill amount	104710	15140	39882
		Total average units consumed per month, kWh			3721

4. Important Parameters: CO_2 Emissions (Average, MT/Month)

No	Consumer No.	Particulars	Value MT/Months
1	174212780691	CO_2- Emissions- Electricity Usage	1.39
2	174212978475		0.12
3	175700190727		0.37
4	174970157733		1.08
		Total	2.96

On the basis of average electricity usage CO_2 emission is 2.96 MT/Month.

In addition to this LPG is being consumed for canteen for food preparation. Nearly LPG consumption annually is 100 commercial cylinders i.e. 1450 kg/annum. On the basis of average LPG usage CO_2 emission is 4.35 MT/annum.

5. Benchmark: In terms of Electrical Energy & CO_2 emissions:

We now present two important benchmarks in respect of Electrical Energy & LPG consumed & CO_2 emissions as under.

No	Particulars	Value	Unit
1	Electrical Energy consumed	0.196	kWh/sq ft
2	LPG Consumed	0.0092	Kg/ sq ft
3	CO_2- Emissions	9.95×10^{-7}	Kg/sq ft

6. Recommendations:

We present herewith various proposals to reduce the Electrical Energy demand and reduce the CO_2 emissions

No	Recommendation	Annual saving potential in kWh /Kg of LPG	Annual Saving Potential in MT of CO_2	Annual monetary gain, Rs.
1	15 kWp solar roof top sanctioned from BoD, SPPU, Pune. The installation is in process.	25200 kWh	21	252000.00
2	Usage of Energy efficient lightings, fans and other electrical appliances	-	-	-
3	Total	25200	21	252000.00

Notes & assumptions:

1. 1 Unit of Electrical Energy releases 0.8 Kg of CO_2 into atmosphere
2. 1 Kg of LPG releases 3 Kg of CO_2 into atmosphere
3. Daily working hours-10
4. Annual working Days-280
5. Average Rate of Electrical Energy- Rs 10 per kWh

ABBREVIATIONS

DP	:	Double Pole
CFL	:	Compact Fluorescent Lamp
EESL	:	Energy Efficiency Services Limited
F P	:	Feeder Pillar
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
kWp	:	Kilo Watt peak

CHAPTER-I
ENERGY AUDIT: INTRODUCTION

1.1 Objectives:

1. To study present level of Energy Consumption
2. To Study the present CO_2 emissions
3. To assess the various equipment/facilities from Energy efficiency aspect
4. To measure various Electrical parameters
5. To study Scope for usage of Renewable Energy
6. 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 Energy Audit Instruments:

1. Portable Power Analyzer
2. Lux meter
3. Anemometer
4. Digital Temperature Indicator
5. CO_2 Meter

1.4 General Details of Shri Shiv Chatrapati College, Junnar:

No	Head	Particulars
1	Name of Institution	Shri Shiv Chhatrapati College,
2	Address	Junnar, Dist. Pune
3	Year of Establishment	1970
4	Salient Features	Affiliated to Savitribai Phule Pune University
4	Courses offered	1. Graduate Level courses in Arts, Science and Commerce 2. Post Graduate Courses in Arts, Commerce and Science 3. Research Center in Commerce and Zoology
5	No of Students	3000
6	Total built up area	157470 Sq ft

CHAPTER-II
STUDY OF CONNECTED LOAD

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

2.1 Study of Floor wise connected load:

No	Location	45 W Tube	CFL 18 W	LED 14 W	Fan 60 W	Exhaust Fan 35 W
1	Science Building	23	66	126	51	23
2	Principal Office Building	9	37	57	01	
3	Teacher Staff room	4	2		4	
4	Ladies Staff Room	-	1	5	4	
5	Ladies Hall/NSS office			9	5	
6	Old Building		1	16	11	
7	Gymkhana/Guest House	9	3	1	9	
8	Grahak Bhandar		1	1	3	
9	Commerce Department		1	32	23	
	Total	45	112	247	111	23

2.2 Study of Fitting wise Connected Load:

No	Type of Fitting	Load/Unit	Qty	Load in kW
1	45 W Tube	45	45	2.025
2	CFL 18 W	18	112	2.016
3	LED 14 W	14	247	3.458
4	Fan-60 W	60	111	6.66
5	Exhaust Fan-35W	35	23	0.805
15	**Total**			**14.96**

We present the same in a PIE Chart as under

Fitting wise Connected load

Legend:
- 45 W Tube
- CFL 18 W
- LED 14 W
- Fan-60 W
- Exhaust Fan-35W

5%, 14%, 13%, 45%, 23%
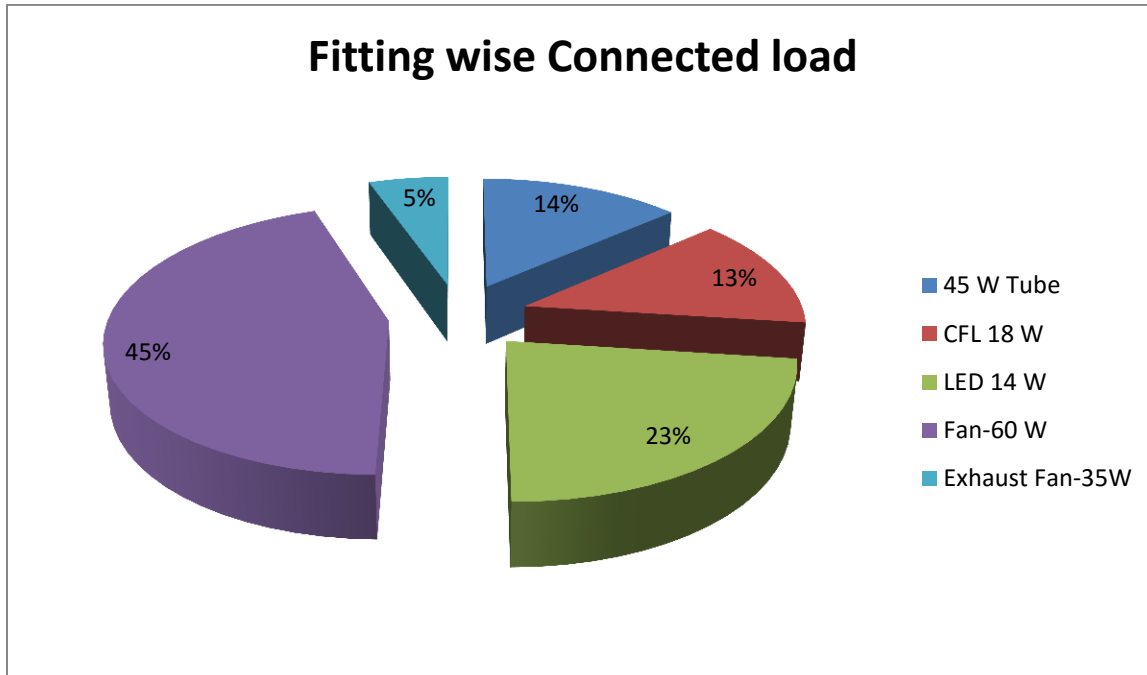
CHAPTER-III
HISTORICAL DATA ANALYSIS: ELECTRICAL ENERGY

