



VIT[®]

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

ENERGY AUDIT REPORT

YEAR - 2019

VELLORE INSTITUTE OF TECHNOLOGY

VELLORE - 632014

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1. INTRODUCTION:

VIT was established under Section 3 of the University Grants Commission (UGC) Act, 1956, and was founded in 1984 as a self-financing institution called the Vellore Engineering College. VIT was established with the aim of providing quality higher education on par with international standards. It persistently seeks and adopts innovative methods to improve the quality of higher education on a consistent basis. VIT is the first institute of India to receive QS 4-Star rating in overall category and QS 5-Star rating in teaching, employability, facilities, innovation and inclusiveness. VIT is accredited by NAAC, Govt. of India with A Grade. FICCI, Industry Consortium of India, awarded VIT as “the University of the Year 2016” and "Excellence in faculty for the year 2017" in India. VIT’s focus on research with international collaborations to move up in world ranking has lead it to be recognized as an Institution of Eminence by the Government of India.

1.1 OBJECTIVE:

The objective is to make Vellore Institute of Technology, Vellore as energy efficient by means of using renewable energy, energy efficient technologies and appliances by proper Energy Audit. The following report is the result of the Energy Audit of VIT done for the year 2019. An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building. This will involve the analysis of energy consumption of Vellore Institute of Technology by knowing the different loads that are in use, their ratings, their consumption, the consumption pattern and providing alternatives to reduce the energy consumption and thereby reducing the cost spent on electricity bills and also reduce the harmful effects on the environment due to conventional way of power generation. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output. In an organization like an Engineering College, the top operating expense is often found to be electrical energy. Thus by the help of this audit the institution is made both energy and cost efficient.

2. ENERGY AUDIT METHODOLOGY:

2.1 DATA COLLECTION:

The first step involves the collection of data of all sorts such as, the number of hostel, departmental and administrative buildings and the number of floors, their occupancies, the number and the different type of loads connected, the usage hours which involves surveys, observations and measurements.

2.2 DATA ANALYSIS:

This step is where the collected data is analysed for the rate of energy usage, the energy usage pattern and for other information and the analysed data is represented in graphs for visual understanding.

2.3 RECOMMENDATIONS:

Based on the analysis the system of high energy consumption are taken into account and steps are taken to reduce the energy consumption without affecting the ability of the particular system to perform it's required operation.

3. ENERGY REPORT:

VIT's sanctioned maximum demand is 9 MW with the incoming voltage of 33 kV. The incoming supply is connected to 2 X 5 MVA transformers of 33 kV / 11 kV. 11 kV is drawn to the incoming internal substations of 8 no's of 11 kV / 415 V transformers of different capacity. Three transformer stations are supplying 14 men's hostels, three transformers supply academic buildings and 4 ladies hostels. The following table shows the transformer and DG capacity of different power houses.

3.1 TRANSFORMER CAPACITY IN VIT

S. No	Capacity	Voltage rating	Quantity
1	5 MVA Transformer	33 kV/11 kV	2 Nos
2	2000 kVA Transformer	11 kV/433 V	1 No.
3	1000 kVA Transformer	11 kV/433 V	10 Nos.
4	800 kVA Transformer	11 kV/433 V	3 Nos.
5	630 kVA Transformer	11 kV/433 V	1 No.

3.2 GENERATOR CAPACITY IN VIT

S. No	Capacity	Voltage rating	Quantity
1	500 kVA Generator	433 V	13 Nos
2	250 kVA Generator	433 V	4 Nos
3	180 kVA Generator	433 V	1 No
4	140 kVA Generator	433 V	1 No
5	40 kVA Generator	433 V	3 Nos

4. EB CONSUMPTION AND BILL ANALYSIS:

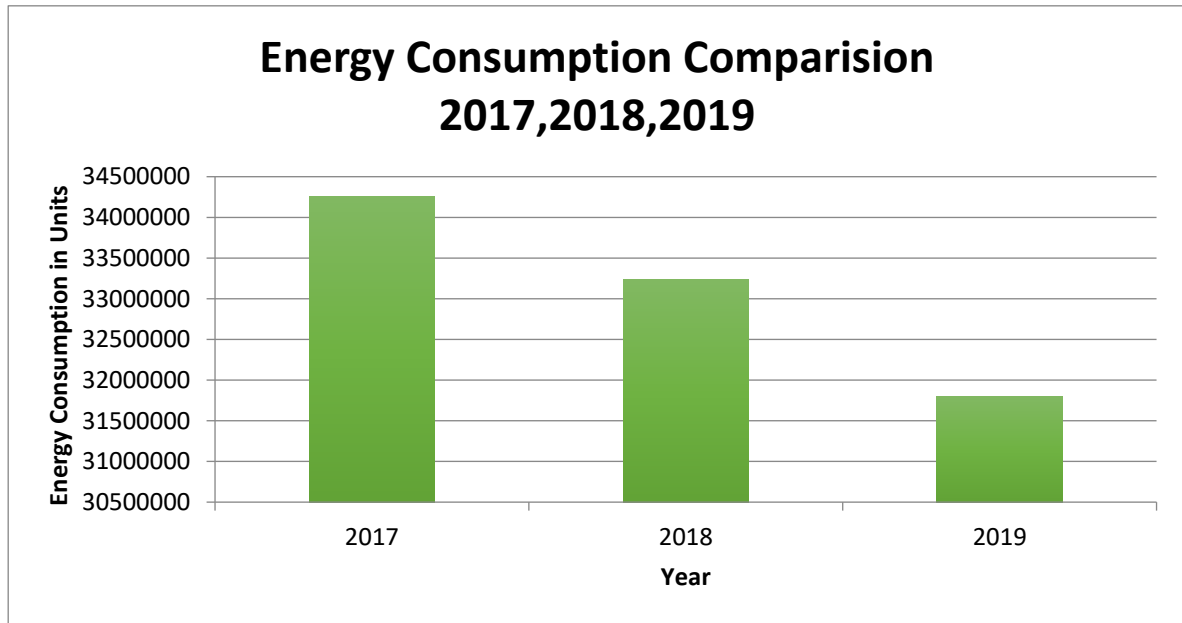
4.1 EB Bill Analysis in terms of units consumed for last three years

The following table shows the electricity consumption for the student strength of 33000 in 2019. In addition roof top solar PV of 1.125 MW is installed in various buildings also produce electricity.

