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ENERGY AUDIT OF EDUCATIONAL INSTITUTE

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Abstract–The energy auditing is presented in depth, as is the auditing method. The energy audit has been conducted with sincerity. At Institute of engineering, Pune to estimate Energy consumption in a day, week and month. Energy is a critical factor in the economic development of any country, impacting all sectors. Conventional sources such as coal and gas, while valuable for electricity generation, are finite in supply. It's crucial to utilize natural resources as efficiently as possible and to prevent an energy crisis. demand has increased assist consumption is increased proper energy conservation methodology to be adopted. The academic sector significantly contributes to energy consumption as one of its primary areas of focus. The main focus of this paper is on the identification of energy conservation in our college. A comprehensive examination of power usage in the college was conducted during the energy audit. The audit encompassed various aspects including Single-phase and three-phase water, lighting, fans, laptops, air conditioners, and pumps are focused on for the identification of energy conservation in our college.as well as laboratory equipment. The power consumption patterns were analyzed to estimate the monthly energy consumption, with particular attention given toexamining the electric bill. areas for energy conservation are noted. An energy audit of the engineering institute offering an engineering program will be carried out through this paper. The aim is to facilitate the implementation of an energy-efficient project, focusing on improving the energy efficiency of the institute's buildings. By conducting the audit, valuable information will be obtained, which will guide the implementation measures to enhance energy efficiency within the institute's premises.

Key Words*: *Energy Audit, Energy Consumption, Energy saving, Energy conservation.

1. INTRODUCTION

The introduction of an energy audit is done for plants to ensure energy efficiency. An energy audit can be defined as a process where the use of energy is verified, monitored, and analyzed. It can be included as a section of the Technical Report that offers suggestions, an action plan for optimization of energy, and a cost benefit analysis. Before commencing energy audit, it is crucial to establish and clearly define the scope and extent of the economic evaluation.

Figure1: Reason to perform an Energy Audit.

Energy audit typically involves a systematic review and analysis of energy usage in a building, facility,

or process. It includes various steps and activities to assess energy efficiency and identify opportunities for improve. It is a systematically study or survey aimed at understanding how energy is utilized in a building or plant, while also identifying opportunities for energy savings. By employing appropriate audit methodologies and implementing an action plan, energy consumption can be effectively reduced. The outcomes of an energy audit furnish crucial information to energy managers regarding the quantity, location, and manner in which energy is consume. This energy audit of modern college of Engineering Pune has been carried out and reported in the paper. We have compiled a list of suggested measures to protect and effectively use our limited resources and have determined their potential savings. The following stage would be to give implementation top priority of the recommendations, and it is anticipated with optimism that the greatest possible implementation of these suggestions and the success of work will be ensured by the institute authorities, staff, and students.

2. ENERGY AUDIT TYPES AND METHODOLOGY

Startup Meeting
↓
Basic Data collect
↓
Work on the Field
↓
The Data Reporting analysis
↓
adoption of cost-cutting methods

1. METHODOLOGY:

- Measurements determine, confirm consumption of energy and other factors.
- Analyses, specific calculations and suppositions.
- Validation.
- Potential for conserving energy opportunity.

1.1 Grouping and Strategy

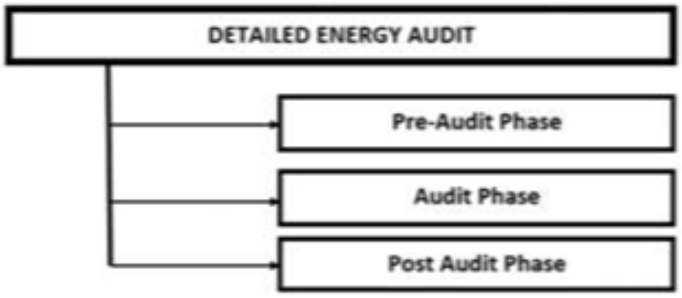
The following steps were undertaken with specific target area and end user assign.
Step1: Accumulate the electrical data associated with the lighting, fans, and other applicable components in our college.
Step2: Retrieve data and specifications from the various laboratories within our college.
Step3: Data analyzing by means of calculations.

