

Energy Audit Report of VSSUT (2021-22)



**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 analysis and survey of all electrical loads of VSSUT was done and studied and it was found that if common appliances are used in smart and effective ways it may help to reduce consumption. 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 looking electricity bills every month which are in many Lakhs. 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 and these options when implemented, are 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 2021 to June 2022. 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 fluorescent tubes, fans, 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 authority for encouraging us by providing this wonderful opportunity to do the energy audit. Through this, we have arrived to a clear vision of the 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 the university. We tried our best to present this energy report as per requirements of the 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 ₹ 5.70.
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, Laboratory Equipments, Printers, Xerox machines, CCTV, UPS, LCD Projector, Router system, Flood lights, and water pumps 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)	200 x 40-W = 8kW	200 x 450.00 = ₹ 90,000.00 Saving wattage = 200 x 20-W = 4kW ∴ 8 – 4 = 4kW	40,000.00	0.6	Mid/Short Term
2	Replacing 5-star energy Fans or BLDC fans in place of 75-W conventional fans	150 x 75-W = 11.25kW	150x 4000.00 = ₹ 6,00,000.00 Saving wattage = 150 x 36-W = 5.4kW ∴ 11.25 – 5.4 = 5.85-kW	16,00,000.00	2.6	Long Term
3	Replacing Radiator ES Ultra-Thin LED Street light in place of flood light	800 x 12 = 9.6kW	25,000.00 Saving wattage = 300 x 12-W = 3.6kW ∴ 9.6 – 3.6 = 6kW	40,000.00	1.6	Mid Term
4	Procuring 5-star Inverter AC & replacing existing old convention ACs	150 x 2-kW = 300-kW	12,35,250.00 150 x 1-kW = approx. 150kW	6,75,000.00	0.5	Mid/Short Term
	Total Amount	328.85-kW	163-kW	23,55,000.00		

As per prior consumption, we shall save 166-kW/hour (328.85-kW – 163-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) =
 $166\text{-kW/hour} \times ₹ 5.70 \times 8 = ₹7,570.00$
- Monthly saving on account of working hours(considering 25 working days) =
 $₹7,570.00 \times 25 = \text{approx. } ₹ 1.9 \text{ Lakhs}$
- Annual saving on account of working hours = $₹ 1.9 \text{ Lakhs} \times 12 = ₹ 23 \text{ Lakhs}$

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. ₹ 23 Lakhs per annum.

Chapter: 1

Introduction to Energy Audit

General

An audit Committee Constituted on dated 25/08/2020, 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**

<u>S. No.</u>	<u>Particulars</u>	<u>Details</u>
1	Name of University	Veer Surendra Sai University of Technology, Burla, Sambalpur
2	Year of Establishment	1956, 12 th 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 WESCO is not available.

Places	DG Set Capacity
E-Learning Centre	500 KVA
Central Library	250 KVA
Auditorium	125 KVA





Central Library 250 KVA DG Set

- Roof-top SOLAR plant (10 kW): 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.

