“ENERGY AUDIT”
Of
Charotar University of Science & Technology, Changa

BY
M &V PATEL DEPARTMENT OF ELECTRICAL ENGINEERING

DEC-2019

INDEX

EXECUTIVE SUMMARY

- University working hours are from 09:00 am to 4:30 pm, which are ***peak hours***. But from the bill analysis Peak hour consumption has been found more. It means in the morning 6 am to 10:30 am and evening 6 am to 11 pm load is running. Savings in the ToU charges can be achieved by reducing the peak hour consumption. From the analysis it has been observed that ***ToU*** Units and charges are increased after April'2015. So it is strongly recommended to reduce the consumption of unnecessary load. By reduction at least 10% of load in peak hours which can give savings up to 1200 to 1500 Rs/Bill.

- It has been found that in the corridor and bathrooms unnecessarily lights are running during 9:30 am to 7:00 pm. In the corridor area alternate arrangement of lightings is possible, because natural light is already available. And in the bathroom areas placement of motion sensors are possible. Recently occupancy sensors are available in corridor which is very good steps in the direction of energy conservation.

- In the class room and cabins practice should be followed by students or faculties or peon to switch off the light and fans.

- It has been recommended to paste posters of ***"SAVE ENERGY"*** or ***"ENERGY IS LIFE"*** or ***"SAVE WATER"*** at the switchboards in the class room, faculty's cabins and respective locations for awareness. So people can remember to switch off lights. And this already done in most of the buildings.

- It has been observed during walk through energy audit that in the computer laboratories of different the switches of computers are keep on, which consume unnecessary power. It has been recommended to shut down main switch of laboratories or main switch of computers, ACs and lights after completion of laboratory.

- It is strongly recommend do not increase the load without survey as actual KVA consumption is already near to the contract demand.

- It has been observed in the night that excessive lights are running throughout the campus. The lights can be reducing in some locations like corridor area, bathroom area and in some hall. It has been recommended to install 9 W LED by replacing 50 W FTL. University already replaces old lighting argument in some area and this very good step.

- It has been observed that cabin and room lights, fans and ACs are unnecessarily running during the absence of person. Awareness is required to switch off the switches. Personally as team leader advise to make monitoring team for the same and put penalty rules so everyone should learn energy management value.

- It is observed that in cabins and Laboratories computers are running ideally when not in used or main switch is not closed. It is required to close main switch for zero consumption. It has been strongly suggested to close main switch of each computers after work is complete.

- With the help of efficiency fans of 50 W and 20 W LED light it is possible to reduce contract demand up to 49 KVA approx. So it will help full to avoid from excess KVA consumption above 85% contract demand.

- For an energy audit following load has been considered which is regularly used on daily basis and there are scopes of energy saving.

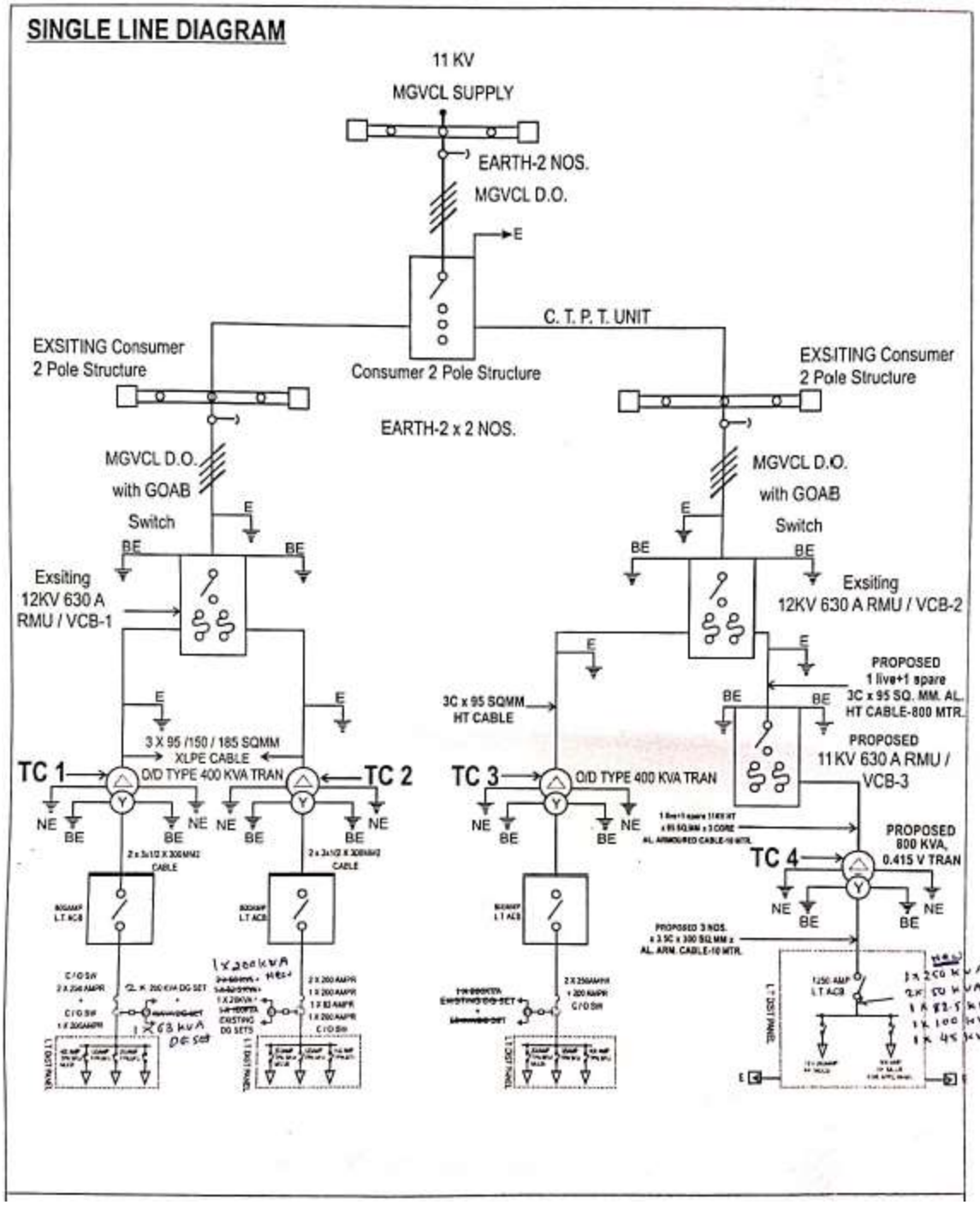

Figure 1.1 Single Line Diagram of feeder distribution in CHARUSAT University.

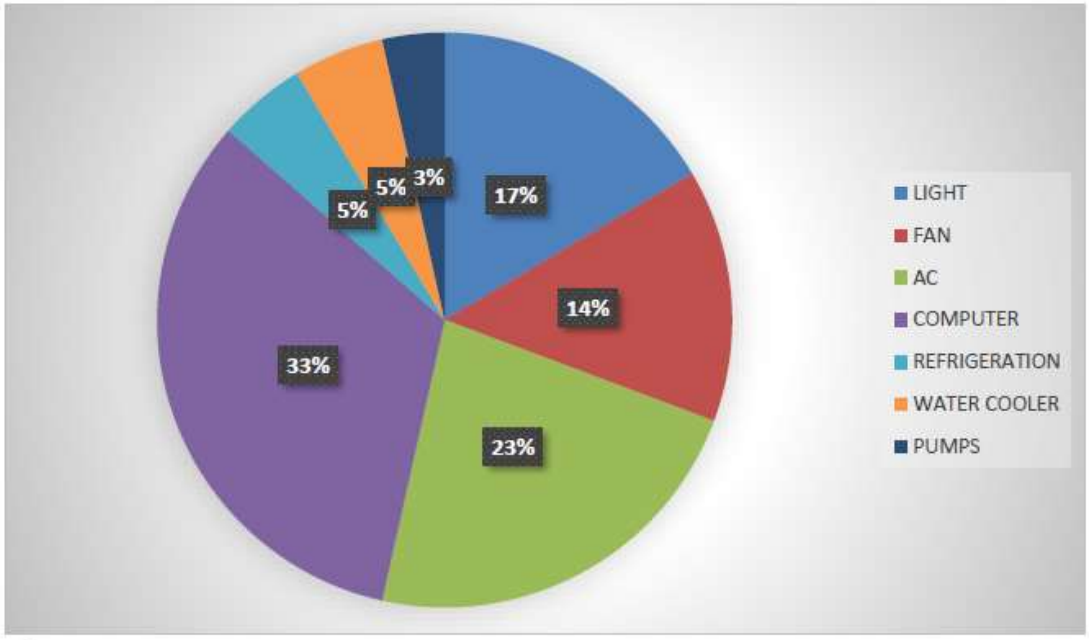

Figure 2 Percentage wise load distribution in CHARUSAT University.

Percentage wise load distribution

Above data shows the load consumption percentage of Major loads in CHARUSAT University.

- Computers consume the highest loads which is around 33% of total load.
- ACs consume around 23 % of total loads.
- Lighting system consume around 17% of total load.
- Fans consume 14% of total load.
- Pumps, Refrigeration and water coolers consume equally around 3 % of total load.

Above data shows us many ways of energy savings, like closing computer when not in use, Using timer option In ACs and such options.

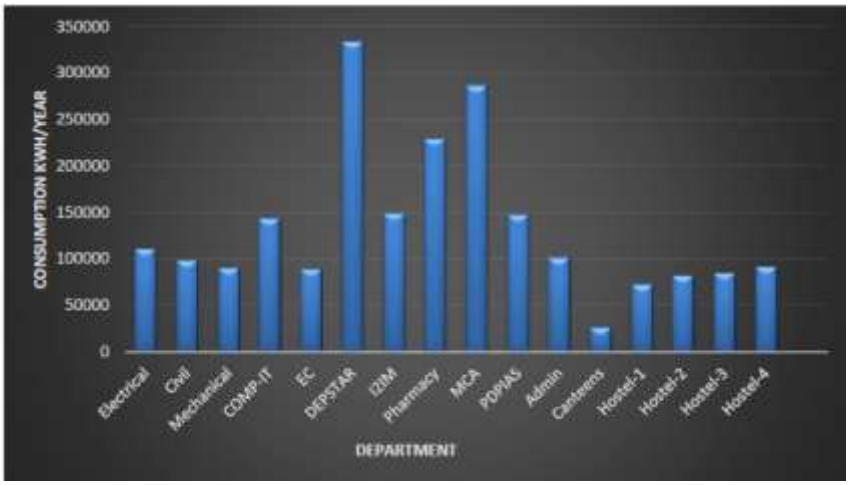

Figure 3 Average load consumption building wise

CHAPTER 1 GENERAL INFORMATION

➢ NEED FOR ENERGY CONSERVATION:

India is the 6th largest consumer of energy in World. Rapid industrialization of the country and prevailing boom in the economy has resulted in the power demand outstripping the current total generation capacity by 10%. To overcome this shortage and for meeting the ever rising electricity demand in the coming years, the nation has proposed capacity expansion by 39920 MW and 60896MW in the 10th and 11th Five Year Plans respectively. However these capacity additions will come at a mammoth cost of nearly Rs. 900000 cr. Hence the message on the wall is clear - there is an urgent need for energy efficiency practices and energy conservation measures for a sustainable development.

Future projections, assuming a business-as-usual scenario under a GDP growth rate of 5%, show that the commercial energy demand for India for the year 2009-10 is projected to be 600 Mote (million tones of oil equivalent) compared to the 1990 consumption level of 200 Mtoe. Conservation of energy assumes great significance in lieu of economic constraints prevailing in our country. Realizing the importance of energy conservation at the national level the Indian government has enacted the energy Conservation Act 2001. The primary objective of the energy Conservation Act, 2001, is to reduce energy intensity (energy per unit GDP) in the Indian economy

Energy Conservation measures leads to reduced energy inputs of the same output and certainly do not mean switching off the loads and reducing the output or quality or comfort. The main objective is to manage the energy use efficiently for an optimum utilization with reduced specific energy consumption for a maximum profitability without the environmental degradation.

➢ WHAT IS ENERGY AUDIT?

Energy Audit is the key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy management. It attempts to balance the total energy inputs with its use, and serves to identify all the streams in a facility. It attempts to balance the total energy inputs with its use, and serves to identify the entire stream in a facility. It quantifies energy usage according to its discrete functions. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy management program.

As per the Energy Conservation Act, 2001, Energy Audit is defined as “the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption”.

➢ NEED FOR AUDIT:

In any industry, the three top operating expenses are often found to be energy (both electrical and thermal), labor and materials. If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes a strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists.

The Energy Audit gives a positive orientation to the energy cost reduction, preventive maintenance and quality control programs which are vital for production and utility activities. Such an audit program helps to keep focus on variation which occurs in the energy costs, availability and reliability to supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc.