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

3.1 Consumer No. 174212780691

This consumer is one of the major contributors for billing. Monthly consumption for last few months and bill amount is as follows.
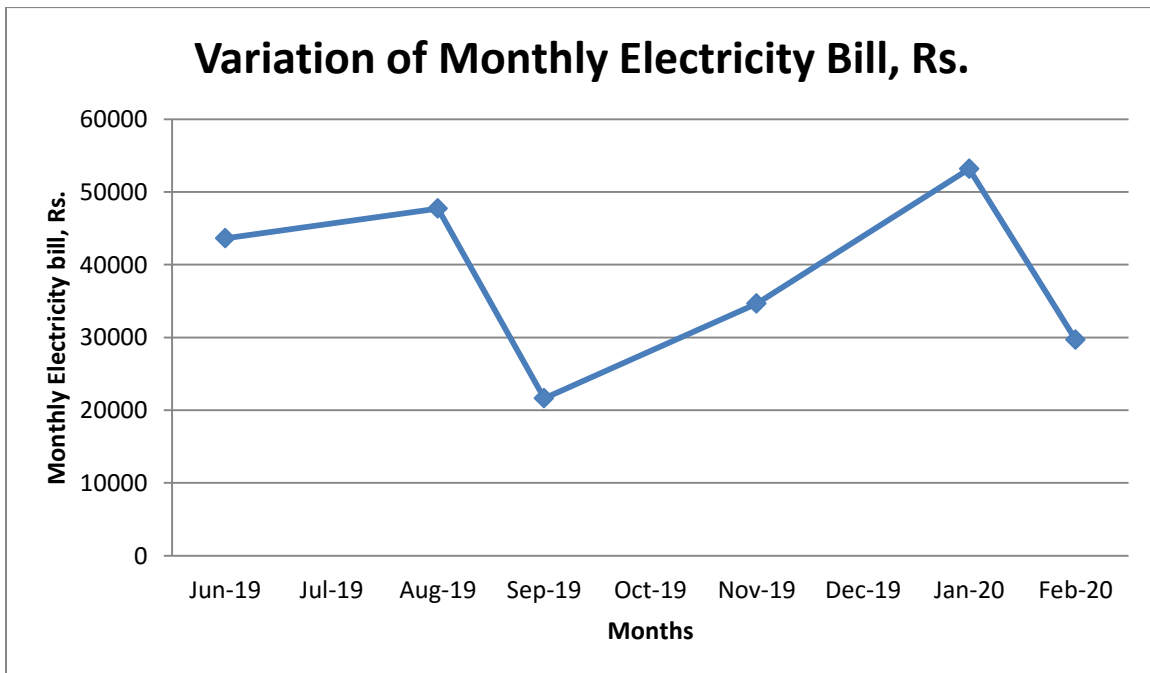
Table No. 1: Electrical Bill Analysis- 2018-19: 174212780691

Sr. No	Month	kWh	Amount
1	June-2019	1529	43620
2	August-2019	1894	47730
3	September-2019	1672	21630
4	November-2019	1180	34650
5	January-2020	2102	53170
6	Febraury-2020	2061	29710
13	Total	10438	195860
14	Average	1739	32643
15	Max	2102	53170
16	Min	1180	21630

