

# ENERGY AUDIT REPORT 2020-2021



**TRIPURA UNIVERSITY**  
Suryamaninagar |  
TRIPURA (W)- 799022|  
TRIPURA | INDIA



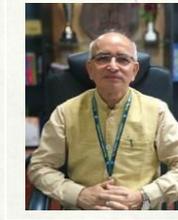


प्रो. गंगा प्रसाद प्रसाई  
कुलपति

**Prof. Ganga Prasad Prasain**  
Vice-Chancellor

त्रिपुरा विश्वविद्यालय  
(केन्द्रीय विश्वविद्यालय)  
सूर्यमणिनगर-799022, त्रिपुरा, भारत

**Tripura University**  
(A Central University)  
Suryamaninagar-799022, Tripura, India



### Foreword from Vice Chancellor

Globally there are many environmental challenges being faced and it is increasingly recognized that it is leading to the situation of unwarranted climate change issues, loss of biodiversity, impact on human health and even natural disasters. For this, small concerted efforts at the local and regional levels are necessary to bring about a balance at the global level. Tripura University as an academic establishment with lots of young talents who are the future nation builders is committed to take a lead role by creating its identity in the protection and conservation of environment. It has implemented eco-friendly practices to manage the available resources. As a part of this, Green/Environmental/Energy Audit is one such step which is taken up by Tripura University in this direction for the second year to record, document, analyze and report the diverse components within our close ambit so that an eco-friendly atmosphere can be created and maintained. It will help us to identify and generate prospects to boost environmental quality, expand hygiene and health measures, improve environmental protection, and augment sustainable development practices. It will help us in management of our environment so that we can make alterations in the ongoing activities. Implementation of environmental policy provides a chance to exploit our opportunities for better performance in future and will help us to develop a sustainable campus.

I have great pleasure in writing foreword for the Green/Environmental/Energy Audit Report 2020-2021 of Tripura University, Suryamaninagar. It is my pleasure to recognize the sincere efforts of the Green/Environmental/Energy Audit Committee led by Prof. Badal Kumar Datta, Department of Botany, Tripura University for their best efforts in preparing this comprehensive report. I do hope that the Green/Environmental/Energy Audit Report-2020-2021 will guide all the stakeholders of this University to define themselves in their future activities and will motivate all to put green steps ahead in future.

(Prof. Ganga Prasad Prasain)  
Vice-Chancellor

## Acknowledgement

Since its establishment, Tripura University has been at the forefront of promoting social change at both national and international levels through various activities such as environmental campaigns and workshops. The university recognizes the significance of energy audits for its ongoing maintenance and future growth. In its pursuit of excellence, Tripura University is dedicated to enhancing environmental quality and preserving its unique ecosystem for the benefit of future students and campus inhabitants.

Although multiple measures have been implemented to conserve and safeguard the environment, the 2020-2021 report marks the university's second formal endeavor to document and analyze the outcomes of its investigations pertaining to energy audits. The university is committed to endorsing the climate neutrality objectives set forth by the Indian Government and is determined to prevent a global ecological crisis. This commitment is exemplified by the establishment of the Energy Audit Committee, composed of faculty members specializing in this field, tasked with gathering essential energy-related data within the campus. This information is crucial in resolving environmental concerns on the premises.

The Energy Audit Committee's primary objective is to identify prevailing and potential energy-related challenges. By doing so, it seeks to oversee the university's environmental management practices and assess their subsequent impact on the campus environment. This proactive approach aligns with Tripura University's larger goal of contributing to ecological sustainability while maintaining the integrity of its academic processes.

This report has been generated as a result of the collaborative endeavors of every participant within the Energy Audit Committee of Tripura University. The committee engaged in the energy audit with the aim of collecting information related to energy usage and energy saving parameters. Subsequently, the gathered data was compiled and scrutinized in order to identify urgent and significant challenges present within the campus environment. The intention behind this effort is to explore possibilities for ongoing enhancement in our environmental practices and standards. This is achieved through the proposals and recommendations we have presented. We anticipate that this report will garner the attention it deserves from all invested parties, promoting an approach that starts from the grassroots level. This approach will better equip us to confront forthcoming challenges.