In general, energy Audit is the translation of conservation ideas into realities by lending technically feasible solutions with economic and other organizational consideration within a specified time frame.

The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a "benchmark" (Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

- **ENERGY AUDIT METHODOLOGY:**

Energy Audit Study was divided in following four steps

1. Historical Data Analysis:

The historical data collection and analysis involves establishment of energy consumption pattern to locate base line of energy consumption and its variation with change in production volumes. This step involves finding out existing Avg. Specific Energy Consumption.

2. Actual Data Analysis:

This step involves actual site measurement and field trails. Tally of the energy consumption pattern against actual measurements through ABC analysis. Electrical Parameters for all electrical loads are measured with electrical online load Manger. The parameters measured are actual kW, actual Pf, actual Ampere and Voltage. It also involves Input to output analysis to establish actual operating equipment efficiency and finding out loses in the system.

Efficiency of Equipment (%) = (Use of Output/ Input Electrical Energy) X 100
Loses in the system = Input Electrical System - Useful Output

3. Evaluation of Energy Conservation Opportunities:

This step involves evaluation of energy conservation opportunity. It gives potential of energy saving and investment required to get expected modification with payback period. All recommendations given for reducing loses in the system with its cost benefit analysis.

4. Monitoring and Control:

Energy accounting followed by energy monitoring and control is the first step of serious Energy Management Program. Due to the absence of electricity sub metering, many organizations still have only their electricity bills and captive power generation log books as their only information on electricity consumption. However with increasing energy prices, many organizations incorporated sub-metering system in their plants. Sub metering is essential for monitoring, establishing energy consumption patter, detailed engineering and energy saving after implementation of energy conservation projects.

INSTRUMENTS USED FOR THE DATA COLLECTION:

The instruments used by the audit team have been depicted below in the table.

Table – 1.1 List of Instruments used for Energy Audit

Sr. No.	Instrument Name	Specification
1	Clamp-on Power Meter	0 - 1200 kW
		0 - 2000 A, Current, AC / DC
2	Lux Meter	0 - 50,000 lux level
		Non-Contact Type
3	Digital Thermo Anemometer	0 - 45 m / sec. ± 3%
4	Relative Humidity and Temperature Indicator	RH – 10% to 95%
		Temp. – 0 – 100 °C
		Handheld unit

CHAPTER 2 BILL ANALYSIS

CHARUSAT University has a contracted demand of 760 KVA. For the critical bill analysis month from January to December has been considered. Bill analysis has been carried out for the period of 4 years from 2016 to 2019 and average consumption in Kwh, power factor and Unit rate has been analyzed in detail. The detail bill analysis has been represented in the table for the five year from 2016-2019

- **ENERGY CONSUMPTION TRENDS FROM 2016 TO 2019.**

UNIT CONSUMPTION

Table 2.1 Unit Consumption of last 4 years

year	Total unit consumed during month (KWH)
2016	1439796
2017	1617212
2018	1660193
2019	1719656

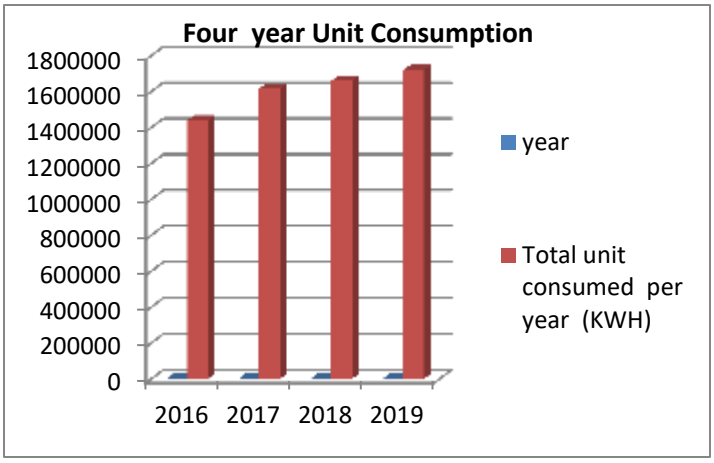

Figure 2.1 Unit Consumption of year 2016-19

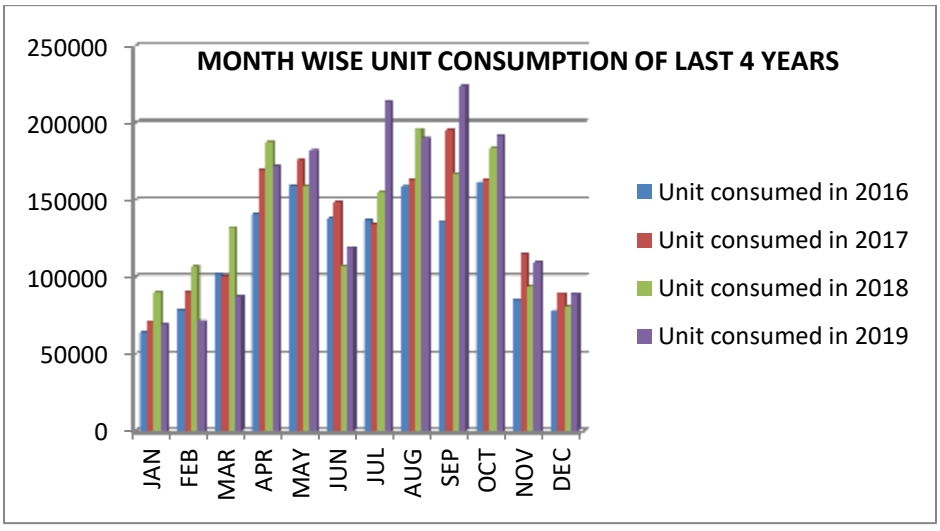

Figure 2.2 Graph shows month wise unit consumption of Charusat University of last four years (2016-19)

Figure 2.1 and 2.2 shows the yearly and monthly unit consumption. It has been found that in the month of May, July, September and October unit consumption has been increased. It has been suggested to take care in this period that should not cross the contract demand of that year in KVA.

1. POWER FACTOR

Power factor is maintained near to 0.99 which is good to avoid penalty due to lower power factor. Following graphs the analyzed value of power factor for the last 4 years. From the year wise and month wise graphs of power factor is can be better understand the maintenance of power factor. And also rebates in the bill had been achieved by maintaining the power factor.

Table 2.2 & 2.3 shows the power factor values of power factor yearly and monthly basis.

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	minimum	maximum	average
PF in 2016	0.911	0.967	0.992	0.997	0.996	0.993	0.995	0.995	0.99	0.994	0.992	0.991	0.911	0.997	0.9844167
PF in 2017	0.989	0.99	0.989	0.994	0.992	0.99	0.991	0.994	0.994	0.991	0.975	0.976	0.975	0.994	0.98875
PF in 2018	0.969	0.985	0.991	0.997	0.993	0.668	1	0.99	0.991	0.993	0.981	0.972	0.668	1	0.9608333
PF in 2019	0.97	0.975	0.988	0.99	0.979	0.981	0.998	0.992	0.989	0.987	0.979	0.982	0.97	0.998	0.9841667

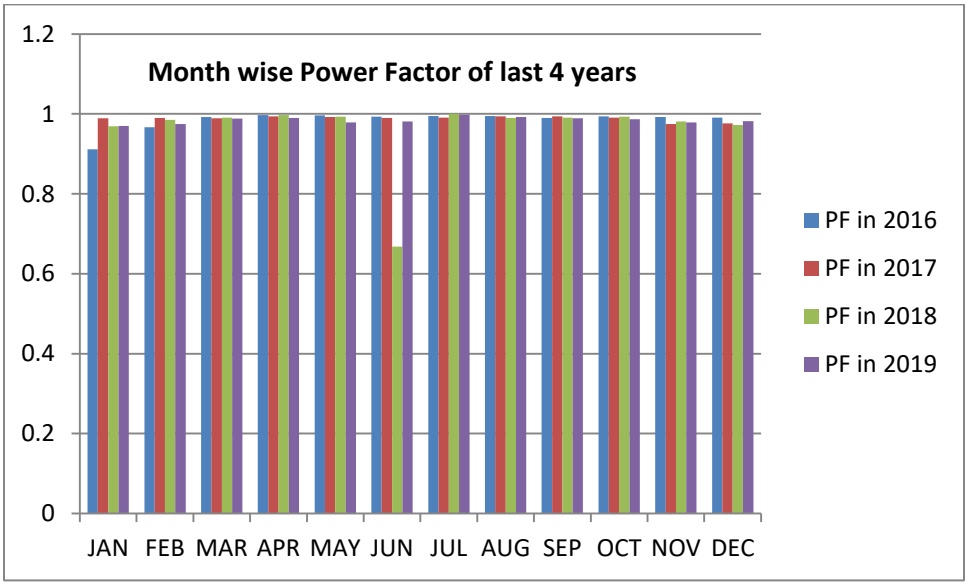

Figure 2.3 Month wise Power Factor of last 4 years

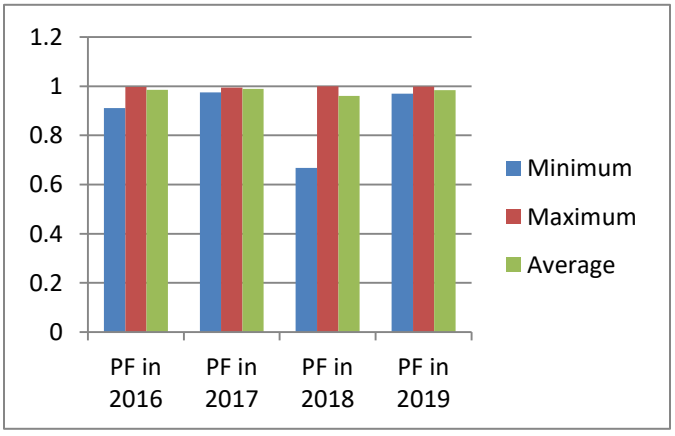

Figure 2.4 Year wise Power Factor of last 4 years

Table 2.3

year	Minimum	Maximum	Average
PF in 2016	0.911	0.997	0.9844
PF in 2017	0.975	0.994	0.9888
PF in 2018	0.668	1	0.9608
PF in 2019	0.97	0.998	0.9842

2. ACTUAL KAV DEMAND

Table 2.5 shows an actual KVA demand of last 4 years. Minimum KVA demand of 195 KVA in January ’2017 and maximum KVA demand of 919 KVA in September’2019 have been recorded. Figure 2.5 shows yearly and monthly basis actual KVA consumption. If actual KVA will more than 85% contract demand more demand charges we have to pay.

Table 2.5

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	minimum	maximum	average
Actual Demand in 2016	240	284	447	512	661	530	614	624	656	642	540	213	213	661	496.9167
Actual Demand in 2017	195	333	418	687	653	588	591	662	815	728	437	253	195	815	530
Actual Demand in 2018	284	355	528	691	596	344	751	748	759	774	474	265	265	774	547.4167
Actual Demand in 2019	205	234	395	682	696	372	886	753	919	876	519	276	205	919	567.75

