

# ENERGY AUDIT

(2017-18)



**VIDYASAGAR UNIVERSITY, MIDNAPORE,  
WEST BENGAL**

CONSULTRAIN MANAGEMENT SERVICES,  
LAKE ROAD, KOLKATA

TROPICAL INSTITUTE OF EARTH &  
ENVIRONMENTAL RESEARCH (TIEER),  
MIDNAPORE

## ENERGY AUDIT : 2017-18

This Audit has been conducted by a Committee constituted by the Experts & Scientists from different reputed Institutes. The Committee developed a questionnaire for audit based on the regulatory & statutory requirements of Central as well State. The basic data was gathered & compiled, which the committee analyzed. By and large, the audit reveals a healthy environment inside the Vidyasagar University campus. The committee has suggested short term as well as long-term suggestions for improved environmental conditions about energy efficiency to a higher levels and authorities and all stakeholders of the University conforms that they will give due attention and utilize opportunities for identified improvements. The Committee members are listed below:

### LIST OF EXPERTS AND SCIENTISTS

SL. No.	NAME	DESIGNATION	AREA IN INTEREST
1.	Dr. Binoy Kr. Chanda	President, TIEER & Former IC, VU	Environment Science & Climatology
2.	Dr. Pranab Sahoo	Secretary, TIEER & Assistant Professor and HOD, Dept of Geography, S.B. Mahavidyalaya, Kaptai	Climate Change and Environment Management and Biogeography
3.	Mrs. Sanchita Bhattachariya	Chief executive officer, Consultrain Management services, Kolkata	Environment management
4.	Dr. SK Mafizul Haque	Assistant Professor in Geography, CU	Climate Change and Environment Management and RS-GIS Techniques
5.	Dr. Koushik Chatterjee	Assistant Professor , Dept of Commerce & Management , Sent Xavier's College, Kol	Management & Marketing
6.	Sri Amal Sasmal	Consultant, EIA and EMS	Environmental management
7.	Dr. Chandan Karan	Faculty, Dept. of Geography, S.B. Mahavidyalaya, Kaptai	Land use Survey, Technician for Lab test. and Map Designer
8.	Dr. Suvendu Ghosh	Assistant Teacher in Geography	Soil Management and Environment Management
9.	Sri Ananda Das	Assistant Teacher in Physics	Solid state Physics and Mechanical & Electrical low cost model
10.	Sri Prasun Sahoo	Electrical Engineer	Machine & Power system



Arial view of the Vidyasagar University campus



Meeting between Director & member of IQAC Cell, VU and Auditing

## CONTENTS :

Chapter No.	Title	Page No.
1.0	INTRODUCTION	5-9
1.1	Goal and Our Mission	
1.2	About the University	
1.3	History and Heritage	
1.4	Campus Area and Infrastructure	
1.5	Core value of the University	
1.6	Academic Department and Research Centre	
1.7	Previous NAAC Grading	
2.0	PRE –AUDIT STAGE	10-14
2.1	Affiance and commitment of the University	
2.2	Objectives and views of Energy Auditing	
2.3	Advantage and favor of Energy Audit	
2.4	Purpose of Energy Auditing	
2.5	Methodology and Survey Schedules	
3.0	AUDIT STAGE	15-23
3.1	Campus Observation and Enquiry	
3.2	Grouping and Strategy	
3.3	Enquiry of different sources Energy	
3.4	Energy Consumption	
3.5	Cost of Energy	
3.6	Measurement of Emission of GHG <sub>s</sub>	
4.0	POST AUDIT STAGE	24-32
4.1	Data analysis and Assessment	
4.2	Result and Findings	
4.3	Consolidation of Audit Findings	
4.4	Summary of Energy Auditing	
4.5	Preparation of Action Plan	
4.6	Follow Up Action and Plans	
4.7	Environmental Education	
4.8	CONCLUSION & RECOMMENDATIONS	
5.0	MEETING AND SUBMIT OF THE AUDIT REPORT	33
6.0	EXECUTIVE SUMMARY	
	Acknowledgements	

## CHAPTER-1

### 1.0 INTRODUCTION

Energy Audit is a process of systematic, documented, periodic and objective evaluation of components of Energy sources with the aim of safeguarding the environment and natural resources in its operations. The process starts with systematic identification, quantification, recording, reporting and analysis of components of Energy sources in the university. Energy auditing is a means of assessing environmental performance (Welford, 2002). It is as systematic, documented, periodic, and objective review by regulated entities of facility operations and practices related to meeting environmental requirements (EPA, 2003).

### 1.1 Goals and Our Mission

It aims to analyse environments within and outside of the concerned area, which will have an impact on the eco-friendly atmosphere. Energy audit is a valuable means for a university to determine how and where they are using the most energy or other resources; the university can then consider how to implement changes and make savings. It can create to resources consciousness and promote environmental awareness, values and ethics. It provides staff and students better understanding of Energy save impact on their area of work.

This includes all emissions to air; land and water; legal constraints; the effects on the neighboring community; landscape and ecology; the public's perception of the operating company in the local area. Vidyasagar University seeks to become a centre of excellence by providing its students a comprehensive education with special emphasis on responsible citizenship, secular outlook, moral values and abiding faith in Environmental ethics expressed inactive concern for others.

The University strives to become a seminal centre for the promotion of the all round development of the students of this region, especially the women students who are socially marginalized and those from a rural background who are economically disadvantaged. The main objectives of carrying of energy audit :



Entrance of the University Campus



Map of the University campus

- To map the Geographical location of the University – aerial view
- To estimate the Energy requirements of the Institution
- To report the expenditure on energy efficiency initiatives, carbon foot print
- To record the air quality
- To conserve the natural resources

### 1.2 About the University

Vidyasagar University, named after one of the most illustrious sons of Bengal as well as one of the doyens of Indian Renaissance, Pandit Iswar Chandra Vidyasagar, has grown out of a long cultural and educational movement in West Bengal in general and in the undivided district of Midnapore in particular. The idea of founding a University in the district was mooted by the various organizations, notably by the Regional Education Association, Midnapore, headed by Professor A.K.Gayen of IIT, Kharagpur. The Ghani Committee appointed by the U.G.C. also suggested, among others, for the setting up of a University in Midnapore on the ground of its 'having a compact area and a manageable number of colleges' (at that time there were 36 colleges with an enrolment of about 42,000), and also of its 'having the great advantage of co-operation of the IIT, Kharagpur. The Committee was also of the opinion that the new University would develop on the lines suited to the needs of this backward area.

Academic activities started when through a Notification [no. 983-Edn (U), dated Calcutta the 23rd May] issued by the State Government, 30 colleges of the District of Midnapore were affiliated to the Vidyasagar University with effect from 1st June 1985. The foundation stone of the main campus at Tantigaria mouza of Midnapore Sadar Town for post graduate teaching and central administration of the University, was laid on 18th July 1983 by the then Hon'ble Chancellor of the University and Governor of West Bengal, Late B.D.Pande. On 15th January 1986, it was inaugurated by Shri Jyoti Basu, the then Chief Minister of West Bengal. From



**Annex Administrative Building**

the next day (16th January) classes commenced in six post graduate departments: Anthropology, Applied Mathematics with Oceanology and Computer Programming, Commerce with Farm Management, Economics with Rural Development, Library and Information Science, Political Science with Rural Administration.



**Green Corridor**

### 1.3 History and Heritage

To give honour and respect to these pious intentions and proposals, the Government of West Bengal decided in 1978 to establish Vidyasagar University. The U.G.C. approved the proposal and on the advice of, and in consultation with the U.G.C., the State Government appointed a Planning Committee in March 1979 to lay down the lines of development and to take initial steps to found

the University. The Committee submitted its report in October. Then the Vidyasagar University Act, 1981 (West Bengal Act XVIII of 1981) was passed; some of its sections were brought into operation on 24th June 1981. Finally, Professor Bhupesh Chandra Mukherjee joined as the first Vice Chancellor of the University on 29th September 1981.