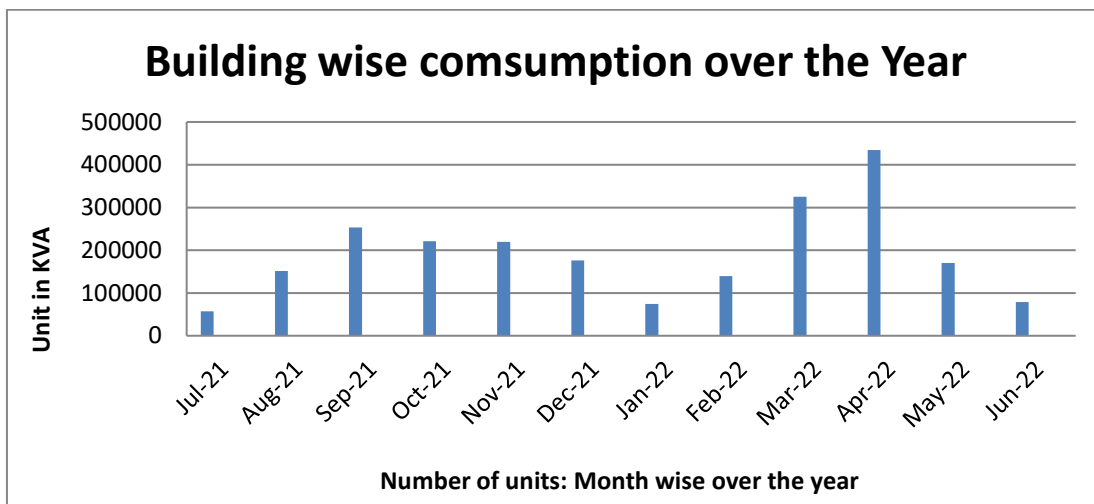


Fig. 1: Number of Units month wise over the Year

TABLE I. VARIATION IN UNIT CONSUMPTION AND POWER FACTOR IN ADMINISTRATIVE/ACADEMIC E-LEARNING CENTRE/BLOCKS AND BOYS HOSTELS

S. No.	Month	No. of Units	Power Factor
1	July 2021	56789	0.9985
2	Aug 2021	151553	0.9976
3	Sep 2021	253439	0.9972
4	Oct 2021	220800	0.8835
5	Nov 2021	219182	0.9990
6	Dec 2021	176313	1.0000
7	Jan 2022	74218	0.9987
8	Feb 2022	139732	0.9954
9	Mar 2022	324815	0.9989
10	Apr 2022	434520	1.0000
11	May 2022	170132	0.9991
12	June 2022	79181	0.9989
	Total units	2300674	Average p.f. 0.9

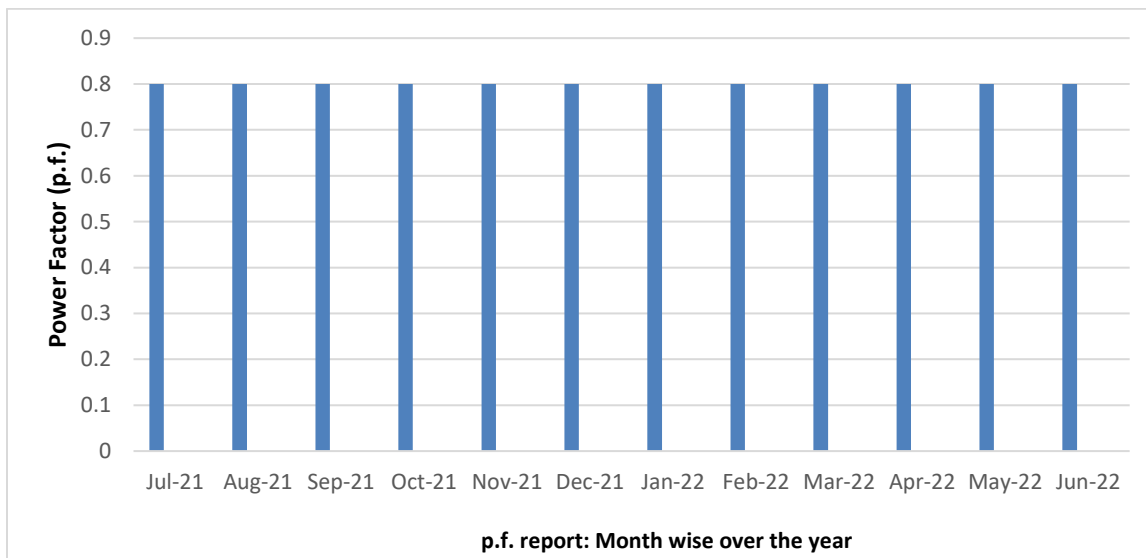


Fig. 2: Power Factor month wise over the Year

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

<u>Sl.</u>	<u>Month</u>	<u>No. of Units</u>	<u>Power Factor</u>
1	July 2021	9526	0.8
2	Aug 2021	18798	0.8
3	Sep 2021	-----	---
4	Oct 2021	23862	0.8
5	Nov 2021	25673	0.8
6	Dec 2021	24213	0.8
7	Jan 2022	14380	0.8
8	Feb 2022	17678	0.8
9	Mar 2022	38855	0.8
10	Apr 2022	59119	0.8
11	May 2022	45639	0.8
12	June 2022	8208	0.8
	Total units	285951	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/E-LEARNING CENTRE AND BOYS HOSTELS BUILDINGS

Sl.	Month	Bill Amount
1	July 2021	511389
2	Aug 2021	745747
3	Sep 2021	941462
4	Oct 2021	827491
5	Nov 2021	858018
6	Dec 2021	759025
7	Jan 2022	497533
8	Feb 2022	668119
9	Mar 2022	1277038
10	Apr 2022	1625165
11	May 2022	1099494
12	June 2022	688651
	Total Amount	10499132
	Average monthly bill	874927.00

