Energy Audit Report of VSSUT (2020-21)

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA, SAMPALPUR- 768018, ODISHA

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Energy Audit of system is key instrument in knowing the present level of efficiency of various components and establishing the areas of shortfall for improvement. This audit was done to identify the areas in the University having wastage of energy and to search for different methods to reduce the electricity consumption. Detailed analyses and survey of all electrical loads was done. It was observed that if common appliances are used in a smart and effective ways, it may help to reduce the consumption of electricity. Data collection consisted loads of all academic areas, hostels, faculty & staff quarters, university guest house, auditorium, e-Learning Centre, Community Centre etc. Necessity of this audit comes in mind after observing the electricity bills on monthly basis. This report made with sincere efforts gives details of the relevant data collected during energy audit study, observation, analysis & recommendations made pertaining to different facilities in campus. Several Energy Conservation Opportunities Measures have been identified and proposed in course of the study. It is expected to bring in lasting benefits (saving) in term of energy as well as cost saving to the university.

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Preface

Data collection for energy audit of the **VSSUT** was conducted by a team for the period of July 2020 to June 2021. This audit was conducted to examine the convenience for progress of the energy competency in the campus. Energy audit survey was completed by Electrical Engineering and EEE students under the guidance of their faculty members. All the data were collected from different classrooms, laboratories, etc. The work is completed by considering the number of tubes, fan, air conditioners (ACs), electronic instruments, etc in each room and also taking into consideration the contribution of each component in total electricity consumption. We really appreciate the effort put by the Electrical Maintenance Section of University for creating awareness for Energy Audit, using renewable energy like solar energy establishing the significance for efficient energy saving. We really appreciate the University management for encouraging us by providing this wonderful opportunity to do the energy audit. Through this, we have arrived to a clear vision of University towards a Green campus and save our green nature.

Acknowledgement

We are very much thankful to our Vice-Chancellor and Director, IQAC, NAAC Team, for motivating us and giving us the opportunity for energy audit. We would like to express our sincere thanks to HOD, EE and HOD, EEE, faculty members and students those who have taken active part in this audit survey for each department, labs, offices etc. of University. We tried our best to present this energy report as per requirements of University.

Summary

The objective of this audit was to study the energy consumption pattern of the available facilities, identify the potential areas for possible energy/cost saving and prepare proposals for energy/cost saving along with investment and payback periods. The salient observations and recommendations are given below.

1. VSSUT consumes energy in the following forms:
   1.1. From TPWODL (the grid),
   1.2. Electricity SOLAR off-Grid roof top solar plant, and
   1.3. High Speed Diesel Generator (HSDG)
2. The average expenditure of energy consumption is around ₹15 lakhs per annum towards our annual load demand that brings approx. ₹ 2.65 lakhs per month of energy consumption at the unit cost of ₹ 6.20
3. After the measurement and analysis, we propose herewith following Energy Efficiency Improvement measures.

Electrical energy is used for various applications, like: Computers, Lighting, Air-Conditioning, Fans Other Laboratory Equipment, Printers, Xerox machines, CCTV, UPS, LCD Projector, Router system, Flood light, and Pumping motor etc.

Table: Energy Efficiency Improvement

Sl.No.	Recommendations	Prior Consumption (in kW)	Annual Saving Potential (in ₹)	Estimated Investment (in ₹)	Pay Back period (in years)	Remarks (Feasibility)
1	Replacing 20-W LED Tube Lights in place of 40-W fluorescent tube light (FTL)	180 x 40-W = 7.2kW	180 x 450.00 = ₹ 81,000.00 Saving wattage = 250 x 20-W = **∴ 7.2-5 = 2.2-kW** Saving wattage = 150 x 36-W = 5.4-kW **∴ 11.25 – 5.4 = 5.85-kW**	50,000.00	0.6	Mid/Short Term
2	Replacing Radiation ES Ultra-Thin LED Street light in place of flood light	800 x 12 = 9.6-kW	25,000.00 Saving wattage = 200 x 12-W =2.4-kW **∴ 9.6 – 2.4 = 7.2kW** 150 x 1-kW = approx. 150-kW	40,000.00	1.6	Mid Term
	Total Amount	329-kW	165-kW	22,75,000.00		

As per prior consumption, we shall save 164-kW/hour (329-kW – 165-kW).

NOTE on the calculations:

As per aforementioned table, implementations of the above-mentioned recommendations bring down energy consumptions in kW/hour to:

- Daily saving on account of working hours(e.g., 8 hours) =
  164-kW/hour x ₹ 6.20 x 8 = ₹8134.00
- Monthly saving on account of working hours(considering 25 working days) =
  ₹8134.00 x 25 = approx. ₹ 2.04 lakhs
- Annual saving on account of working hours = ₹2.04 lakhs x 12 = ₹ 25 lakhs

Considering the life cycle of the items/equipment, this exercise shows that estimated investment as per column 5 of the table may be recovered in one academic year span. Thereafter, the same will be applied to save approx. ₹ 25 lakhs per annum.

Chapter : 1

Introduction to Energy Audit

General

An audit Committee Constituted on dated 23/08/2020, was entrusted with the work of conducting a detailed Energy Audit of University campus with the main objectives are as below:

- To study the present pattern of energy consumption
- To identify potential areas for energy optimization
- To recommend energy conservation proposals with cost benefit analysis.

Scope of Work, Methodology and Approach:

Scope of work and methodology were as per the proposal. While; undertaking data collection, field trials and their analysis, due care was always taken to avoid abnormal situations so as to generate a normal/representative pattern of energy consumption at the facility.

Approach to Energy Audit:

We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipment. The key to such performance evaluation lies in the sound knowledge of performance of equipment and system as a whole.

Energy Audit:

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream. Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on a financial analysis basis.

Energy Audit Methodology:

Energy Audit Study is divided into following steps: -

1. Historical Data Analysis:

The historical data analysis involves establishment of energy consumption patterns to the established baseline data on energy consumption and its variation with change in production volumes.

2. Actual measurement and data analysis:

This step involves actual site measurement and field trials using various portable measurement instruments. It also involves input to output analysis to establish actual operating equipment efficiency and finding out losses in the system.

3. Identification and evaluation of Energy Conservation Opportunities:

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period.