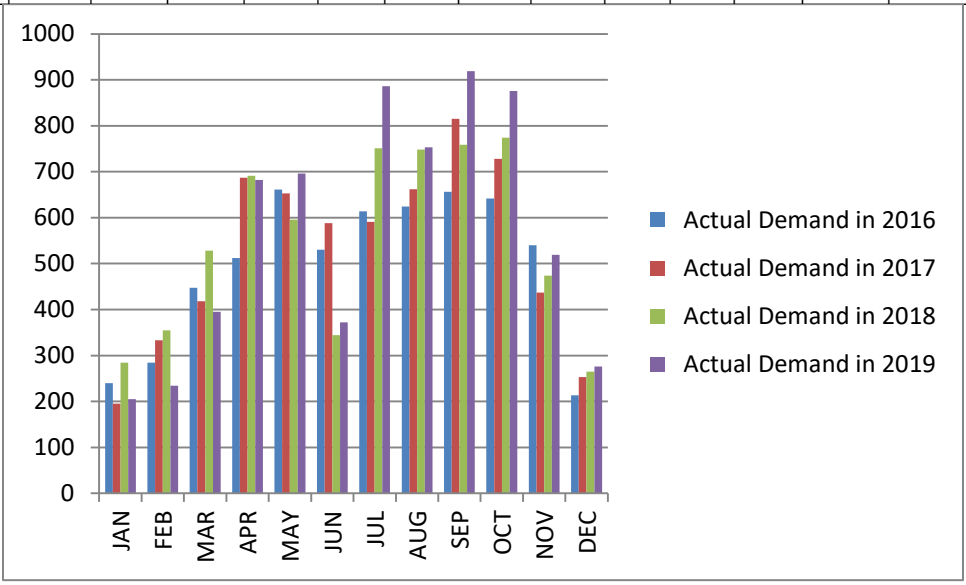

Figure 2.5 Month wise actual KVA demand of last 4 years

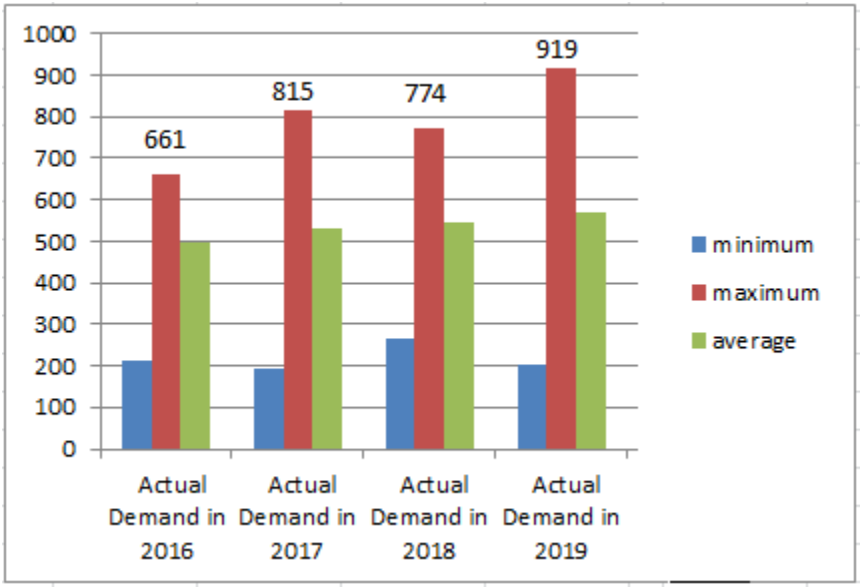

Figure 2.6 year wise actual KVA demand of last 4 years

3. NET BILL AMOUNT

The following graphs show an overview of net payment. From the graph it can be understand that the amount to be paid was gradually increased after 2016. And that is due to increase in the consumption, demand charges and electricity duty charges too.

Table 2.6

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Bill Amount in 2016	530965.56	621182.61	777551.96	1104752.94	1140244.54	1048514.59	1093435.28	1276200.56	1133071.60	1313482.04	724505.59	615812.33
Bill Amount in 2017	570969.60	705929.43	849637.53	1379482.50	1291430.42	1207904.38	1105651.76	1308008.21	1636406.93	1349416.63	951276.28	125876.90
Bill Amount in 2018	585778.93	773897.39	1015719.30	1421320.77	1009186.84	1059276.92	1235862.68	1510964.39	1322682.55	1442536.12	774655.08	673958.04
Bill Amount in 2019	596580.26	634156.80	736783.96	1295372.55	1502474.74	980758.09	1766412.83	1589195.23	1915886.09	1650761.38	939357.99	785366.09

Following Table 2.6 and figures 2.7 gives an idea about average, minimum and maximum amount paid and variation in amount year and month wise.

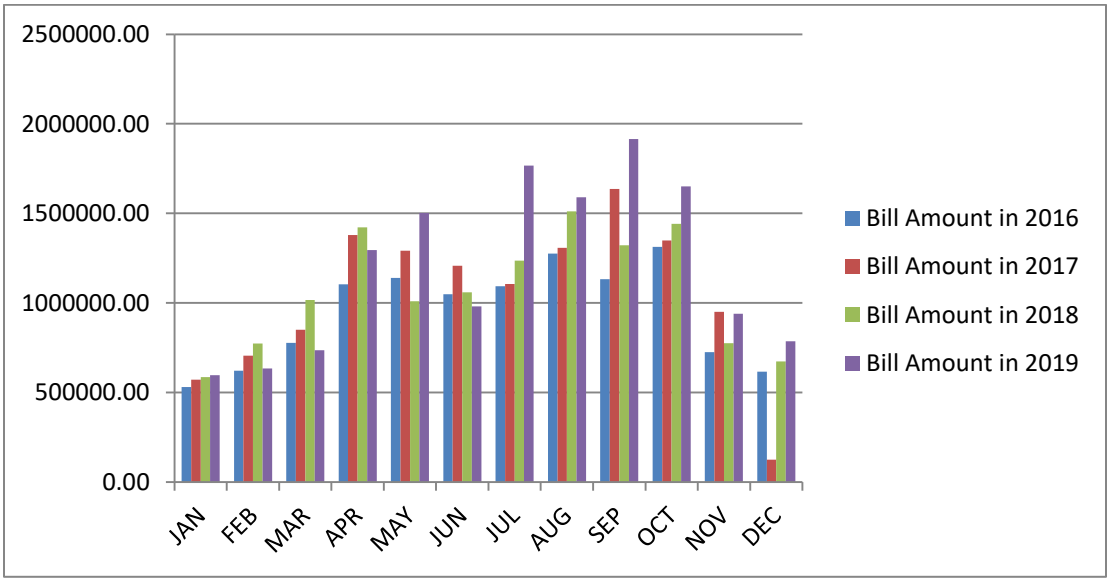

Figure 2.7 Net Bill Paid of last 4 years

- **ENERGY CONSUMPTION TRENDS FROM JANUARY 2016 TO DECEMBER 2019**

Detailed analysis has been presented in the table year wise for the period of 2016 to 2019.

- In 2016 bill data we can identify contract demand is 550 KVA for whole year but in month of May, July, August, September and October demand exceed than contract. It shows by yellow mark in table 2.8 and in month of January, February march and December our actual demand is less than contracted demand. Same way we can identify this kind of data in 2017, 2018, 2019.
- In 2017 our contracted demand was increased in March 2017, 700KVA for March to December 2017. In May 2019 our contracted demand increased 60 KVA so 760 KVA for May to December 2019.

Table 2.7 & 2.8 overall bill analysis for 2016

Table 2.7

Sr.No	Month	JAN'16	FEB'16	MAR'16	APR'16	MAY'16	JUN'16	JUL'16	AUG'16	SEP'16	OCT'16	NOV'16	DEC'16
1	Tarriff	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1
2	Contract Demand (KVA)	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0
3	85 % Contract Demand (KVA)	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0	468.0
4	Actual Demand (KVA)	240.0	284.0	447.0	512.0	661.0	530.0	614.0	624.0	656.0	642.0	540.0	213.0
5	Billing Demand (KVA)	468.0	468.0	468.0	512.0	661.0	530.0	614.0	624.0	656.0	642.0	540.0	468.0
6	Excess Contract Demand (KVA)	0.0	0.0	0.0	0.0	111.0	0.0	64.0	74.0	106.0	92.0	0.0	0.0
7	KVAH	70560.0	81520.0	102728.0	141080.0	159944.0	138888.0	137888.0	159364.0	137664.0	161888.0	86148.0	78476.0
8	KVARH	27680.0	16960.0	8904.0	8024.0	11256.0	13424.0	11520.0	11912.0	16204.0	14064.0	8320.0	8596.0
9	PF	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	Kwh Consumption	64344.0	78880.0	101976.0	140696.0	159416.0	138032.0	137232.0	158584.0	136308.0	161044.0	85476.0	77808.0
11	Units Consumption During Night Hours	18416.0	21032.0	24136.0	30072.0	32616.0	30808.0	27528.0	29420.0	27432.0	29892.0	21584.0	22548.0
12	Time of Use Units	21646.0	26896.0	32328.0	43600.0	49520.0	42776.0	43288.0	49164.0	43020.0	50084.0	27040.0	26060.0
13	Demand Charges (Rs.)	60840.0	60840.0	60840.0	67880.0	149605.0	82800.0	123520.0	12970.0	146830.0	13960.0	85400.0	70200.0
14	Energy Charges (Rs.)	279896.0	343128.0	443595.6	640166.8	656500.8	567411.2	565363.2	654284.8	561520.8	664428.0	350365.6	302212.8
15	Fuel Surcharges (Rs.)	91368.5	106488.0	137367.6	189939.6	229559.0	198766.1	177614.1	244219.4	209914.3	262501.7	147873.5	134607.8
16	PF Adjustment Charges (Rs.)	0.0	-2916.6	-9315.5	-15043.9	-15099.5	-12199.3	-12720.7	-14721.4	-11230.4	-14617.4	-7357.7	-6195.4
17	Time of Use Charge (Rs.)	9741.6	12103.2	14547.6	37060.0	42092.0	36359.6	36794.8	41789.4	36567.0	42571.4	22984.0	11727.0
18	Electricity Duty (Rs.)	88369.3	103928.5	129467.1	184000.5	212531.5	174627.5	182114.3	10928.4	188720.3	218788.7	119853.0	102510.5
19	Meter Charges (Rs.)	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0
20	Total Bill (Rs.)	530965.8	624321.1	777552.4	1104753.0	1275938.8	1048515.1	1093435.7	1266320.6	1133072.0	1313482.4	719868.5	615812.7
21	Actual Unit Rate (Rs.)	**8.3**	**7.9**	**7.6**	**7.9**	**8.0**	**7.6**	**8.0**	**8.0**	**8.3**	**8.2**	**8.4**	**7.9**
22	Total Bill-Demand Charges (Rs.)	470125.8	563481.1	716712.4	1036873.0	1126333.8	965715.1	969915.7	1253350.6	986242.0	1299522.4	634468.5	545612.7
23	Units Rate for Saving Calculation	**7.3**	**7.1**	**7.0**	**7.4**	**7.1**	**7.0**	**7.1**	**7.9**	**7.2**	**8.1**	**7.4**	**7.0**
24	% Load Factor	98.0	95.7	76.6	91.8	80.7	87.4	74.9	85.1	70.0	84.1	53.2	122.8
25	% TOU Consumption	33.6	34.1	31.7	31.0	31.1	31.0	31.5	31.0	31.6	31.1	31.6	33.5
26	% Night Consumption	28.6	26.7	23.7	21.4	20.5	22.3	20.1	18.6	20.1	18.6	25.3	29.0
27	TOU Unit Rates	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.5

Table 2.8

Bill Detail for year 2016

Sr. No.	Date of Bill	Total unit consumed during the Month	MD					KVAH	KVARH	PF	AMOUNT
			Contract MD	85% Cont'c Demand	Actual Demand	Billing Demand	Excess Cont. DMD				
1	19.01.2016	64344	550	468	240	468	0	70560	27680	0.911	530965.56
2	20.02.2016	78880	550	468	284	468	0	81520	16960	0.967	621182.61
3	19.03.2016	101976	550	468	447	468	0	102728	8904	0.992	777551.96
4	19.04.2016	140696	550	468	512	512	0	141080	8024	0.997	1104752.94
5	20.05.2016	159416	550	468	661	661	111	159944	11256	0.996	1140244.54
6	20.06.2016	138032	550	468	530	530	0	138888	13424	0.993	1048514.59
7	20.07.2016	137232	550	468	614	614	64	137880	11520	0.995	1093435.28
8	20.08.2016	158584	550	468	624	624	74	159364	11912	0.995	1276200.56
9	19.09.2016	136308	550	468	656	656	106	137664	16204	0.99	1133071.60
10	19.10.2016	161044	550	468	642	642	92	161888	14064	0.994	1313482.04
11	20.11.2016	85476	550	468	540	540	0	86148	8320	0.992	724505.59
12	19.12.2016	77808	550	468	213	468	0	78476	8596	0.991	615812.33
Total Unit		**1439796**								**Total Amount**	**11379719.60**

