GREEN AUDIT REPORT

OF

Tezpur University , Assam

Tezpur University, Napaam, Tezpur, Assam 784028

Prepared By–

VC,
For consideration & acceptance pl.
25/3/22
Accepted
28/3/22

Audittech Industrial Services Private Limited

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Acknowledgement

We express our sincere gratitude to **Tezpur University Assam** for giving us the opportunity to be a part of their mission towards Energy Conservation. We are thankful to all officers and employees of **Tezpur University Assam** with whom we have interacted during the field study for their whole-hearted support in undertaking measurements and eagerness to assess the system/equipment efficiencies and saving potential. The willingness of these key personnel to participate in this program and acknowledge the call for energy efficiency is more than half the issues received.

Date: 23 February 2022 **Authorized Signatory**

Place: Balod **for, Audittech Industrial Services Private Limited**

Ref: 2021-22/GA/Certificate

Date :- 26/03/2022

CERTIFICATE

This is to certify that Tezpur University has conducted a detailed "***Green Audit***" for its campus during the academic year 2021-2022. The green audit was conducted in accordance with the applicable standards prescribed by the Central Pollution Control Board, New Delhi, and the Ministry of Environment, Forest and Climate Change, New Delhi. The audit involves water, wastewater, energy, air, green inventory, solid waste, etc., and gives an 'Environmental Management Plan', which the university can follow to minimize the impact on the institutional working framework. In an opinion and to the best of our information and according to the information given to us, said green audit gives a true and fair view in conformity with environmental auditing principles' accepted in India.

Date: 26 March 2022

Authorized Signatory and Seal

Place: Balod

for, Audittech Industrial Services Private Limited

Audittech Industrial Services Pvt. Ltd.

Opps. Mahavir Bhawan, Tikarapara, Balod (C.G.)-491226

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EXECUTIVE SUMMARY

Green auditing is the process of identifying and determining whether institutions' practices are eco-friendly and sustainable. The main objective to carry out a green audit is to check green practices followed by the university and to conduct a well-formulated audit report to understand where we stand on a scale of environmental soundness. The initiative taken by **Tezpur University** to conduct a **Green Audit** of the university campus is a commendable sustainable goal. The strategies followed were the preparation of questionnaires and subsequent action plans to implement the project. Questionnaires prepared to conduct the green audit were based on the guidelines, rules, acts, and formats set by the Government of India, Ministry of Environment and Forest, New Delhi, and Central Pollution Control Board, New Delhi. Questionnaires were prepared for solid waste, energy, water, hazardous waste, and e-waste. For audit purposes, analysis of suitable data is required, for the same study area is grouped into various Blocks and Departments. The audit was carried out for solid waste, electricity and energy, water and wastewater, hazardous waste, air quality, and green inventory including carbon footprints. It also indicates the green initiatives taken by universities to save environmental resources. The "Green Audit" also presents the "Environmental Management Plan".

CHAPTER 1

INTRODUCTION

1.1 Green Audit - *An Effective Efforts towards Environment Sustainability & Energy Conservation*

Modernization and industrialization are the two important outputs of the twentieth century that have made human life more luxurious and comfortable. Simultaneously, they are responsible for voracious use of natural resources, exploitation of forests and wildlife, producing massive solid waste, polluting the scarce and sacred water resources, and finally making our mother Earth ugly and inhospitable. Today, people are getting more familiar with global issues like global warming, greenhouse effect, ozone depletion, climate change, etc. Now, it is considered as a final call by mother Earth to walk on the path of sustainable development. The time has come to wake up, unite and combat together for a sustainable environment.

Considering the present environmental problems of pollution and excessive use of natural resources, Honorable Prime Minister, Shri. Narendra Modiji has declared the Mission of Swachch Bharat Abhiyan. Also, University Grants Commission has mentioned the "Green Campus, Clean Campus" mission mandatory for all higher educational institutes. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.

Green Audit is the most efficient ecological tool to solve such environmental problems. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. Through this process, the regular environmental activities are monitored within and outside of the concerned sites which have direct and indirect impacts on the surroundings. A green audit can be one of the initiatives for such institutes to account for their energy, water resource use as well as wastewater, solid waste, hazardous waste generation. The green Audit process can play an important role in the promotion of environmental awareness and sensitization about resource use. It can create consciousness towards ecological

values and ethics. Through the green audit, one can get direction about how to improve the condition of the environment.

1.2 Why Green Audit

Green auditing is the process of identifying and determining whether an institution's practices are eco-friendly and sustainable. Traditionally, we are good and efficient users of natural resources. However, over the period of time excess use of resources like energy, water, chemicals are become habitual for everyone especially, in common areas. Now, it is necessary to check whether our processes are consuming more than the required resources? Whether we are handling waste carefully? Green audit regulates all such practices and gives an efficient way of natural resource utilization. In the era of climate change and resource depletion, it is necessary to verify the processes and convert them into green and clean ones. The green audit provides an approach for it. It also increases overall consciousness among the people working in institutions towards an environment.

1.3 Goals of Green audit

University has conducted a green audit with specific goals as:

- Assess facility of different types of waste management.
- Increase environmental awareness throughout campus.
- Identificationanddocumentationofgreenpracticesfollowedbyuniversity.
- Identify strengths and weaknesses in green practices.
- Conduct a survey to know the ground reality about green practices.
- Analyze and suggest solutions for problems identified from the survey.
- Identify and assess environmental risk.
- The long-term goal of the environmental audit program is to collect baseline data of environmental parameters and resolve environmental issues.
- To motivate staff for optimized sustainable use of available resources.

Objectives of Green audit

- To examine the current practices which can impact the environment such as resource utilization, waste management, etc.

- To prepare an Environmental Statement Report on green practices followed by different departments, support services, and administration building.
- To set goals, vision, and mission for Green practices on the campus.
- To identify and analyze significant environmental issues.
- To establish and implement Environmental Management Plan in various departments.
- To assess for better performance in green practices and its valuation.

1.4 About Criteria 7 of NAAC

Universities are playing a key role in the development of human resources worldwide. Higher education institutes campus run various activities with the aim to percolate the knowledge along with practical dimension among the society. Likewise, different technological solutions related to the environment are also provided by the higher education institutes. Different types of evolutionary methods are used to assess the problem concerning the environment. It includes Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, Green audit, etc.

National Assessment and Accreditation Council (NAAC) is a self-governing organization that rated the institutions according to the scores assigned at the time of accreditation of the institution. Green Audit has become a mandatory procedure for educational institutes under Criterion VII of NAAC. The intention of the green audits is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like water and wastewater accounting, energy conservation, waste management, air, noise monitoring, etc. for making the institution eco-friendlier.

Students are the major strength of any academic institution. Practicing green action in any educational institution will inculcate the good habit of caring for natural resources in students. Many environmental activities like plantation and nurturing saplings and trees, Cleanliness drives, Bird watching camps, no vehicle day, Rainwater harvesting, etc. will make the students good citizens of the country. Through Green Audit, higher

educational institutions can ensure that they contribute towards the reduction of global warming through Carbon Footprint reduction measures.

1.5 Benefits of Green Audit to an Educational Institute

There are many advantages of green audit to an Educational Institute.

- It would help to protect the environment in and around the campus.
- Recognize the cost-saving methods through waste minimization and energy conservation.
- Empower the organization to frame a better environmental performance.
- It portrays a good image of the institution through its clean and green campus.
- More efficient resource management
- To create a green campus
- To enable waste management through reduction of waste generation, solid and waste
- To create plastic-free campus and evolve health consciousness among the stakeholder
- Recognize the cost-saving methods through waste minimizing and managing
- Authenticate conformity with the implemented laws
- Empower the organizations to frame a better environmental performance
- Enhance the alertness for environmental guidelines and duties
- Impart environmental education through systematic environmental management approach and Improving environmental standards
- Benchmarking for environmental protection initiatives
- Financial savings through a reduction in resource use
- Development of ownership, personal and social responsibility for the University and its environment
- Developing an environmental ethic and value systems in youngsters.
- Green auditing should become a valuable tool in the management and monitoring of environmental and sustainable development programs of the University.
- Finally, it will help to build a positive impression through green initiatives for the upcoming NAAC visit.

1.6 Introduction of Auditing Firm

M/s. Audittech is an empaneled Accredited Energy Audit Firm from the Bureau of Energy Efficiency, Ministry of Power, Government of India. It is one of the fast-growing Energy Audit & Energy services providing company executed several projects covering all the energy Intensive Sectors & states of India. The directors and associate team members are very well experienced in the field of Energy Audit and executed more than 150 no's Detailed Energy Audit so far. The associate team and experts are highly qualified and experienced in the field of Energy Audit and Services. Individual credential of each member in the field of Energy Audit is very rich due to their past association with the very reputed organization of Energy Audit Services. The company has Head office at Balod (C.G.) & Branch offices at Raipur, Durg, Bhopal, Mumbai, and Delhi.

Name of Firm	Audittech Industrial Services Private Limited
Address	C/o Aashish Bafna, Opp Mahavir Bhawan, Tikra Para, Balod, Chhattisgarh- 491226
Contact details	9827143100 / 8103651115 Email id: info@audittech.co.in

Directors Details

Sr. No.	Name	Designation / Technical Experience	Technical Experience /Qualification
1	Mr. Aashish Bafna	Managing Director - 10yrs	B.E (E&I). , MBA(Energy Management), Certified Energy Auditor, Surveyor & Loss Assessor
2	Mr. Rakesh Khichariya	Director- 25Yrs	B.E (Elect.)., Accredited Energy Auditor
3	Mr. Ramesh Patel	Director- 25Yrs	B.E.(Mech), Government approved Valuer, Competent Person for Factory Act
4	Mr. Isshant Chainani	Director- 10 Yrs	B.E. (Elect & telecom)
5	Mrs. Shikha Golchha	Director- 8 yrs	B.E., MBA (Finance)

M/s. Audittech Recognized as **"Startup"** from Department of Promotion of Industry and Internal Trade, Ministry of Commerce & Industry, Government of India and also Registered in Ministry of Micro, Small & Medium Enterprises **(MSME)** as Micro unit.

Energy audit team

The energy audit team involved in the energy audit of Tezpur University, Assam details are in the following.

SN	Name	Designation/ Qualification	Experience	Contact Details
1	Mr. Rakesh khichariya	Accredited Energy Auditor (AEA-0295)	25 yrs.	9827411444
2	Mr. Aashish Bafna	Certified Energy Auditor (EA-28916)	10 yrs.	9827143100
3	Mr. Sachet Chitransh	Consultant & B.Tech (Electronics & Comm.)	14 yrs.	9873751602
4	Mr. Prashant Sonwani	Energy Engineer	3 yrs.	9755567156

List of Instruments

Following are the instrument used at the time of the Energy Audit.

Sr. No.	Instrument	Make/Sr.No.
1	Power & Harmonics Analyzer, 1 Set (With CT, PT) HT	Krykard ALM 31/ 123673RCH
2	Power & Harmonics Analyzer, 1 Set (With CT, PT) HT	Krykard ALM 20/ 28107280
3	Temperature gun 1 Set (infrared Thermometer)	MECO 550 T/ IRT550T_17120136
4	Lux Meter 1Set (Digital Lux Meter)	MECO G 930P/201704004601
5	Flue gas Analyzer	KANE-905/ 54019395

1.7 About Tezpur University

Tezpur University was established by an Act of Parliament in 1994. The objective of this Central University as envisaged in the statutes are that it shall strive to offer employment oriented and interdisciplinary courses to meet the local and regional aspirations and the development needs of the state of Assam and also offer courses and promote research in areas which are of special and direct relevance to the region and in

emerging areas in Science and Technology.

Initially, the university operated from the premises of the Darrang College, and Law College in Tezpur. The present location is at Napaam, a suburb, which is about 15 km (9.3 mi) east of Tezpur town, with an area totaling 262 acres (106 ha). The university campus is at Napaam about 15 km east of Tezpur, the headquarters of the Sonitpur district of Assam. Napaam is an urban area surrounded by people of diverse caste, religions, and languages. The campus is bounded by pucca walls. Napaam is linked by a PWD road from the National Highway No. 37A at almost the midpoint between the Kalia-Bhomora bridge and Misson Chariali. Tezpur is linked by road and rail with the rest of the state and the country. There is a tri-weekly flight between Kolkata and Tezpur.

Over the years, it has steadily evolved itself as one of the leading centers of comprehensive learning with its exposure to and linkages with its peers at national and international levels. With its state-of-the-art infrastructure, well-equipped laboratories, and highly qualified and dedicated faculty, the University is committed to the task of harnessing and cultivating the capabilities of young students with a view to enabling them to carve suitable space for themselves in the modern economic world. During the last few years' plan, the introduction of many learning courses keeping in pace with the changing demands of the society and also for human resources development was planned. Now, there are four main schools including the School of Engineering, School of Humanities & Social Sciences, School of Management Sciences, and School of Sciences comprises 26 academic departments equipped with more than 40 job-oriented courses along with 4000 students on the campus. There are 280 faculties on the University Campus. There is a separate cell for Student welfare, Research & Development, and the Centre for Distance and Online Education. The University Building Campus is categorized mainly into 4 Building Blocks. The details of all departments are mentioned in the below table of Buildings:

- Academic Buildings
- Facilities Buildings
- Hostel Buildings
- Residential Buildings

Name of the Building Blocks and their coding	
Academic Buildings	
Building / Blocks	**Name of the Departments**
Academic Building I	Department of Assamese, Department of Law, Women Studies Center, Center for Distance and Online Education, Center for Inclusive Development
Academic Building 2	Department of Physics, Department of Mathematical Sciences, Computer Center
Department of Mass Communication &Journalism	Department of Mass Communication &Journalism
Department of Molecular Biology and Biotechnology	Department of Molecular Biology and Biotechnology
Department of Environmental Science	Department of Environmental Science
Humanities and Social Sciences Building	Department of English, Department of Hindi, Department of Cultural Studies, Department of Social Work, Department of Sociology, Department of Education, Department of Foreign Languages, Department of Commerce
Department of Energy	Department of Energy
Department of Chemical Sciences	Department of Chemical Sciences
School of Management Science	Department of Business Administration, Center for Disaster Management
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering, Department of Electrical Engineering
Department of Computer Science & Engineering	Department of Computer Science & Engineering
Dean, School of Engineering Building	Department of Applied Sciences, Department of Design
Department of Mechanical Engineering	Department of Mechanical Engineering
Department of Food Engineering & Technology	Department of Food Engineering & Technology
Department of Civil Engineering	Department of Civil Engineering

Facilities	
Facilities	Sophisticated Analytical Instrumentation Centre
	Engineering Workshop
	Water Pumping and Treatment Facility
	Guest House
	Central Library
	Administrative Building
	Health Center
	Auditorium
	Council Hall
	Student Activity Center
	Canteen, Shopping Complex
	Teaching and Learning Center
Hostels	
Hostels	Charaideo Men's Hostel
	Nilachal Men's Hostel
	Kanchenjungha Men's Hostel
	Patkai Men's Hostel
	Saraighat C. V. Raman Men's Hostel
	Transit Men's Hostel
	Bordoichila Women's Hostel
	Dhansiri Women's Hostel
	Pragjyotika Women's Hostel
	Subansiri Women's Hostel
	KopiliWomens' Hostel
	New Women's Hostel
	Pobitora Madam Curie Women's Hostel

The University has also adopted the 'Green Campus' system for environmental conservation and sustainability. The 'Green Campus' has been active for the last several years as an assembly group of sub committees along with the Horticulture section that actively promotes the various projects. The University administration works on several activities for 'Green Campus' including Renewable Energy, Water Conservation, Tree Plantation, Waste Management, Paperless Work, etc.

1.7.1 Campus Infrastructure

Tezpur University has a very good and systematic building infrastructure. All classrooms are fully ventilated and comfortable. The University from the outside looks great and is quite unique keeping the architecture of other universities in mind. The University has also an interesting historical legacy which is interesting to learn about.

Presently, it is one of the premier educational institutions of the country encompassing a vast, beautiful, and pollution-free campus which sprawls over 262 acres of land having vast playgrounds and experimental fields, swimming pool, botanical garden, ornamental and fruits garden with Indoor Stadium, well equipped Central Library, hostels for both girls and boys, Administrative Block, Spacious Auditorium, Guest House, Computer Center, Health Center, Food Quality Control Laboratory, Kendriya Vidyalaya, Yoga Centre, Horticulture Section, Residential Quarters for faculty members and employees, Canteen and Bank. The teaching department belonging to different faculties, are housed in spacious buildings and have well-equipped laboratories and advanced facilities.

The University Campus is itself is a combination of all standards and amenities required as far as great educational infrastructure is concerned such as Bank, School, Health Centre, etc. Badminton Court, Computer Centers are the center of attraction. The Central library has a large number of books to issue or read in the library itself. There is ample sitting space also available. Students can get Internet access at the library and power back up. University has provided a Wi-Fi facility to all students and residential blocks. The University Campus also has a book bank facility that enables students to use the books, for the entire academic session and the computer laboratories have access to advance web activity with its subscription to E-resources through a digital Network that links students and researchers to the databases required for research. There are 7 number girls and 6 number boy's Hostels. University has facilities for both outdoor and indoor games. The campus also has sports facilities which include a well-maintained Cricket ground, football ground, and basketball court. Students also use this platform for their cultural competitions etc. Very beautiful auditorium is available for seminars and conferences on the University Campus. University has a dedicated health center building with all the necessary first aid facilities. The existing facilities are continuously upgrading and improving.

TEZPUR UNIVERSITY – CAMPUS HIGHLIGHTS

Horticulture Section

The campus has a dedicated horticulture section that takes care of all green activities including plantation, maintenance of the botanical garden, nursery, areas of all department buildings, and new plantations in the campus. This section plays a major role to make the campus Green and Environment friendly. The entire green activities in the campus are managed by the Horticulture Section under the monitoring and guidance of Shri Girindra Hazarika, Assistant Horticulturist, and Dr. Satya Sundar Bhattacharya, Assistant Professor, Department of Environmental Science.

