

**June 2023**

**Vasantidevi Patil Institute of Pharmacy  
Kodoli – Maharashtra**

**Detailed Energy Audit Report**

**Vasantidevi Patil Institute of  
Pharmacy  
Kodoli- Maharashtra**

**Detailed Energy Audit Report**

**June 2023**



**Encon Education and Research  
Foundation**

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Report on

**ENERGY AUDIT**

of

**Vasantidevi Patil Institute of Pharmacy**

Kodoli, Dist. Kolhapur, Maharashtra.

Conducted by

**Dr. Talange Dhananjay Balu**

Certified Energy Auditor (EA-2924)

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June 2023

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### C. List of Abbreviations

BEE	: Bureau of Energy Efficiency
MEDA	: Maharashtra Energy Development Agency
EB	: Electricity Board
DG	: Diesel Generator
ECM	: Energy Conservation Measures
GCV	: Gross Calorific Value
kWh	: kilo Watt hour
LT	: Low Tension
HT	: High Tension
MSEDCL	: Maharashtra State Electricity Distribution Co. Ltd.
MT	: Metric Ton
MTOE	: Metric Ton Oil Equivalent
kW	: Kilo Watt
TPA	: Tons per Annum
SEC	: Specific Energy Consumption
SPC	: Specific Power Consumption
TPH	: Tons per Hour
VFD	: Variable Frequency Drive
DOL	: Direct On Line
Yr	: Year
Kg	: Kilo Gram
W	: Watt
°C	: Celsius

## II. Acknowledgement

Energy Audit Team of ENCON expresses our sincere gratitude to management of Vasantidevi Patil Institute of Pharmacy, Kodoli, for providing us an opportunity to conduct an Energy Audit of their organization located in Kodoli Dist. Kolhapur 416114. We are grateful to **Dr. S. A. Payghan** Principal, **Vaishali Powar** Office Suprident, **Mr. A. S. Babar** HoD and other administrative staff for showing keen interest in the study and active help and co-operation extended to ENCON Energy Audit Team during study.

We do hope that you will find the recommendations given in this report useful in helping you save energy. While we have made every attempt to adhere to high quality standards, in both data collection and analysis, as well as in presentation through the report, we should welcome any suggestions from your side as to how we can improve further.

In case of any suggestions or queries:

### **Encon Education and Research Foundation**

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### III. Introduction

Project	Energy Audit
Client	Vasantidevi Patil Institute of Pharmacy, Kodoli
Segment	Properties owned by College
Contact	<b>Dr. S. A. Payghan</b>
Site	Vasantidevi Patil Institute of Pharmacy, Kodoli, Dist. Kolhapur 416114, Maharashtra, India
Consultant	<b>Dr. Talange Dhananjay Balu (EA-2924)</b> Certified Energy Auditor
Involved faculty	Mrs. Gargi H. Bargale Mr. Prasad Ganthade
Duration	June 2023
Project scope	Conducting energy audit as per Bureau of Energy Efficiency (BEE) New Delhi to establish energy consumption in the institute and estimate scope for energy saving and also to recommend energy efficient appliances in place of energy intensive with payback calculation.
Report	This document gives recommendations, details of survey and the way forward.
Notes	The suggestions/ alternatives in the audit report are based on the inventory, name plate details and usage of equipment systems. It is recommended to obtain vendor quotations before implementation.

## IV. Executive Summary

### ❖ Highlights

Description	Units	Values
Total annual savings	₹	213246
Total investments	₹	543665
Payback period	Years	2.55
Annual electricity consumption	kWh	66719
Annual electricity cost/annum	₹	741471

### ❖ Impact of Proposed Energy Conservation Measures

Description	Units	Values
Electricity Saving	kWh/annum	15865
	%	23.78
Estimated annual cost reduction	₹/annum	213246
Simple Payback period	Years	2.55
Reduction in CO <sub>2</sub> emissions	MT/year	13.01

## ❖ Summary of Energy Conservation Measures

❖ **Table 1: Summary of Energy Conservation Measures**

Sr. No.	Energy Conservation Measures	Annual Saving		Investment	Simple payback period	Reduction in CO <sub>2</sub> emissions
		kWh	₹	₹	Years	MT/Year
1	Replace conventional ceiling fan with energy efficient fan (157 Nos.)	11118	163431.07	540740	3.31	9.12
2	Replace conventional tube with energy efficient tube (13 Nos.)	499	7338.24	2925.00	0.40	0.41
3	Optimization of water consumption	4248	42476.88	0.00	0.00	3.48
<b>Total</b>		<b>15864.96</b>	<b>213246.19</b>	<b>543665.00</b>	<b>3.71</b>	<b>13.01</b>

**Table 2: Recommendation for nearly zero energy building**

Name of Building	Annual Electricity Consumption kWh	Daily Electricity Consumption kWh	Unit Charge	Solar PV System Required- kW <sub>p</sub>	Annual Electricity Generated by Solar kWh	Monetary Saving ₹	Investment @60000/kw <sub>p</sub> ₹	Simple Payback
College building	62161	170.30	10.61	57.00	55575	589651	3420000	5.80

\* Already 73.5 kW Solar PV system is exist, additional 3 kW solar PV system need to be installed

## 1. Energy and Utility System Description

Vasantidevi Patil Institute of Pharmacy is located in Kodoli, Dist. Kolhapur.

Major utilities in this university are

1. General
2. Electrical

### 1.1 Brief Description of each Facility

This study is being done under the indicative scope of work for conduct of Energy Audit specified by MEDA (Maharashtra Energy Development Agency) & BEE (Bureau of Energy Efficiency). This study is mainly carried out to identify saving areas in Vasantidevi Patil Institute of Pharmacy, Kodoli with short term, medium term & long-term investments, yielding significant savings. The study can be mainly divided into following groups.

#### a. General

Energy Audit focuses on study of correlation of electricity consumption on production. Opportunities for load factor improvement, power factor improvements, etc.

#### b. Electrical

It includes motor load study of 5 HP & above by measuring input parameters (Voltage, Current, P.F., & kW), performance analysis of water pumps having capacities above 5 HP, performance analysis and identification of energy efficiency opportunities in motors, pumps, air compressors, lighting, etc.

### 1.2 Instrument Used

Following instruments are used for the study:

- a. Three phase power analyzer
- b. Lux Meter
- c. Measuring tape
- d. Anemometer
- e. Thermal imager

The site study was carried out in June 2023.

## **2. Description and Energy Consumption**

### **2.1 About Institute**

Vasantidevi Patil Institute of Pharmacy, Kodoli was established with the aim to impart quality pharmacy education and training to cater the needs of the pharmacy profession and society at large. The journey started in 2003 by introducing the first Pharmacy institute in the Kodoli under aegis of Shri Yashwant Shikshan Prasarak Mandal, Kodoli. The institute is approved by AICTE New Delhi, PCI New Delhi, and DTE Mumbai, recognized by Government of Maharashtra & affiliated to a MSBTE, Mumbai and Shivaji University, Kolhapur. The Institute is situated at the foot hills of Panhala, in the area of Kodoli, about 10 kilometres away from National Highway- 4 and 35 km away from major city, Kolhapur. The institute occupies the area of approximately 4 acres having its own 5470 sq.mts. building with excellent infrastructure which in-houses facilities such as sophisticated laboratories, resourceful library with latest books, national& international journals and well-equipped classrooms with modern teaching aid. Vasantidevi Patil Institute of Pharmacy is a progressive edifying organization, dedicated to the pursuit of excellence. This institute has been dedicated to decree solutions to big challenges and to prepare the student for leadership in a multifaceted world.

### **2.2 Annual Energy Consumption**

#### **2.2.1 Electricity**

Vasantidevi Institute of Pharmacy, Kodoli is receiving electricity from MSEDCL. A part of the plant electricity is met by open access. Contract demand with MSEDCL is 21.52 kVA with a minimum billing demand 40% contract demand or 75% highest billing demand during preceding 11 months.

#### **2.2.2 Marginal Energy Cost**

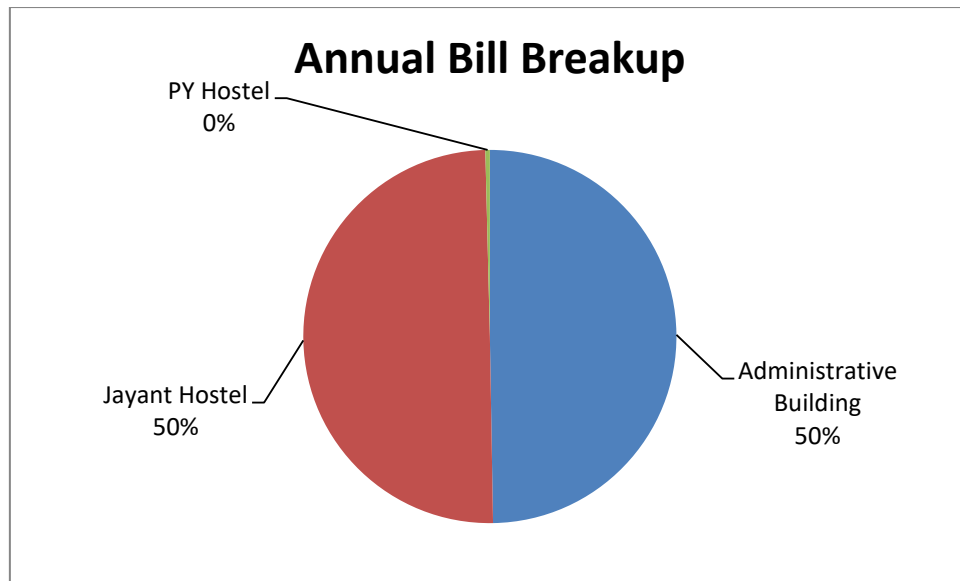
Marginal cost of electricity is calculated based on the energy cost of electricity from EB. This marginal cost is considered for the cost benefit analysis of energy conservation measures.