3.1.1. To study the variation of Monthly Units' Consumption:
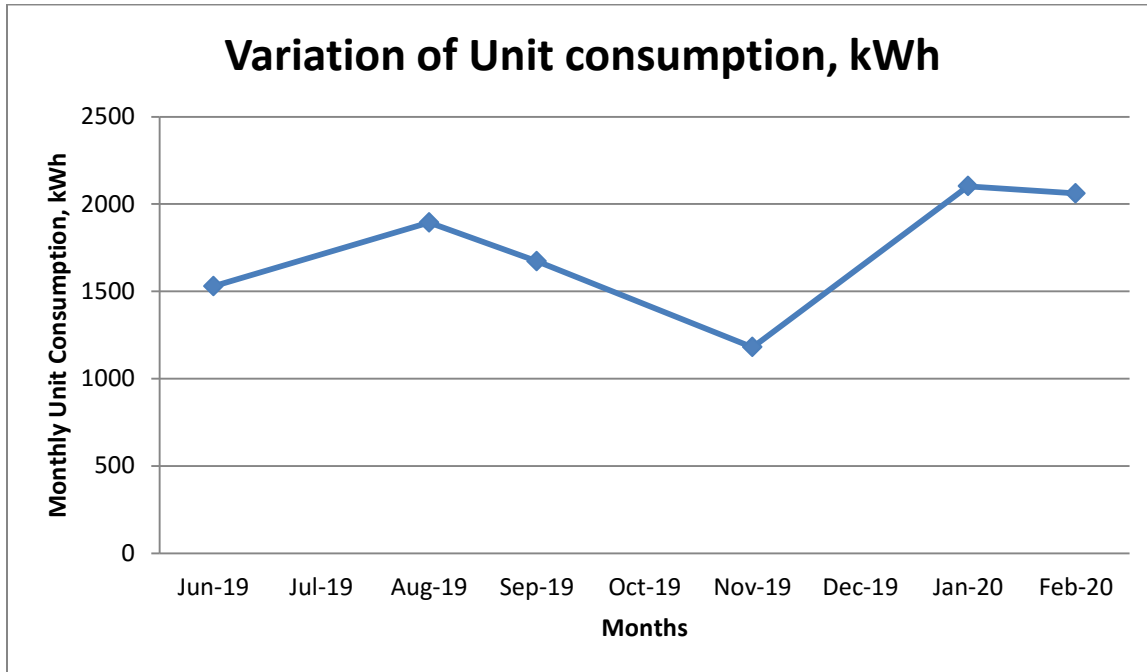
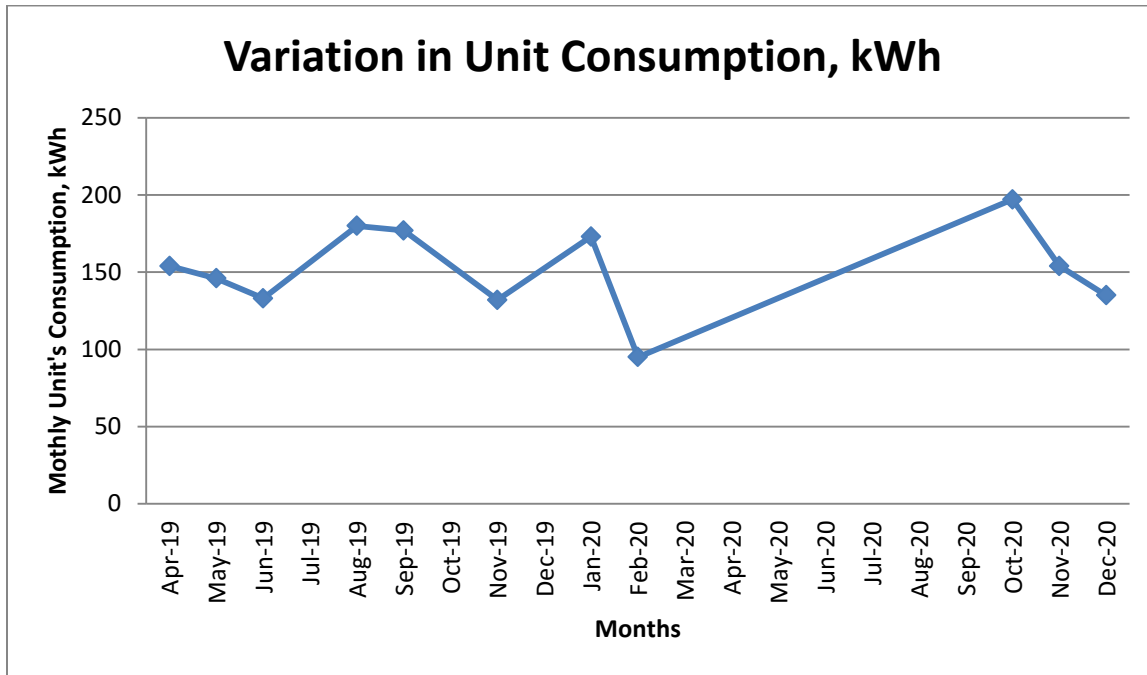### 3.1.2 To study the variation of Monthly Electricity Bill:

3.2 Consumer No. 174212978475

This consumer is one of the contributors for monthly electricity billing. Monthly consumption for last few months and bill amount is as follows.
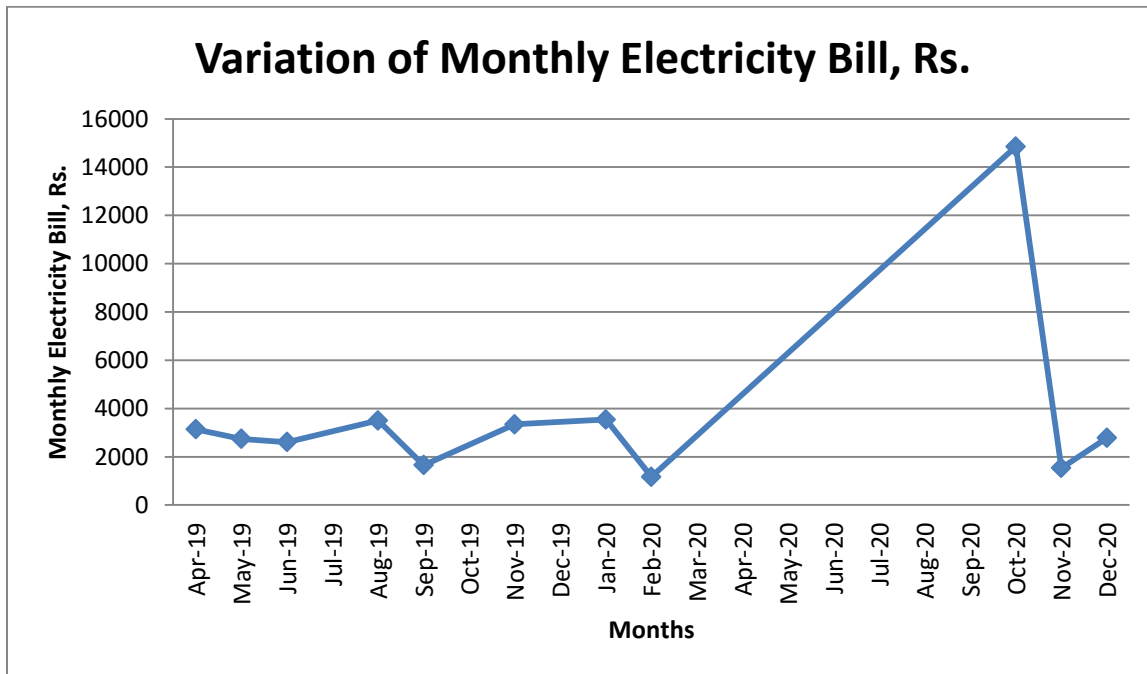
Table No. 3: Electrical Bill Analysis- 2018-19: 174212978475