The U.G.C. accorded recognition to the University in terms of Section 12B of the U.G.C. Act, on 1st March 1990. The University presently houses 27 PG departments (apart from this course – MBA - being run under the Department of Commerce with Farm Management), 12 in Humanities and 15 in Science while 46 undergraduate colleges apart from 11 courses in yet 11 other colleges / institutes are affiliated to it. Fourteen vocational subjects and six other specialized courses are also offered at the UG level. The overall emphasis of the university is not to perpetuate the traditional nature of the other universities of West Bengal but to merge as a distinctive entity with a special nature of its own. The National Assessment and Accreditation Council (NAAC) awarded Vidyasagar University with a 3-star status. The campus has a

picturesque background within which afforestation programmes are being under taken. The Vidyasagar University thus began its journey to sail through many trials and tribulation.

#### 1.4 Campus Area and Infrastructure

Total area of the university campus – 138.78 acres,

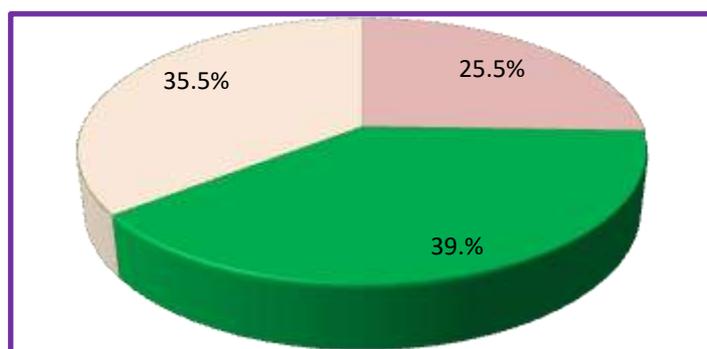
Main campus – 103.74 acres,

Residential campus - 35.04 acres.

MAIN CAMPUS CONSISTING	RESIDENTIAL CAMPUS CONSISTING
<b>Administrative building</b>	Vice Chancellor Bungalow
<b>DDE Building with Guest House</b>	V.I.P Guest House
<b>Science building</b>	Student Amenities Center
<b>Humanities Building</b>	P.G Girls Hostel (2 Blocks)
<b>Silver Jubilee Building</b>	Teacher & Officers Hostel (2 Blocks)
<b>Central Library</b>	Teacher Quarter (2 Blocks)
<b>P.G Boys Hostel(2- Blocks)</b>	Non Teaching Staff Quarter (2 Blocks)
<b>Non-teaching Staff hostel (2 Blocks)</b>	
<b>Women Infrastructure</b>	
<b>Sports complex with Pavilion</b>	
<b>Tribal cultural Building</b>	
<b>Electrical Sub Station</b>	
<b>Over Head Water Reservoir with deep tube well (4 Nos) &amp; Pump House</b>	



### Area Coverage of the University campus in the session , 2017-18



- Building & Construction
- Greenery
- Fellowland & Play Ground

### 1.5 Core value of the University

Named after Pandit Ishwar Chandra Vidyasagar, the 19th century messiah of social and educational reform in Bengal, this university engages in an unrelenting Endeavour to realize the goals and objectives he has set for the country's progress. We esteem the uncompromising grit and fortitude with which he strove to overcome the hurdles on the path to progress.

- This university believes in holistic progress of students through right education and attainment of right knowledge.
- Education, knowledge and progress is a composite leitmotif that governs the activities and plans of this varsity.



**Administrative Building**



**Aerial View of DDE Building & Guest House**

- We focus on an organic fusion of curricular and extra-curricular activities, the substantial part of which is based primarily on the principles of moral uplift and ethical dispensation. We take special care in addressing both the material and spiritual needs of the students.

- In the process the educators are advised to upgrade themselves in a manner that takes care not only of the disciplinary progress of the students but also the psychological and mental health of the learners.

- The care givers are taught regularly by the best specialists in respective disciplines and also by trained psychologists. The students are given adequate scope to develop their bodies and minds by inspiring them to engage in sports and athletic activities along with subject based learning and research pursuits.
- The university takes care in sustainable development and considers the environment as one of the major planks for security and holistic development of the whole institution.

We also believe in auto-learning so that the students here are encouraged to learn from experience gained both in formal and informal settings. They are motivated to appraise the formative benefits that they reap from everyday experiences. We intend them to grow to become independent learners faster than the average student of this country. Our motivational programmes steer clear of any discriminatory practices and focus on creating more convenient space for the development of less privileged and differently-abled learners. Above all, we believe in an everlasting process of reforming ourselves and to that effect look forward to formative advices and suggestions from anyone who happens to visit this site and our sacred premises. Your good wishes will act as grist in our Endeavour to make this planet a better place to live in.

### 1.6 Academic Department and Research Centre

Academic Departments		Research Centre
Bengali	<b>Anthropology</b>	<b>Centre for Environmental Studies (CES)</b>
Business Administration	<b>Applied Mathematics with Oceanology and Computer Programming</b>	<b><u>Centre for Life Sciences</u></b>
Commerce with Farm Management	<b>Aquaculture management &amp; Technology</b>	<b><u>Gandhian Studies Centre</u></b>
Economics with Rural Development	<b>Bio-Medical Laboratory Science &amp; Management</b>	<b><u>Women's Studies Centre</u></b>
English	<b>Botany and Forestry</b>	<b><u>Centre for Adivasi Studies and Museum</u></b>
Hindi	<b>Chemistry &amp; Chemical Technology</b>	
History	<b>Computer Science</b>	
Library and Information Science	<b>Electronics</b>	
Philosophy & Life world	<b>Geography &amp; Environment Management</b>	
Political Science with Rural Administration	<b>Human Physiology with Community Health</b>	
Sanskrit	<b>Microbiology</b>	
Santali	<b>Physics &amp; Technophysics</b>	
Sociology	<b>Remote Sensing and GIS</b>	
	<b>Zoology</b>	

### 1.7 Previous NAAC Grading:

The National Assessment and Accreditation Council (NAAC) awarded Vidyasagar University with a 3-star status. The campus has a picturesque background within which afforestation programme are being under taken.

## CHAPTER – 2

### 2.1 Affiance and commitment of the University:

The Management of the IQAC Cell in the University has shown the commitment towards the energy auditing during the pre-audit meeting. They were ready to encourage supporting all green activities. It was decided to promote all activities that are environment friendly such as awareness programs on the environment, campus farming, planting more trees, biodiversity management on the campus etc., after the energy auditing. The management of the University was willing to formulate policies based on energy auditing report.

### 2.2 Objectives of energy auditing :

The objectives of Energy Auditing are to assess a resource and fossil fuel utilization aids effective learning and provides a learning Resource management. Energy Audit is the most efficient and ecological way to manage environmental problems. It is a kind of professional care which is the responsibility of each individual who are the part of economical, financial, social, environmental factors. It is necessary to conduct energy audit in university campus because students become aware of the energy audit, its advantages to save the planet and they become good citizen of our country. Thus Energy audit becomes necessary at the University level. This energy audit assumes significance due to the fact that the Vidyasagar University electricity bill had crossed Rs. 1.6 crores during 2017-18, and it was aimed at obtaining a detailed idea about the various end use energy consumption activities and identifying, enumerating and evaluating the possible energy savings opportunities. The target is to achieve savings in the electrical energy



consumption to the extent of 25%. The audit was also aimed at giving the students a feel of the practical problems and difficulties in carrying out energy audits. As energy engineers, the students of the department enthusiastically participated in the endeavor.

➤ To study of interrelationship between beneficiary and environment in the University campus

➤ To Establish to provide basis for improved sustainability

➤ Recognize the cost

saving methods through energy minimizing and managing

- Point out the prevailing and forthcoming complications
- Authenticate conformity with the implemented laws
- Empower the organizations to frame a better environmental performance
- Financial savings through a reduction in resource use
- Development of ownership, personal and social responsibility for the University and its environment and resource
- Enhancement of university profile developing an environmental ethic and value systems in youngsters.