Botanical Garden

The campus has a very vast and beautiful Botanical Garden. There is a Botanical garden in about 13,125 sq. m (9.8 bighas) of land within the University campus. Ministry of Forest, Environment and Climate change, Govt. of India had granted an amount of Rs.25.296 lakhs for the development of this garden. Developmental work of the garden was started in 2013 and completed in 2017. The Botanical garden is now becoming a point of attraction for the inhabitants of the campus as well as visitors.

Different Infrastructure of the Garden

- An Orchidarium
- A Fern House
- A Nursery Shed
- Boundary with chain-linked fencing
- Concrete approach road and the inside track
- A visiting cum office room (under construction: at final stage)

About 300 different plant species (like Medicinal plants, Palm, Bamboo, Economically Important plants, Fruit, Beverage and spices, Tarul, Ferns, Orchid, Gymnosperm, RET, and other species) are available in the garden. The maintenance of the garden is done by the Horticulture Section in collaboration with the Engineering Cell of the University under the guidance of the Campus Horticultural Committee, Tezpur University.


सामुदायिक हॉल
COMMUNITY HALL
HORTICULTURE UNIT


TEZPUR UNIVERSITY BOTANICAL GARDEN


BOUNDARY WALL
PALM GARDEN
NURSERY SHED HOUSE
CHARAKA LODHAN
MEDICINAL PLANTS
ORCHIDARIUM
PROPOSED OFFICE
CHARAKA LODHAN
ENTRANCE
MAIN ROAD
FERN HOUSE
RARE ENDANGERED AND THREATENED (RET) PLANTS
B TYPE QUARTERS
ECONOMIC PLANTS
BAMBUSETUM
RET PLANTS
ORCHIDS
GYMNOSPERMS
ECONOMICALLY IMPORTANT PLANTS
MEDICINAL PLANTS
BAMBOOS
PALMS
FRUITS
BEVERAGE & SPICES
TARUL
FERNS
OTHERS
MAP AND LAYOUT OF TEZPUR UNIVERSITY BOTANICAL GARDEN (TUBG)


CHARAKA VANAM


PALM GARDEN


FERN HOUSE

Departmental Nursery

The Horticulture section has a nursery, which is the source of seedlings of ornamental/avenue trees, fruit trees, shrubs, valuable timber trees, indoor plants of

different types, and also some seasonal flowers for the use of the University. It is located within the premise of the Botanical Garden. Essential maintenance works of the nursery are carried out throughout the year and excess seedlings are also sold to the University employees and outsiders from time to time. The horticulture section conducts various activities in order to make the campus green, beautiful and bright which includes the Plantation and landscape activities, Maintenance of gardens, and landscape and plantations. Towards the sustainable land use practice, a total of 24,978 plant saplings of different species have been planted in various sites in the last 2 decades (from July'1997 to March 2021) through routine and special plantation drives organized by the Horticulture Section, Tezpur University on various national and international events/occasions with active participation from university communities and guests. In addition to new plantation drives and landscaping/beautification activities, all essential maintenance work (like lawn, hedge, existing plants /shrubs, growing of seasonal flowers) for previously developed flower and other gardens, as well as other locations of the University campus, is done regularly under the supervision of Horticulture Section. Apart from the maintenance of gardens, all old plantations (like roadside and other plantations) in different locations of the University campus are regularly nurtured by cleaning, fertilization, watering, etc. In addition to that campus celebrates various events like Special Plantation Drive every year on World Environment Day and other extension activities like the Plantation program.

Administration Office

Department of Energy

Department of Civil Engineering

School of Humanities and Social Sciences

Teaching Learning Centre

Department of Food Engineering & Technology

Community Hall

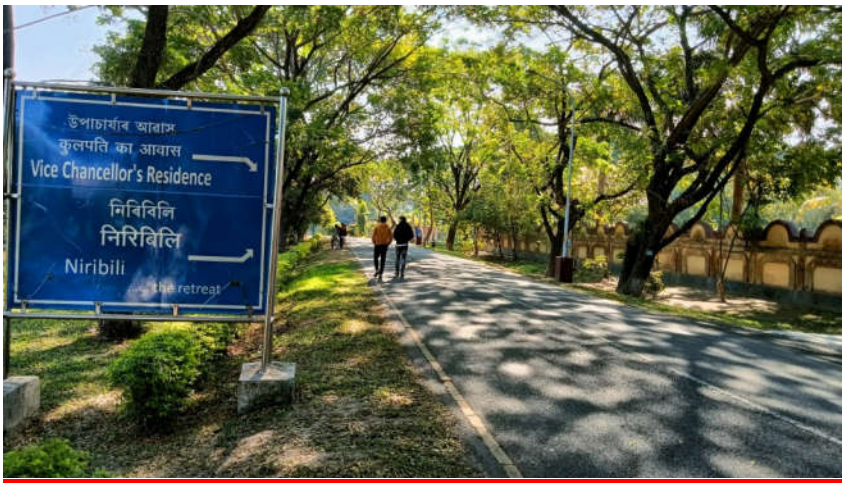
Play Ground

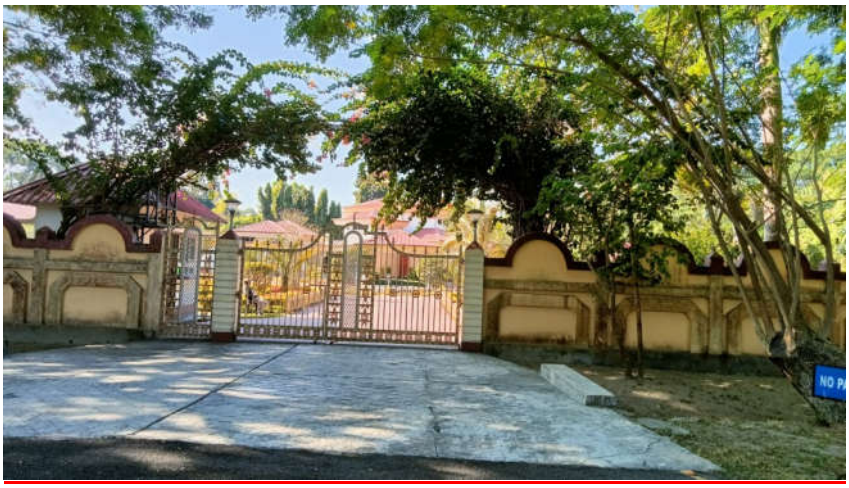
Bank Facility

Tunovation

Swimming Pool

Central Library





Vice Chancellor's Residence

CHAPTER 2

GREEN AUDIT METHODOLOGY

2.1 Pre Audit Stage

A pre-audit meeting provided an opportunity to reinforce the scope and objectives of the audit and pre-audit discussions were held on the basis of green initiatives taken and the current scenario of the University campus. This meeting is an important prerequisite for the green audit because it is the first opportunity to understand the concerns. It was held with the concerned person of the University regarding initiatives taken by the University and regarding the last NAAC Green Audit conducted by the University. The meeting was an opportunity to gather the information that the audit team can study before arriving on the site. The audit protocol and audit plan were handed over at this meeting and discussed in advance of the audit itself. The pre-audit meeting was conducted successfully and necessary documents were collected directly from the University before the initiation of the audit processes. The actual planning of audit processes was discussed in the pre-audit meeting. An Audit team was also selected in this meeting with the help of staff and the University management. The audit protocol and audit plan were handed over at this meeting and discussed in advance of the audit itself.

2.2 Management Commitment

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

2.3 Objectives of the study

A clean and healthy environment aids effective learning and provides a conducive learning environment. There are various efforts around the world to address environmental education issues. Green Audit is the most efficient and ecological way to manage environmental problems. It is a kind of professional care that is the

responsibility of each individual who is part of economic, financial, social, environmental factors. It is necessary to conduct a green audit on a University campus because students become aware of the green audit, its advantages to saving the planet and they become social and responsible citizens of our country. Thus Green audit becomes necessary at the university level. The broad objectives are as follows.

- Diagnosing the environmental problems to eliminate them.
- Environmental education through a systematic environmental management approach.
- Improving environmental standards.
- Benchmarking for environmental protection initiatives.
- Efficient utilization of resources.
- Financial savings through a reduction in resource use.
- Curriculum enrichment through practical experience.
- Development of ownership, personal and social responsibility for the University and its environment.
- Developing environmental ethics and value systems in young people.
- Providing certain recommendations based on environmental audit reports.
- Ensuring compliance, not only with laws, regulations, and standards but also with company policies and the requirements of an Environmental Management System (EMS) standard.
- Enabling environmental problems and risks to be anticipated.
- To demonstrate that University is aware of its impact upon the environment.

2.4 Audit Stage

Green Audit was done with the help of co-associates involving different student groups, teaching, and non-teaching staff. The green audit began with the teams walking through all the different facilities at the University, determining the different types of appliances and utilities as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an appliance is used) and their impacts. The staff and learners were interviewed to get details of usage, frequency, or general characteristics of certain appliances. Data collection was done in the sectors such as Energy, Waste, Green Area,

Carbon footprint, and Water use. University records and documents were verified several times to clarify the data received through surveys and discussions.

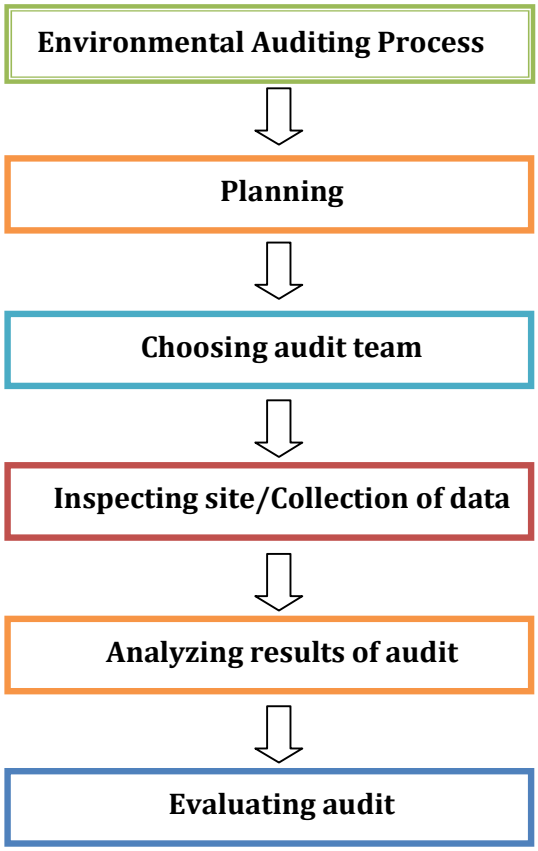
2.4.1 Methodology

The Management of the University has shown a commitment towards green auditing during the pre-audit meeting. They were ready to encourage all green activities. It was decided to promote all activities that are environmentally friendly such as awareness programs on the environment, campus farming, planting more trees on the campus, etc., after the green auditing. The management of the University was willing to formulate policies based on a green auditing report. In order to perform green audits, the methodology included different tools such as preparation of questionnaires, physical inspection of the campus, observation, and review of the documentation, interviewing key persons, and data analysis, measurements, and recommendations. The study covered the following areas to summarize the present status of environmental management on the campus:

- Energy Management
- Water Management
- Waste Management
- Environment Management

Methodology – Step by Step

The audit process was carried out in three phases. At first, all the secondary data required for the study was collected from various sources, like concerned departments such as engineering cell, horticulture section, etc. A broad reference work was carried out to clear the idea of green auditing. Different case studies and methodologies were studied and the following methodology was adopted for the present audit. The methodology of the present study is based on onsite visits, personal observations, and questionnaires survey tools. Initially, based on data requirements, sets of questionnaires were prepared. The surveyors then visited all the departments of the university and the questionnaires were filled. The generated data is subsequently gathered and used for further analysis. From the outcome of the overall study, a final report is prepared.



Survey by Questionnaire

Baseline data for green audit report preparation was collected by questionnaire survey method. Questionnaires are prepared to conduct the green audit in the university campus based on the guidelines, rules, acts, and formats prepared by the Ministry of Environment, Forest and Climate Change, New Delhi, Central Pollution Control Board, and other statutory organizations. Most of the guidelines and formats are based on broad aspects and some of the issues or formats were not applicable for the University campus. Therefore, using these guidelines and formats, combinations, modifications, and restructuring were done and sets of questionnaires were prepared for solid waste, energy, water, hazardous waste, and e-waste data.

All the questionnaires are a group of modules. The first module is related to the general information of the concerned department, which broadly includes the name of the department, month and year, the total number of students and employees, visitors of the department, average working days and office timings, etc. The next module is related to

the present consumption of resources like water, energy, or the handling of solid and hazardous waste. Maintaining records of the handling of solid and hazardous waste is much important in green audits. There are possibilities of loss of resources like water, energy due to improper maintenance, and assessment of this kind of probability is necessary for the green audit. One separate module is based on the questions related to this aspect. Another module is related to maintaining records, like records of disposal of solid waste, records of solid waste recovery, etc. For better convenience of the surveyor, some statistics like basic energy consumption characteristics for electrical equipment, etc. were provided with the questionnaires.

Onsite visit and observations

Tezpur University has a vast built-up area comprising various departments under various academic buildings, teachers and staff quarters, many facilities including Academic Buildings, Guest House, Health Centre, Council hall, Auditorium, other facilities and separate men's and women's hostels. All these amenities have different kinds of infrastructure as per their requirement. All these buildings were visited by the surveyors and the present condition is checked with the help of the questionnaires. Personal observations were made during the onsite visit. All the amenities were clubbed in, as per their similarities and differences, which makes the survey and further analysis easier. For the data compilation purpose, the University Departments and support services were clubbed into Three Types of Buildings and given names as academic buildings, Facilities Buildings, and Hostel Buildings. The details of the Buildings are as follows:

Sr. No.	Name of the Buildings
1.	Academic Buildings
2.	Facilities Buildings
3.	Hostel Buildings

After the collection of secondary data, the reviews related to each environmental factor were taken by the green audit team. The data were tabulated, analyzed and graphs were prepared. Depending upon the observations and data collected, interpretations were made. The lacunas and good practices were documented. The Environmental Management

Plan (EMP) was prepared for the next academic year in order to have better environmental sensitization. Finally, all the information was compiled in the form of the Green Audit Report.

2.4.2 Data analysis and final report preparation

Proper analysis and presentation of data produced from work is a vital element. In the case of a green audit, the filled questionnaires of the survey from each group were tabulated as per their modules, in Excel spreadsheets. The tabulated data is then used for further analysis. For a better understanding of the results and to avoid complications, averages, and percentages of the tables were calculated. A graphical representation of these results was made to give a quick idea of the status. Interpretation of the overall outcomes was made which incorporates all the primary and secondary data, references, and interrelations within. Final report preparation was done using this interpretation.

Internal Audit Team

SI No.	Name	Department/Section
1	Dr. Sadhan Mahapatra	Department of Energy
2	Shri Ratual Ranjan Hazarika	Executive Engineer
3	Dr Satya Sundar Bhattacharya	Department of Environment Science
4	Shri Girindra Hazarika	Assistant Horticulturist
5	Shri Gobinda Kalita	Assistant Engineer (Electrical)
6	Shri Dhiraj Kumar Sarma	Computer Engineer

CHAPTER 3

WATER & WASTE WATER AUDIT

Water is a precious natural national resource available with a fixed quantum. The availability of water is decreasing due to the increasing population of the nation; as per capita availability of utilized water is going down. Due to the ever-rising standard of living of people, industrialization, urbanization, demand for freshwater is increasing day by day. The unabated discharge of industrial effluent in the available water bodies is reducing the quality of these ample sources of water continuously. Hence, the national mission on water conservation was declared by the Honorable Prime Minister Narendra Modi as 'Jal Shakti Abhiyan' and appealed to all citizens to collectively address the problem of water shortage, by conserving every drop of water and suggesting conducting water audits for all sectors of water use. Water audit can be defined as a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing, and recycling water. Water Audit is nothing but an effective measure for minimizing losses, optimizing various uses, and thus enabling considerable conservation of water in the irrigation sector, domestic, power, and industrial sectors. A water audit is a technique or method which makes it possible to identify ways of conserving water by determining any inefficiency in the system of water distribution. The measurement of water losses due to different uses in the system or any utility is essential to implement water conservation measures in such an establishment.

Importance of Water Audit

- Systematic process
- May yield some surprising results
- Easier to work on solutions when the problems are identified.
- Attracting mechanism can be put into place.

It is observed that a number of factors like climate, culture, food habits, work and working conditions, level and type of development, and physiology determine the requirement of water. The community which has a population between 20,000 to 1, 00,000 requires 100 to 150 liters per person (capita) per day. The communities with a population over 1, 00,000 require 150 to 200 liters per person (capita) per day. As per the standards provided by WHO Regional Office for Southeast Asia Schools require 2 liters of water per

student for drinking purposes; 10-15 liters per student for Water-flush toilets. Administration requires (Staff Accommodation not included) 50 liters per person per day,

3.1 Water Audit

Water usage can be defined as water used for all activities which are carried out on campus from different water sources. This includes usage in all residential halls, academic buildings, on-campus, and on-grounds. Wastewater is referred to as the water which is transported off the campus. The wastewater includes sewerage, residence water used in cooking, showering, clothes washing as well as wastewater from chemical and biological laboratories which ultimately go down in the sink or drainage system.

University water resources

The major resource for the water in the university is a self-reliant water boring system installed on the campus. There are Ground Water Tube wells installed on the campus with 3x15 HP and 1x21 HP which operate to fill the 2 overhead tanks. To fulfill the need for the supply of the campus, overhead storage tanks are available with capacity (1x 350 Kilo Litres and 1x 300 Kilo Litres). Total building-wise discharge for the campus is 150 Kilo Litres for 8 hours per day.