We extend our sincere gratitude to Prof. Ganga Prasad Prasain, the esteemed Vice Chancellor of Tripura University, for his unwavering encouragement and administrative support throughout the study. As representatives of the Energy Audit Committee for the year 2020-2021, we wholeheartedly appreciate the Hon'ble Vice Chancellor's kind involvement. Our heartfelt thanks go to the Registrar, Deans, Heads of Departments, Teachers, Officers, all staff members, and the entire community of Tripura University for their invaluable assistance in gathering data for this report.

We must also express our special appreciation to Er. Krishna Das, Executive Engineer and his team for their essential contribution of campus data. Lastly, but by no means least, our profound gratitude is extended to all committee members who played a role in the creation of this report. A special mention goes to Dr. Thiru Selvan, the Convener of the Tripura University Energy Audit Committee for 2020-21, for his tireless dedication in compiling this comprehensive document.

I sincerely hope and believe that the efforts made by the present Energy Audit Committee will be helpful for Tripura University and I hope that it becomes a responsibility of all the stakeholders of this university to follow the proposed management plan suggested in the report to reduce our impact on our environment.

Prof. Badal K Datta  
Chairman

## **Tripura University Energy Audit Committee 2020-2021**

### **Chairman:**

Prof. B K Datta, Dean, Faculty of Science, Tripura University

### **Members:**

Prof. Ranendu Kumar Nath, Department of Chemistry, Tripura University - Member

Prof. A K Saha, Department of Botany, Tripura University - Member

Dr. Y V Krishnaiah, Associate professor, Department of Geography and Disaster, - Member  
Tripura University

Dr Sabyasachi Dasgupta, Associate professor, Department of Forestry and - Member  
Biodiversity, Tripura University

Dr. S S Singh, Assistant Professor, Department of Zoology, Tripura University - Member

Dr Sourabh Deb, Assistant Professor, Department of Forestry and Biodiversity, - Member  
Tripura University

Mr. Harjeet Nath, Assistant Professor, Tripura University - Member

Er. Krishna Das, Executive Engineer, Tripura University - Member

Mr Surajit Sarkar, Campus Incharge, Tripura University - Member

### **Convener:**

Dr. Thiru Selvan, Assistant professor, Department of Forestry and Biodiversity,  
Tripura University

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## Introduction

In an era characterized by burgeoning energy demands and growing environmental concerns, the importance of energy efficiency cannot be overstated. This energy audit report represents a comprehensive assessment of energy consumption, utilization patterns, and potential areas for optimization within the campus of Tripura University. Undertaken with the aim of enhancing energy efficiency, reducing operational costs, and minimizing the organization's ecological footprint, this report encapsulates a meticulous analysis conducted by our expert team members.

As the global community strives for sustainable development, organizations are increasingly recognizing the pivotal role that energy efficiency plays in achieving both economic and environmental objectives. This energy audit report serves as a valuable tool to identify energy-saving opportunities, prioritize interventions, and outline a roadmap for the implementation of energy-efficient practices. By providing a detailed overview of the energy consumption landscape, current operational practices, and equipment efficiency, this report equips Tripura University with actionable insights that will drive informed decision-making.

The analysis presented in this report is the result of collaborative efforts between our dedicated energy audit committee members and Tripura University's personnel who provided invaluable input and access to crucial data. Through a combination of on-site inspections and data collection, we have endeavored to unearth a holistic view of energy usage and potential areas for improvement.

This report is structured to present a clear delineation of the current energy scenario, followed by an in-depth exploration of energy conservation measures tailored to Tripura University's specific needs and goals. Our findings are categorized to encompass low-cost and no-cost opportunities, moderate investments, and long-term strategic recommendations. The recommendations will enable Tripura University to make prudent decisions aligned with its operational objectives.

In the pursuit of a more sustainable and energy-efficient future, this energy audit report stands as a cornerstone, offering a comprehensive understanding of energy usage patterns and a roadmap to realize tangible improvements. By embracing the insights contained within, Tripura University takes a significant step towards minimizing energy waste, optimizing resource allocation, and contributing to a greener, more prosperous tomorrow.

Energy audit is assigned to the criteria 7 of NAAC, National Assessment and Accreditation Council which is a self-governing organization of India which declares the institutions as Grade A, B or C according to the scores assigned during the accreditation.