Sr. No	Month	kWh	Amount
1	April-2019	154	3140
2	May-2019	146	2740
3	June-2019	133	2610
4	August-2019	180	3500
5	September-2019	177	1650
6	November-2019	132	3340
7	Janaury-2020	173	3540
8	February-2020	95	1170
9	October-2020	197	14850
10	November-2020	154	1530
11	December-2020	135	2780
13	Total	1676	40850
14	Average	152	3713
15	Max	197	14850
16	Min	95	1170

3.2.1 To study the variation of Monthly Units' Consumption:

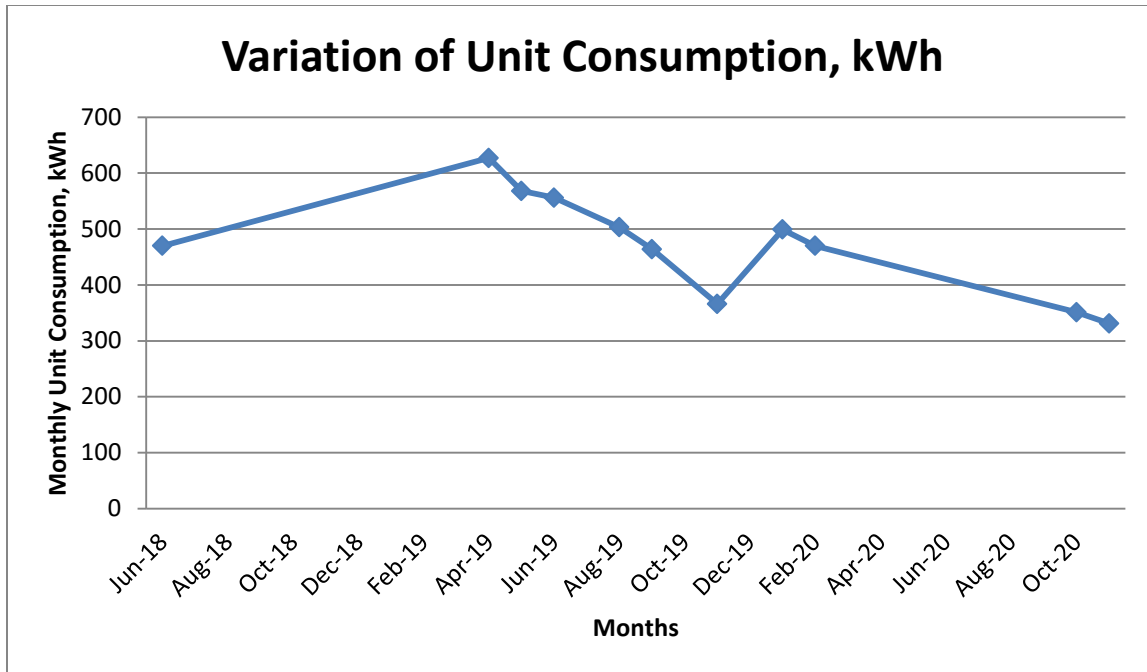**3.2.2 To study the variation of Monthly Electricity Bill:**

3.3. Consumer No. 175700190727

This consumer is one of the contributors for monthly electricity billing. Monthly consumption for last 12 months and bill amount is as follows.

Table No. 4: Electrical Bill Analysis- 2018-19: 175700190727

Sr. No	Month	kWh	Amount
1	April-2019	627	12910
2	May-2019	568	11200
3	June-2019	556	10500
4	Aug-2019	503	11930
5	Sep-2019	464	4780
6	Nov-2019	366	4700
7	June-2018	470	8360
8	Jan-2020	499	10500
9	Feb-2020	470	5340
10	October-2020	351	22900
11	November-2020	331	3580
13	Total	5205	106700
14	Average	473	9700
15	Max	627	22900
16	Min	331	5340

3.3.1 To study the variation of Monthly Units' Consumption:

3.3.2 To study the variation of Monthly Electricity Bill:

3.4. Consumer No. 174970157733

This consumer is one of the contributors for monthly electricity billing. Monthly consumption for last 12 months and bill amount is as follows.
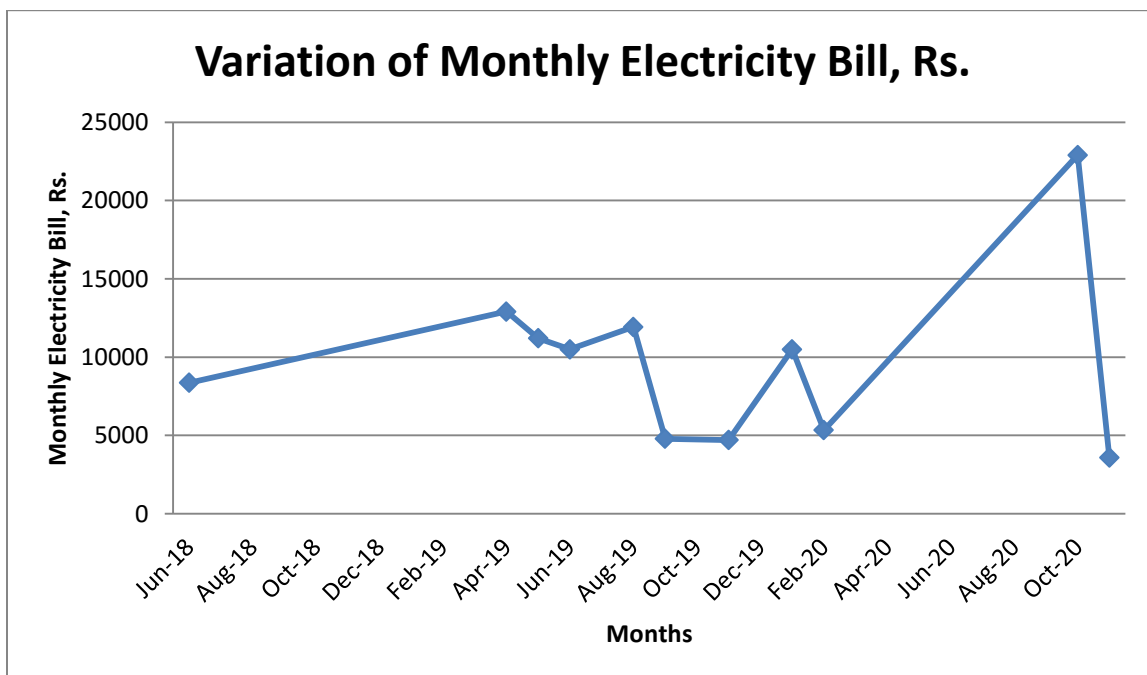
Table No. 4: Electrical Bill Analysis- 2018-19: 174970157733