Chapter : 2

General Details

S. No.	Particulars	Details
1	Name of University	Veer Surendra Sai University of Technology, Burla, Sambalpur
2	Year of Establishment	1956, 12th August
3	Full address	SIDHI VIHAR BURLA-768018
4	Programmes offered	B Tech, B. Arch, M.Tech., M. Sc., Ph.D., Int. M.Sc., MCA
5	AICTE Approval	F.No. Eastern/1-4262239940/2019/EOA Date-30.04.2019
6	UGC 2(f) and 12(B)	F-9-36/2009(CPP-1/PO) Date-08.11.2012
7	Odisha Act No.	9 of 2009
8	Govt. order for University Status	Industries Dept, Govt of Odisha 8554 and 8565, 10/06/2019

Chapter : 3

Energy Consumption Profile

Source of Energy

VSSUT uses Energy in following forms:

- Electricity from TPWODL :VSSUT receives Electricity from TPWODL.
- High Speed Diesel Generator (HSDG): HSD is used as a fuel for Diesel Generator which is run whenever power supply from TPWODL is not available.

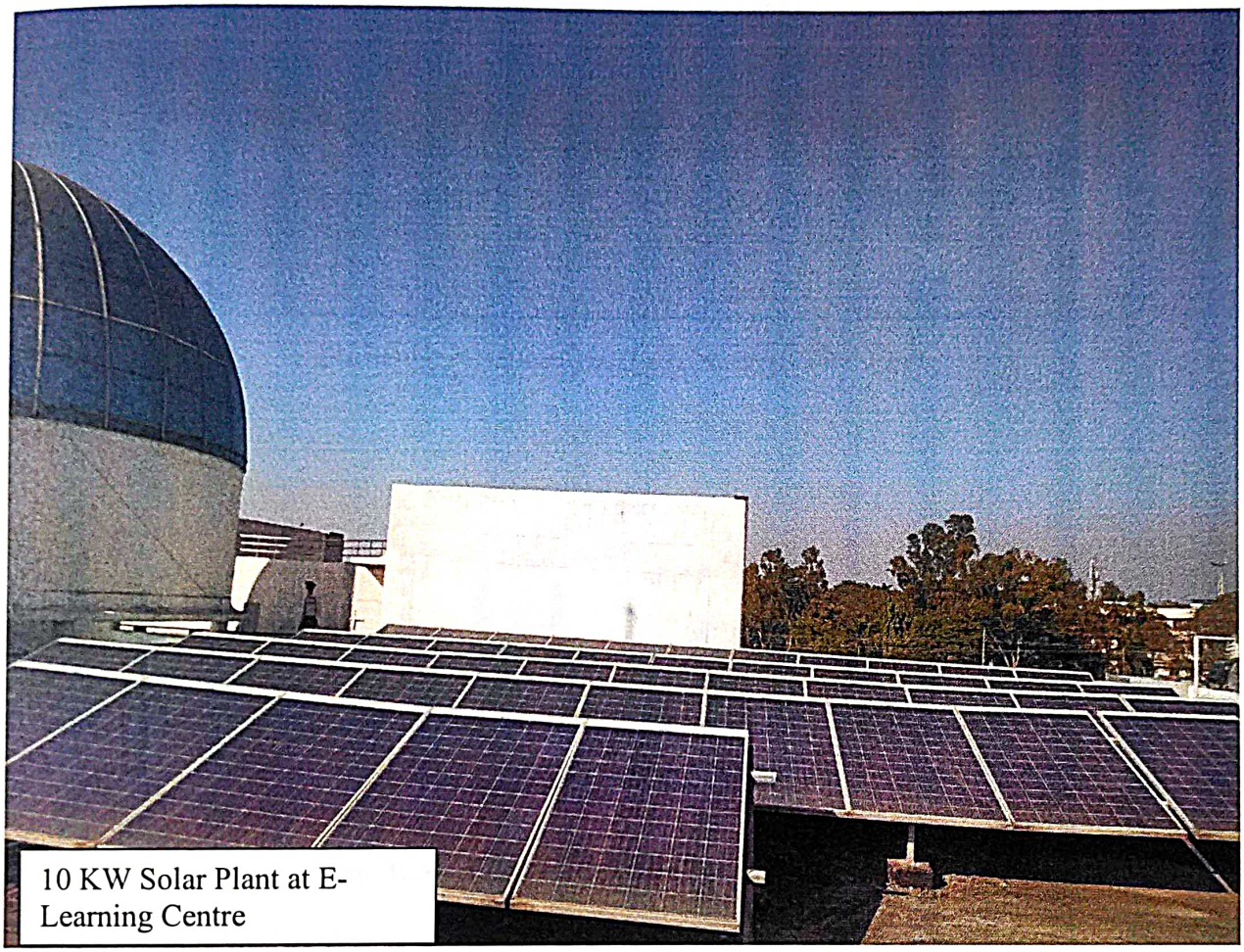
Places	DG Set Capacity
E-Learning Centre	500 kVA
Central Library	250 kVA
Auditorium	125 kVA
Pullah Hall	2 x 320 kVA
Vasundhara Hall	82.5kVA

E-Learning Centre,
500-KVA DG Set

Central Library 250 KVA DG Set

Pullah Hall 2 X 320 kVA DG Set

- Roof-top SOLAR plant (10 kW): e-Learning Centre



10 KW Solar Plant at E-Learning Centre

Following are the major consumers of electricity in the facility:

Lighting, Fans, Laboratory Equipment, Pumping motors and Ovens, Flood Lights and Computers, Printers, CCTV, UPS, LCD Projector, Router System, Air-Conditioning, Xerox machines etc.

Specific Energy Consumption (SEC):

Specific Energy Consumption (SEC) is defined as energy usage per Square meter of area. It is calculated as total electrical kWh/total area of the campus. By calculating SEC, we can crudely target the factors of energy efficiency or inefficiency

Chapter : 4

Historical Data Analysis

Study of Variation of Monthly Units consumption & Power Factor:

In this Chapter, we studied the details of the 12-months Electricity Bills.

