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ENERGY AUDIT REPORT

2022-2023

PREPARED BY

QUALITY CARE ALLIANCE

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ENERGY AIR QUALITY WATER WASTE

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1. INTRODUCTION - ENERGY

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

1.0 Energy

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

Energy Audit Objectives Primary

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

Secondary

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

Source of Energy

College withdraws Energy from Followings:

- Electricity from BEST
- Solar Energy

The Following are the Major consumers of Electricity in the facility

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

Indirect Benefits of Energy Audit

Every time the Energy Audit is carried out it rekindles the interest in Energy Conservation as an important function. Energy Auditors sharing their experience and

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

1.1 ELECTRICAL SYSTEM

A single electricity meter is provided for the entire complex. The monthly average electricity consumption from December, 2021 to June, 2022 is 2700 Units.

Further, we presume that the institute has holiday in May/ June each year and Dec January & February are the winter season, in which energy consumption is less.

The areas of major consumption of electricity are:

INVENTORY DETAILS OF LIGHT UNITS

Sr. No	Gadgets	Total No	Watt
1	LED Light	229	20
2	Ceiling Fans	130	75Avg
3	Air Conditioners/Split Ac	23	1000Avg
4	Desktops	44	NA
5	Laptops	06	NA
6	Printers	03	NA
7	CCTV Cameras	70	NA
8	Water cooler	04	750 Avg

Details of AC			
Location	**Type**	**Capacity**	**No**
Staff Room	Split Ac	1Ton	02
Principal Cabin	Split Ac	1Ton	01
Management Office	Split Ac	1Ton	01
Computer Lab	Split Ac	2Ton	02

Ceiling Fans

Ceiling Fan is the major part which consumes electricity and however, it is very useful in household, universities, offices, etc. Hence, Innovation and continuous

improvement in the field of fans, have given rise to tremendous energy-saving opportunities in this area. The fan is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient Fans, BLDC Fans, smart Fans, apart from good operational practices

1.2 Lighting system

Lighting is an essential service in all industries, Universities, Hospitals, Malls, etc. Innovation and continuous improvement in the field of lighting, have given rise to tremendous energy-saving opportunities in this area. Lighting is an area, which provides a major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient lamps, luminaries, and gears, apart from good operational practices.
Basic Terms in Lighting System and Features Lamps
Lamp is equipment, which produces light. The most commonly used lamps are described briefly as follows:

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

Observation

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

POWER QUALITY

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

MAJOR CAUSES OF HARMONICS

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

- Electronic Switching Power Converters

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

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

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

harmonic current limitations

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

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

Even harmonics are limited to 25% of the odd harmonic limits

TDD refers to Total Demand Distortion based on the average demand current at the fundamental frequency and measured at the PCC (Point of Common Coupling).

*All power generation equipment is limited to these values of current distortion regardless of ISC/ IL value.

ISC = Maximum short-circuit current at PCC.

IL = Maximum demand load current (fundamental) at the PCC.

h = Harmonic number.

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

1.3 General Tips for Energy Conservation in Different Utilities Systems

1.1.1 **ELECTRICITY**

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

1.1.2 **MOTORS**

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Check alignment.
- Provide proper ventilation, (For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.
- (An Imbalanced voltage can reduce 3 - 5% in motor input power)
- Demand efficiency restoration after motor rewinding.

1.1.3 **FANS**

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

1.1.4 **PUMPS**

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.

- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

1.1.5 LIGHTING

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

1.1.6. DG SETS

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

1.1.7. WATER & WASTE WATER

- Recycle water, particularly for uses with less-critical quality requirements.
- Recycle water, especially if sewer costs are based on water consumption.
- Balance closed systems to minimize flows and reduce pump power requirements.
- Eliminate once-through cooling with water.
- Use the least expensive type of water that will satisfy the requirement.
- Fix water leaks.
- Test for underground water leaks. (It's easy to do over a holiday shutdown.)
- Check water overflow pipes for proper operating level.
- Automate blowdown to minimize it.
- Provide proper tools for wash down -- especially self-closing nozzles.
- Reduce flows at water sampling stations.
- Eliminate continuous overflow at water tanks.

- Promptly repair leaking toilets and faucets.
- Use water restrictors on faucets, showers, etc.
- Use self-closing type faucets in restrooms.

1.4 ENERGY MANAGEMENT STRATEGY

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

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

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

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

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

limit while also considering the economic and other organizational issues (Asnani and Bhawana, 2015). It also dealt with the uncover ways to cut operating expenses or reduce energy use per unit of production in terms of savings. It serves as a “benchmark” (reference point) for managing energy in the organization for planning more energy- efficient use across the board (Cabrera *et al*., 2010).

2. Need for an Energy Audit

In any Organization, the three top operating expenses are often found to be energy (both electrical and thermal), labour and materials. If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes a strategic area for cost reduction. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists. The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc. In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame. The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a “bench-mark” (Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

Eco-campus concept mainly focuses on the efficient use of energy and its conservation including savings opportunities in a sustainable manner. It also focuses on the reduction of contribution to carbon emissions, carbon footprint calculation, procurement of star rated equipment for a cost effective and secure supply of energy, encourage and enhance energy use conservation in all buildings, reduce the organization’s energy consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts.