Electricity consumption in terms of Units

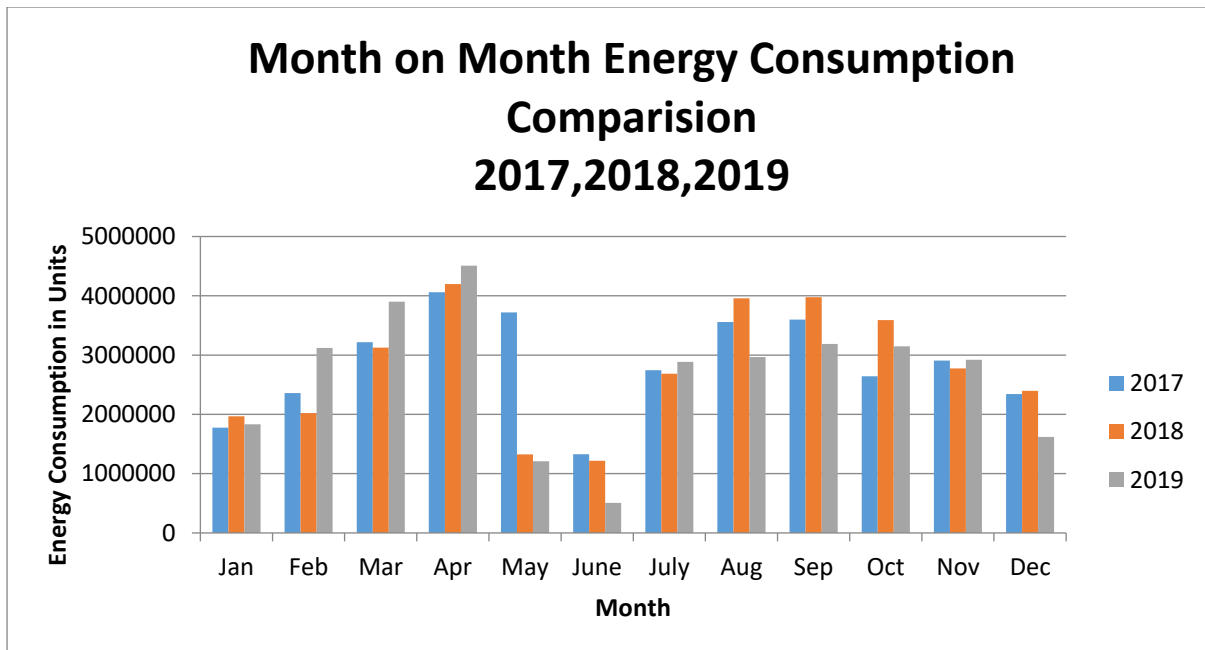
Unit Energy Consumption of VIT					
2017		2018		2019	
Month	EB UNITS	Month	EB UNITS	Month	EB UNITS
Jan-17	1775930	Jan-18	1966786	Jan-19	1833634
Feb-17	2359845	Feb-18	2022594	Feb-19	3121000
Mar-17	3218193	Mar-18	3125487	Mar-19	3900048
Apr-17	4061164	Apr-18	4197333	Apr-19	4508386
May-17	3719356	May-18	1326293	May-19	1208502
Jun-17	1328682	Jun-18	1216629	Jun-19	505883
Jul-17	2744051	Jul-18	2684659	Jul-19	2885280
Aug-17	3558053	Aug-18	3956288	Aug-19	2965579
Sep-17	3598346	Sep-18	3977284	Sep-19	3186686
Oct-17	2642021	Oct-18	3588903	Oct-19	3146106
Nov-17	2908064	Nov-18	2774807	Nov-19	2920836
Dec-17	2344110	Dec-18	2396822	Dec-19	1618597
Total	34257815	Total	33233885	Total	31800537

Year on Year comparison



Because of the roof top solar PV and centralised chiller plant the electricity consumption is reduced in 2019.