Sr. No	Month	kWh	Amount
1	May-2019	1357	27440
2	June-2019	1357	27770
3	Aug-2019	1357	28730
4	Sep-2019	1357	42230
5	Nov-2019	1357	28470
6	Jan-2020	1357	29940
7	Feb-2020	1357	15140
8	Dec-2020	1357	94390
9	Jan-2021	1357	104710
13	Total	13570	398820
14	Average	1357	39882
15	Max	1357	104710
16	Min	1357	15140

3.4.1 To study the variation of Monthly Units' Consumption:
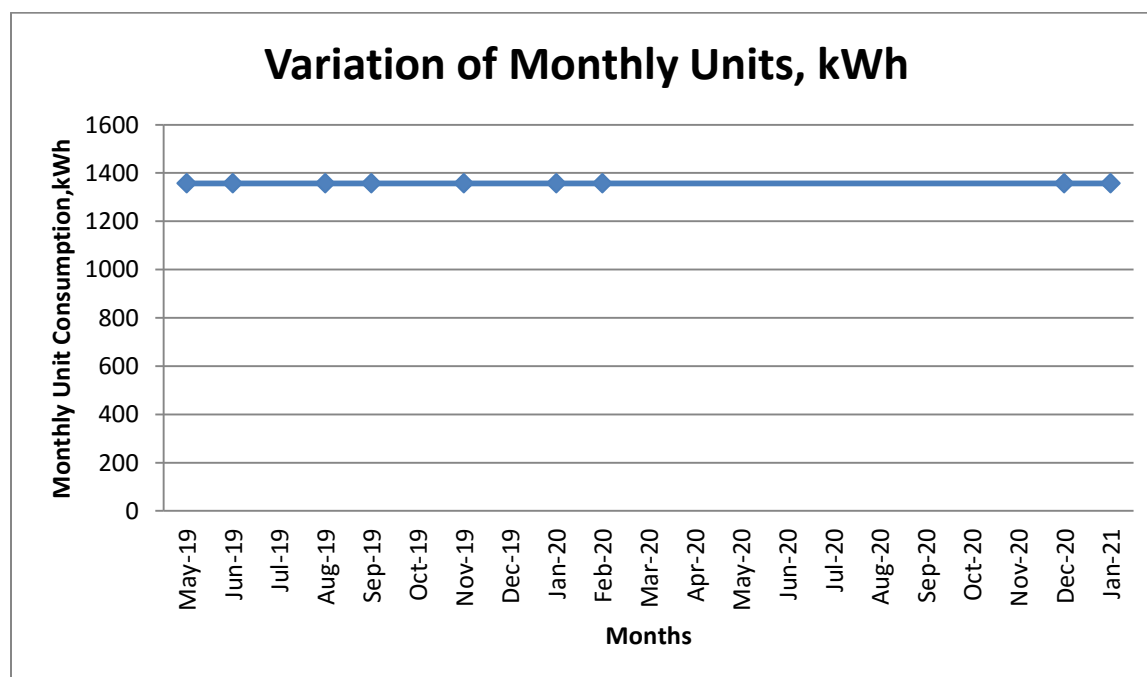
3.4.2 To study the variation of Monthly Electricity Bill:
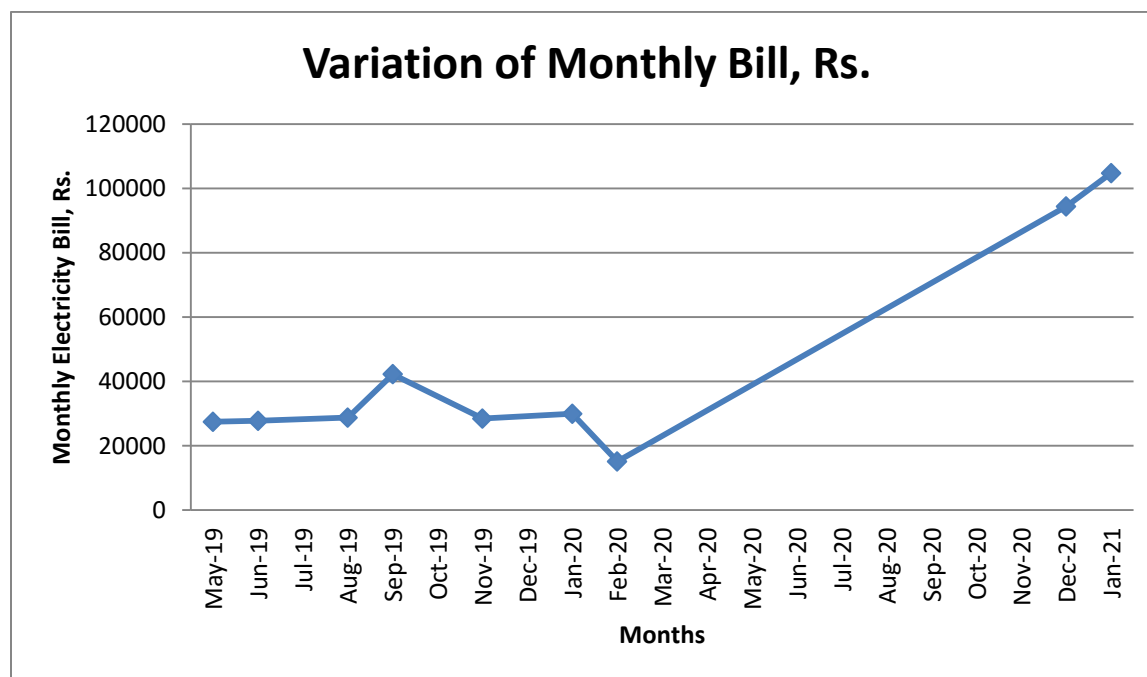
3.5 Summary:

Sr. No.	Consumer No.	Annual Electricity Consumption, kWh	Annual Bill, Rs
1	174212780691	10438	32643
2	174212978475	1676	40850
3	175700190727	5205	106700
4	174970157733	13570	398820
	Total	**30889**	**579013**

3.6 Key Inference drawn:
From the above analysis, we present following important parameters:
Variation in Important Parameters Consumer number wise:

Sr. No	Consumer No.	Parameter	Max	Min	Average
1	174212780691	Units consumed, kWh	2102	1180	1730
		Electricity Bill amount	53170	21630	32643
2	174212978475	Units consumed, kWh	197	95	152
		Electricity Bill amount	14850	1170	3713

3	175700190727	Units consumed, kWh	627	331	473
		Electricity Bill amount	22900	5340	9700
4	174970157733	Units consumed, kWh	1357	1357	1357
		Electricity Bill amount	104710	15140	39882

3.7 Benchmarking:

Now we compute the Electrical Energy Consumed per square feet of the College Building as under

No	Parameter	Value	Unit
1	Units consumed, kWh	**30889**	kWh
2	College area	157470	Sq ft
3	**Unit consumed/sq ft**	**0.196**	**kWh/sq ft**

CHAPTER-IV
CARBON FOOTPRINTING

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 electrical energy for operating various electrical gadgets.

We herewith furnish the details of electrical Energy consumption consumer number wise as under

4.1. Month wise Consumption of Electrical Energy : 174212780691

Sr. No	Month	kWh
1	June-2019	1529
2	August-2019	1894
3	September-2019	1672
4	November-2019	1180
5	January-2020	2102
6	Febraury-2020	2061
13	Total	10438
14	Average	1739
15	Max	2102
16	Min	1180

4.2 Basis for computation of CO_2 Emissions:

The basis of Calculation for CO_2 emissions due to Electrical Energy are as under

- 1 Unit (kWh) of Electrical Energy releases **0.8 Kg of CO_2** into atmosphere

Based on the above Data we compute the CO_2 emissions which are being released in to the atmosphere by the College due to its Day to Day operations.

4.3 Month wise CO2 Emissions: 174212780691

Sr. No	Month	Electrical Energy Consumed, kWh	CO2 Emission due to Electricity, MT
1	June-2019	1529	1.22
2	August-2019	1894	1.51
3	September-2019	1672	1.33
4	November-2019	1180	0.94
5	January-2020	2102	1.68
6	Febraury-2020	2061	1.64
13	Total	10438	8.35
14	Average	1739	1.39
15	Max	2102	1.68
16	Min	1180	0.94

4.4 Representation of Month wise CO_2 emissions:

Monthly CO2 Emmission due to Electricity Use, MT
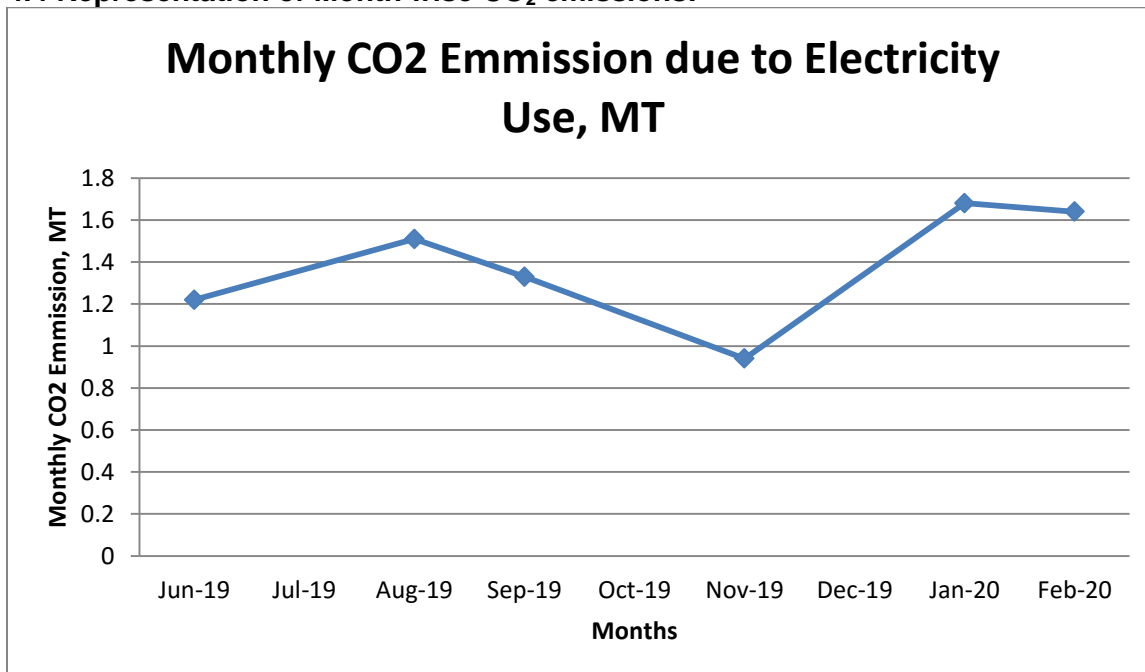
4.5 Month wise Consumption of Electrical Energy : 174212978475

Sr. No	Month	kWh
1	April-2019	154
2	May-2019	146
3	June-2019	133
4	August-2019	180
5	September-2019	177
6	November-2019	132
7	Janaury-2020	173
8	February-2020	95
9	October-2020	197
10	November-2020	154
11	December-2020	135
13	Total	1676
14	Average	152
15	Max	197
16	Min	95