**Table 03: Marginal Energy Cost**

Description	Units	Value	Value	Value
Name of building	-	Main building	Jayant Hostel	PY Hostel
Average monthly EB energy consumption	kWh	62691	62161	53
Average basic cost of energy from EB	₹/kWh	10.61	10.65	32.41
% of electricity from EB	%	100	100	100
Marginal cost of electricity	₹/kWh	10.61	10.65	32.41

**2.2.3 Annual Energy Consumption Breakup****Table 04: Annual Energy Consumption**

Month	Administrative Building	Jayant Hostel	PY Hostel	Total bill in Lakhs
May-23	45538.86	3275.81	1185	4460.81
Apr-23	77956.17	15256.97	1717.66	16974.63
Mar-23	77106.43	740	1130	1870
Feb-23	55195.07	740	1130	1870
Jan-23	54110.81	740		740
Dec-22	55010.4	740		740
Nov-22	49963.32	740		740
Oct-22	47829.15	740		740
Sep-22	45459.16	4190.66		4190.66
Aug-22	47205.14	10635.83		10635.83
Jul-22	50537.99	31158.23		31158.23
Jun-22	54590.13	6848.15		6848.15
<b>Total</b>	<b>660502.6</b>	<b>75805.65</b>	<b>5162.66</b>	<b>80968.31</b>



**Figure 01: Annual Energy Consumption Breakup**

## 3. Energy Scenario

### 3.1 Electrical Systems

#### 3.1.1 Electrical bill analysis

**Vasantidevi Institute of Pharmacy, Kodoli** is getting electricity supply from Maharashtra State Electricity Distribution Co. Ltd. Major portion of the energy consumption is used for academics and hostel.

The observations made during the study are given in the following sections.

#### The Tariff Structure

Tariff structure of the facility is given below

**Table 05: Tariff Structure of buildings**

Sr. No.	Name of Building	Tariff Code	Supply voltage kV	Contracted demand kVA	Minimum billing demand kVA	Demand charges ₹/kVA	TOD	Unit charge ₹/kWh
1	Administrative Building	88 LT-VII B I	11	21.52	8.61	422	Opted	9.40
2	Jayant Hostel	092 LT I Res 3-Phase	11	0	0	740	Opted	7.43
3	PY Hostel	92 LT-I A	11	18	7.20	385	Opted	15.57

#### 1. Billing Demand

The billing demand during unrestricted period shall be minimum billing demand 50% contract demand or 75% highest billing demand during preceding 11 months or actual Maximum Demand recorded in the month during 0600 hours to 2200 hours; whichever is higher.

#### 2. Power factor (PF)

It shall be the responsibility of the HT Consumer to determine the capacity of PF correction apparatus and maintain an average PF of not less than 0.90.

#### 3. Load Factor Incentive

Consumers having Load Factor above 75% and up to 85% will be entitled to an incentive in the form of a rebate of 0.75% on the Energy Charges for every percentage point increase in Load



Factor from 75% to 85%. Consumers having a Load Factor above 85 % will be entitled to a rebate of 1% on the Energy Charges for every percentage point increase in Load Factor from 85%. The total rebate will be subject to a ceiling of 15% of the Energy Charges applicable to the consumer.

#### 4. Time of Day Tariff

As per Maharashtra State Electricity Distribution Company Limited, HT consumers have an option to take Time of Day (TOD) tariff instead of the normal tariff. Under TOD tariff electricity consumption and maximum demand in respect of HT consumers for different periods of the day i.e. normal period, peak load period and off-peak load period could be recorded by installing TOD meter. The maximum demand and consumption recorded in different periods could be billed on the following rates of the tariff applicable.

**Table 06: Time of Day Tariff (TOD)**

S. No	Description	Energy Charge (₹/kWh)
<b>1</b>	<b>Energy Charges</b>	
(i)	22:00 Hrs-06:00 Hrs	-1.50
(ii)	06:00 Hrs-09:00 Hrs & 12:00 Hrs-18:00 Hrs	0.00
(iii)	09:00 Hrs-12:00 Hrs	0.80
(iv)	18:00 Hrs-22:00 Hrs	1.10
<b>2</b>	<b>Demand Charges</b>	Normal rate of Demand Charges

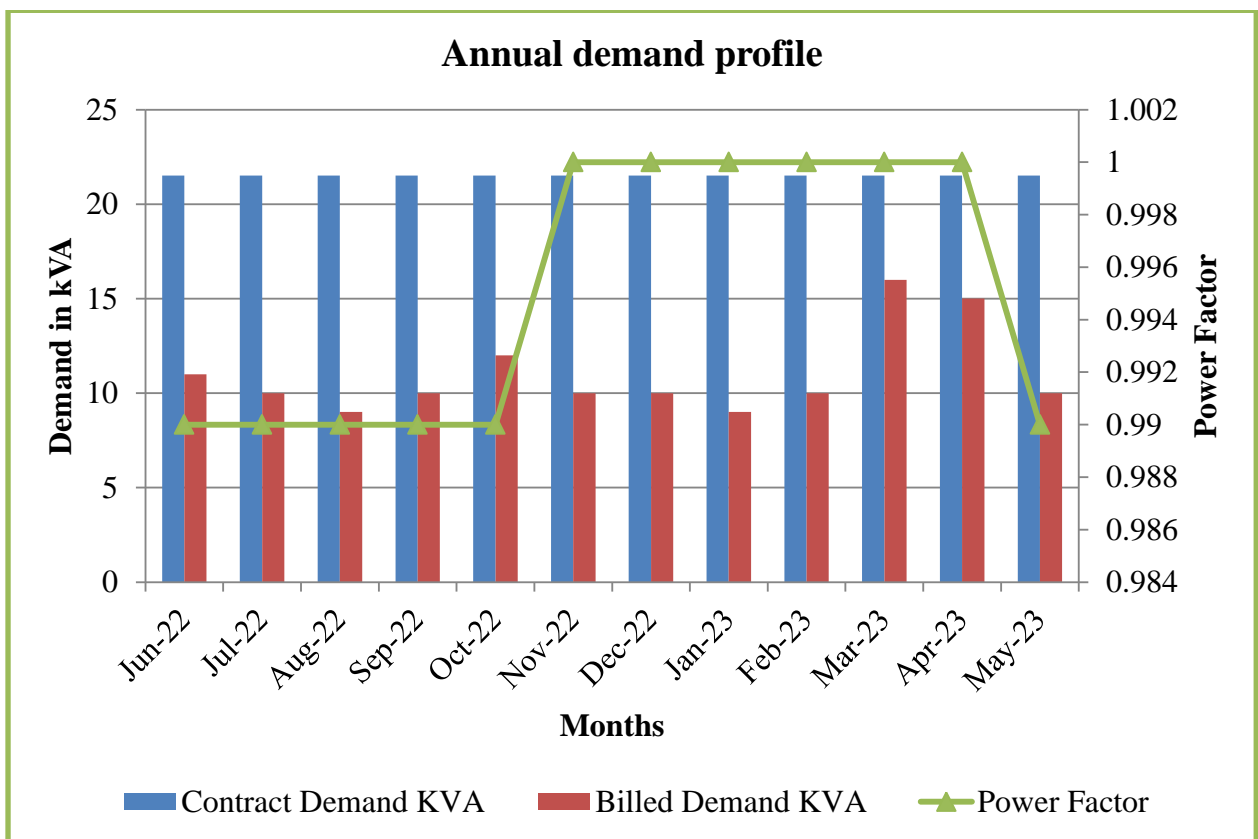
The analysis of plant electricity consumption from EB and Open Access is given below. For the electricity consumption analysis, electricity bill for the last twelve months (June-2022 to May 2023) is considered.

