ENERGY AUDIT REPORT

2020-2021

Shanti Education Society's

A.G. Patil Institute of Technology, Solapur

This Report has been prepared by:

***Co-ordinator*: -** **1) Prof. M. M. Chakole**

2) Prof. R. S. Wale

With the support and co-operation of the following staff and supporting staff of the various departments of the institute.

1. Prof. Bhaganagare R. M. (General Science Dept.)
2. Prof. Gajul S. V. (Computer Science Engg. Dept.)
3. Prof. Katke S.P. (Electronics & Telecommunication Dept.)
4. Prof. Bhogade V.M. (Civil Engg. Dept)
5. Mr. Patane R. S. & Mr. Vedpathak (Mechanical Engg Dept.)
6. Mr. Ashwin Savalgi (Administrative Dept.)
7. Mr. Londhe S.B. (Library Engg)
8. Mr. S.B. Pandhare (Diploma Civil Engg Dept.)
9. Mr. Narote B. E. (Diploma Mechanical Engg Dept.)
10. Mr. Burhanpure C. C. (Diploma Information Technology Dept.)
11. Mr. Margur L. S. (Diploma Electronics & Telecommunication Dept.)
12. Mrs. Adam M. M. (Library Diploma)
13. Ms. Alkauthi S. B. (Diploma General Science Dept)
14. Mr. Pinjar J.P.(Rector - Hostels)
15. Mr. Kore S.S. (Gymkhana)

Under the Guidance of

Dr. S. B. Gadwal

(Head - Energy Audit)

Preface

Data collection for energy audit of the AGPIT Solapur Campus was carried out by the team in the month of July 2021. This audit was conducted to seek opportunities to improve the energy efficiency of the campus. Reduction of energy consumption while maintaining or improving human comfort, health and safety were of primary concern. Beyond simply identifying the energy consumption pattern, this audit sought to identify the most energy efficient appliances. Moreover, some daily practices relating common appliances have been provided which may help reducing the energy consumption.

The report accounts for the energy consumption patterns of the academic area, central facilities and hostels based on actual survey and detailed analysis during the audit. The work encompasses the area wise consumption traced using suitable equipment. The report compiles a list of possible actions to conserve and efficiently access the available scarce resources and their saving potential was also identified. We look forward towards optimization that the authorities, students and staff would follow the recommendations in the best possible way.

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 consumers.

Acknowledgement

It is a matter of great pleasure for us to prepare report on **"ENERGY AUDIT OF A. G. PATIL INSTITUTE OF TECHNOLOGY CAMPUS".** First and foremost, we are highly thankful to our Energy Audit team head **Dr. S. B. Gadwal**, Department of Mechanical Engg., AGPIT, Solapur for his expert guidance and continuous encouragement during all stages of the audit. His help in the form of valuable information & thoughts at proper time had helped us to complete the audit report. We feel lucky to get an opportunity to work with him. We thankful to the kindness and generosity shown by him towards us, as it helped us morally to complete the work.

We would like to thanks all H.O.D's of various departments for giving us precious time and giving guidance till the end of the work.

We would also like to thank **Dr. V. V. Potdar**, Vice Principal AGPIT, Solapur, for his constant inspiration, motivation, direction, and guidance; without which it would not been possible to do this work.

Special thanks to **Dr. M. A. Chougule**, Campus Director AGPIT and **Dr. S. A. Patil**, Principal AGPIT, Solapur for their motivation, support and stimulation.

Last but not the least we are also thankful to all our Collogues and the staff members of the various departments for continuously helping us for completing the work within time.

Energy Audit Team
AGPIT Solapur

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1. Introduction

The A. G. Patil Institute of Technology was established in 2008 AD. Today, the Institute is recognized as one of the best academic excellence in the Solapur region. Over the years, there has been significant progress at AGPIT in all academic and research activities, and a parallel improvement in facilities and infrastructure, to keep it on par with the best institutions. Institutes in positions of excellence grow with time. As on date, the campus has Engineering departments, Diploma departments, Library, boys & girls Hostels, Gymkhana and Canteen. The student strength of the institute is about 1575 (675 Engineering students & 900 Diploma students), with faculty strength of about 110 (51 for Engineering & 59 for Diploma) and supporting staff of about 79 (41 from Engineering & 38 from diploma) over an area of about 16 acres.