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

Sl.	Month	Bill Amount
1	July 2021	144248.00
2	Aug 2021	57244.00
3	Sep 2021	-----
4	Oct 2021	170433.00
5	Nov 2021	296460.00
6	Dec 2021	253429.00
7	Jan 2022	131073.00
8	Feb 2022	196339.00
9	Mar 2022	591762.00
10	Apr 2022	599212.00
11	May 2022	418608.00
12	June 2022	114756.00
	Total Amount	2973564.00
	Average monthly bill	247797.00

CONCLUSION

Monthly Electricity Bill Variation has been identified.

Roof Top PV Solar System (10kW) installed on beginning of e-learning centre installed February 2019.

- 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

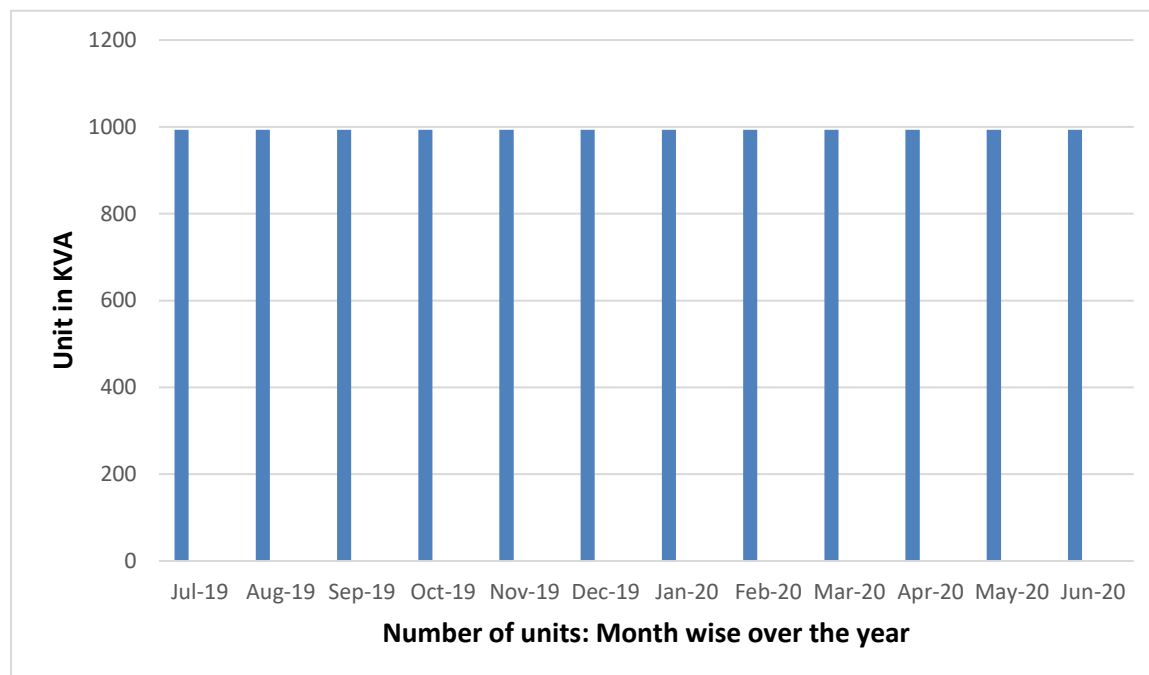


Fig. 3: Max. Demand of Administrative/ Academic Blocks and Boys Hostels: Month wise over the year

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

TABLE V. MONTH WISE MAXIMUM DEMAND VARIATION IN ALL BUILDINGS

Sl.	Month	Maximum demand KVA/month
1	July 2021	993
2	Aug 2021	993
3	Sep 2021	993
4	Oct 2021	993
5	Nov 2021	993
6	Dec 2021	993