**Table 07: Electrical Bill Analysis of Main Building**

Month	Contract Demand KVA	Billed Demand KVA	KVA (MD)	Power Factor	Ideal PF	Consumption kWh	Consumption KVAH	Demand Charges	Wheeling Charge	Energy charges	TOD tariff EC	FAC	Tax on sale	P.F. Penal Charges	Charges for Excess Demand	Total Bill
May-23	21.52	10	16	0.99	1	3981	4014	4220	4657.77	37421.40	-327.60	0.00	716.58	-1149.29	0	45538.86
Apr-23	21.52	15	22	1	1	6881	6910	6330	8050.77	64681.40	-532.90	0.00	1238.58	-2748.52	937	77956.17
Mar-23	21.52	16	25	1	1	7118	7148	6144	9609.30	51463.14	-1039.40	10321.10	1281.24	-2677.43	2004	77106.43
Feb-23	21.52	10	15	1	1	5340	5373	3840	7209.00	38608.20	-1199.30	7743.00	961.20	-1967.03	0	55195.07
Jan-23	21.52	9	14	1	1	5341	5375	3456	7210.35	38615.43	-1949.10	7744.45	961.38	-1927.70	0	54110.81
Dec-22	21.52	10	16	1	1	5360	5392	3840	7236.00	38752.80	-1595.00	7772.00	964.80	-1960.20	0	55010.40
Nov-22	21.52	10	15	1	1	4838	4867	3840	6531.30	34978.74	-1492.10	7015.10	870.84	-1780.56	0	49963.32
Oct-22	21.52	12	18	0.99	1	4457	4505	4608	6016.95	32224.11	-1079.00	6462.65	802.26	-1205.82	0	47829.15
Sep-22	21.52	10	16	0.99	1	4309	4360	3840	5817.15	31154.07	-1230.00	6248.05	775.62	-1145.73	0	45459.16
Aug-22	21.52	9	12	0.99	1	4518	4574	3456	6099.3	32665.14	-1190.10	6551.10	813.24	-1189.54	0	47205.14
Jul-22	21.52	10	16	0.99	1	4833	4907	3840	6524.55	34942.59	-1373.40	7007.85	869.94	-1273.54	0	50537.99
Jun-22	21.52	11	17	0.99	1	5185	5266	4224	6999.75	37487.55	-1196.90	7518.25	933.30	-1375.82	0	54590.13
Min	21.52	9	12	0.99	1	3981	4014	3456	4657.77	31154.07	-1949.1	0	716.58	-2748.52	0	45459.16
Max	21.52	16	25	1	1	7118	7148	6330	9609.3	64681.4	-327.6	10321.1	1281.24	-1145.73	2004.48	77956.17
Average	21.5	11	16.83	1	1	5180	5224	4303	6830	39416	-1184	6199	932	-1700	245	55041.89
Total						62161	62691	51638	81962.19	472994.57	-14204.8	74383.55	11188.98	-20401.18	2941.32	660502.63

**Observation:**

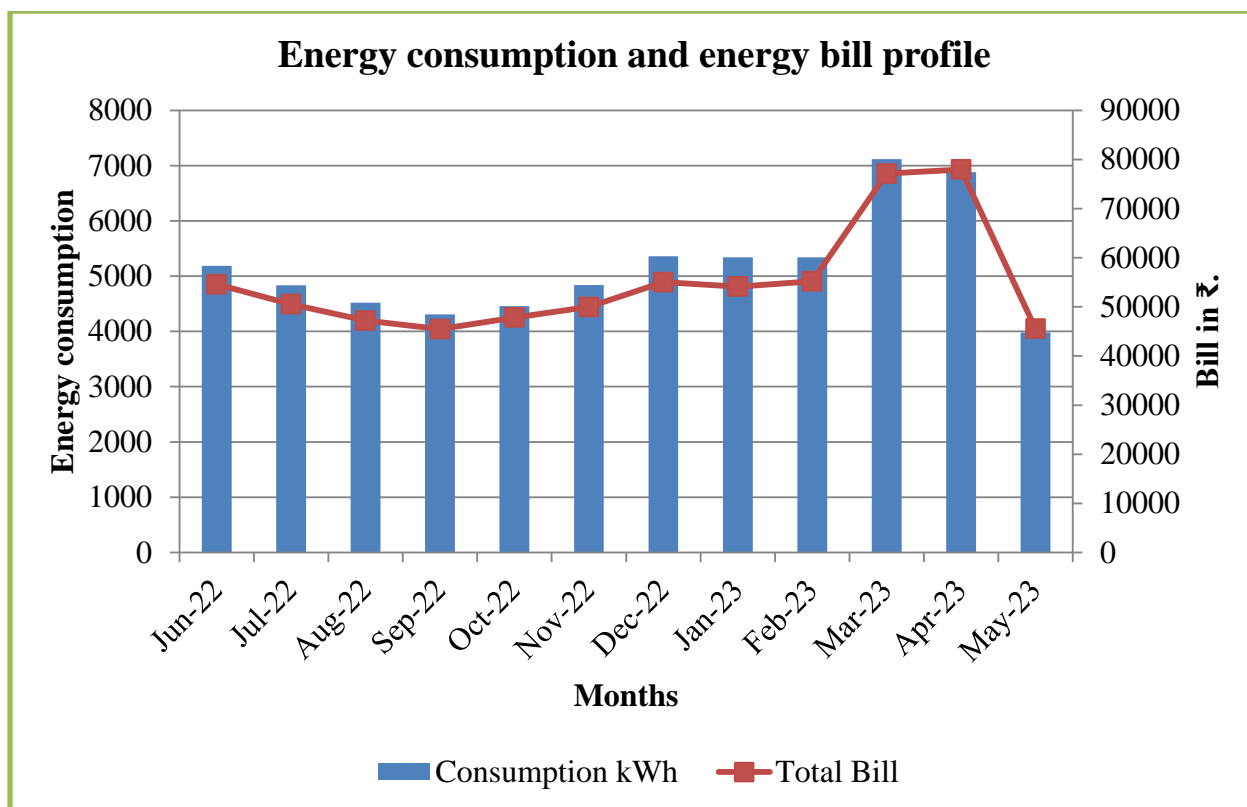
- The contract demand is 21.52 kVA and the minimum billing demand 40% contract demand or 75% highest billing demand during preceding 11 months whichever is higher.
- Max demand recorded for the month March 2023 is 16 kVA.
- The average demand recorded for twelve months; from June 2022 to May 2023 is 11 kVA which is more than the minimum billed demand i.e. 9 kVA.
- The lowest recorded demand in the month of January 2023 is 9 kVA and & highest recorded demand 16 kVA in the month of March 2023.
- The average energy consumption is 5180 kWh.



**Figure 02: Contract Demand, Recorded Demand and PF Profile of Main Building**

**Observation:**

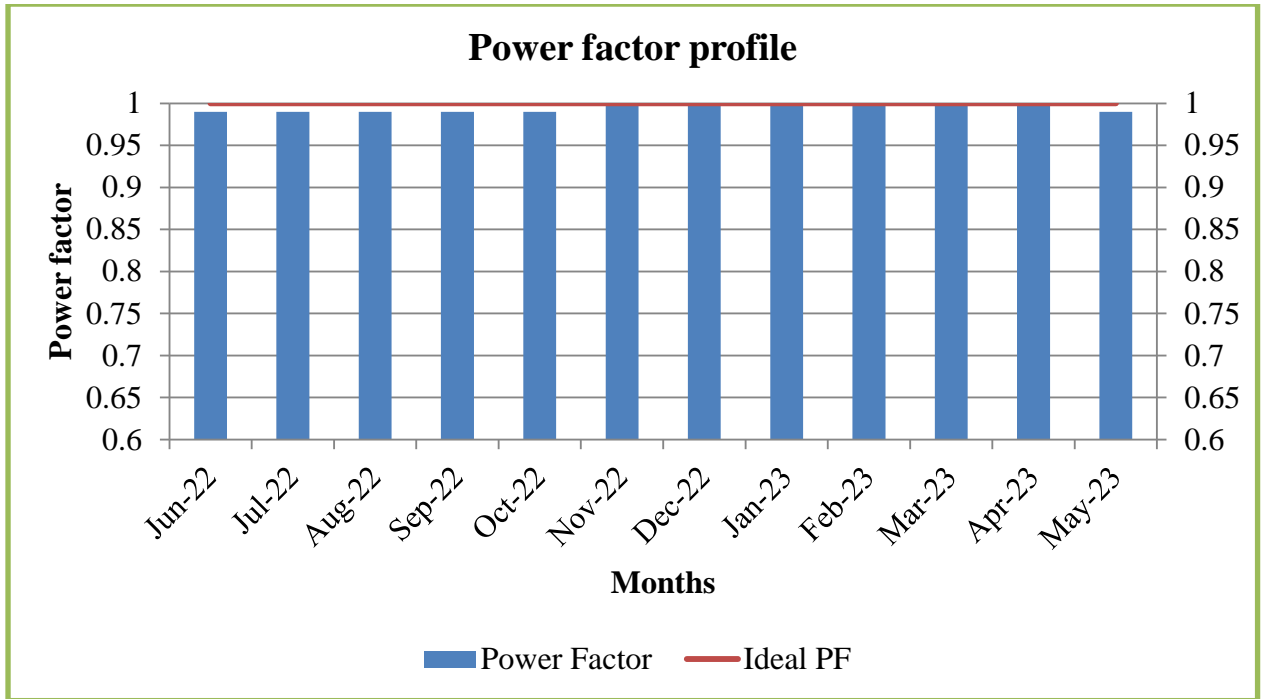
- The maximum and minimum recorded demand was 16 kVA in Mach 2023 and 9 kVA in January 2023 respectively.
- The power factor is maintained.