1.1 Objective of Energy Audit Exercise

The objective of Energy Audit is to promote the idea of Energy Conservation in the Campus of A. G. Patil Institute of Technology, Solapur. The purpose of the energy audit is to identify, quantify, describe and prioritize cost saving measures relating to energy use in the Departments and Institute Central Facilities.

The work eligible for Energy Audit Study should be directed towards:

• Identification of areas of energy wastage and estimation of energy saving potential in Departments and Institute Central Facilities.

• Suggesting cost-effective measures to improve the efficiency of energy use.

• Documenting results & vital information generated through these activities.

• Identification of possible usages of co-generation, renewable sources of energy (say Solar Energy) and recommendations for implementation, wherever possible, with cost benefit analysis.

1.2 Analysis of Area of Use

Identifying where energy is used is useful because it identifies which areas the audit should focus on and raises awareness of energy use and cost. The results of the analysis can be used in the review of management structures and procedures for controlling energy use.

Analysis of energy use can be done by Energy Audit team by visual inspection in various department of college campus to pinpoint actual energy usage per area. This is a good source data for allocating energy use. The Department or Lab incharge can also list all equipment used and the corresponding operating hours. With this information, spreadsheet can be created and charts useful for analysis may be generated.

Important Points to Consider When Collecting Load Data:

A. Usage – The usage of the equipment in terms of hours per day and days per year can be collected from key persons in departments. It is important to ensure the accuracy of this data because much of the potential for energy savings lies on wise allocation of the equipment's operating hours.

B. Power consumed – The power consumption of the equipment's in the various departments is done by visual inspection and taken the views of key person of the respective labs.

C. Supplementary Information – Some other supplementary information are also collected such as state of insulation in case of ACs or availability of natural light etc.

1.3 Identification of Target Areas

Opportunities for energy savings can range from the simplest, such as lighting retrofits, to the most complex such as the installation of a cogeneration plant. After the preliminary identification of opportunities, more time should be spent on those which have shorter payback periods.

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1.4 Action Plan to Set Implementation Priority

After passing the cost benefit test, an action plan should be developed to ensure that the opportunities identified are implemented. The action plan should include all the major steps for implementing the opportunity as well as the people responsible. Furthermore, there should be a plan for monitoring the results.

2. Energy Audit Methodology

The methodology adopted for this audit was a three step process comprising of:

1. Data Collection – In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing key persons, and measurements.

2. Data Analysis - The analysis of data collected was done. And the collected data were used for producing the graphical representation.

3. Recommendation – On the basis of results of data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

2.1 Data Collection

For suggesting any corrective measures to reduce power consumption, it is first necessary to know the power consumption pattern in detail. For this, the exhaustive data collection exercise was performed at all the departments, academic centers and other supporting entities such as library, institute hospital, computer centers etc.

Following steps were taken for data collection:

- The team went to each department, center etc.
- Information about the general electrical appliances was collected by observation and interviewing.
- The power consumption of appliances was measured using power analyzer in some cases (such as fans) while in other cases, rated power was used (CFL for example).
- The details of usage of the appliances were collected by interviewing key persons e.g. Warden (in case of hostels), caretaker (in case of departments) etc.
- Light intensity was measured using luxmeters at the places where light intensity was either very low or very high.
- In case of Air Conditioning, insulation was checked by visual inspection.
- Approximations and generalizations were done at places with lack of information.

2.2 Data Analysis

In data analysis, the data collected is processed to draw significant conclusions to pinpoint loopholes and identify the areas to focus upon. Analysis of the power consumption observations obtained was used to obtain the power consumption pattern and also to get the information about the points where electric power is wasted.

2.3 Recommendation

Energy as well as cost analysis of different appliances were performed and recommendations were made based on the capital cost recovery time.

Following were the steps involved in this process:

- The capital cost involved in replacing an appliance and/or process was estimated.
- The energy saving by the move was calculated in terms of price of energy per year.
- These two costs were compared to calculate the capital cost recovery time which is defined as the total time by which the saving in energy bill balances the capital cost involved.
- If capital cost recovery time is less than the product life, the move can be supported. Some other recommendations were also made which are based on lighting intensity, AC insulation etc.