1.2 Analysis of data

The data that was gathered was thoroughly analyses. Each department is used to compute the daily energy consumption in kWh. The following method is used for data analysis:

- Power Flow diagram.
- The Collected data was evaluated through department wise, location wise.
- The created database was further investigated, and the outcomes were graphically shown.
- This aids in identifying the locations with the most potential for energy savings.
- The goal was to determine what caused the difference between the connection load and actual usage.

The three phases of the energy audit are typically consisting of the Pre-Audit Phase, Audit Phase, and Post-Audit Phase, which are carried out to find solutions to cut facility running costs and/or reduce energy consumption per unit of production.



1.Pre-audit stage

The pre-audit phase is when the main focus is on planning and preparing for the energy audit process. This involves establishing an energy audit team to ensure smooth coordination during the audit activities. Additionally, careful attention is given to

thoroughly identifying and documenting the specific details of the facilities that will be included in the scope of the audit. A Kick off meeting is carried out to discuss any first hand observation.

2.Audit Phase

The audit phase is the next phase in a thorough energy audit and its duration is determined by the characteristics and intricacy of the site being assessed. During this phase, The auditing procedure may take days, weeks or even a month, and may involve working outside of regular business hours, including evenings and nights. This approach ensures that no aspect of the audit is overlooked and allows for a thorough examination of the site's energy consumption. The information mentioned below has been gathered during the audit phase:

- the source of information the energy supply has collected.
- Energy bills were gathered to determine tariff information and costs.
- The load sector data has been collected.
- There has been a review of the current energy management process and training programme.
- A flowchart for energy.

The Audit Phase comprises a series of designated steps outlined as follows:

I. Gathering of Primary Data

Data pertaining to energy usage in facilities will be collected, encompassing various aspects such as facilities drawings, details about electricity supply, metering information, energy consumption data, and production details. Furthermore, the operational team may be required to complete questionnaires or surveys to provide additional insights into the performance of the facilities.

II. Conduct Site Survey, measuring and watching; A site survey conducted identify the source of supply to facilities. The supply facilities, encompassing the loads and their condition, will be included. Measurements of power consumption, specifically the The loads' nominal current will be collected for analysis purposes.

III. Analysis of Energy Use; The site survey and primary data collection are essential components of the analysis process for energy consumption. They serve to identify areas of concern, and the resulting analysis can be presented in the form of an energy analysis or an analysis of energy waste/loss.

IV. Reporting and Presentation: summary, facility description, historical energy usage data, present energy use, and energy conservation measures.

3.Post Audit Phase

monitoring actions and measurements will be implemented to ensure the fulfilment of the action plan. A schedule for implementation will be documented and periodically reviewed.

3. ELECTRICITY BILL ANALYSIS

In institution of Pune receives power from Maharashtra State Electricity Distribution Co. Ltd.

3.1Monthly Energy Consumption:

The details from the college bill for the fiscal year 2021–2022 show maximum demand, energy use, and constant costs, energy costs, and total bill in RS. The various graphs show all of the data from one year. Energy sources, energy consumption, energy monitoring, and power usage are all included by this indicator.

- **Tariff: 146 HT**-VIII B
- **Sanctioned Load (KW):** 245
- **Contract Demand (KVA):** 200.00
- **Urban/Rural:** Urban
- **65% of Con. Demand (KVA):** 130.00
- **Feeder Voltage (KV):** 11
- **Prev. Highest (Month):** MAY
- **Prev. Highest Bill Demand (KVA):** 136