7	Jan 2022	993
8	Feb 2022	993
9	Mar 2022	993
10	Apr 2022	993
11	May2022	993
12	June 2022	993

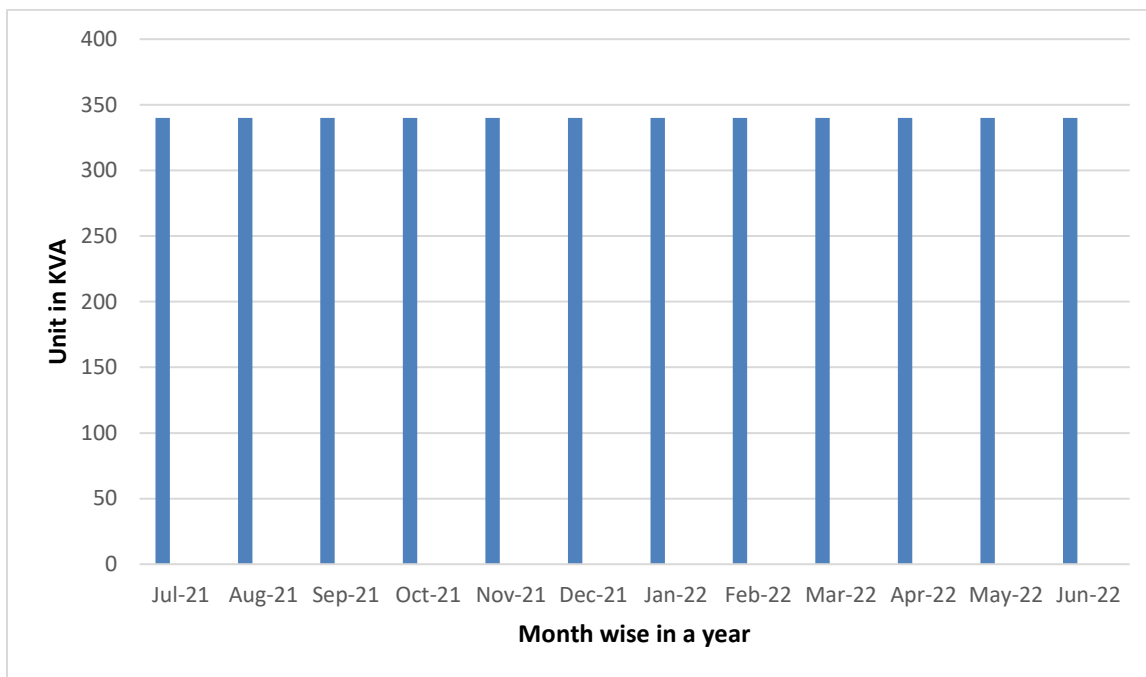


Fig. 4: Max. Demand month wise over the Year of Gils Hostel & Guest House

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

Sl.	Month	Maximum demand KVA/month
1	July 2021	340
2	Aug 2021	340
3	Sep 2021	340
4	Oct 2021	340
5	Nov 2021	340
6	Dec 2021	340
7	Jan 2022	340
8	Feb 2022	340
9	Mar 2022	340
10	Apr 2022	340
11	May2022	340
12	June 2022	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 $360000/100 \times 30 \times 24 = 0.5$