### About Tripura University

Tripura University, born from the renowned Calcutta University, emerged as an independent State University on October 2nd, 1987. Since its inception, the university has dedicated itself to achieving academic excellence in the northeastern region of the country. Nestled within a verdant 75-acre semi-urban landscape along the National Highway at Suryamaninagar (23°45'40"N; 91°15'58"E), the university was established within the former CUPGC premises, approximately 9 kilometers south of the capital city Agartala.

A member of the distinguished group of 49 Central Universities in India, Tripura University was instituted on July 2nd, 2007, through a parliamentary act. This act aimed to establish a teaching and affiliating university in the state of Tripura. Over the years, Tripura University has made substantial strides, with dedicated efforts directed towards enhancing academic infrastructure and fostering overall university growth.

Currently, the University administers a range of courses within the Science & Arts, and Commerce Faculty. The University provides a comprehensive selection of 58 programs, encompassing Undergraduate, Postgraduate Diploma, and other Postgraduate Programs. Moreover, the institution extends Ph.D. opportunities in 38 diverse subjects. Across the academic year, the campus enrolls over 4000 students, each pursuing various programs. The University is committed to fostering cutting-edge research ventures across multiple fields of science and technology.

Despite its geographically peripheral location and inherent communication challenges, the university has consistently strived to measure up to the academic accomplishments, research advancements, and placement successes of other esteemed universities in the country. This dedication is clearly mirrored in the university's accolades through NAAC Assessments and its ranking in the NIRF evaluations.

The University comprises 46 Departments, each equipped with modern classrooms, cutting-edge laboratories, continuous 24-hour internet access, a computer center, a well-stocked library, unrestricted Wi-Fi coverage spanning the Campus, sports fields, an open-air theater, a healthcare facility, a bank, a cafeteria, a post office, a food court, hostels, and a guest house. The faculty members are not only dynamic but also nurturing and approachable. Alongside academic pursuits, extracurricular activities like sports, film screenings, musical showcases, art festivals, debates, in-house University celebrations, sports competitions, and walking events are integrated into the regular curriculum. Within Tripura University's premises thrives a lively campus life, fostering an academic environment that is among the most secure and safest in the entire region.

The Campus sprawls across an expansive picturesque expanse, featuring lakes, woodlands, hillocks, as well as flower and fruit gardens, creating a serene and peaceful setting. The lush tree canopies, the aroma of blossoms, the melodies of bird flocks, the fluttering of butterflies, and even the presence of reptiles collectively provide a respite from academic rigor, offering students a calming and rejuvenating mental space.

## Energy Audit at Tripura University

In a global landscape where governments prioritize policies that boost labor productivity and economic growth through the accumulation of human capital, Tripura University aligns itself with these objectives by fostering knowledge and skills enhancement. This approach not only contributes to the well-being of the nation but also drives substantial gains in GDP. To this end, Tripura University has diligently invested in elevating educational standards, reflecting its commitment to transformative change.

As the university propels forward with cutting-edge research endeavors spanning diverse science and technology disciplines, its growth is accompanied by an inevitable increase in energy consumption and associated impacts. In sync with the vision of the Government of India led by the esteemed Prime Minister Shri Narendra Modi Ji, sustainable practices are emphasized across sectors. This resonates harmoniously with the mission launched by the University Grants Commission (UGC), mandating an "Environmental Consciousness" criterion (Criterion VII) for the grading of educational institutions.

In the current era of sustainable development, Tripura University embraces the ethos of responsible resource utilization and environmental stewardship, where energy efficiency emerges as an indispensable element of campus management. Energy auditing constitutes the systematic assessment of practices to ascertain their efficiency, identify wastages, and explore optimization opportunities. By analyzing energy consumption patterns, identifying inefficiencies, and recommending energy-saving measures, the university aims to minimize its carbon footprint and contribute to broader environmental goals.

Tripura University is resolutely committed to responsible resource stewardship and endeavors to lead by example in the realm of sustainable academic practices. Embracing the sustainability objectives set by the Government of India, the university undertakes to monitor the energy efficiency of its research and educational mission through the diligent efforts of the Energy Audit Committee.