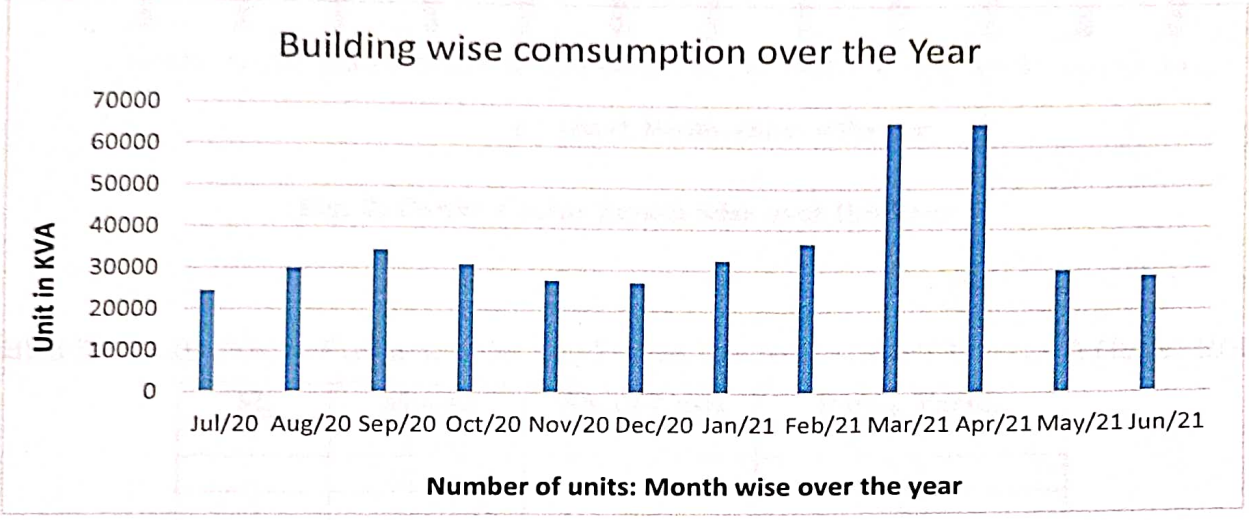


Fig. 1: Number of Units month wise over the Year

TABLE I. VARIATION IN UNIT CONSUMPTION AND POWER FACTOR IN ADMINISTRETIVE/ACADEMIC BLOCKS AND BOYS HOSTELS

S. No.	Month	No. of Units	Power Factor
1	July 2020	24461	0.9985
2	Aug 2020	30080	0.9976
3	Sep 2020	34571	0.9972
4	Oct 2020	31179	0.8835
5	Nov 2020	27376	0.9990
6	Dec 2020	26955	1.0000
7	Jan 2021	32432	0.9987
8	Feb 2021	36662	0.9954
9	Mar 2021	65888	0.9989
10	Apr 2021	65675	1.0000
11	May 2021	29926	0.9991
12	June 2021	28369	0.9989
	Total units	**433574**	Average p. f. 0.9

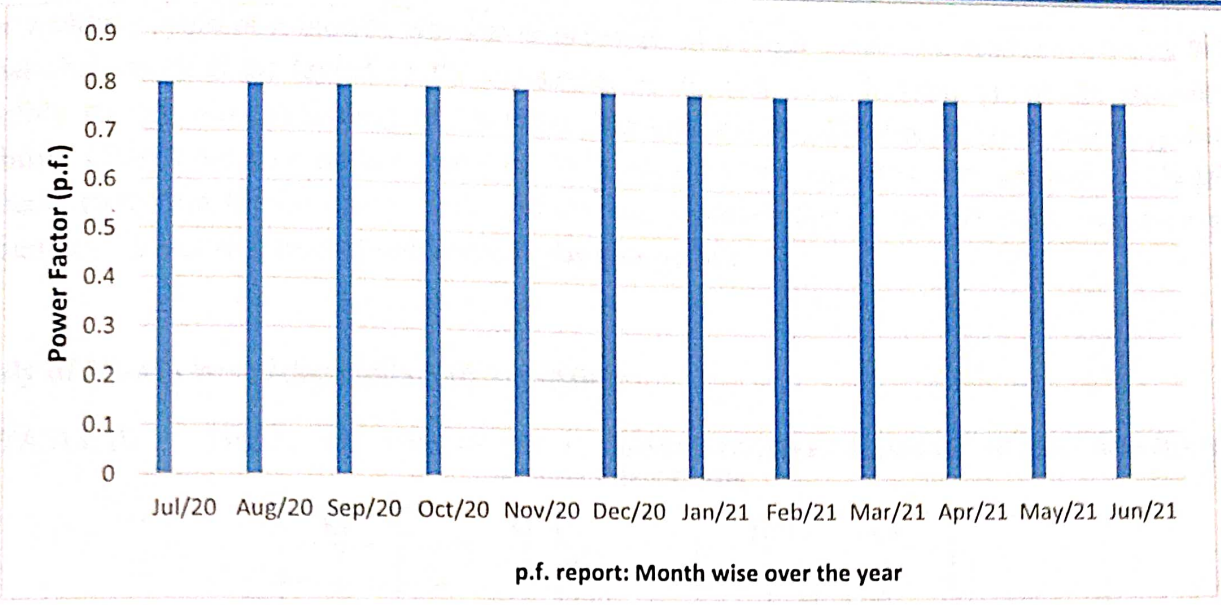


Fig. 2: Power Factor month wise over the Year

TABLE II. VARIATION IN CONSUMPTION AND POWER FACTOR IN GIRL'S HOSTEL & GUEST HOUSE

Sl.	Month	No. of Units	Power Factor
1	July 2020	5921	0.8
2	Aug 2020	5023	0.8
3	Sep 2020	7419	0.8
4	Oct 2020	3503	0.8
5	Nov 2020	4883	0.8
6	Dec 2020	4857	0.8
7	Jan 2021	10275	0.8
8	Feb 2021	18215	0.8
9	Mar 2021	33460	0.8
10	Apr 2021	46682	0.8
11	May 2021	53708	0.8
12	June 2021	3396	0.8
	Total units	**197342**	Average p.f. 0.8

Conclusion

Variation of PF

The Power Factor helps to reduce the utility power bill. Most utility bills are influenced by KVAR usage. A good Power Factor provides a better voltage, reduces the pressure on the electrical distribution network, reduces cable heating, cable overloading and cable losses, reduces over loadings of control gears and switch-gears etc. Whenever the average power factor

over a billing cycle or a month, whichever is lower, of a High-Tension consumer is below 90%, Penal charges shall be levied to the consumer at the rate of 2 % (two %) of the amount of monthly energy bill (excluding of Demand Charges, FOCA, Electricity Duty and Regulatory Liability Charge etc.)For power factor of 0.99, the effective incentive will amount to 5% (five percent) reduction in the energy bill and for unity power factor; the effective incentive will amount to 7% (seven percent) reduction in the energy bill.