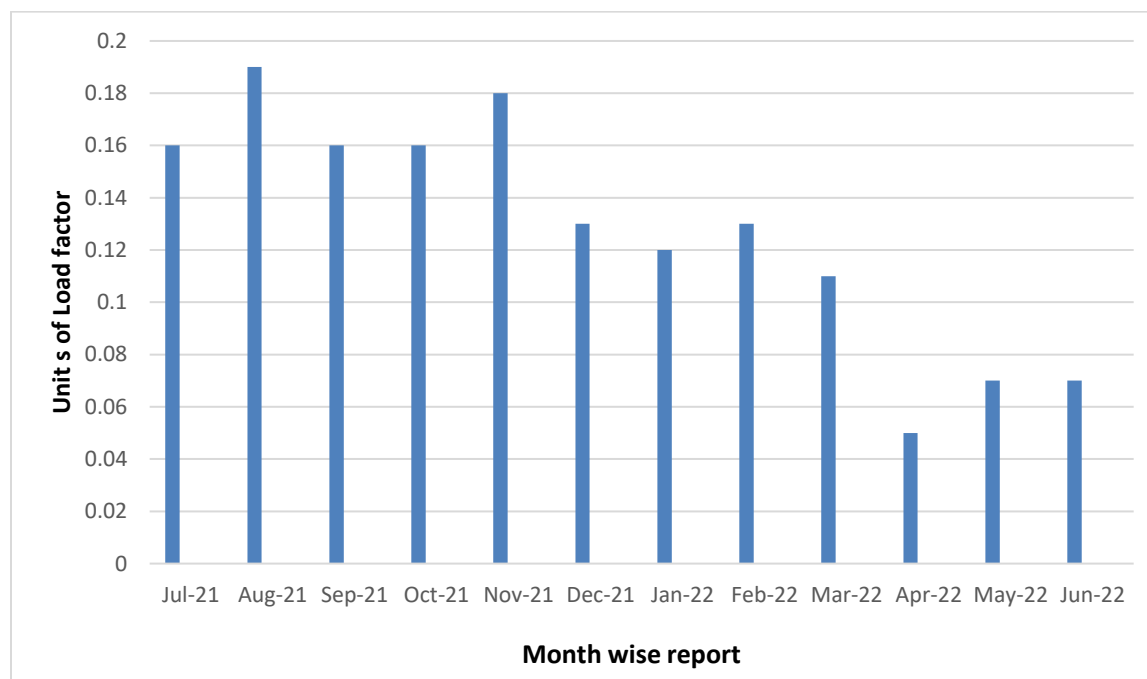


Fig. 5: Load Factor month wise over the Year of Administrative/Academic Blocks and Boys Hostels

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

Sl.	Month	Load Factor
1	July 2021	0.16
2	Aug 2021	0.19
3	Sep 2021	0.16
4	Oct 2021	0.16
5	Nov 2021	0.18
6	Dec 2021	0.13
7	Jan 2022	0.12
8	Feb 2022	0.13
9	Mar 2022	0.11
10	Apr 2022	0.05
11	May2022	0.07
12	June 2022	0.07
	Avg L.F.	0.12

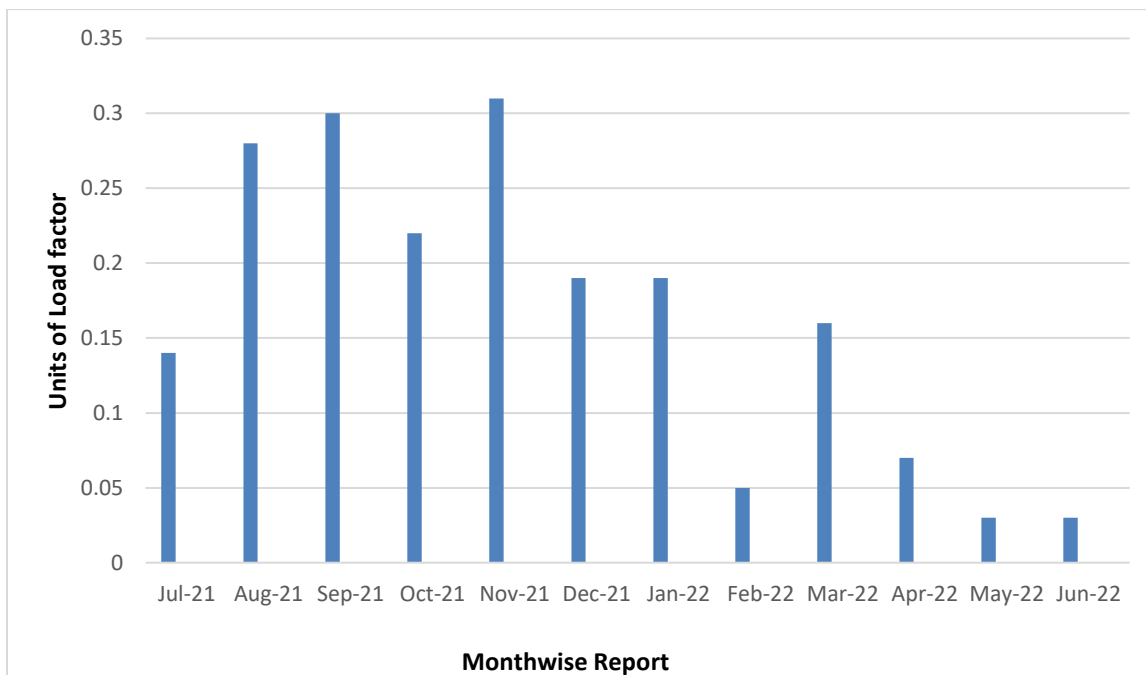


Fig. 6: Load Factor month wise over the Year of Girls Hostel and Guest House

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

Sl.	Month	Load Factor
1	July 2021	0.14
2	Aug 2021	0.28
3	Sep 2021	0.30
4	Oct 2021	0.22
5	Nov 2021	0.31
6	Dec 2021	0.19
7	Jan 2022	0.19
8	Feb 2022	0.05
9	Mar 2022	0.16
10	Apr 2022	0.07
11	May2022	0.03
12	June 2022	0.03
	Avg L.F.	0.16