The policy goals of the Tripura University Energy Audit are:

### **Identifying Strengths and Improvement Areas:**

Our policy aims to conduct a comprehensive energy audit, assessing sustainable operations within administrative, academic, and research laboratories. Through gap analysis, we will pinpoint strengths and areas needing enhancement. Subsequently, actionable strategies will be outlined to advance our sustainability objectives.

### **Promoting Environmental Awareness:**

We are committed to fostering a culture of environmental awareness across our campus. By engaging all stakeholders, including students, faculty, staff, and administration, we intend to inspire and motivate responsible and optimized use of available resources, thereby minimizing our ecological impact.

### **Proactive Environmental Management:**

Our policy underscores the importance of proactive environmental management. By collecting baseline data on key environmental parameters, we will identify potential issues in advance and address them before they escalate. This approach ensures a sustainable and ecologically balanced campus environment.

Through these policy goals, Tripura University demonstrates its dedication to efficient resource utilization, environmental consciousness, and proactive resolution of environmental concerns through the implementation of energy audits.

To attain the previously mentioned objectives, the Energy Audit Committee of Tripura University is committed to the subsequent aims:

- ❖ Identifying current and emerging energy-related issues.
- ❖ Monitoring energy management practices.
- ❖ Evaluating existing practices that could impact energy consumption.
- ❖ Promoting awareness among the University's stakeholders.
- ❖ Compiling an Energy Audit Report detailing energy-efficient practices adopted by different departments, support services, and administrative entities.

### **METHODOLOGY ADOPTED**

The methodology adopted to conduct the Energy Audit of Tripura University had the following components:

#### **Preliminary Assessment:**

- ❖ Gather information about the energy consumption patterns, utility bills, and energy-related data for the university campus.
- ❖ Identify major energy-consuming areas and equipment such as lighting, HVAC systems, electrical appliances, etc.

#### **Onsite Data Collection:**

- ❖ Conduct onsite visits to various buildings and facilities within the campus to assess energy usage.
- ❖ Collect data on equipment specifications, operational hours, and energy consumption for different systems.

## **Enquiries and Stakeholder Interviews:**

- ❖ Conduct interviews and discussions with relevant stakeholders, including facility managers, maintenance staff, and occupants.
- ❖ Gain insights into operational practices, maintenance routines, and potential energy-saving opportunities.

## **Energy Use Analysis:**

- ❖ Analyze the collected data to calculate energy consumption for different equipment and areas.
- ❖ Identify trends, patterns, and anomalies in energy usage.

## **Lighting Systems Analysis:**

- ❖ Evaluate lighting systems to identify lighting technologies.
- ❖ Propose energy-efficient lighting solutions, such as LED replacements.

## **Renewable Energy Potential:**

- ❖ Explore opportunities for integrating renewable energy sources like solar panels, wind turbines, etc., to supplement energy needs.

## **Energy Conservation Measures (ECMs):**

- ❖ Propose energy-saving measures and strategies tailored to the university's specific needs and challenges.
- ❖ Prioritize ECMs based on their potential impact and feasibility.

## **Cost-Benefit Analysis:**

- ❖ Estimate the costs associated with implementing each energy-saving measure.
- ❖ Calculate the potential energy and cost savings over time.
- ❖ Evaluate the return on investment (ROI) for each proposed measure.

## **Report Preparation:**

- ❖ Compile the findings, recommendations, and analyses into a comprehensive energy audit report.
- ❖ Include a detailed breakdown of energy consumption, proposed ECMs, and their expected benefits.

By following this comprehensive energy audit methodology, Tripura University can identify opportunities to reduce energy consumption, lower operational costs, and contribute to a more sustainable campus environment.

### AUDIT STAGE

Tripura University started its Energy audit by assessing and gathering information about the energy consumption patterns, utility bills, energy-related data, energy-consuming areas and equipment, equipment specifications, operational hours, and energy consumption and their management practices, conservation strategies, etc. The members of the audit team recorded the different facilities at the Tripura University campus and their impacts. The staffs, students and other stakeholders were interviewed through structured questionnaires to get details of usage, frequency or general characteristics of different appliances. Data collection was done by onsite visit and also through questionnaires. The data obtained were collated and analyzed to prepare this audit report of Tripura University.