Total consumption of the campus is approx. 980 Kilo Litres per day by operating discharge pumps with a total discharge capacity of 140 Kilo Litres for 8 hours per day. Out of this, 80,000 Litres were utilized against 2 number filtration units with 40,000 Litres capacity each for Kitchen and Park area. Balance 900 Kilo Litres of water is used to cover the total daily consumption in the University Campus including Drinking, Bathroom, Toilet, Garden, Urinals, Wash Basin, Laboratory etc. in the total population of 5500 (Including office staff, strength and residential buildings) of the University campus. Hence total approx. 160

Litres per day per head is used for Bathroom, Toilet, Garden, Urinals, Shower, Drinking, and Laboratories etc.

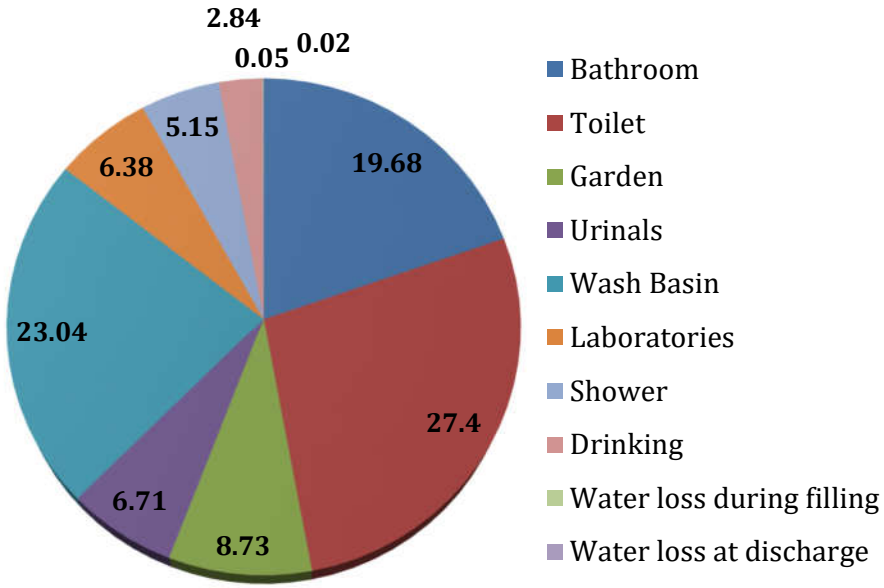
3.1.1 Water consumption in the University

From the data collected for water audit of Tezpur University, the water distribution and water consumption pattern is noticed as follows.

Yearly Average Water Consumption at Tezpur University

Sr. No.	Sector	Total Daily Use (liter)	Total Monthly use (kl)	Total yearly use (kl)	Percentage %
1	Bathroom	192,864	5,785,920	69,431,040	19.68
2	Toilet	268,520	8,055,600	96,667,200	27.4
3	Garden	85,554	2,566,620	30,799,440	8.73
4	Urinals	65,758	1,972,740	23,672,880	6.71
5	Wash Basin	225,792	6,773,760	81,285,120	23.04
6	Laboratories	62,524	1,875,720	22,508,640	6.38
7	Shower	50,470	1,514,100	18,169,200	5.15
8	Drinking	27,832	834,960	10,019,520	2.84
9	Water loss during filling	490	14,700	176,400	0.05
10	Water loss at discharge	196	5,880	70,560	0.02
Total		**980,000**	**29,400,000**	**352,800,000**	**100**

Water Audit Process



Yearly Average Water Consumption at Tezpur University

The Figure shows the total percentage of water consumed by all the Building Blocks of Tezpur University, Tezpur. The figure shows that toilets, washbasins, and bathrooms as the major sources of water utilization comprising 27.40 %, 23.04 %, and 19.68 % respectively. The other uses namely garden, urinals, laboratory, and shower consume water with yearly water requirements of 8.73 %, 6.71%, 6.38 %, and 5.15 % respectively. Further also includes water required for drinking purposes, and loss of water during filling and during discharge which is 2.84 %, 0.05 %, and 0.02 %. It was observed that the water required for drinking purposes is 2.84%. In the case of filling loss of water was observed 0.05 % and during discharging water, the loss is about 0.02% only.

3.1.2 Sustainable Water Practices

Watershed Management Practices

Tezpur University has taken many initiatives in water conservation and management of water available on the campus. Now, the university is self-reliant through decentralized water conservation and management practices.

3.1.3 Waste Water Filtration Tank

The university has a huge campus with its administrative setup and there is a lot of waste water collected from laboratories and other open areas which are disposed of in the tank. University has constructed a Mini Water Filtration Tank on the campus. This filter house is used to filter the wastewater regularly. This water is utilized for further trees and plants in the university campus as self-filtered water throughout the year.

3.1.4 Rain Water Harvesting Units

The underground water table is decreasing day by day & minute by minute. The reason is that no attempt is made to replenish the groundwater table with rainwater during the monsoon & other rainy days. Rainwater harvesting is the simple collection or storing of water through scientific techniques from the areas where the rain falls. It involves the utilization of rainwater for domestic or agricultural purposes. The method of rainwater harvesting has been in practice since ancient times. It is as far the best possible way to conserve water and awaken society towards the importance of water. The method is simple and cost-effective too. It is especially beneficial in the areas, which face a scarcity of water. We can see that the People usually make complaints about the lack of water. During the monsoons, lots of water goes waste into the gutters. And this is when Rain Water Harvesting proves to be the most effective way to conserve water. We can collect the rainwater into the tanks and prevent it from flowing into drains and being wasted. It is practiced on a large scale in metropolitan cities. Rainwater harvesting comprises the storage of water and water recharging through the technical process. Currently, five

numbers of rainwater harvesting exist on the campus further the university is planning to extend and install several units under rainwater harvesting mission including rooftop RWH installation at different buildings for the coming year which will be spread into the mass-scale which covers several units. These units will be utilized for further storing and reusing of natural water.

- Non-teaching staff or peons in the concerned section should take responsibility for monitoring the overflow of water tanks.
- A Large amount of water is wasted during the practical process in Science laboratories. Designs of small water recycling systems help to reuse of water.
- Producing distilled water in the laboratories required a large amount of water to the distillate. To produce 1 liter of distilled water required more than 33 liters of water. To avoid more wastage university should design a common distillation plant for Science Department.
- Reduce chemical waste formation in the Chemistry laboratory; adopt the principles of green chemistry to reduce chemical waste.
- Pipes, overhead tanks, and plumbing systems should be maintained properly to reduce leakages and wastages of water.
- University should install its own Sewage Treatment Plant (STP). By doing so there will be a great reduction in water usage, as the water after treatment can be used for various purposes in the University.
- As University is already planning to set up multiple units of Rain Water Harvesting Units. To set up and install will certainly add value in order to meet the mission of water conservation.

CHAPTER 4

ENERGY AUDIT

Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. Also, it can be said as "the strategy of adjusting and optimizing energy, using system and procedure so as to reduce energy requirements per unit of output while holding constant or reducing total costs producing the output from these systems". The energy audit is key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use and serves to identify all the energy streams in a facility.

4.0 Energy audit

Energy resources utilized by all the departments, support services, and the administrative buildings of Tezpur University, include Electricity, Solar Roof Top Systems, and Diesel Generators installed on the campus.

Energy Audit Objectives

Primary

- The first objective is to acquire and analyze data and find the necessary consumption pattern of these facilities.
- The second objective will be to calculate the wastage pattern based on the results of the first objective.
- The final objective is to find and implement solutions that are acceptable and feasible.

Secondary

- This would be our first exposure to this field hence experience gain would be vital.
- This project will precede many follow up projects and hence helps to gain technical and management exposure required for future energy projects.
- It is sure to help create a repertoire of vital contacts hence will develop

interaction with alumni, faculty and students.

Source of Energy

Tezpur University, Assam withdraws Energy from Followings:

- Electricity from APDCL
- Solar Energy

The Following are the Major consumers of Electricity in the facility

- Lightning
- Air Conditioner
- Fans
- Computers
- Other Lab Equipment

Indirect Benefits of Energy Audit

Every time the Energy Audit is carried out it rekindles the interest in Energy Conservation as an important function. Energy Auditors sharing their experience and knowledge with the Plant Personnel helps in fueling the innovative ideas for further action of reduction in Specific Power consumption (SPC). Any loose connections or heating of cables come to timely vision. For an external agency due to unbiased vision, a few points for Energy Conservation may be visible each time they perform the audit and this would help in achieving further saving. Inform any irregularities in Energy meter HT connections for rectification.

Energy Savings& Conservation Measures identified						
			Yearly energy savings			
S.N.	***Energy saving measures***	***Investment Rs. Lakhs***	***Electricity (kWh)***	***Others***	***Cost saving /year (Rs. Lakhs)***	***Payback Period (Year)***
A	NIL INVESTMENT					
1	Reduction of Existing Contract Demand from 2352.94KVA to 1764KVA (i.e 75% of Existing Contract Demand)	0.00			**9.18**	Immediate
B	**LOW INVESTMENT**					
2	Replacement of 94 No's CFL Post lantern Light of 15 W with 94 No's 9 Watt LED latern light	0.10	1353.6	.....	0.09	1.18
3	Replacement of 11 No's CFL light bulb of 70 watt with 11 no's of 30 Watt energy efficient LED bulb	0.11	1056.00	.....	0.07	1.61
4	Replacement of 39 No's Post lantern Light of 70 W with 39 No's 35 Watt LED Latern Light	0.23	1920.00	.....	0.21	1.11
5	Replacement of 32 No's HPMV Post Lantern Light of 125 W with 32 No's 70 Watt energy efficient LED Flood light	0.54	3276.00	.....	0.27	2.00
	Total(A)	**0.99**	**7605.6**	.....	**0.64**	1.55
C	**MEDIUM INVESTMENT**					
6	Replacement of 526 No's CFL light bulb of 9 watt with 526 no's of 12 Watt energy efficient LED bulb	0.52	11361.60	.....	0.73	0.71
7	Replacement of 660 No's CFL light bulb of 22 watt with 660 no's of 12 Watt energy efficient LED bulb	0.99	15840.00	.....	1.02	0.97
8	Replacement of 1562 No's CFL light bulb of 36 watt with 1562 no's of 20 Watt energy efficient LED bulb	3.59	59980.80	.....	3.87	0.93
	Total (B)	**5.10**	**87182.40**	.....	**5.62**	0.91
D	**HIGH INVESTMENT**					
9	Replacement of 5469 No's Inefficient tubelight (single) of 36 watt with 5469 no's of 20 Watt energy efficient LED tubelight	16.41	210009.60	.....	13.55	1.21
10	Replacement of 2875 No's Inefficient tubelight (Double) of 72 watt with 2875 no's of 40 Watt energy efficient LED tubelight	17.25	220800.00	.....	14.24	1.21
11	Replacement of 6705 No's inefficient Normal Ceiling Fan of 70 W with 6705 No's 30 W BLDC Fan	100.57	643680.00	.....	41.52	2.42
	Total (C)	**134.23**	**1074489.60**	.....	**69.30**	**1.94**
	Grand Total (A+B+C)	**140.32**	**1176654.72**	.....	**84.67**	**1.66**
	Total implementation cost proposed	**140.32**				
	Total cost saving Potential	**84.67**				
	Payback Period	**1.66**				

4.1 Electrical System

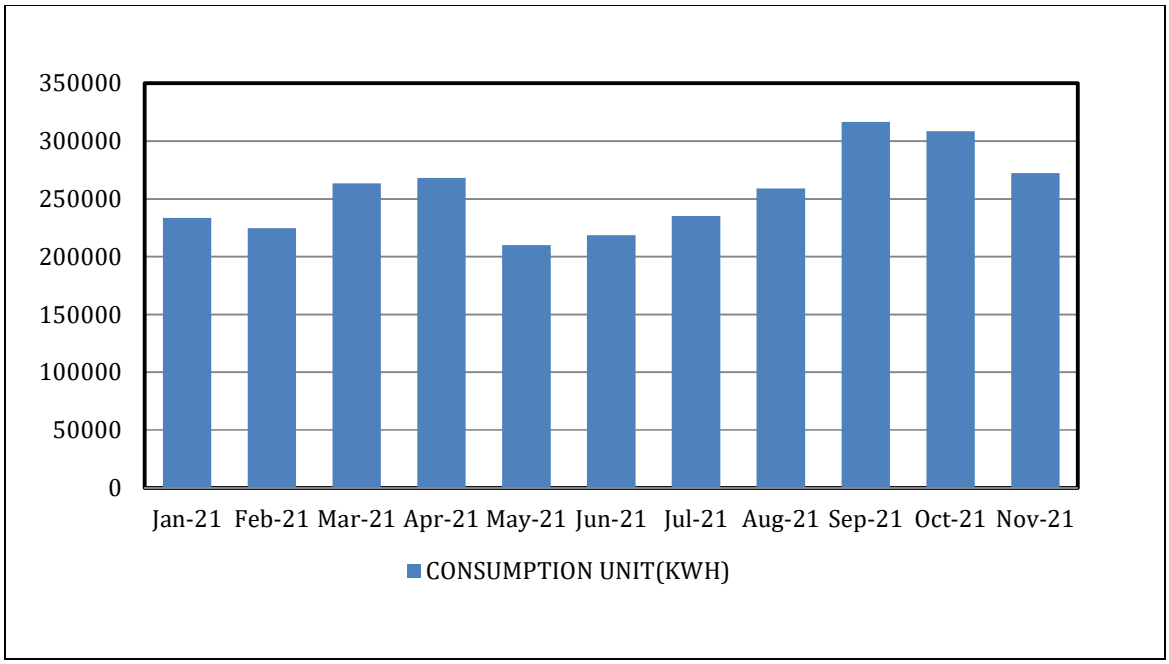
Electricity Bill Summary of year 2021, 2020 & 2017 are as follows. Due to the Covid19 Pandemic, we have also considered 2017-year electricity bill to represent the full load electric potential of the University.

ELECTRICITY CONSUMPTION DETAILS Year 2021 (Transformer reading)						
BILL MONTH	**Consumption Unit (kWh)**	**Contract demand (kVA)**	**Actual demand (kVA)**	**Bill amount (Rs.)**	**Power Factor**	**Unit Cost (In Rs./KW)**
Jan-21	233674	1764.7	670	1839288	0.82	6.6
Feb-21	224820	1764.7	762	1250306	0.82	6.6
Mar-21	263427	2352.941	834	2116204	0.83	6.6
Apr-21	268245	2352.941	840	2056305	0.86	6.45
May-21	209865	2352.941	690	1659824	0.86	6.45
Jun-21	218535	2352.941	630	1726926	0.88	6.45
Jul-21	235200	2352.941	630	1847528	0.89	6.45
Aug-21	259200	2352.941	690	2020746	0.88	6.45
Sep-21	316500	2352.941	1020	2390817	0.88	6.45
Oct-21	308587.5	2352.941	947	2331046	0.85	6.45
Nov-21	272400	2352.941	1020	2174544	0.81	6.45
Total	**2810453.5**	**24705.87**	**8733**	**21413534**	**9.38**	**71.4**
Average	**255495.77**	**2245.99**	**793.91**	**1946684.91**	**0.85**	**6.49**
Max	**316500**	**2352.941**	**1020**	**2390817**	**0.89**	**6.6**
Min	**209865**	**1764.7**	**630**	**1250306**	**0.82**	**6.45**

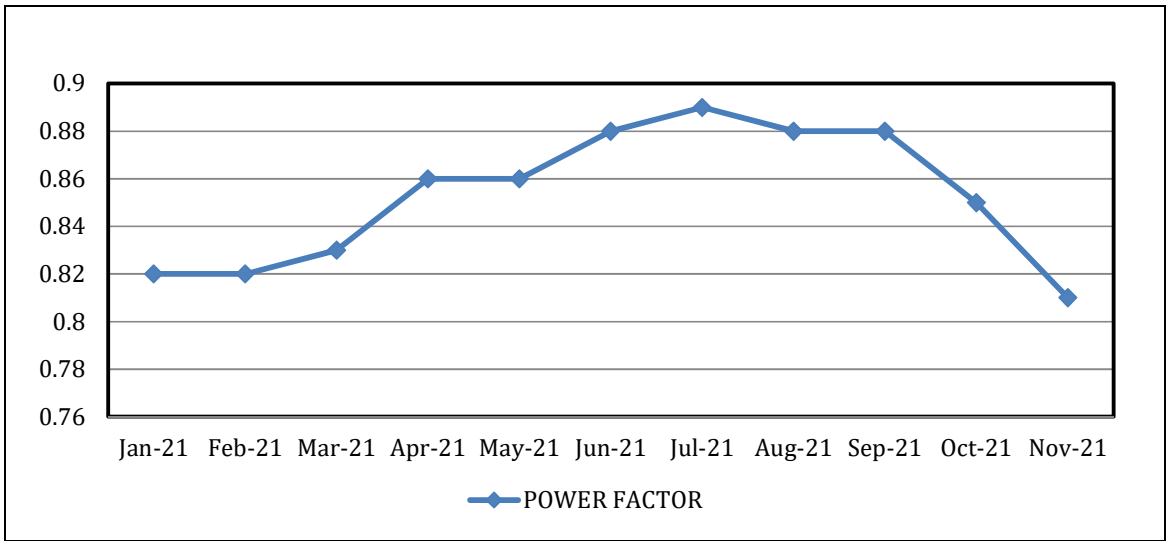
Observation

The recorded maximum demand is in the range of 630 KVA to 1020 KVA whereas the Maximum Contract Demand is 2352.941 KVA. This is due to the non-occupancy of students in the covid-19 crises period. It is recommended to reduce contract demand till the regular functioning (i.e. full occupancy) of the University.