Auditing for Energy Management may be studied in terms of energy savings and opportunities. In general, energy cannot be seen, but we know it is there in wire, pipes and other non-living materials because we can see its effects in the forms of heat, light and power. This indicator addresses energy consumption, energy sources, energy monitoring, lighting, vehicle movement, electrical and electronics appliances, and transportation. Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the assessment. However, energy saving and opportunities may be taken into consideration while energy is extensively used. An old incandescent (tungsten) bulb uses approximately 60W to 100W while an energy efficient light emitting diode (LED) uses only less than 10W which indicated the positive indication on energy savings. Energy auditing deals with the conservation and methods to reduce its consumption related to environmental degradation. In addition, suggestions and recommendations might be given after auditing which in turn useful for energy savings. It is therefore essential that any environmentally responsible institution examine its energy use practices at least once in two years using internal and external auditors.

The conduct of energy audit using internal and external energy auditors is playing important role in any organization in terms of energy management. It is able to measure the impact of energy potential in an organization so that we can determine better ways to manage the impact on environment. In addition to the water, liquid and solid wastes, biomedical and electronic wastes energy potential and biodiversity audits, attempts may be made to measure the carbon footprint in the organization based on the amount of carbon emissions created by the electrical appliances, vehicles and human population. It undertakes the measure of bulk of carbon dioxide equivalents exhaled by the organization through which the carbon accounting is done. It is necessary to know how much the organization is contributing towards sustainable development in terms of energy management is being done. It is therefore to recommend to measure the carbon footprint in each organization which may be useful for maintaining the ecofriendly campus to the stakeholders.

3. AIMS AND OBJECTIVES OF AN ENERGY AUDIT

An energy audit is a useful tool for developing and implementing comprehensive energy management plans of an Organization. The aim of an energy audit is to identify the energy efficiency, conservation and savings opportunities at the premises of the audit sites in a systematic manner. The audit process is carried out as per the following.

- Review of energy saving opportunities and measures implemented in the audit sites.
- Identification of additional various energy conservation measures and saving opportunities.
- Implementation of alternative energy resources for energy saving opportunities and decision making in the field of energy management.
- Providing a technical information on how to build an energy balance as well as guidance to be sought for particular applications.
- Detailed analysis on the calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plan provided by the central and State Electricity Board.
- List ways that the use of energy in terms of electricity, electric stove, kettle, microwave, LPG, firewood, Petrol, diesel and others.
- Analysis of electricity bill amount for the last two to three years, amount paid for LPG cylinders for last one year and amount paid for water consumption for human beings and watering to the plants.
- Use of incandescent (tungsten) bulb and CFL bulbs, fans, air conditioners, cooling apparatus, heaters, computers, photo copiers, inverter, generators and laboratory equipment and instruments installed in the organization (for example- 60 watt bulb x 4hours x number of bulbs = kwh).
- Alternative energy sources / nonconventional energy sources are employed / installed in the organization (photovoltaic cells for solar energy, windmill, energy efficient stoves, Biogas, etc.).
    - Creating awareness among the stakeholders on energy conservation and utilization.

4. BENEFITS OF AN ENERGY AUDIT

- **Reduced Energy Expenses:** The most obvious benefit is that the less energy the Organization uses, the less money that the Organization will have to spend on energy costs.
- **Identify Problems:** An energy audit can also help to identify any issues that the equipment might have. For example, the auditor could find small leaks in the compressed air system. These leaks would cost a significant amount of money if it is not noticed. Auditors can also detect dangerous health risks like the carbon monoxide that's emitted from equipment that hasn't been vented properly. With a regular energy audit, the organization will be able to address these kinds of issues promptly to help ensure the health and safety of the staff members.
- **Increased Employee Comfort:** During the audit, the Organization might learn about changes that have been made regarding insulation and air sealing. Completing these enhancements will help create a more reliable and more efficiently cooled or heated space for the employees. In turn, more comfortable employees tend to be more productive, so not only will the Organization save on energy costs, but may also improve overall well-being.
- **Personalized Recommendations:** Working with an energy expert can help learn about new energy-efficient technologies. The professional will customize a plan, recommending which upgrades will give the most return on investment. These might include updated lighting systems, a new HVAC system, weatherization measures like insulation and air sealing, and more. While some of the recommendations might have a substantial up-front cost that many of them will pay for themselves in a short period of time with significantly reduced energy expenses.
- **Show Environmental Concern:** By taking steps to be more energy efficient, the Organization will be showing the employees and clients that the organization cares about the impact on the environment.
- **Increased Property Value:** Using the recommendations of an energy auditor to make facility more energy efficient could also help to increase its overall worth. Things like solar panels, high-efficiency LED lighting, and weatherization procedures are all things that contribute to a higher property value.
- **Longer Equipment Lifespan:** An energy auditor might recommend to update some of the equipment for maximum energy savings. If the Organization decide to upgrade, it will not only save on energy costs, but also expect the equipment to last a long time. This is because newer, more energy-efficient equipment doesn't have to work as hard as older, outdated units to provide the same level of performance.
- **Energy audit evaluation:** Energy audits will evaluate the Organization "as a whole", the goal is not to evaluate single measures but to consider a wide range of available alternatives (Electrical, Mechanical, Envelope and Water).
- **Energy audit Opportunities:** The audit will not only inform about the opportunities but also provide information with financial analysis. This will enable prioritization based on financial benefit and return on investment.

It provides technical information regarding the proposed energy conservation measures.

- **Energy audit quality analysis:** A good quality audit will analyse the historical energy use and find potential issues using statistical methods. Provide information with emissions analysis to help understand the benefits of the decisions from an environmental standpoint. Understand where energy is used and which areas are worth focusing on the most. Provide benchmark information to help understand the energy use performance compared to others.