**Figure 03: Annual Energy Consumption of Main Building**

**Observation:**

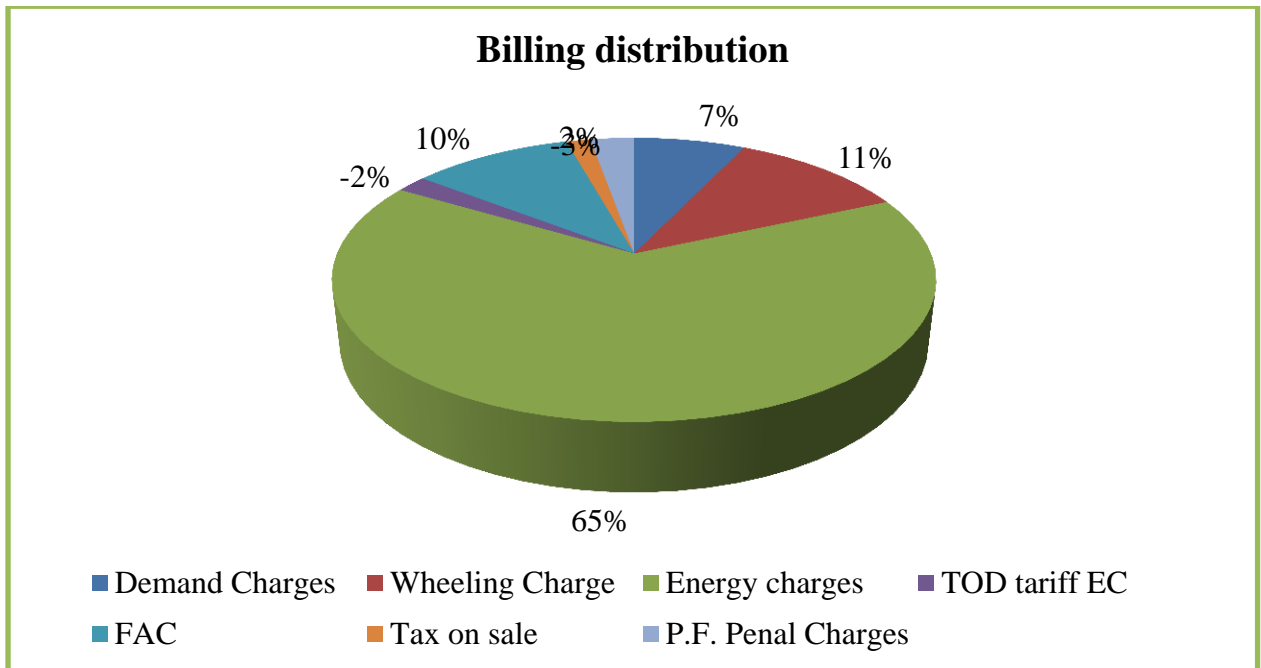
- Energy consumption varies from 3981 to 7118 kWh from June 2022 to May 2023.
- The bill as per MERC for last twelve months is ₹ 6.60 lakhs.



**Figure 04: Billed PF Vs Ideal PF of Main Building**

**Observation:**

- Billed PF varies from 0.99 to 1.



**Figure 05: Billing Distribution of Main Building**

**Observations**

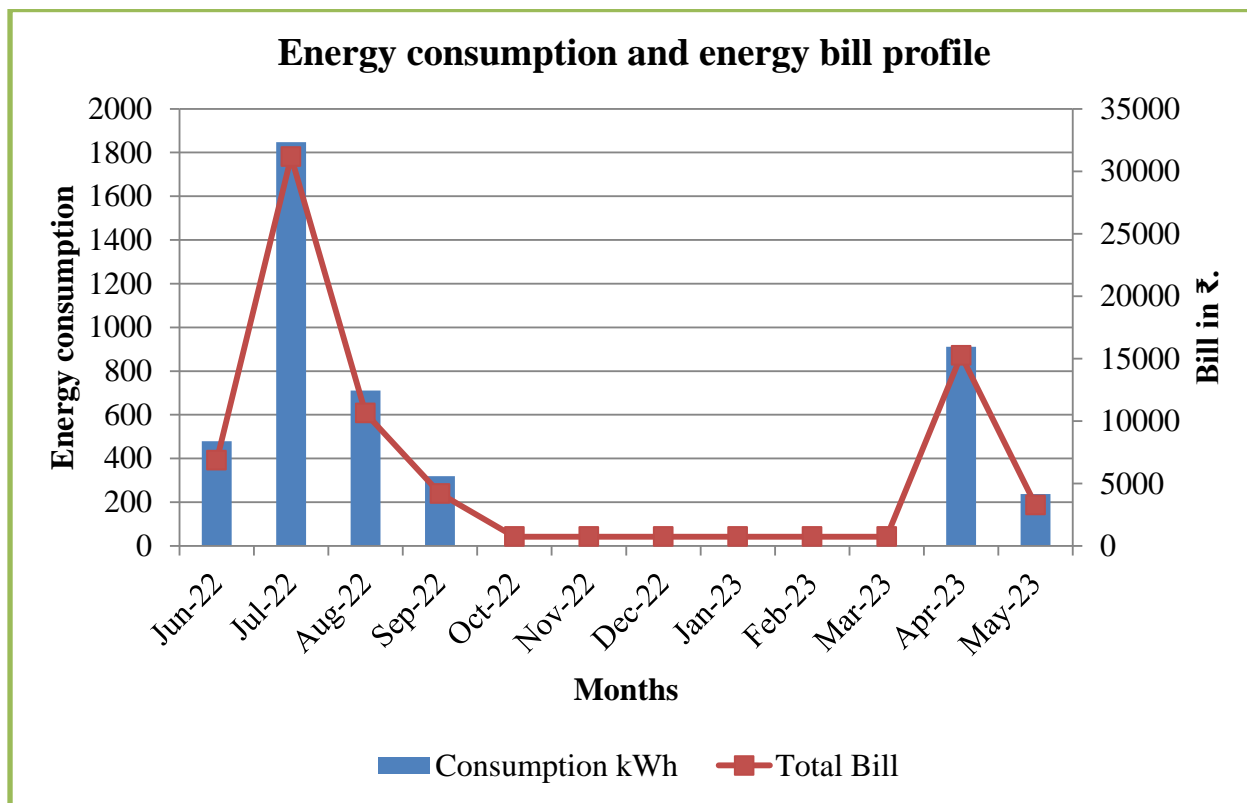
- ❖ Energy charges are 73 % of total bill.
- ❖ Demand charges are 19 % of total bill.

**Table 08: Electrical Bill Analysis of Jayant Hostel**

Month	Import kWh	Export kWh	Generation kWh	Consumption kWh	Demand Charges	Wheeling Charge	Energy charges	FAC	Electricity Duty	Total Bill
May-23	2699	2462	3706	237	785	277.29	1761.68	0.00	451.84	3275.81
Apr-23	3273	2362	3961	911	785	1065.87	11301.69	0.00	2104.41	15256.97
Mar-23	3582	3350	4904	0	740	0.00	0.00	0.00		740.00
Feb-23	2027	2658	3912	0	740	0.00	0.00	0.00	0.00	740.00
Jan-23	1246	2277	3230	0	740	0.00	0.00	0.00	0.00	740.00
Dec-22	2344	2814	3707	0	740	0.00	0.00	0.00	0.00	740.00
Nov-22	2401	2442	3704	0	740	0.00	0.00	0.00		740.00
Oct-22	1596	2144	2995	0	740	0.00	0.00	0.00		740.00
Sep-22	2193	1874	2999	319	740	430.65	2040.24	401.75	578.02	4190.66
Aug-22	2539	1828	2970	711	740	959.85	6236.82	1232.15	1467.01	10635.83
Jul-22	3084	1236	2458	1848	740	2494.80	19721.64	3904.10	4297.69	31158.23
Jun-22	2631	1732	2965	479	740	646.65	3772.58	744.35	944.57	6848.15
Min	1246	1236	2458	0	740	0	0	0	0	740.00
Max	3582	3350	4904	1848	785	2494.8	19721.64	3904.1	4297.69	31158.23
Average	2468	2265	3459	375	748	490	3736	524	1094	6317.14
Total	29615	27179	41511	4505	8970	5875.11	44834.65	6282.35	9843.54	75805.65

**Observation:**

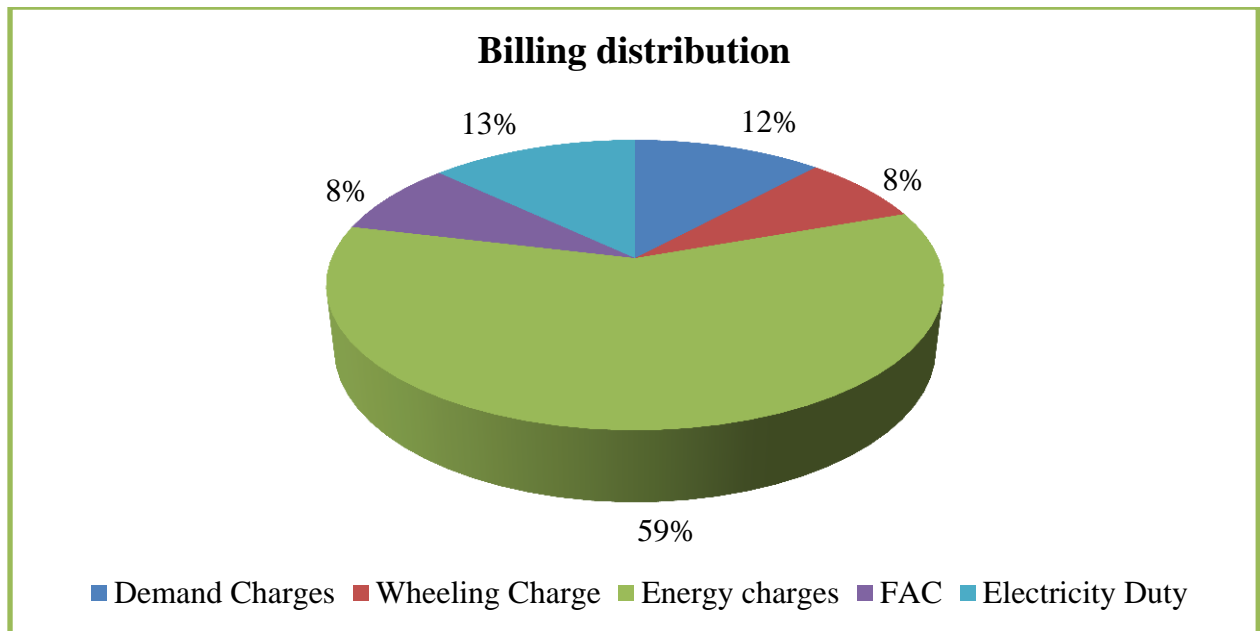
- Imported and exported units are 29615 and 27179 respectively.
- Units generated are 41511.
- The average energy consumption is 375 kWh.



