# Energy Audit Report of VSSUT (2019-20)


## 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 he 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 & proposed in course of the study & these options when implemented , are expected to bring in lasting benefits( saving) in term of energy as well as cost saving to the University.

# INDEX

## Preface

Data collection for energy audit of the **VSSUT** was conducted by a team for the period of July 2019 to June 2020. 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 WESCO (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 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) | 200 x 40-W = 8-kW | 200 x 450.00 = ₹ 90,000.00<br>Saving wattage = 200 x 20-W = **∴ 8 – 4 = 4-kW** | 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 = 11.25-kW | 150x 4000.00 = 6,00,000.00<br>Saving wattage = 150 x 36-W = 5.4-kW **∴ 11.25 – 5.4 = 5.85-kW** | 16,00,000.00 | 2.6 | Long Term |
| 3 | Replacing Radiato ES Ultra-Thin LED Street light in place of flood light | 800 x 12 = 9.6-kW | 25,000.00<br>Saving wattage = 300 x 12-W = 3.6-kW **∴ 9.6 – 3.6 = 6-kW** | 40,000.00 | 1.6 | Mid Term |
| 4 | Procuring5-star Inverter AC & replacing existing old convention ACs | 150 x 2-kW = 300-kW | 12,35,250.00<br>150 x 1-kW = approx. 150-kW | 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-kW/hour x ₹ 5.70 x 8 = ₹7,570.00
- Monthly saving on account of working hours(considering 25 working days) =
  ₹7,570.00 x 25 = approx. ₹ 1.9 lakhs
- Annual saving on account of working hours = ₹ 1.9 lakhs x 12 = ₹ 23 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

| 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 WESCO**:** VSSUT receives Electricity from WESCO.
- 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 |


E-Learning Centre,
500-KVA DG Set


Central Library 250 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.

