ENERGY AUDIT REPORT
OF
ASSAM DON BOSCO UNIVERSITY CAMPUSES AT TAPESIA, AZARA AND KHARGHULI

ASSAM DON BOSCO UNIVERSITY

2019-20

Preface

Energy Audit of the campuses of Assam Don Bosco University started as an initiative of the department of Electrical and Electronics Engineering of the School of Technology. However, a more formal survey was done during the 2019-20 academic year, after a recommendation by the IQAC for an internal audit and a notification issued from the office of the Vice-Chancellor about that. Formal data collection from the campuses was carried out by the team during September-November 2020.

This formal internal energy audit was conducted to seek opportunities to improve the energy efficiency of the campus, reduce energy consumption while maintaining or improving human comfort, health and safety-related aspects. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy-efficient appliances. Moreover, some daily practices relating to common appliances have been identified which may help reduce energy consumption.

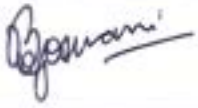
The report accounts for the energy consumption patterns of the academic area, central facilities and residential buildings based on actual surveys and detailed analysis during the audit. The work encompasses the area-wise consumption traced using suitable equipment. The report also compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potentials were also identified.

The report is based on certain generalizations and approximations wherever necessary. The views expressed may not reflect the general opinion. They merely represent the opinion of the team guided by the interviews of different stakeholders of the University.

Energy Audit Team
Assam Don Bosco University
December 2020

Committee for Energy Audit of Assam Don Bosco University

The following committee has been involved in planning, mentoring, surveying, analysing, report preparing and recommending the necessary changes related to the Energy Audit of Assam Don Bosco University campuses in 2019-20.

Committee Designation	Name, Designation and Institution	Signature
External Expert	Prof. Durlav Hazarika, Department of Electrical Engineering, Assam Engineering College, Guwahati	
Advisor and Expert	Prof. Shakuntala Laskar, HoD, Department of EEE, Assam Don Bosco University	
Team Leader	Dr. Bikramjit Goswami, Assistant Professor, Department of EEE, Assam Don Bosco University	
Members	Dr. Papul Changmai, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Hironmay Deb, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Gitu Das, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Pushpanjalee Konwar, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Smriti Dey, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Sunil Deka, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Jesif Ahmed, Assistant Professor, Department of EEE, Assam Don Bosco University	
	Jyoti Kumar Barman, Assistant Professor, Department of EEE, Assam Don Bosco University	

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Part- A

Objectives and Methodology

Energy Audit

As per the Bureau of Energy Efficiency, Energy Audit is the 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. It quantifies energy usage according to its discrete functions.

Objective

In any institution, the energy consumption is found to be one of the top most cost involving aspect. It is also observed that often Energy has the highest potential for cost reduction. The primary objective of conducting regular Energy Audit at Assam Don Bosco University is to understand more about the ways energy is used in the University, and help in identifying the areas where waste can occur and where scope for improvement exists. Such audit programmes help reviewing variations in energy costs, availability and reliability of supply of energy, decide on appropriate energy usage, identify energy conservation technologies, retrofit for energy conservation etc.

Committee for Energy Audit

The committee constituted for Energy Audit of the University comprises of members from the School of Technology as detailed in the following table.

Committee for Energy Audit at Assam Don Bosco University

<table>
<tr><th colspan="2">Team Members and Coordinators</th><th>Assisted by</th><th>Campus audited</th></tr>
<tr><td>Advisor and Expert</td><td>Prof Shakuntala Laskar, HoD, Department of EEE</td><td rowspan="3">IQAC Office Members</td><td rowspan="3">All the Campuses</td></tr>
<tr><td>External Expert</td><td>Prof Durlav Hazarika
Department of Electrical Engineering
Assam Engineering College</td></tr>
<tr><td>Team Leader</td><td>Dr Bikramjit Goswami, Coordinator, IQAC</td></tr>
<tr><td rowspan="10">Members</td><td>Dr Papul Changmai (Coordinator), Assistant Professor</td><td rowspan="3">Nitumoni Bora, Laboratory Staff</td><td rowspan="3">Azara Campus</td></tr>
<tr><td>Pushpanjalee Konwar, Assistant Professor</td></tr>
<tr><td>Smriti Dey, Assistant Professor</td></tr>
<tr><td>Gitu Das (Coordinator), Assistant Professor</td><td rowspan="3">Sushil Kr Minj, Laboratory Staff</td><td rowspan="3">Tapesia Campus</td></tr>
<tr><td>Sunil Deka, Assistant Professor</td></tr>
<tr><td>Jesif Ahmed, Assistant Professor</td></tr>
<tr><td>Hironmay Deb (Coordinator), Assistant Professor</td><td rowspan="2">Nomal Ch Nath, Laboratory Staff</td><td rowspan="2">Kharghuli Campus</td></tr>
<tr><td>Jyoti Kumar Barman, Assistant Professor</td></tr>
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Methodology followed

The methodology followed for performing Energy Audit of the University Campuses comprises of the following steps.

1. Walk through survey of the campus for first hand collection of data regarding all energy consuming devices/equipment.
2. First hand observation and assessment of current level of operation and practices regarding all energy consuming devices/equipment in the University.
3. Overall load survey.
4. Historic data collection and analysis for setting up Baseline energy consumption.
5. Gathering schedule of operation of all energy consuming devices/equipment/load.
6. Analysis of energy consumption pattern.
7. Load variation trend analysis and equipment performance tests.
8. Energy loss/waste analysis.
9. Assessment of technical feasibility, economic viability and prioritization of Energy Conservation options for implementation.
10. Documentation, report preparation and presentation.