4.6 Month wise CO2 Emissions: 174212978475

Sr. No	Month	Electrical Energy Consumed, kWh	CO2 Emission due to Electricity, MT
1	April-2019	154	0.12
2	May-2019	146	0.11
3	June-2019	133	0.10
4	August-2019	180	0.14
5	September-2019	177	0.14
6	November-2019	132	0.10
7	Janaury-2020	173	0.13
8	February-2020	95	0.07
9	October-2020	197	0.15
10	November-2020	154	0.12
11	December-2020	135	0.10
13	Total	1676	1.34

14	Average	152	0.12
15	Max	197	0.15
16	Min	95	0.07

4.7 Representation of Month wise CO_2 emissions: 174212978475
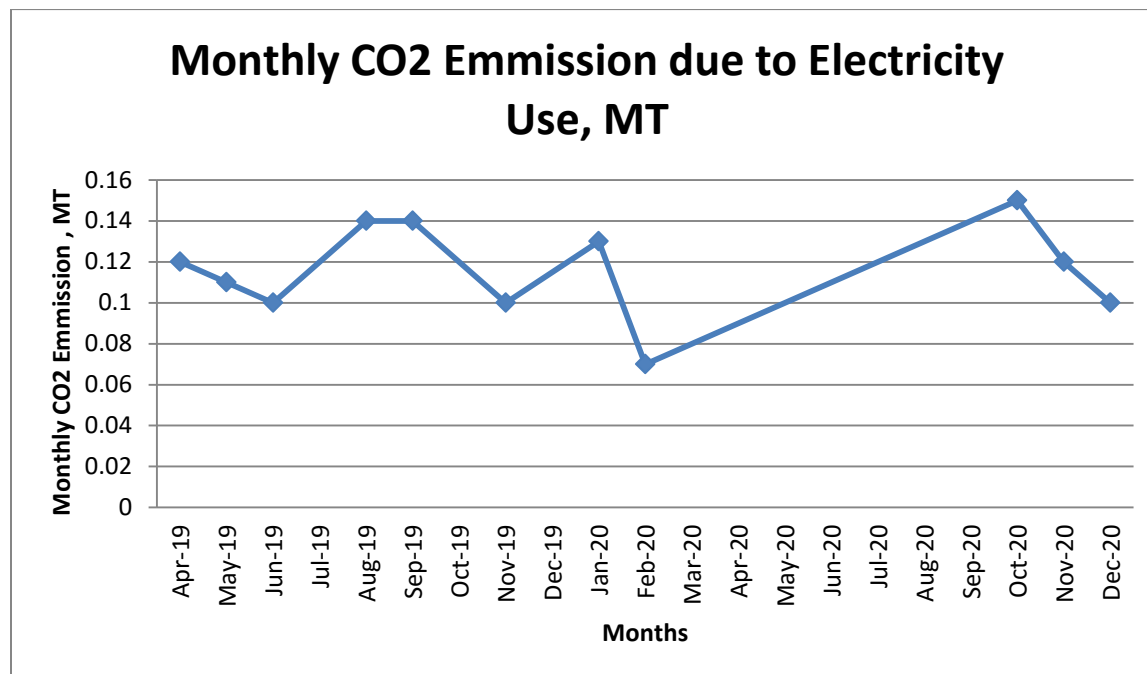
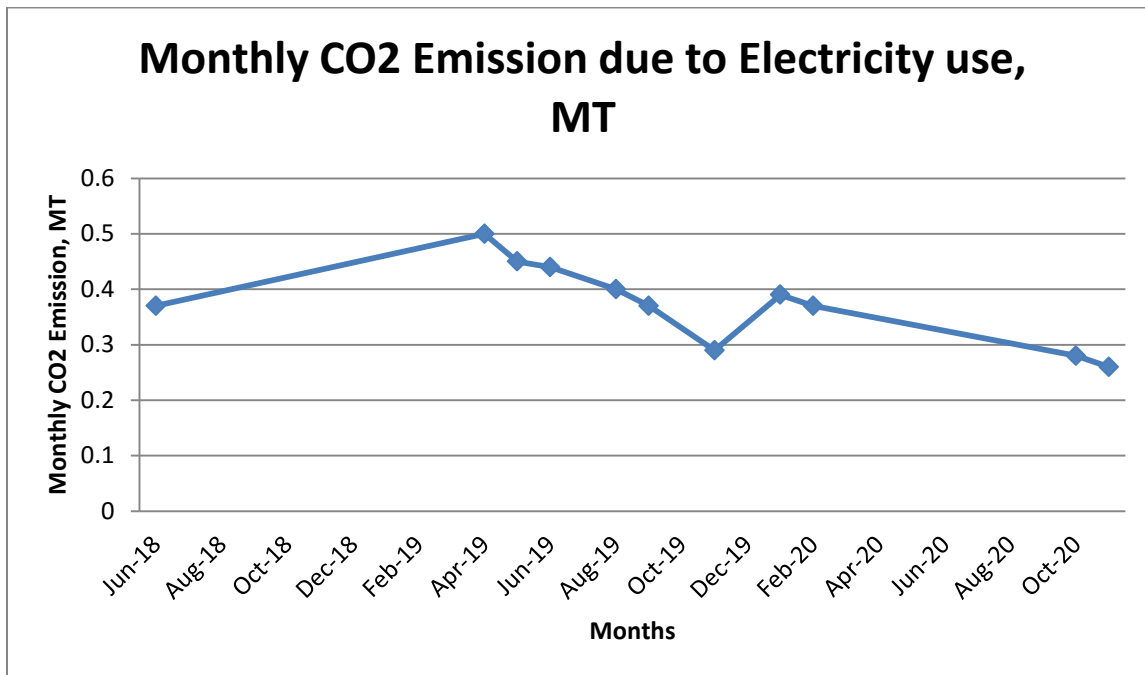**4.8 Month wise Consumption of Electrical Energy: 175700190727**