5. PROCEDURES FOLLOWED IN AN ENERGY AUDIT

In order to conduct an energy audit, several methods are adopted in the audit sites in which walk-through audit is conducted. The balance of total energy inputs with total energy outputs and identification of all energy streams in a facility are taken into account. The amount of energy used by each of its energy streams are calculated as per the methodology mentioned in the Manual of Gnanamangai *et al*. (2021). The top three operating expenses of the Organization are typically observed to be energy (both electrical and thermal), labour and materials. During the audit, physical verification of Lighting, Ceiling, Table and Exhaust Fans, A/C machines, Solar panels, Heaters, Generators, Uninterrupted power supply machines and ventilators load fixtures and verification of installed energy efficient system's capacities are carried out. Inspection of when the cost or prospective cost savings in each of the above components are considered, energy always wins, and the energy management task becomes a key cost reduction area. The energy audit assisted in better understanding how energy and fuel are used in the Organization as well as identifying waste factors and development potential towards energy savings opportunities. Finally after the audit process, the energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for the utility operations in the auditee (Organization).

The audit involved visiting the campus and physical verification of the loads and sources installed. The entire campus is divided into different sections and those sections are audited in which electrical fittings and energy supply are monitored. The production process flow is studied and electricity consumption are measured. Location of the electrical machines, conditions of them and their accessories are inspected through physical verification is observed as per the regulation of Indian Green Building Council (IGBC, 2021) and World Green Building Council (WGBC, 2021). The energy bill from the supply utility company (Example: Maharashtra State Electricity Board) is audited and assessed for the load demand requirement and efficient consumption of energy. Stakeholders are interacted with the scope for improvement and energy management during the audit. Potential areas in which the scope of energy conservation and saving opportunities available in the current context have been identified and suggested for implementation to the Organization. The level of carbon dioxide might be measured in different places across the Organization campus using a portable CO_2 Analyzer to calculate the carbon footprint. It may be useful to check where carbon

emission is prominent which could be taken into account to reduce.

The audit involves visiting physical position of load & carry out inventory of load. Due measurement of electrical load of equipment & circuit is carried out. Energy bill received from BEST is audited & studied for KWH requirement & how efficiently energy is used. Various positions are interacted, familiarized with energy audit & involved for successful & result oriented energy audit. Energy conservation & saving opportunities are identified during round & measurement for implementation.

6. TYPES OF ENERGY AUDIT

The type of Energy Audit to be performed depends on:

- Function and type of industry
- Depth to which final audit is needed, and
- Potential and magnitude of cost reduction desired

Thus Energy Audit can be classified into the following two types.

I. Preliminary Energy Audit
II. Detailed Energy Audit
III. Potential and magnitude of Energy Audit
IV. Comprehensive Energy Audit

6.1 Preliminary Energy Audit Methodology

Preliminary energy audit is a relatively quick exercise to:

6.2 Establish energy consumption in the organization
6.3 Estimate the scope for saving
6.4 Identify the most likely (and the easiest areas for attention
6.5 Identify immediate (especially no-/low-cost) improvements/ savings
6.6 Set a 'reference point'
6.7 Identify areas for more detailed study/measurement
6.8 Preliminary energy audit uses existing, or easily obtained data.

6.9 Detailed Energy Audit Methodology

A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems. This type of audit offers the most accurate estimate of energy savings and cost. It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost. In a comprehensive audit, one of the key elements is the energy balance. This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then compared to utility bill charges. Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I - Pre Audit Phase
Phase II - Audit Phase
Phase III - Post Audit Phase

6.10 Potential and Magnitude of Energy Audit

A structured methodology to carry out an energy audit is necessary for efficient working. An initial study of the site should always be carried out, as the planning of the procedures necessary for an audit is most important.

Initial Site Visit and Preparation Required for Detailed Auditing

An initial site visit may take one day and gives the Energy Auditor/Engineer an opportunity to meet the personnel concerned, to familiarize him with the site and to assess the procedures necessary to carry out the energy audit.

During the initial site visit the Energy Auditor/Engineer should carry out the following actions: -

6.11 Discuss with the site's senior management the aims of the energy audit.

6.12 Discuss economic guidelines associated with the recommendations of the audit.

6.13 Analyse the major energy consumption data with the relevant personnel.

6.14 Obtain site drawings where available – building layout, steam distribution, compressed air distribution, electricity distribution etc.

6.15 Tour the site accompanied by engineering/production

The main aims of this visit are:

6.16 To finalise Energy Audit team

6.17 To identify the main energy consuming areas to be surveyed during the audit.

6.18 To identify any existing instrumentation/ additional metering required.

6.19 To decide whether any meters will have to be installed prior to the audit eg. kWh, steam, oil or gas meters.

6.20 To identify the instrumentation required for carrying out the audit.

6.21 To plan with time frame

6.22 To collect macro data on major energy consuming centers

6.23 To create awareness through meetings/ programme.

6.24 Comprehensive Energy Audit

Depending on the nature and complexity of the site, a comprehensive audit can take from several weeks to several months to complete. Detailed studies to establish, and investigate, energy and material balances for specific plant departments or items of process equipment are carried out. Whenever possible, checks of plant operations are carried out over extended periods of time, at nights and at weekends as well as during normal daytime working hours, to ensure that nothing is overlooked.