- Energy auditing should become a valuable tool in the management and monitoring of Eco- sustainable development programs of the University

### 2.3 Advantages of Energy Audit:

- To develop to more efficient resource management
- To provide basis for improved sustainability
- To create a GHG free campus
- Recognize the cost saving methods through Energy minimizing and Managing
- Energy auditing should become a valuable tool in the management and monitoring of environmental and sustainable development Programs of the University



Interview with Faculty



Electric consumption in Bio- Medical Laboratory



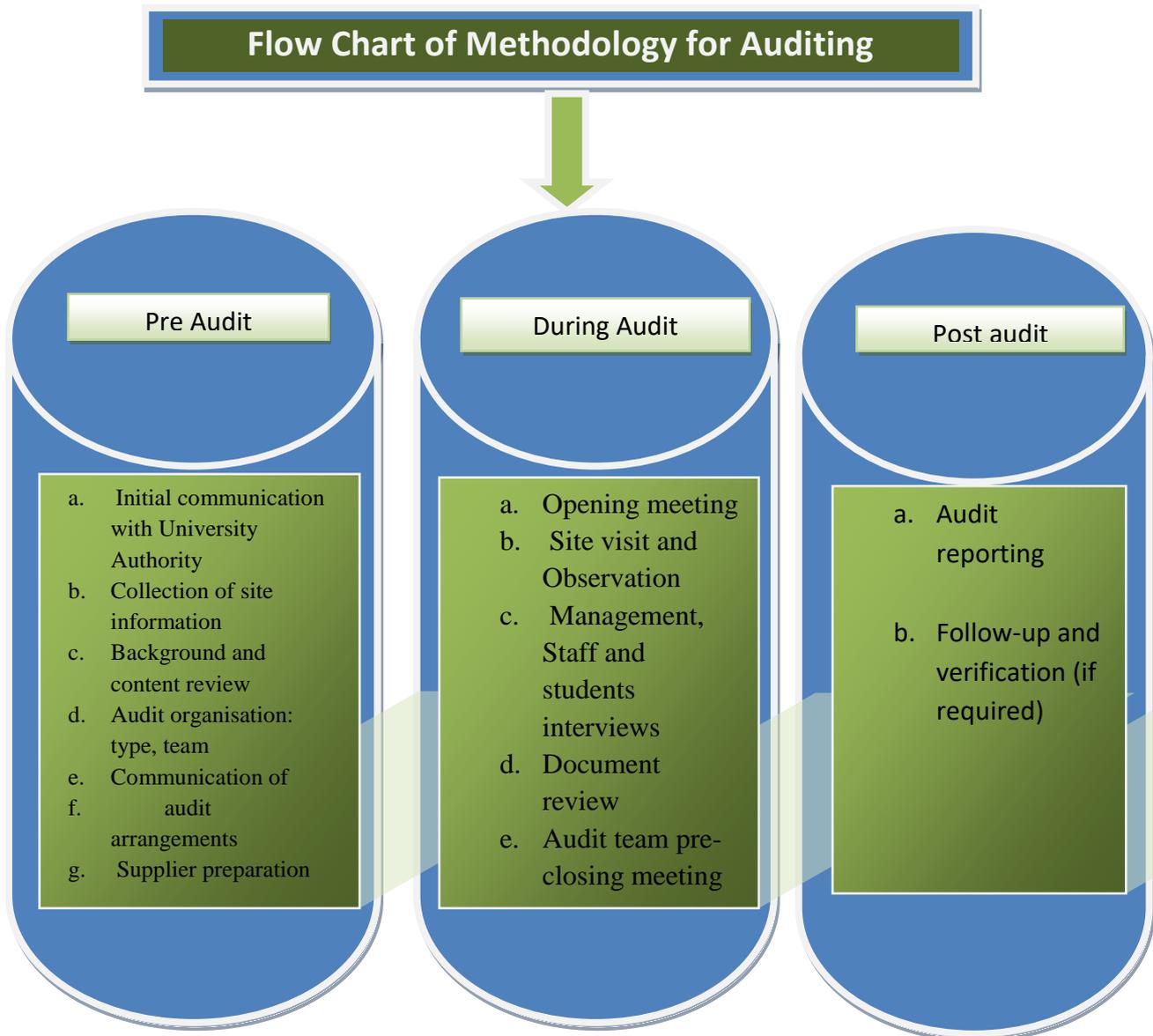
Solar power station(100kWh)



Use of electricity for laboratory work in Bio-Medical Dept.

## 2.5 Methodology and Survey Schedules

The methodology is adopted for this Assessment by collecting the information by Onsite visit, group discussion, Campus survey, Enquiry, Observation, Perception study and opinion also included in the Auditing Report.



The Audit team started the audit at the University Campus on 6<sup>th</sup> July, 2017

SL.NO	PURPOSE	DATE	REMARKS
1.	Communication with university authority	6th July,2017	Discuss about term and condition
2.	Opening Meeting	24th July,2017	Submitted the survey schedule
3.	Collection information about the University	16th Agust,2017	Introduced to Administrative Officer
4.	Campus visit and observation	28th August,2017	Outdoor observation with Drown camera& Photo camera
5.	Campus enquiry	13th September, 2017	Building enquiry with expert
6.	Departments visit and enquiry	17th November.,2017	Laboratory enquiry
7.	Departments visit and enquiry	27th November,2017	Laboratory enquiry
8.	Interview with Students	14 <sup>th</sup> December,2017	Meet with students & Researchers
9.	Interview with staff	11th January,2018	Collected different information from engineering section
10.	Interview with others Stakeholders ( Canteen)	23th February ,2018	Collected different information
11.	Review data and Assessment	24th February, 2018 -15th April, 2018	Data generate and drown figures
12.	Pre Closing meeting	5th May, 2018	Meeting with IQAC
13	Closing Meeting	20th May, 2018	Pre-submission of report
14.	Submit audit report	14 <sup>th</sup> June,2018	Submit of the Report

#### Site Visit :

University and its premises were visited and analyzed by the audit-teams several times to gather information. Campus trees were counted and identified. Medicinal garden, play grounds, canteen, library, All Department, office rooms, Hostels, DDE Building, Guest House, Staff Quarter and parking grounds were also visited to collect data. Number and type of vehicles used by the stakeholders were counted and fuel consumption for each vehicle was verified with the user. Number of LPG cylinders used in labs, canteen and hostel kitchen were also counted. Leakage of a few water taps and over flow tanks were noticed during the site inspection.

#### Group Discussion

The Discussion was focused on identifying the attitudes and awareness towards environmental issues at the institutional, district, national and global level. From the Group Discussion we gathered information on office-based environmental impacts like built-up area, utility bills, reuse of water, waste management energy-saving devices and IT equipment/e-waste was collected.

This information was added to the carbon footprint data, generating a fairly clearer picture of the emissions and impact of the reduction measures undertaken.

13



Collected Information from Guest House



Electric strong room and substation



Interview with HOD & Faculty of Chemistry Dept.

## Chapter 3.0 : AUDIT STAGE

### 3.1 Campus Survey and Enquiry

Energy audit forms part of a resource management process. Although they are individual events, the real value of energy audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time. Eco-campus concept mainly focuses on the efficient use of energy, pollution and also economic efficiency. All these indicators are assessed in process of Energy Auditing of educational institute". Eco-campus focuses on the reduction of contribution to emissions, procure a cost effective and secure supply of energy, encourage and enhance energy use conservation, promotes personal action, reduce the institute's energy and integrate environmental considerations into all contracts and services considered to have significant environmental impacts.

The Audit covered the following major areas:

1. Sources of Energy
2. Consumption of Energy
3. Cost of Energy
4. Measurement of Emission of GHG<sub>s</sub>
5. Energy Efficiency and Energy Management



### 3.2 Grouping and strategy

The following groups were formed with specific target areas and end users assigned.

**Group 1:** Lighting and fans in Main building, Library and staff canteen

**Group 2:** Lighting and fans in Departments (all departments, offices, class rooms and labs)

**Group 3:** Lighting common area – Covering Street lights, corridors, grounds

**Group 4:** Lighting and fans in boys Hostels

**Group 5:** Lighting and fans in Girls Hostels and Staff Quarters

**Group 6:** Total energy audit of DDE Building and Guest house

**Group 7:** Energy use in Dulung Canteen and Guest canteen

**Group 8:** Total room air conditioners in Administrative building, departments and labs.

**Group 9:** Total Energy audit of Central library and Computer Lab.

**Group 10:** Enquiry of total energy cost from Power Office

**Group 11:** Water Pumps in the entire campus

**Group 12:** Benchmarking of electricity consumption

The groups are allowed the use of various measuring instruments to assist in the auditing activity. Also, cooperation of the Electrical Maintenance Section was sought to collect past data and for taking measurements.