Part- B

Energy Audit Report of the Campuses of Assam Don Bosco University

This part of the report presents the energy audit reports of the three campuses of the University. The reports are presented in 3 sections as-

Section 1: Tapesia Campus

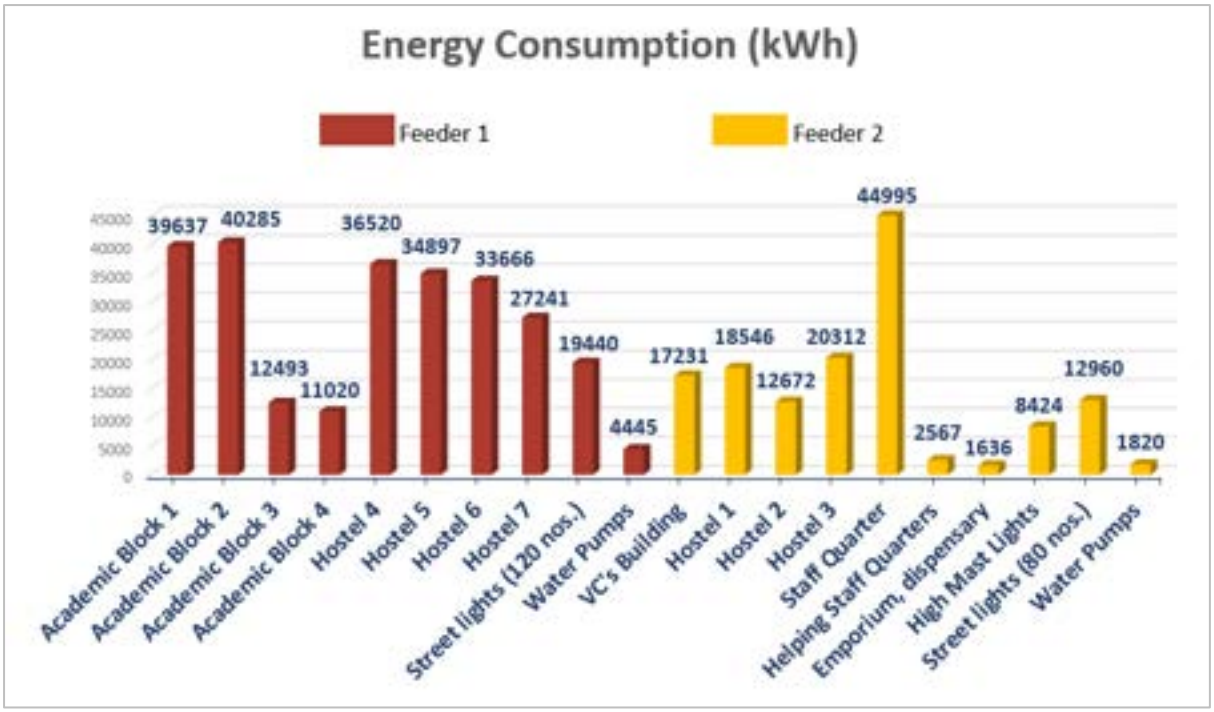
Section 2: Azara Campus

Section 3: Kharghuli Campus

Section 1: Energy Audit Report of Assam Don Bosco University, Tapesia Campus

1.1 Overall Campus Energy Consumption of the buildings

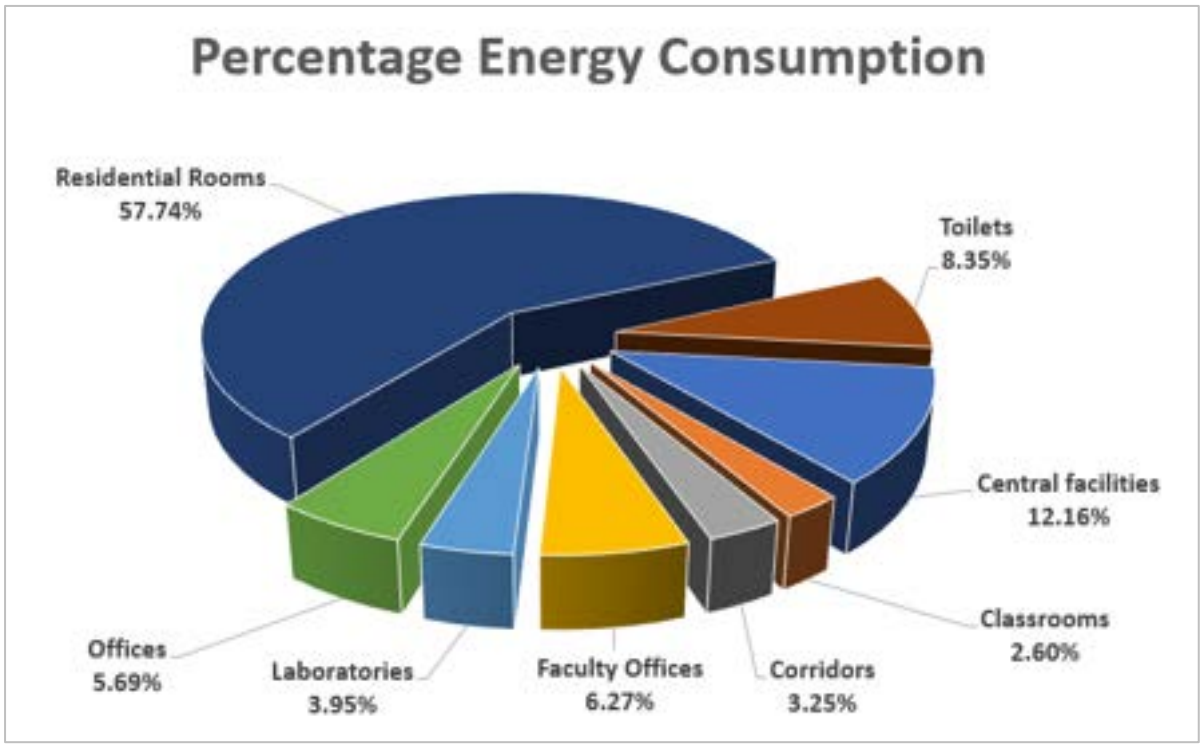
There are 7 hostels, 4 academic buildings, 1 emporium and dispensary, and quarters for the staff in the campus. Overall energy consumption of the campus is shown in the graph below. From the audit conducted for the year 2020 the staff quarters are the highest power consuming units followed by the academic building 2 and 1.