The audit report will include a description of energy inputs and product outputs by major department or by major processing function, and will evaluate the efficiency of each step of the Organization. Means of improving

these efficiencies will be listed, and at least a preliminary assessment of the cost of the improvements will be made to indicate the expected payback on any capital investment needed. The audit report should conclude with specific recommendations for detailed engineering studies and feasibility analyses, which must then be performed to justify the implementation of those conservation measures that require investments. The comprehensive energy audit may be useful to identify the consuming areas to be surveyed during the audit and to identify any existing instrumentation/ additional metering required. A care should be taken to identify the instrumentation required for carrying out the audit and to plan with time frame including the collection macro data on major energy consuming centers. It will be definitely useful for energy management towards energy savings opportunities.

The information to be collected during the detailed audit includes:

1. Energy consumption by type of energy, by department, by major items of process equipment, by end-use
2. Energy cost and tariff data
3. Generation and distribution of site services (eg. compressed air, steam).
4. Sources of energy supply (e.g. electricity from the grid or self-generation)
5. Potential for fuel substitution, process modifications, and the use of co- generation systems (combined heat and power generation).
6. Energy Management procedures and energy awareness training programs within the establishment.
   Existing baseline information and reports are useful to get consumption pattern. The audit team should collect the following baseline data:
   - Technology, processes used and equipment details
   - Capacity utilisation
   - Water consumption
   - Fuel Consumption
   - Electrical energy consumption
   - Steam consumption
   - Efficiencies / yield

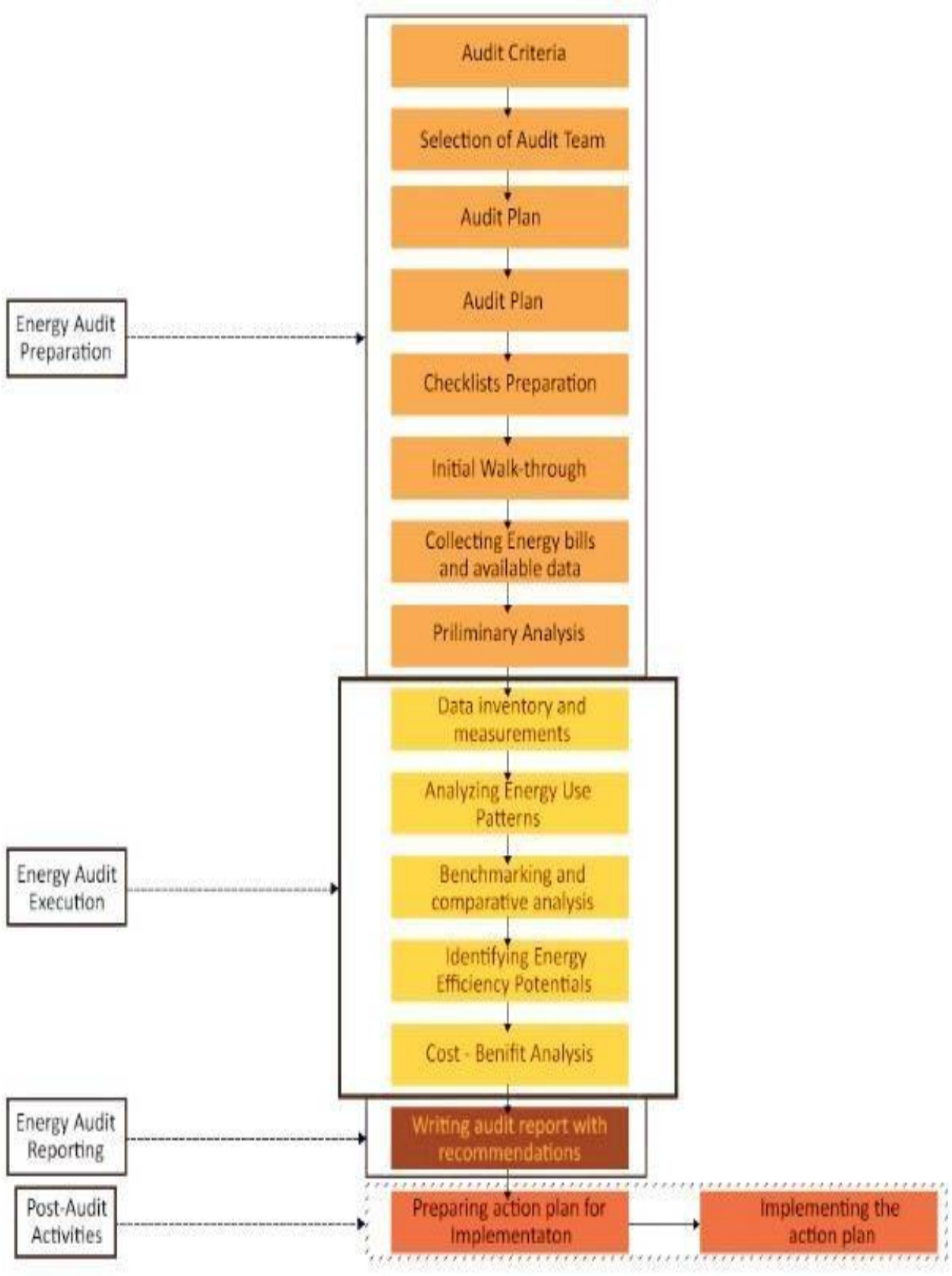
7 Carbon footprint by measuring Carbon dioxide level in the Campus

The level of Carbon dioxide is measured in different places across the Organization campus using a portable CO_2 Analyzer (Non dispersive infra-red meter). In addition, CO_2 meter is also displayed the readings of atmospheric temperature, relative humidity and dew point in the places, where the level CO_2 is measured. The meter started measurements of CO_2 level in the atmosphere after powered ON and updated the readings every second in the display screen. If the operating environment is changed (example from high to low temperature) which took 30 seconds for CO_2 sensor to respond and 30 minutes for flexibility in relative humidity. The meter features an audible alarm to give warnings when CO_2 concentration exceeds the set limit. It emits beeps (Abt.80Db) when CO_2 level goes over the set value and stops when any key (except SET) is pressed or the readings fall below the set values.