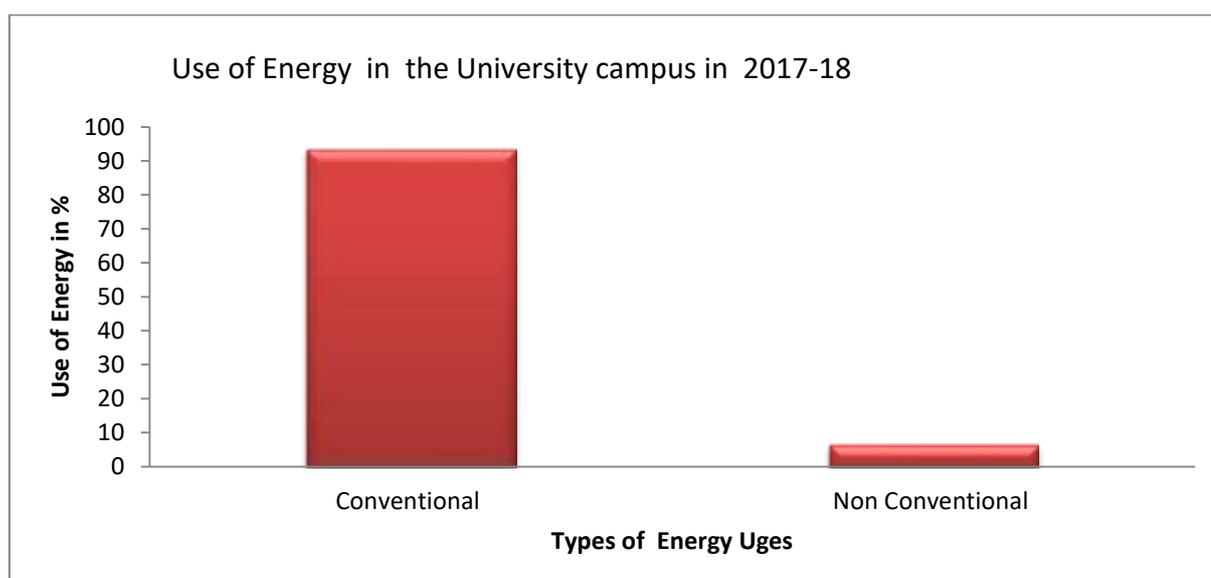
### 3.3 Source of Energy:

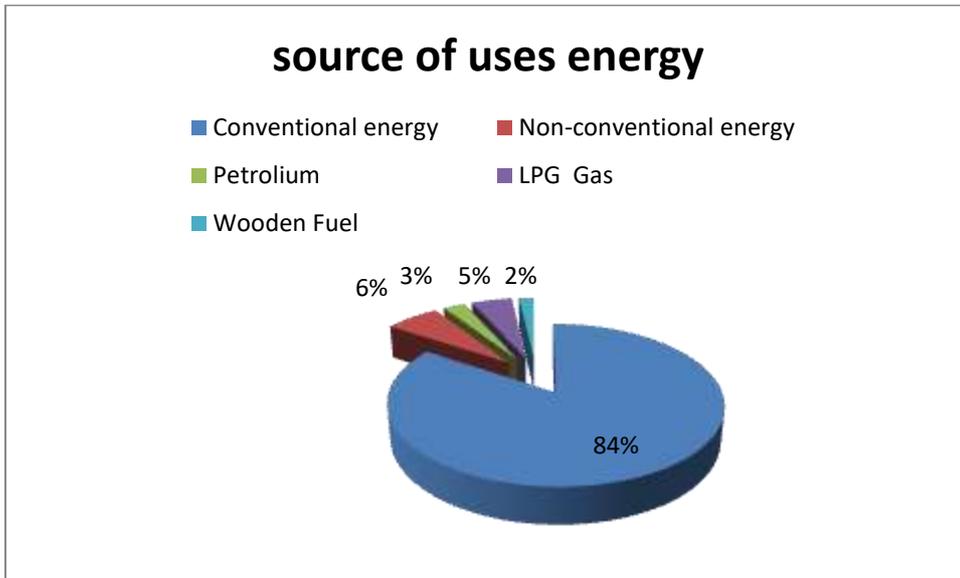
This indicator addresses energy consumption, energy sources, energy monitoring, lighting, appliances, and vehicles. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. An old incandescent Tube uses approximately 40W while an energy efficient light emitting diode (LED) uses only less than 10 W. By the enquiry, we have observed that the uses of energy have come from Conventional and Non-Conventional energy source. The uses energy is 1639117 unit which Rs. Amount is Rs.16001910/. Only 6% uses Energy is Non-conventional energy which is Solar Power. About 1000sq ft area(100kwh) is cover by the solar plate. The Maximum energy is consumption to Light & Fan purpose which amount about 42.5 % from total consumption. Other hand Departmental and Computer laboratory has been more expended about 34%. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. It is therefore essential that any environmentally responsible institution examine its energy use practices. Energy cannot be seen, but we know it is there because we can see its effects in the forms of heat, light and power.



Canteen Observation

Other hand, it has been observed that LPG gas cylinders are used in Chemistry laboratories (4pc/year) and in the hostels(90PC/Month) and canteen (50pc/month) for cooking. Other than this, LPG gas is not used anywhere. There is no dedicated gas storage area. Gas cylinders are refilled as and when required. There are Green generators used in the premises.

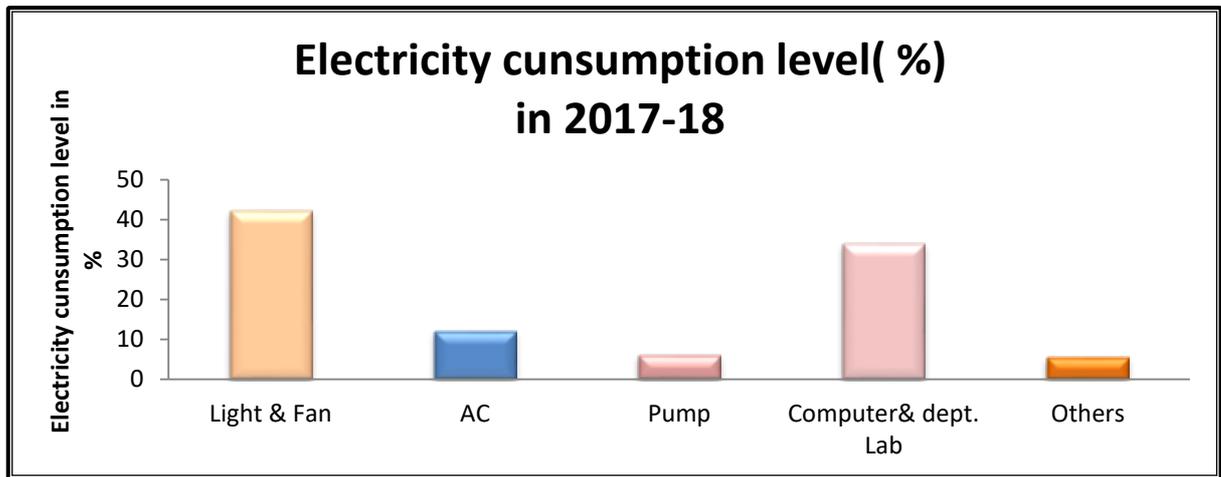




### 3.4 Energy Consumption

Power consumption ( kWh) of particulars

Sl.no	Particulars	Power consumption per hour
1.	Air Conditionar	1.5kw
2.	Computer	300w
3.	Xerox Machine/Network printer	500w
4.	Inkjet printer	50w
5.	Dot matrix printer	50w
6.	Tube light	40w
7.	Fans	50w
8.	LCD Projector	500w
9.	Water Coolar	200w
10	Chimni for cooking	850w
11	Spot light(CFL)	25w
12	Electric kettle	850w
13	Refregerator	500w
14	Water pump	1kw



Power Consumption of Uses Items( kWh/day):

Sl.no	Particulars	Uses number	Power consumption/day
	Air Conditionar	320	2400 kWh
	Computer	700	1680 kWh
	Xerox Machine/Network printer	16	16 kWh
	Inkjet printer	40	4 kWh
	Dot matrix printer	110	5.5 kWh
	Tube light	6600	2112 kWh
	Fans	2100	840 kWh
	LCD Projector	80	80 kWh
	Water Coolar	55	55 kWh
	Chimni for cooking	8	20.4 kWh
	Spot light(CFL)/ Vapour light	1200	300 kWh
	Electric kettle	48	20.4 kWh
	Refregerator	42	210 kWh
	Water pump	5	10 kWh