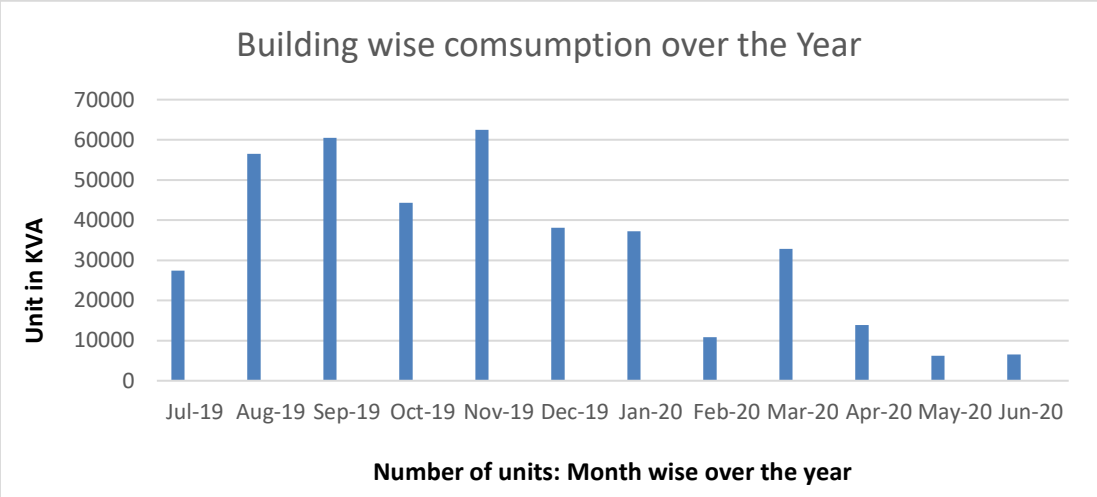


**Fig. 1: Number of Units month wise over the Year**

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 2019 | 119689 | 0.9985 |
| 2 | Aug 2019 | 137445 | 0.9976 |
| 3 | Sep 2019 | 117225 | 0.9972 |
| 4 | Oct 2019 | 120393 | 0.8835 |
| 5 | Nov 2019 | 131674 | 0.9990 |
| 6 | Dec 2019 | 94746 | 1.0000 |
| 7 | Jan 2020 | 88786 | 0.9987 |
| 8 | Feb 2020 | 99202 | 0.9954 |
| 9 | Mar 2020 | 81578 | 0.9989 |
| 10 | Apr 2020 | 37548 | 1.0000 |
| 11 | May 2020 | 50086 | 0.9991 |
| 12 | June 2020 | 50394 | 0.9989 |
| | Total units | 1128766 | Average p.f. 0.9 |

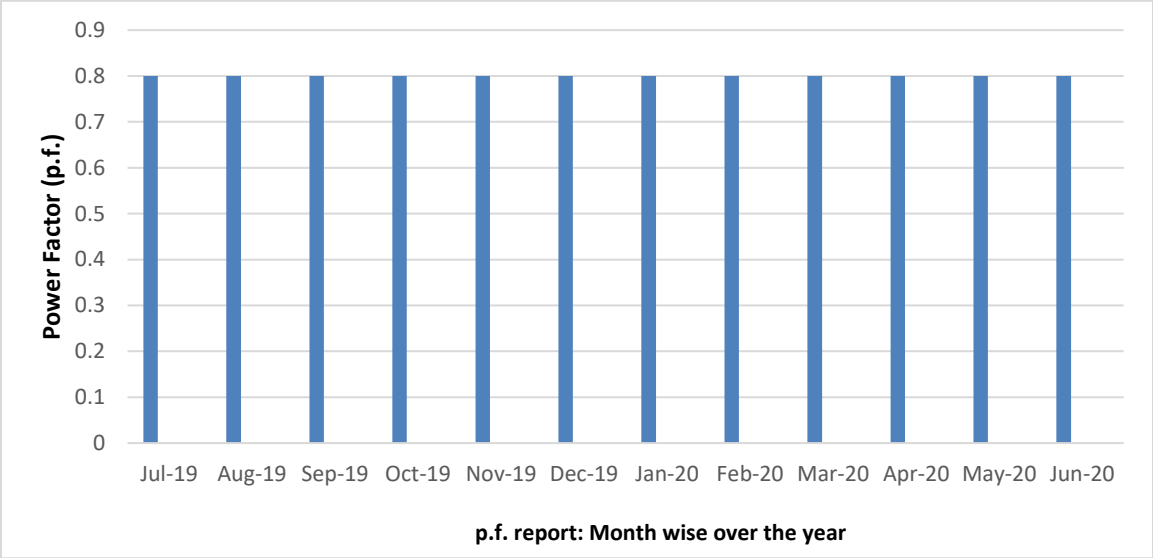


**Fig. 2: Power Factor month wise over the Year**

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

| Sl. | Month | No. of Units | Power Factor |
|---|---|---|---|
| 1 | July 2019 | 27443 | 0.8 |
| 2 | Aug 2019 | 56534 | 0.8 |
| 3 | Sep 2019 | 60520 | 0.8 |
| 4 | Oct 2019 | 44330 | 0.8 |
| 5 | Nov 2019 | 62520 | 0.8 |
| 6 | Dec 2019 | 38098 | 0.8 |
| 7 | Jan 2020 | 37214 | 0.8 |
| 8 | Feb 2020 | 10806 | 0.8 |
| 9 | Mar 2020 | 32852 | 0.8 |
| 10 | Apr 2020 | 13843 | 0.8 |
| 11 | May 2020 | 6211 | 0.8 |
| 12 | June 2020 | 6519 | 0.8 |
| | **Total units** | **396890** | **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 2019 | 840265.00 |
| 2 | Aug 2019 | 1003728.00 |
| 3 | Sep 2019 | 1072331.00 |
| 4 | Oct 2019 | 838512.00 |
| 5 | Nov 2019 | 909922.00 |
| 6 | Dec 2019 | 751896.00 |
| 7 | Jan 2020 | 682306.00 |
| 8 | Feb 2020 | 734222.00 |
| 9 | Mar 2020 | 370794.00 |
| 10 | Apr 2020 | 245901.00 |
| 11 | May2020 | 157135.00 |
| 12 | June 2020 | 652361.00 |
| | Total Amount | 7582666.00 |
| | Average monthly bill | 631888.00 |