3. Analysis Of Power Consumption

3.*1 Overall Campus*

There are 2 hostels, 11 academic departments and supporting infrastructures like library, computer center, instrumentation center, institute administrative block in AGPIT campus. The analysis implies that in general the workshops, Mechanical Engineering Department, Electronics Engineering Department are relatively more power consuming unit of the campus. Workshops are the largest power consuming unit.

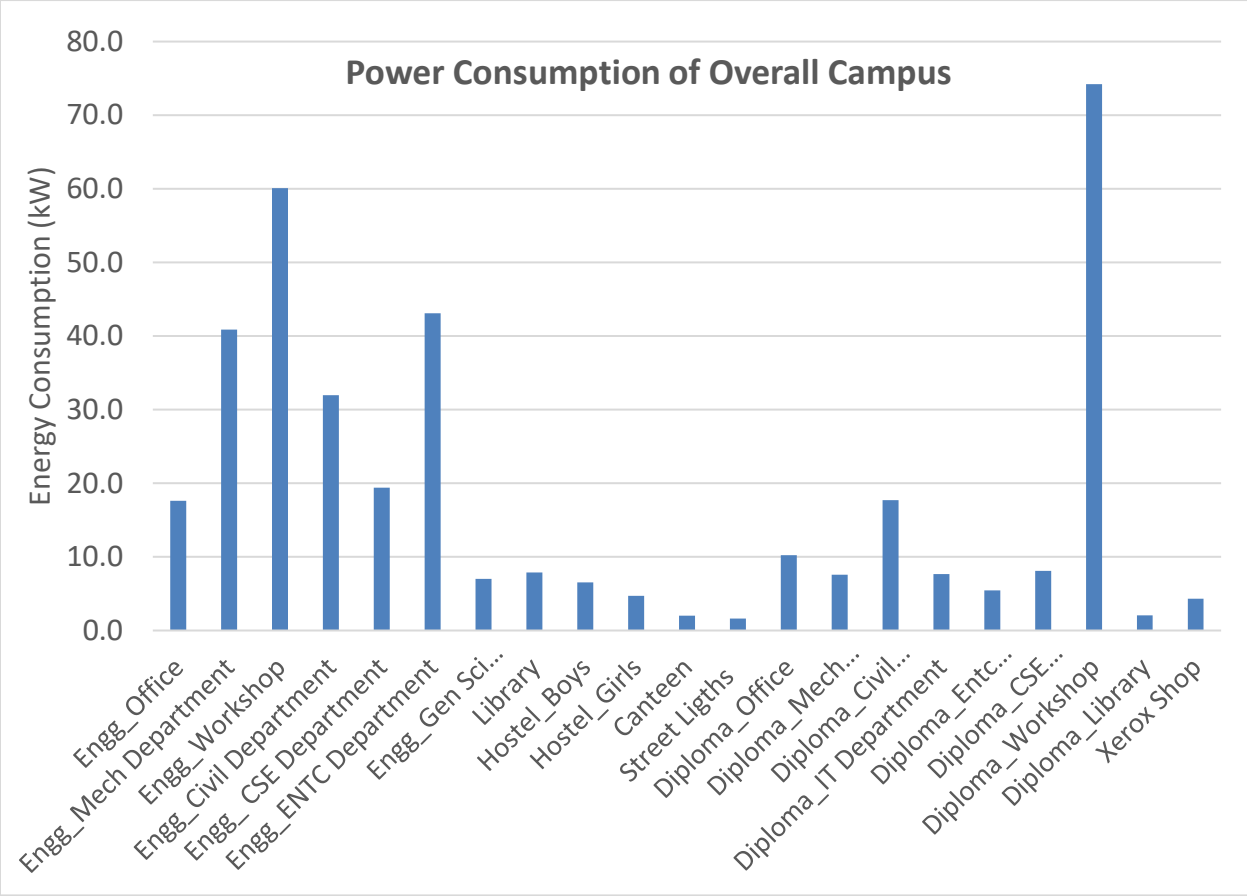

Fig.3.1 Total Power Consumption of Different Units

A point to note in the above chart is the higher consumption of workshop as compared to departments which in itself explains how machines affect the consumption distribution. Small power consumption of Libraries, Xerox shop, Canteen etc. is due to its small size and no laboratories.

3.2 Course wise Analysis of Campus:

The Course wise analysis of overall campus has been carried out to find out the course wise power consumption.

