TECHNICAL AUDIT REPORT
Energy Audit

Submitted to

MANNAR THIRUMALAI NAICKER COLLEGE (AUTONOMOUS)
MADURAI - 625 004, TAMIL NADU

Date of Audit: 24.08.2022

Submitted by

NATURE SCIENCE FOUNDATION
(A Unique Research and Development Centre for Society Improvement)
[ISO Certified and Ministry of MSME Registered Organization]
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1. ENERGY AUDIT

1.1 Introduction

An energy audit is a survey in which the study of energy flows for the purpose of conservation is examined at an organization. It refers to a technique or system that seeks to reduce the amount of energy used in the Organization without impacting the output. The audit includes suggestions of alternative means and methods for achieving energy savings to a greater extent. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind energy. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of conventional electric energy. In general, the primary objective of an energy auditing and management of energy consumption is to offer goods or services at the lowest possible cost and with the least amount of environmental impact (Backlund and Thollander, 2015).

Energy Conservation Building Code (ECBC) was established in the year 2017 which provides minimum requirements for the energy-efficient design and construction of buildings across India. It also provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements. The Bureau of Energy Efficiency (BEE) came into force in 2002 towards implementation of energy saving practices in an organization. Energy-efficiency labels are information affixed to manufactured products and usually communicate the product energy performance (Ingle *et. Al.,* 2014).

BEE Star Rating Scheme is based on actual performance of the building as well as equipment in terms of specific energy usage termed as 'Energy Performance Indicator' by means of star ratings labeled items used which will be useful for energy savings in a sustainable manner (Mishra and Patel, 2016). Energy audit programme provide aid in maintaining a focus on energy price variations, energy supply availability and efficiency, determining an appropriate energy mix, identifying energy- saving technology, retrofitting for energy-saving equipment and so on (Gnanamangai *et al.,* 2021, 2022; Rajalakshmi *et al.,* 2019). In general, an energy audit process dealt with driving energy conservation concepts into reality by giving technically possible solutions within a specified time limit while 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" for managing energy in the organization for planning more energy-efficient use across the board (Cabrera *et al.,* 2010).

1.2 Need for an Energy Audit

In an organization, the top three operating expenses are energy, labor and materials. Relating the manageability of the cost or potential cost savings in each of the above components, energy management is found to be the top ranker and thus energy management constitutes the essential part in reducing the cost. Energy audit helps in understanding the ways energy and fuel are being used in any organization and identifies the areas where wastes occur and the scope for improvement exists.

Energy audit gives a positive orientation to the energy cost reduction, preventive maintenance quality control programmes and will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy.

The eco-friendly campus concept essentially focuses on the efficient use of energy conservation and its savings opportunities in a sustainable way. It also gives importance for reduction in carbon emissions, carbon footprint calculation, use of star rated equipment, encouraging energy use conservation practices, reducing the organization's energy consumption, and reducing wastes to landfill. Of course, integrating environmental considerations into all contracts and services considered to have significant environmental impacts .The energy consumption, energy sources, energy monitoring, lighting, vehicle movement, electrical and electronics appliances and transportation are addressed by this indicator.

Energy usage is an important aspect of campus sustainability (Shriberg, 2002), however, energy saving and opportunities may be taken into consideration while energy is extensively used (Choy and Karudan, 2016). In addition, suggestions and recommendations might be given after auditing which in turn are useful for energy savings. Thus, it is essential for any environmentally responsible institution to examine its energy use practices at least once in two years using internal and external auditors (Sri Santhya *et al*., 2022). 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 is therefore recommended to measure the carbon footprint in each organization which may be useful for maintaining the environment friendly campus for the benefit of stakeholders.

1.2.1 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. As mentioned earlier, the aim of an energy audit is to identify the energy efficiency, conservation and savings opportunities at the audit sites in a systematic manner. The audit process involves following steps.