Graphical Representation of Consumption Unit (kWh)



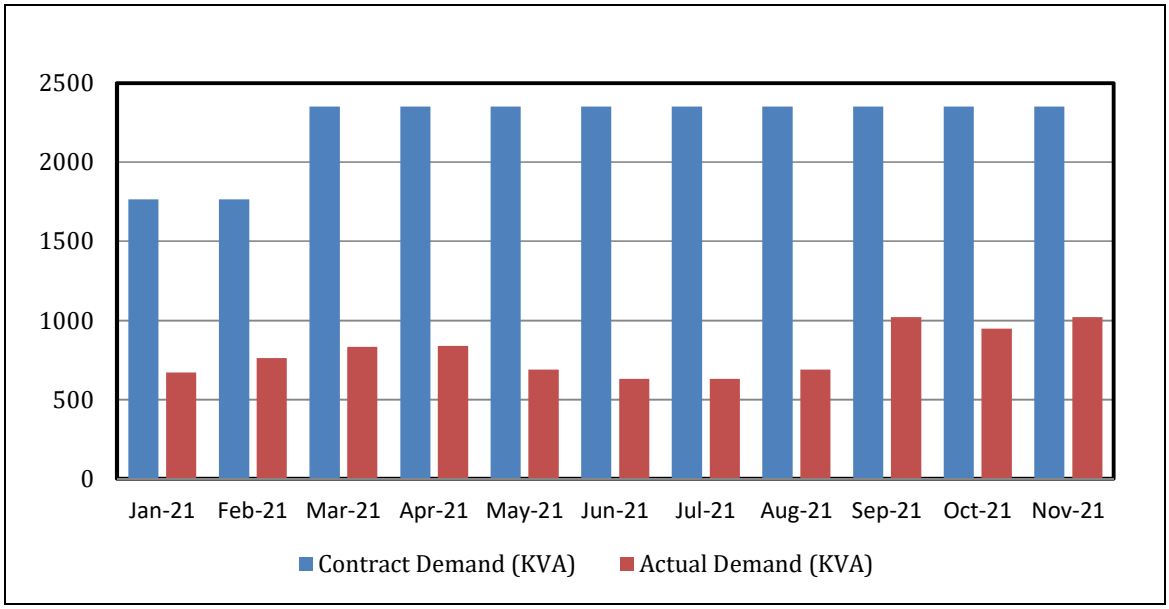
Graphical Representation of Power Factor



Observation

The average Power factor recorded in the last year of 2021 is 0.85 which is satisfactory. It is recommended to install an Automatic Power Factor Correction machine (APFC) on the premises to maintain the Power factor.

Graphical Representation of Contract Demand & Actual Demand



Observation

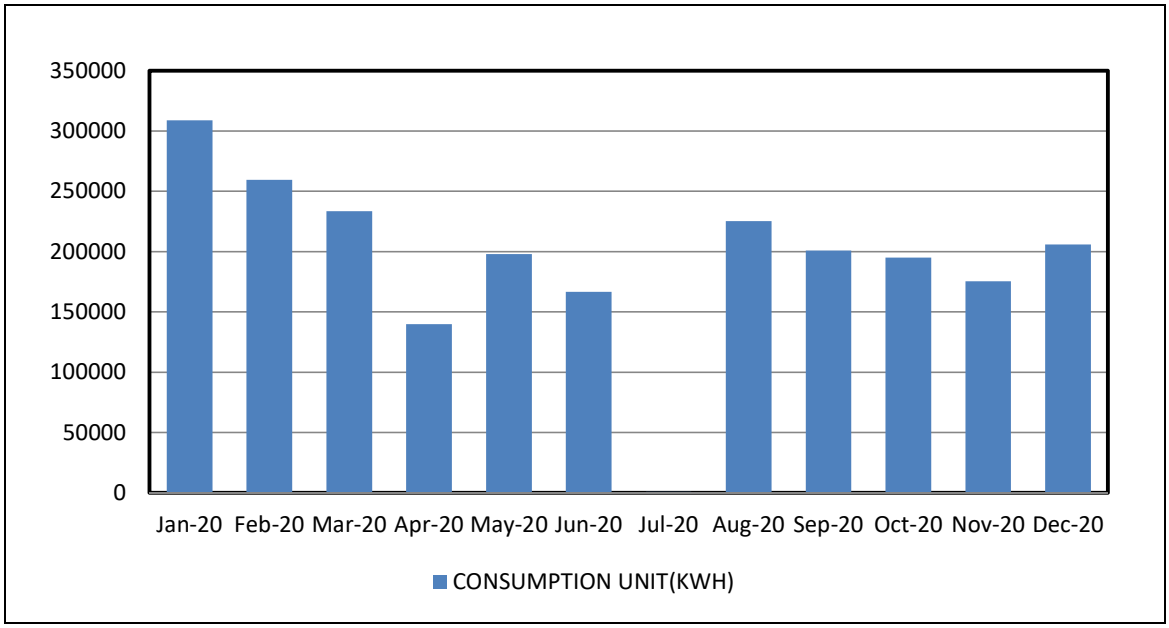
It is observed that the recorded demand is below the actual demand by 64.7%, Overall Margin is less than 36% which is due to the non-availability of students at university due to covid-19.

ELECTRICITY CONSUMPTION DETAILS Year 2020 (Transformer reading)						
BILL MONTH	**Consumption Unit (kWh)**	**Contract demand (kVA)**	**Actual demand (kVA)**	**Bill amount (Rs.)**	**Power Factor**	**Unit Cost (Rs./kWh)**
Jan-20	309000	1764.7	930	1870937	0.82	6.6
Feb-20	259500	1764.7	930	2100021	0.8	6.6
Mar-20	233700	1764.7	945	1881542	0.79	6.6
Apr-20	139800	1764.7	480	1085616	0.81	6.6
May-20	198000	1764.7	537	1475600	0.83	6.6
Jun-20	166800	1764.7	567	1313289	0.853	6.6
Jul-20	849	21.08	NA	4440	0.85	6.6
Aug-20	225300	1764.7	627	1703594	0.86	6.6
Sep-20	201000	1764.7	600	1543083	0.87	6.6
Oct-20	195042	1764.7	615	1486532	0.866	6.6
Nov-20	175413	1764.7	597	1371054	0.82	6.6
Dec-20	206004	1764.7	651	1647534	0.81	6.6
Total	**2310408**	**19432.78**	**7479**	**17483242**	**9.979**	**79.2**
Average	**192534.00**	**1619.40**	**623.25**	**1456936.83**	**0.83**	**6.60**
Max	**309000**	**1764.7**	**945**	**2100021**	**0.87**	**6.6**
Min	**849**	**21.08**	**480**	**4440**	**0.79**	**6.6**

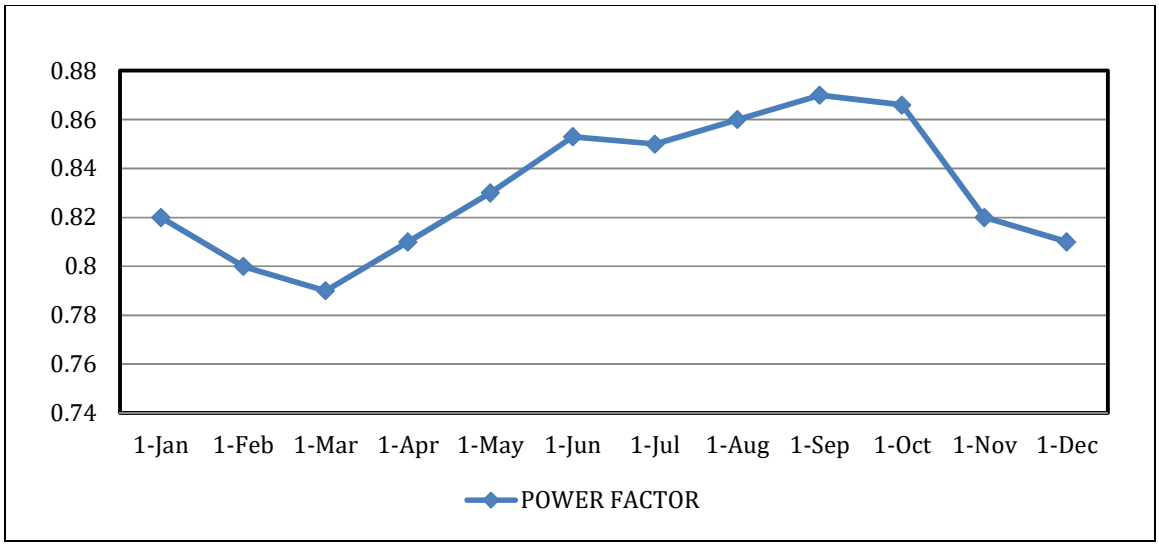
Observation

The recorded maximum demand is in the range of 480 KVA to 945 KVA whereas the Maximum Contract Demand is 1764.7 KVA. This is due to the non-occupancy of students in the covid-19 crises period. It is recommended to reduce contract demand till the regular functioning (i.e. full occupancy) of the University.

Graphical Representation of Consumption Unit (KWH)



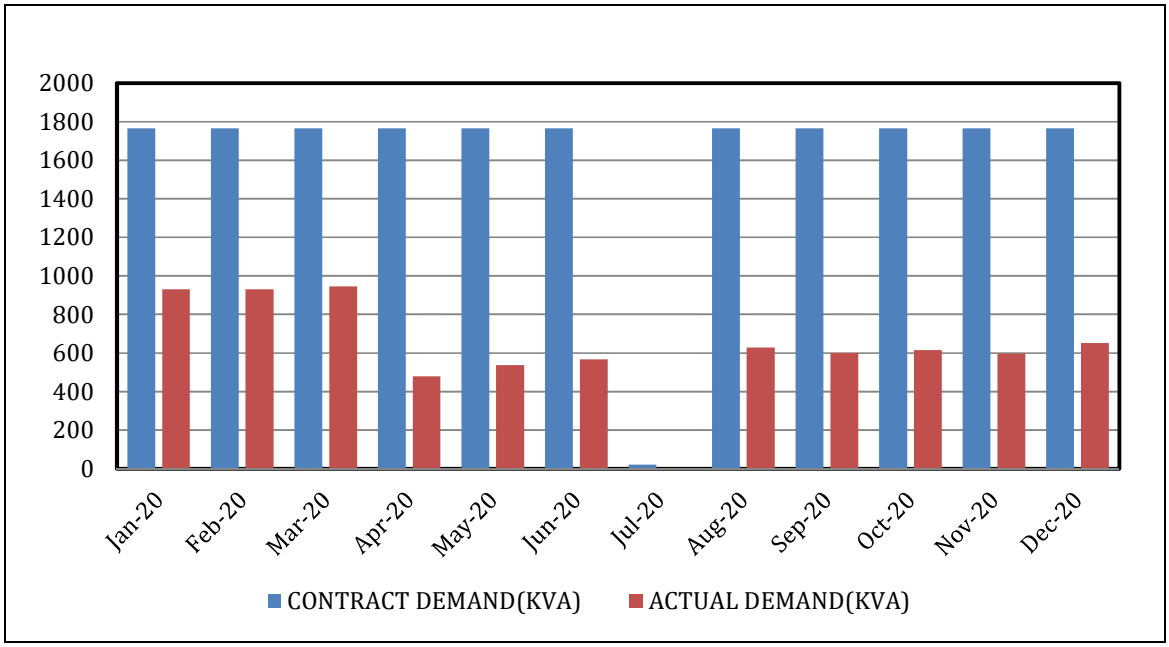
Graphical Representation of Power Factor



Observation

The average Power factor recorded in the year 2020 is 0.83 which is not satisfactory. It is recommended to install an Automatic Power Factor Correction instrument (APFC) in the premises to maintain the Power factor.

Graphical Representation of Contract demand and Actual demand



Observation

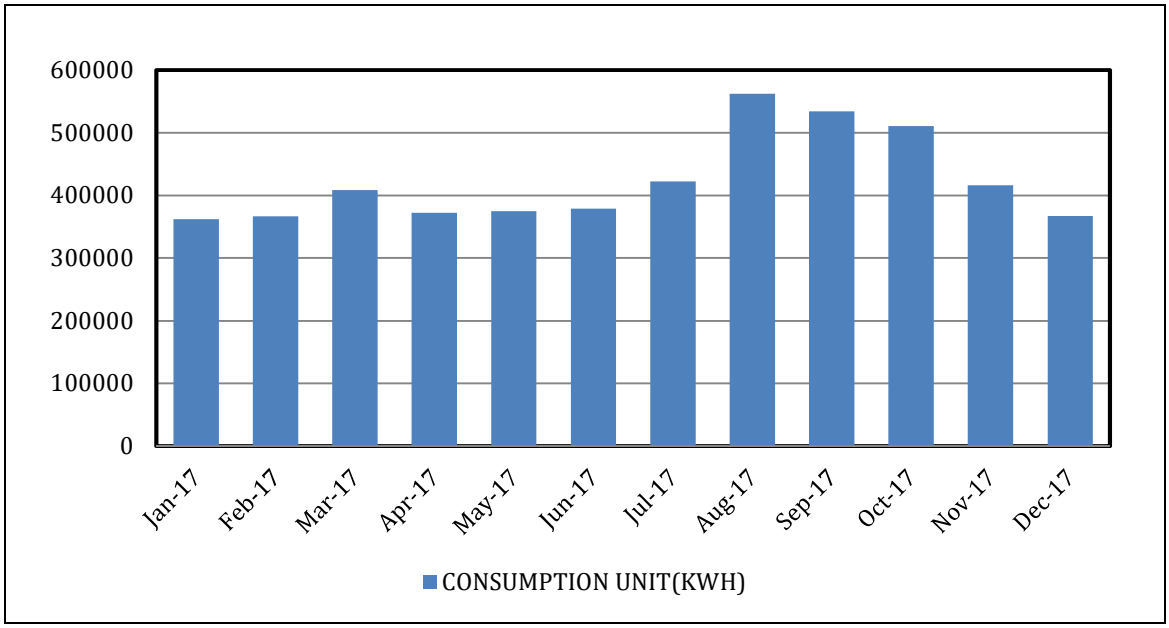
It is observed that the recorded demand is below the actual demand by 61.5%, Overall Margin is less than 38% which is due to the non-availability of students at university due to covid-19.

ELECTRICITY CONSUMPTION DETAILS Year 2017 (Transformer reading)						
BILL MONTH	**Consumption Unit (kWh)**	**Contract demand (kVA)**	**Actual demand (kVA)**	**Bill amount (Rs.)**	**Power Factor**	**Unit Cost (Rs./kWh)**
Jan-17	362040	1764.7	1020	2758518	0.88	6.45
Feb-17	366780	1764.7	1071	2772726	0.87	6.45
Mar-17	408510	1764.7	1077	3086996	0.88	6.45
Apr-17	371990	1764.7	1056	2887560	0.87	6.45
May-17	375318.9	1764.7	1061	2887560	0.85	6.45
Jun-17	379110	1764.7	1068	2893908	0.86	6.45
Jul-17	422742	1764.7	1176	3208537	0.92	6.45
Aug-17	562470	1764.7	1308	4197305	0.91	6.45
Sep-17	533850	1764.7	1266	3987755	0.93	6.45
Oct-17	511144	1764.7	1260	3836089	0.91	6.45
Nov-17	416280	1764.7	1068	3196749	0.87	6.45
Dec-17	367470	1764.7	981	2853377	0.86	6.45
Total	**5077704.9**	**21176.4**	**13412**	**38567080**	**10.61**	**77.4**
Average	**423142.08**	**1764.70**	**1117.67**	**3213923.33**	**0.88**	**6.45**
Max	**562470**	**1764.7**	**1308**	**4197305**	**0.93**	**6.45**
Min	**362040**	**1764.7**	**981**	**2758518**	**0.85**	**6.45**

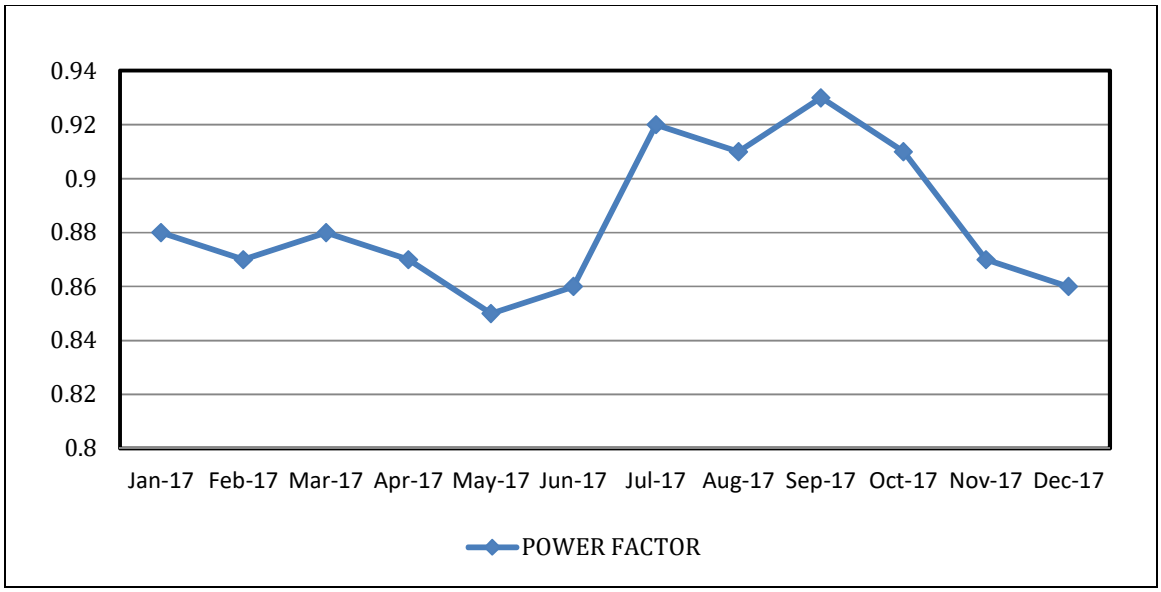
Observation

The recorded maximum demand is in the range of 981 KVA to 1308 KVA whereas the Maximum Contract Demand is 1764.7 KVA.