Location	Energy Consumption (kWh)
Feeder 1	
Academic Block 1	39637
Academic Block 2	40285
Academic Block 3	12493
Academic Block 4	11020
Hostel 4	36520
Hostel 5	34897
Hostel 6	33666
Hostel 7	27241
Street lights (120 nos.)	19440
Water Pumps	4445
Feeder 2	
VC's Building	17231
Hostel 1	18546
Hostel 2	12672
Hostel 3	20312
Staff Quarter	44995
Helping Staff Quarters	2567
Emporium, dispensary	1636
High Mast Lights	8424
Street lights (80 nos.)	12960
Water Pumps	1820
TOTAL (FOR YEAR 2020)	400807

1.2 Location wise consumption of energy

The location wise distribution of power consumption in the campus has been shown in the following chart:

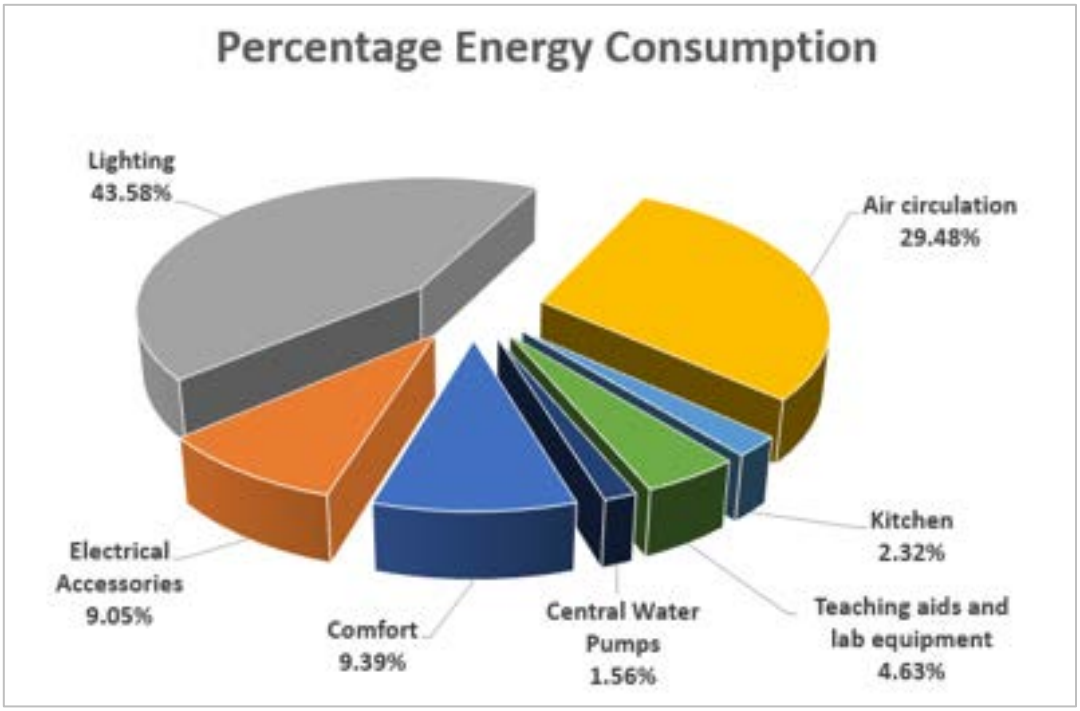


As the chart suggests the major portion of energy is consumed in the residential quarters of the staff and helpers. Due to the absence of students in the campus for the major portion of the year power consumption in the laboratories are only due to usage of the refrigerators and some other equipment which could not be kept off.

Locations	Energy Consumption (kWh)	Percentage energy consumption (%)
Central facilities	48725	12.16 %
Classrooms	10411	2.60 %
Corridors	13015	3.25 %
Faculty Offices	25124	6.27 %
Laboratories	15831	3.95 %
Offices	22805	5.69 %
Residential Rooms	231416	57.74 %
Toilets	33480	8.35 %
TOTAL (FOR YEAR 2020)	400807	

1.3 Application Wise Energy Consumption

Application wise energy consumption is shown in the chart below.

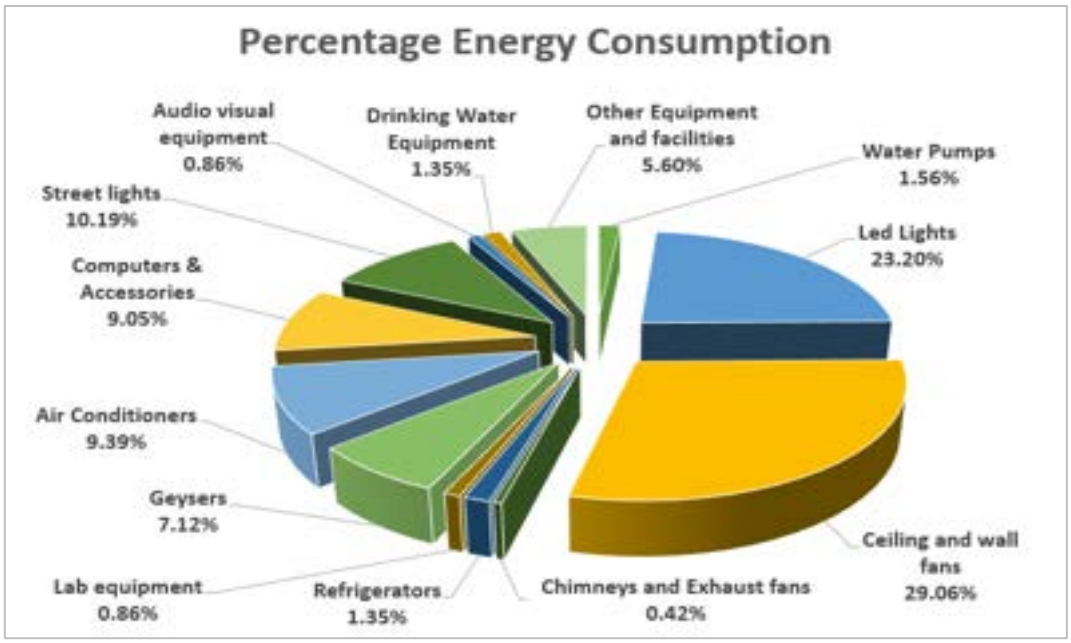


As seen from the chart a major portion of the energy is used for lighting. Air circulation consumes the next highest consumption. A significant portion of power is also consumed for comfort which includes Air conditioners and Geysers.