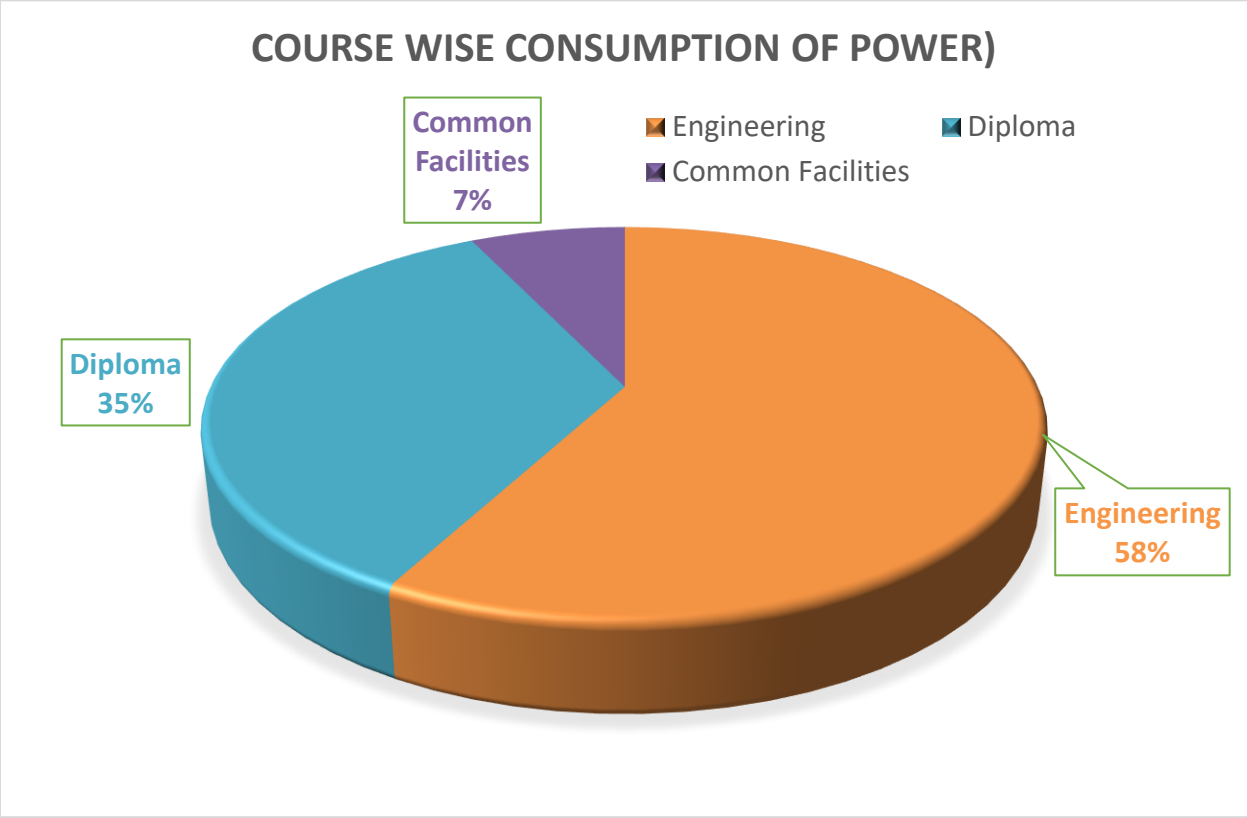

Fig 3.2 Course wise Power Consumption (%)

The above chart shows the course wise power consumption of overall AGPIT campus. The chart shows that the Engineering Departments consumes the maximum power (58%) in the campus. The common facilities consume (7%) power which includes canteen, Gymkhana, Playground, Xerox Shop, Boys hostel, Girls hostel, street lights etc. And the Diploma college campus consumes (35%) power of total power.