The Carbon footprint per year is calculated (www.carbonfootprint.com) based on electricity usage per year in which CO_2 emission from electricity and the sum of transportation per year in terms of number of the shuttle buses service operated by the Organization and number of cars, motorcycles and trucks entering in the Organization campus. These factors are multiplied with total number of trips in each day and approximate travel distance of vehicles covered in each day with a coefficient (0.01) to calculate the emission of CO_2 in metric tons per year.

Humans contribute an increase of carbon dioxide emissions by burning fossil fuels, deforestation, and cement production. Methane (CH4) is largely released by coal, oil, and natural gas industries. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities is from burning fossil fuels for electricity, heat, and transportation.

The Methodology of the Audit is presented in the following chart:



Flow chart of Energy Audit Methodology

Calculating Carbon footprint

8 ENERGY AUDIT PROCESS

Energy audit is a sequence of tasks performed in a planned manner. It requires discussion, survey, collection of data, analysis, and reporting.

8.1 Steps involved in an Energy Audit

Step 1: Opening meeting among the audit team and auditees
Step 2: Planning and organizing the energy audit
Step 3: Conduct a walk-through audit at different sites
Step 4: Macro data collection and observation
Step 5: Analysis of data collected from the Organization
Step 6: Best practices followed in the Organization towards energy savings
Step 7: Recommendations for further improvement
Step 8: Exit meeting after the audit to discuss about the audit findings

8.2 Systems studied during the Energy Audit

8.3 Physical verification of lighting, fan a/c machines, ventilators load fixtures.
8.4 Verification of installed energy efficient systems.
8.5 Inspection of Solar panel, Generators, Uninterrupted power supply machines.
8.6 Inspect and verify the maintenance aspects of installed Generators and additional backup power sources.
8.7 Analyse the electricity consumption through the supply utility company (Example: BEST).
8.8 Review the potential usage of alternative energy resources.
8.9 Review the energy conservation awareness among the stakeholders for optimum use of electricity and its savings.

8.10 Planning and organizing the Energy Audit

Planning and organizing are the integral part of the energy audit. An initial visit to the audit sites is organized and the areas to be inspected are listed. Following the listing, information on the energy consumption of various blocks in the recent past is obtained, and a planned analysis is carried out.

8.11 Walk-through Audit Process

Simple audit, screening audit or visual audit are the other names, by which walk-through audits are addressed. The main purpose of the walk-through audit is to obtain general information about the sites in which electrical energy is being used at the maximum. More specific information have been obtained from the maintenance and operational people during the time walk-through audit. It also included a walk-through of the facility to become familiar with the building's operation and a brief evaluation of facility utility bills (amount paid for electricity) and other operating data. During the audit the primary problem areas are discovered.

8.12 Macro Data collection and observation

Current level operation and practices within the campus are assessed and then the data regarding the number of electrical loads connected in each section are collected. The power ratings of each component and their respective hours of operation are also observed and documented for preparing the recommendations to the Organization.

8.13 Measurements in the Energy Audit process

An energy audit required measurements, such as the energy identification and quantification, and these quantities necessitate the instruments used in a consistent way. Some of the basic electrical parameters are monitored during the energy audit such as Voltage (V), Current (I), Power factor, active power (Kw), apparent power (demand in Kva), reactive power (Kvar), energy consumption (Kwh), frequency (Hz), harmonics, illumination level, etc. Temperature and heat flow, radiation, air and gas flow, liquid flow, speed, air velocity, noise and vibration, dust concentration, TDS, Ph, moisture content, relative humidity, flue gas analysis – CO_2, O_2, CO, SO_x, NO_x, combustion efficiency are the mechanical, thermal and other parameters that are analysed during the audit depending upon the requirements.

9 ABOUT THE INSTITUTIONS

Anjuman-I-Islam's
College of Hotel & Tourism Management Studies & Research
92, Dr. D. N. Road, Opp C.S.M.T. Mumbai - 400 001.
Tel.: +91 22 2263 2817 / 9833279737
E-mail: principal@anjumanihmct.org

AIICHTMS&R is one amongst the floral tiara of Anjuman-I-Islam's Education Trust. It is conveniently located in the heart of Mumbai at Chhatrapati Shivaji Terminus (V.T) which covers the important business area of Mumbai.

Anjuman - I - Islam is a premier Educational and Social Organization of India, established in the year 1874 by a group of visionaries led by the Late Justice Badruddin Tayabji. It has a glorious past of more than 130 years dedicated to the cause of education and social service.

The Education Trust mainly stands for Secularism and National Integration.

Today with well over 100,000 students, Anjuman -I - Islam is well poised to be declared a deemed University.

It has established three Orphanages, a Centre for Distressed Families and Ambulance Services.

It is the only Institution in the State of Maharashtra, which has been awarded the prestigious Maharashtra Government's "State Award 2000" for excellence in Educational and Social Activities.

The trust is headed by the dynamic President Dr. Zahir I. Kazi who is supported by his dedicated team.