Study of Month wise Electricity Bill Variation

TABLE III. MONTH WISE EXPENDITURE OF ADMINISTRATIVE / ACADEMIC BLOCKS AND BOYS HOSTELSBUILDINGS

Sl.	Month	Bill Amount
1	July 2020	576291.00
2	Aug 2020	573809.00
3	Sep 2020	608482.00
4	Oct 2020	553793.00
5	Nov 2020	524621.00
6	Dec 2020	450729.00
7	Jan 2021	526034.00
8	Feb 2021	328140.00
9	Mar 2021	770896.00
10	Apr 2021	909249.00
11	May2021	297175.00
12	June 2021	419426.00
	Total Amount	**65,38,645.00**
	Average monthly bill	544888.00

TABLE IV. MONTH WISE EXPENDITURE OF THE GIRLS HOSTELS AND GUEST HOUSE

Sl.	Month	Bill Amount
1	July 2020	66701.00
2	Aug 2020	73661.00
3	Sep 2020	70816.00
4	Oct 2020	51008.00
5	Nov 2020	56226.00
6	Dec 2020	57600.00
7	Jan 2021	151277.00
8	Feb 2021	157586.00
9	Mar 2021	228094.00
10	Apr 2021	347342.00
11	May2021	112776.00
12	June 2021	94890.00
	Total Amount	**1467977.00**
	Average monthly bill	122331.00

Conclusion

Monthly Electricity Bill Variation has been identified.

Roof Top PV Solar System (10-kW) installed on beginning of e-learning centre installed February 2019. Bill cycle is calculated for the period of three months only [FY 2020-21].

- Before Installation Average Monthly Bill = ₹ 61,235.00
- After Installation Average Monthly Bill = ₹ 47,915.00
- Savings in Bill due to Installation (per month) = ₹13,320.00
- Annual Savings in Bill (One Year) = ₹ 13320.00x12 = ₹ 159,840.00

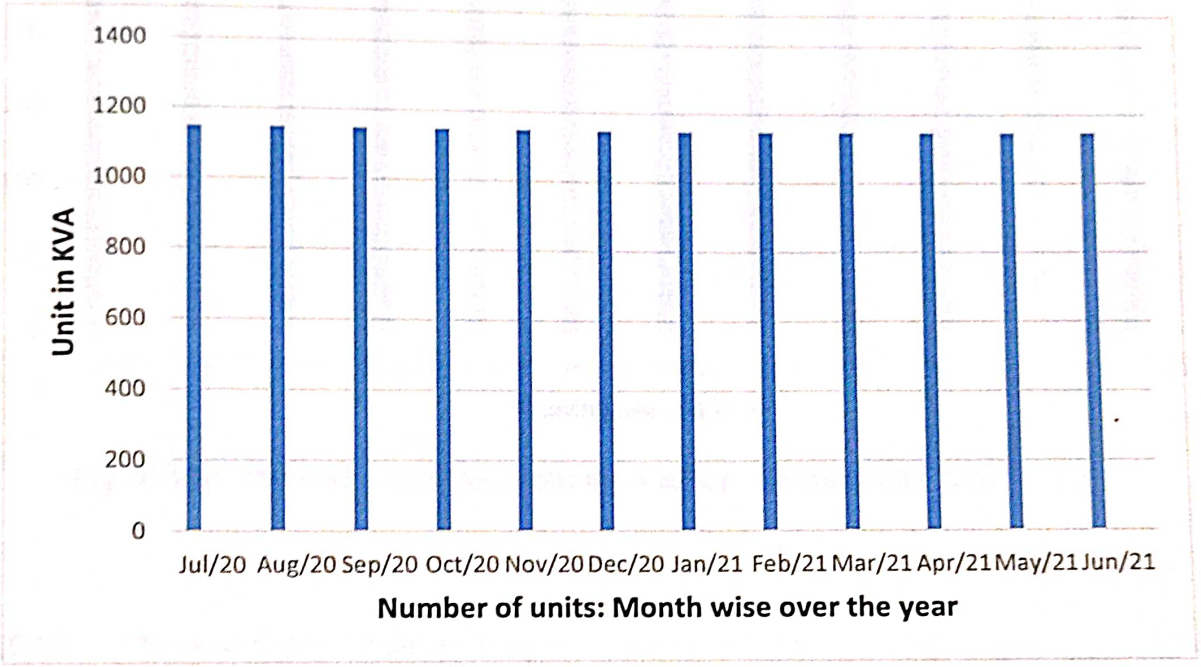


Fig. 3: Max. Demand of Administrative/ Academic Blocks and Boys Hostels: Month wise over the year

Sl.	Month	Maximum demand KVA/month
1	July 2020	1148
2	Aug 2020	1148
3	Sep 2020	1148
4	Oct 2020	1148
5	Nov 2020	1148
6	Dec 2020	1148
7	Jan 2021	1148
8	Feb 2021	1148
9	Mar 2021	1148
10	Apr 2021	1148
11	May 2021	1148
12	June 2021	1148

* Considering the average of Administrative/ Academic Blocks and Boys Hostels buildings.