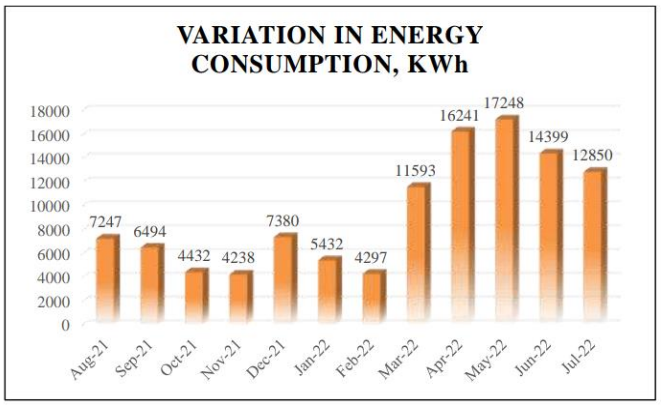


Figure 2: Monthly Unit Consumption (kWh) Variation

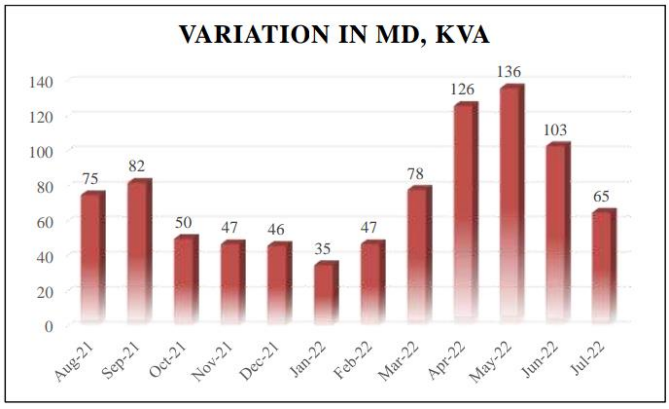


Figure 3: Monthly Variation in Maximum Demand, kVA

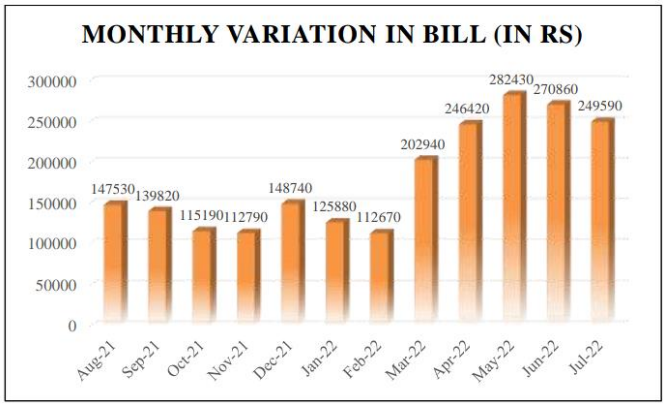


Figure 4: Monthly Variation in Electricity Bill (in Rs.)

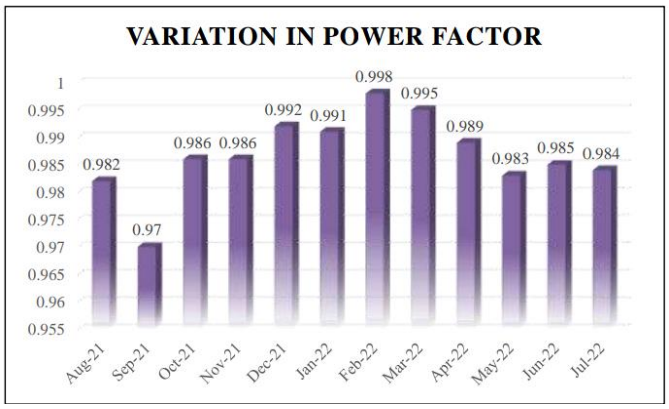


Fig 5: Monthly Variation in Power Factor

- Electricity bills observation and analysis. The total sanction load for the 12 power bills in the college's facilities is 245 kW.
- According to observation and analysis of electricity bills, the average electricity unit (kWh) usage is 9315.92 kWh, and the total cost for all 12 electricity bills on the college premises is Rs. 2154860.
- We installing a central electrical connection with a capacity of 100 kW, which will save you between Rs. 98k and Rs. 1 lac per year.
- Below, we provide a detailed analysis and observation of an electrical bill:
- Electricity bill November Month Energy Consumption is 17248 kWh, which is very high and Maximum Electricity Charges (Rs / kWh) is 26.61.
- Bill November Month, Energy Consumption is 4238 kWh, which is minimum and minimum Electricity Charges (Rs / kWh) is 15.17 in month April.