Table 2.9 & 2.10 overall bill analysis for 2017

Table 2.9

SR.NO	MONTH	JAN'17	FEB'17	MAR'17	APR'17	MAY'17	JUN'17	JUL'17	AUG'17	SEP'17	OCT'17	NOV'17	DEC'17
1	Tarriff	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1
2	Contract Demand (KVA)	550.00	550.00	700.00	700.00	700.00	700.00	700.00	700.00	700.00	700.00	700.00	700.00
3	85 % Contract Demand (KVA)	468.00	468.00	595.00	595.00	595.00	595.00	595.00	595.00	595.00	595.00	595.00	595.00
4	Actual Demand (KVA)	195.00	333.00	418.00	687.00	653.00	588.00	591.00	662.00	815.00	728.00	437.00	253.00
5	Billing Demand (KVA)	468.00	468.00	595.00	687.00	653.00	595.00	595.00	662.00	815.00	728.00	595.00	595.00
6	Excess Contract Demand (KVA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	115.00	28.00	0.00	0.00
7	KVAH	71936.00	90972.00	101568.00	170604.00	176964.00	150264.00	135984.00	164156.00	196396.00	164896.00	117872.00	91532.00
8	KVARH	8620.00	10792.00	12508.00	78009.50	19460.00	19016.00	16236.00	14972.00	17820.00	18520.00	21828.00	18492.00
9	PF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98
10	Kwh Consumption	71200.00	90128.00	100516.00	169652.00	175692.00	148824.00	134776.00	163192.00	195376.00	163504.00	114952.00	89400.00
11	Units Consumption During Night Hours	21328.00	23532.00	26004.00	33843.00	35024.00	33256.00	29072.00	33132.00	38896.00	34728.00	30720.00	26212.00
12	Time of Use Units	24280.00	30016.00	31852.00	50724.00	52712.00	45712.00	41636.00	50724.00	59788.00	50264.00	36716.00	29448.00
13	Demand Charges (Rs.)	70200.00	70200.00	105409.67	123620.00	114780.00	99700.00	99700.00	117120.00	63825.00	142540.00	99700.00	99700.00
14	Energy Charges (Rs.)	276268.80	351099.20	408188.80	698999.20	723896.80	611758.40	554430.40	672153.60	805020.82	672825.60	470510.40	364995.20
15	Fuel Surcharges (Rs.)	123176.00	158625.28	176908.16	298587.52	316245.60	267883.20	242596.80	279058.32	334092.96	279591.84	196567.92	152874.00
16	PF Adjustment Charges (Rs.)	-5387.24	-7021.98	-7959.68	-15377.98	-15201.83	-12235.17	-11365.82	-14787.38	-17710.46	-13792.92	-5881.38	-4744.94
17	Time of Use Charge (Rs.)	10926.00	13507.20	24859.80	43115.40	44805.20	38855.20	35390.60	50724.00	50819.80	42724.40	31208.60	25030.80
18	Electricity Duty (Rs.)	95036.71	117281.94	141481.35	229788.83	236905.15	201192.33	184150.40	219331.99	272609.62	224777.78	158421.11	127571.01
19	Meter Charges (Rs.)	750.00	750.00	750.00	750.00	750.00	750.00	750.00	750.00	750.00	750.00	750.00	750.00
20	Total Bill (Rs.)	570969.60	705929.43	849637.53	1379482.50	1291430.42	1207904.38	1105651.76	1308008.21	1636406.93	1349416.63	951276.28	125876.90
21	Actual Unit Rate (Rs.)	8.02	7.83	8.45	8.13	7.35	8.12	8.20	8.02	8.38	8.25	8.28	1.41
22	Total Bill-Demand Charges (Rs.)	500769.60	635729.43	744227.86	1255862.50	1176650.42	1108204.38	1005951.76	1190888.21	1572581.93	1206876.63	851576.28	26176.90
23	Units Rate for Saving Calculation	7.03	7.05	7.40	7.40	6.70	7.45	7.46	7.30	8.05	7.38	7.41	0.29
24	% Load Factor	122.97	91.06	81.00	82.78	90.33	85.18	76.70	82.66	80.33	75.50	89.91	120.60
25	% TOU Consumption	34.10	33.30	31.69	29.90	30.00	30.72	30.89	31.08	30.60	30.74	31.94	32.94
26	% Night Consumption	29.96	26.11	25.87	19.95	19.93	22.35	21.57	20.30	19.91	21.24	26.72	29.32
27	TOU Unit Rates	0.45	0.45	0.78	0.85	0.85	0.85	0.85	1.00	0.85	0.85	0.85	0.85

Table 2.10

Bill Detail for year 2017

Sr. No.	Date of Bill	Total unit consumed during the Month	MD					KVAH	KVARH	PF	AMOUNT
			Contract MD	85% Cont'c Demand	Actual Demand	Billing Demand	Excess Cont. DMD				
1	19.01.2017	71200	550	468	195	468	0	71936	8620	0.989	570969.60
2	20.02.2017	90128	550	468	333	468	0	90972	10792	0.99	705929.43
3	22.03.2017	100516	700	595	418	595	0	101568	12508	0.989	849637.53
4	19.04.2017	169652	700	595	687	687	0	170604	16076	0.994	1379482.50
5	19.05.2017	175692	700	595	653	653	0	176964	19460	0.992	1291430.42
6	19.06.2017	148824	700	595	588	595	0	150264	19016	0.99	1207904.38
7	19.07.2017	134776	700	595	591	595	0	135984	16236	0.991	1105651.76
8	19.08.2017	163192	700	595	662	662	0	164156	14972	0.994	1308008.21
9	19.09.2017	195376	700	595	815	815	115	196396	17820	0.994	1636406.93
10	17.10.2017	163504	700	595	728	728	28	164896	18520	0.991	1349416.63
11	19.11.2017	114952	700	595	437	595	0	117872	21828	0.975	951276.28
12	20.12.2017	89400	700	595	253	595	0	91532	18492	0.976	125876.90
Total Unit		1617212								Total Amount	12230236.77

Table 2.10

Table 2.11 & 2.12 overall bill analysis for 2018

Table 2.11

Sr.No	Month	JAN'18	FEB'18	MAR'18	APR'18	MAY'18	JUN'18	JUL'18	AUG'18	SEP'18	OCT'18	NOV'18	DEC'18	MIN	MAX
1	Tariff	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1
2	Contract Demand (KVA)	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0	700.0
3	85 % Contract Demand (KVA)	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0	595.0
4	Actual Demand (KVA)	284.0	355.0	528.0	691.0	596.0	344.0	751.0	748.0	759.0	774.0	474.0	265.0	265.0	774.0
5	Billing Demand (KVA)	595.0	595.0	595.0	691.0	596.0	595.0	751.0	748.0	759.0	774.0	595.0	595.0	595.0	774.0
6	Excess Contract Demand (KVA)	0.0	0.0	0.0	0.0	0.0	0.0	51.0	48.0	59.0	74.0	0.0	0.0	0.0	74.0
7	KVAH	93168.0	108216.0	133436.0	188254.0	159327.0	159972.0	102628.0	198002.0	168614.0	185104.0	95608.0	83028.0	83028.0	198002.0
8	KVARH	21028.0	16896.0	15064.0	9123.0	4806.0	5000.0	4230.0	23897.0	17600.0	18980.0	14906.0	15282.0	4230.0	23897.0
9	PF	0.969	0.985	0.991	0.997	0.993	0.668	1.000	0.990	0.991	0.993	0.981	0.977	0.668	1.000
10	Kwh Consumption	90312.0	106600.0	132344.0	187836.0	159146.0	106946.0	155259.0	196140.0	167228.0	183824.0	93792.0	80763.0	80763.0	196140.0
11	Units Consumption During Night Hours	25248.0	27128.0	30564.0	41119.0	40004.0	31669.0	33950.0	40235.0	36161.0	41104.0	30224.0	27141.0	25248.0	41119.0
12	Time of Use Units	30676.0	34860.0	40808.0	58508.0	52484.0	35114.0	51460.0	64447.0	55748.0	59976.0	30824.0	27658.0	27658.0	64447.0
13	Demand Charges (Rs.)	99700.0	99700.0	99700.0	124660.0	99960.0	99700.0	155305.0	153640.0	159745.0	168070.0	99700.0	99700.0	99700.0	168070.0
14	Energy Charges (Rs.)	369211.20	436868.80	543619.20	772463.60	652411.60	436518.20	638507.80	807694.00	687893.20	755619.20	981836.80	328348.20	328348.20	981836.80
15	Fuel Surcharges (Rs.)	154433.52	173758.00	215720.72	306172.68	259407.98	174326.87	253072.17	315785.40	269237.08	295956.64	160384.32	138104.73	138104.73	315785.40
16	PF Adjustment Charges (Rs.)	-3507.51	-7645.20	-11144.19	-18152.89	-15657.88	180718.53	-15962.70	-16153.88	-14101.81	-16245.81	-5918.45	-3611.83	-18152.89	180718.53
17	Time of Use Charge (Rs.)	26074.00	29631.00	34686.80	49731.80	44611.40	29846.90	43741.00	54779.95	47385.80	50979.60	26200.40	23509.30	23509.30	54779.95
18	Electricity Duty (Rs.)	96886.77	109846.89	132387.38	185031.28	156109.97	138166.58	161199.49	197361.82	172523.89	188156.94	99330.46	87907.56	87907.56	197361.82
19	Meter Charges (Rs.)	750.00	750.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	750.00
20	Total Bill (Rs.)	585778.93	773897.39	1015719.30	1421320.77	1009186.84	1059276.93	1235862.68	1510964.39	1322682.55	1442536.12	774655.08	673958.04	585778.93	1510964.39
21	Actual Unit Rate (Rs.)	6.5	7.3	7.7	7.6	6.3	9.9	8.0	7.7	7.9	7.8	8.3	8.3	6.3	9.9
22	Total Bill-Demand Charges (Rs.)	486078.9	674197.4	916019.3	1296660.8	909226.8	959576.9	1080557.7	1357324.4	1162937.6	1274466.1	674955.1	574258.0	486078.9	1357324.4
23	Units Rate for Saving Calculation	5.4	6.3	6.9	6.9	5.7	9.0	7.0	6.9	7.0	6.9	7.2	7.1	5.4	9.0
24	% Load Factor	109.4	101.6	84.2	90.8	89.1	155.0	45.6	88.2	74.1	79.7	67.2	104.4	45.6	155.0
25	% TOU Consumption	34.0	32.7	30.8	31.1	33.0	32.8	33.1	32.9	33.3	32.6	32.9	34.2	30.8	34.2
26	% Night Consumption	28.0	25.4	23.1	21.9	25.1	29.6	21.9	20.5	21.6	22.4	32.2	33.6	20.5	33.6
27	TOU Unit Rates	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9

Table 2.12

Bill Detail for year 2018

Sr. No.	Date of Bill	Total unit consumed during the Month	MD					KVAH	KVARH	PF	AMOUNT
			Contract MD	85% Cont'c Demand	Actual Demand	Billing Demand	Excess Cont. DMD				
1	19.01.2018	90312	700	595	284	595	0	93168	21028	0.969	585778.93
2	20.02.2018	106600	700	595	355	595	0	108216	16896	0.985	773897.39
3	19.03.2018	132344	700	595	528	595	0	133436	15064	0.991	1015719.30
4	20.04.2018	187836	700	595	691	691	0	188254	9123	0.997	1421320.77
5	22.05.2018	159146	700	595	596	596	0	159327	4806	0.993	1009186.84
6	20.06.2018	106949	700	595	344	595	0	159972	5000	0.668	1059276.92
7	20.07.2018	155259	700	595	751	751	51	102628	4230	1	1235862.68
8	21.08.2018	196140	700	595	748	748	48	198002	23897	0.99	1510964.39
9	20.09.2018	167228	700	595	759	759	59	168614	17600	0.991	1322682.55
10	20.10.2018	183824	700	595	774	774	74	185104	18980	0.993	1442536.12
11	20.11.2018	93792	700	595	474	595	0	95608	14906	0.981	774655.08
12	20.12.2018	80763	700	595	265	595	0	83028	15282	0.972	673958.04
Total Unit		**1660193**								**Total Amount**	**12825839.01**