### 3.5 Energy cost:

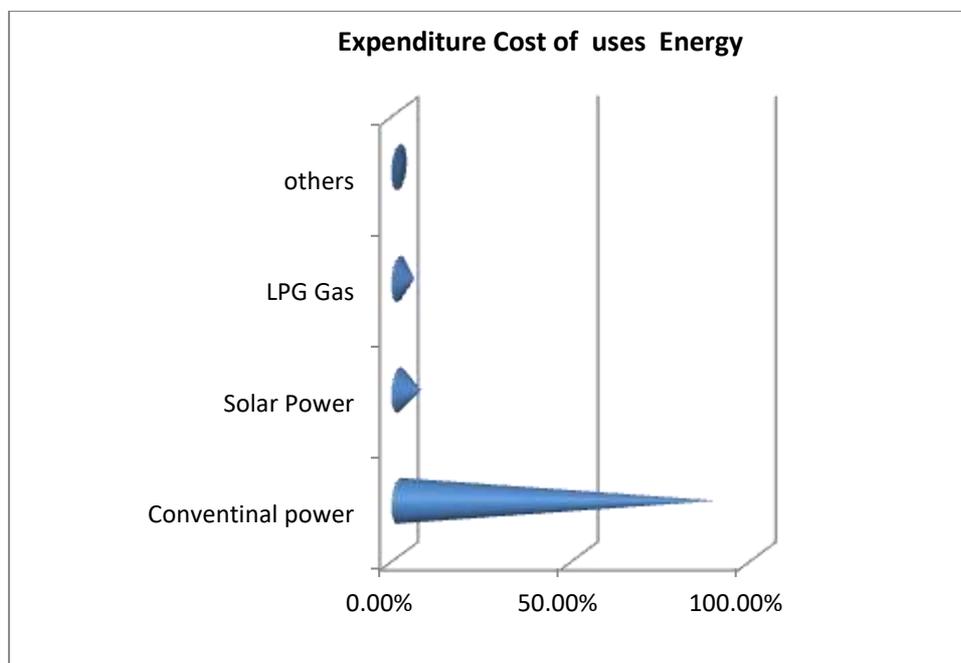
. Electricity Consumption -1639117 Unit, Rs.-16001910/- per Year

- a) Conventional energy-1532574 Units
- b) Nonconventional energy-106543 Units



Pump House

Sl.no	Sectors	% of expenditure Cost
1.	Conventional power	88.56%
2.	Solar Power	6.15%
3.	LPG Gas	4.26%
4.	Others	1.00%



- ❖ Fossil fuel consumption per Year:
  - a. Number of Gas cylinders used for cooking purpose( Hostels& Canteen) – 1080PC
  - b. Number of Gas cylinders used in Chemistry Laboratory - 4PC
  - c. Diesel used for green Generator-1500 liter
- Number of Gas cylinders used per month – 130 PC
- Cost of Gas cylinders used Rs. 84500/month
- Number of Green Generators - 4
- Cost of generator fuel – Rs. 8125/month
- Total cost of energy – Rs. 1426117.5/month

Energy consumption in different purpose : 2017-18

1	Lights & Fans	696624.72 unit
2	Air Condition	198333.15 unit
3	Lifting of water( HP pump)	98347.02 unit
4	Computer & Dept. Lab	557299.78 unit
5	Others( CCTV,TV, water cooler & others)	88512.31unit



### 3.6 Emission of GHG<sub>s</sub> and Carbon Footprint:

Commutation of stakeholders has an impact on the environment through the emission of greenhouse gases into the atmosphere consequent to burning of fossil fuels (such as petrol, Diesel, LPG Gas). The most common greenhouse gases are carbon dioxide, CFC, water vapour, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the most leading greenhouse gas, comprising 407.4 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. An important aspect of doing an audit is to be able to measure your impact so that we can determine better ways to manage the impact. In addition to the water, waste, energy and biodiversity audits we can also determine what our carbon footprint is, based on the amount of carbon emissions created. One aspect is to consider the distance and method traveled between home and University every day. It undertakes the measure of bulk of carbon dioxide equivalents exhaled by the organization through which the carbon accounting is done. It is necessary to know how much the organization is contributing towards sustainable development. It is therefore essential that any environmentally responsible institution examine its carbon footprint.

It is was observed that the Outdoor air quality is Fresh and comfortable for breathing to human life.

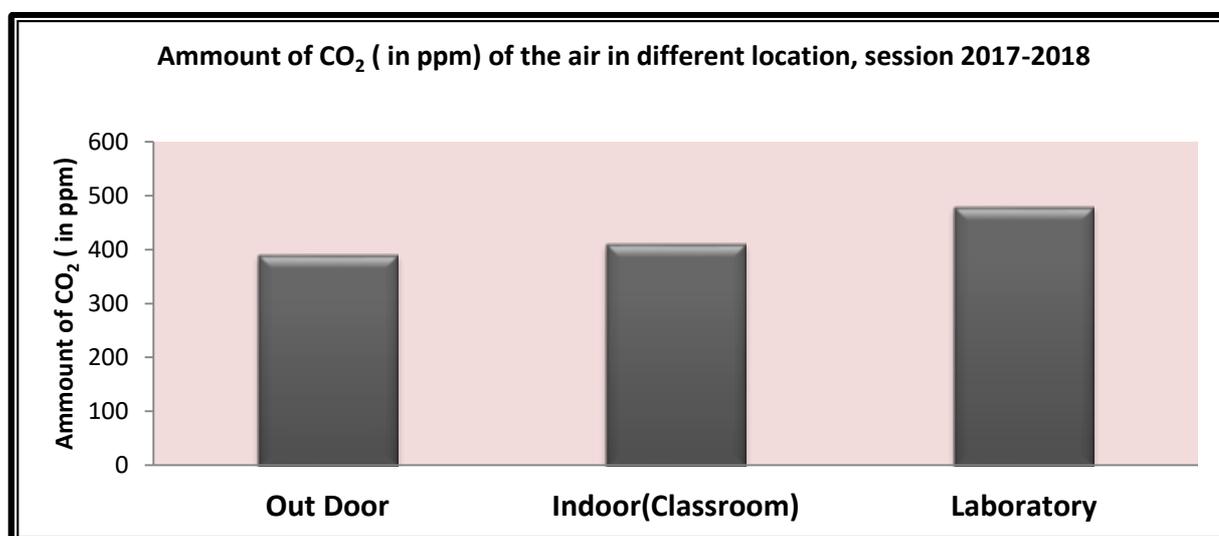
By the enquiry, it was observed that more than 21% Oxygen available in the air. While, Indoor air quality especially Computer and Departmental Laboratories is usually uncomfortable, there are level of Oxygen is less than 20.80%. Other hand the amount of CO<sub>2</sub> is very high in the departmental and Computer laboratories which amount is more than 440ppm and also amount of CO is 5 to 6 ppm.

Computer & Printer used for HOD work in Botany dept.



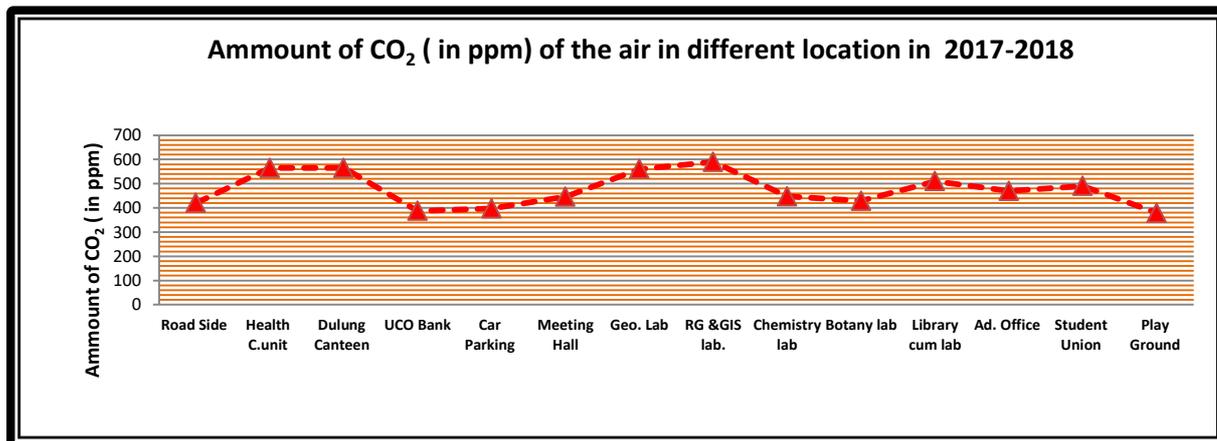
**Amount of CO<sub>2</sub> ( in ppm) of the air in different location, session 2017-2018**