4. LOADS SURVEY

To determine connected load, an electrical load survey is conducted institute of Engineering. Table is utilized measure and present the quantities of connected load within the institute;

4.1 Light load;

I. Indoor lighting system,

	No. of Lighting Fixtures	Total Power (W)	WH
TOTAL	513	10246	52446
Total Power Consumption in KW	10.246KW		
Total Power Consumption in kWh	52.446 kWh		

II. Outdoor lighting system,

	No. of Lighting Fixtures	Total Power in(W)	WH
TOTAL	294	8543	67324
Total Power Consumption in KW	8.543KW		
Total Power Consumption in kWh	67.324kWh		

4.2 Fan system;

	No. of Fans	Total Power in(W)	WH
TOTAL	712	43810	226550
Total Power Consumption in KW	43.810KW		
Total Power Consumption in kWh	226.550kWh		

4.3 Air conditioning system;

	No. of AC	Total Power in(W)	WH
TOTAL	65	43810	405.2
Total Power Consumption in KW	182.7KW		
Total Power Consumption in kWh	405.2 kWh		

4.4 computer system load,

	No. of Computer	Total Power in(W)	WH
TOTAL	851	114960	729240
Total Power Consumption in KW	114.960KW		
Total Power Consumption in kWh	729.24kWh		

4.5 Water cooler Load;

	No. of	Total Power in(W)	WH
TOTAL	4	4.44	162000
Total Power Consumption in KW	4.44KW		
Total Power Consumption in kWh	162 kWh		

a) Analysis of current major energy-consuming technology and electricity bills,

Major equipment's are installed in institute of engineering like Lighting fixtures, Air-conditioning system, Ceiling Fans and Water Cooler

Connected Load (KW) in Table 1

Sr. No	Connected Load	Power (KW)	Connected Load (%)
1	Light Load	18.92	7.93
2	Fan Load	43.45	9.17
3	Ac Load	182.76	49.9
4	Computer Load	114.960	31.53
5	Water cooler Load	4.4	1.20
Total Connected Load		**364.49**	**100%**

- According to observation and analysis of electricity bills, the total sanction load for all 10 electricity bill connections within the college grounds is 245 kW.
- Average Energy Charge in per unit is Rs/kWh 20.94.
- As per above table we observed that AC & Computer load is major power consuming areas.

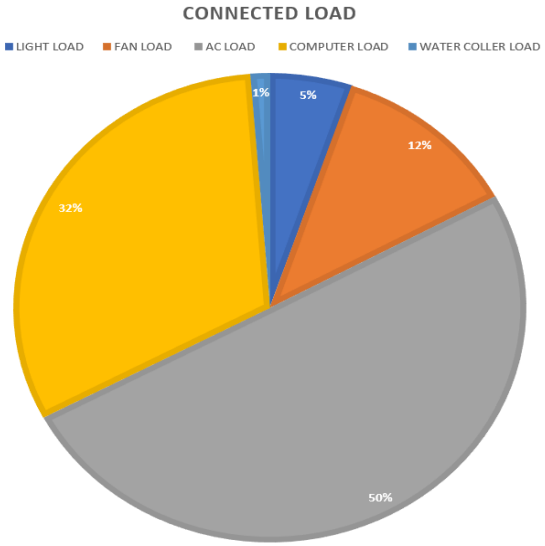


Figure 6. Appliances wise Energy Consumption

- As per Above Pie chart we observed that Air conditioning system & Computer load is major power consuming areas.
- Total connected load distribution consists 32%of computer load and 50% of Air conditioning load.

5. RECOMMENDATIONS

5.1 Lightning system.

- During the audit and site visit, we noticed that the lighting luminaries were traditional, such as fluorescent tube lights and CFLs, which were using a lot more electricity than lights that use LED.
- It is advised that we switch to energy-efficient 18 W LED lighting in place of the standard FTL (40 W) and EBT (36 W) models.
- The Bureau of Energy Efficiency advises us to buy all electrical equipment in accordance with the star Levelling programmed, which will result in significant electricity savings.
- Recommended undertake routine The star Levelling initiative, which will result in significant electricity savings, is recommended by the Bureau of Energy Efficiency for the purchase of all electrical equipment for optimize their lux level and boost lighting effectiveness.
- **Motion sensor for lighting;**
  Installing a lighting sensor motion system will result in annual energy savings of about 122 kWh and financial savings of about Rs. 3595.