Table 2.13 & 2.14 overall bill analysis for 2019

Table 2.13

Sr.No	Month	JAN'19	FEB'19	MAR'19	APR'19	MAY'19	JUN'19	JUL'19	AUG'19	SEP'19	OCT'19	NOV'19	DEC'19
1	Tarriff	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1	HTP-1
2	Contract Demand (KVA)	700.0	700.0	700.0	700.0	760.0	760.0	760.0	760.0	760.0	760.0	760.0	760.0
3	85 % Contract Demand (KVA)	595.0	595.0	595.0	595.0	646.0	646.0	646.0	646.0	646.0	646.0	646.0	646.0
4	Actual Demand (KVA)	205.0	234.0	395.0	682.0	696.0	372.0	886.0	753.0	919.0	876.0	519.0	276.0
5	Billing Demand (KVA)	595.0	595.0	595.0	682.0	696.0	646.0	886.0	753.0	919.0	876.0	646.0	646.0
6	Excess Contract Demand (KVA)	0.0	0.0	0.0	0.0	0.0	0.0	126.0	0.0	159.0	116.0	0.0	0.0
7	KVAH	71492.0	73158.0	88410.0	173663.0	185856.0	121610.0	214120.0	191138.0	226224.0	194163.0	112336.0	90715.0
8	KVARH	13382.0	11702.0	10172.0	20830.0	33939.0	16267.0	8373.0	10882.0	29899.0	26009.0	17174.0	13648.0
9	PF	0.970	0.975	0.988	0.990	0.979	0.981	0.998	0.992	0.989	0.987	0.979	0.982
10	Kwh Consumption	69397.0	71335.0	87390.0	171947.0	181969.0	119318.0	213750.0	189758.0	223899.0	191776.0	110009.0	89108.0
11	Units Consumption During Night Hours	24779.0	25880.0	28097.0	41199.0	48124.0	34492.0	45908.0	42156.0	48257.0	42958.0	33151.0	28907.0
12	Time of Use Units	25478.0	26952.0	30724.0	55644.0	58494.0	39527.0	70019.0	63062.0	37200.0	61600.0	36207.0	30750.0
13	Demand Charges (Rs.)	99700.0	99700.0	99700.0	61160.0	125960.0	112960.0	212530.0	140780.0	230845.0	206980.0	112960.0	112960.0
14	Energy Charges (Rs.)	28155.80	289255.00	367038.00	722177.40	764269.84	501135.60	897750.00	796983.60	940375.80	805459.20	462037.80	374253.60
15	Fuel Surcharges (Rs.)	118668.87	135536.50	166041.00	326699.30	345741.10	226704.20	406125.00	398491.80	470187.90	402729.60	231018.90	187126.80
16	PF Adjustment Charges (Rs.)	-2815.56	-3615.69	-6973.72	-14443.55	-11081.91	-7767.60	-21546.00	-16736.66	-18337.33	-14901.00	-6699.55	-5988.06
17	Time of Use Charge (Rs.)	21656.30	22909.20	26115.40	47297.40	49719.90	33597.95	59516.15	53602.70	62220.00	52360.00	30775.95	26137.50
18	Electricity Duty (Rs.)	77814.81	81567.75	96102.28	168961.64	188303.89	127925.00	230401.79	203438.86	249898.29	215316.69	122524.91	102439.06
19	Meter Charges (Rs.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Total Bill (Rs.)	596580.26	634156.80	736783.96	1295372.55	1502474.74	980758.09	1766412.83	1589195.23	1915886.09	1650761.38	939357.99	785366.09
21	Actual Unit Rate (Rs.)	**8.6**	**8.9**	**8.4**	**7.5**	**8.3**	**8.2**	**8.3**	**8.4**	**8.6**	**8.6**	**8.5**	**8.8**
22	Total Bill-Demand Charges (Rs.)	496880.26	534456.80	637083.96	1234212.55	1376514.74	867798.09	1553882.83	1448415.23	1685041.09	1443781.38	826397.99	672406.09
23	Units Rate for Saving Calculation	**7.2**	**7.5**	**7.3**	**7.2**	**7.6**	**7.3**	**7.3**	**7.6**	**7.5**	**7.5**	**7.5**	**7.5**
24	% Load Factor	116.2	104.2	74.6	84.9	89.0	109.0	80.6	84.6	82.1	73.9	72.1	109.6
25	% TOU Consumption	36.7	37.8	35.2	32.4	32.1	33.1	32.8	33.2	16.6	32.1	32.9	34.5
26	% Night Consumption	35.7	36.3	32.2	24.0	26.4	28.9	21.5	22.2	21.6	22.4	30.1	32.4
27	TOU Unit Rates	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.7	0.9	0.9	0.9

Table 2.14

Bill Detail for year 2019

Sr. No.	Date of Bill	Total unit consumed during the Month	MD					KVAH	KVARH	PF	AMOUNT
			Contract MD	85% Cont'c Demand	Actual Demand	Billing Demand	Excess Cont. DMD				
1	21.01.2019	69397	700	595	205	595	0	71492	13382	0.97	596580.26
2	20.02.2019	71335	700	595	234	595	0	73158	11702	0.975	634156.80
3	19.03.2019	87390	700	595	395	595	0	88410	10172	0.988	736783.96
4	20.04.2019	171947	700	595	682	682	0	173663	20830	0.99	1295372.55
5	21.05.2019	181969	760	646	696	696	0	185856	33939	0.979	1502474.74
6	20.06.2019	119318	760	646	372	646	0	121610	16267	0.981	980758.09
7	20.07.2019	213750	760	646	886	886	126	214120	8373	0.998	1766412.83
8	20.08.2019	189758	760	646	753	753	0	191138	10882	0.992	1589195.23
9	19.09.2019	223899	760	646	919	919	159	226224	29899	0.989	1915886.09
10	19.10.2019	191776	760	646	876	876	116	194163	26009	0.987	1650761.38
11	19.11.2019	110009	760	646	519	646	0	112336	17174	0.979	939357.99
12	19.12.2019	89108	760	646	276	646	0	90715	13648	0.982	785366.09
Total Unit		**1719656**								**Total Amount**	**14393106.01**

- Electric bill Analysis is one of the most important steps of energy audit as it gives the understanding of how can we increase energy efficiency in the institution. It shows uses and can help us achieve various methods for reducing monthly electricity costs without any large investments. Institute choosing proper Contract demand, maintaining Power Factor and such remedies suggested in paper above can decrease in monthly energy costs. For the purpose of increase in energy efficiency in institute following steps were suggested:

a. All the computer sleep mode settings were set to 10-minute timer, due to which when computer not in use would automatically go in sleep mode reducing energy wastage.
b. All the lights were cleaned and the suggestion was given that they should be cleaned every 5 to 6 months. Due to this the luminosity resulting in usage of less numbers of lights for same amount output.
c. All the compressors of air conditioners were placed are proper heights for increase in energy efficiency of air conditioners.
d. Unnecessary fans and lights we suggested to be removed and unnecessary usage of lights, fans and office equipment like Xerox machine, projectors etc. was decreased to stop energy wastage in institute.
e. Regular maintenance of air conditioners, pumps, water coolers and such other electrical equipment was suggested for maintaining their energy efficiency.
f. Wall gardens were suggested for increasing coolness inside the buildings resulting in decreased usage of air conditioners and fans.
g. Water wastage in institute was also decreased resulting in decrease of time period for which the pumps were operated.

Above measures were used to decrease in energy wastage and increase energy efficiency in educational institute and effect on time of use (TOU). This Utility bill analysis helped us achieve better energy management in educational institute and this is one the main reasons for performing Bill analysis under energy audit increasing a scope for energy conservation in an institution.

CHAPTER 3 TRANSFORMER PERFORMANCE

Transformer efficiency has been calculated on the basis of average consumption and average power factor. The rated no load loss and copper loss has been considered from the rated data from transformer guide line. The following table shows the performance of transformer. Efficiency is good.

It has been found that transformer is working in a good condition and efficiency also found good.

Figure 3.1 Transformers at Charusat University

Table 3.1 Transformer performance data

Sr No.	Description	Units	TR1	TR2
1	**Rated KVA**	KVA	400	400
2	**HV VOLTAGE**	KV	11	11
3	**HV CURRENT**	AMP	21	21
4	**LV VOLTAGE**	VOLT	433	433
5	**LV CURRENT**	AMP	533	533
6	**RESISTANCE/PHASE**	OHMS	5.737	5.737
7	**NO LOAD LOSSES**	WATTS	760	760
8	**MAGNETIZING CURRENT**	AMPS	8.25	8.25
9	**LOAD LOSSES**	WATTS	4592	3900
10	**IMPEDENCE**	%	4.82	4.50
11	**HV SIDE TEMP**	^{o}C	50	51
12	**LV SIDE TEMP**	^{o}C	55	55
13	**EFFICIENCY AT U.P.F**	%	98.68	98.52
14	**EFFICIENCY AT 0.8 PF**	%	98.36	97.95

Saving Potential

The following points are to be taken care for energy saving measures.

1. Measure the loading pattern of the transformer connected on same bus. If total loading of that entire bus is less than the installed capacity then check for sparing of one transformer. If this is permitted, then switch off one transformer. After some specified period (a week or fortnightly) switch off the first transformer and switch on the other transformer. By this way we can save the No-load losses of the transformer. Compare to Oil cooled transformer, dry type transformer is very convenient and easily Switched ON & Off. One or two transformers may be disconnected on holiday or in periods of low load. Many industries are doing this regularly. When switching on after long periods of non-use transformer, oil condition and IR value must be checked. In monsoon, especially this must be done.

2. Unlike motors, transformers have maximum efficiency at part loads. When more than one unit is available if may be worthwhile sharing load. Always try to keep transformers optimum loaded.

3. As the load losses depend on the value of load current, improvement of power factor on the load side (LT), would reduce the transformer I^2R losses.
4. While selecting a new transformer one should not to see only the price but also evaluate the cost of losses.
5. Use of Amorphous stampings in construction of transformer core, which will have low iron losses.

The amorphous core distribution transformers are more energy efficient than transformers made with silicon iron cores. The reduction of the iron losses is due to unique non-crystalline (random) atomic structure of the amorphous alloy use as core material. The amorphous alloy core has lower hysteresis losses. It also has lower eddy current losses. There are two reasons for this.

- The electrical resistivity of the alloy is higher than silicon steel by a factor of three.
- The thickness of lamination, use in amorphous cores is much lower.

CHAPTER 4 APFC PERFORMANCE

For maintaining of power factor near to unity value and avoid penalty due to lower value of power factor periodic checking of capacitors are required. There is a good practice that periodical checking is carried out in time. The following table shows the performance assessment of capacitors installed in APFC panel.

Table 4.1 APFC Panel: 165 KVAR

Sr. no.	Stage wise3	Installed Capacitor	Measured Amp.	Remarks
1	Capacitor bank 1	5 KVAR	-	off
2	Capacitor bank 2	10 KVAR	-	Off
3	Capacitor bank 3	25 KVAR	-	Off
4	Capacitor bank 4	25 KVAR	-	Off
5	Capacitor bank 5	25 KVAR	30.1	Off
6	Capacitor bank 6	25 KVAR	-	off
7	Capacitor bank 7	25 KVAR	-	Off
8	Capacitor bank 8	25 KVAR	-	Off
Total		165 KVAR	30.1	Off

Table 4.2 APFC Panel: 140 KVAR

Sr. no.	Stage wise3	Installed Capacitor	Measured Amp.	Remarks
1	Capacitor bank 1	7.5 KVAR	0.15	Weak
2	Capacitor bank 2	10 KVAR	10.9	Average
3	Capacitor bank 3	12.5 KVAR	12.5	Average
4	Capacitor bank 4	15 KVAR	-	Off
5	Capacitor bank 5	20 KVAR	-	Ok
6	Capacitor bank 6	25 KVAR	-	off
7	Capacitor bank 7	25KVAR	16.7	Weak
8	Capacitor bank 8	25 KVAR	-	Off
Total		140 KVAR	40.25	Off

Total installed capacity of capacitors is 165 Kvar and one capacitor of 25 Kvar is installed near to the main transformer. The capacitors currents has been checked and found in healthy condition. From the bill analysis it has been found that an average power factor throughout the year is very well maintained between 0.98 to 0.99.

CHAPTER 5 LIGHTING SYSTEM PERFORMANCE

Lighting illumination level has been checked by lux meter. Lux level found is average. Natural lights are available which is good. Most of the lightings are florescent lights and it requires replacement by LEDs. Which helps in increase lux level and also reduction in power consumption? The following table shows the general guide lines for saving opportunities in lighting system.

Best Practices Guideline for Energy Conservations in Lighting System

Sr. No	Suggestion
1	Use as much natural day light as possible by use of translucent roofing sheets
2	Use day lighting effectively by locating work stations requiring good luminance near the windows.
3	Minimize luminance in non- task areas by reducing the wattage of lamps or number of fittings
4	Avoid use of incandescent/tungsten filament lamps. The power consumed by these lamps is 80% more than the fluorescent lamps (discharge) for same lumen output.
5	Use electronic ballasts in place of conventional ballast for fluorescent lamps.
6	Task lighting saves energy, utilize it whenever possible.
7	All surfaces absorb light to some degree and lower their reflectance. Light colored surfaces are more efficient and need to be regularly painted or washed in order to ensure economical use of light.
8	Maintenance is very important factor. Evaluate present lighting maintenance program and revise it as necessary to provide the most efficient use of lighting system.
9	Clean luminaries, ceilings, walls, lamps etc. on a regular basis.
10	Controls are very effective for reducing lighting cost. Provide separate controls for large ratings.
11	Install switching or dimmer controls to provide flexibility when spaces are used for multiple purposes and require different amounts of illumination for various activities.
12	Switching arrangements should permit luminaries or rows of luminaries near natural light sources like windows or roof lights to be controlled separately.
13	Separate lighting feeder and maintain the feeder at permissible voltages by using transformers.
14	Install occupancy sensors for indoor cabin light controls

- **recommended Lighting Level**

Light output is measured in lumens and the availability of light in a particular area is called illumination, which is measured in lumens/m2 or LUX. The luminance level in the Indian industry, with some rare exceptions, is generally much lower than the recommended levels. Table shows the recommended levels.

The following table shows the details of lux measured, no of fixtures and lux levels at different locations.