Application	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Comfort	37627	9.39 %
Electrical Accessories	36266	9.05 %
Lighting	174655	43.58 %
Air circulation	118168	29.48 %
Kitchen	9279	2.32 %
Teaching aids and lab equipment	18547	4.63 %
Central Water Pumps	6265	1.56 %
TOTAL (FOR YEAR 2020)	400807	

1.4 Equipment wise energy consumption

Equipment wise analysis has been performed in order to identify the equipment, within same application area, which consume more power as compared to others. During equipment wise analysis of the overall campus, the equipment with power consumption less than 1% of total power consumption of the campus were also considered so as to make a detailed analysis. Following chart summarizes the results of equipment wise analysis of power consumption of the overall campus:



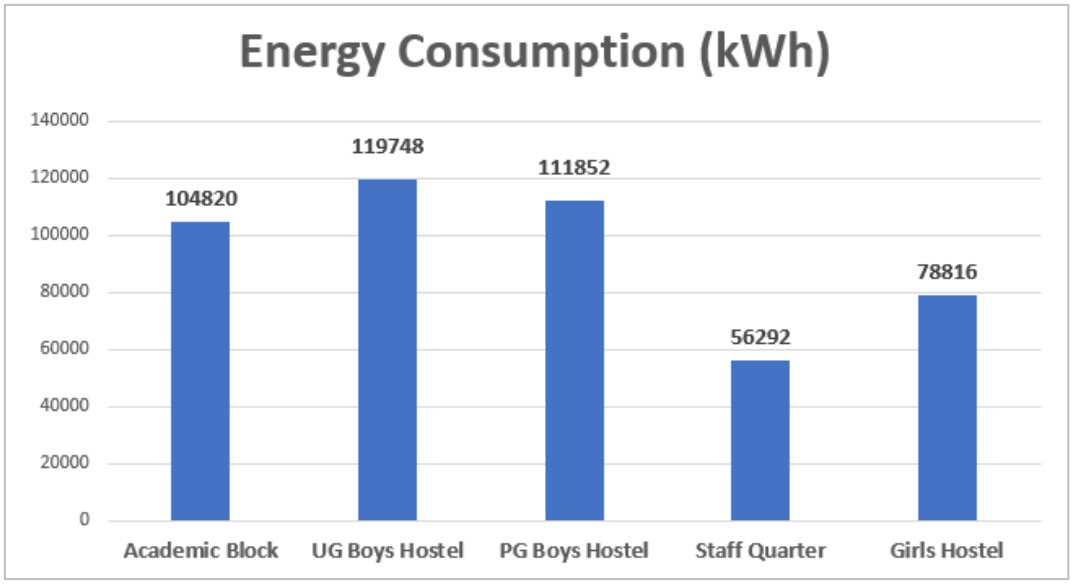
Highest energy is consumed by the ceiling fans and the wall fans followed by the Led Lights. Air conditioners also draws a considerable portion of the energy share.

Equipment	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Water Pumps	6265	1.56 %
Led Lights	93007	23.20 %
Ceiling and wall fans	116466	29.06 %
Chimneys and Exhaust fans	1702	0.42 %
Refrigerators	5417	1.35 %
Lab equipment	3429	0.86 %
Geysers	28520	7.12 %
Air Conditioners	37627	9.39 %
Computers & Accessories	36266	9.05 %
Street lights	40824	10.19 %
Audio visual equipment	3429	0.86 %
Drinking Water Equipment	5418	1.35 %
Other Equipment and facilities	22437	5.60 %
TOTAL (FOR YEAR 2020)	400807	

Section 2: Energy Audit Report of Assam Don Bosco University, Azara Campus

2.1 Overall Campus Energy Consumption of the buildings

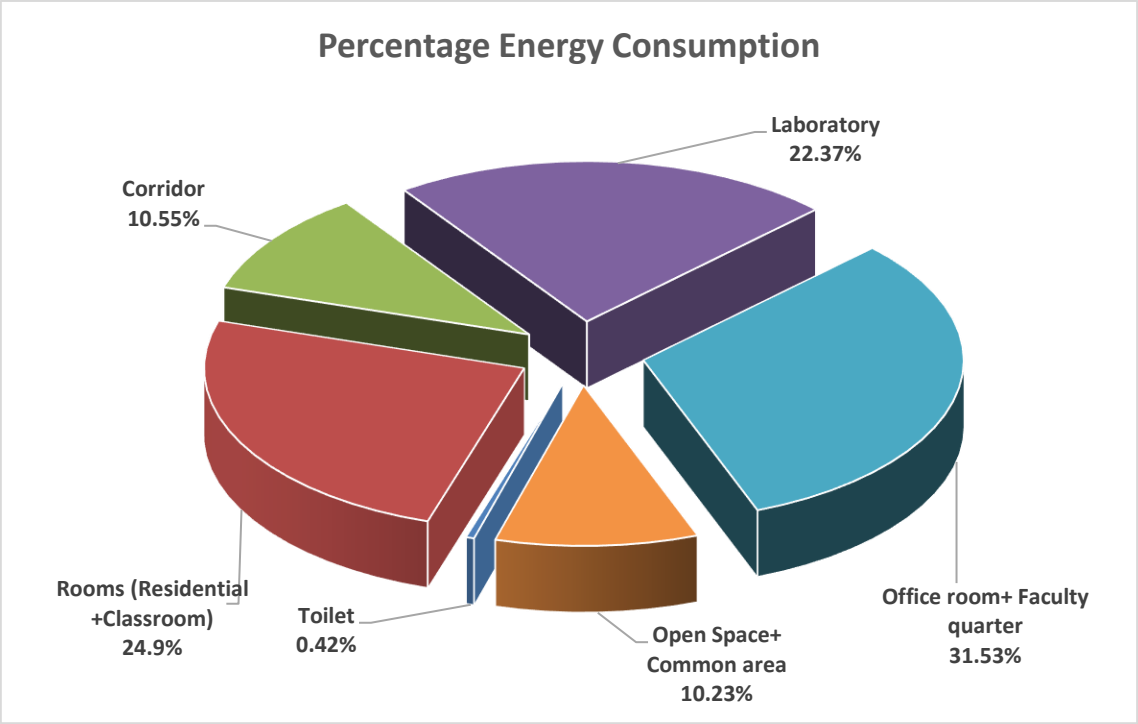
There are 3 hostels, 1 academic complex and 1 staff quarter in the campus. Overall energy consumption of the campus is shown in the graph below. From the audit conducted for the year 2020 the UG Boys hostel are the highest power consuming units followed by the PG Boys hostel and Academic Block.