5.2 Ceiling and wall mounted fan system

- The majority of the fans that we saw were traditional, quite old, and used a lot of electricity.
- According to the Bureau of Energy Efficiency's Star levelling programme, it is advised that we replace 458 60 W and 42 120w brand-new, extremely energy-efficient ceiling fans BLDC ceiling lights. This will result in significant electricity savings.
- • The Bureau of Energy Efficiency has advised us to acquire a new, energy-efficient BLDC fan in accordance with the Star levelling

programmed, which will result in significant electricity savings.

- Recommend to conduct regular maintenance and clean of fans.
- As per the Bureau of Energy Efficiency's 5-star rating, it is advised that users replace their old inefficient fans with new energy-efficient BLDC fans to increase air delivery.

5.3 Air-conditioning system

- Recommend to purchase new 5-star ac.
- Also Recommended to maintain temperature 24 degree Celsius.
- Installed patio apartment facing the building's north side wall.

5.4 Computer system

- Devices like printer and scanner consume more power should be only used when required instead of keeping them always connected.
- Turn off monitors instead of screensavers
- We can keep the screen brightness as low as possible to save more energy.
- To save energy, it is advisable to power off the PC when it is not being used.
- It is recommended to avoid leaving the PC idle, as desktop computers consume a higher amount of electricity during this period.
- Operate the PC at less brightness. Implementing these simple actions can contribute to the conservation of energy.
- Utilize sleep mode for short breaks: Instead of leaving your computer fully powered on during short breaks, utilize sleep mode to save energy. Sleep mode allows for quick resumption of work while minimizing power usage.

6. CONSERVATION MEASURE;

Table 2 Energy-saving techniques or conversation

Sr. No.	Energy Conservation Measures	Annual Savings		Investment	Payback
		kWH	Rs.	Rs.	Months
LIGHTING					
1.	Replace 431 no. of 36 W EBT with energy efficient 18 Watt LED lights installed in different Places in College.	20947 (22.77%)	354468 (22.74%)	258600	9
2.	Replace 116 no. of 40 W FTL with energy efficient 18 W LED light installed in different Places in College.	6890.4 (7.49%)	116602.41 (7.48%)	69600	7
3.	Replace 24 no. of 28 W FTL with energy efficient 18 W LED light installed in different Places in College.	648 (0.70%)	10966 (0.70%)	12000	13
FANS					
4.	Replace 42 no. of Existing 120 W Ceiling Fan with Energy efficient Energy Efficient 28 W GORILLA Atomberg Fan in College.	10433 (11.34%)	176548 (11.33%)	126000	9
5.	Replace 458 no. of Existing 60 W Ceiling Fan With Energy efficient Energy Efficient 28 W GORILLA Atomberg Fan in College.	39571 (43.01%)	669641 (42.97%)	1374000	25
AIR CONDITIONING SYSTEM					
6.	To install 15 no. of "Airtron" energy saver" device using 1.5 TR Split type of air-conditioning system	13373 (14.53%)	226306 (14.52%)	94650	5
MOTION SENSOR					
7.	To install 1 no. of motion sensor at Principal Room for energy saving	122 (0.13%)	3595 (0.23%)	4000	13
Total		**91984.4**	**1558126**	**1938850**	

7. CONCLUSIONS

A thorough energy management programme can be found and established with the help of an energy audit, which is a very powerful instrument. Conducting meticulous auditing, irrespective its nature, equips the organization with a comprehensive plan to effectively manage its energy system while minimizing energy costs. In a project detailed study created to limit the amount of electricity used in the institute of Engineering Pune. Audit emphasizes the magnitude of energy savings, leading to a considerable reduction in the energy crisis.

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