TABLE V. MONTH WISE MAXIMUM DEMAND VARIATION IN ALL BUILDINGS

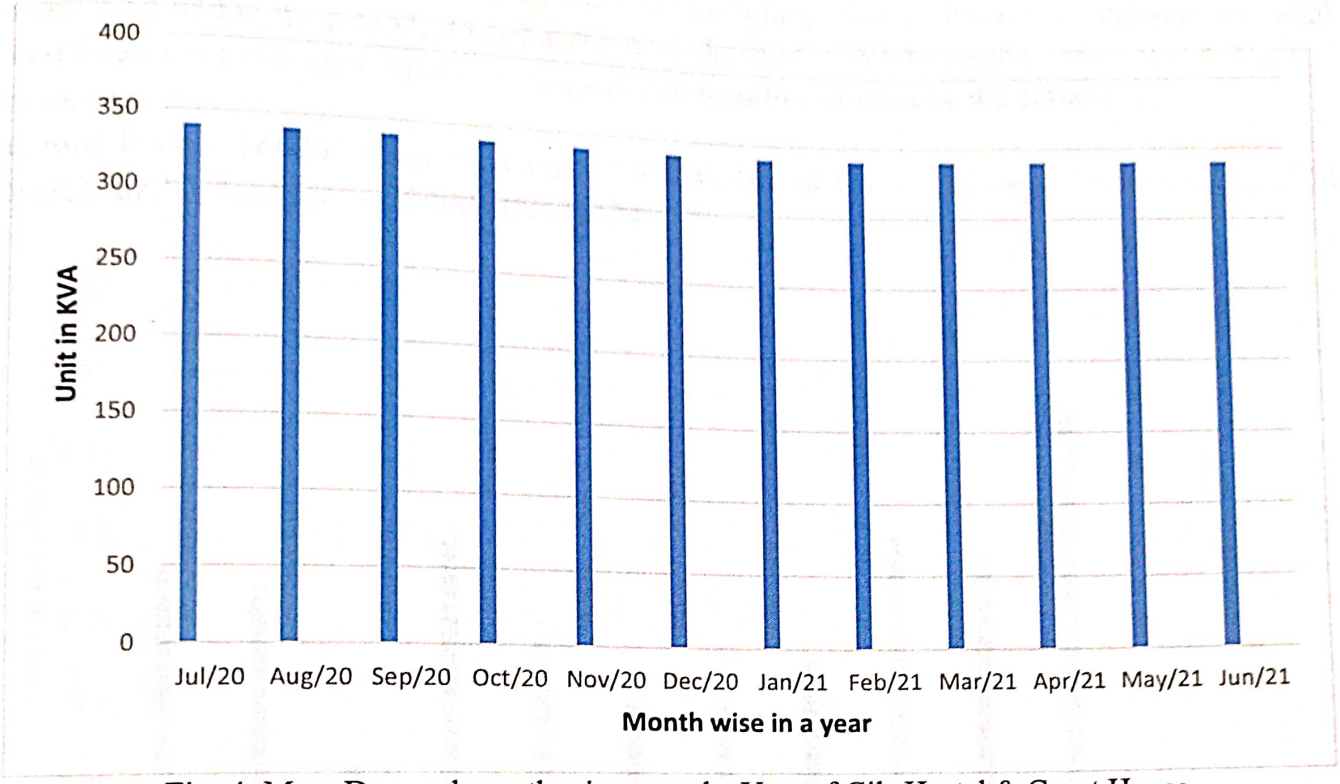


Fig. 4: Max. Demand month wise over the Year of Gils Hostel & Guest House

TABLE VI. MONTH WISE MAXIMUM DEMAND VARIATION IN GIRL'S HOSTEL AND GUEST HOUSE

Sl.	Month	Maximum demand KVA/month
1	July 2020	340
2	Aug 2020	340
3	Sep 2020	340
4	Oct 2020	340
5	Nov 2020	340
6	Dec 2020	340
7	Jan 2021	340
8	Feb 2021	340
9	Mar 2021	340
10	Apr 2021	340
11	May2021	340
12	June 2021	340

Study of Month wise Load Factor Variation

Electrical Load factor is a measure of the utilization rate, or efficiency of electrical energy usage. It is the ratio of total energy (kW h) used in the billing period divided by the possible total energy used within the period, if used at the peak demand (KW) during the entire period. Thus,

Load Factor = kWh/ **(KW/hours in the period/ number of days in the billing cycle)**

For example:

Let total kWh = 360000 kWh; Demand = 100kW; No. of Days = 30 days; Hours per day = 24 hours; Monthly load factor 36000/100x30x24=0.5

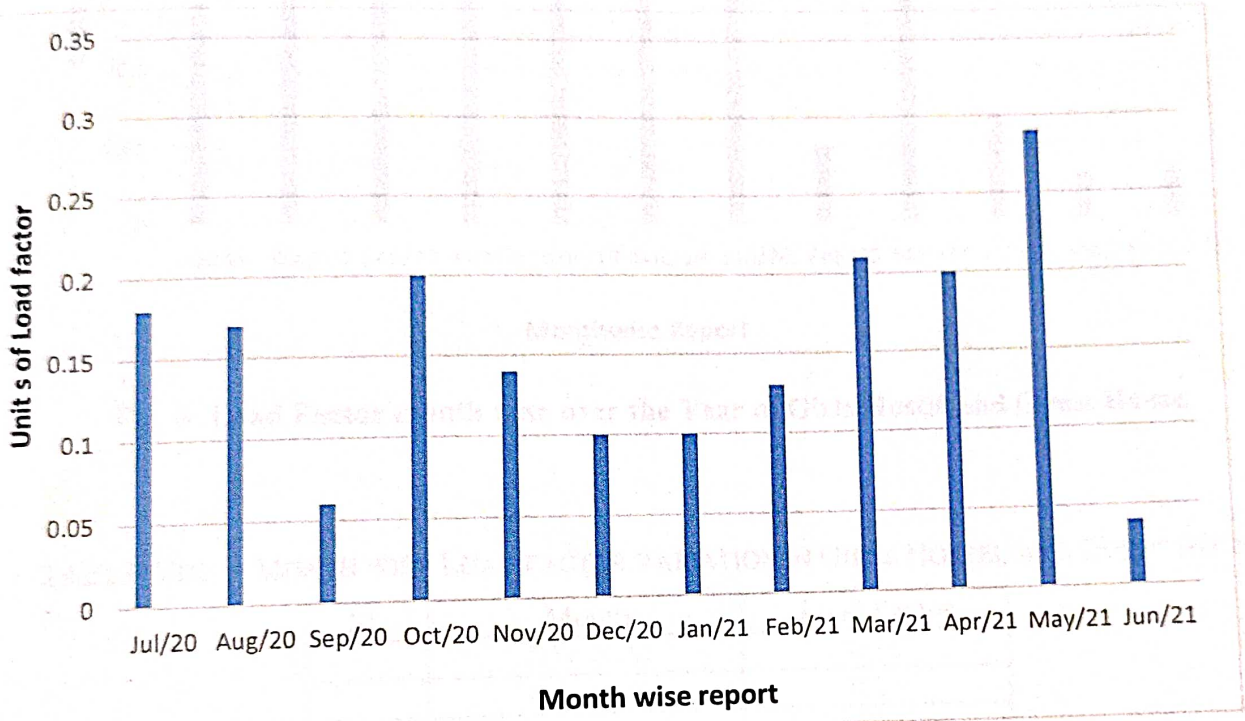


Fig. 5: Load Factor month wise over the Year of Administrative/Academic Blocks and Boys Hostels