Month on month comparison for 2017, 2018 & 2019

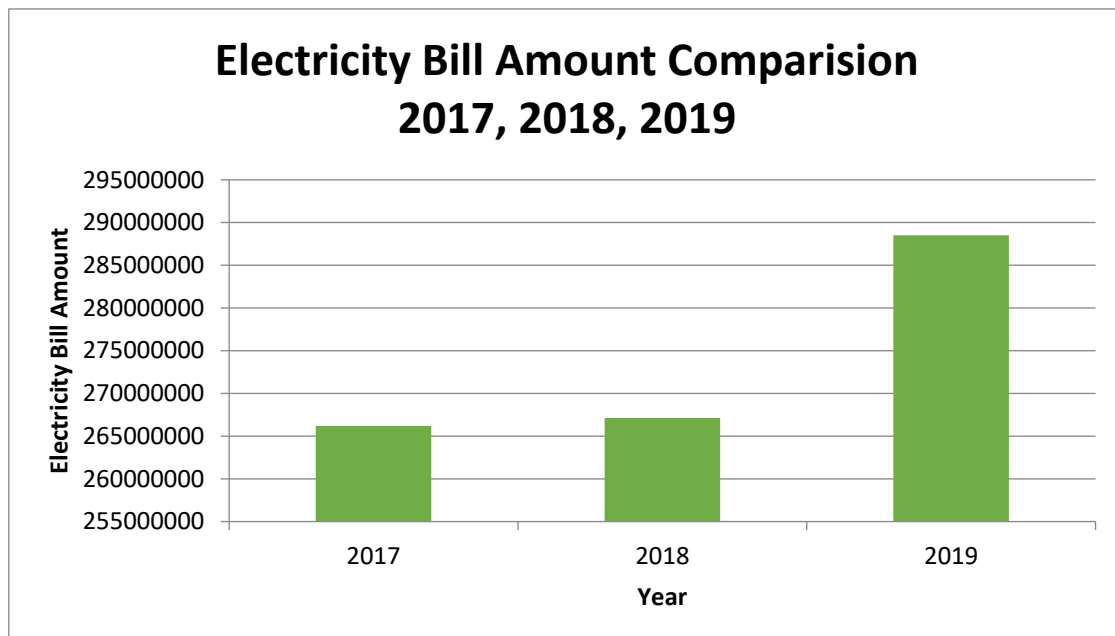


From Nov 2018 onwards the wind power is purchased and the cost is one rupee less than the utility prize. Since the number of AC rooms increased along with student strength the consumption is also increased. From 2019 July, two new hostel buildings with more AC rooms are in operation. Because of the replacement of conventional split ACs in to centralised chiller ACs the electricity consumption is within the contract demand. In 2019 most of the conventional tube lights are replaced with LED lamps.

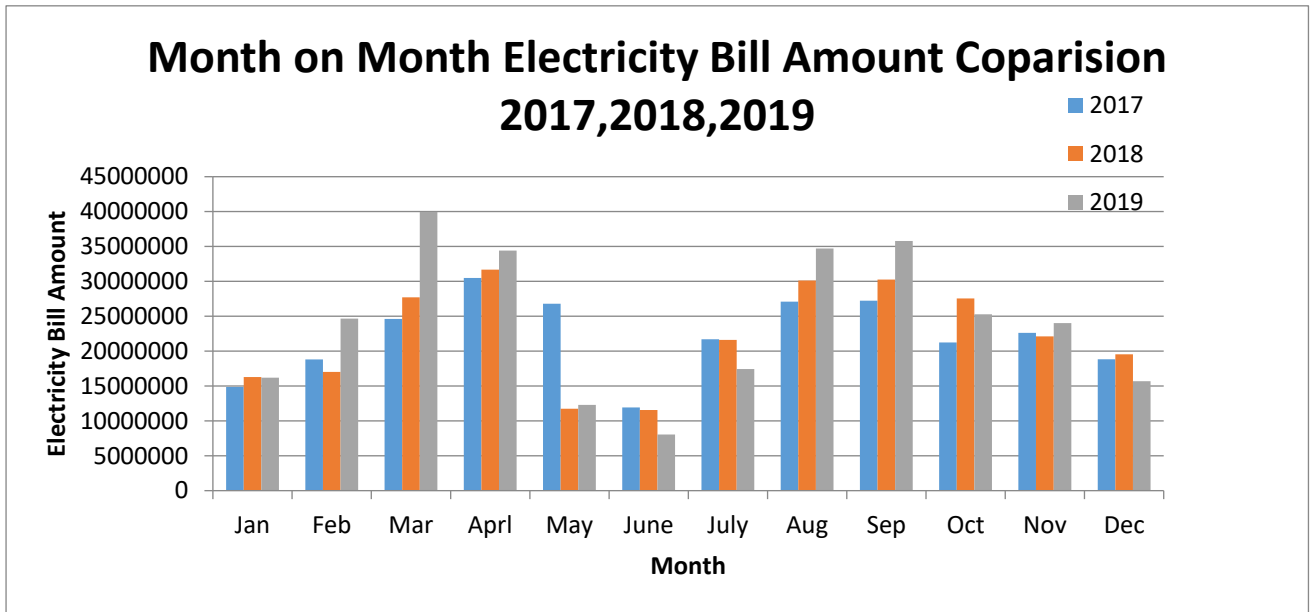
4.2 EB Bill Analysis in terms of bill amount for last three years

Electricity Bill Amount in Rupees					
2017		2018		2019	
Jan-17	14870958	Jan-18	16289951	Jan-19	16195685
Feb-17	18820552	Feb-18	17011884	Feb-19	24664385
Mar-17	24620253	Mar-18	27706784	Mar-19	39958182
Apr-17	30480262	Apr-18	31676946	Apr-19	34413114
May-17	26789270	May-18	11743162	May-19	12294040
Jun-17	11927059	Jun-18	11556586	Jun-19	8056050
Jul-17	21691941	Jul-18	21597849	Jul-19	17431988
Aug-17	27093154	Aug-18	30108700	Aug-19	34717193
Sep-17	27219016	Sep-18	30249210	Sep-19	35774858
Oct-17	21248028	Oct-18	27539146	Oct-19	25284250
Nov-17	22607600	Nov-18	22109442	Nov-19	24023453
Dec-17	18830101	Dec-18	19538229	Dec-19	15697790
Total Bill Amount	266198194		267127889		288510988