Location	Energy Consumption (kWh)
Academic Block	104820
UG Boys Hostel	119748
PG Boys Hostel	111852
Staff Quarter	56292
Girls Hostel	78816
TOTAL (FOR YEAR 2020)	471528

2.2 Location wise consumption of energy

The location wise distribution of power consumption in the campus has been shown in the following chart:

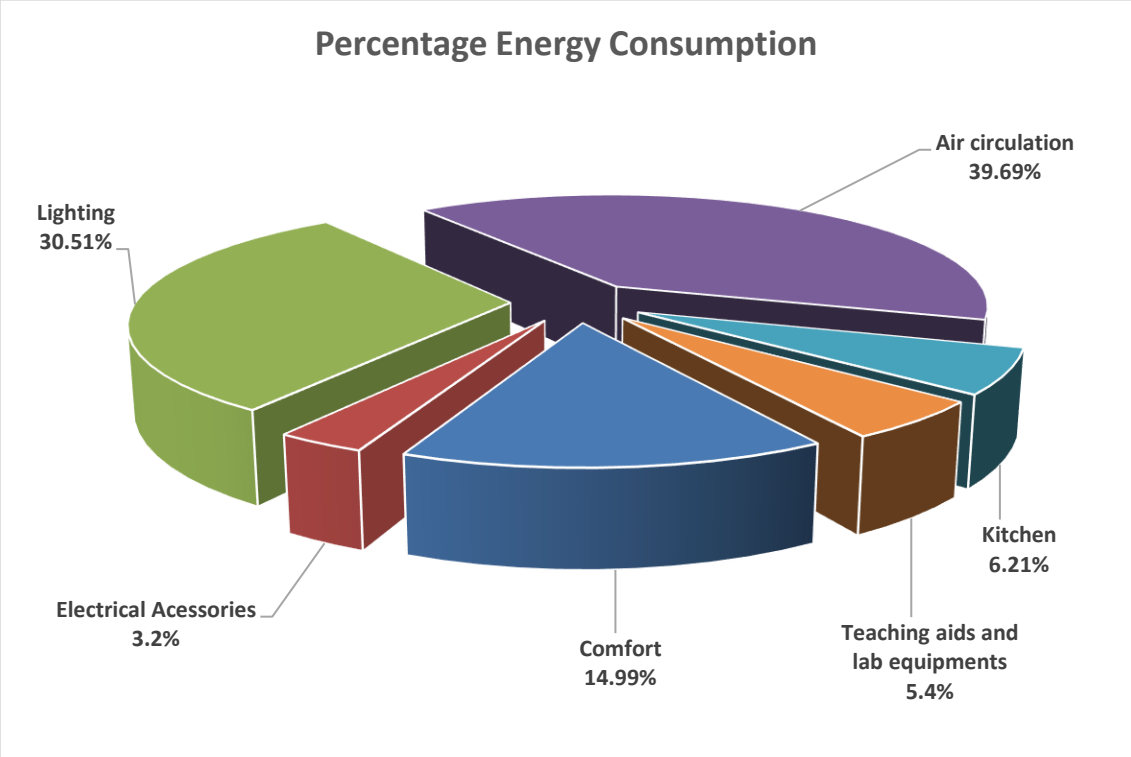


As the chart suggests the major portion of energy is consumed in the office rooms and residential quarters of the staff and helpers. Due to the absence of students in the campus for the major portion of the year power consumption in the laboratories are only due to usage of the refrigerators and some other equipment which could not be kept off.

Locations	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Toilet	1980	0.42 %
Rooms (Residential + Classroom)	117403.24	24.90 %
Corridor	49764	10.55 %
Laboratory	105472.76	22.37 %
Office room+ Faculty quarter	148656	31.53 %
Open Space+ Common area	48252	10.23 %
TOTAL (FOR YEAR 2020)	471528	

2.3 Application Wise Energy Consumption

Application wise energy consumption is shown in the chart below.

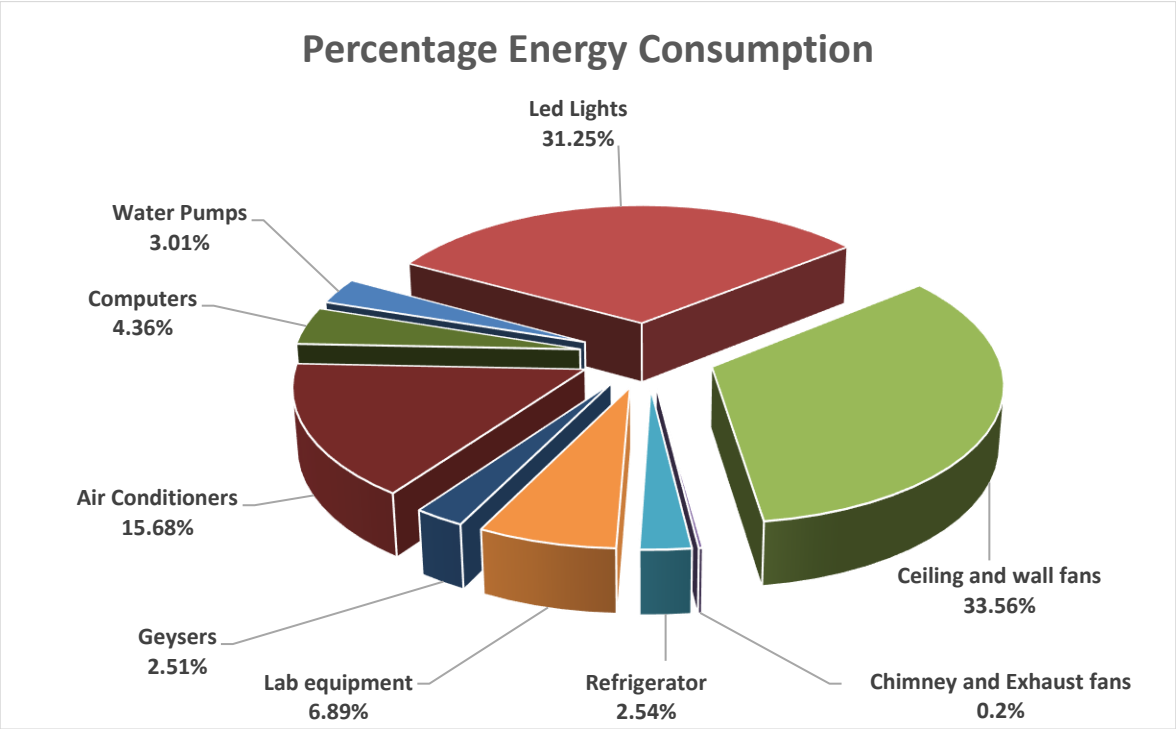


From the Pi chart a major portion of the energy is used for air circulation. Lighting consumes the next highest consumption. A significant portion of power is also consumed for comfort which includes Air conditioners and Geysers.