**Figure 06: Annual Energy Consumption of Jayant Hostel**

**Observation:**

- Energy consumption varies from 20080 to 32597 kWh from March 2022 to February 2023.
- The bill as per MERC for last twelve months is ₹ 36.75 in Lakhs.



**Figure 07: Billing Distribution of Jayant Hostel**

### Observations

- ❖ Energy charges are 59 % of total bill.
- ❖ Demand charges are 12 % of total bill.

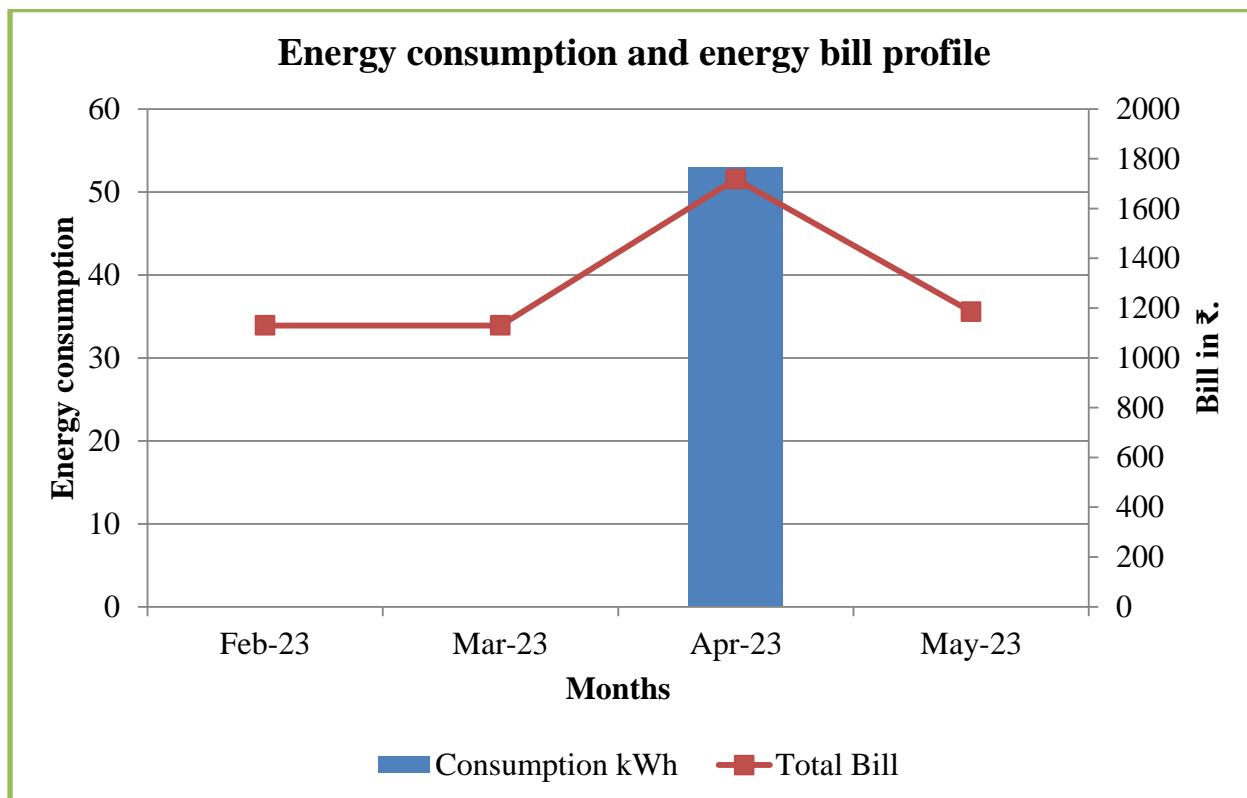


**Table 09: Electrical Bill Analysis of PY Hostel**

Month	Contract Demand KVA	Billed Demand KVA	KVA (MD)	Consumption kWh	Demand Charges	Wheeling Charge	Energy charges	Electricity Duty	Incremental Consumption Rebate	Total Bill
May-23	18	0	15	0	1185	0.00	0.00	0.00	0.00	1185.00
Apr-23	18	0	20	53	1185	62.01	233.73	236.92	0.00	1717.66
Mar-23	18	0	21	0	1130	0.00	0.00	0.00	0.00	1130.00
Feb-23	18	0	20	0	1130	0.00	0.00	0.00	0.00	1130.00
Min	18	0	15	0	1130	0	0	0	0	0.00
Max	18	0	21	53	1185	62.01	233.73	236.92	0	1717.66
Average	18	0	19.00	13	1158	16	58	59	0	430.22
Total				53	4630	62.01	233.73	236.92	0	5162.66

**Observation:**

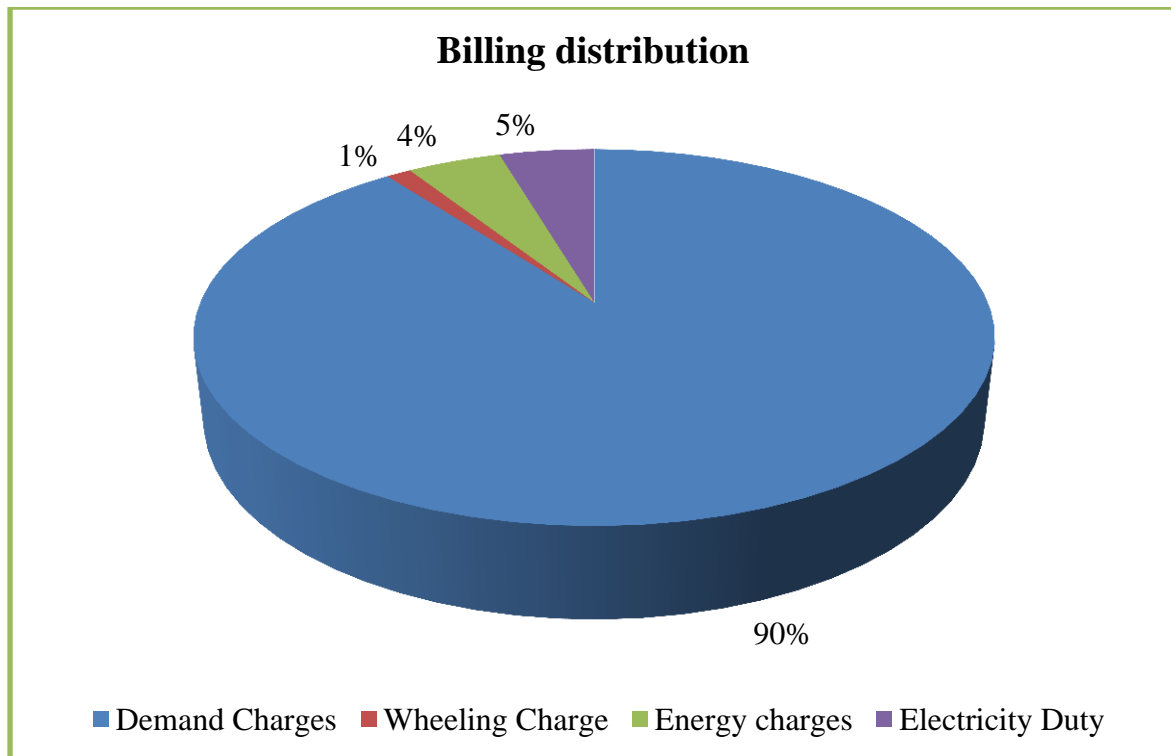
- The contract demand is 18 kVA .
- The lowest & highest recorded demand in the month of May 2023 was 15 kVA and 21 kVA in month of March 2023 respectively.
- The average energy consumption is 13 kWh.



**Figure 08: Annual Energy Consumption of PY Hostel**

**Observation:**

- Energy consumption varies from 0 to 53 kWh from February 2023 to May 2023.
- The bill as per MERC for last twelve months is ₹ 5163.



**Figure 09: Billing Distribution of Hostel C&D Building**

### Observations

- ❖ Energy charges are 4 % of total bill.
- ❖ Demand charges are 90 % of total bill.