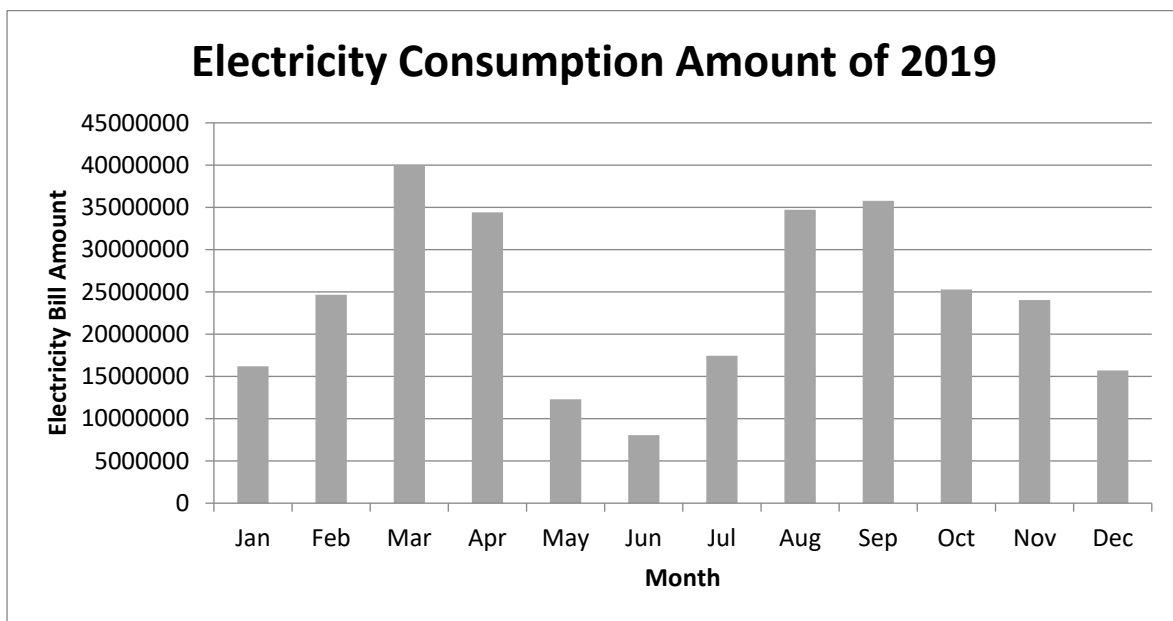
Year on Year comparison



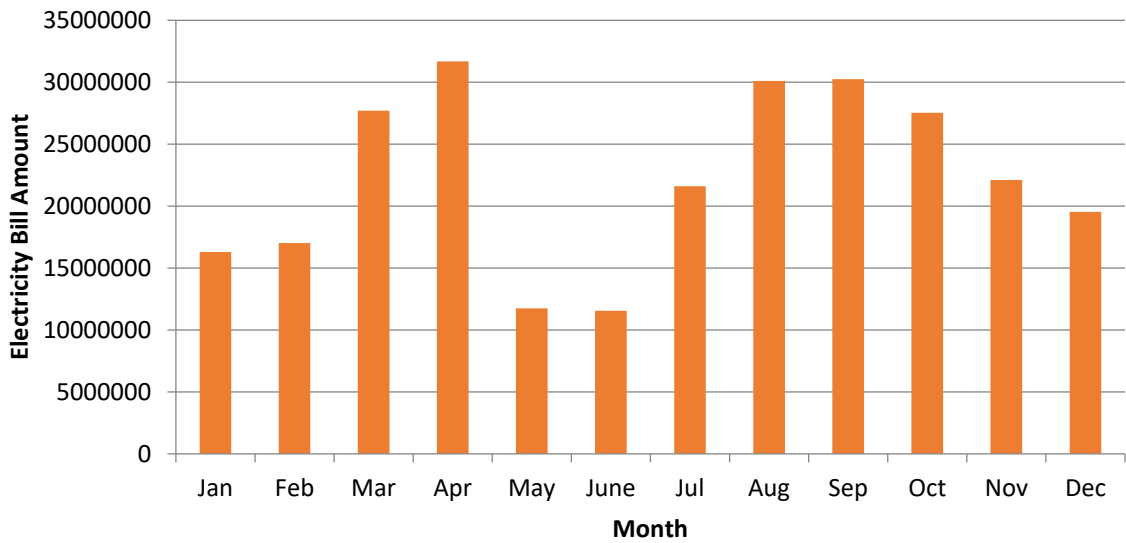
Month on Month comparison for 2017, 2018 and 2019:



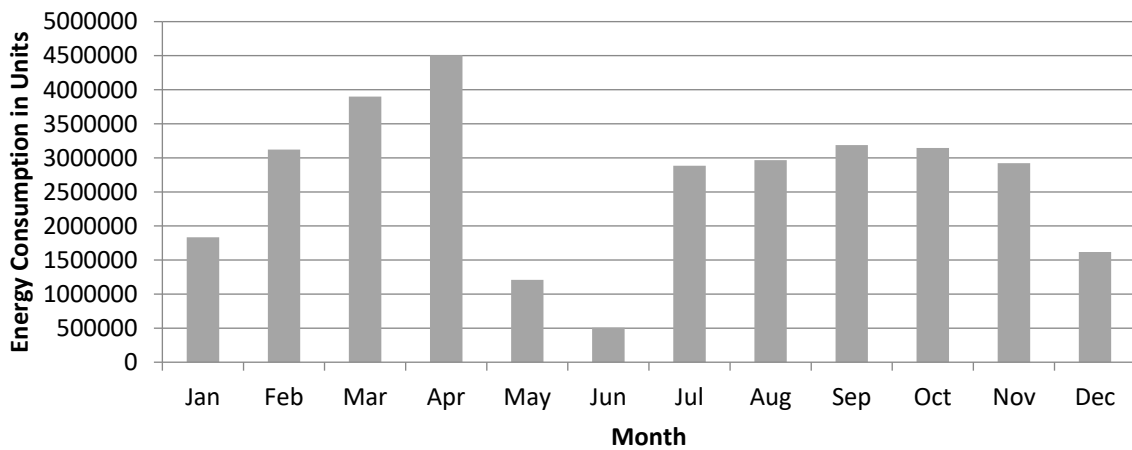
Month on month comparisons



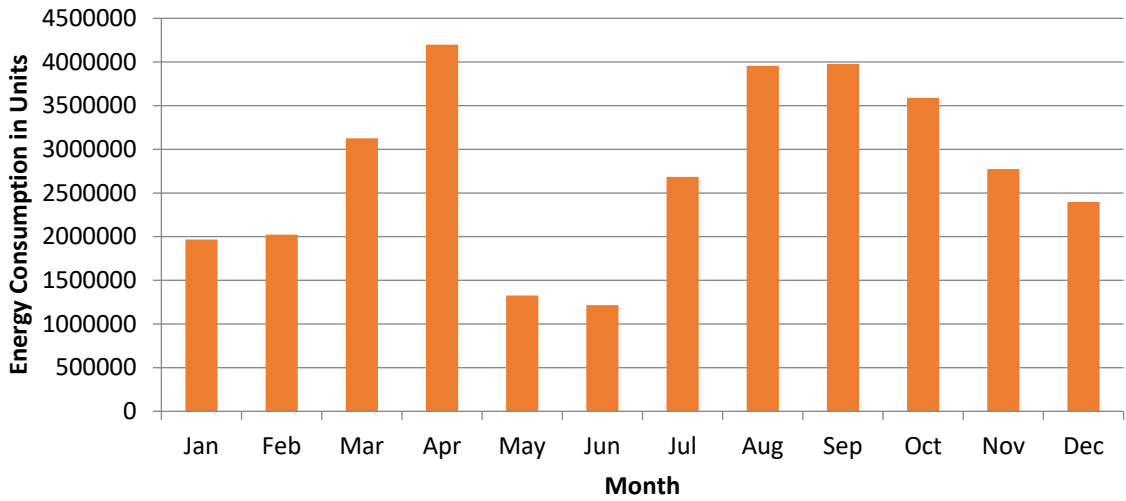
Electricity Consumption Amount of 2018



Energy Consumption of VIT in 2019



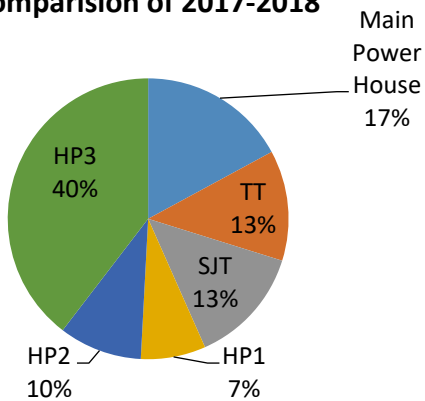
Energy Consumption of VIT in 2018



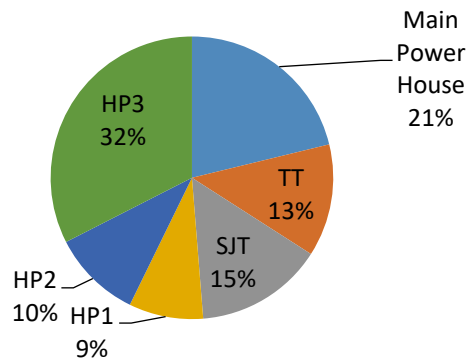
Substation wise comparison for Fiscal year (2017-2018 and 2018-2019)

Consumption in Units (April- March)		
Substations	2017-2018	2018-2019
Main Power House	860131	987367
TT	639591	599477
SJT	680941	683068
HP1	375870	396505
HP2	481612	477642
HP3	1990689	1514030