AIICHTMS&R recognize and keeps abreast with the multification role of Education in the 21st century, thus contributing to Nation building.

MISSION & VISION

Mission
To emphasize upon Theory and Practical- where the students gain the breath of knowledge
and the depth of experience that address the evolving needs of business and industry.

Vision
To Inculcate Excellence in Hospitality Education and State of the Art Technology

10. AUDIT Details

10.1 OBSERVATIONS OF THE ENERGY AUDIT

a) College is procuring LED lights and electrical equipment with star ratings and followed for purchasing green equipment, equipment star rating and eco-friendly materials.
b) Use of energy saving bulbs(Compact Flore scent light/LED lights)
c) Regular maintenance of electrical system
d) Maximum Use of daylighting system
e) Maximum Use of energy efficient equipment

SUGGESTIONS:

a) Solar energy system can be installed for energy conservation and to generate more renewable energy.
b) Usage of light reflectors is recommended as there flexors can spread light to relatively large areas.
c) If possible, computers should be switched off from main power connections.
d) Notices/signage can be put up/displayed near switches and on notice boards, informing students and staff to switch of fall electrical when not in use.
e) Install Solar Energy (Photo voltaic or Solar Panels)for sustainability
f) Raise awareness:
g) Encourage students to help in monitoring energy consumption & implement corrective actions.
h) Integrate energy education in to classroom learning.
i) Computerized monitoring of electrical system
j) ISO 50001 (EnMS) Energy Management System certification can be implemented for Energy conservation & management, effectively.

10.2 Facilities visited during the Energy Audit

Date	Section where Energy Audit is conducted
01-11-2022	Administrative Block
	Power House
	Faculty Rooms
	Classrooms
	Seminar Halls
	Auditorium
	Laboratories
	Computer Centres
	Well, Sump and pumps.
	Sewage Treatment Plant
	Hostel
	Library

In the sections, the services offered are monitored, verified and analysed on the aspects of energy consumption. In all these areas lighting systems forms the major consumer of electrical energy. Three phase electricity service connections available in the campus are provided by BEST. The electricity consumption charges are audited and studied for the load demand requirement and efficient consumption of energy. Stake holders are interacted and the scope for improvement has been discussed. Potential areas in which scope of energy conservation and saving opportunities available have been identified and suggested for implementation.

10.3 Systems Studied during the Energy Audit

1. Lighting fixtures were verified physically.
2. Installation of energy efficient lighting systems were verified.
3. Installation of safety systems were verified
4. Installation of power backup systems (generators and UPS) were verified on the aspect of maintenance and consumption.
5. Electricity consumption through the BEST bills was analysed.
6. The energy conservation awareness among the stakeholders for optimum use of electricity and its savings were reviewed.

10.4 Power supply Equipment and Major Loads

Sanctioned MD : 120 kW
Transformer : 250 kVA
Generator : 250 kVA + 63.11 kVA

10.5 Measurement of Carbon dioxide level in the Campus

Despite a massive increase in global warming, environmental changes and human population including many commercial activities now-a-days, the amount of carbon in Earth's atmosphere is playing an important role which act as a global indicator for checking the purity of the atmosphere. Using a portable CO_2 Analyzer, the level of carbon dioxide was measured in different places across AIICHTMS&R. The observation showed that the concentration of CO_2 in the atmosphere is found to be low which did not exceeds the critical limit of CO_2. It is further revealed that all the selected locations are having pure air with good air exchange which are free from pollutants (Table 6).

Carbon footprint, amount of CO_2 emissions associated with all the activities of the College or other entities like building construction and anthropogenic activity by human beings includes direct emissions, such as those that result from fossil-fuel combustion in manufacturing, heating, and transportation, as well as emissions required to produce the electricity associated with goods and services consumed. In addition, the carbon footprint concept also often included the emissions of other greenhouse gases.

Reference of Set values of CO_2 level

- 350-1000 ppm: Typical level found in occupied spaces with good air exchange along with pure air.
- 1000-2000 ppm: Moderate level associated with complaints of drowsiness and poor air quality.
- 2000-5000 ppm: Critical level associated with headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may present.

Calculation of Carbon Footprint at AIICHTMS&R with respect to electricity usage

The Carbon footprint calculation can be conducted based on the stage of calculation as stated in www.carbonfootprint.com, which is the sum of electricity usage per year.

The CO_2 emission from electricity
= (electricity usage per year in kWh/1000) x 0.84
= (4304668.8kWh/1000) x 0.84
= 3615.92 metric tons

Notes:

Electricity usage per year = 4304668.8 kWh
0.84 is the coefficient to convert kWh to metric tons.

10.6 Ways to reduce Carbon Footprint

Understanding the carbon footprint can help limit the impact of your consumption on the environment. Small changes can make a big difference in the long run, for example when it comes to transportation, food, clothing, waste, etc. Here are some tips:

Food

10.6.1 Consume local and seasonal products.
10.6.2 Limit meat consumption, especially beef.
10.6.3 Select fish from sustainable fishing.

10.6.4 Bring reusable shopping bags and avoid products with excessive plastic packaging
10.6.5 Make sure to buy only what you need, to avoid waste

Clothing

10.6.6 Take good care of your clothes
10.6.7 Try swapping, borrowing, renting or buying second-hand
10.6.8 Buy responsibly-made clothes, e.g. made from recycled material or with an eco- label

Transport

10.6.9 Cycle or use public transport
10.6.10 Be smart about when and how you drive

Energy and waste

10.6.11 Turn down the heating by 1°, it will already make a difference
10.6.12 Take short showers
10.6.13 Turn off the water while you brush your teeth or clean the dishes
10.6.14 Unplug your electronic equipment and don't leave your phone on charge when the battery is already full
10.6.15 Select energy efficient products with an "A" label (EU Energy label)
10.6.16 Limit and recycle your waste.