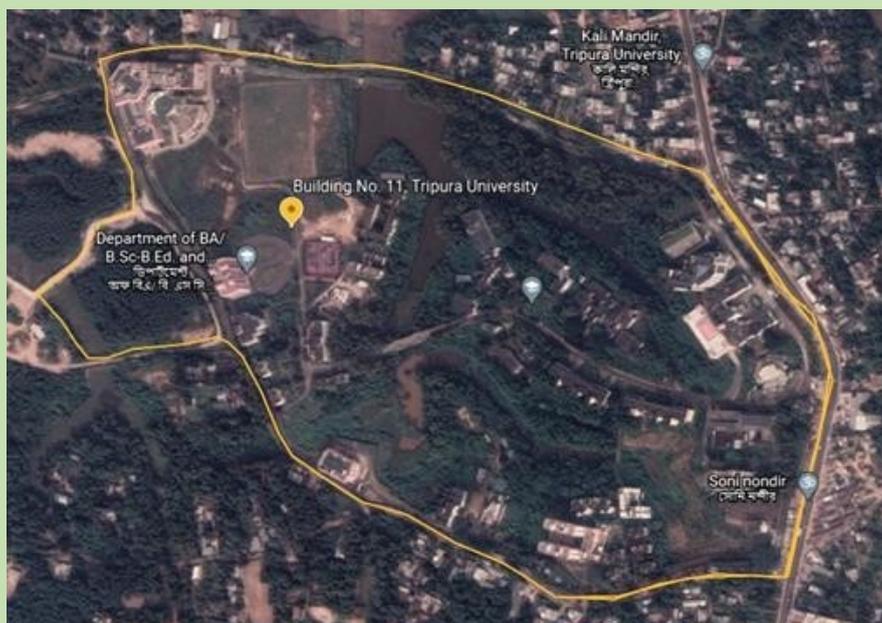
### POST AUDIT STAGE

#### Land use and land cover

The topography of Tripura University campus is undulating with a wetland (lake) towards the centre that drains to the south eastern boundary. The water body is rain fed and has water almost throughout the year. The whole campus is interspersed with scattered trees at few places thus, making it a picturesque landscape suitable for a wide spectrum of flora and fauna. The Academic Departments and residential quarters/hostels have come up over the area which were highlands or in gradually filled lowlands.

The present study revealed that the TU campus has a total of 97 acres of land of which 75 acres existed as a part of the main campus and an additional area of 22 acres was added to the total area during 2015. The TU campus occupies an area of 10.94 acres under orchards, 7.95 acres under wetland (Lake area), 3.75 acres under Botanical garden and Forest Park, 6.43 acres of playground which together constitutes 29.07 acres (29.97%; Fig: 1). Organized plantations in the campus are mainly along the internal roads, around guest House/hostel, residential quarters and in the Botanical garden and Forest Park. The large wetland is a home to a wide diversity of aquatic flora and fauna.

It is found that a total of about 38.74 acres (~39.94% of total) are under the built-up category, of which residential quarters, hostels, academic departments and administrative units form a significant part. The buildings which are coming up in the last few years are multistoried as a part of the initiative of the TU administration for vertical expansion. The campus is dispersed with roads connecting each building and along the boundary of the main area which covered an estimated area of approximately 2.82 Acres and the playgrounds covering an area of nearly 6.43 acres of land.



**Fig 1: The Map of Tripura University campus**

**Table 1: Land use categories in Tripura University Campus**

Sl. No.	Land Use Category	Area (in approx. Acres)
1	Botanical Garden and Forest Park	3.75
2	Wetland (Lake area)	7.95
3	Play ground	6.43
4	Orchards	10.94
5	Road	2.82
6	Foot Path	0.21
7	Pump Station	0.20
8	Protection Wall	0.02
9	Drain	0.46
10	Retaining Wall	0.02
11	Culvert	0.02
12	Building Under Construction	1.03
13	Overhead Tank	0.009
14	Car Parking	1.48
15	Garage	0.15
16	Building	29.17
17	Transformer	0.104
18	Generator	0.05
19	Security House	0.012
20	Water Pump	0.04
21	Septic Tank	0.88
22	Jungle Area	5.51
23	Tin Shed	0.06
24	Power Sub Station	0.25
25	Toilet	0.49
26	Garden	0.25
27	Statue	0.001

### Energy audit

According to Energy Conservation Act, 2001, Energy Audit is the verification, monitoring, and analysis of the use of energy including submission of a technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption.