TABLE VII. MONTH WISE LOAD FACTOR VARIATION IN ADMINISTRATIVE/ACADEMIC BLOCKS AND BOYS HOSTELS

Sl.	Month	Load Factor
1	July 2020	0.18
2	Aug 2020	0.17
3	Sep 2020	0.06
4	Oct 2020	0.20
5	Nov 2020	0.14
6	Dec 2020	0.10
7	Jan 2021	0.10
8	Feb 2021	0.13
9	Mar 2021	0.21
10	Apr 2021	0.20
11	May2021	0.29
12	June 2021	0.04
	Avg L.F.	0.14

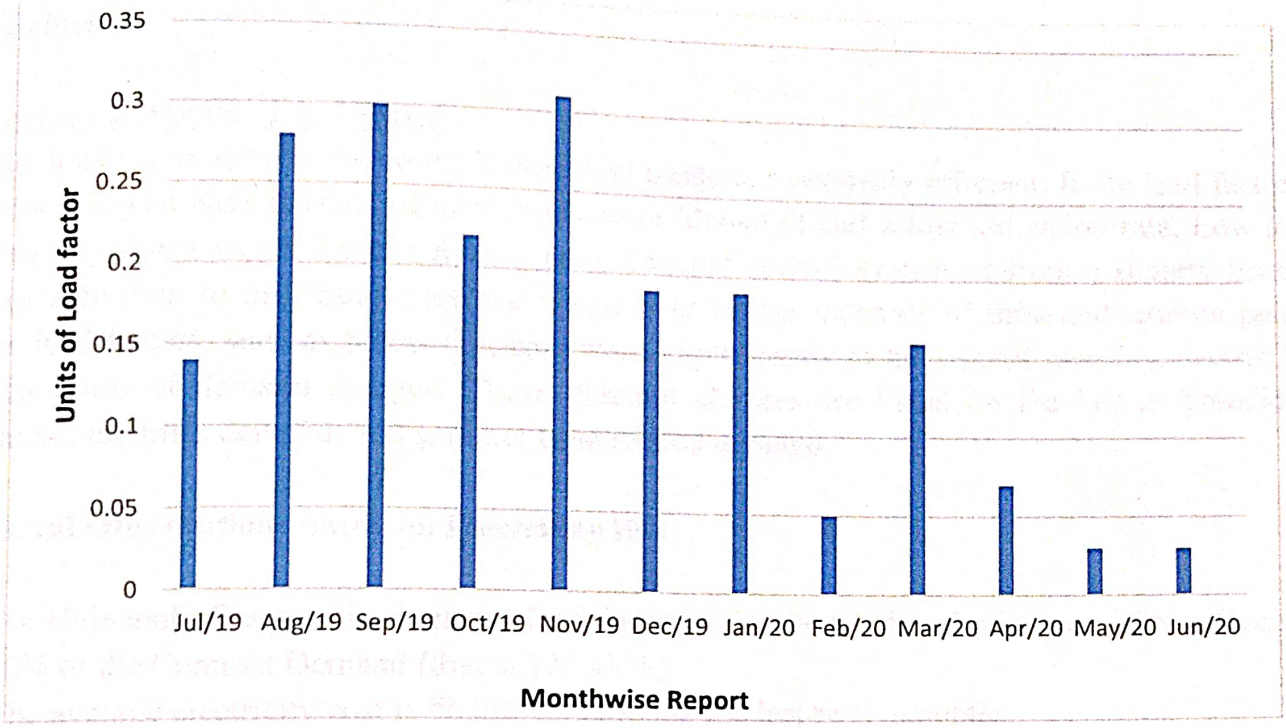


Fig. 6: Load Factor month wise over the Year of Girls Hostel and Guest House

TABLE VIII. MONTH WISE LOAD FACTOR VARIATION IN GIRLS HOSTEL AND GUEST HOUSE

Sl.	Month	Load Factor
1	July 2020	0.16
2	Aug 2020	0.28
3	Sep 2020	0.27
4	Oct 2020	0.20
5	Nov 2020	0.20
6	Dec 2020	0.13
7	Jan 2021	0.14
8	Feb 2021	0.14
9	Mar 2021	0.23
10	Apr 2021	0.42
11	May2021	0.39
12	June 2021	0.06
	Avg L.F.	0.21

Conclusion

Variation in monthly Load Factor

If the load factor ratio is above 0.75, electrical usage is reasonably efficient. If the load factor is below 0.5, you have periods of very high usage (demand) and a low utilization rate. Low load factor customers would benefit from a peak demand control system or from a Battery Energy Storage System to distribute electrical usage over longer intervals of time and smooth peaks. Low load factors, such as below 0.4, contribute significantly to the overall monthly electric bill in the form of demand charges. These demand charges are listed on the bill as coincident demand, facilities demand, and summer time related demand.

General Observations based on Electricity Bill

1. For University Campus the Contract Demand (CD) is 400 KVA and minimum billing Demand is 80% of the Contract Demand (that is,320 kVA).
2. The average electricity cost is ₹6.20/-considering the last twelvemonths. (Excluding TOD charges, MD and the p.f. charges)
3. Average monthly Power Factor is maintained near p.f0.9.
4. Load Factor need to be improved to maximum value.
5. Power factor is affected as per table No 4.1(b). pf =0.8 needs to improve power factor up to 0.9

Department wise load consumption:

TABLE IX. BLOCK A

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF
1	Tube Light	20 watts	200	4 kW	8Hr	32 kWh
2	Fans	50 watts	88	4.4 kW	8Hr	35.2 kWh
3	Computer Load	100 watts	50	5 kW	8Hr	40 kWh
4	Single Phase Load (Power Point)	2000watts	20	40 kW	8 Hr	320 kWh

TABLE X. BLOCK B

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF

1	Tube Light	20 watts	150	3kW	8 Hr	24 kWh
2	Fans	50 watts	142	7kW	8 Hr	56 kWh
3	Computer Load	100 watts	80	08 kW	8 Hr	64 kWh
4	Single Phase Load (Power Point)	2000watts	08	16 kW	8 Hr	128 kWh
5	Three Phase load(Power load)	1492 watts	03	4.476 kW	4 Hr	17.904 kWh