11 Best Practices followed in the Organization

- Transformer, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'.
- Most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders.
- Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members.
- Installed roof top solar power plant.
- Solar Water heaters are installed and they are functioning well.
- LED lights and Solar street lights are used.
- Installed automatic switches with sensors.
- HVLS Fans are fitted in the auditorium.
- Water level controllers are used.
- Power factor is maintained near to unity with APFC.
- STP is used for water recycling which is functioning well.
- VFDs based Lift and ACs.
- Replaced old generation computers and TVs with LED monitors.
- Availability of e-vehicle inside the campus.
- Adopted Sprinkler Irrigation.
- Use of few star rated equipment

12 Recommendations for improving the energy efficiency and energy conservation in the Organization

The energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for utility operation in the audit sites.

- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- Sub meters in all the buildings for energy monitoring is recommended so that energy load required and energy consumption in each building may be noted.
- Optimal water usage and temperature settings may be used which are coming under automatic process towards energy savings.
- Continuous monitoring and analysis of energy consumption by dedicated team may be planned within the campus.
- Promoting ECON awareness and practice among the stakeholders may be conducted periodical through Association, Clubs, Forums and Chapters.
- Turn off electrical equipment when not in use
- Maintain appliances and replace old appliances in all laboratories.
- Use computers and electronic equipment in power saving mode.
- Installation of Biogas plant for hostel kitchen as well canteen.
- Automatic switches with occupancy sensors in common areas
- Monthly use of electricity in the College is very high which may be reduce to a greater extent by means of undertaking a periodical energy audit.
- There are fans of older generation and non-energy efficient which can be phase out by replacing with new energy efficient fans.
- Regular monitoring of equipment in all laboratories and immediate rectification of any problems.
- Value added / Non-formal / Certificate / Diploma course on ‘Energy and Environment Management Audits’ may be conducted for the benefit of students and research scholars to become a certified Lead Auditor.

13 Recommendations on Carbon Footprint in the Organization

- Establish a more efficient cooking system to save gas in hostel kitchen and canteen.
- More use of generators, inverters and UPS every day should be discouraged.
- Switch off the lights, fan, air conditioners, equipment and instruments when they are not in use.
- Large number of ventilation and exhaust systems may be placed in auditorium, seminar and conference halls to reduce the carbon dioxide level among the participating students, scholars and staff members.

14 Conclusions

Considering the fact that the organization is a well-established, long time run establishment with good reputation, there is significant scope for conserving energy and make the campus as self-sustained in it. The energy conservation initiatives taken up by the institution are substantial. Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'. It is observed that the most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members. Adaptation of sprinkler irrigation in the campus to minimize the energy potential are well appreciated. Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the prosperous future in context of Energy Efficiency Campus and thus sustainable environment and community development to the stakeholders in coming years to come.

15 Acknowledgement

Quality Care Alliance is grateful to the Management and Principal of AIICHTMS&R, for providing us necessary facilities and co-operation during the energy audit process. This helped us in making the audit a success. Further, we hope that the best practices on sustainability followed by the Organization and recommendations and suggestions given by the QCA will boost the new generations to take care of the Electrical energy conservation, Energy saving measures and sustainability incompliance with the applicable regulations, policies and standards in AIICHTMS&R.

ENERGY AUDIT CERTIFICATE

Consultancy & Services
qualitycare.in@gmail.com

Cert. No.: QC/EAC/22-23/056

Energy Audit Certificate

This is to certify that

Anjuman-I-Islam's

College of Hotel & Tourism Management Studies & Research

92, Dr. D.N. Road, Opp. CSMT, Mumbai - 400001. MAHARASHTRA, INDIA

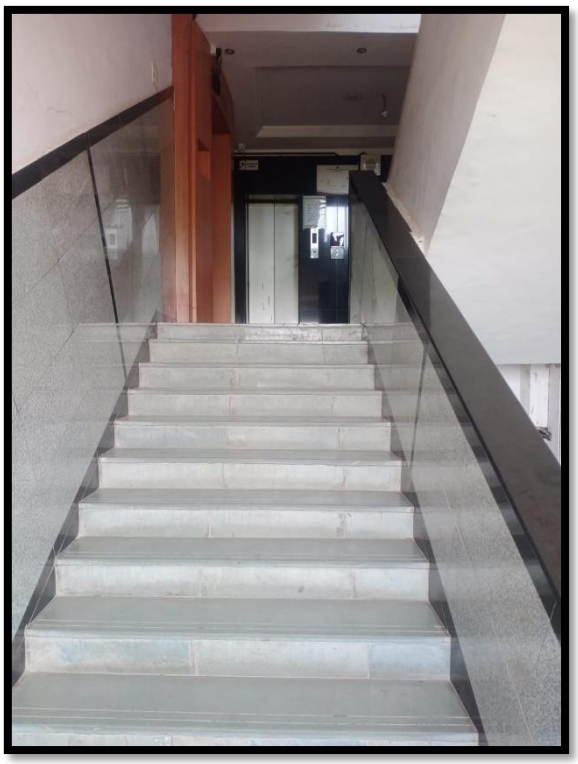
has successfully undergone the "Energy Audit" during the period of Feb to April 2023 under our supervision and the efforts taken by the management and the faculty towards the Energy Management and conservation are highly appreciable.