Location	Density of CO <sub>2</sub> (ppm) in
Out Door	390
Indoor(Classroom)	410
Laboratory	480



**Amount of CO<sub>2</sub> in ppm in Different stations in 2017-2018**

Different stations	Density of CO <sub>2</sub> (ppm) in
Road Side	420
Health C.unit	565
Dulung Canteen	565
UCO Bank	387
Car Parking	397
Meeting Hall	446
Geo. Lab	560
RG &GIS lab.	590
Chemistry lab	447
Botany lab	429
Library cum lab	510
Ad. Office	470
Student Union	490
Play Ground	379



Indoor Air Quality (IAQ) refers to the air quality within and around buildings and structures, as it relates to the health and comfort of building occupants. Some common indoor pollutants are listed as below:

- Molds and other allergens – This may arise from water seeping into the building envelope or skin, plumbing leaks, condensation due to improper ventilation, or from ground moisture penetrating a building part.
- Carbon monoxide – Sources of carbon monoxide are incomplete combustion of fossil fuels.
- Volatile organic compounds – VOCs are emitted by paints and lacquers, paint strippers, pesticides, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions etc.
- Carbon dioxide – Due to human respiration
- Particulate matter – Due to construction and maintenance activities

**Major observations under indoor air quality are as below:**

- a) Ventilation is achieved by fans in the institute and air conditioners in Official and Lab. places.
- b) Heating Ventilation and Air Conditioning (HVAC) system is not installed.
- d) Exhaust fans are only provided in washrooms and chemistry lab.
- e) No indoor plants were observed in the entire institute. Indoor plants can be plotted not only for the aesthetic appearance but also for health benefits.

**3.9 Interviews**

In order to university information for energy auditing different audit groups with Interviewed IQAC Cell, Deputy Registrar, Dean of Student Welfare, and Director DDE, Dept. HOD, Teaching and non-teaching staff, students, Students Union, parents and other stakeholders of the University. Discussions were also made with the PTA office bearers to clarify doubts regarding certain points.



Information collection from Dept of Geography



Laboratory testing  
Dept



Replace the solar plate

## CHAPTER : 4.0 POST AUDIT STAGE

### 4.1 Data analysis and Assessment

The audit process seeks, on a sampled basis, to track past actions, activities, events, and procedures to ensure that they are carried out according to systems requirements and in the correct manner. Energy audits form a part of a process. Although they are individual events, the real value of energy audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time.

Although Energy audit carried out using policies, procedures, documented systems and objectives as a test, there is always an element of subjectivity in an audit. The essence of any Energy audit is to find out how well the Energy utilization, Resource management and environmental equipment are performing. The individual functioning and the success of integration will all play a role in the degree of success or failure of the organization's environmental performance.

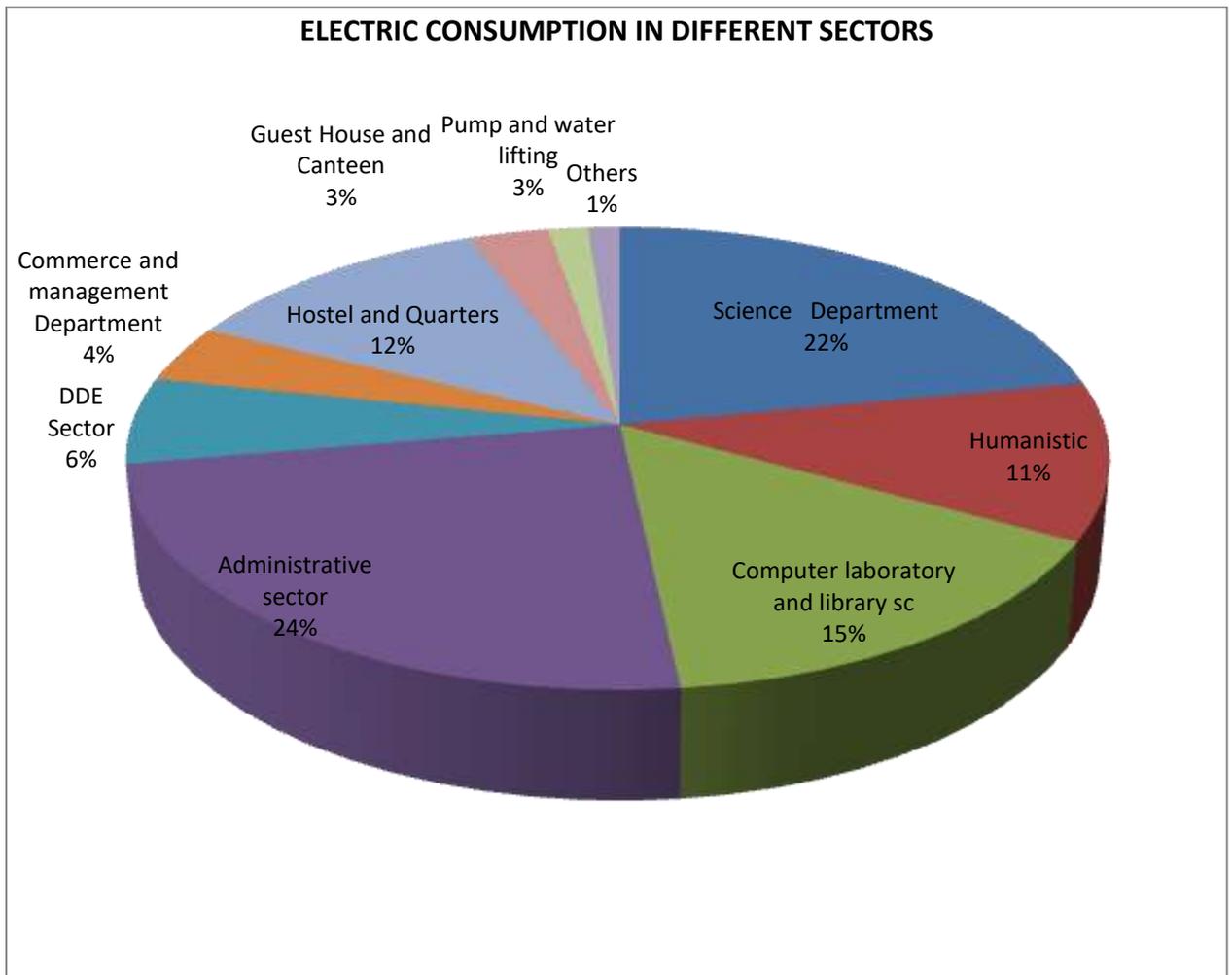


Departmental Panel box & Main Switch

### 4.2 Results and Findings

Power Consumption in Different Sectors( kWh &%/Day):

Sl.no	Sectors and purpose	Power consumption(kWh/day)	Power consumption(%)/day
1.	Science Department	2468.68kWh	22%
2.	Humanistics Department	1234.34 kWh	11%
3.	Computer laboratory and library sc	1716.85 kWh	15.3%
4.	Administrative sector	2693.11 kWh	24%
5.	DDE Sector	673.27 kWh	6%
6.	Commerce and management Department	448.85 kWh	4%
7.	Hostel and Quarters	1346.55 kWh	12%
8.	Guest House and Canteen	336.63 kWh	3%
9.	Pump and water lifting	168.31 kWh	1.5%
10.	Others	134.65 kWh	1.2%