TABLE XI. BLOCK C

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF
1	Tube Light	20 watts	100	2 kW	8 Hr	32 kWh
2	Fans	50 watts	71	3.5 kW	8 Hr	28 kWh
3	Computer Load	100 watts	50	5 kW	8 Hr	40 kWh
4	Single Phase Load (Power Point)	2000watts	09	18kW	8 Hr	144 kWh
5	Three Phase load(Power load)	1492 watts	02	03 kW	4 Hr	12 kWh

TABLE XII. BLOCK D

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF
1	Tube Light	20 watts	100	2 kW	8 Hr	32 kWh
2	Fans	50 watts	71	3.5 KW	8 Hr	28 kWh
3	Computer Load	100 watts	50	5 KW	8 Hr	40 kWh
4	Single Phase Load (Power Point)	2000 watts	09	18 KW	8 Hr	144 kWh
5	Three Phase load(Power load)	1492 watts	13	20KW	4 Hr	80 kWh

TABLE XIII. CSE&IT, EEE, WORKSHOP & LIBRARY

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in Numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF
1	Tube Light	20 watts	250	5 kW	8 Hr	40 kWh
2	Fans	50 watts	200	10 kW	8 Hr	80 kWh

3	Computer Load	100 watts	55	5.5 kW	8 Hr	44 kWh
4	Single Phase Load (Power Point)	2000watts	10	20kW	8 Hr	160 kWh
5	Three Phase load(Power load)	1492 watts	16	25kW	4 Hr	100 kWh

TABLE XIV. AVC HALL & STREET LIGHT

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in Numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF
1	Tube Light	20 watts	50	1 kW	1 Hr	1 kWh
2	Ex F& Fans	70 watts	50	3.5 kW	1 Hr	3.5 kWh
3	Street Light	60 watts	80	4.8 kW	12 Hr	57.6 kWh
4	Single Phase Load (Power Point)	4000watts	01	4 kW	1Hr	4 kWh

TABLE XV. FOUR NUMBERS OF BOYS HOSTEL

Sl	Name of Appliance	Power Rating (Watts)	Quantity (in Numbers)	Power Consumption (Watts)	Usage per Day Hr.	Power Consumption/day (Watts)
A	B	C	D	E=CxD	F	G=ExF
1	Tube Light	20 watts	450	9 kW	12 Hr	108 kWh
2	Ex F& Fans	50 watts	285	14.25 kW	12 Hr	171 kWh
3	Computer	100 watts	200	20 kW	12 Hr	240 kWh
4	Single Phase Load (Power Point)	1492 watts	10	16 kW	1Hr	16 kWh

Remarks

- ✓ It has been observed that in all the building, administrative/academic blocks and annex buildings majority of electrical power consumption is through light load such as fan, FTL and power load such as refrigerator, ups, ACs, etc. Unnecessary use of electrical equipment must be avoided.
- ✓ As per individual department level load consumption, we understand the scope for improvement of energy saving. Hence our electricity bill will be reduced by proper load management techniques along with optimum utilization of resources.

Chapter: 5

Study of Electrical Systems

Electrical Supply Details

The electrical supply to VSSUT is provided by TPWODL at 11 kV, which is stepped down to 400-V by a transformer owned by the University.

Study of Electrical Demand

There is a single meter installed in the different premises. The details of meters are as follows:

TABLE XVI. METER DETAILS

Places	Meter No	Sanctioned Demand	Contract Demand	Recorded Maximum Demand
University Building	WES52587	400 kVA	400 kVA	320 kVA
e-Learning+ Swimming Pool	WES51914	298 kVA+ 30 kVA	328 kVA	328 kVA
PULLAH	WES51932	375 kVA	375 kVA	375 kVA
Pulasthay + Agasthay	WES48846	167kVA+125kVA	292 kVA	133.60 kVA
Anuradha	SWSE26294	50 kW	50 kW	50 kW
Arundhati	WDT02388	62 kW	62 kW	62 kW
Visakha	CWSE26298	35kW	35 kW	35kW
Rohini	CWDT02347	35 kW	35 kW	35 kW
Vasundhara	WES51715	80 kW	80 kW	80 kW
Angira	SWDT02166	14 kW	14 kW	14 kW
Guest House	SWDT02284	76 kW	76 kW	76 kW
Vice Chancellor Residence	WSE45069	20 kW	20 kW	20 kW

Electrical Energy Cost Analysis

The electrical bills from TPWODL, Burla for 12 months from July 2020 to June 2021 have been studied.

Chapter-6

Tariff Slab imposed by TPWODL

PF Incentive

As per the TPWODL tariff, whenever average power factor (p.f.) in a month, is more than0.95, following incentives are offered:

- For every 0.01 improvement of average p.f. above 0.95, an incentive of 1% of the amount of monthly energy bill, (excluding RLC, Demand Charges, FOCA, and Electricity Duty) is offered.
- For p.f. of 0.99 the effective incentive will amount to 5% of the energy charges, and for unity p.f. the effective incentive will amount to 7% of the energy charges.

PF Penalty

As per the MSEDCL tariff, whenever average power factor in a month, is less than 0.95, following incentives are offered:

- For every 0.01 decrease of average p.f. below 0.95, a penalty of 1% of the amount of monthly energy bill, (excluding RLC, Demand Charges, FOCA, and Electricity Duty) is offered. Similarly, it would be changed by 1 % for further decrement of PF.

Performance in power factor is appreciable as the p.f. is maintained average 0.8225 in annual power consumption.
Similarly, there is scope for further improvement of power factor in particular cases. Power factor is affected during June and May 2021 at 0.86 and 0.230. Similarly, during February and March 2021, it is 0.680 and 0.150 respectively, and there is a need to improve power factor up to 0.95. If we focus more on the average power factor of 0.95, we will get the incentives instead of penalty. Thus, it is required to focus more on power factor correction/improvement using a capacitor Bank or APFC panel.

Lighting System

Observations and suggestions

- It is found that FTL, Bulbs, CFLs are installed in the facility.
- It is recommended that some tube lights in this area should be switched off when sufficient daylight is available.
- Presently there are no reflectors installed for tube lights.

- Every light or electric gadget should be kept ON when not needed, is wasting energy and money and is causing pollution that is totally unnecessary.
- Stand-by power can use up to 8% of a household's total electricity.