**Table 10: Solar Generation of PY Hostel**

Month	Import					Export					Generation				
	0000Hrs.- 0600Hrs & 2200Hrs- 2400 Hrs	0600Hrs.- 0900Hrs & 1200Hrs- 1800 Hrs	0900Hrs- 1200 Hrs	1800Hrs- 2200 Hrs	Total	0000Hrs.- 0600Hrs & 2200Hrs- 2400 Hrs	0600Hrs.- 0900Hrs & 1200Hrs- 1800 Hrs	0900Hrs- 1200 Hrs	1800Hrs- 2200 Hrs	Total	0000Hrs.- 0600Hrs & 2200Hrs- 2400 Hrs	0600Hrs.- 0900Hrs & 1200Hrs- 1800 Hrs	0900Hrs- 1200 Hrs	1800Hrs- 2200 Hrs	Total
May-23	1319	237	4	715	2275	0	2322	1554	5	3881	4	3783.5	2294.1	42.5	6124.1
Apr-23	2078	452	3	1289	3822	0	2299	1470	0	3769	6.4	3004	1708.8	23	4742.2
Mar-23	1999	396	3	1379	3777	0	2583	1566	0	4149	2	2489.1	1373	13.2	3877.3
Feb-23	1572	278	1	1146	2997	0	2017	1390	0	3407	0	1251.9	656	21.8	1929.7
Min	1319	237	1	715	2275	0	2017	1390	0	3407	0	1251.9	656	13.2	1929.7
Max	2078	452	4	1379	3822	0	2583	1566	5	4149	6.4	3783.5	2294.1	23.1	6124.1
Average	1742	340.75	2.75	1132.25	3217.75	0	2305.25	1495	1.25	3801.5	3.1	2632.125	1507.975	25.125	4168.325
Total	6968	1363	11	4529	12871	0	9221	5980	5	15206	12.4	10528.5	6031.9	100.5	16673.3

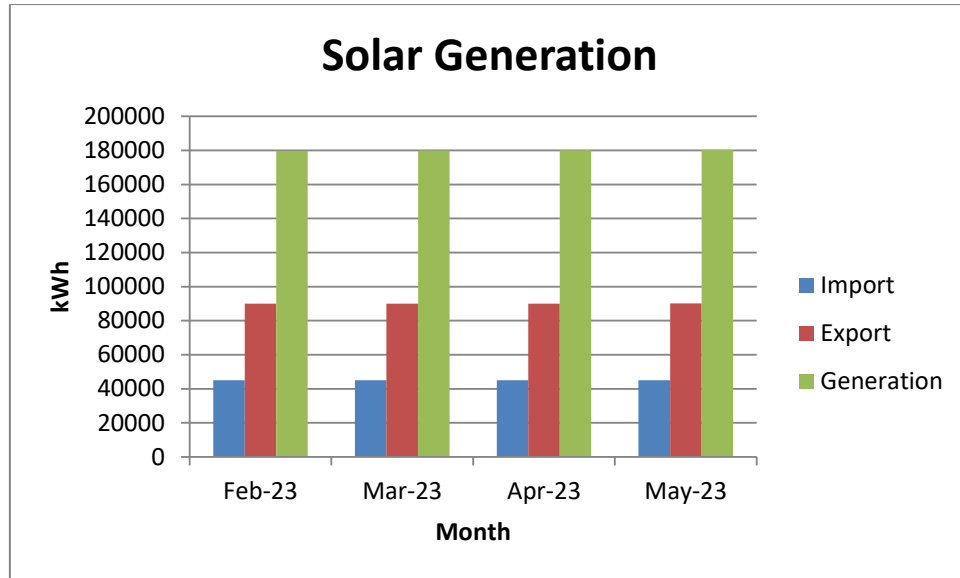


Figure 10: Solar Generation of PY Hostel

### 3.2 Water Pump

The performance analysis of the pumps used for water required for the institute is done based on the present operating parameters like water flow, head and power. The water supply of the institute is met by bore well.

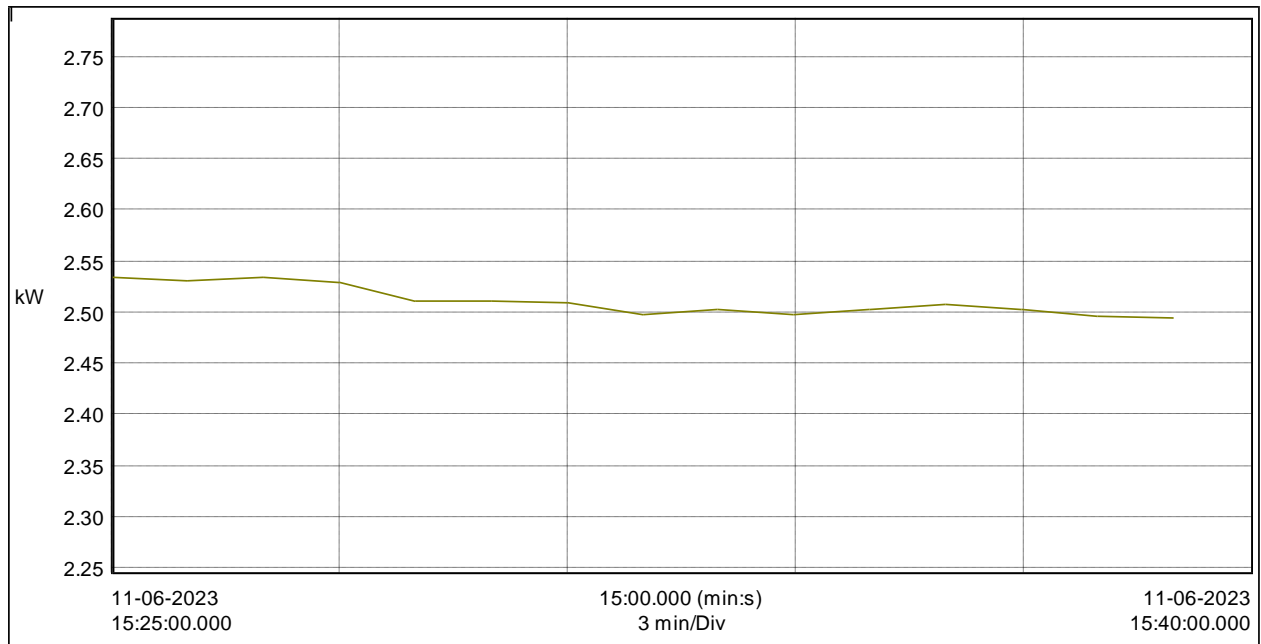


Figure 11: Power profile of water pump (5.55 kW)

#### Observations:

- The pumps which are used are more than 5 years old.
- The motor input power is varying from 2.50 kW to 2.53 kW.

### 3.4 Lighting System

Lighting is provided in commercial buildings, indoor and outdoor for providing comfortable working environment. The primary objective is to provide the required lighting effect for the lowest installed load i.e. highest lighting at lowest power consumption. There are number of buildings in VIP Campus. The details of inventories are shown in the table.

The details of inventories are shown in the table.

**Table 11: Inventory of Vasantidevi Patil Institute of Pharmacy, Kodoli**

Name of Department	Ceiling Fan	Exhaust Fan	Wall Fan	Tube T8	LED Tube	LED Bulb 6 W	LED Bulb 12 W	LED Bulb 15 W	LED sq. 12 W	LED Bulb 500 W	LED strip	Computer	Printer	Xerox	Oven	Heater	Induction cooker	Tea Machine	Sound system	Inverter	Refrigerator	Water cooler	LED Screen AC 3 star (Blue star 1.5 ton)	Projector	Pump
<b>Library</b> open space				40	18	6	12	15	12																
Reading Room	5						32				48														
Open space	5					22	15																		
Computer room	2					8						11													
Book Stack	4					20	5					3	1	1											
Open space							6																		
NSS room	3						10					3													
Toilet					1	3	2																		
Pharmaceutical Lab1	1	1		1	2										1	1									
Preparation room	1	1			1																				
Lab 2 diploma	1	1		1	1																				
Pharmacy Practice lab 3	1	2			2																				
Preparation room	1				1																				
Lab 4	1	2		1	1											1									

Name of Department	Ceiling Fan	Exhaust Fan	Wall Fan	Tube T8	LED Tube	LED Bulb 6 W	LED Bulb 12 W	LED Bulb 15 W	LED sq. 12 W	LED Bulb 500 W	LED strip	Computer	Printer	Xerox	Oven	Heater	Induction cooker	Tea Machine	Sound system	Inverter	Refrigerator	Water cooler	LED Screen AC 3 star (Blue star 1.5 ton)	Projector	Pumps
Ladies common room	4								4																
Pharmacy Practice-II	1				4																				
Lab PG-I	2			1	4										1	1									
Faculty room	2				1							2	1												
Store	2			2								2	1												
Store 1	1			1	1							1													
Lab PG	2			1	4																				
Corridor					9																	1			1 (HP)
<b>First floor</b> Class room 2	5			2	4																				
Ladies toilet					1																				
Corridor					6					1															
Class room 1 (diploma)	6			1	5																			1	
Computer Lab	4			1	1							27													
Exam Controller	1			1	1							2	1							1					
IQAC	2				1							2	1												
Cognocly Lab	1				1										2										
Ecology lab	3				2				5			1													1
Administrative office	2								14																
cabin	2					5			1			1											1		
cabin	1								4																