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

| Sl. | Month | Bill Amount |
|---|---|---|
| 1 | July 2019 | 199433.00 |
| 2 | Aug 2019 | 393941.00 |
| 3 | Sep 2019 | 426961.00 |
| 4 | Oct 2019 | 282212.00 |
| 5 | Nov 2019 | 377696.00 |
| 6 | Dec 2019 | 247469.00 |
| 7 | Jan 2020 | 251492.00 |
| 8 | Feb 2020 | 249049.00 |
| 9 | Mar 2020 | 218842.00 |
| 10 | Apr 2020 | 110211.00 |
| 11 | May2020 | -14449.00 |
| 12 | June 2020 | 31830.00 |
| | Total Amount | 2774687.00 |
| | Average monthly bill | 231223.00 |

**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

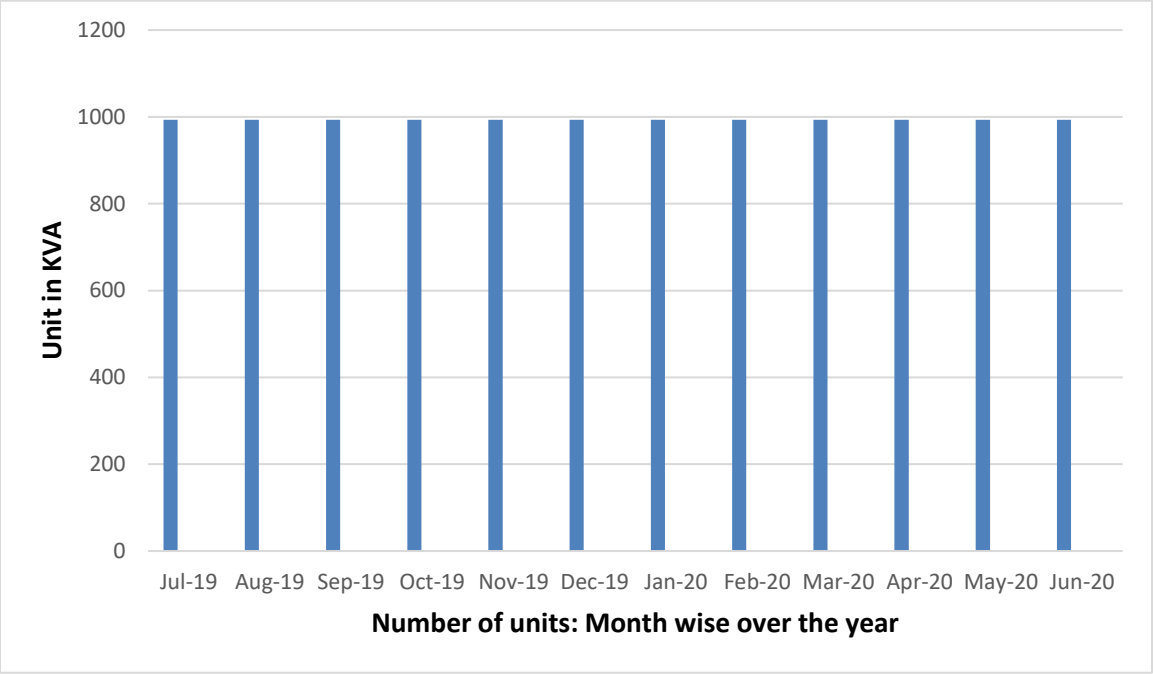


**Fig. 3: Max. Demand of Administrative/ Academic Blocks and Boys Hostels: Month wise over the year**

***** 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 2019 | 993 |
| 2 | Aug 2019 | 993 |
| 3 | Sep 2019 | 993 |
| 4 | Oct 2019 | 993 |
| 5 | Nov 2019 | 993 |
| 6 | Dec 2019 | 993 |