Application	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Comfort	70682.05	14.99 %
Electrical Accessories	15088.90	3.2 %
Lighting	143863.19	30.51 %
Air circulation	187149.46	39.69 %
Kitchen	29281.89	6.21 %
Teaching aids and lab equipment	25462.51	5.4 %
TOTAL (FOR YEAR 2020)	471528	

2.4 Equipment wise energy consumption

Equipment wise analysis has been performed in order to identify the equipment, within same application area, which consume more power as compared to others. Following chart summarizes the results of equipment wise analysis of power consumption of the overall campus:



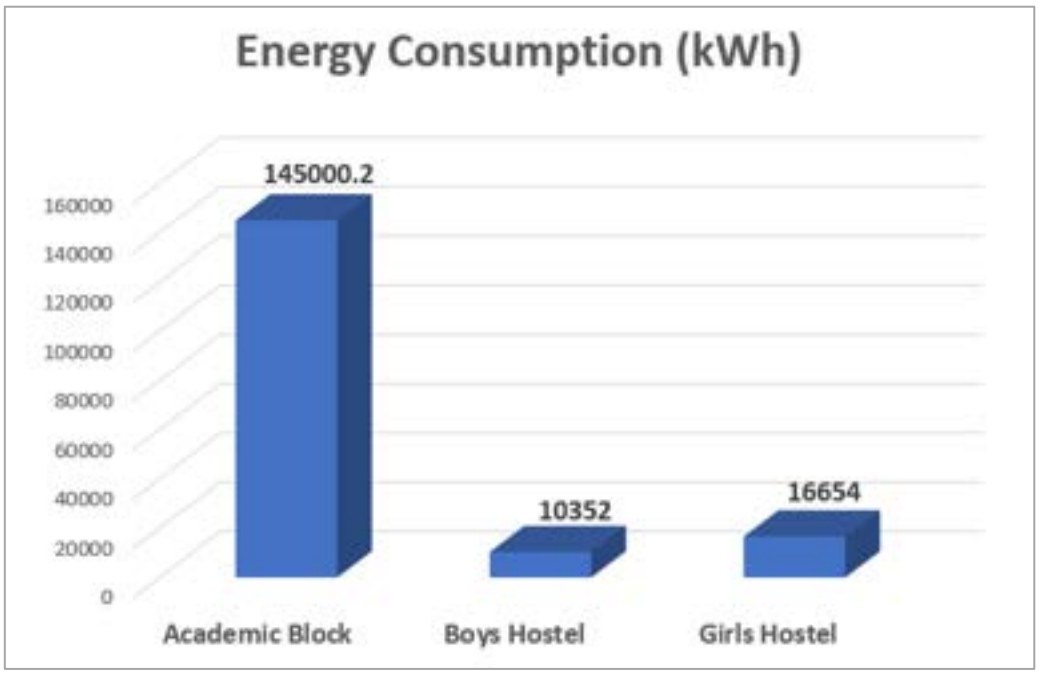
Highest energy is consumed by the ceiling fans and the wall fans followed by the Led Lights. Air conditioners also draws a considerable portion of the energy share.

Equipment	Energy Consumption (KWh)	Percentage Energy Consumption (%)
Water Pumps	14192.99	3.01 %
Led Lights	147352.50	31.25 %
Ceiling and wall fans	158244.80	33.56 %
Chimney and Exhaust fans	943.06	0.2 %
Refrigerator	11976.81	2.54 %
Lab equipment	32488.28	6.89 %
Geysers	11835.35	2.51 %
Air Conditioners	73935.59	15.68 %
Computers	20558.62	4.36 %
TOTAL (FOR YEAR 2020)	471528	

Section 3: Energy Audit Report of Assam Don Bosco University, Kharghuli Campus

3.1 Overall Campus Energy Consumption of the buildings

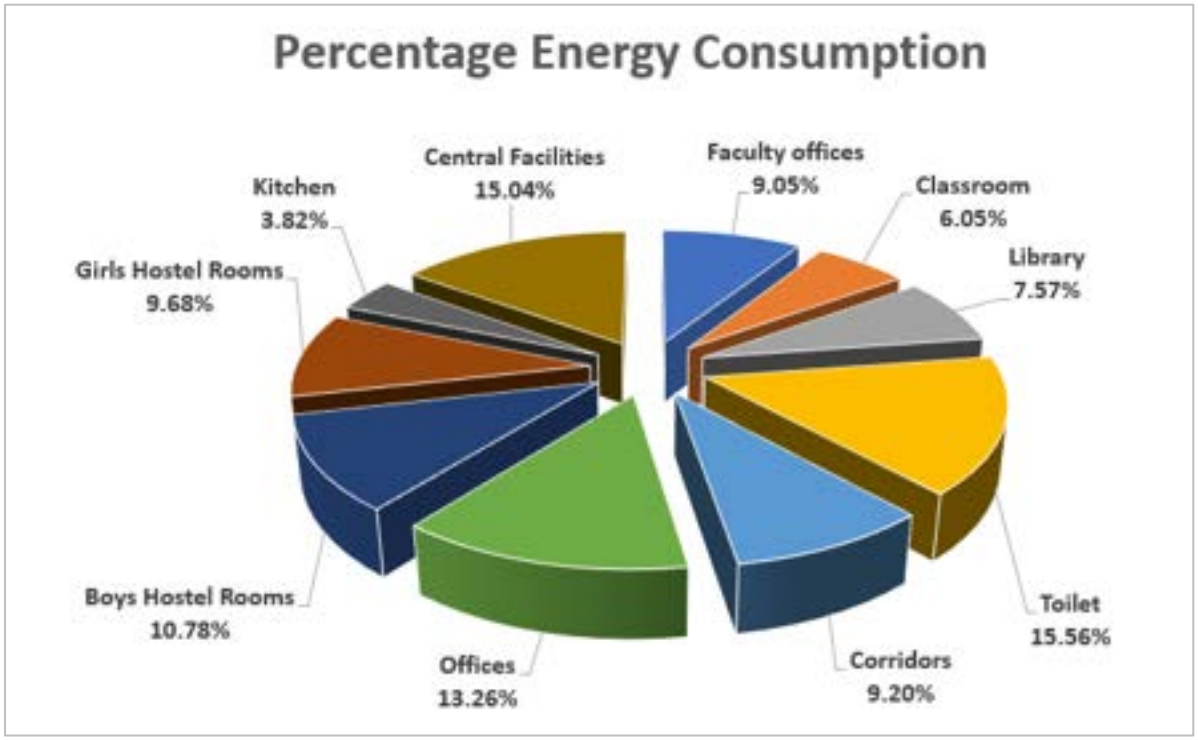
There is one academic block, one boys' hostel and one girls' hostel in the campus. Overall energy consumption of the campus is shown in the graph below. From the audit conducted for the year 2020 the academic block consumes the highest energy.