Substation wise consumption comparison of 2017-2018

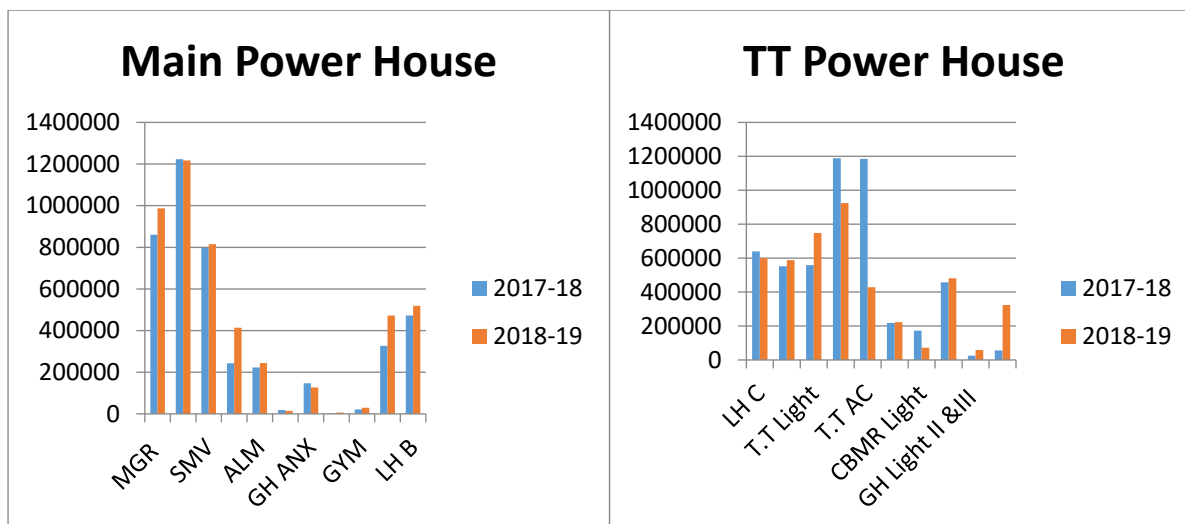


Substation wise Consumption Comparison of 2018-2019

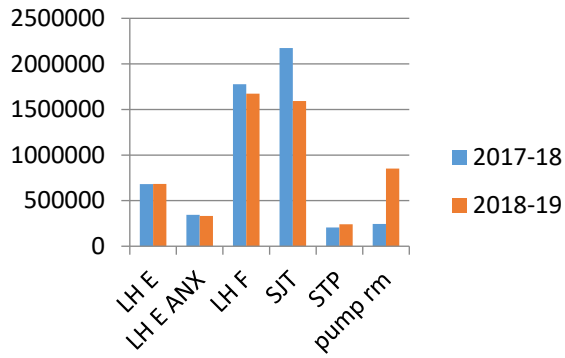


	MAIN POWER HOUSE			TT POWER HOUSE			SJT			HP1			HP2			HP3		
	2017-18	2018-19		2017-18	2018-19		2017-18	2018-19		2017-18	2018-19		2017-18	2018-19		2017-18	2018-19	
MGR	860131	987367	LH C	639591	599477	LH E	680941	683068	A	375870	396505	E - Block	481612	477642	M - Block	1990689	1564050	
LIBRARY	1223399	1216978	LH D	552288	588233	LH E ANX	344738	331981	B	497265	558743	K - Block	1786819	1629654	N - Block	1733173	1759643	
SMV	797445	814940	T.T Light	558514	748190	LH F	1777873	1674150	BA	152051	170646	L - Block	1876850	1638376	P - Block	935968	904119	
GDN	242811	414030	T.T POWER	1189146	924468	SJT	2174319	1593564	C	146968	215970	STADIUM	24416	25913	STP-5	175820	167745	
ALM	222850	243904	T.T AC	1184763	428786	STP	205606	241694	D	329102	366424	Swim pool	86110	84170	Q BLOCK	0	469523	
CDMM	18621	15001	STP	217731	222632	pump rm	244291.7	852543	DA	555041	563665	STP 1-4	651710	503287.2	CHILLER	0	659350	
GH ANX	147264	126896	CBMR Light	172449	71991				F	1035216	1022031							
SOU SHOP	3517	5948	CBMR Pow & AC	457493	481261				G	1170899	1438067							
GYM	21591	29462	GH Light II & III	24502	58486				H	987162	1239787							
LH A	326511	471894	GH Pow II & III	55827	324228				J	827287	808927							
LH B	472236	519123							co2 Cntr	146686	196128							
									HOSTEL	138714	161579							
TOTAL	4336376	4845543	TOTAL	5052304	4447752	TOTAL	5427769	5377000	TOTAL	6362261	7138472	TOTAL	4907517	4359043	TOTAL	4835650	5524430	

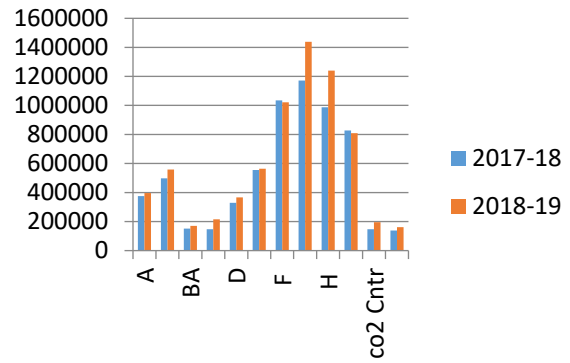
Substation wise unit's consumption for the fiscal year (April-17 to March-18) and (April-18 to March-19)



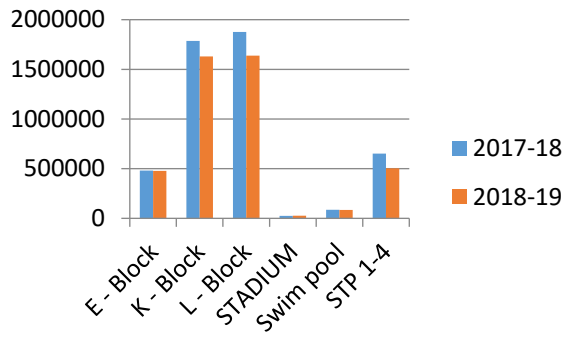
SJT Power House



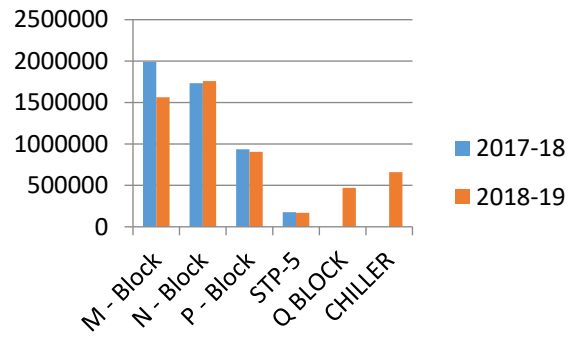
HP1



HP2



HP3



5. WIND POWER SUPPLY SAVINGS CALCULATION:

Month	Quantum of Wind Energy	Wind Amount/month	EB Amount/month
April	2	11.8	12.7
May	5	29.5	31.75
June	7	41.3	44.45
July	22	129.8	139.7
August	22	129.8	139.7
September	22	129.8	139.7
October	7	41.3	44.45
November	1	5.9	6.35
December	1	5.9	6.35
January	2	11.8	12.7
February	2	11.8	12.7
March	2	11.8	12.7
	95 Lakhs Units	Rs. 560.5 Lakhs/year	Rs. 603.25 Lakhs/year
No of Wind energy units sanctioned		95.00 Lakhs	
1 Unit Wind energy cost		5.90 Rs/Unit	
1 Unit EB energy cost		6.35 Rs/Unit	
Calculated EB Amount(in Lakhs)		603.25 Lakhs/year	
Wind energy (in Lakhs)		560.5 Lakhs/year	
Savings		42.75 Lakhs	

Solar PV of 500 kW and 613.33 kW are installed in 2015 and 2018 respectively in the building roof tops. The panel installation details at different building are detailed below.