The Energy and electricity audit aimed to cover the aggregate consumption of Electrical and Natural gas energy within the Tripura University campus including academic and administrative blocks. In different hostels, LPG cylinders are primarily used for cooking purposes and the number of uses was also counted. Domestic LPG connections were not included in the present study. Within the campus, no other fossil fuel like coal-fire or firewood, etc. based energy is used.

All the buildings of the University are designed and constructed in such a way that during day time no electricity is consumed for lighting of tube lights and other electric lights. Proper day light and ventilation facilities are available for every building.

Moreover, Tripura University is taking its initiative to utilize renewable energy has installed roof top solar panels of capacity 600 KWp in 14 buildings to compensate for the necessity of electrical energy within the campus. This has resulted tremendous curtailment in the electricity consumption. Tripura University has saved a substantial amount Rs. 62,57,087/- for the period of almost 2 years i.e., from January, 2019 to November, 2020. In addition to that, all the High Pressure Sodium Vapour lamps (HP-SV) and High Pressure Metal Halide (HP-MH) street lights have been replaced by the energy efficient LED street lights and mushroom head LED lights are installed to reduce the consumption of the electricity under the green initiatives schemes. The total number of energy efficient LED lights is 258 and total savings is Rs. 61,78,791.00 for the period of 3 years 6 months i.e., from May, 2017 to November, 2020. At present, TU has 500 numbers of LED bulbs and LED panels, LED outdoor streetlight as compared to 220 numbers CFL and 280 numbers Halogen bulbs in various academic and administrative blocks. There were 500 numbers of AC (Air Conditioner) and 3500 numbers of Fan installed in the different academic and administrative blocks. On the other hand, on an average 45 worth of natural gas (LPG cylinders) per month has been utilized in the different hostels and guest house within the campus.



Fig 2(a): Use of solar power panels in TU Campus



Fig 2(b): Use of solar power panels in TU Campus

On average, 110000 units per month of electricity were consumed by the University in the year 2020-21 including the residential quarters. In the previous year’s 2018-19 and 2019-20 the average power consumption was 220000 and 110000 units per month (Fig. 3 and Fig. 4). It has also been observed that there is a slight decrease of around 46% in the monthly average electricity consumption during the current year which could be attributed to the installation of solar panels in some specific zones (Fig. 5).