Table 5.1 illumination data of Charusat University

AREA	LUMINATION		CONSUPTION (KW)	HOURS/DAY	DAYS/YEAR	CONSUPTION/YEAR	UNIT COST	TOTAL COST
	FTB	LED-TB						
EE	404	221	18.96	6.5	200	24653.20	7.6	187364.32
EC	279	71	11.46	6.5	200	14903.20	7.6	113264.32
EE Building 2nd Floor	0	208	4.16	6.5	200	5408.00	7.6	41100.8
DEPSTAR 2F	27	311	7.19	6.5	200	9349.60	7.6	71056.96
DEPSTAR 1F	79	138	5.60	6.5	200	7285.20	7.6	55367.52
DEPSTAR GF	66	108	4.54	6.5	200	5896.80	7.6	44815.68
PHARMACY	128	227	9.15	6.5	200	11892.40	7.6	90382.24
MECHANICAL	312	285	16.93	6.5	200	22011.60	7.6	167288.16
CIVIL	328	41	12.63	6.5	200	16416.40	7.6	124764.64
COMP/IT	33	261	6.41	6.5	200	8330.40	7.6	63311.04
I2IM	13	616	12.79	6.5	200	16624.40	7.6	126345.44
MCA	13	606	12.59	6.5	200	16364.40	7.6	124369.44
PDPIAS	331	554	23.00	6.5	200	29894.80	7.6	227200.48
HOSTEL-1	0	300	6.00	6.5	330	12870.00	7.6	97812
HOSTEL-2	12	269	5.81	6.5	330	12466.74	7.6	94747.224
HOSTEL-3	90	231	7.86	6.5	330	16859.70	7.6	128133.72
HOSTEL-4	0	382	7.64	6.5	330	16387.80	7.6	124547.28
ADMIN	16	520	10.98	6.5	200	14268.80	7.6	108442.88
LIBRARY	0	0	0.00	6.5	330	0.00	7.6	0
TOTAL	**2131**	**5349**	**183.70**	**123.5**	**4450**	**261883.44**	**144.4**	**1990314.14**

Table 5.2 recommended Lighting Level

Range	Lighting level (Lux)	Examples of Area of activity
General lighting for rooms and areas used either infrequently and/or casual or simple visual tasks.	20	Minimum service luminance in exterior circulation areas, outdoor stores, stockyards.
	50	Exterior walkways & platforms.
	70	Boiler house.
	100	Transformer yards, furnace room etc.
	150	Circulation areas in industry, stores and stock room.
General lighting for interiors	200	Minimum service luminance on the task.
	300	Medium bench and machine work, general process in chemical and food industries casual reading and filling activities.
	450	Hangers, Inspection, Drawing offices
	700	Fine bench and machine work; office machine assembly; colour work; critical drawing task.
	1500	Very fine bench and machine work; instrument and small precision mechanism assembly; electronic component

CHAPTER 6 HVAC SYSTEM

- **About Fan:**

The fans in the campus are of 70 W. But out of this the following table shows the details of existing fans Power consumption. Most people focus on lighting to fix their high electricity bills, but fans consume a lot more than lights. To give a perspective a regular (non BEE star rated) ceiling fan consumes 70 to 75 Watts as compared to a regular (most inefficient) tube light that consumes 55 to 60 Watts.

Table 6.2 shows for same number of fan how we save the energy if we use energy efficient fan and what is the payback period for the same.

Table 6.1 Fan data and its consumption per year of Charusat University

AREA	TOTAL FANS	CONSUMPTION(KWH)	DAYS/YEAR	TOTAL CONSUMPTION PER YEAR	UNIT COST	TOTAL COST
ELECTRICAL	220	1491.1875	200	298237.5	7.6	2266605
EC	207	1464.9375	200	292987.5	7.6	2226705
EE Building 2nd Floor	157	1412.4375	200	282487.5	7.6	2146905
DEPSTAR 2F	141	1412.4375	200	282487.5	7.6	2146905
DEPSTAR 1F	119	1202.25	200	240450	7.6	1827420
DEPSTAR GF	80	1202.25	200	240450	7.6	1827420
pharmacy	274	1205.75	200	241150	7.6	1832740
Mechanical	298	1183	200	236600	7.6	1798160
Civil	321	1237.25	200	247450	7.6	1880620
Comp/IT	187	1298.5	200	259700	7.6	1973720
I2IM	280	1249.5	200	249900	7.6	1899240
MCA	262	1200.5	200	240100	7.6	1824760
PDPAIS	624	1151.5	200	230300	7.6	1750280
Hostel 1	152	1181.25	200	236250	7.6	1795500
Hostel 2	241	1141.875	200	228375	7.6	1735650
Hostel 3	154	973.875	200	194775	7.6	1480290
Hostel 4	225	973.875	200	194775	7.6	1480290
ADMIN	171	921.375	200	184275	7.6	1400490
Library	15	196.875	200	39375	7.6	299250
TOTAL	4128	22100.625		4420125	**Total cost**	33592950

Table 6.2 Fan calculation and replacement saving data

Data	FANS USED	REPLACEMENT	
		EFFICIENT FANS	SUPER-EFFICIENT FANS
TOTAL	4128	4128	4128
RS/FAN	1500	1600	2600
WATT-HOUR	70	50	35
HOURS/DAY	7.5	7.5	7.5
DAYS/YEAR	200	200	200
UNIT COST	7.6	7.6	7.6
CONSUMPTION COST	3294144	2352960	1647072
FANS COST	6192000	6604800	10732800
ANNUAL SAVINGS	NA	941184	1647072
PAYBACK PERIOD(YEARS)	NA	0.438596491	2.756892231

- **About Air Conditioning System:**

The following are the suggestion for the AC system

1. Install temperature controller for the ACs.
2. When replacement is required replace it with 3 stars or 5 stars rated efficient ACs.
3. From the following performance and calculation there is a requirement of ACs but the use of AC is limited in a year (530 hrs/ Year) if it is replaced the payback period will very long. So when requirement of replacement is there the replace it by efficient ACs.

It has been not suggested to replace existing AC with efficient AC because working hours of AC is less. If it will replace the payback period will more than 3 years, which is not liable. But it has been suggested to replace AC one by one in 5 stars rated AC.

The following method has been to find out the performance of ACs. The ACs are working in good condition, but need maintenance. For old AC an average current is between 9 to 18 Amps, so power consumption is more. But it can be replace by new 5 star rated efficient ACs.

Table 6.3 AC data and its consumption per year of Charusat University

AREA	NOS OF AC	CONSUMPTION(UNITS)kw	HOURS/DAY	DAYS/YEAR	TOTAL CONSUMPTION KWH/YEAR	UNIT RATE	COST
ELECTRICAL	20	50	4	100	20000	7.6	152000
EC	33	82.5	4	100	33000	7.6	250800
EC 2	61	152.5	4	100	61000	7.6	463600
DEP 2ND	30	75	4	100	30000	7.6	228000
DEP 1ST	37	92.5	4	100	37000	7.6	281200
DEP GF	31	77.5	4	100	31000	7.6	235600
PHARMACY	29	72.5	4	100	29000	7.6	220400
MECHANICAL	21	52.5	4	100	21000	7.6	159600
CIVIL	18	45	4	100	18000	7.6	136800
COMP/IT	50	125	4	100	50000	7.6	380000
IIIM	48	120	4	100	48000	7.6	364800
MCA	56	140	4	100	56000	7.6	425600
PDPIAS	73	182.5	4	100	73000	7.6	554800
HOSTEL 1	15	37.5	4	100	15000	7.6	114000
HOSTEL 2	14	35	4	100	14000	7.6	106400
HOSTEL 3	26	65	4	100	26000	7.6	197600
HOSTEL 4	21	52.5	4	100	21000	7.6	159600
ADMIN	40	100	4	100	40000	7.6	304000
LIBRARY	1	2.5	4	100	1000	7.6	7600
TOTAL	624				624000		4742400

Control Of ON/OFF Compressor

The compressor is the most important component of a vapor compression refrigeration system. The ON/OFF type of compressor used to be popular in the past but DC Inverter type of compressor is the latest technology in the market though more costly.

The ON/OFF compressor will totally ON or totally OFF depending on the set temperature and the ambient temperature. Usually there is a dead band of about 1.5 C to 2.0C to prevent ON-OFF cycling of compressor that will reduce its lifespan. In cooling mode, the compressor will turn ON when the ambient temperature of the room is higher than the set temperature by 0.75C (different manufacturer will have different value). It will only go off when the room temperature drops below 1.25 C (different manufacturer will have different value).

REFRIGERATION

Introduction

Refrigeration is a process of moving heat from one location to another in controlled conditions. The work of heat transport is traditionally driven by mechanical work, but can also be driven by heat, magnetism, electricity, laser, or other means. Refrigeration has many applications, including, but not limited to: household refrigerators, industrial freezers, cryogenics, and air conditioning. Heat pumps may use the heat output of the refrigeration process, and also may be designed to be reversible, but are otherwise similar to air conditioning units.

Table 6.4 Consumption of University

AREA	NO. OF REFRIGERATOR	UNITS/YEAR	UNIT COST	TOTAL COST
ELECTRICAL	1	450	7.6	3420
MECH	1	450	7.6	3420
CIVIL	1	450	7.6	3420
EC	1	450	7.6	3420
COMP	1	450	7.6	3420
IT	1	450	7.6	3420
MBA	1	450	7.6	3420
MCA	1	450	7.6	3420
ADMIN	1	450	7.6	3420
PHARMACY	1	500	7.6	3800
	1	450	7.6	3420
	1	217	7.6	1649.2
	1	549	7.6	4172.4
PDPIAS	5	245	7.6	1862
	4	450	7.6	3420
				49103.6

Remedial measures

a) Reducing Need For Refrigeration: In many industries using process technologies and equipment develop in colder countries, temperatures of 10 deg .c or 50 deg .c for cooling is routinely specified as this are normal wet bulb temperatures in those countries. The possibility of redesigning the heat exchangers to suit the wet bulb of 25 to 30 deg .c, normally prevalent in India, should be investigated. Elimination of reduction in the use low temperature fluids or air can result in large energy savings.

b) Optimize Temperatures: Over specification in temperature settings should be avoided, without jeopardizing process and personnel safety. Specification of –20 deg c in place of –15 deg c can lead to 15 to 20% higher energy consumption. Some industries have achieved significant savings by operating at higher temperatures.

c) Improve Insulation And Reduce Heat Ingress: Higher energy prices justify better insulation. Domestic refrigerator efficiency has been improved by polyurethane (PUF) insulation. Insulation of valves and pipefittings is also justified. Heat ingress into cold storages and air-conditioned spaces should be reduced by having properly designed doors, air curtains, PVC curtains, use of low emissivity (sun-control) films etc.

d) Improve Heat Exchanger Design: For the same endues temperatures, use of heat exchanger with larger surface area can result in the refrigerant gas operating at higher temperature in the chiller and lower temperature in the condenser, resulting in the large energy savings. This implies that for chilled water at 8 deg.c, larger heat exchanger may result in gas temperature of 3 deg.c, say, instead of 0 deg.c say. Every 1 deg.c higher gas temperature in the chiller or 1 deg.c gas temperature in the condenser reduces the specific energy consumption of the compressor by about 2% to 3%.

e) Energy Storage: Reduction in maximum kVA demand and peak time energy consumption can be achieved by building in energy storage in the form of ice banks or use of other salts hydrates. This can facilitate the operation of more refrigeration machines during of peak hours, usually night time when ambient conditions are more favorable, and switching of some machines during the plant's peak time.

CHAPTER 7 COMPUTER DATA

Computers usually consume 200W-250W including desktop, CPU, printer, etc. They are also included in major consumption equipment's in commercial areas or institutes or universities as more number of computers are used there.

Computers and monitors account for 40%-60% of the energy used by office equipment. Their energy consumption is second only to office lighting.

Table 7.1 Consumption in University

AREA	NOS OF COMPUTER	CONSUMPTION	HOURS/DAY	DAYS/YEARS	UNIT RATE	COST
ELECTRICAL	105	18.375	5.5	280	7.6	215061
EC	226	39.55	5.5	280	7.6	462893.2
EC/ 2ND FLOOR	106	18.55	5.5	280	7.6	217109.2
DEPSTAR 2F	291	50.925	5.5	280	7.6	596026.2
DEPSTAR 1F	288	50.4	5.5	280	7.6	589881.6
DEPSTAR GF	173	30.45	5.5	280	7.6	356386.8
PHARMACY	83	15.05	5.5	280	7.6	176145.2
MECHANICAL	140	24.5	5.5	280	7.6	286748
CIVIL	118	20.65	5.5	280	7.6	241687.6
COMPUTER/IT	451	73.675	5.5	280	7.6	862292.2
I2IM	234	40.95	5.5	280	7.6	479278.8
MCA	624	109.2	5.5	280	7.6	1278076.8
PDPIAS	214	35.525	5.5	280	7.6	415784.6
HOSTEL 1	2	0.35	5.5	280	7.6	4096.4
HOSTEL 2	0	0	0	280	7.6	0
HOSTEL 3	0	0	0	280	7.6	0
HOSTEL 4	0	0	0	280	7.6	0
ADMIN	67	12.425	7	280	7.6	185082.8
LIBRARY	20	3.5	4	280	7.6	29792
Total	3142	544.075			TOTAL COST	6396342.4

- **Remedial measures**

(1) Computers should be shut down instead of keeping in sleep mode when there is no long time usage.