| | | |
|---|---|---|
| 7 | Jan 2020 | 993 |
| 8 | Feb 2020 | 993 |
| 9 | Mar 2020 | 993 |
| 10 | Apr 2020 | 993 |
| 11 | May2020 | 993 |
| 12 | June 2020 | 993 |

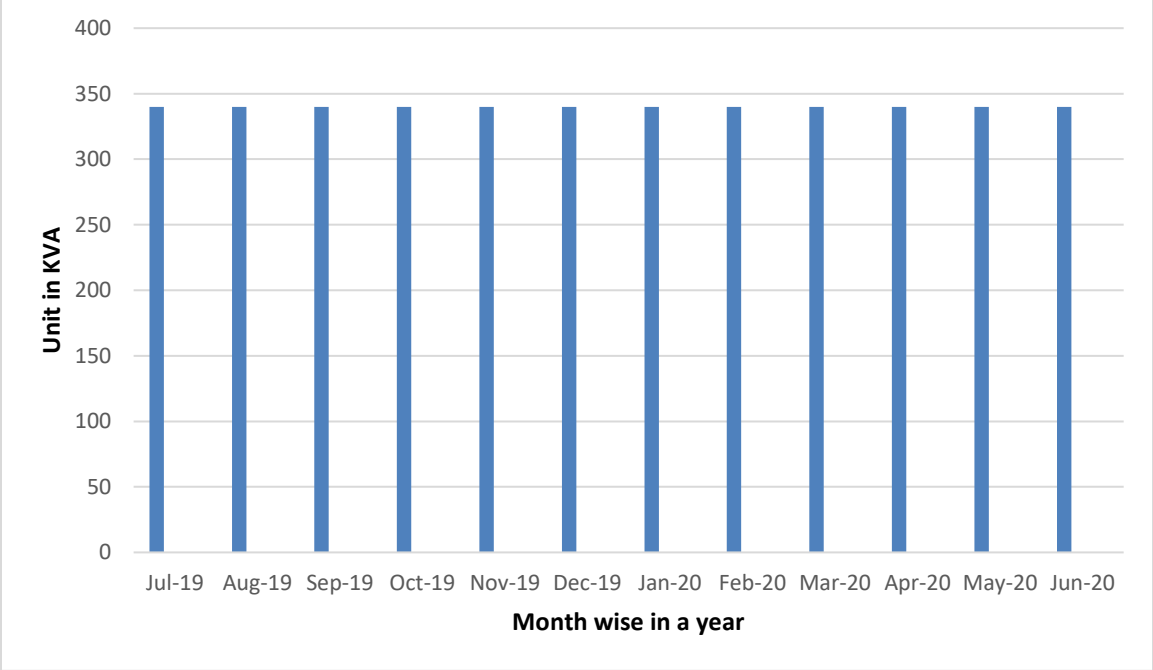


Fig. 4: Max. Demand month wise over the Year of Gils Hostel & Guest House

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

| Sl. | Month | Maximum demand KVA/month |
|---|---|---|
| 1 | July 2019 | 340 |
| 2 | Aug 2019 | 340 |
| 3 | Sep 2019 | 340 |
| 4 | Oct 2019 | 340 |
| 5 | Nov 2019 | 340 |
| 6 | Dec 2019 | 340 |
| 7 | Jan 2020 | 340 |
| 8 | Feb 2020 | 340 |
| 9 | Mar 2020 | 340 |
| 10 | Apr 2020 | 340 |
| 11 | May2020 | 340 |
| 12 | June 2020 | 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