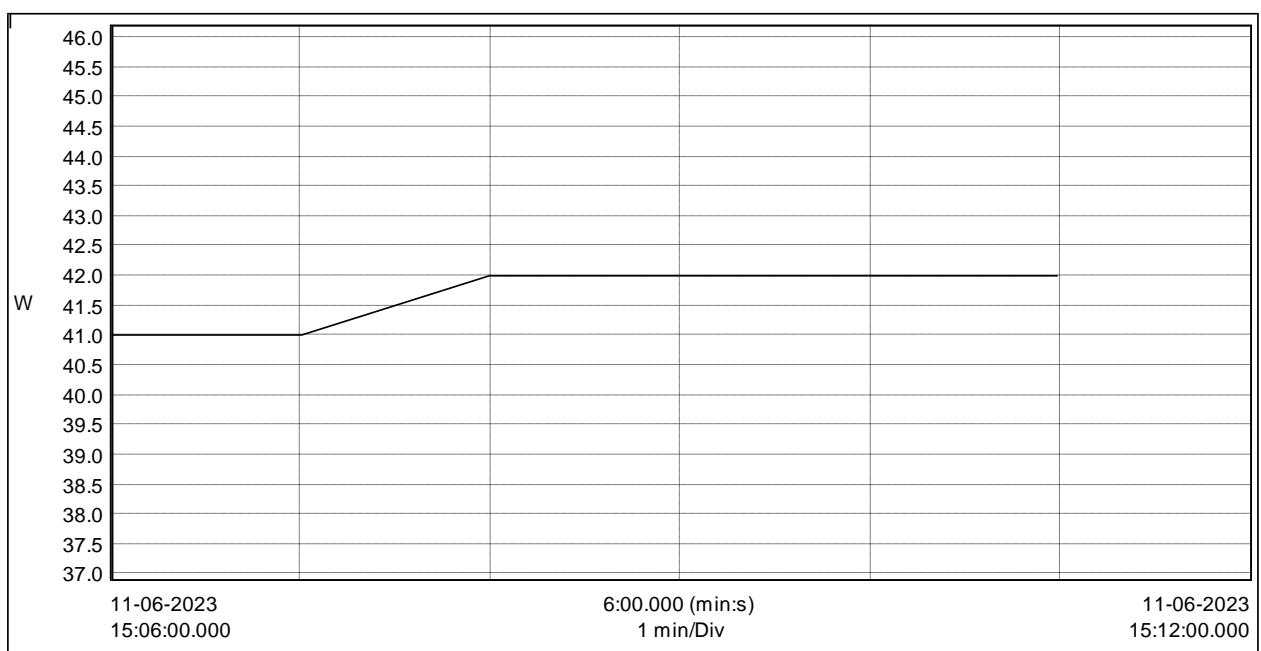
Name of Department	Ceiling Fan	Exhaust Fan	Wall Fan	Tube T8	LED Tube	LED Bulb 6 W	LED Bulb 12 W	LED Bulb 15 W	LED sq. 12 W	LED Bulb 500 W	LED strip	Computer	Printer	Xerox	Oven	Heater	Induction cooker	Tea Machine	Sound system	Inverter	Refrigerator	Water cooler	LED Screen AC 3 star (Blue star 1.5 ton)	Projector	Pumps	
pantry	1				1													1	1							
Administrative office HoD Office	1				1							1														
Confidential room	1				2			2									1									
Backup room																				1		1				
Corridor	4		1		5																					
Cashier	1				1							1	1													
Office	4				8							7	3	1									1			
Board room	2				6							1	1										1	1		
Principal Office	1				2																					
Lab 1	4		1		6							2														
Lab 2 diploma	2				3																					
<b>Second floor</b> faculty room	4				3							4	1													
Auditorium	8				3																					
Corridor					9																	1				
Pharma Analysis lab	5				6																					
Lab-II	2				1				2			1														
Lab-II	1								2																	
Chemistry lab-I	1								2						1											



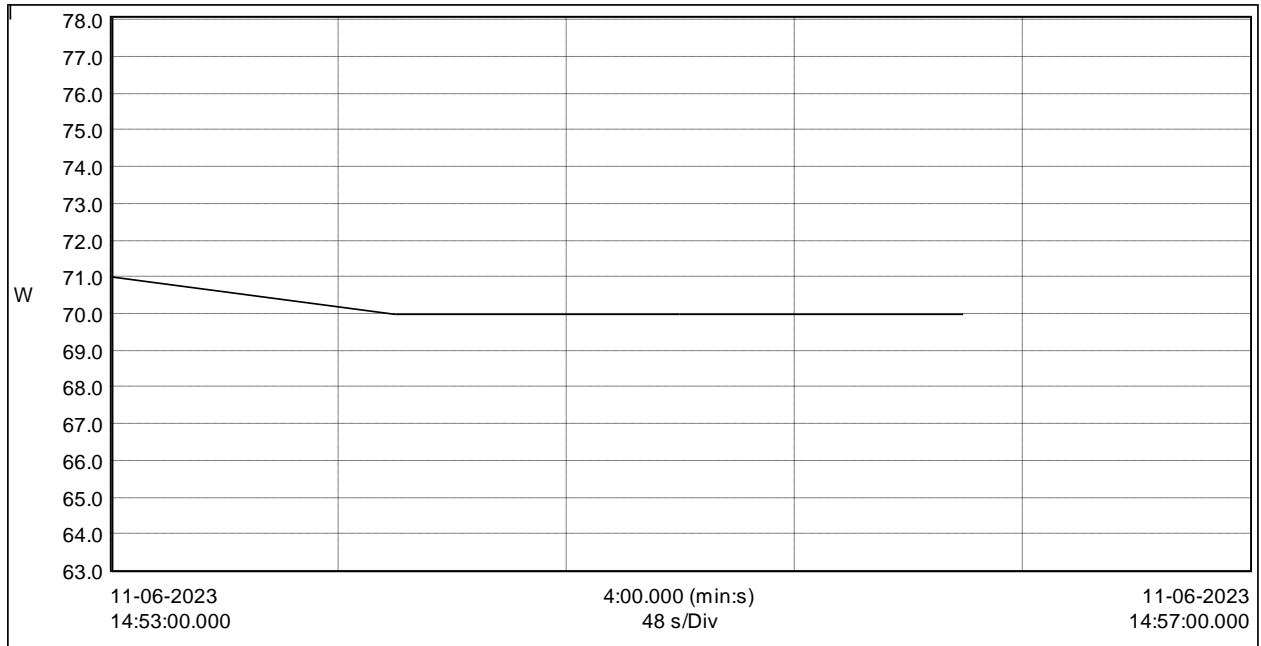
Name of Department	Ceiling Fan	Exhaust Fan	Wall Fan	Tube T8	LED Tube	LED Bulb 6 W	LED Bulb 12 W	LED Bulb 15 W	LED sq. 12 W	LED Bulb 500 W	LED strip	Computer	Printer	Xerox	Oven	Heater	Induction cooker	Tea Machine	Sound system	Inverter	Refrigerator	Water cooler	LED Screen	AC 3 star (Blue star 1.5 ton)	Projector	Pumps	
Preparation room	2				1				2																		
Chemistry lab-II																											
microbiology	1								4						1												
Preparation room	1		1		1							1			1							1					
First year M pharma	2						1																				
FY D pharma	4				1		3																				
Class room 2	6						2																				
Tutorial room	1						1																				
Class room 3	4						3																			1	
Class room 4	6						2																			1	
Gents toilet					1																						
Hostel (Total rooms 136)	158				176																						1(5 hp) 1(2 HP)
<b>Total</b>	<b>293</b>	<b>7</b>	<b>3</b>	<b>13</b>	<b>291</b>	<b>58</b>	<b>82</b>	<b>2</b>	<b>40</b>	<b>1</b>	<b>48</b>	<b>73</b>	<b>11</b>	<b>2</b>	<b>7</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>4</b>		