(2) Required instruments should only be kept on. Like if there is no use of printer or modem or such instrument then it's should be kept detach so that power is not consumed.

CHAPTER 8 SOLAR DATA

Charusat University installed 2 solar plants in year 2018 with installation capacity 100 KW each. One is installed on DEPSTAR building and other on PDPIS. Their electricity generation is given in following table.

Table 8.1: April 2018 to December-2018 per day electricity generation in KWH

Year : January -2018 to December-2018												
Date	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18
1				210.37	1245.35	1167.45	855.57	1008.6	771.96	1249.28	1034.31	839.23
2				227.32	1285.32	1131.27	1014.25	908.03	999.86	1149.11	958.16	725.13
3				361.44	1308.97	1169.75	695.53	1022.57	719.12	1079.24	972.82	840.4
4				1142.64	1254.08	1150.21	179.81	1102.01	830.54	1112.65	943.88	571.79
5				1028.56	1223.3	821.6	1023.91	782.18	1079.38	1124.6	996.16	807.83
6				1144.83	1246.69	1119.67	878.37	591.32	1253.64	1184.72	1019.86	813.36
7				1192.34	1288.01	1190.52	1155.6	818.33	1222.42	1177.02	1057.76	899.48
8				933.99	1241.15	1147.45	1108.74	516.07	445.53	1123.81	922.46	903.15
9				1189.96	1241.76	1071.07	941	1033.28	412.3	1131.76	966.55	903.19
10				915.9	1218.94	1040.09	686.3	1233.98	721.24	1126.31	954.15	867.32
11				920.36	1239.77	1020.11	537.56	1059.78	1246.02	1048.7	955.77	845.54
12				968.88	1260.17	1077.73	431.48	769.25	1085.74	1069.52	924.31	701.82
13				956.24	364.63	1092.58	803.93	797.01	1221.72	1047.84	575.61	908.49
14				986.06	1157.66	1060.93	693.33	713.25	1132.83	1045.81	842.31	935.49
15				620.88	1135.91	1152.99	601.69	876.68	1182.05	1022.38	922.8	896.4
16				1085.69	1172.86	1148.51	285.74	883.75	1264.02	970.54	921.14	929.08
17				1041.63	1181.48	1082.16	428.01	124.91	1045.92	1013.34	911.02	978.93
18				1015.26	1103.3	1118.29	477.96	573.06	1216.19	1050.36	918.76	1025.28
19				982.39	1087.35	1129.78	346.85	547.98	1221.28	1015.4	925.42	988.54
20				1045.25	1172.42	1209.81	494.58	992.86	1262.76	961.24	941.78	966.94
21				1241.21	1222.49	1217.6	481.9	221.9	1296.77	559.65	884.03	361.9
22				1127.93	1202.2	1135.25	613.21	661.57	482.24	583.75	851.21	943.11
23				1202.19	1157.84	954.12	496.96	924.07	712.67	577.82	835.14	957.68
24				1256.93	1159.6	607.31	377.12	1002.24	1061.93	737.6	916.05	901.04
25				1290.84	671.38	631.08	504.94	837.86	1258.32	1047.13	912.17	899.3
26				1277.99	1261.1	779.34	556.26	579.94	1312.88	1032.37	906.58	884.22
27				1235.42	1211.56	894.75	540.07	973.01	1260.03	1050.6	771.8	985.99
28				1237.58	1224.16	919.75	905.3	962.59	1290.51	779.77	781.76	993.04
29				1252.62	1233.76	1020.51	718.09	351	1265.81	1045.85	888.28	1007.39
30				1231.48	1155.76	1060.1	950.49	570.46	1280.22	1034.71	981.9	962.19
31					1173.63		921.66	863.23		1027.62		941.75
Total				30324.2	36102.6	31321.8	20706.2	24302.8	31555.9	31180.5	27394	27185

- April 2018 to December-2018 total generation is **260072.89** KWH
- Highest generation in September 2018 can show in the table 8.1 and graph 8.1

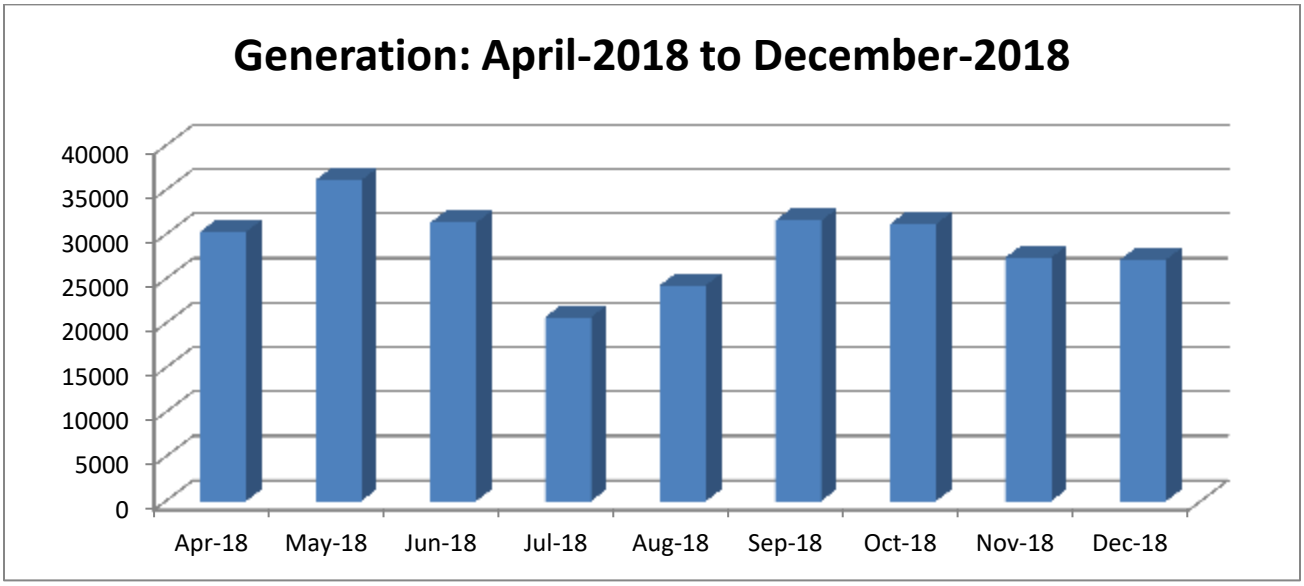

Figure 8.1 April 2018 to December 2018 per month electricity generation in KWH

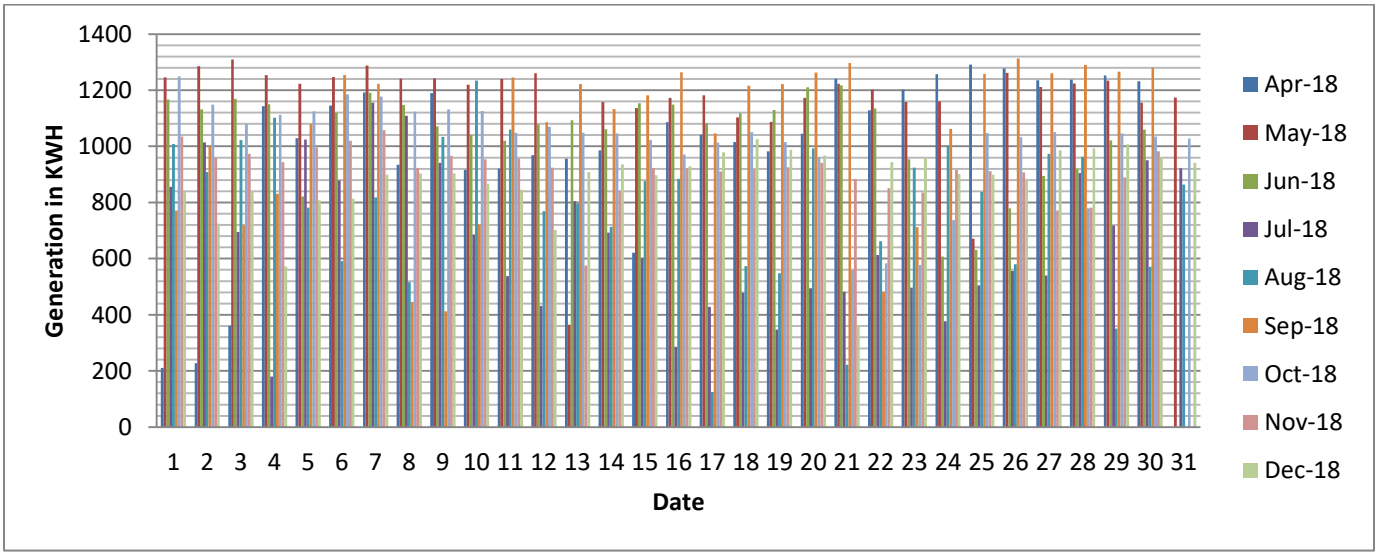

Figure 8.2 Year: April -2018 to March-2019 per day electricity generation in KWH

Table 8.2 January -2019 to December-2019 per day electricity generation in KWH

Year : January -2019 to December-2019												
Date	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
1	883.43	1025.54	**1295.08**	1143.1	1040.36	1095.56	901.94	96.25	504.4	540.64	1017.46	812.13
2	908.64	1066.23	1054.11	1141.83	1060.25	1061.63	873.72	632.01	765.56	1024.8	410.21	829.84
3	956.7	891.32	878.91	1150.94	1090.66	1071.31	800.09	228.42	466.02	1114.64	696.3	826.56
4	900.79	767.27	1137.54	1103.85	1126.73	1052.12	332.18	185.87	677.71	1019.21	839.3	806.11
5	812.36	773.55	1173.9	1159.08	1099.35	1042.7	622.44	457	669.7	1096.18	978.78	553.01
6	951.52	991.78	1158.35	1154.62	1102.99	1015.24	643.54	659.4	275.7	1104.93	894.8	486.62
7	896.4	991.55	1136.1	1153.18	1104.95	994.94	349.48	524.66	786.64	1152.28	568.46	889.95
8	893.93	1035.89	1139.3	1162.63	1117.76	1013.15	667.36	286.74	772.21	1212.38	904.2	969.68
9	841.64	1116.1	1189.98	1172.38	1068.91	1004.38	891.08	58.66	320.65	1197.51	958.72	930
10	955.18	1114.37	1121.91	1138.34	1115.73	972.34	968.9	237.16	179.67	1166.08	912.41	955.5
11	859.94	1064.62	1220.58	1141.87	1085.35	970.94	908.31	521.62	479.27	1234.18	789.9	942.66
12	861.23	1007.54	1214.1	1155.26	1080.07	952.87	1018.69	796.48	469.06	1251.14	951.77	930.35
13	831.34	854.54	960.46	1104.84	1103.85	780.74	996.67	859.13	232.11	1189.44	940.28	918.69
14	787.78	916.67	1201.16	1054.74	1138.92	930.94	875.98	691.83	234.02	1159.72	977.82	1020.06
15	879.55	932.99	1214.13	874.49	1138.35	559.44	823.47	385.45	371.37	1113.51	999.61	1036.5
16	898.27	1127.59	1129.95	590.74	1107.54	926.82	952.67	425.66	162.9	1118.84	880.83	1059.33
17	891.86	1098.75	1212.75	1028.9	1055.98	1067.58	880.48	793.29	897.38	1083.88	940	1049.22
18	918.84	1081.58	1198.76	1032.45	1091.42	591.14	946.87	925.32	508.38	1055.44	907.9	915.49
19	933.42	1084.32	1184.41	1210.82	1113.42	812.93	1014.22	965.66	663.13	876.26	952.44	979.44
20	824.64	1046.7	1220.46	1160.5	1108.27	830.96	1003.69	961.59	401.66	996	785.18	221.34
21	752.73	1113.49	1107.12	1141.25	1120.9	882.79	546.65	941.49	449.22	987.47	828.81	856.27
22	852.78	979.59	1171.17	1161.14	1082.27	891.56	1043.73	1068.73	636.43	668.55	933.98	868.08
23	683.94	936.94	1161.54	1109.36	1048.25	1063.25	967.05	1002.34	718.14	996.39	890.05	692.64
24	906.3	971.49	1145.31	1100.83	603.74	641.11	945.82	1008.98	879.1	1075.18	913.22	814.48
25	1105.69	1084.66	1141.58	1073.79	1028.31	668.69	629.71	694.07	783.84	898.97	861.57	914.37
26	1102.59	1041.41	1164.35	1042.23	985.76	897.16	401.42	200.26	452.93	894.97	850.18	976.54
27	1099.54	1024.26	1169.42	1101.64	1062.02	869.73	413.33	100.2	249.57	471.43	780.46	1109.31
28	1140.98	1171.94	1144.1	1122.46	1050.74	390.62	340.02	463.38	252.54	627.04	831.6	1093.31
29	1138.35		1168.98	1089.19	1048.18	520.73	288.12	672.26	636.25	900.9	861.74	747.66
30	1090.9		1130.94	1070.26	1082.24	689.77	301.32	910.45	399.66	1162.74	863.25	1027.52
31	873.19		1192.97		1087.77		174.89	1027.1		939.87		885.98
Total	28434	28313	35739.4	32846.7	33151	26263.1	22523.8	18781.5	15295.2	31330.6	25921.2	27118.6