CONCLUSIONVariation 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, 320KVA).
2. The average electricity cost is ₹5.70/- considering the last twelve months.
(Excluding TOD charges, MD and the p.f. charges)
3. Average monthly Power Factor is maintained near p.f 0.9.
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	40 watts	125	5 kW	8Hr	40 kWh
2	Fans	70 watts	88	6.2 kW	8Hr	49.6 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	40 watts	150	06kW	8 Hr	48 kWh
2	Fans	70 watts	142	10 kW	8 Hr	80 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	40 watts	100	4 kW	8 Hr	32 kWh
2	Fans	70 watts	71	5 kW	8 Hr	40 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	40 watts	100	4 kW	8 Hr	32 kWh
2	Fans	70 watts	71	5 KW	8 Hr	40 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	40 watts	250	10 kW	8 Hr	80 kWh
2	Fans	70 watts	200	14 kW	8 Hr	112 kWh
3	Computer Load	100 watts	55	5.5 kW	8 Hr	44 kWh
4	Single Phase	2000watts	10	20kW	8 Hr	160 kWh

	Load (Power Point)					
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	40 watts	50	2 kW	1 Hr	2 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	40 watts	450	18 kW	12 Hr	216 kWh
2	Ex F& Fans	70 watts	285	20 kW	12 Hr	240 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	WES51914	298 KVA	298 KVA	238.40 KVA
PULLAH	WES51932	375 KVA	375 KVA	300 KVA
PULASTHYA	WES48846	167 KVA	167 KVA	133.60 KVA
Anuradha	TWSL11000179	50 KW	50 KW	50 KW
Arundhati	TWSL11002039	62 KW	62 KW	62 KW
Visakha	TWSL11000377	35KW	35 KW	35KW
Rohini	WDT02347	35 KW	35 KW	35 KW
Vasundhara	TWSL12001264	80 KW	80 KW	80 KW
Angira	SWDT02166	14 KW	14 KW	14 KW
Guest House	TWSL11000633	76 KW	76 KW	76 KW
Vice Chancellor Residence	10038342	20 KW	20 KW	20 KW

Electrical Energy Cost Analysis

The electrical bills from TPWODL, Burla for 12 months from July 2021 to June 2022 have been studied.

Chapter: 6

Tariff Slab imposed by WESCO

PF Incentive

As per the TPWODL tariff, whenever average power factor (p.f.) in a month, is more than 0.95, 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 2019 at 0.86 and 0.230. Similarly, during February and March 2019, 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.

Don'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 LOADS

<u>Types of ACs</u>	<u>Rated Power (kW)</u>	<u>Qty</u>	<u>Voltage</u>	<u>Amps</u>	<u>Actual Power(kW)</u>
Window type	1.5 Ton	10 Nos.	230	7	1.5 KW
Split type	2 Ton	140 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 = $6.1 \times 5 = 30.5$ kWh/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 = $15\% \times 9150 = 1372.5$ kWh/year/ air conditioner
- ✚ Cost of electricity = ₹ 5.70 / kWh
- ✚ Yearly savings = $5.70 \times 1372.5 = ₹ 8235$ /year/ air conditioner
- ✚ Total number of Air Conditioners = 150 numbers

Summary

- Total yearly Saving = $150 \times 8235/\text{year} = ₹12,35,250/\text{year}$
- 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 = $2400 \times 24 \text{ W} = 57.6$ kWh/year/Tube Light
- ✚ Average Cost of electricity = ₹5.70/ kWh
- ✚ Saving = $57.6 \text{ kWh} \times 5.70 = ₹328.32 / \text{year/ Tube light}$

- ✚ Approximate investment on single LED Tube lights = ₹ 200
- ✚ Number of Tube Lights to be replaced = 200

Summary

- Total Yearly Saving = $200 \times 328.32 = ₹65664.00/\text{year}$
- Total Investment = $200 \times ₹ 200 = ₹40000.00$

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 22.00 – 06.00 Hr
- 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 to 26°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 efficient/renewable energy awareness inside the university campus. The University needs to take initiative to arrange seminars, lectures and 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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