	Capacity in kW	kW per panel	No.of panels
GDN Block	196.35	0.255	770
LH A & B Block	89.76	0.255	352
LH-C Block	28.8	0.32	90
LH-D Block	50.56	0.32	158
LH-E Block	40.96	0.32	128
LH-F Block	65.28	0.32	204
MH-A Block	65.28	0.32	204
MH-B Block	84.48	0.32	264
MH-C Block	60.16	0.32	188
MH-D Block	50.56	0.32	158
MH-E Block	78.72	0.32	246
MH-F Block	58.65	0.255	230
MH-G Block	33.66	0.255	132
MH-L Block	45.44	0.32	142
MH-P Block	114.75	0.255	450
MH SWIMMING POOL	49.92	0.32	156
TOTAL Capacity	1113.33 kW		3872

From 2018 and 2019, total of 37781 LED lamps are fitted in place of conventional fluorescent tube lights, metal halide and sodium vapour lamps. This reduced almost 50 % energy consumption.

Description	LED Qty	Wattage	Load in KW	Running Hours	kWh/day
16W LED Tube light	3426	16	54.816	12	657.792
18W Round LED light	1356	18	24.408	12	292.896
20W LED Tube light	1894	20	37.88	12	454.56
10.5W LED Round light	341	10.5	3.5805	10	35.805
9W Bulk head LED light	477	9	4.293	10	42.93
1' x 1' 16W Square LED light	629	16	10.064	10	100.64
48W Square LED light	12	48	0.576	6	3.456
150W Square LED light	24	150	3.6	6	21.6
0.5W Foot lamp LED light	1256	0.5	0.628	8	5.024
22W Round LED light	29	22	0.638	10	6.38
22W Square LED light	339	22	7.458	10	74.58
2' x 2' 36W Square LED light	143	36	5.148	10	51.48
10W Round LED light	436	10	4.36	10	43.6
12W RoundLED fitting	252	12	3.024	4	12.096
8W RoundLED fitting	127	8	1.016	4	4.064

6.5 W spot LED fitting	167	6.5	1.0855	4	4.342
5W Bed lamp LED fitting	87	5	0.435	4	1.74
3W Foot lampLED fitting	86	3	0.258	4	1.032
2.5W strip LED fitting	40	2.5	0.1	4	0.4
10W mirror light	107	10	1.07	4	4.28
5W LED light	450	5	2.25	12	27
25W Street light LED	41	25	1.025	12	12.3
200W LED light	14	200	2.8	12	33.6
60W LED street light	18	60	1.08	12	12.96
30W LED street light	12	30	0.36	12	4.32
6W LED street light	25	6	0.15	12	1.8
90W street light fittings	30	90	2.7	12	32.4
15W Sq fitting	408	15	6.12	8	48.96
18W Sq fitting	608	18	10.944	8	87.552
2' x 2' 34w fitting	250	34	8.5	8	68
1 x 18W TL	40	18	0.72	8	5.76
2 x 20w TL	10	40	0.4	8	3.2
18W LED Tube light	23510	18	423.18	8	3385.44
2 x28w Tubelight	122	56	6.832	8	54.656
5W round light	28	5	0.14	8	1.12
75W square fitting	28	75	2.1	8	16.8
2x2 24W square	959	24	23.016	15	345.24
	37781		656.755		5959.805

Lighting load	Power Consumption in kW
Conventional	1254.27 kW
LED	656.755 kW

Annual lighting power requirement met through LED bulbs = 5959 kWh x 313 days = 1865167 kWh

Annual lighting energy savings met through LED bulbs (in percentage)
= 656.755/1254.27 = 52.36 %.

6. CENTRALISED CHILLER PLANT:

Last year centralised chiller plant was commissioned and 1415 additional rooms air conditioned.

50 % of energy is saved and that is used for additional room air condition purpose.

No of AC UNITs in K, L, M, N hostel blocks

Conventional AC						
Blocks	2 bed	3 bed	4 bed	6 bed	Dorm	No of AC rooms
K			12	179		191
L	100		2	78	9	189
M	117	165		70		352
N	161	190		42		393
	378	355	14	369	TOTAL	1125

AC TYPE	Rooms	kW
1 ton	378	491.4
1.5 ton	372	725.4
2 ton	375	979
	1125	2195.8
Avg load /AC room		1.95182 kW

Chiller plant and Fan coil unit details:

Chiller plant						
Block	2 bed	3 bed	4 bed	6 bed	dorm	no of ac rooms
K			40	262		302
L	343	17	36	151		547
M	152	196		84		432
N	190	230		72		492
Q	220	412	132	3		767
					TOTAL	2540