Graphical Representation of Consumption Unit (KWH)



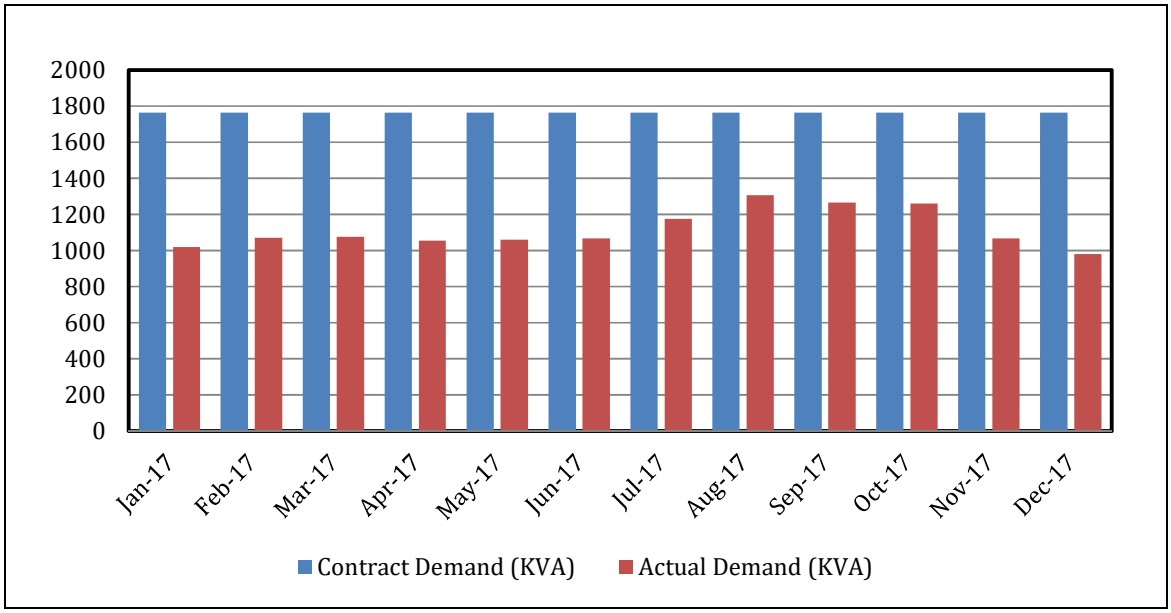
Graphical Representation of Power Factor



Observation

The average Power factor recorded in the year 2017 is 0.88 which is satisfactory. It is recommended to install an Automatic Power Factor Correction instrument (APFC) in the premises to maintain the Power factor.

Graphical Representation of Contract Demand & Actual Demand



Energy & Cost Saving Measures		
PARTICULAR	**UOM**	
Existing Contract Demand	KVA	2352.94
Maximum Demand Recorded as per Electricity Bill	KVA	1020
Proposed Contract Demand after reduction (i.e. 75% of Existing Contract Demand)	KVA	1764.71
Reduced Contract Demand	KVA	588.24
Demand/Fixed Charge	Rs.	130
Annual Cost Saving	Rs.	917647

Recommendation

As per Electricity Bills, the Maximum demand recorded FY 2020-21 is 1020 KVA which is 56.66 % less than the Existing Contract demand of 2352.94. It is recommended to reduce the Contract demand up to 25% from the Existing Contract Demand.

4.2 Lighting system

Lighting is an essential service in all industries, Universities, Hospitals, Malls, etc. Innovation and continuous improvement in the field of lighting, have given rise to tremendous energy-saving opportunities in this area. Lighting is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient lamps, luminaries, and gears, apart from good operational practices.

Basic Terms in Lighting System and Features

Lamps

Lamp is equipment, which produces light. The most commonly used lamps are described briefly as follows:

Incandescent lamps

Incandescent lamps produce light by means of a filament heated to incandescence by the flow of electric current through it. The principal parts of an incandescent lamp, also known as GLS (General Lighting Service) lamp include the filament, the bulb, the fill gas and the cap.

Reflector lamps

Reflector lamps are basically incandescent, provided with a high quality internal mirror, which follows exactly the parabolic shape of the lamp. The reflector is resistant to corrosion, thus making the lamp maintenance free and output efficient.

Gas discharge lamps

The light from a gas discharge lamp is produced by the excitation of gas contained in either a tubular or elliptical outer bulb. The most commonly used discharge lamps are as follows:

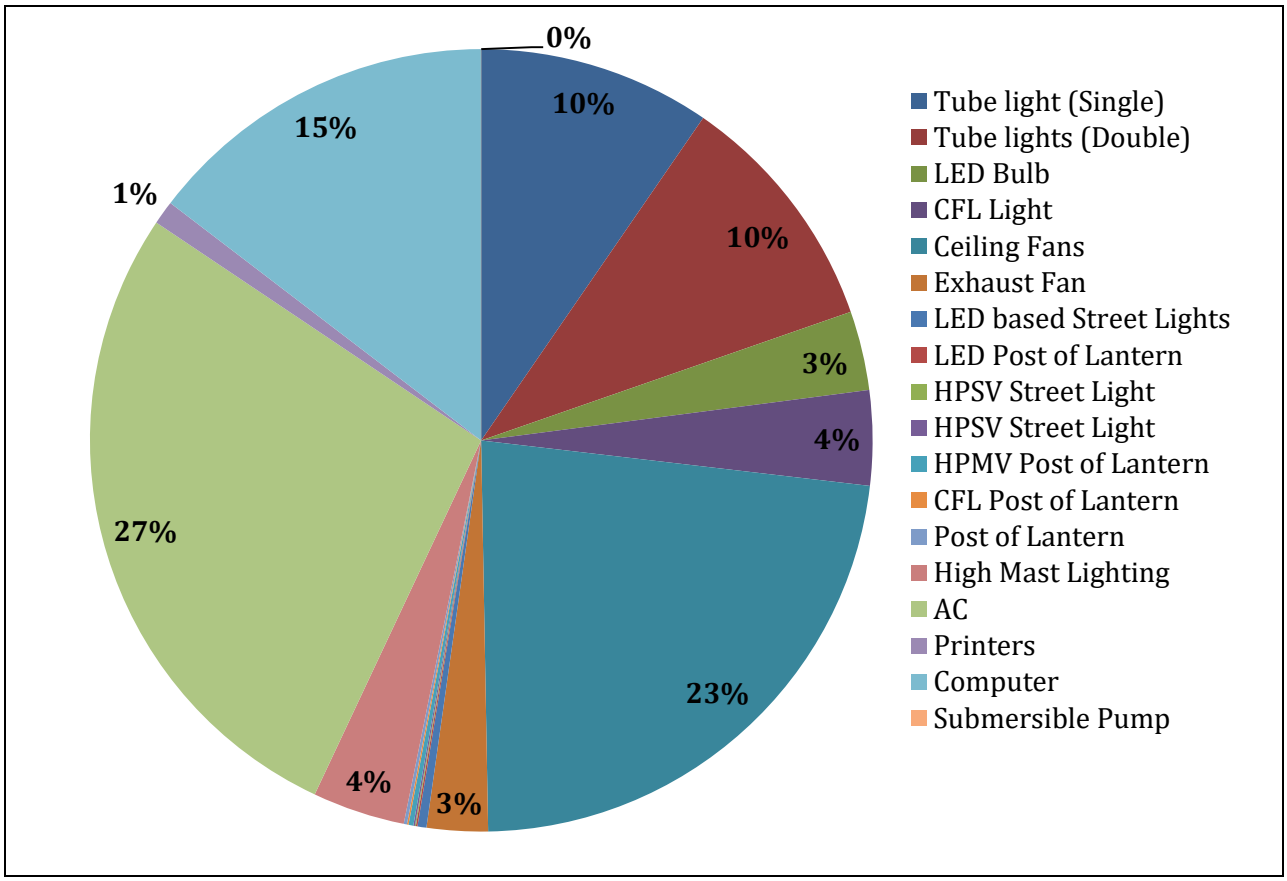
- Fluorescent tube lamps (FTL)
- Compact Fluorescent Lamps (CFL)
- Mercury Vapour Lamps
- Sodium Vapour Lamps
- Metal Halide Lamps

4.3 Inventory Details

The audit team has done the Inventory with Wattage analysis of the different types of lighting installed and the other electrical equipment across the campus. The below table shows the electrical equipment install at the University. The total connected load of the campus is 2052.369 kW as per the inventory of the electrical equipment.

Sl. No.	Electrical Equipment	Quantity	Wattage/HP	Total load (Watt)
1	Tube light (Single)	5469	36	196884
2	Tube lights (Double)	2875	72	207000
3	LED Bulb	4555	7	31885
		1688	18	30384
		280	15	4200
		14	36	504
4	CFL Lights	526	18	9468
		660	22	14520
		1562	36	56232
5	Ceiling Fans	6705	70	469350
6	Exhaust Fans	472	35	16520
		610	50	30500
		60	80	4800
7	LED based Street Lights	124	60	7440
8	LED Post of Lantern	68	20	1360
9	HPSV Street Light	11	70	770
10	HPSV Street Light	10	150	1500
11	HPMV Post of Lantern	32	125	4000
12	CFL Post of Lantern	94	15	1410
13	Post of Lantern	39	70	2730
14	High Mast Lighting	50	1500	75000
		6	300	1800
		3	500	1500
15	AC	375	1500	562500
16	Printers	500	40	20000
17	Computer	1500	200	300000
18	Submersible Pump	3.75	1	3.75
		7.5	4	30
		11.25	3	33.75
		15	3	45
	TOTAL (W)			**2052369.50**

Representation of Percentage Wattage Consumption



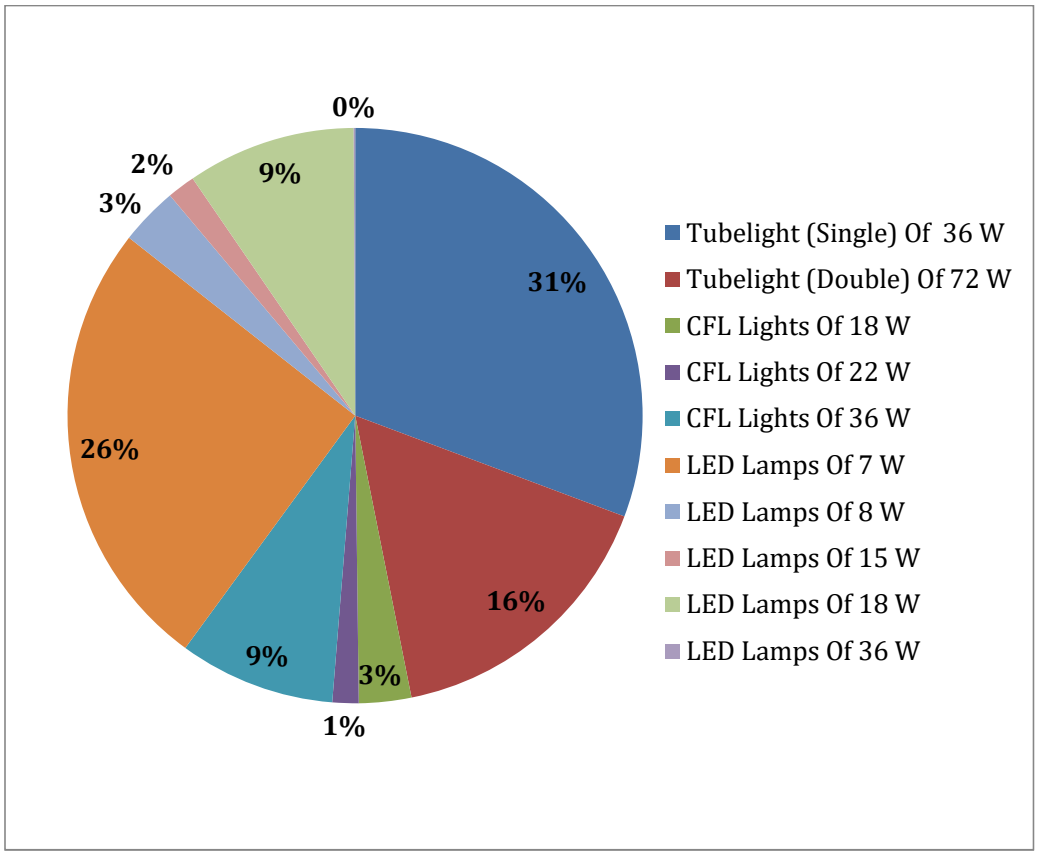
Observation

It is observed that the consumption of old conventional light (Tube light & HPSV light) is very high. It is recommended to replace old inefficient conventional light with energy-efficient LED Light.

Inventory details of lights Building wise

SR. No.	Name of the Building	Tube light (Single) Of 36 W	Tube light (Double) Of 72 W	CFL Lights Of 18 W	CFL Lights Of 22 W	CFL Lights Of 36 W	LED Lamps Of 7 W	LED Lamps Of 8 W	LED Lamps Of 15 W	LED Lamps Of 18 W	LED Lamps Of 36 W	Total Load
1	Bordoichila Women's Hostel	120					91					211
2	Charaideo Men's Hostel	336					224					560
3	Dhansiri Women's Hostel	360					169					529
4	New Women's Hostel	120					91					211
5	Subansiri Women's Hostel	210					145					355
6	Kanchenjungha Men's Hostel	375					270					645
7	Kopili Womens' Hostel	219					145					364
8	Pragjyotika Women's Hostel	201					145					346
9	Nilachal Men's Hostel	350					270					620
10	C. V. Raman Men's Hostel	510					1088					1598
11	Pobitora Women's Hostel	405					928					1333
12	Patkai Men's Hostel	450					105					555
13	Energy Building	20	75	126			29					250
14	MCJ Building	94	260				27					381
15	Environmental Sc.	95	195				30					320
16	MBBT	92	200				30					322
17	Central Library		60	150		150						360
18	Chem Sc	30	90	250			50					420
19	Computer Sc	160	250			350	83					843
20	KBR Auditorium	110				200	30					340
21	Admin Building	78	150			210	53					491
22	Guest House	12				322	72					406
23	Academic Building I						87			360		447
24	Academic Building II						72			390		462
25	Dean, SoE Building	220	320			180	41					761
26	Business Administration	119	121				15					255
27	Food Engg & Tech	180	260				93					533
28	Mech Engg	218	324			150	50					742
29	ECE Building	202	305		150		39					696
30	Civil Engg	183	265		112		83					643
31	HSS Building							580	280	938	14	1812
Total		**5469**	**2875**	**526**	**262**	**1562**	**4555**	**580**	**280**	**1688**	**14**	**17811**

Percentage type of lighting fixture



Observation

It is observed that consumption of Tube light of 36 & 72 Watt light is high and it is taking more electricity so we recommend to replace old inefficient tube light with energy efficient LED tube light. Rest all lights and lamps to be also replaced with LED lights.

Energy Saving Potential

Replacement of Tube Light of 36W with 20W LED Tube		
Particulars		Units
Total Number of 36 Watt Tube Light	5469	No.s
Measured Watt	36	Watts
Total Watts	196884	Watts
Proposed watt after replacement	20	Watts
Total Watt Saving After Replacement	109380	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	210009.6	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	1354561.92	Rs
Cost of Per Fixtures	300	Rs
Total Investment Cost	1640700	Rs
Payback	1.21	Year

Replacement of Tube Light (Double) of 72W with 40 W LED Tube		
Particulars		Units
Total Number of 72 Watt Tube Light	2875	No.s
Measured Watt	72	Watts
Total Watts	207000	Watts
Proposed watt after replacement	40	Watts
Total Watt Saving After Replacement	115000	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	220800	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	1424160	Rs
Cost of Per Fixtures	600	Rs
Total Investment Cost	1725000	Rs
Payback	1.21	Year

Replacement of CFL Light of 18 W with 9 W LED bulb		
Particulars		Units
Total Number of 18 W CFL light	526	No.s
Measured Watt	18	Watts
Total Watts	9468	Watts
Proposed watt after replacement	9	Watts
Total Watt Saving After Replacement	4734	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	11361.6	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	73282.32	Rs
Cost of Per Fixtures	100	Rs
Total Investment Cost	52600	Rs
Payback	0.72	Year

Replacement of CFL Light of 22 W with 12 W LED bulb		
Particulars		Units
Total Number of 18 W CFL light	660	No.s
Measured Watt	22	Watts
Total Watts	14520	Watts
Proposed watt after replacement	12	Watts
Total Watt Saving After Replacement	7920	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	15840	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	102168	Rs
Cost of Per Fixtures	150	Rs
Total Investment Cost	99000	Rs
Payback	0.96	Year

Replacement of CFL Light of 36 W with 20 W LED bulb		
Particulars		Units
Total Number of 18 W CFL light	1562	No.s
Measured Watt	36	Watts
Total Watts	56232	Watts
Proposed watt after replacement	20	Watts
Total Watt Saving After Replacement	31240	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	59980.8	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	386876.16	Rs
Cost of Per Fixtures	230	Rs
Total Investment Cost	359260	Rs
Payback	0.92	Year

Replacement of HPSV Light of 70 W with 30 W LED Flood Light		
Particulars		Units
Total Number of 70 Watt HPSV Street Light	11	No.s
Measured Watt	70	Watts
Total Watts	770	Watts
Proposed watt after replacement	30	Watts
Total Watt Saving After Replacement	330	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	1056	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	6811.2	Rs
Cost of Per Fixtures	1000	Rs
Total Investment Cost	11000	Rs
Payback	1.61	Year

Replacement of HPSV Light of 150 W with 70 W LED Flood light		
Particulars		Units
Total Number of 70 Watt HPSV Street Light	10	No.s
Measured Watt	150	Watts
Total Watts	1500	Watts
Proposed watt after replacement	70	Watts
Total Watt Saving After Replacement	700	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	1920	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	12384	Rs
Cost of Per Fixtures	2100	Rs
Total Investment Cost	21000	Rs
Payback	1.69	Year

Replacement of HPMV Post Lantern Light of 125 W with 70 W LED Flood light		
Particulars		Units
Total Number of 70 Watt HPSV Street Light	32	No.s
Measured Watt	125	Watts
Total Watts	4000	Watts
Proposed watt after replacement	70	Watts
Total Watt Saving After Replacement	2240	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	4224	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	27244.8	Rs
Cost of Per Fixtures	1700	Rs
Total Investment Cost	54400	Rs
Payback	1.99	Year