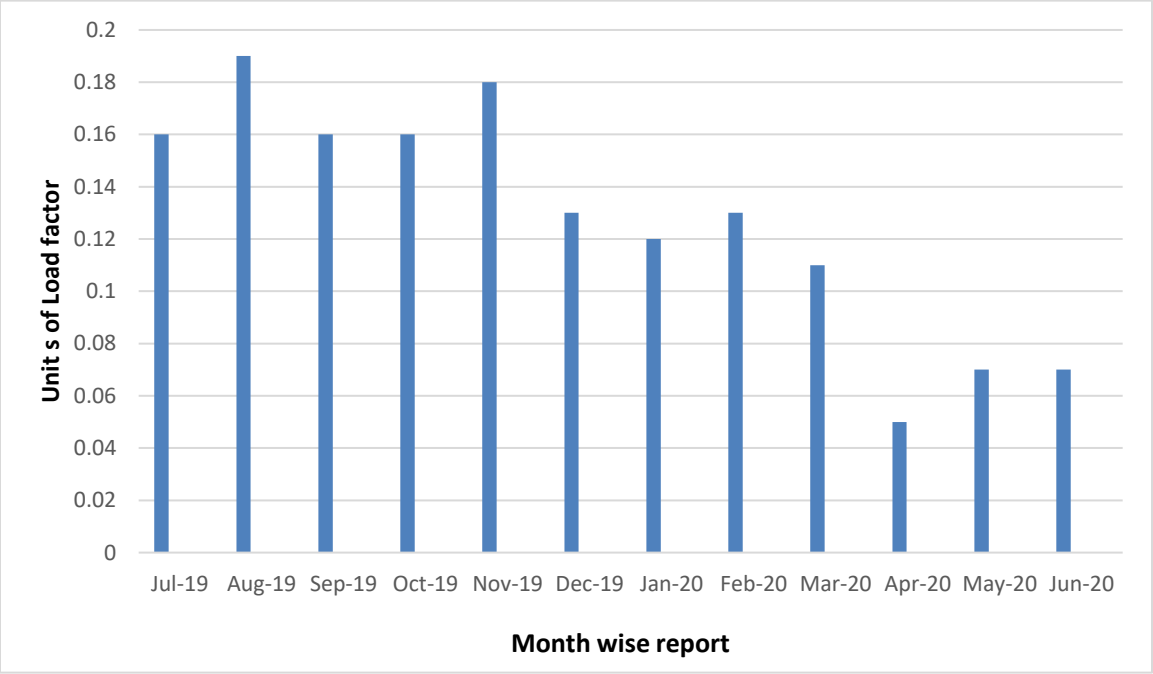


**Fig. 5: Load Factor month wise over the Year of Administrative/Academic Blocks and Boys Hostels**

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

| Sl. | Month | Load Factor |
|---|---|---|
| 1 | July 2019 | 0.16 |
| 2 | Aug 2019 | 0.19 |
| 3 | Sep 2019 | 0.16 |
| 4 | Oct 2019 | 0.16 |
| 5 | Nov 2019 | 0.18 |
| 6 | Dec 2019 | 0.13 |
| 7 | Jan 2020 | 0.12 |
| 8 | Feb 2020 | 0.13 |
| 9 | Mar 2020 | 0.11 |
| 10 | Apr 2020 | 0.05 |
| 11 | May2020 | 0.07 |
| 12 | June 2020 | 0.07 |
| | Avg L.F. | 0.12 |