)on't forget to power down these things when not in use

- Lights
- Heaters and fans (or air-conditioning)
- Printers and scanners
- Battery and phone chargers
- Computers
- Gaming consoles
- TVs, DVD players
- Stereos
- Kitchen gadgets such as blenders, kettles, toasters et

Chapter : 7

Energy saving

Study of Air Conditioners

In the facility for air conditioning there is no centralized system with AHU (air handling unit). However, mostly split air conditioners (ACs) are installed.

TABLE XVII. AC LOAD

Type of AC	Rated Power (kW)	Qty	Voltage	Amps	Actual Power(kW)
Window type	1.5 Ton	10 Nos	230	7	1.5 KW
Split type	2 Ton	169 Nos	230	9	2KW
Central AC	110TR	2 Nos	440	250	750 KW

Observations and suggestions

1. Normal air conditioning temperature should be kept as high as possible (that is, 24 degree Celsius).By thumb rule, an increase in 3 degrees in indoor air temperatures can save 1% of electricity.
2. The ventilation in the area can be provided with installation of natural ventilation. Natural ventilation will also minimize the requirement of exhaust fans.

Merits/Existing Features for Energy Savings

1. Staff vigilance.
2. Computers are connected in LAN.
3. Printers are shared in LAN.
4. Screen savers facility implemented for every computer.
5. AC's used are of three/five STARS/inverter types.
6. Refrigerators are of three STARS
7. Incandescent Bulbs are nowhere used.
8. They are replaced by CFL tubes with electronic choke.
9. Maximum use of natural light.
10. Cross Ventilation is provided in laboratory & class rooms, which reduces the number of fans.
11. Most of the practical's are scheduled at noon where Billing Rate is normal.
12. Walls are painted with off white colour to have sufficient brightness.
13. Solar powered street lamps are used.
14. LED flash light is used in Seminar hall.
15. PV solar system (12V) is installed which is expected to generate 100 Units/day. This exercise saves ₹17100/Year.

Chapter: 8
Energy Conservation Proposals

Providing Energy Saver Circuit to the Air Conditioners:

The energy saver circuits for the air conditioners, intelligently reduces the operating hours of the compressors either by timing or temperature difference logic without affecting the human comfort. This can save around 15% to 30% of the electricity depending on the weather conditions and temperature settings. There are a total 150 numbers split type air conditioner in Indian National Rupees (₹) It is Recommended that the old air conditioners are being replaced with new energy efficient BEE STAR labelled (5 Star and above) air conditioners in a phased manner.

- Considering the average compressor ON Time = 5 h/day;
- Power consumption by 2 TR compressor = 6.1 kW;
- Average daily consumption = 6.1 x 5 = 30.5kWh/day/ air conditioner Yearly operating days = 300 days/year/ air conditioner
- Yearly electricity consumption = 9150 kWh/year/ air conditioner;
- Considering a saving of 15%, total annual savings = 15% x 9150= 1372.5 kWh/year/ air conditioner
- Cost of electricity = ₹ 6.20 / kWh
- Yearly savings = 6.20 x 1372.5 = ₹ 8510/year/ air conditioner
- Total number of Air Conditioners = 169 numbers

Summary

- Total yearly Saving = 169 x 8235/year = ₹1,39,17,15/year
- Total Cost of each energy saver circuit = ₹ 4500 x 1 = ₹4500

Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights

The 40 W FTLs can be replaced with the LED tube lights of 16 W. These changes can be made at the places where the life is higher. Usually a minimum of 3 years warranty is provided, and approximate burning hours is 40 000. (15 years considering 8 hours per day running).

Following calculations are done for 8 hours working

- Power consumption by 36 W FTL with conventional choke = 40 W/ Tube Light
- Equivalent LED tube light = 20 W/ Tube Light
- Savings in power = 24 W/ Tube Light
- Operating hours = 8 h/day x 300 = 2400 h/year
- Tube Light Yearly savings = 2400 x 24 W = 57.6 kWh/year/Tube Light
- Average Cost of electricity = ₹6.20/ kWh
- Saving = 57.6 kWh x 6.20 = ₹357.12 / year/ Tube light
- Approximate investment on single LED Tube lights = ₹ 180
- Number of Tube Lights to be replaced = 200

Summary

- Total Yearly Saving =200 x 357.12 = ₹71424.00/year
- Total Investment = 200x ₹ 200 = ₹40000.00

General Recommendations

- All Class Rooms and labs have Display Messages regarding optimum use of electrical appliances in the room such as lights, fans, computers and projector to save electricity. Display the stickers to save electricity, save nature everywhere in the campus. So that all stakeholders were encouraged to save electricity.
- Most of the time, all the tube lights in a classroom are kept ON, even though there is sufficient light level near the window opening. In such cases, the light row near the window may be kept OFF.
- Trying to get the benefit of -01.50 rate in addition to actual rate for per unit consumption of electric motor pumping during 2200 – 0600 H₹
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers have power saving settings to turn off monitors and hard discs, say after 10 minutes/30 minutes.
- The comfort/Default air conditioning temperature to be set between 24˚C to26˚C.
- Lights in toilet area may be kept OFF during daytime
- Use AUTOMATIC POWER FACTOR CORRECTION (APFC) Panel FOR PF improvement. Need to focus on existing solar plant which is generating power below the rated power
- Need to use power saver circuits for AC.
- Need to replace FTL by smart LED Tube
- Need to replace ordinary bulbs with LED bulbs.
- Need to replace ordinary CRT monitor by LED.
- Need to replace an ordinary refrigerator with a BEE power saver refrigerator if possible.
- Out of total electricity bill paid, 53 percentage are actual energy utilized charges and remaining expense belongs to additional taxes on energy consumption
- Recently the government. be approached for the exemption on electricity duty charges for academic institutes as soon as possible.

Recommendations

1. There has to be a University level student community that keeps track of the energy consumption. Parameters of the various departments, class rooms, halls, areas, meters, etc.
2. Energy auditing inside the campus has to be done on a regular basis and reports should be made public to generate awareness.
3. Need to Create energy efficiency/ renewable energy awareness among the college campus, that is, solar, wind, Biogas energy. The University needs to take initiative to arrange seminars, lectures, paper presentation competitions among students and staff for general awareness.

DECLARATION

This is to certify that the Energy Audit report prepared by the University and the data base used in the report is truthful, and will be validated by IQAC during the visit.

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