Total load consumed by fan coil unit =101.894 kW

Total Load Consumed by Chiller plant for pumps and cooling fans = 2682 kW

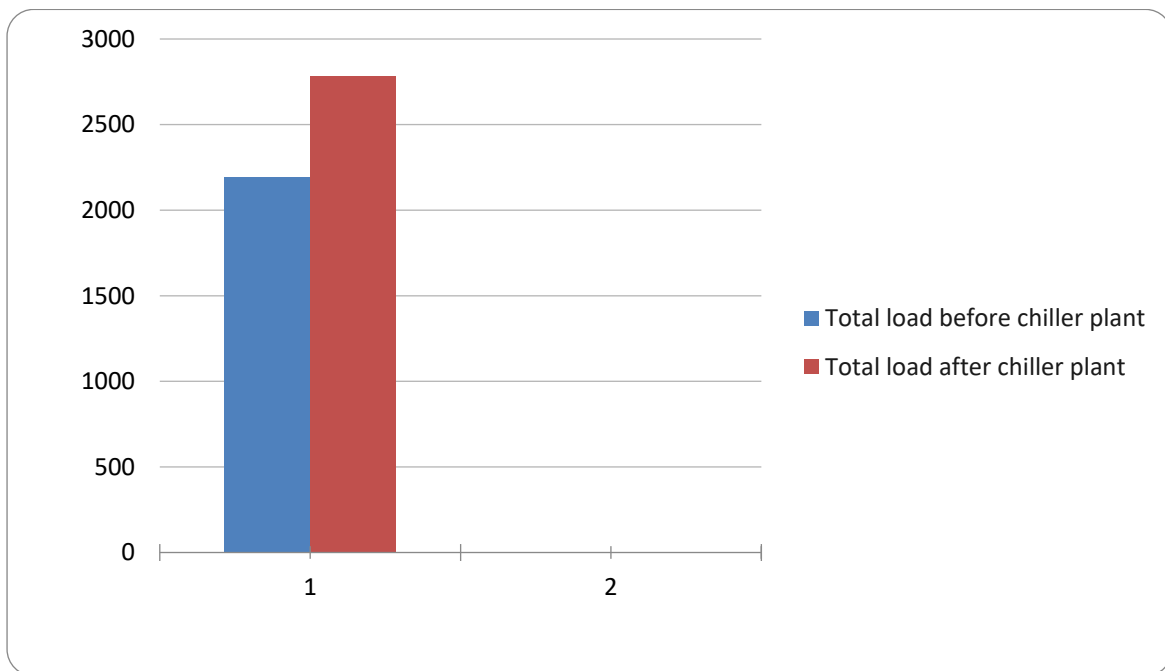
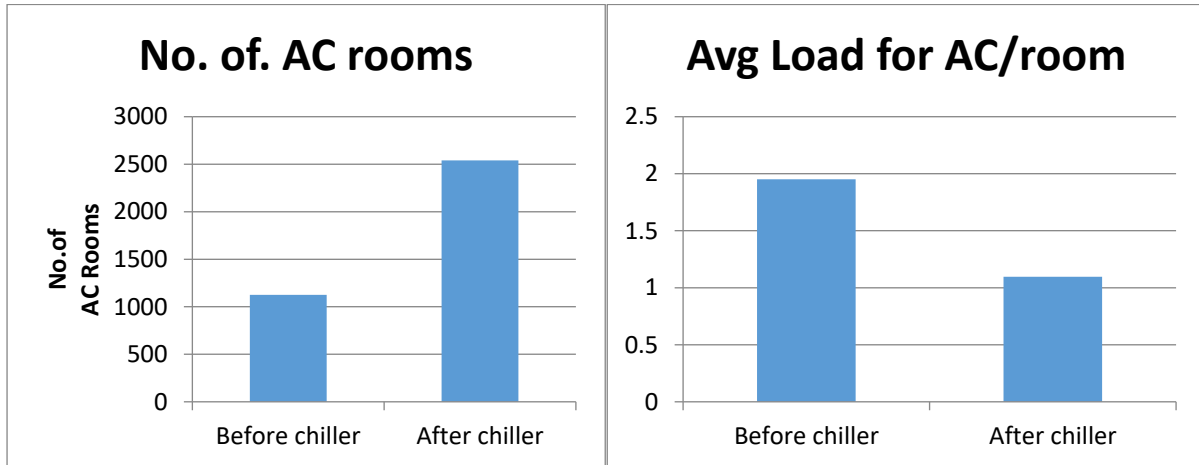
Total = 2783.9 kW

No of rooms having AC=2540

Avg Load per AC room= 1.096 kW

Efficiency = $(1.096/1.95182)*100 = 43\%$

	No.AC rooms	Avg load AC/room
Before chiller	1125	1.9518 kW
After chiller	2540	1.096 kW



In the Academic year 2019, approximately 4000 more students and two new hostels with 1415 additional number of rooms are given AC. Even after this the contract demand is maintained because of the replacement of conventional split ACs and increased usage of LEDs instead of FTLs.

A power saving proximity sensor unit of worth Rs 1,400 is fit in individual hostel rooms. An approximate calculation for single, double, three, four, six beds and dome is calculated approximately taking 4 hours of energy savings in AC and Non AC rooms.

	Tube Light	Fan	Mirror Light	Study Light	AC	Total kW	ApX Run hrs Before sensor	ApX Run hrs After sensor
KW	0.04	0.07	0.08	0.011	1.3			
1 BED	1	1	1	1	1	1.501	12	8
2 BED	1	1	1	2	1	1.512	12	8
3 BED	2	2	1	3	1.5	2.283	12	8
4 BED	2	2	1	4	1.5	2.294	12	8
6 BED	2	4	1	6	2	3.106	12	8
DOME	4	4	1	0	2	3.12	12	8

	kWH/MONTH	kWH/MON	Rs/Yr	Rs/ Yr	SAVINGS
1 BED	540.36	360.24	41175.432	27450.3	13725.144
2 BED	544.32	362.88	41477.184	27651.5	13825.728
3 BED	821.88	547.92	62627.256	41751.5	20875.752
4 BED	825.84	550.56	62929.008	41952.7	20976.336
6 BED	1118.16	745.44	85203.792	56802.5	28401.264
DOME	1123.2	748.8	85587.84	57058.6	28529.28

With initial investment of Rs.1400/room approximately,

$$\begin{aligned} \text{Average savings/room} &= (13725.144+13825.728+20875.752+20976.336+28401.264+28529.28) \\ &= 21055.584 \text{ Rs/year/room} \end{aligned}$$

7. CONCLUSION:

. The energy audit of Vellore Institute of Technology, Vellore has been conducted successfully based on the data collected and analysed. The consumption pattern of 2019 shows a significant decrease when compared to the previous years due to the introduction of chiller plants in the place of air conditioners for cooling, but there is an increase as well in the bill amount spent on energy because of the opening of new hostel buildings in the university. Measures to reduce the cost spent on energy has been taken such as replacement of conventional lights with LEDs, buying wind power from external sources in cheaper rates compared to EB, etc. Few remarkable efforts which VIT has put forth consistently is leading to an energy efficient infrastructure without reduction in the requirements. Thus VIT University persistently follows the path of achieving the goal of energy conservation .

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