3.3 Location wise Analysis of Campus:

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

Table 3.1 Locations of the Different Departments

Building P	Engg Office
	Engg Mechanical Department
	Engg Civil Department
Building Q	Engg CSE Department
	Engg ENTC Department
	Engg Gen Science Department
Building R	Workshop
	Diploma ENTC Department
	Xerox Shop
Building A	Diploma Office
	Diploma IT Department
	Diploma CSE Department
Building B	Diploma MECH Department
	Diploma Civil Department
	Diploma Library
	Diploma Workshop
Building V	Library
Building W	Hostel Boys
Building X	Hostel Girls
Building Y	Canteen
Open Space	Street Lights

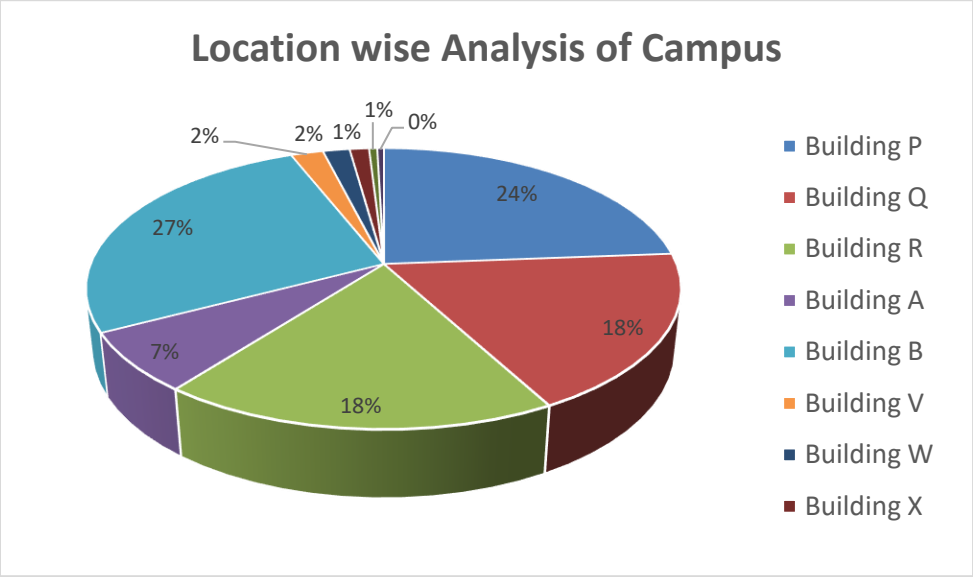

Fig 3.3 Location wise Power Consumption of Campus (%)

As per the above chart the power consumption in P in building is (27%) which includes Mechanical Engineering Department, Civil Engineering Department and Engineering administrative Office. After that the building Q and R consuming (18%) power each, which includes CSE Department, ENTC Department, General Science Department in Q building and in R building Mechanical Engineering Workshop, Diploma ENTC Department and Xerox Shop. After that the building B consumes (24%) power which includes Diploma Mechanical Engineering Department, Diploma Civil Engineering Department, Diploma workshop and Diploma Library. The building A which includes Diploma Administrative Department, Diploma CSE Department, Diploma IT Department combinely consumes (7%) power. At the end the building V, W, X and Y are consuming power (2%), (2%), (1%) & (1%) respectively; which includes Engineering Library, Boys hostel, Girls hostel and Canteen.

3.*4 Department wise Analysis of Campus*

Department wise analysis of overall campus has been carried out to find out the Departmental areas with relatively higher power consumption. The chart shows below the department wise power consumption. From the above chart it is clear that the Diploma workshop consuming the maximum power (74.2 kW) as compared to other departments. The street lights consume the lowest power (2 kW) as compared to other.