Sr. No	Month	kWh
1	April-2019	627
2	May-2019	568
3	June-2019	556
4	Aug-2019	503
5	Sep-2019	464
6	Nov-2019	366
7	June-2018	470
8	Jan-2020	499
9	Feb-2020	470
10	October-2020	351
11	November-2020	331
13	Total	5205

14	Average	473
15	Max	627
16	Min	331

4.9 Month wise CO2 Emissions: 175700190727

Sr. No	Month	Electrical Energy Consumed, kWh	CO_2 Emissions due to Electricity, MT
1	April-2019	627	0.50
2	May-2019	568	0.45
3	June-2019	556	0.44
4	Aug-2019	503	0.40
5	Sep-2019	464	0.37
6	Nov-2019	366	0.29
7	June-2018	470	0.37
8	Jan-2020	499	0.39
9	Feb-2020	470	0.37
10	October-2020	351	0.28
11	November-2020	331	0.26
13	Total	5205	4.16
14	Average	473	0.37
15	Max	627	0.50
16	Min	331	0.26

4.10 Representation of Month wise CO$_2$ emissions: 175700190727

Monthly CO2 Emission due to Electricity use, MT

4.11 Month wise Consumption of Electrical Energy: 174970157733

Sr. No	Month	kWh
1	May-2019	1357
2	June-2019	1357
3	Aug-2019	1357
4	Sep-2019	1357
5	Nov-2019	1357
6	Jan-2020	1357
7	Feb-2020	1357
8	Dec-2020	1357
9	Jan-2021	1357
13	Total	13570
14	Average	1357
15	Max	1357
16	Min	1357

4.12 Month wise CO2 Emissions: 174970157733

Sr. No	Month	Electrical Energy Consumed, kWh	CO_2 Emissions due to Electricity, MT
1	May-2019	1357	1.08
2	June-2019	1357	1.08
3	Aug-2019	1357	1.08
4	Sep-2019	1357	1.08
5	Nov-2019	1357	1.08
6	Jan-2020	1357	1.08
7	Feb-2020	1357	1.08
8	Dec-2020	1357	1.08
9	Jan-2021	1357	1.08
13	Total	13570	10.8
14	Average	1357	1.08
15	Max	1357	1.08
16	Min	1357	1.08

4.13 Representation of Month wise CO_2 emissions: 174970157733
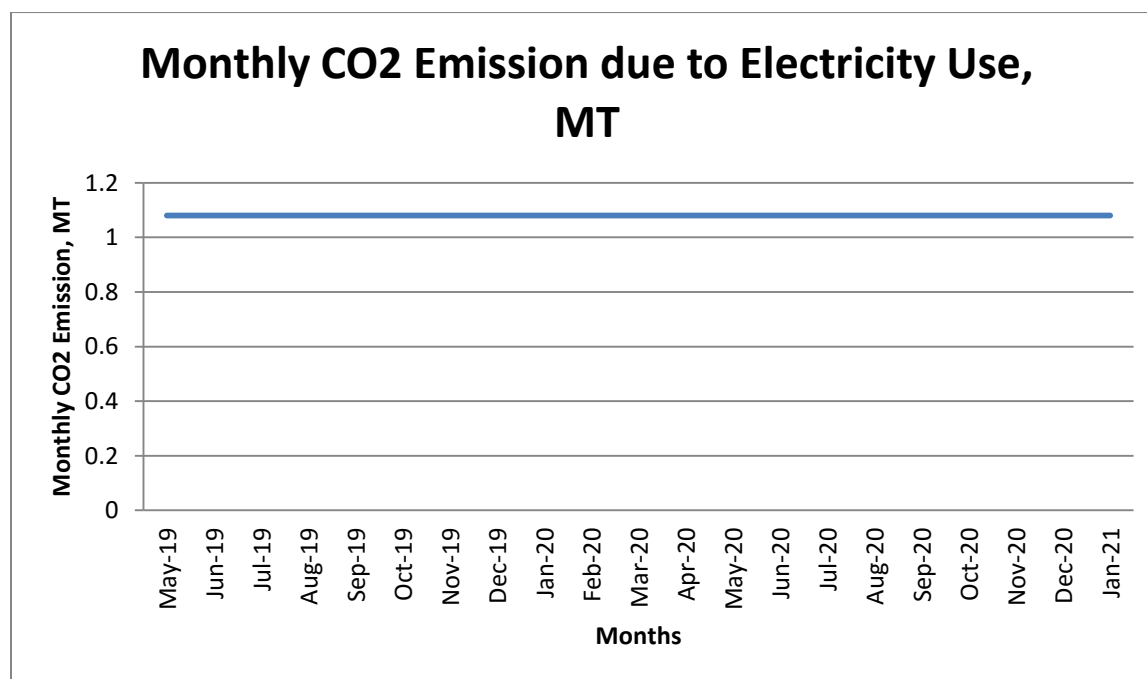
4.14 Benchmarking:

Now we compute the CO2 emissions per sq ft basis as under:

No	Parameter	Value	Unit
1	CO2 emissions	24.65	MT/annum
2	College area	157470	Sq ft
3	**CO2 emissions/sq ft**	**0.156**	**Kg of CO_2/sq ft**

CHAPTER-V
Suggestions and Recommendations

5.1 Energy conservation opportunities

Following are the energy conservation opportunities are possible as per the detailed energy audit. These energy conservation opportunities are of the type of no and low cost investment.

➢ Installation of 10 kWp Solar PV Power Pack
➢ Water management system must be in place. Reduction in water consumption by addressing leakages of taps and other miscellaneous utilities. Installation of flow meters which will help in reduction of water consumption. TOD can be implemented for pumping application.
➢ Conventional lights are required to replace with energy efficient lamps. May be this replacement can be workout in phase manner.
➢ There are 05 consumer nos in the premises with separate electrical meters from electric supply company. It is found that few of them are not in use or inconsistent use for which minimum charge as per sanctioned demand required to pay. If these nos are required in future may be continued but with minimizing the demand of electricity under corresponding consumer.
➢ Water sprinklers must be in use for maintaining the garden which will result in saving of water and power.
➢ Replacement of CRT monitors with LED.