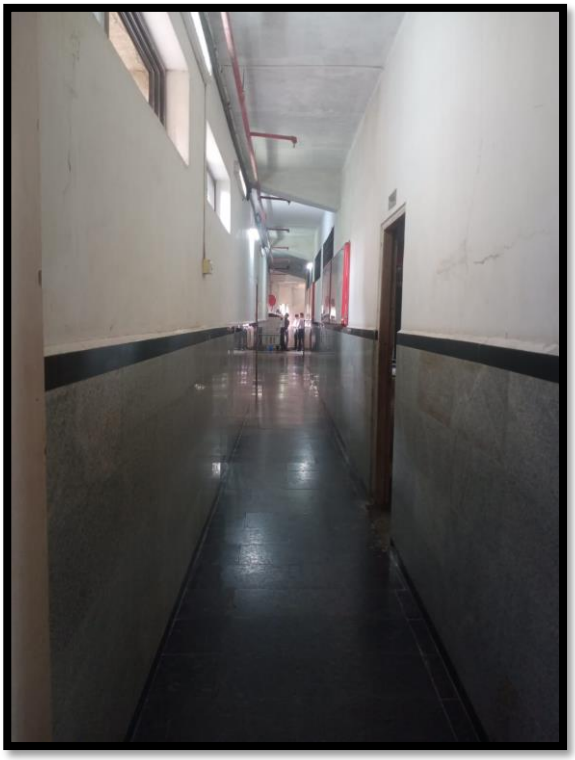
Certificate issued on : 10-April-2023

Project Head & QEHS Consultant
QUALITY CARE ALLIANCE
QUALITY I ENVIRONMENT I SAFETY I ENERGY CONSULTANTS

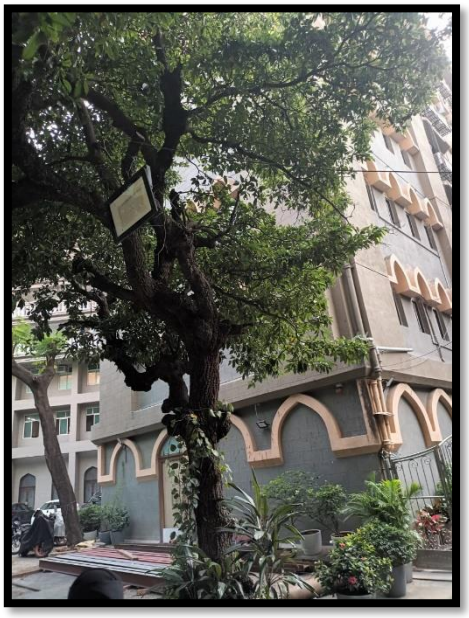
An Environment and Energy Consultancy developing healthy and sustainable Environment

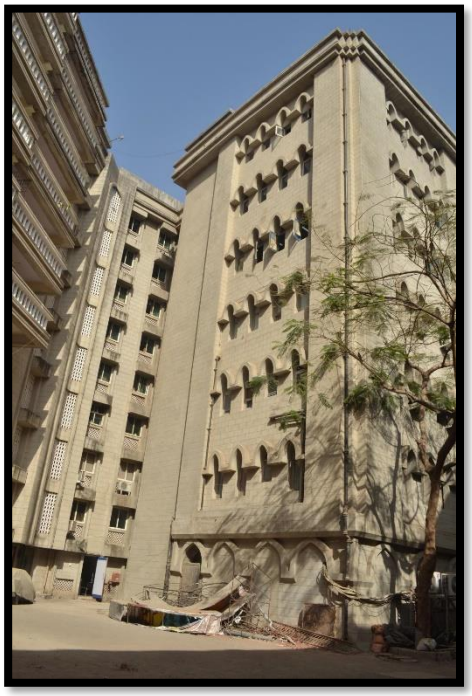
ANNEXURE: CAMPUS PHOTOS

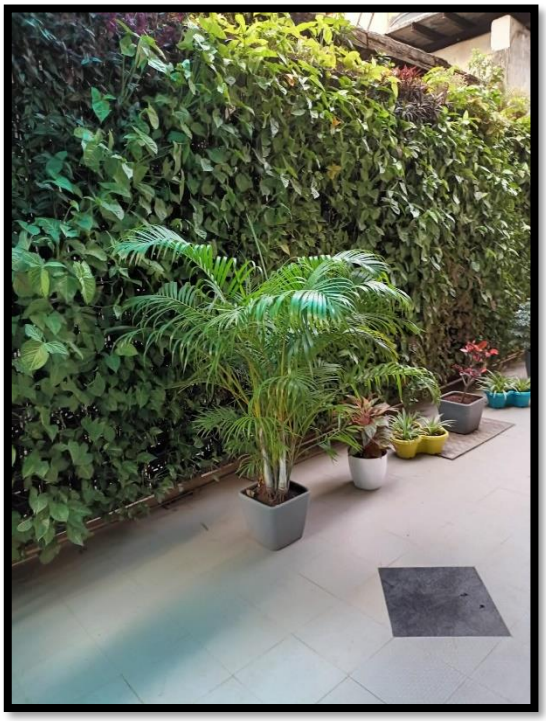




Abundant Natural Light in corridors







Green Entrance to the Campus

Session on green Air rooms in hotel

Students rallying for a Green Cause

AMPUS PHOTOS

















*********End of the Audit Report*******
THANKS!!!