- January -2019 to December-2019 total generation is **325718.4 KWH**

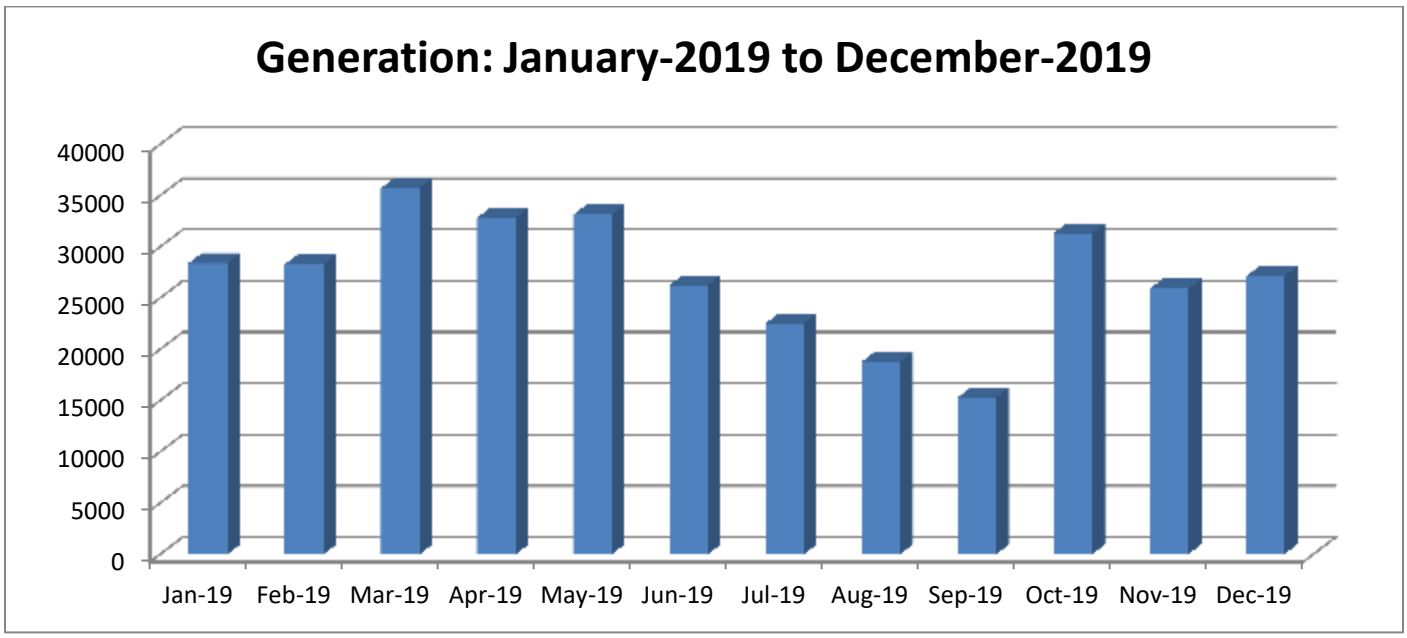

Figure 8.3 January -2019 to December -2019 per month electricity generation in KWH

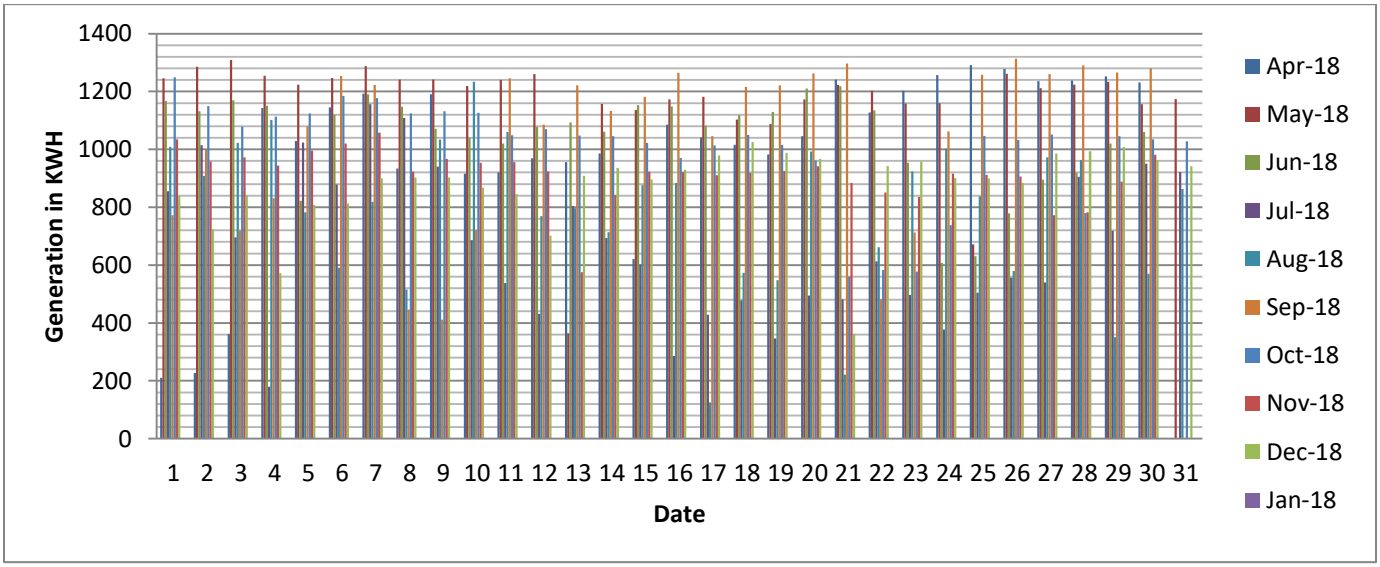

Figure 8.4 January -2019 to December -2019 per day electricity generation in KWH

Charusat Solar Power Plant Data

Table 8.3 January -2019 to December-2019 per month electricity generation in KWH

Month	Generation in 2018	Generation in 2019
January	NA	28434.45
February	NA	28312.68
Marsh	NA	35739.42
April	30324.18	32846.71
May	36102.6	33151.04
June	31321.78	26263.14
July	20706.21	22523.84
August	24302.77	18781.46
September	31555.9	15295.22
October	31180.5	31330.57
November	27393.95	25921.23
December	27185	27118.64

Note: Electricity generation in KWH

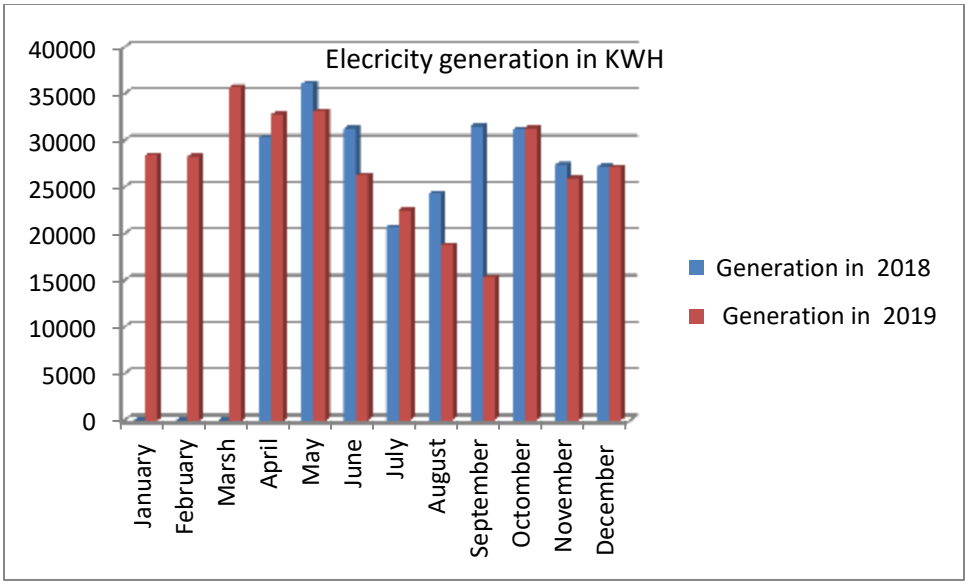

Figure 8.4 January -2019 to December-2019 per month electricity generation in KWH

CHAPTER 9 : PUMPS AND WATER COOLERS

Table 9.1 Consumption of Pumps

AREA	NO. OF PUMPS	CONSUMPTION/PUMP(HP)	WATT/HP	TOTAL CONSUMPTION	HOURS/DAY	DAYS/YEAR	TOTAL UNITS	RS/UNIT	COST
HOSTEL	2	3	746	4476	7	320	10026.24	7.6	76199.42
ANIMAL HOUSE	1	10	746	7460	7	320	16710.4	7.6	126999
CIVIL	1	5	746	3730	7	320	8355.2	7.6	63499.52
WATER TANK	2	15	746	22380	16	320	114585.6	7.6	870850.6
HOSTEL-3	1	10	746	7460	7	320	16710.4	7.6	126999
MCA	1	10	746	7460	7	320	16710.4	7.6	126999
HOSTEL	2	5	746	7460	7	320	16710.4	7.6	126999
COMP/IT	1	5	746	3730	7	320	8355.2	7.6	63499.52
				64156					1582045

- **Remedial Measures For Pumps**

(1) Disassemble the pump motor for cleaning the surfaces and make it free from corrosion and burrs

(2) Should be coated with grease and oil

(3) Whole process should be monitored by skilled person

(4) Pumps bearings should be given proper maintenance at least once in 18 months

(5) Defective bearings should be replaced immediately

Table 9.2 Consumption of Water Coolers

AREA	NO. OF COOLERS	CAPACITY(LTRS)	CONSUMPTION/COOLER	TOTAL CONSUMPTION(UNITS)	UNIT RATE	COST
ADMIN	4	300	1800	13860	7.6	105336
MBA	2	300	1800	6930	7.6	52668
PHARMACY	2	300	1800	6930	7.6	52668
CE/IT	2	300	1800	6930	7.6	52668
EE/EC	3	300	1800	10395	7.6	79002
CIVIL/MECH	2	300	1800	6930	7.6	52668
PDPIAS	2	300	1800	6930	7.6	52668
MCA	2	300	1800	6930	7.6	52668
HOSTEL-1	2	300	1800	6930	7.6	52668
HOSTEL-2	2	300	1800	6930	7.6	52668
HOSTEL-3	2	300	1800	6930	7.6	52668
MESS ROOM	1	300	1800	3465	7.6	26334
CANTEEN	1	300	1800	3465	7.6	26334
				93555		711018

Remedies

(1) Keep the water cooler off whenever not in use.

(2) Don’t keep the water cooler in direct sunlight else will consume more power.

(3) Time clocks are fitted washing machines, heaters, pumps, compressors etc. The equipment/appliance is switched of automatically after set time and over consumption of electrical energy is avoided.

(4) HVAC module installation

(5) Insulate roof and walls, close leaks, reduce temperature set points, reduce setting during unoccupied period, shift operating cycle from off peak load duration, and use double plastic films on glass panes of windows and curtains in for A. C. rooms.

CHAPTER 10 ENERGY CONSERVATION OPPORTUNITY IN DAY TO DAY LIFE

-Switch off the lights whenever it is not required.

-Maximum use of daylight.

-Stop frequent opening of refrigerator.

-Keep the refrigerator at a proper distance (6 inch from the wall)

-Check the gasket of refrigerator.

-Don’t place hot food inside the refrigerator.

-Defrost the freeze regularly.

-Avoid use of less efficient appliances

-Minimize the use of dryers especially in summer days.

-Use light colored wall paint.

-Use thermostat settings.

-Stop the engine at signal.

-Use level indicator & automatic controller for overhead tank.

-Use solar cooker & pressure cooker whenever possible.

-Clean the carburetor, air filter & fuel filter regularly.

-Maintain proper air pressure in tyre.

-Avoid sudden acceleration & breaking.

It is here is declared that all the information submitted in with respect to this format is correct.

Name and Designation of Energy Audit Team Members

Sr. No.	Name with Designation	Signature
1	Vibha Parmar, Assistant Professor, Electrical Engineering	
2	Dr. Nilay Patel, HOD, Electrical Engineering	
3	Dr. Yogesh Prajapati, Assistant Professor, Electrical Engineering, BVM Engineering Collage