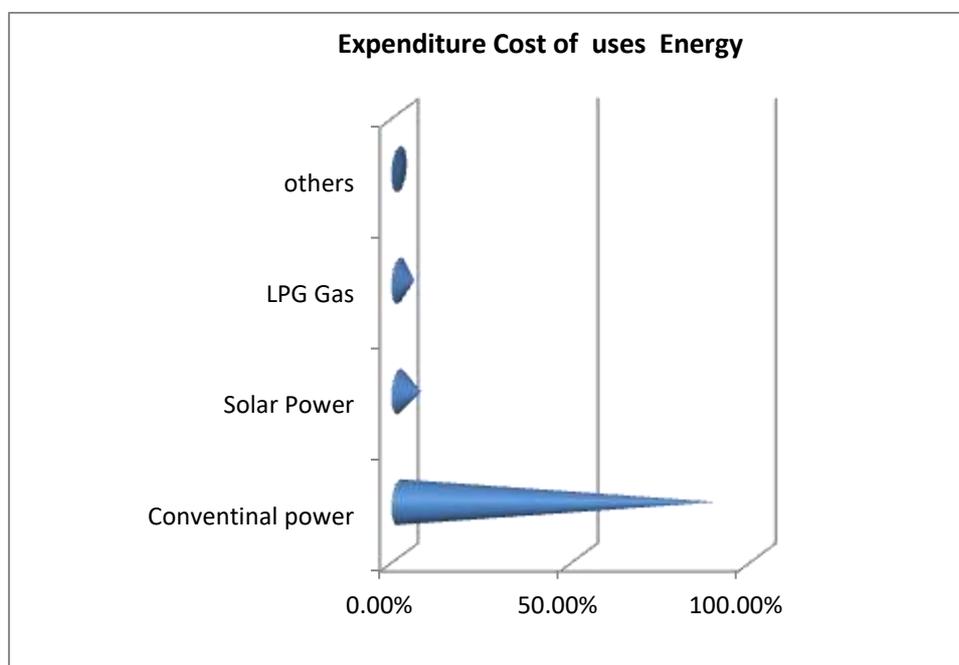
After the auditing, we have observed that the Department of Science and Administrative Building are extreme uses of electricity. By the enquiry we have find out that more than 45 % (5161.79kw/day) energy is consumed those Sectors. Other hand only 11 % ( 1234.34kw/day) energy is consumed in the Humanistic Department.

#### 4.2. Energy cost:

- ❖ Electricity Consumption -1639117 Unit, Rs.-16001910/- per Year
  - c) Conventional energy-1532574 Units
  - d) Nonconventional energy-106543 Units

Sl.no	Sectors	% of expenditure	Cost
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1.	Conventional power	88.56%
2.	Solar Power	6.15%
3.	LPG Gas	4.26%
4.	Others	1.00%



- ❖ Fossil fuel consumption per Year:
  - d. Number of Gas cylinders used for cooking purpose( Hostels& Canteen) – 1080PC
  - e. Number of Gas cylinders used in Chemistry Laboratory - 4PC
  - f. Diesel used for green Generater-1500 liter
- Number of Gas cylinders used per month – 130 PC
- Cost of Gas cylinders used Rs. 84500/month
- Number of Green Generators - 4
- Cost of generator fuel – Rs. 8125/month
- Total cost of energy – Rs. 1426117.5/month

Energy consumption in different purpose : 2017-18		
1	Lights & Fans	696624.72 unit
2	Air Condition	198333.15 unit
3	Lifting of water( HP pump)	98347.02 unit
4	Computer & Dept. Lab	557299.78 unit
5	Others( CCTV,TV, water cooler & others)	88512.31unit

### 4.3 Consolidation of Audit Findings

We hope that students and Stakeholder will have developed a greater appreciation and understanding of the impact of their actions on the environment and Resource management. They have successfully been able to determine the impacts on the environment through the various auditing exercises. Participating in this energy auditing procedure they have gained knowledge about the need of sustainability of the university campus. It will create awareness on the use of the Earth's resources in their home, University, local community and beyond.

### **Routine Energy save Practices**

World Environment Day – June 5,

Ozone Day – September 16

Awareness seminars are organized on various environmental problems.

Non-degradable and electronic waste and toxic materials are regularly disposed of. Important days like World Environment Day, Ozone Day, and Hiroshima Day etc are observed and several programmes including processions with placards, competitions and street plays are conducted by various departments to create awareness in environment protection and Energy save.

### **4.4 Summary of Energy Auditing**

- The communication process for awareness in relation to energy conservation is found inadequate.
- Assessment of electrical load calculation is yet to be done by the university.
- Monthly use of electricity in the university is very high.
- Objectives for reducing energy, water and fuel consumption are meager.
- There are fans and Tube light of older generation and non energy efficient which can be phase out by replacing with new energy efficient fans and tubes.
- Regular monitoring of equipments and immediate rectification of any problems.

### **4.5 Carbon foot print auditing**

#### **Carbon Footprint**

- ✓ Number of Students & Staff using cycles – 360
- ✓ Number of persons using cars – 12
- ✓ Number of persons uses two wheelers – 112
- ✓ Number of students uses Buses - 85
- ✓ Number of persons using other transportations – 2725
- ✓ Number of visitors per day – 160
- ✓ Number of Students staying in the hostel – 632
- ✓ Number of Faculty and staff staying in the quarters – 88
- ✓ Average distance travelled by stake holders – 6x2 kms /day
- ✓ Expenditure for transportation per person per day – Rs.40/-

- University has not yet taken any initiative for carbon accounting.
- Too much adequate common transportation facilities should be provided by the University
- Encourage students to use cycles.

- Fossil fuel is burned every day for the functioning of the University. This is too high carbon emission.
- Minimum % of the energy is used from Non-conventional power.
- Uses of 130 gas cylinders per month is very high.

<b>Implemented Air Quality management</b>		
<b>Sl No</b>	<b>Indicator</b>	<b>Weightage</b>
1	Carbon & Smoke free	H
2	Exhaust fans & Ventilation	M
3	Emission of GHGs	M
4	Indoor Plants	L

\* H denote- Taken management policy level above 60%

\*\* M denote- Taken management policy level 40%-60%

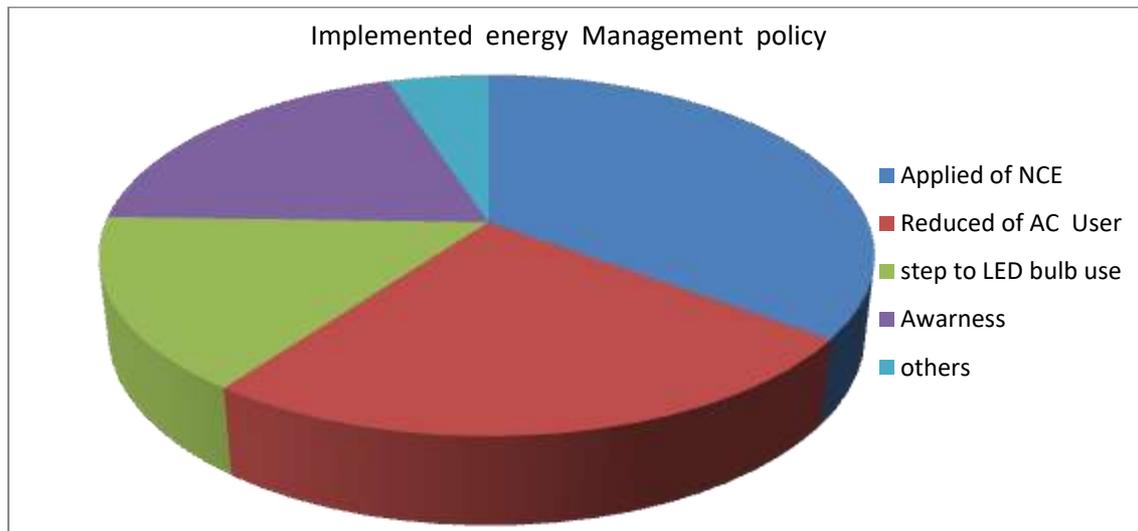
\*\*\* L denote- Taken management policy level below 40%

<b>Major Audit Observations</b>		
<b>Sl. No</b>	<b>Sectors/Indicators</b>	<b>weightage</b>
1	Applied of NCE	L
2	Step to LED and CFL Bulb use	M
3	Reduce of AC User	H
4	Awareness	M
5	Management of GHG <sub>s</sub>	H

\* H denote- Taken management policy level above 25%

\*\* M denote- Taken management policy level 15%-25%

\*\*\* L denote- Taken management policy level below 15%



#### 4.6 Preparation of Action Plan

Policies referring to university's management and approaches towards the use of resources need to be considered. The university should have a energy policy/environmental policy for its sustainable development. The environmental policy formulated by the management of the university should be implemented meticulously. The university should have a policy on awareness rising or training programs (for ground staff or kitchen staff for example) and university also should have a procurement policy (the university's policy for purchasing materials).