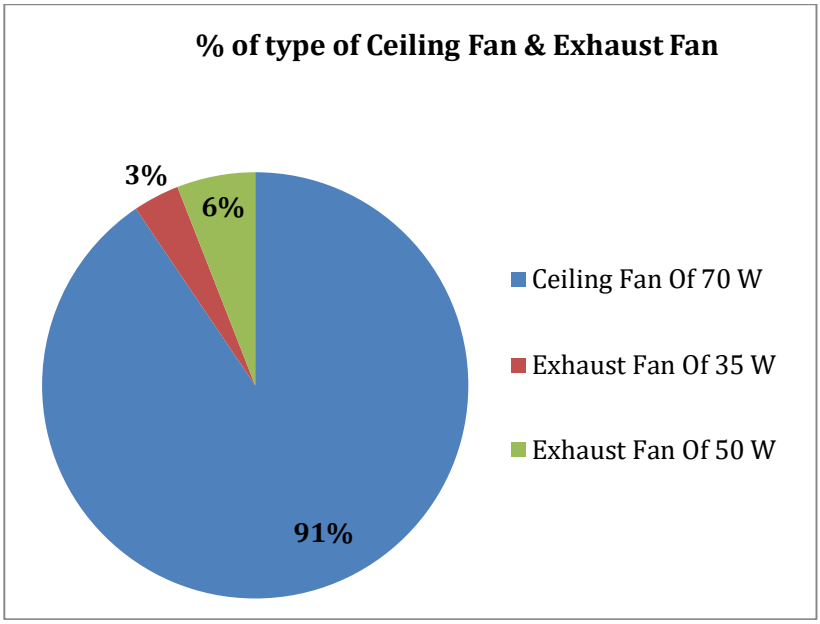
Replacement of Post lantern Light of 70 W with 35 W LED Lantern Light		
Particulars		Units
Total Number of 70 Watt HPSV Street Light	39	Number
Measured Watt	70	Watts
Total Watts	2730	Watts
Proposed watt after replacement	35	Watts
Total Watt Saving After Replacement	1365	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	3276	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	21130.20	Rs
Cost of Per Fixtures	600	Rs
Total Investment Cost	23400	Rs
Payback	1.11	Year

Replacement of CFL Post lantern Light of 15 W with 9 W LED lantern light		
Particulars		Units
Total Number of CFL Post lantern Light of 125 W	94	Number
Measured Watt	15	Watts
Total Watts	1410	Watts
Proposed watt after replacement	9	Watts
Total Watt Saving After Replacement	846	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual KWH	1353.6	KWH
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	8730.72	Rs
Cost of Per Fixtures	110	Rs
Total Investment Cost	10340	Rs
Payback	1.184323859	Year

4.4 Ceiling Fans

Ceiling Fan is the major part which consumes electricity and however, it is very useful in household, universities, offices, etc. Hence, Innovation and continuous improvement in the field of fans, have given rise to tremendous energy-saving opportunities in this area. The fan is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient Fans, BLDC Fans, smart Fans, apart from good operational practices.

Replacement of Normal Ceiling Fan of 70 W with 30 W BLDC Fan		
Particulars		Units
Total Number of 70 Watt Ceiling Fan	6705	Number
Measured Watt	70	Watts
Total Watts	469350	Watts
Proposed watt after replacement	30	Watts
Total Watt After Replacement	201150	Watts
Operating Hours in a day	8	Hours
Estimated Energy Saving after Replacement Annual kWh	643680	kWh
Per Unit Cost as Per APDCL Bill	6.45	Rs
Estimated Cost Saving Per Year	4151736	Rs
Cost of Per Fan	1500	Rs
Total Investment Cost	10057500	Rs
Payback	2.42	Year



Inventory details of Fans Building wise

SR. No.	Name of the Building	Ceiling Fan of 70 W	Exhaust Fan of 35 W	Exhaust Fan of 50 W	Total Load (W)
1	Bordoichila Women's Hostel	100	8		108
2	Charaideo Men's Hostel	240	6		246
3	Dhansiri Women's Hostel	176	6		182
4	New Women's Hostel	100	8		108
5	Subansiri Women's Hostel	145	24		169
6	Kanchenjungha Men's Hostel	285	33		318
7	Kopili Womens' Hostel	135	22		157
8	Pragjyotika Women's Hostel	120	16		136
9	Nilachal Men's Hostel	324	33		357
10	C. V. Raman Men's Hostel	450	43		493
11	Pobitora Women's Hostel	350	21		371
12	Patkai Men's Hostel	310	40		350
13	Energy Building	75		10	85
14	MCJ Building	76		20	96
15	Environmental Sc.	150		27	177
16	MBBT	175		27	202
17	Central Library	100		6	106
18	Chem Sc	120		11	131
19	Computer Sc	220		22	242
20	KBR Auditorium	20		10	30
21	Admin Building	112		10	122
22	Guest House	185		90	275
23	Academic Building I	325		15	340
24	Academic Building II	325		12	337
25	Dean, SoE Building	285		12	297
26	Business Administration	82		5	87
27	Food Engg & Tech	285		45	330
28	Mech Engg	310		30	340
29	ECE Building	265		12	277
30	Civil Engg	250		20	270
31	HSS Building	610		57	667
Total		**6705**	**260**	**441**	**7406**

Recording of Electrical Parameters of Main incomer & Transformer

4.5 Transformer Load Profile

The Table below shows the Load Profile of Main incomer line of 33KV/11 line which is located on Main station at Tezpur University:

Parameter	Unit	Min	Max	Average
R RMS Voltage	V	32022	32385	32203.5
Y RMS Voltage	V	32333	32852	32592.5
B RMS Voltage	V	32250	32670	32460
R RMS Current	Amp	16.20	22.56	19.38
Y RMS Current	Amp	17.96	25.56	21.76
B RMS Current	Amp	16.36	23.6	18.08
L1 PF	-	0.96	0.99	0.975
L2 PF	-	0.86	0.99	0.9265
L3 PF	-	0.89	0.98	0.935
R Active Power	W	256123	722320	489221.5
Y Active Power	W	97569	427264	262416.5
B Active Power	W	95869	649277	372573
Total Active Power	**W**	**455521**	**495810**	**475665.5**
R Apparent Power	VA	266260	728195	497227.5
Y Apparent Power	VA	112136	477505	294820.5
B Apparent Power	VA	275094	303497	289295.5
Total Apparent Power	**VA**	**653490**	**1509197**	**1081343.5**
R THD Voltage	%	1.8	2	1.9
Y THD Voltage	%	1.8	1.9	1.85
B THD Voltage	%	1.7	1.9	1.8
R THD Current	%	9.1	11.9	10.5
Y THD Current	%	8	11.2	9.6
B THD Current	%	7.9	11.1	9.5

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The Table below shows the Transformer Load Profile of Transformer 1 and Transformer 2 of 11 KV/440 line which is located on Main station at Tezpur University.

Parameter	Unit	Transformer 1			Transformer 2		
		Min	**Max**	**Average**	**Min**	**Max**	**Average**
R RMS Voltage	V	10910	10960	10935	10790	11010	10900
Y RMS Voltage	V	10820	10880	10850	10740	10940	10840
B RMS Voltage	V	10820	10880	10850	10760	10930	10845
R RMS Current	Amp	12.36	25.32	18.84	13.02	22.56	17.79
Y RMS Current	Amp	14.3	32.4	23.35	2.04	20.8	11.42
B RMS Current	Amp	13.98	28.32	21.15	3.78	14.76	9.27
L1 PF	-	0.58	0.73	0.66	0.33	0.98	0.655
L2 PF	-	0.34	0.99	0.66	0.35	0.66	0.50
L3 PF	-	0.95	0.98	0.97	0.39	0.63	0.51
R Active Power	W	73487	345833	209660	49879	239764	144821.5
Y Active Power	W	69487	153939	111713	33603	115978	74790.5
B Active Power	W	112314	149201	130757.5	16103	99251	57677
Total Active Power	**W**	**255288**	**648973**	**452130.5**	**99585**	**454993**	**277289**
R Apparent Power	VA	122372	160661	141516.5	143429	244380	193904.5
Y Apparent Power	VA	126850	349080	237965	77927	155852	116889.5
B Apparent Power	VA	117922	151839	134880.5	41132	158770	99951
Total Apparent Power	**VA**	**367144**	**661580**	**514362**	**262488**	**559002**	**410745**
R THD Voltage	%	1.7	2.1	1.9	2.3	2.5	2.4
Y THD Voltage	%	1.9	2.2	2.05	2.2	2.4	2.3
B THD Voltage	%	2	2.2	2.1	2.2	2.4	2.3
R THD Current	%	9.2	23.2	16.2	14.7	30.4	22.55
Y THD Current	%	6.3	17	11.65	14.5	52	33.25
B THD Current	%	8	22.6	15.3	16	29.6	22.8

4.6 Power Quality

Power Quality & Harmonics

- Maximum Individual Frequency Voltage Harmonic: 3%
- Total Harmonic Distortion of the Voltage: 5%

harmonic current limitations

Maximum Harmonic Current Distortion in Percent of IL
120 Volt through 69 KV
Individual Harmonic Order (Odd Harmonics)

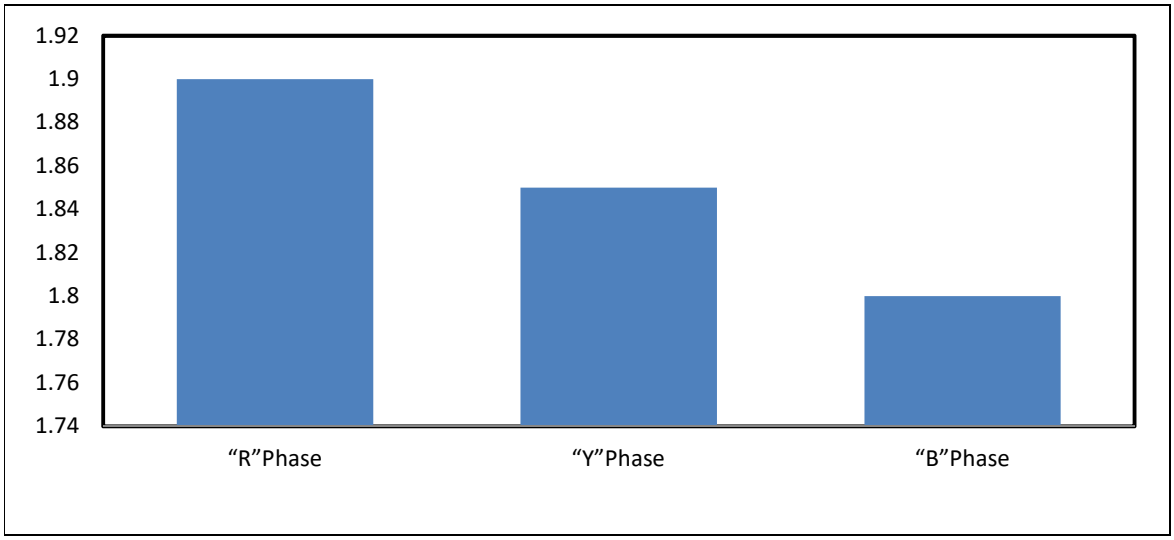
ISC/IL	h<11	11<h<17	17<h<23	23<h<35	35<h	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits
TDD refers to Total Demand Distortion based on the average demand current at the fundamental frequency and measured at the PCC (Point of Common Coupling).
*All power generation equipment is limited to these values of current distortion regardless of ISC/ IL value.
ISC = Maximum short-circuit current at PCC.
IL = Maximum demand load current (fundamental) at the PCC.
h = Harmonic number.

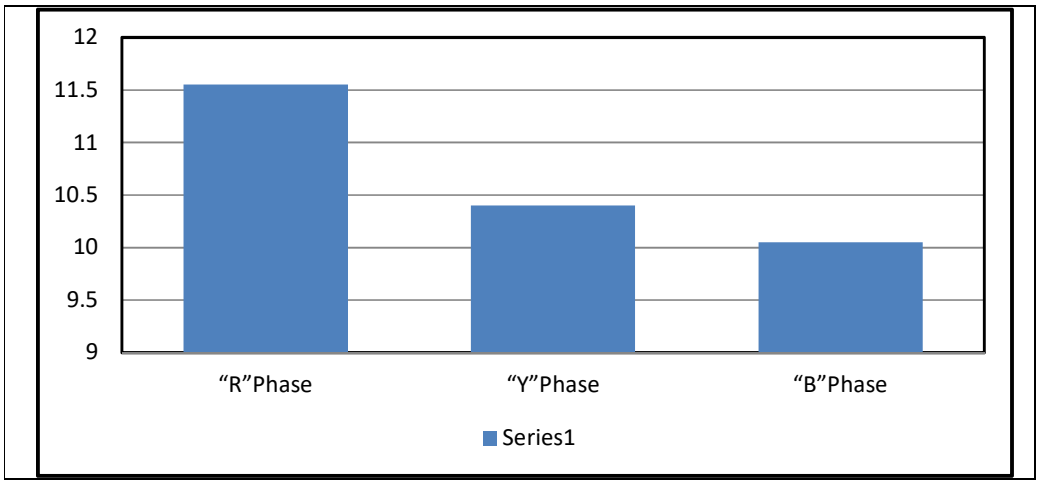
Equipment based on frequency conversion techniques generates harmonics. With the increased use of such equipment, harmonics-related problems have been enhanced. The harmonic currents generated by different types of loads travel back to the source. While traveling back to the source, they generate harmonic voltages, following simple Ohm's Law. Harmonic voltages, which appear on the system bus, are harmful to other equipment connected to the same bus. In general, sensitive electronic equipment connected to this bus will be affected. The Harmonics Level on the HT side of the Transformers was measured, details of which is as under: -

Particulars	TR
Voltage Harmonics(VTHD)	
"R"Phase	1.9
"Y"Phase	1.85
"B"Phase	1.8
Current Harmonics(ATHD)	
"R"Phase	11.55
"Y"Phase	10.4
"B"Phase	10.05

Graphical Representation of Voltage Harmonics (V THD) of Main Incomer



Graphical Representation of Voltage Harmonics (V THD) of Main Incomer



OBSERVATIONS & SUGGESTIONS

As detailed above, the voltage harmonics levels were around 1.8-1.9% and the levels of the current harmonics were 10.4-11.55%. **The Overall harmonics are within limits.** If the Harmonics level is on the higher side, then appropriate harmonic filters may have to be installed in the system. Different technologies are available mitigating the harmonics from the system. These include **Detuned or broadband harmonic filters**: these filter banks are tuned to a frequency just below the predominant harmonic frequency. If the

predominant harmonic frequency is say, 5th, it is normal practice to tune the filters to 189 Hz, or 3.78th harmonic, in 50 Hz systems.

Active Harmonic Filters: these units are designed in such a manner that, they will inject harmonic frequencies in the system, which will be in anti-phase of the load harmonic frequencies. This will effectively free the source being loaded due to harmonics.

MAJOR CAUSES OF HARMONICS

Devices that draw non-sinusoidal currents when a sinusoidal voltage is applied create harmonics. Frequently these are devices that convert AC to DC. Some of these devices are listed below:

- Electronic Switching Power Converters
- Computers, Uninterruptible power supplies (UPS), Solid-state rectifiers
- Electronic process control equipment, PLC's, etc.
- Electronic lighting ballasts, including light dimmer
- Reduced voltage motor controllers
- Arcing Devices
- Discharge lighting, e.g. Fluorescent, Sodium and Mercury vapor
- Transformers operating near saturation level
- Magnetic ballasts (Saturated Iron core)
- Induction heating equipment, Chokes, Motors, Appliances
- TV sets, air conditioners, washing machines, microwave ovens
- Fax machines, photocopiers, printers
- These devices use power electronics like SCRs, diodes, and thyristors, which are a growing percentage of the load in industrial power systems.