Location	Energy Consumption (kWh)
Academic block	145000.2
Boys Hostel (SAVIO NIWAS)	10352
Girls Hostel (VACCHI NIWAS)	16654
TOTAL (FOR YEAR 2020)	172006.2

3.2 Location wise consumption of energy

The location wise distribution of power consumption in the campus has been shown in the following chart:

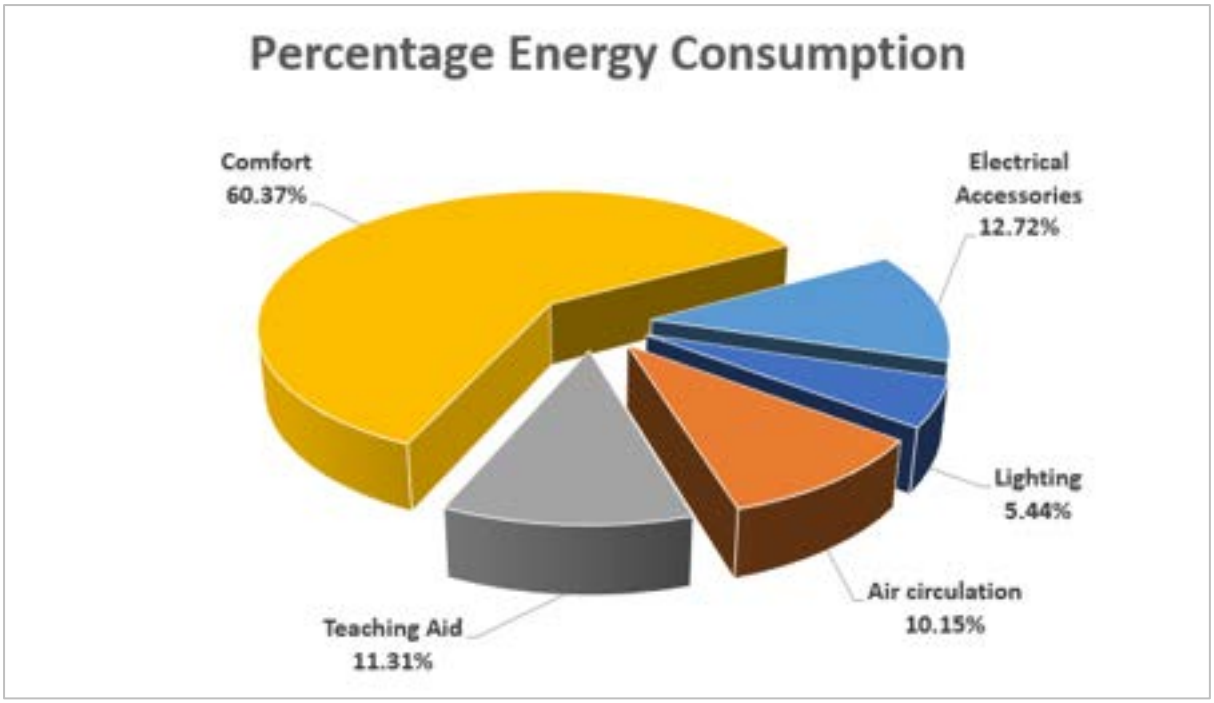


As the chart suggests the major portion of energy is consumed in the office rooms and classrooms. Library and central facilities also consume considerate amount of energy.

Locations	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Faculty offices	15563	9.05 %
Classroom	10411	6.05 %
Library	13015	7.57 %
Toilet	26762	15.56 %
Corridors	15831	9.20 %
Offices	22805	13.26 %
Boys Hostel Rooms	18537.4	10.78 %
Girls Hostel Rooms	16654	9.68 %
Kitchen	6566.4	3.82 %
Central Facilities	25861.4	15.04 %
TOTAL FOR YEAR 2020	172006.2	

3.3 Application Wise Energy Consumption

Application wise energy consumption is shown in the chart below.