### 3.4.1 Purpose of the Performance Test

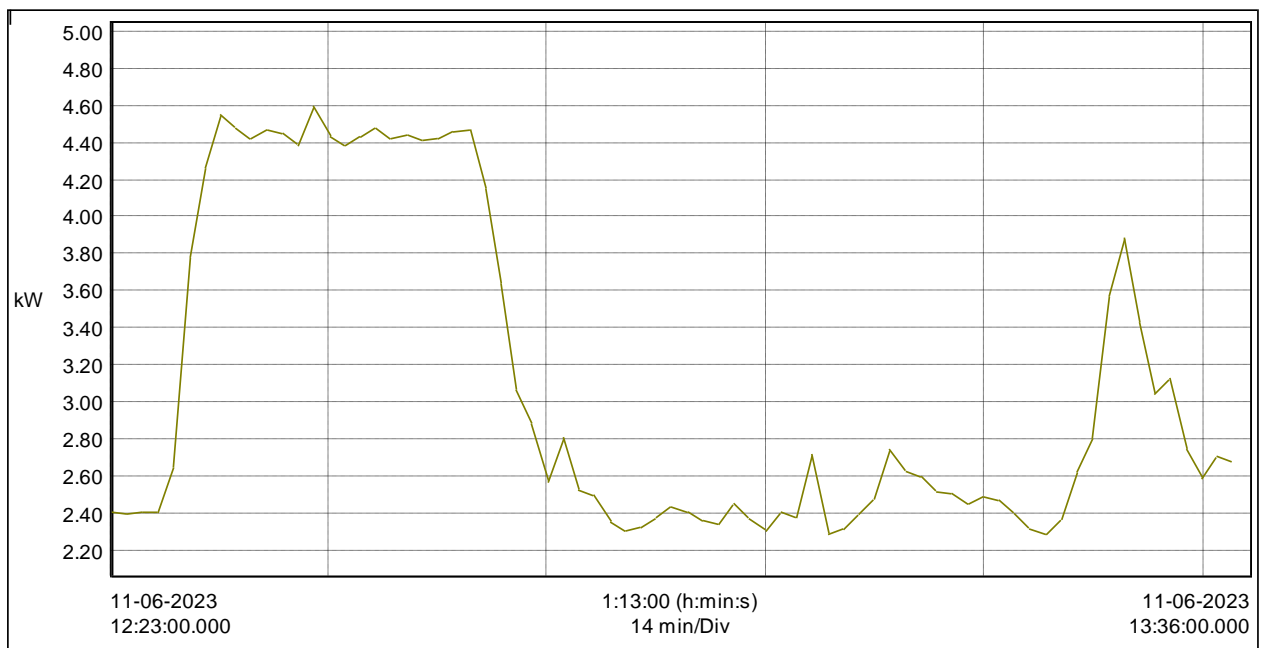
Most interior lighting requirements are for meeting average luminance on a horizontal plane, either throughout the interior, or in specific areas within the interior combined with general lighting of lower value. The purpose of performance test is to calculate the installed efficacy in terms of lux/watt/m<sup>2</sup> (existing or design) for general lighting installation. The calculated value can be compared with the norms for specific types of interior installations for assessing improvement options. The installed load efficacy of an existing (or design) lighting installation can be as follows



**Figure 12: Power consumption of tube light**



**Figure 13: Power consumption of fan**



**Figure 14: Power profile of mains connection**

**Table12: Main building: Calculation of ILER**

Title	Units	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
Name of Lab		Library Reading Room	Open space	Computer room	Book Stack	Pharmaceutical Lab1	Pharmacy Practice lab 3	First floor Class room 2	Computer Lab	Office	Second Floor Class room 2
Length of interior	Meter	19.5	12.68	6.3	9.6	10	10	14	7.7	6.1	11.9
Width of interior	Meter	3.7	10.06	3.5	7.8	7.3	7.3	8	9.2	4.57	7.8
Mounting height	Meter	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Floor area of interior	Meter <sup>2</sup>	72.15	127.56	22.05	74.88	73.00	73.00	112.00	70.84	27.88	92.82
Room Index	No	1.24	2.24	0.90	1.72	1.69	1.69	2.04	1.68	1.05	1.88
No of light fittings	No	80	37	8	25	3	2	6	2	8	2
Total circuit watts	Watt	1344	312	48	180	60	40	160	60	160	24
Watts per square meter	W/m <sup>2</sup>	18.6	2.4	2.2	2.4	0.8	0.5	1.4	0.8	5.7	0.3
Average maintained luminance	Lux	827.50	332.07	278.57	214.15	165.43	145.42	162.00	78.23	341.00	471.00
Actual lux per watt per meter square	Lux/W/m <sup>2</sup>	44.42	135.77	127.97	89.09	201.27	265.39	113.40	92.36	59.41	1821.59
Target lux/W/m <sup>2</sup> lux for type of the type of interior	Lux/W/m <sup>2</sup>	44.62	41.92	46.68	46.7	47.84	47.68	49.68	44.86	44.8	44.5
Installed load efficiency ratio	ILER	1.00	3.24	2.74	1.91	4.21	5.57	2.28	2.06	1.33	40.93

## 4. Energy Conservation Measures

### 1. Replacing the Conventional fan with energy efficient fan

#### Findings:

The conventional fan consumes average 65 W energy.

#### Recommendations:

Replace the conventional fan with energy efficient fan which consume less energy.

#### Benefits:

The cost benefit analysis of replacing energy efficient fan is given below.

**Table 13: Cost benefit analysis of replacing the energy efficient fan**

Description	Units	Value	Value	Value
<b>Present system</b>				
Type of fan	-	Ceiling fan	Wall fan	Exhaust fan
Number of existing fan	Nos	293	3	7
Wattage /fan	Watt	65	65	65
Usage of fan per day	Hrs	8	8	8
Working days per annum	Days	240	240	240
Annual Energy consumption	kWh	36566	374	874
<b>Proposed system</b>				
Recommended for replacement	%	50%	100%	100%
Recommended of EE fan	Nos	147	3	7
Wattage of EE fan	Watt	28	28	28
Annual Energy consumption	kWh	7876	161	376
Annual Power saving	kWh	10407	213	497
Energy tariff	₹	14.7	14.7	14.7
Monitory saving	₹	152988.19	3132.86	7310.02
Investment/fan	₹	3400	5440	3760
Total investment	₹	498100	16320	26320
Simple Payback period	Years	3.26	5.21	3.60
Reduction in CO <sub>2</sub> emissions	MT/year	8.53	0.17	0.41

## 2. Replacing the Tube with LED tube

### Findings:

Current existing tube light consumes 40 W and 28 W which is replaced by LED tube.

### Recommendations:

Replace the current tube light with LED tube which consume less energy.

### Benefits:

The cost benefit analysis of replacing current tube light with LED tube is given below.

**Table 14: Cost benefit analysis of replacing the current tube light with LED tube**

Description	Units	Value
<b>Present system</b>		
Type of tube	-	40 W
Number of existing tube lights(T12/T8)	Nos	13
wattage /tube	Watt	40
Total wattage	Watt	520
Daily usage	Hrs/day	8
Annual working days	days/yr	240
Annual Energy consumption	kWh	998
<b>Proposed system</b>		
Recommended for replacement	%	100%
Recommended of LED tube light	Nos	13
Wattage of LED tube light	Watt	20
Annual Energy consumption	kWh	499
Annual Power saving	kWh	499
Energy tariff	₹	14.7
Monitory saving	₹	7338.24
Investment/LED tube light	₹	225
Total investment	₹	2925.00
Simple Payback period	Years	0.40
Reduction in CO <sub>2</sub> emissions	MT/year	0.41

### 3. Monetary saving by proper utilization of potable water

Monetary saving can be achieved through proper utilization of potable water.

**Table 15: Monetary saving by proper utilization of potable water**

Description	Unit	Hostel value	College
Total Population (Approx.)	Nos.	225	553
Daily water requirement per capita (Through Awareness)	lit	135	45
<b>Existing System</b>			
Number of pump at stage I	hp	5	5
<b>Measured Power Consumption</b>			
Pump Stage I- Pump	hp/kW	5/3.7	5/3.7
Measured water discharge by filter house pump	m <sup>3</sup> /hr.	14.4	14.4
Working hour of pump	Hr	3.5	3.5
Theoretical water discharge	litrs	50400	50400
Quantity of water supplied to hostel per day	litrs	45000	50400
Actual water distributed per capita	lit.	200.00	91.14
Excess water per capita	lit.	65.00	46.14
Water saved per day @ 135	lit.	14625.00	25515.00
Energy saving by distributing 135 liters water/day	hrs.	1.14	1.77
Energy saving annually	kWh	1661	2587
Energy Tariff	₹/kWh	10	10
Monetary saving annually	₹	16607.50	25869.38
Reduction in CO <sub>2</sub> emissions	MT/Year	1.36	2.12

### 5. Design Solar PV Grid Rooftop System

**Table 16: Solar PV Grid Rooftop System**

Name of Building	Annual Electricity Consumption kWh	Daily Electricity Consumption kWh	Unit Charge	Solar PV System Required- kW <sub>p</sub>	Annual Electricity Generated by Solar kWh	Monetary Saving ₹	Investment @ 60000/kw <sub>p</sub> ₹	Simple Payback Years
College building	62161	170.30	10.61	57.00	55575	589651	3420000	5.80

## 6. General Recommendations: -

- Establish Energy conservation cell.
- Procure only B.E.E star labeled appliances ([www.beestar.com](http://www.beestar.com))
- Don't use discarded old conventional appliances at other places.
- Use occupancy sensor at appropriate place.
- Display energy conservation poster at every building.
- Clean window glass regularly.
- Steps to follow before procurement of renewable energy system-
  1. Conservation of Energy
  2. Replacement of all energy intensive appliances with energy efficient appliances.
  3. Finally install the preferred renewable energy system



## 7. Conclusion

Vasantidevi Patil Institute of Pharmacy, Kodoli has scope to install renewable energy system. The energy intensive appliances need to be replaced with energy efficient appliances.

The annual energy consumption of Vasantidevi Patil Institute of Pharmacy, Kodoli is 66719 kWh. The total annual electricity bill is ₹ 741470. The outcome of our proposed system will lead to an annual saving of ₹ 170769. It will also lead to a decrease of 9.53 MT in emission of CO<sub>2</sub> per year.

Solar PV on Grid Rooftop System should be installed on college building need to be repair. **As per BEE, New Delhi these buildings will be considered nearly Zero Energy Buildings (nZEB).** The installation of Solar PV on Grid Rooftop System will further increase the total annual savings by ₹ 589651.