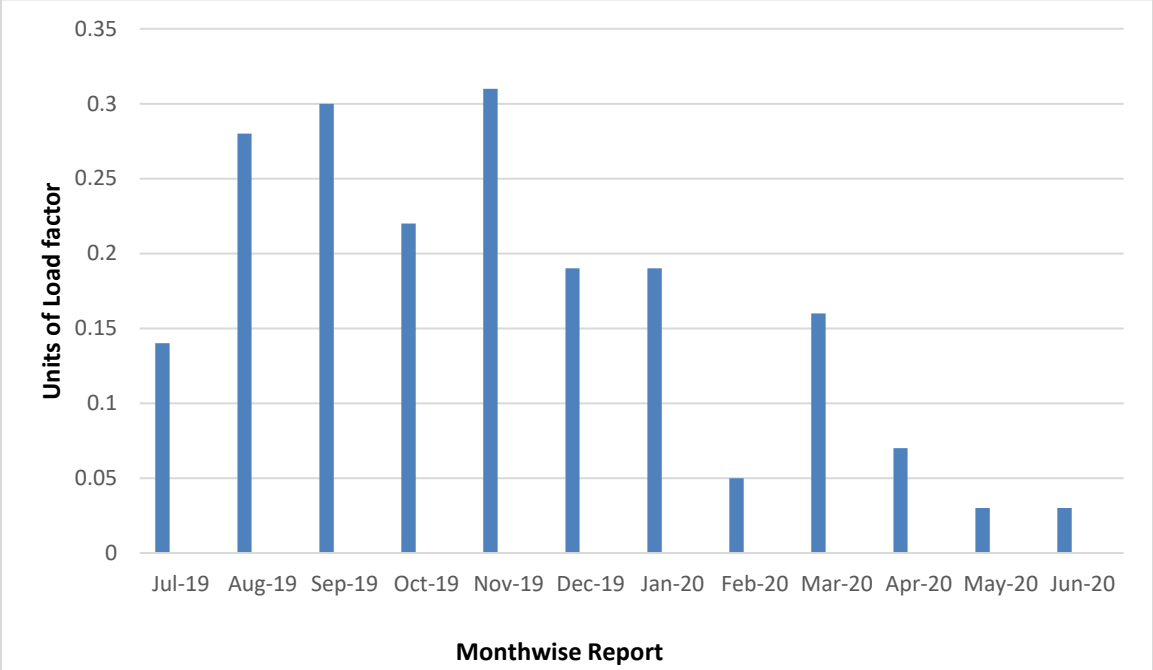


**Fig. 6: Load Factor month wise over the Year of Girls Hostel and Guest House**

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

| Sl. | Month | Load Factor |
|---|---|---|
| 1 | July 2019 | 0.14 |
| 2 | Aug 2019 | 0.28 |
| 3 | Sep 2019 | 0.30 |
| 4 | Oct 2019 | 0.22 |
| 5 | Nov 2019 | 0.31 |
| 6 | Dec 2019 | 0.19 |
| 7 | Jan 2020 | 0.19 |
| 8 | Feb 2020 | 0.05 |
| 9 | Mar 2020 | 0.16 |
| 10 | Apr 2020 | 0.07 |
| 11 | May2020 | 0.03 |
| 12 | June 2020 | 0.03 |
| | Avg L.F. | 0.16 |

## 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,320KVA).
**2.** The average electricity cost is ₹5.70/-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 | 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 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 | 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 WESCO 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 | 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 WESCO, Burla for 12 months from July 2019 to June 2020 have been studied.

# Chapter-6

## Tariff Slab imposed by WESCO

### PF Incentive

As per the WESCO 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 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 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 | 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 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 = ₹ 5.70 / kWh
- Yearly savings = 5.70 x 1372.5 = ₹ 8235/year/ air conditioner
- Total number of Air Conditioners = 150 numbers

**Summary**

- Total yearly Saving = 150 x 8235/year = ₹12,35,250/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 = ₹5.70/ kWh
- Saving = 57.6 kWh x 5.70 = ₹328.32 / year/ Tube light

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

**Summary**

- Total Yearly Saving =200 x 328.32 = ₹65664.00/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.

14/12/2020

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Prof. Electrical Maintenance
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