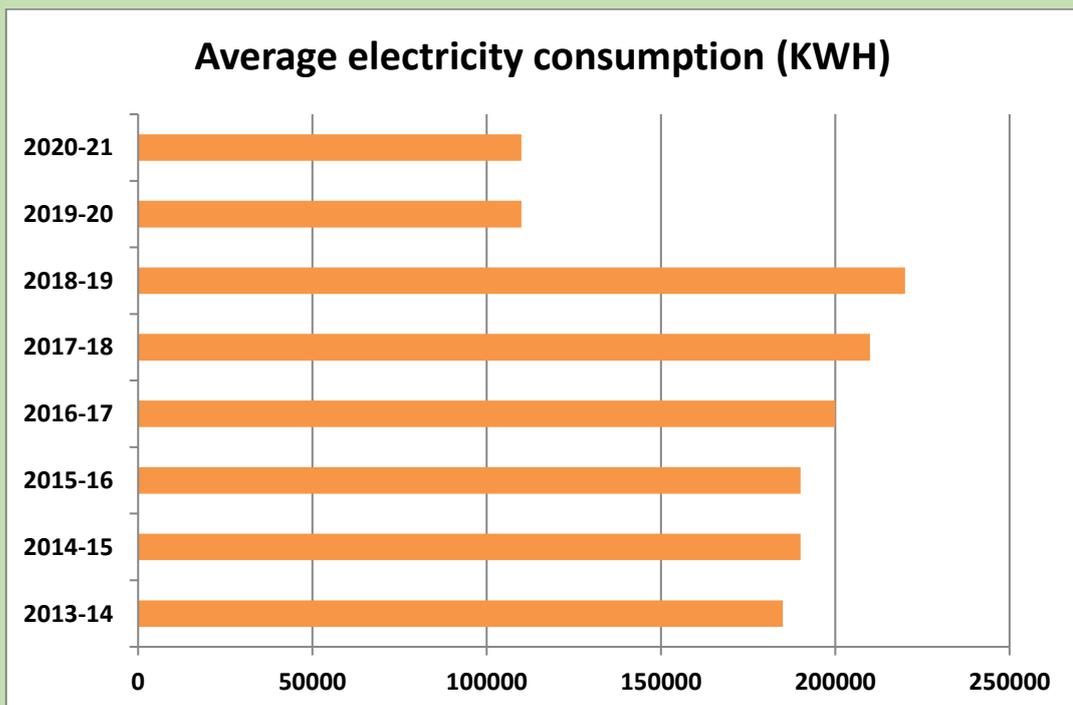


Fig. 3: Average electricity consumption in TU campus from 2013-14 to 2020-21

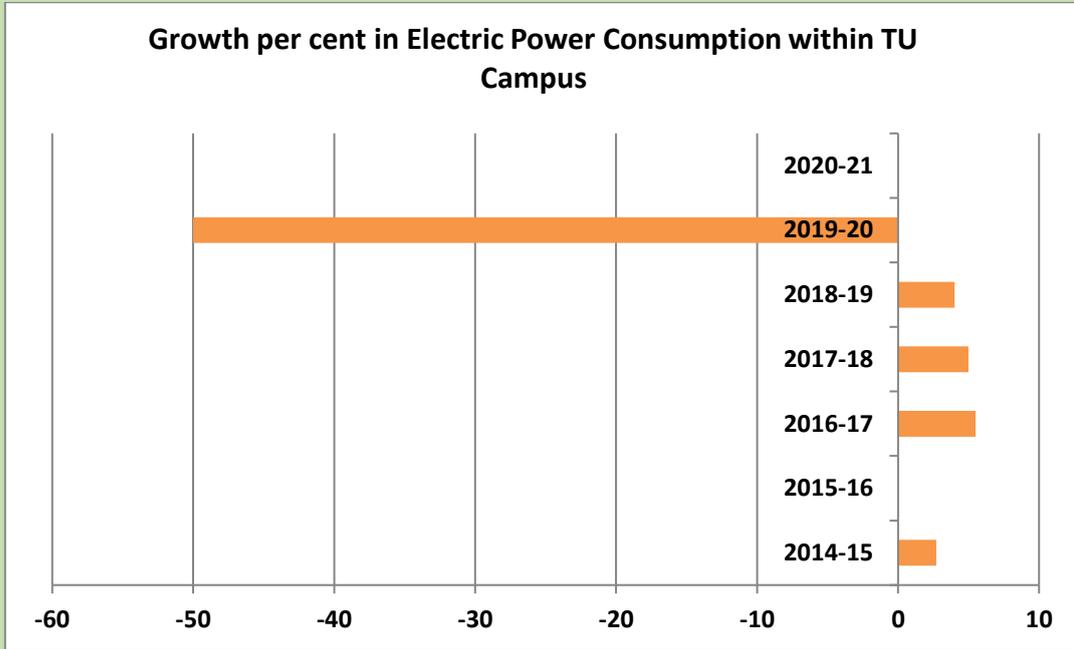


Fig. 4: Percentage growth in Electric Power consumption in TU campus from 2014-15 to 2020-21