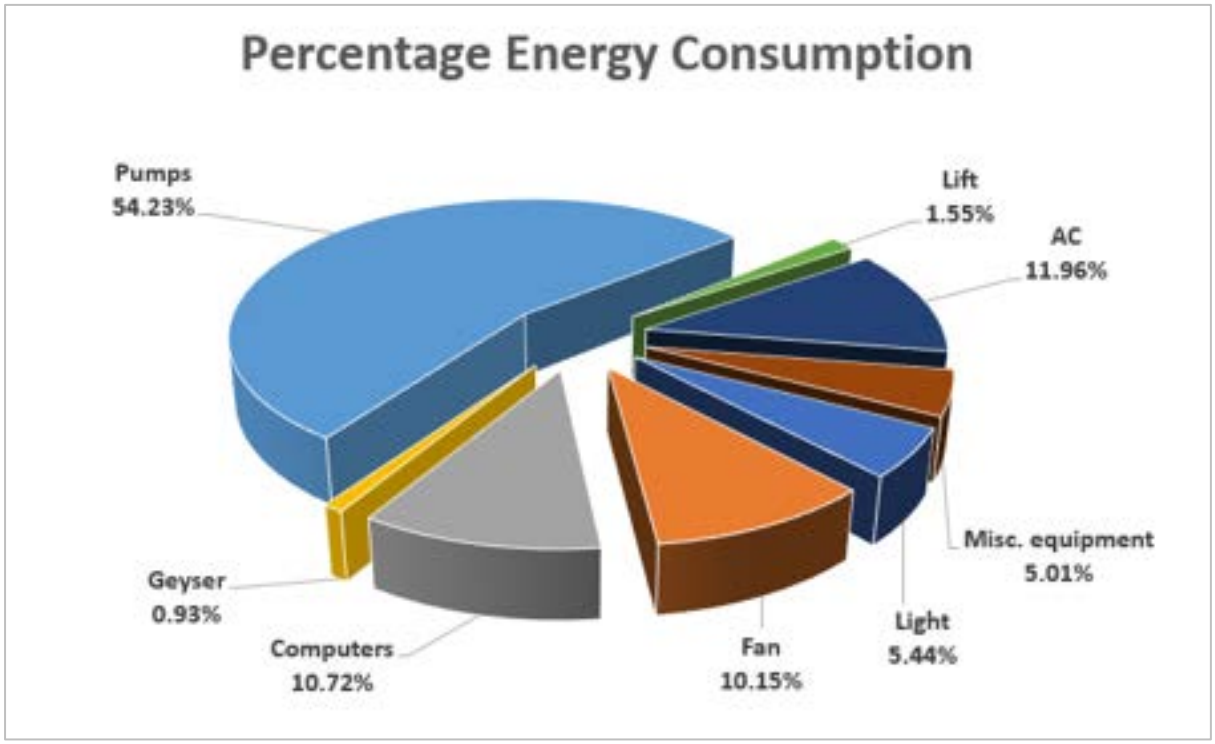
As seen from the chart a major portion of the energy is used for comfort which includes Air conditioners and Geysers. A significant portion of power is also consumed in electrical accessories and air circulation.

Application	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Lighting	9364.66	5.44 %
Air circulation	17452.18	10.15 %
Teaching Aid	19454	11.31 %
Comfort	103848	60.37 %
Electrical Accessories	21887.36	12.72 %
TOTAL (FOR YEAR 2020)	172006.2	

3.4 Equipment wise energy consumption

Equipment wise analysis has been performed in order to identify the equipment, within same application area, which consume more power as compared to others. During equipment wise analysis of the overall campus, the equipment with power consumption less than 1% of total power consumption of the campus were ignored so as to make the analysis results simple and

easy to observe. Following chart summarizes the results of equipment wise analysis of power consumption of the overall campus:



Highest energy is consumed by the pumps, computers and fans followed by the Led Lights.

Equipment	Energy Consumption (kWh)	Percentage Energy Consumption (%)
Light	9364.66	5.44%
Fan	17452.18	10.15%
Computers	18446.4	10.72%
Geyser	1602	0.93%
Pumps	93279	54.23%
Lift	2672	1.55%
AC	20568	11.96%
Misc. equipment	8621.96	5.01%
TOTAL (FOR YEAR 2020)	172006.2	

Part C

Recommendations for Energy Savings

Based on the analysis of the power consumption data of all the three campuses of the University, certain steps have been recommended for improving energy efficiency of the campuses.

1. Replacing Geysers by Solar Water Heating System:
   Geyser is the device with highest non-efficient energy consumption in the residential buildings in the University. It is the appliance where maximum power is wasted while utilising it. Heating water by electricity is the most inefficient way. Alternatively, heating water for bathing can be accomplished by Solar Water Heating System (SWHS).

   Cost analysis of replacing conventional geysers by SWHS-

   - Cost of a domestic SWHS = Rs. 20,000
   - Capacity of the SWHS = 100 litre
   - Average capacity of geyser = 50 litre
   - Number of geysers one SWHS can be used to replace = 2
   - Average power of geysers = 2 kW
   - Average use per year = 250 hr
   - Energy saved per year by replacing geysers by SWHS = 2 x 2 x 250 = 1000 kWh
   - Saving in Rs. Per year = 1000 x 8 = Rs. 8,000
   - Capital Cost Recovery Time= (20,000) / (8000) = 2.5 year

   Hence, the capital cost recovery time for replacing geysers by SWHS is 2.5 years. So, the replacement of domestic geysers with SWHS will help in increasing the energy efficiency and reducing the cost of bathing water.

2. Use of Motion Sensors in Corridors and Toilets:
   Corridors and toilets have large potential of saving energy by use of automation tools. Motion sensors can be used in those areas to automatically switch on the light when there is any movement of people and switch off the light when there is no movement. This can greatly reduce the total load in corridors and toilets, as the switches for lighting in those areas are often left ON even when there is nobody present there.

Cost analysis of installing motion sensors in a typical corridor-

- Average number of lights in a corridor = 5
- Average power of the lights = 9 W
- Average number of motion sensors required = 3
- Average reduction in usage per day by motion sensor = 5 hr
- Total energy saved in corridor per year = (5 x 9 x 5 x 365)/1000 = 82 kWh
- Saving in Rs. per year = 82x8 = Rs. 656
- Cost of installation of motion sensor = Rs. 300
- Total cost of installation of motion sensor in a corridor = 3 x 300 = Rs. 900
- Capital Cost Recovery Time = (900/656) = 1.37 year

Hence, the capital cost recovery time for installing motion sensors in corridors is 1.37 years. Toilets also have comparable capital cost recovery time. Therefore, this is a highly recommended step to largely reduce the consumption of power in the corridors and toilets.

3. Better Practices for AC:

The Azara Campus of the University has a total of 30 ACs of split type, Kharghuli campus has 66 ACs of split type and 4 Central ACs, Tapesia campus has 53 ACs of split type, which make a very large part of total energy consumption of the campuses. But, at many places it was found that AC is not used with best recommended practices, such as insulation, are not taken care of. Also, at certain places ACs were found to be used without keeping curtains. These poor practices account for increase in AC load and thus consumption.

Summarized below are some guidelines for most efficient use of ACs:

- Proper Insulation – Good quality insulation must be maintained in the air-conditioned rooms by keeping all doors and windows closed properly so as to prevent cool air go out and hot air come in.
- Curtains – Curtains should always be kept on windows to prevent direct sunlight inside the room to avoid heating of cooled air. This reduces AC load significantly.
- Maintenance – Proper maintenance and cleaning of ACs is required at regular intervals to make it work at highest efficiency. Any dirt in filter may reduce efficiency of ACs very significantly.
- Operation – The ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room.

4. Use of Master Switch outside each Room:
   Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.