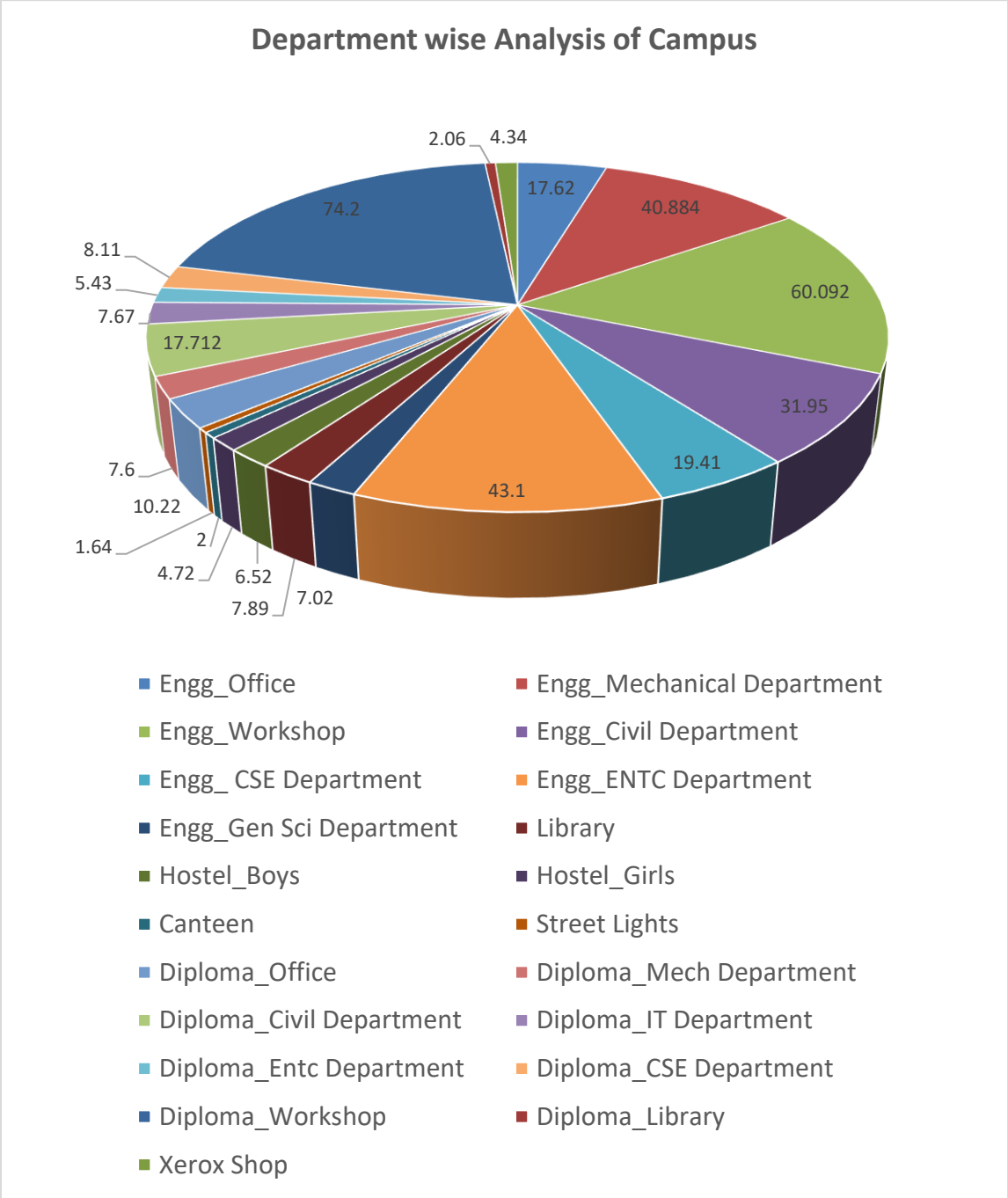

Fig 3.4 Department wise Power Consumption of Campus (kW)

3.5 Equipment wise Analysis of Campus:

Equipment wise analysis has been performed in order to identify the equipment's, within same application area, which consume more power as compared to others. During equipment wise

analysis of the overall campus, the equipment's 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 AGPIT campus:

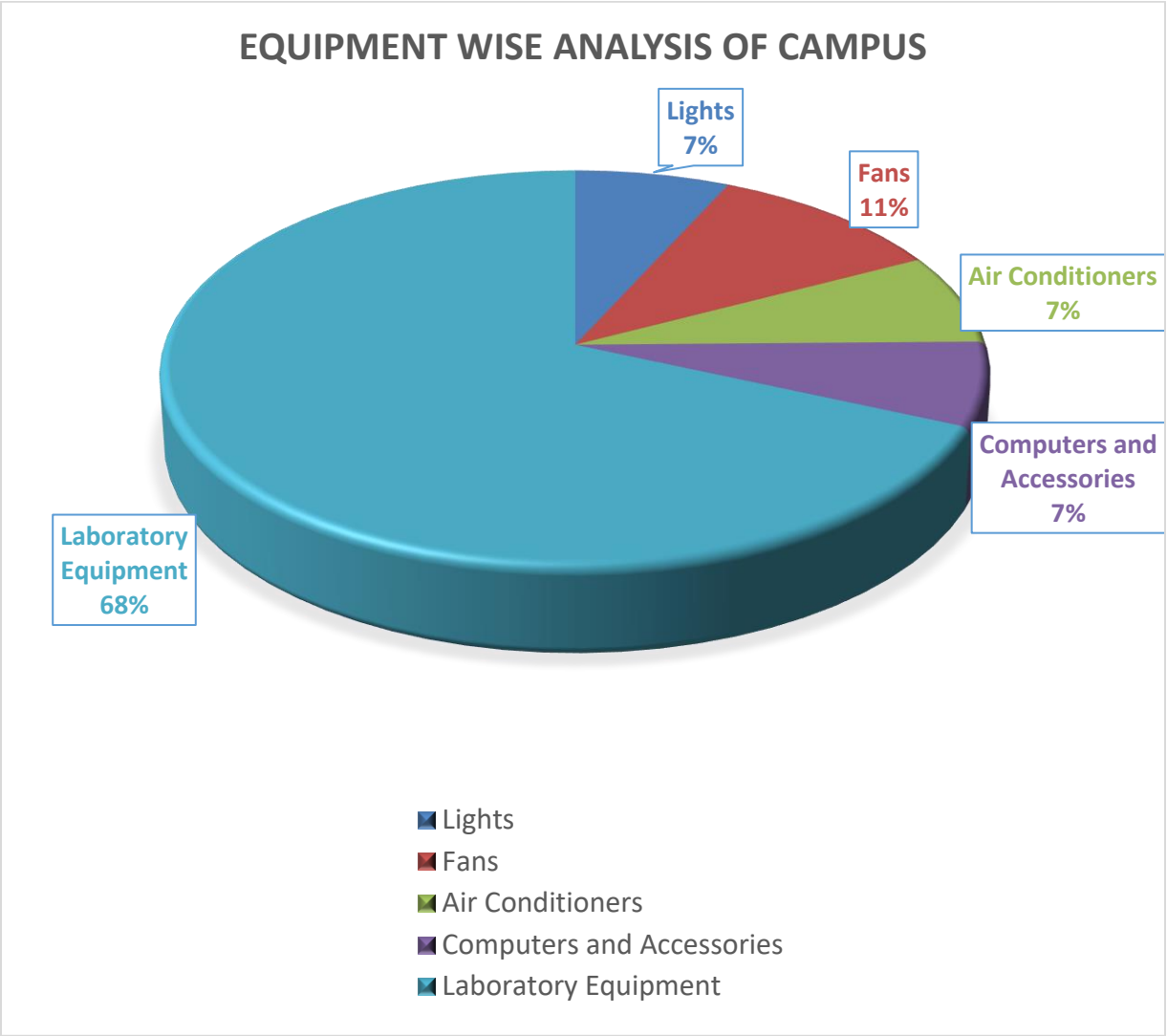

Fig 3.5 Equipment wise Power Consumption of Campus (%)

The AC available in the campus is of window type which consumes 9% power of total power. For lighting, dominant appliance is the conventional Ballast [Choke] tube light which consumes 7% power. The fans in the departments, library, laboratories, canteen etc. consuming 11% power of the total power. The Computers and the accessories also have a contribution of 7% to total power consumption. The laboratories equipment's having the largest power consumption which is 68% of total power.

4. Recommendations for Better Energy Efficiency

Based on the analysis of the power consumption data, certain steps have been recommended for improving energy efficiency of the campus. Complete cost analysis of implementation of recommended measures has been performed wherever necessary. Described below are some important recommendations for better energy efficiency:

4.1 Replacing Conventional Ballast [Choke] FTLs with Electronic Ballast [Choke] FTLs:

The light source at most places in the campus is traditional 40W FTLs with conventional Ballast [Choke] which consumes 14-16W in addition to the 40W. So if we replace the conventional Ballast lights with electronic Ballast or with CFL which will consume low power as compared to conventional Ballast lights.

4.2 Master Switch:

Master switch can be installed at every class room, Laboratories, Conference Hall etc. to avoid the unnecessary energy consumption due to students unawareness.

4.3 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 there to automatically switch on the light when there is any movement and switch off the light when there is no movement. This can reduce the total load in corridors and toilets.

4.4 Better Practices for AC:

The institute has in total 7 window type ACs. At many places it was found that AC is not used with best recommended practices. Even simple things, such as insulation, are not taken care of. Window panes were found broken at many places. 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 –** Always keep curtains 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.
- **Operating –** The ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room.

4.5 Solar Power Plant:

Solar Power plant of 50kW capacity has been installed in campus premises on 26/01/2017.