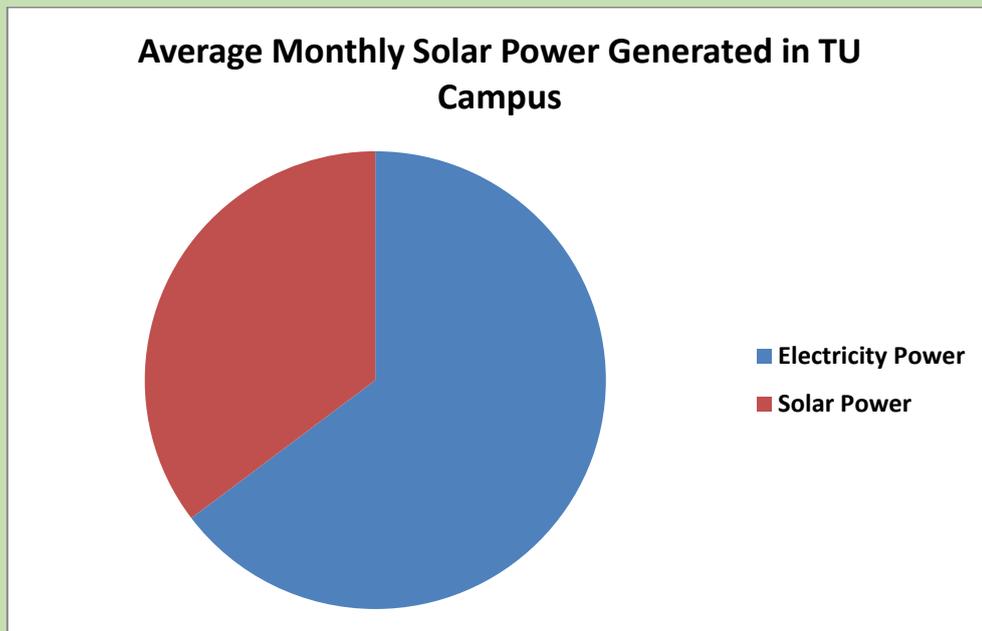


Fig. 5: Monthly Solar power generated within TU campus

### **Observations**

- ❖ Separate Electricity meters were not found in the Hostels, Academic, and Administrative blocks.

### **Suggestions and Recommendations**

- ❖ There should be facility to record energy consumption in every building.
- ❖ Solar power generated roadside poles can be installed.
- ❖ Solar power can be augmented in coming years.
- ❖ Regular Campaigns should be done to switch off of lights and other electric appliances after use.
- ❖ Future plans of construction and activities should be based on the Landscape.

### Summary

Energy auditing is the systematic process of assessing and determining the energy efficiency practices of an institution, aimed at optimizing energy consumption and sustainability. In alignment with this objective, Tripura University conducted its annual "Energy Audit" for the fiscal year 2020-2021. The primary aim of this audit was to compile a comprehensive account of the energy practices embraced by the university and to present a meticulously formulated energy audit report.

The energy audit encompassed a multifaceted evaluation, commencing with an analysis of various factors including energy consumption patterns, energy conservation strategies, and the efficiency of energy-related utilities within the university premises. The audit team meticulously scrutinized diverse facilities across the campus, identifying a spectrum of appliances and utilities such as lighting fixtures, water coolers, faucets, restrooms, fans, air conditioning units, and more. The evaluation involved quantifying energy usage for each item (in terms of indicated appliance wattage or water flow rates) and discerning the associated consumption trends, such as frequency of appliance usage, and their consequential impacts. To bolster the data collection process, faculty members and students were engaged in providing insights into appliance usage frequencies and general characteristics. The data acquisition was a combination of on-site visits and direct measurements. The assimilated data was meticulously collated, subjected to rigorous analysis, and subsequently forms the foundation of this comprehensive energy audit report for Tripura University.

An exceptional feature of the university's infrastructure is that all its buildings are meticulously designed and constructed to minimize electricity consumption during daylight hours. This design strategy is realized through the ample provision of daylight and ventilation, eliminating the need for electric lighting during daytime hours. Notably, Tripura University has taken commendable strides toward harnessing renewable energy sources. The installation of rooftop solar panels with a collective capacity of 600 KWp across 14 buildings is a testament to this commitment, effectively offsetting a substantial portion of the campus's electricity demands. This strategic implementation has yielded remarkable outcomes, leading to a noteworthy reduction in electricity consumption. Over a span of nearly two years, from January 2019 to November 2020, the university achieved substantial savings amounting to Rs. 62,57,087/-. In the fiscal year 2020-21, including residential quarters, the university consumed an average of 110,000 units of electricity per month. However, it was observed that separate electricity meters were not ubiquitously present across all buildings, including the hostels, academic blocks, and administrative buildings. To enhance energy management, it is recommended to ensure the provision of energy consumption recording facilities in all university buildings. Moreover additional solar power can be generated to augment in the coming years like roadside solar poles can be installed. In addition to installing renewable sources, regular Campaigns should be done to switch off of lights and other electric appliances after use.





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