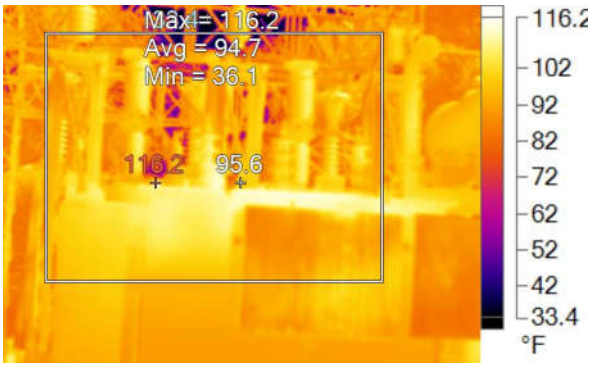
Many problems can arise from harmonic currents in a power system. Some problems are easy to detect; others exist and persist because harmonics are not suspected. Higher RMS current and voltage in the system are caused by harmonic currents, which can result in any of the problems listed below:

Blinking of Incandescent Lights	Transformer Saturation
Capacitor Failure	Harmonic Resonance
Circuit Breakers Tripping	Inductive Heating and Overload
Conductor Failure	Inductive Heating
Electronic Equipment Shutting down	Voltage Distortion
Flickering of Fluorescent Lights	Transformer Saturation
Fuses Blowing for No Apparent Reason	Inductive Heating and Overload
Motor Failures (overheating)	Voltage Drop
Electromagnetic Load Failures	Inductive Heating
Overheating of Metal Enclosures	Inductive Heating
Power Interference on Voice Communication	Harmonic Noise
Transformer Failures	Inductive Heating

4.7 Thermal Image of Transformer

IR000132.IS2

Visible Light Image



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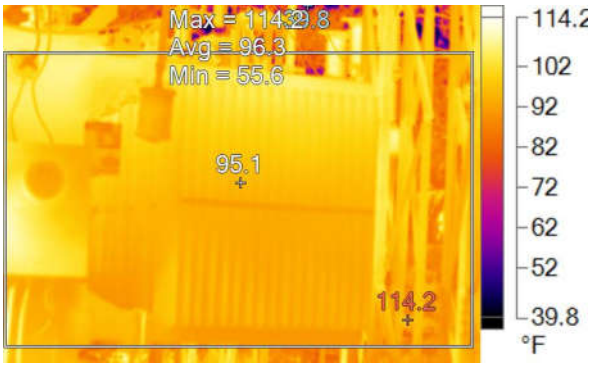
Visible Light Image



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Visible Light Image

IR000135.IS2

Visible Light Image

Image Info : IR000132.IS2	
Background temperature	68.0°F
Emissivity	0.95
Average Temperature	98.7°F
Camera Model	Fluke Ti32
IR Sensor Size	320 x 240
Camera serial number	Ti32-11050340 (9Hz)
Observations	**There is no hotspot observed**
Max. Temp. Rise (ΔT_{MAX}), ^0C	**< 10^0C**
Fault category	**4**
Recommendations	**Record and continue to monitor**

Image Info : IR000133.IS2	
Background temperature	68.0°F
Emissivity	0.95
Average Temperature	92.8°F
Camera Model	Fluke Ti32
IR Sensor Size	320 x 240
Camera serial number	Ti32-11050340 (9Hz)
Observations	**There is no hotspot observed**
Max. Temp. Rise (ΔT_{MAX}), ^0C	< 10^0C
Fault category	4
Recommendations	Record and continue to monitor

Image Info : IR000134.IS2	
Background temperature	68.0°F
Emissivity	0.95
Average Temperature	95.8°F
Camera Model	Fluke Ti32
IR Sensor Size	320 x 240
Camera serial number	Ti32-11050340 (9Hz)
Observations	**There is no hotspot observed**
Max. Temp. Rise (ΔT_{MAX}), ^0C	< 10^0C
Fault category	4
Recommendations	Record and continue to monitor

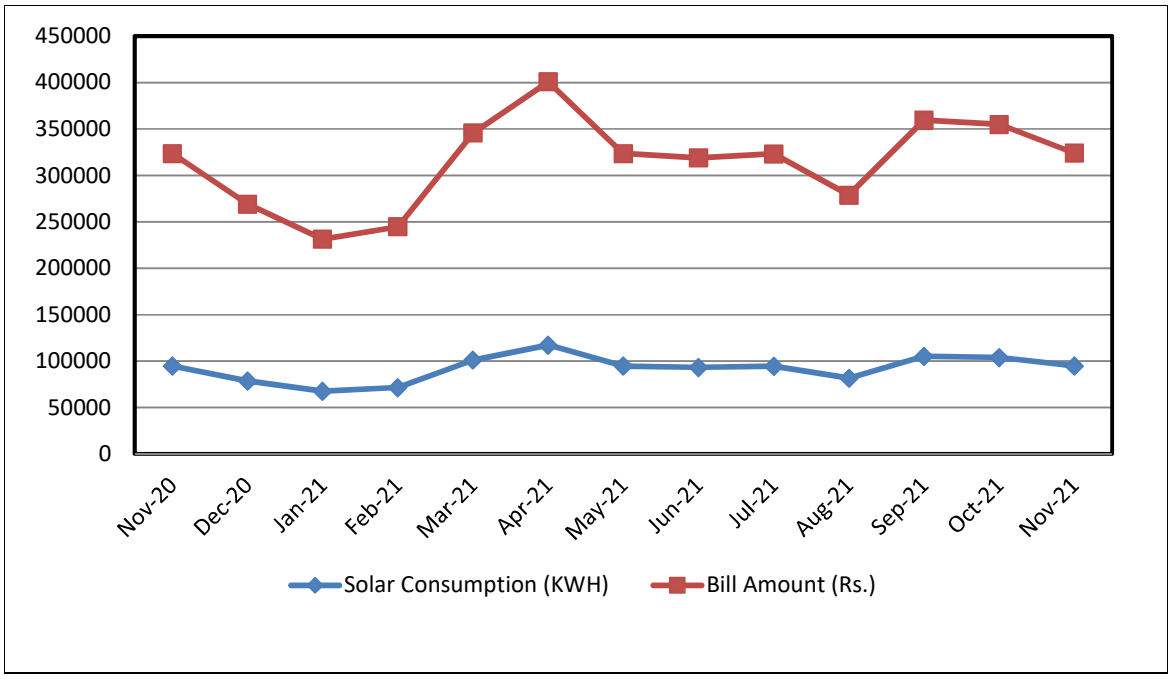
Image Info : IR000135.IS2	
Background temperature	68.0°F
Emissivity	0.95
Average Temperature	91.3°F
Camera Model	Fluke Ti32
IR Sensor Size	320 x 240
Camera serial number	Ti32-11050340 (9Hz)
Observations	**There is no hotspot observed**
Max. Temp. Rise (ΔT_{MAX}), ^0C	< 10^0C
Fault category	4
Recommendations	Record and continue to monitor

4.8 Solar Electricity Bill

The University already installed 1000 kWp rooftop grid-connected solar power plant on the campus in the year 2018. The bill summary of Solar Electricity of last year 2021 is given in the following Table.

BILL MONTH	SOLAR CONSUMPTION UNITS (kWh)	Total Amount (Rs.)
Nov-20	94653.3	229060
Dec-20	78691.9	190434
Jan-21	67657.1	163730
Feb-21	71550	173151
Mar-21	101119	244709
Apr-21	117218	283669
May-21	94623.7	228989
Jun-21	93280	225738
Jul-21	94526	228753
Aug-21	81562	197381
Sep-21	105151	254465
Oct-21	103954	251085
Nov-21	94790	229393
Total	**1198776**	**2900557**
Average	**99898.00**	**241713.08**
Max	**117218**	**283669**
Min	**67657.1**	**163730**

Graphical Representation of Consumption Unit (kWh)



4.11 General Tips for Energy Conservation in Different Utilities Systems

4.11.1 ELECTRICITY

- Schedule your operations to maintain a high load factor
- Minimize maximum demand by tripping loads through a demand controller
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.99 under rated load conditions.
- Set transformer taps to optimum settings.
- Shut off unnecessary computers, printers, and copiers at night.

4.11.2 Motors

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Check alignment.
- Provide proper ventilation, (For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.

- (An Imbalanced voltage can reduce 3 - 5% in motor input power)
- Demand efficiency restoration after motor rewinding.

4.11.3 FANS

- Use smooth, well-rounded air inlet cones for fan air intakes.
- Avoid poor flow distribution at the fan inlet.
- Minimize fan inlet and outlet obstructions.
- Clean screens, filters, and fan blades regularly
- Use aero foil-shaped fan blades.
- Minimize fan speed.
- Use low-slip or flat belts.
- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable fan loads.
- Use energy-efficient motors for continuous or near-continuous operation
- Eliminate leaks in ductwork.
- Minimize bends in ductwork
- Turn fans off when not needed

4.11.4 PUMPS

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

4.11.5 LIGHTING

- Reduce excessive illumination levels to standard levels using switching, delamping, etc. (Know the electrical effects before doing delamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc.
- Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
- Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- Consider lowering the fixtures to enable using less of them.
- Consider day lighting, skylights, etc.
- Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.
- Use task lighting and reduce background illumination.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- Change exit signs from incandescent to LED.

4.11.6. DG SETS

- Optimize loading
- Use waste heat to generate steam/hot water /power an absorption chiller or preheat process or utility feeds.
- Use jacket and head cooling water for process needs
- Clean air filters regularly
- Insulate exhaust pipes to reduce DG set room temperatures.

4.11.7. WATER & WASTE WATER

- Recycle water, particularly for uses with less-critical quality requirements.
- Recycle water, especially if sewer costs are based on water consumption.
- Balance closed systems to minimize flows and reduce pump power requirements.

- Eliminate once-through cooling with water.
- Use the least expensive type of water that will satisfy the requirement.
- Fix water leaks.
- Test for underground water leaks. (It's easy to do over a holiday shutdown.)
- Check water overflow pipes for proper operating level.
- Automate blowdown to minimize it.
- Provide proper tools for wash down -- especially self-closing nozzles.
- Reduce flows at water sampling stations.
- Eliminate continuous overflow at water tanks.
- Promptly repair leaking toilets and faucets.
- Use water restrictors on faucets, showers, etc.
- Use self-closing type faucets in restrooms.

4.12 ENERGY MANAGEMENT STRATEGY

Energy Management should be seen as a continuous process. Strategies should be reviewed annually and revised as necessary. The key activities suggested have been outlined below:

IDENTIFY A STRATEGIC CORPORATE APPROACH

The starting point in energy management is to identify a strategic corporate approach to energy management. Clear accountability for energy usage needs to be established, appropriate financial and staffing resources must be allocated and reporting procedures initiated. An energy management program requires commitment from the whole organization in order to be successful. A record of Energy consumption must be kept and monitored on regular basis, to optimize the Energy consumption. For this, various meters may have to be installed.

DESIGNATE AN ENERGY MANAGER

An Energy Manager must be identified and time bound responsibility must be given to him in getting implemented the findings of the Energy Audit points, which the Plant Establishment has planned to implement.

SET UP AN ENERGY MONITORING AND REPORTING SYSTEM

Successful energy management requires the establishment of a system to collect/ analyze and report the energy costs and consumption pattern. This will enable an overview of energy use and its related costs, as well as facilitating the identification of savings that might `otherwise not be detected. The system needs to record both historical and ongoing energy use, as well as cost information from billing data, and capable of producing summary reports on a regular basis. This information will provide the means by which trends can be analyzed and reviewed for corrective measures.

IMPLEMENT A STAFF AWARENESS AND TRAINING PROGRAM

A key ingredient to the success of an energy management program is maintaining a high level of awareness among staff. This can be achieved in a number of ways, including formal training, newsletters, posters and publications. It is important to communicate program plans and case studies that demonstrate savings, and to report results at least at 12-month intervals. Staff may need training from specialists on energy saving practices and equipment.

CHAPTER 5

SOLID WASTE AUDIT

Solid waste is the unwanted or useless solid material generated from human activities in a residential, industrial, or commercial area. Solid waste management reduces or eliminates the adverse impact on the environment and human health. A number of processes are involved inefficiently managing waste for an organization. It is necessary to manage the solid waste properly to reduce the load on the waste management system. Solid waste generation and its management is a burning issue in current days. The rate of generation of solid waste is very high and yet we do not have adequate technology to manage the generated waste. Unscientific handling of solid waste can create threats to public health and environmental safety issues. Thus, it is necessary to manage solid waste properly to reduce the load on the waste management system. The purpose of this audit is to find out the quantity, volume, type, and current management practice of solid waste generation in the Tezpur University campus. This report will help for further solid waste management and to go for green campus development.

5.1 Generation of solid waste in Tezpur University

Tezpur University campus solid waste data is collected from all the Building areas and the same is directly handed over to the Municipalities' Bin for further segregation and recycling purpose. There are different types of waste are recorded such as paper waste, plastic waste, construction waste, glass waste, etc. However biodegradable waste is recycled through the vermicomposting process. The daily rate of waste generation has been increasing in the recent time reaching up to an estimated amount of about 7 tons per day (tpd) during peak academic sessions and the minimum amount generated during the lean period is about 4 tpd. The wastes generated in the campus include (i) kitchen wastes, (ii) wastes from construction sites, (iii) liquid waste (residential and eateries), (iv) sewage and sludge, (v) biomedical waste, (vi) laboratory chemical wastes, (vi) plastic wastes, (vii) cans and bottles, (viii) damaged or spoiled laboratory glassware, (ix) unused tools and machinery including battery, (xi) papers including packaging materials (xii) electronics waste (xiii) garden leaves and (xiv) sweeping litters, etc. The total solid waste generated in the annual year 64,223 Kg.

Status of solid waste generation in Tezpur University Campus

SI No.	Month	Total Waste Kg/ Month
1	Jan-21	4976
2	Feb-21	5051
3	Mar-21	5184
4	Apr-21	5674
5	May-21	5704
6	Jun-21	5733
7	Jul-21	5897
8	Aug-21	5305
9	Sep-21	5439
10	Oct-21	5220
11	Nov-21	5050
12	Dec-21	4990

The University is committed to ensuring that all forms of wastes generated are handled based on the RRRR (Reduce, Reuse, Recycle, Recover) principles following appropriate source segregation protocols including safe disposal of bio, medical and hazardous wastes. There are studies from time to time to estimate the amount and nature of wastes, particularly solid waste which indicates the increasing trend of the volume. A preliminary survey reveals the domination of biodegradable components (volume basis) over the non-biodegradable counterparts on the campus. The students' hostels share the highest amount of solid waste mostly dominated by food/kitchen wastes (a substantial amount of papers, plastics, metals are also seen with waste also generated in hostels) followed by residential areas, eateries including shopping complex and offices including academic buildings, construction sites (occasionally), open areas including gardens and roads.

5.2 Waste Management

Biodegradable Waste Management – Vermicomposting Unit

University has taken initiative for Biodegradable Waste Management to compost using processes like Dry & Wet Waste Management. Vermicomposting technology relies upon the conjoint action of earthworms and microorganisms to rapidly transform varied types of solid wastes. Considering the simplicity and flexibility of the technology, a vermicomposting unit was established in January 2009 in the University under the supervision of the Horticulture Section. The prime objectives are to recycle biodegradable waste fractions in a sustainable manner and curtail the cost of purchasing

organic manure from the market for landscaping ventures. Presently, the unit is running successfully to fulfill the need for organic manure for plantation/gardening works of the University. So far, the ready-to-use vermicompost is produced entirely from garden waste (grass) and leaf litter of the campus.

VERMICOMPOST UNIT

The vermicomposting unit has a waste accommodating capacity of about 16.5 m^3, i.e., about 10 quintals (on a fresh weight basis) at a given time. On average, one vermicomposting period (or one batch) takes about 60-90 days depending on the nature of the feedstock. Epegeic earthworm species (Eiseniafetida, Eudriluseugeniae, and Perionyxexcavatus) are applied at a rate of 10 worms/kg (approximately) feedstock to carry out the composting process. Approximately 126 quintal vermicompost has been produced in the last five years (i.e. April 2016 to March 2021). The produced vermicompost is used for all sorts of plantation and landscaping activities at the University. The unit is ready for expansion to accommodate various other kinds of biodegradable solid wastes generated in the University. The table below is the data Production Record of Vermicompost Unit for 5 years. Apart from utilizing the required amount of vermicompost for landscaping work, University is selling certain quantities to the campus dwellers. The table below shows the revenue generated from selling Vermicompost from the Departmental Vermicompost Unit of Horticulture Section.

PRODUCTION RECORD OF VERMICOMPOST UNIT
(April 2016 to March 2021)

Financial Year	Total Production (Quintals)
April 2016 – March 2017	18.90
April 2017 – March 2018	19.35
April 2018 – March 2019	28.60
April 2019 – March 2020	25.74
April 2020 – March 2021	32.95
Total	**125.54**

Financial Year	Revenue Earning (In INR)
FY 2016-17	**-**
FY 2017-18	**5,000/-**
FY 2018-19	**5,000/-**
FY 2019-20	**-**
FY 2020-21	**-**
Total	**10,000/-**

Initiatives taken by the University for Waste Management

- Glass waste is generated from the laboratory mainly in the form of bottles; Many times bottles are reused for storing other chemicals.
- The e-waste generated at Tezpur University is sent for recycling and reuse.
- Hazardous waste generated in a solid and liquid state during experiments in the laboratory is disposed of properly.
- Biodegradable waste is a major solid waste generated on campus which is further treated by vermicompost technology.
- University has banned single-use of plastic for any administrative as well as other purposes.

Recommendations

- Provision of installation of garbage unit should be introduced where the multilevel segregation of various wastes such as paper, construction, glass, metal scrap, and food waste should be done. Further various waste recycling plans for different types of waste should be introduced.
- Provision for E-waste management should be introduced in the University Campus.

- Paper waste like answer sheets, old bills, and confidential reports should be sent for shredding, pulping, and recycling after completion of their preservation period.
- Recycling facilities should be introduced and should be supported by City Municipality and private suppliers, including glass, cans, white, colored, and brown paper, plastic bottles, batteries, print cartridges, cardboard, and furniture.

CHAPTER 6

ENVIORNMENT QUALITY AUDIT

This includes the plants, greenery, and sustainability of the campus to ensure that the buildings conform to green standards. This also helps in ensuring that the Environmental Policy is enacted, enforced, and reviewed using various environmental awareness programs.

6.1 Environment Quality Audit

To keep the greeneries in the campus, the University regularly maintains the gardens which are looked after by concerned staff under the guidance of higher authorities of the University. Activities organized to create greenery and its conservation at the university campus is as follows-

- Plantation of diversified species, Uses of medicinal plants, Identification of plants species
- Waste management plan and disposal facility
- Awareness of carbon consumption and carbon footprint program

To create a green cover, Eco-friendly atmosphere, pure oxygen at the university campus, a plantation program is organized every year with active participation from the university community and visitors. A committee has been formed as the Campus Horticulture Committee to keep the greeneries in the University campus. All gardens are regularly maintained and looked after by Horticulture Section under the guidance of committee members. Various departmental activities are being carried out every year such as: -

- Plantations and other Landscaping Activities
- Maintenance of Gardens and Landscape
- Maintenance of Plantations

The horticultural activities for landscaping and beautification of Tezpur University was started with constitution of a Landscaping Committee in 1995. There were transformation and redeemed of certain natural vegetation patches for requisite infrastructure development to facilitate the emerging needs for the growth of the

university. However, spaces for academic, administrative and recreational areas are delineated in harmony with the landscape to ensure an eco-friendly campus. Horticulture section of the University is looking after all the plantation and other landscaping activities within the University campus under the guidance of a Campus Horticultural Committee. This committee member develops strategies for smooth execution of plantation, maintenance and overall protection of the landscape. Therefore, greenery of the large area in the campus is well maintained besides keeping remnants of the natural vegetation patches undisturbed. There are block plantation, plantations along roads side, garden space of departmental building premises, and along the residential compounds, while several tree species regenerated naturally and there are seasonal herbaceous plants that cover the whole natural landscapes. Several indigenous trees, shrubs and ornamental plants are carefully selected for the plantation to provide shelter for birds and to deliver a shaded walkway. Massive plantations and different landscaping/beautification activities have already been carried out in different parts of the University campus.