#### 4.7 Follow Up Action and Plans

Energy Audits are exercises which generate considerable quantities of valuable management information. The time and effort and cost involved in this exercise is often considerable and in order to be able to justify this expenditure, it is important to ensure that the findings and recommendations of the audit are considered at the correct level within the organisation and that action plans and implementation programs result from the findings. Audit follow up is part of the wider process of continuous improvement. Without follow-up, the audit becomes an isolated event which soon becomes forgotten in the pressures of organizational priorities and the passing of time.

#### 4.8 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 total 7 split type air conditioners. It is Recommended that the old air conditioners are being replaced with new energy efficient BEE STAR labeled (3 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 = 30.5

- kWh/day/ air conditioner Yearly operating days = 160 days/year/ air conditioner
- Yearly electricity consumption = 1.28 lakh kWh/year/ air conditioner
- Considering a saving of 15%, total annual savings = 15% x 1.28lakh kWh
- Yearly savings = 19200 kWh/year/ air conditioner Cost of electricity = Rs. 9.75/ kWh
- Yearly savings = Rs. 1.87 lakh /year/ air conditioner

#### **Proposal for Replacement of Tube Light:**

Replacing Fluorescent Tube Lights (FTL) with LED Tube Lights

The 416 W FTLs can be replaced with the LED tube lights 16 W.

These changes can be made at the places where the life is higher.

Usually minimum of 3 years warranty is given and approximate burning hours is 40 000. (15 years considering 8 hours per day running) 39 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 = 16 W/ Tube Light
- Savings in power = 24 W/ Tube Light
- Operating hours = 8 h/day x 6600 = 1.584crore h/year
- Tube Light Yearly savings = 1.584crore x 24 W = 3.80 lakh kWh/year/Tube Light
- Average Cost of electricity = Rs.9.75/ kWh
- Saving = Rs.37.06 lakh/ year/ Tube light
- Approximate investment on single LED Tube lights = Rs. 220
- Number of Tube Lights to be replaced = 2000
- Total yearly Investment = 2000 x Rs. 220 = Rs. 4.40 lakh

Total Yearly Savings =Rs. 32.66 lakh

#### **Awareness on Carbon Consumption**

- ✓ Students and Staff members may be made totally aware of pollution caused by use of vehicles.
- ✓ The carbon consumption awareness programs on carbon emission at Individual as well as social level will help to avoid air and noise pollution in the campus due to vehicles.

#### **5.8 Conclusion and Recommendations**

The green and environmental audit assists in the process of testing performance in the environmental arena and is fast becoming an indispensable aid to decision making in a university. The energy audit reports assist in the process of attaining an eco friendly approach to the sustainable development of the university. Hope that the results presented in the energy auditing report will serve as a guide for educating the university community on the existing environment related practices and resource usage at the university as well as spawn new activities and innovative practices. A few recommendations are added to curb the menace of waste management using eco-friendly and scientific techniques. This may lead to the prosperous future in context of Green Campus and thus sustainable environment and community development. It has been shown frequently that the practical suggestions, alternatives, and observations that have resulted from audits have added positive value to the audited organisation. An outside view, perspective and opinion often helps staff who have been too close to problems or methods to see the value of alternative approaches. A energy audit report is a very powerful and valuable communications tool to use when working with various stakeholders who need to be convinced that things are running smoothly and systems and procedures are coping with natural changes and modifications that occur.

#### **General Recommendations:**

- All Class Rooms and labs to have Display Messages regarding optimum use of electrical appliances in the room like lights, fans, computers and projectors.
- Save electricity. Display the stickers of save electricity, save nature everywhere in the campus. So, that all stakeholders are encouraged to save the electricity.
- Most of the time, all the tube lights in a class room 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**.
- All projectors to be kept OFF or in idle mode if there will be no presentation slides.
- All computers to have power saving settings to turn off monitors and hard discs, say after 10 minutes/30 minutes.
- The Power Factor to reduce the utility power bill.
- Most utility bills are influenced by KVAR usage.
- A good Power Factor provides a better voltage.
- Reducing the pressure on electrical distribution network.
- Reducing cable heating, cable over loading and cable losses.
- Reducing 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

### Common Recommendations

- ✓ Adopt an environmental policy for the university
  - ✓ Establish a purchase policy for environmental friendly materials
  - ✓ Introduce UGC Environmental Science course to all students
  - ✓ Conduct more seminars and group discussions on environmental education
  - ✓ Students and staff can be permitted to solve local environmental problems
  - ✓ Renovation of cooking system in the canteen to save gas
  - ✓ Establish water, waste and energy management systems
  - ✓ . Adopt an environmental policy for the university
  - ✓ Establish a purchase policy for environmental friendly materials
  - ✓ Introduce UGC Environmental Science course to all students
  - ✓ Conduct more seminars and group discussions on environmental education
  - ✓ Students and staff can be permitted to solve local environmental problems
  - ✓ Renovation of cooking system in the canteen to save gas
  - ✓ Establish water, waste and energy management systems
1. There has to be Institute 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 report should be made public to generate awareness.
  3. Need to create energy efficiency/ renewable energy awareness among the University campus i.e. solar, wind, Biogas energy. University should take initiative to arrange seminars, lectures, paper presentation competition among students and staff for general awareness.

### Criteria Wise Recommendations

## **Energy**

- ✓ Employment of more solar panels and other renewable energy sources.
- ✓ Conduct more save energy awareness programs for students and staff.
- ✓ Replace computers and TVs with LED monitors.
- ✓ More energy efficient fans , tubes and bulb should be replaced.
- ✓ Observe a power saving day every year.
- ✓ Automatic power switch off systems may be introduced.
- ✓ Observation of Non Air Condition Day in a week or month
- ✓

## **GHGs & Carbon footprint**

- ❖ Establish a system of car pooling among the staff and visitors to reduce the number of four wheelers coming to the university.
- ❖ More providing university bus services to the students and staff.
- ❖ Encourage students and staff to use cycles.
- ❖ Establish a more efficient cooking system to save gas.
- ❖ Discourage the students using two wheelers for their commutation.
- ❖ More use of generators every day should be discouraged.
- ❖ Observation of Non Motor vehicles day in a week or month

# Chapter 5

## **CLOSING MEETING AND REPORT SUBMIT:**

The exit meeting was conducted by the lead auditors Dr. Pranab Sahoo and Mrs. Sanchita Bhattachariya. It was a mechanism to provide the IQAC management and staff a broad feedback on the preliminary findings of the audit team before completing the audited report. The exit meeting was held in the IQAC Office in the University on 20<sup>th</sup> Feb., 2018. Clarification on certain information gathered was sought by the audit team from the management and staff of the University.

### **Draft audit Report:**

The information gathered by the audit team was consolidated as a draft audit report. This draft report was then circulated to the audit team and those directly concerned with the audit to check the report for accuracy. The draft energy audit report was also discussed in the exit meeting.

### **Final Audit Report:**

The final audit report is the corrected final document which contains the findings and recommendations of the audit. It will also form one of the bases of future audits because the information it contains informs some of the tests and analyses that need to be performed in the future. Final Audit Report was submitted on 14<sup>th</sup> June, 2018 to the Director, IQAC of the university.

### **Follow Up and Action Plans:**

Energy audits form a part of an on-going process. Innovative green initiatives have to be designed and implemented every year to make the University environmentally sustainable. Follow up programs of energy auditing recommendations should be done meticulously before the next audit.

### **Next Audit:**

In order to promote continuous improvement it is recommended to conduct the next Energy auditing during the year 2019.

### **Transparency of Energy Audit Report:**

Energy audit report is one of the useful means of demonstrating an organisation's commitment to openness and transparency. If an organisation believes it has nothing to hide from its stakeholders, then it should feel confident enough to make its green audit reports freely available to those who request them. As a basic rule, energy audit reports should be made available to all stakeholders.

## ***Acknowledgements:-***

*TIEER and CMS are thankful to the Honorable Vice Chancellor & Administration and the Director, IQAC of the Vidyasagar University for entrusting processes of Green and Environmental auditing with us. We thank all the participants of the auditing team especially, Administrative Officers, HOD, faculty and non-teaching staff , students, Research Scholars also others stakeholders who took pain along with us to gather data through survey. We also thank the office staff who helped us during the document verification.*