PLANTATIONS

Towards the sustainable land use practice, a total of 24,978 plant saplings of different species have been planted in various sites in the last 2 decades (from July'1997 to March 2021) through routine and special plantation drives organized by the Horticulture Section, Tezpur University on various national and international events/occasions with active participation from university communities and guests. This program helps in encouraging an eco-friendly environment that provides pure oxygen within the institute and awareness among villagers. The plantation program includes various types of indigenous species of ornamental and medicinal wild plant species. The plants have medicinal value, which faculty members of the Department of Environmental Science help students to identify with scientific names and give information about medicinal uses of the plants.

PLANTATION DRIVE AT THE EASTERN SIDE OF DEPARTMENT OF ENERGY: 2017-2018

PLANTATION DRIVE ALONG THE BOUNDARY WALL: 2020-2021

LANDSCAPING AND GARDENING ACTIVITIES

In addition, to carry out different plantation programs, efforts were also made by the Horticulture Section, Tezpur University for beautification of different parts of the University campus by the development of flower gardens and other landscaping activities such as the development of lawns, hedges, ornamental and avenue plantations, etc. From July'1997 to March'2021, landscaping and gardening work in most of the prime locations of the University campus like the front side of the Entrance gate, different Administrative and Academic buildings, Guest House, Central Library, Auditorium, Vice-Chancellor's residence, etc. and other amenity centers have been completed. In addition, two Citrus gardens (one near Subansiri Women Hostel and another at the western side of Academic Building-I) have also been developed within the University campus. Moreover, plantation of different types of orchids on the existing

trees of different locations of the University campus has also been done for further beautification of the landscape.

MAINTENANCE OF GARDENS AND LANDSCAPE

In addition to new plantation drives and landscaping/beautification activities, all essential maintenance work (like lawn, hedge, existing plants /shrubs, growing of seasonal flowers) for previously developed flower and other gardens, as well as other locations of the University campus, is done regularly under the supervision of Horticulture Section.

FRONT SIDE OF DEPARTMENT OF MASS COMMUNICATION AND JOURNALISM: 2016-2017

GUEST HOUSE: 2017-2018

FRONT SIDE OF DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING: 2017-2018

FRONT SIDE OF ADMINISTRATIVE BUILDING: 2018-2019

FRONT SIDE OF DEPARTMENT OF BUSINESS ADMINISTRATION: 2019-2020

VICE-CHANCELLOR'S RESIDENCE: 2020-2021

MAINTENANCE OF PLANTATIONS

Apart from the maintenance of gardens, all previously planted trees (like roadside and other plantations) in different locations of the University campus are regularly nurtured by cleaning, fertilization, watering, etc.

HOUSE PLANTS

House plants do not just look good – they can make us feel good, too. Studies have shown that house plants-

- Boost our mood, productivity, concentration, and creativity
- Reduce our stress, fatigue, sore throats, and colds
- Help clean indoor air by absorbing toxins, increasing humidity & producing oxygen
- Add life to a sterile space, give privacy and reduce noise levels

Considering the different benefits of house plants, currently, about 950 House plant pots are placed in the interior space of different Administrative offices and Academic buildings, Guest House, Library, Auditoriums, VC's residence etc. and other amenity centers for beautification, greenery, and purifying the air. Essential maintenance works of these house plants are carried out regularly under the supervision of the Horticulture Section, Tezpur University,

Campus Involvement

For sustainable use of resources and for the mission of "GO-GREEN" it is necessary that the students, faculty, and administration welcome it. Tezpur University is an environment that invites opportunities to better its community through campus organizations. The green initiative started on the campus many years ago. The University students are actively participating and solely concerned with the environment. These students under the guidance of faculties strive to create an environmentally friendly campus. Their purpose is to create awareness and eventually act on that awareness. University is also actively conducting environmental awareness programs on campus regularly.

Environmental Conservation Programme

University is very active in the practical education of the students with regard to environmental conservation. The University has arranged visits to their faculties to the Wildlife Institute of India (WII), Botanical Garden, Sanctuaries, Zoological park Sacred grooves in order to educate their students. The University also took their students to different National Park in order to educate the students about in situ Conservation of Wildlife.

6.2 National Ambient Air Quality Program (NAAQM)

Central Pollution Control Board, New Delhi initiated National Ambient Air Quality Monitoring (NAAQM) program in the year 1984 to get a spatial and temporal variation of ambient air concentrations for a wide range of pollutants that are considered relevant for evolving strategic management plan. The program was subsequently renamed NAMP (National Air Quality Monitoring Program). Under NAMP, three air pollutants viz., Sulphur dioxide (SO_2), Nitrogen dioxides (NO_2), and Repairable Suspended Particulate Matter (RSPM/PM_{10}) have been identified for regular monitoring at three locations. Monitoring of pollutants has been carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) as per CPCB monitoring protocol. One Repairable Dust Sampler (RDS) machine is installed at the Main Gate of the University Campus which monitored the changes in ambient air quality during 24- hours. Tezpur University monitors air pollution regularly under National Ambient Air Quality Monitoring Program, Central Pollution Control Board, New Delhi.

6.3 Ambient air quality in the Tezpur University

Sr. No	Parameters	Unit	Result	Requirement permissible limits as per NAAQS/CPCB	Test Method
1	Particulate Matter, PM10	µg/m3	88.9	100	IS:5182 (P-23) : 2006
2	Particulate Matter, PM 2.5	µg/m3	50.2	60	SOP1/Ambient Air/01/010416
3	Sulphur Dioxide (as O2)	µg/m3	8.0	80	IS:5182 (P-2) : 2006
4	Carbon Monoxide (as O)	mg/m3	0.930	04	IS:5182 (P-10) : 1999
5	Oxide of Nitrogen (as O2)	µg/m3	20.3	80	IS:5182 (P-6) : 2006

Central Pollution Control Board, New Delhi has set guidelines to monitor and analyze the air pollution quality parameters. The trees cover on the campus are the leading sources to absorb CO_2 and release enough fresh O_2 across the University Campus. The result shows that Tezpur University Campus's air quality status is good as compared to other locations. It is identified that Tezpur University's campus is a green campus. University campus observed minimum air pollution as compared to other Ambient Air Pollution Centers located in different parts of the city.

Precautionary measures

- Avoid using diesel generators

6.3.1 Ambient noise monitoring status

Tezpur University is located in the center of the city. The major source of noise in university is automobile noise. At the main gate of the Campus, human communication and transportation are producing some sound levels. Ambient noise monitoring was carried out in different areas of Tezpur University campus like at University campus entry, administration building, and horticulture section. The sampling was carried out using calibrated Sound Level Meter (AZ 8921) by logarithmic scale in decibels (dB). The noise readings were collected on the University campus and calculated. The details of noise status in University campuses are given in the below table.

Ambient Noise levels in Tezpur University

Sr. No	Department Name	Leq (dB) Day time
1	MAIN GATE – Campus Entry	69
2	Administration	61
3	Community Hall	59

Note:

- All parameters expressed in dB(A) Leq. and observed under permissible limits.
- Monitoring is carried out during the daytime.

Recommendations

- University Campus should follow the Environmental aware laws for different aspects of environmental management.
- Campus should make the rule & poster the slogan in the campus for protecting the environment


Forests, Wildlife
and Wildlife Conservation

CHAPTER 7

CARBON FOOTPRINTS

Carbon is the basis of life on mother Earth. It is incorporated into the plants through photosynthesis, consumed by animal species through the food, present in the form of carbon dioxide (CO2) in the atmosphere, locked into the rocks like limestone, and compressed into the different fossil fuels such as coal and oil. As CO2 levels in the atmosphere continue to increase, most climate designs or projects that the oceans of the world and trees will keep soaking up more than half of CO2. The plants on land and in the sea, taken up carbon over many years increased the percentage discharged during decay, and this increased carbon became locked away as fossil fuels beneath the surface of the planet. At the start of the 21st century, we brought growing concern about global warming, climate change, food security, poverty, and population growth. In the 21st century, more carbon has been released into the atmosphere than that has been absorbed. CO2 is a principal component causing global warming. Atmospheric carbon dioxide levels have increased to 40 % from preindustrial levels to more than 390 parts per million CO2. On this background, it is a need of time to cover the research areas interrelated with climate change.

7.1 Carbon foot prints

In today's world, one of the biggest issues faced by all of us is global warming. Global warming refers to an increase in the average global temperature of mother Earth. The main cause of global warming is an increase in the concentration of greenhouse gases (GHGs) in the atmosphere due to anthropogenic activities and their level is determined with the help of global warming potential (GWP) and expressed as Carbon Footprint (CF). Carbon Footprint is another phenomenon used for GHGs or carbon dioxide emission in terms of CO_2 equivalents. There are various definitions of carbon footprint are in literature. But the most recognized definition given by Wiedmann is "*the Carbon footprint is the measure of carbon dioxide emissions directly or indirectly caused by an activity or accumulated over the life stages of a product*." In other words, "*A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product.*"

As Tezpur University is considered an institutional organization, various energy resources like electricity, solar rooftop systems are used. It is necessary to calculate the carbon footprint of the University to upgrade the Clean Developmental Mechanism (CDM) in various processes. All the data from the various sources were collected from all the sectors where energy resources are used. The collected data is calculated by using standard emission factors.

Efforts for Carbon Neutrality

Air pollution is a matter of serious concern on the campus owing to its urban location. Tezpur University as a responsible institution understands the importance of its carbon footprint and developed a plan to reduce greenhouse gas emissions in all its activities. Strictly ban on burning of dried leaves and waste paper in University.

Electricity carbon footprint

In the university, electricity is used for various purposes like residential, office use, and laboratories. The total electricity used in the University liberates mass kg of CO_2 per year. The laboratory equipment consumes the highest electricity which emits a large amount of carbon CO_2 per year. The solar panels are installed on the roof of various buildings produce electricity from solar panels which further saves ample mass of CO_2 per year.

Paper footprint

The papers are used in the institution for various purposes like exam answer sheets, circulars, notices, office work, etc. The papers are responsible for the emission of CO_2. The University used a total used 1,765.17 reams of paper which emits 3.67 tons of CO_2. On the University campus, various departments follow paperless methods of communication to reduce the footprint by the use of papers. The various sections on the campus save 13, 48,914 papers per year i.e. 2,697 reams. The paperless work reduces approximately 5.61tons of CO_2 approximately. A total of 2.80 tons of biomass is saved by paperless communication i.e. green computing.

The total footprint of the University

The total footprint is the addition of all the footprints and it is expressed as tons of CO_2 per year. The total footprint of Tezpur University is approx. more than 10,000 tons of CO_2 per year approximately. As the university is following the Clean Developmental Mechanism to reduce the emission of CO_2 and greenhouse emission by using solar panels for electricity generation and minimize the paperwork at the university reduces of 18.10 tons of CO_2 per year approximately.

Conclusion

India's CO2 emission is increased by an estimated 4.6 % in 2017, despite a turbulent year for its economy. The carbon footprint of the nation is measured per person; India's emissions are still very low – at only 1.8 tons of CO2 per capita which is much lower than the world average of 4.2 tons. But those emissions have been increasing steadily, with an average growth rate over the past decade of 6 %. The universities are the organizations which are having large areas which consume high quantities of electricity and LPG for many purposes. The Tezpur University Campus emits approx. 24,000 tons of CO2 per year approximately. The present Clean Development Mechanism (CDM) practices to reduce the 18.10 tons CO2 per year approximately.

Recommendations

- The food waste generated from university hostel mess, guest house, canteens, and staff quarters should be converted into biogas which can be further utilized for hostel kitchens.

- The solar battery-operated vehicles should be used on the campus to overcome the vehicle footprint.
- Green computing or E- work is helping the organization to reduce footprint very effectively.
- The solar energy-based street lamps on campus will reduce carbon footprint.
- The awareness should be made among the faculty, students, and other employees regarding Clean Development Mechanism (CDM) to reduce the consumption of electricity and natural resources.
- "Carbon Sequestration" survey should be conducted on the campus. Carbon sequestration is a process of converting atmospheric carbon i.e. CO2 into other sinks of carbon such as vegetation, soil, ocean, etc. in various forms to mitigate global warming audit is one of the important clauses of the Kyoto Protocol.

Carbon Sequestration

While transforming ourselves from regional universities to global universities, the need of such universities to face the global future challenges and try to find out possible solutions for them. It is a social and environmental responsibility of Government Institutes, Universities, National and International Organizations to respond positively to various global issues at the local level and should collate the generated knowledge into the society. Global warming and climate change are current environmental issues that need to be addressed scientifically and efficiently. As Universities are provided with skillful human resources supported by analytical infrastructure, it is our duty to bring such ideas into practice.

CHAPTER 8

GREEN INITIATIVES

University is located in the area which is one of the important wilder areas of Tezpur city with its precious biodiversity. It covers an area of about 262 acres. The major portion is covered with vegetation. The university aims to protect and conserve its biodiversity, fresh and clean ambiance through many initiatives. The university has taken the following green initiatives to protect and conserve nature.

Plantation and Nurturing Programme

Many plantation drives are taken by the University on its campus. Every year on 5th June i.e. World Environment Day, the University takes Plantation activity. Under 33 Crore tree plantation scheme of Government. University has taken many plantation drives. The Horticulture Section looks after tree plantation activities. The trees are watered by students of various Departments. They nurture these trees throughout the year. Students of various departments and students make the plantation and nurturing program successful. A total of 23 plant saplings of different species (like ornamental, fruit and medicinal plant, etc.) were planted in various sites of the University campus during this year's environment day program.

WORLD ENVIRONMENT DAY CELEBRATION, 2021

Green computing practice

Being an academic institution, papers are used for various purposes like exam answer sheets, circulars, notices, office work, document printing, and Xeroxing. Since the trees are cut for paper manufacturing, the sequestration of carbon is reduced increasing carbon footprint. To cut down the carbon footprint, the university administration and various departments follow paperless methods of communication by using emails, online forms submission, etc. The paperless work was helpful in reducing tons of CO_2. The tons of biomass are saved by this green computing practice.

Solar Electricity Generation

The University has installed a 1000KWp capacity Solar Power Plant for electricity generation which produces electricity and sends it to the local grid which is helpful for an electricity bill reduction. Most of the buildings are constructed considering the need for Light and ventilation which reduces the use of electricity. The air conditioners are used only in essential conditions in the laboratories and offices to reduce electricity consumption.

Conferences and workshops on Environmental Sustainability

Tezpur University organizes Conferences and Workshops based on the theme of environmental sustainability.

CHAPTER 9

CONCLUSIONS

Green Audit is one of the important tools to check the balance of natural resources and their judicial use. Green auditing is the process of identifying and determining whether institutional practices are eco-friendly and sustainable. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. The main objective to carry out a green audit is to check the green practices followed by the university and to conduct a well-defined audit report to understand whether the university is on the track of sustainable development. After completing the audit procedure of the university for green practices, there are the following conclusions, recommendations, and Environmental Management Plan(EMP) which can be followed by the university in the future for keeping campus environment friendly.

- University takes efforts to dispose of majority of waste by proper methods. Green computing i.e. Online payment systems, online circulars, and examination procedures are helpful for reducing the use of papers and ultimately reducing carbon footprint.
- Reducing the use of one-time use plastic bottles, cups, folders, pens, bouquets, decorative items will be useful to solve the problem of plastic pollution to some extent.
- Biodegradable waste is used efficiently for composting and vermicomposting.
- Use of LED lamps and Tube Lights is to be encouraged.
- Toilets and bathrooms are consuming more water in the departments. The replacement of old taps can be beneficial for solving this issue
- The use of electric cars on the campus is a good initiative to save fuel.
- The overall ambient air quality on the campus is good while some air quality issues that may arise due to developmental activities on the campus should be addressed. The sound levels on the campus are good.
- Science departments are following the principles of Green Chemistry to reduce chemical waste.

Key Recommendations & Environment Management Plan (EMP)

Following are some of the key recommendations for improving the campus environment and to be considered as Environment Management Plan (EMP).

- An environmental policy document has to be prepared with all the recommendations and current practices carried by the university.
- A frequent visit should be conducted to ensure that the generated waste is measured, monitored, and recorded regularly and information should be made available to the administration.
- The university should develop internal procedures to ensure its compliance with environmental legislation and responsibility should be fixed to carry out it in practice.
- The solid waste should be reused or recycled at maximum possible places.
- Installation of sensor-based electrification items like fans, lights, etc. can save electricity
- Installation of solar panels and rainwater harvesting system to every terrace of the building will be useful in conserving the natural resources.
- Regular checkups and maintenance of pipes, overhead tanks, and plumbing systems should be done by the engineering section to reduce overflow, leakages, and corrosions.
- Science laboratories large amount of water goes waste during the process of making distilled water; the system should develop to reuse this water for other purposes. The solar distillation unit is installed at the earliest.
- No such processes or activities were observed at Tezpur University which can deteriorate the environmental quality.
- The said University is in continuous efforts to spread the environmental awareness programs among staff and students.
- It was also observed that the said University is keeping the environmental quality at priority in every developmental stage.

DEVELOPMENT IS AN IMPORTANT ASPECT OF ANY ORGANIZATION, COLLEGE, OR UNIVERSITY. THIS DEVELOPMENT BY TEZPUR UNIVERSITY IS ALWAYS ACHIEVED AT THE EXPENSE OF ENVIRONMENTAL REHABILITATION.

WE ARE GLAD TO DECLARE THAT TEZPUR UNIVERSITY IS AN ENVIRONMENT-FRIENDLY UNIVERSITY ALONG WITH MANY GREEN DEVELOPMENT PROCESSES THAT ARE FAIRLY PRACTICED BY THE UNIVERSITY.