- Review of energy saving opportunities and measures implemented in an audit site.
- Identification of various energy conservation measures and saving opportunities.
- Implementation of alternative energy resources for energy saving opportunities and decision making.
- Providing technical information on how to build an energy balance as well as guidance to be sought for particular applications.
- Detailed analysis on energy consumption based on latest electricity bills and understanding the tariff plan provided by the Central and State Electricity Board.
- The utility of energy in terms of electricity, LPG, firewood, petrol, diesel and other resources to calculate carbon footprint analysis within the campus.
- Utility of incandescent (tungsten) bulb and CFL bulbs, fans, air conditioners, cooling apparatus, heaters, computers, photocopiers, inverter, generators and laboratory equipment and instruments installed in the organization to calculate the energy utilization.

- 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.

1.2.2 Benefits of an Energy Audit

- **Reduced energy expenses:** Less energy used by an organization, reduced the energy costs.
- **Identify problems:** Energy audit can help to identify any issues that the equipment might have.
- **Increased employee comfort:** Insulation and air sealing is an important criterion which enhances more reliable and more efficiently cooled or heated space for the employees. More comfortable employees tend to be more productive, in turn, it is not only a savings on energy costs, but will improve overall productivity.
- **Personalized recommendations:** The professional will customize a plan, recommending which upgrades will give the most return on investment which includes updated lighting, new HVAC system, weatherization measures like insulation and air sealing and more.
- **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 a facility more energy efficient could also help to increase its overall property value and longer equipment lifespan.
- **Energy audit evaluation:** Energy audits will evaluate the Organization "as a whole", the aim is to consider a wide range of available alternatives (electrical, mechanical, thermal water and transportation). The audit will not only inform about the opportunities but also provide information with financial analysis.
- **Analyzing the quality of energy audit:** It provides information with emissions analysis to help understand the benefits of the decisions from an environmental standpoint.

1.2.3 Types of Energy Audit

The energy audit types depend on the following factors:

- ✔ Industry/ Organization and its function
- ✔ Intense and the extent to which final audit is required and
- ✔ The magnitude of cost reduction

Thus, energy audits can be classified into the following types.

Preliminary Energy Audit: Preliminary energy audit gives a quick access to 1) estimating and establishing energy consumption in the organization, 2) estimate the scope of audit, 3) identify the areas of maximum energy consumption, 4) identify the areas of improvement, 5) setting benchmark on the basis of existing data.

Detailed Energy Audit: The detailed energy audit offers the most accurate estimation of energy savings and cost. A comprehensive audit provides detailed energy implementation plans for a facility, as it evaluates all major energy consumption systems. It considers the effects of all projects, accounts for the energy use of all major equipment and includes detailed energy cost saving calculations and project cost. Energy balance is the key element in detailed energy audit. The estimated use is compared to utility bill charges. There are three phases in detailed energy audit which include Phase I: pre-audit phase, Phase II: audit phase and Phase III: post audit phase.

Potential and Magnitude of Energy Audit: A systematic and structured method is necessary for an efficient working of energy audit process. An initial site study is carried out for planning the procedures necessary for an audit.

Initial site Study and Preparation for Detailed Audit

An initial site study visit might take one or two days and gives the energy auditor an opportunity to meet the concerned person (Auditee) to familiarize with the site and to assess the procedures necessary to carry out the energy audit. During the initial site visit the Energy Auditor carries out the following actions: a) discussion on the aims and scope of the energy audit b) economic factors associated with the recommendations of the audit, c) analyzing the major energy consumption data with the concerned person, d) obtaining the available audit site drawings (building layout, electricity distribution, steam distribution, compressed air distribution, etc.) and e) walk-through audit around site.

Comprehensive Energy Audit: A comprehensive audit can take from several weeks to several months depending on the nature and complexity of the site to complete the audit process. Detailed study is carried out to establish and investigate the energy and material balances for specific departments. Possible checks of plant operations were 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 Information to be Collected during the Detailed Audit Includes

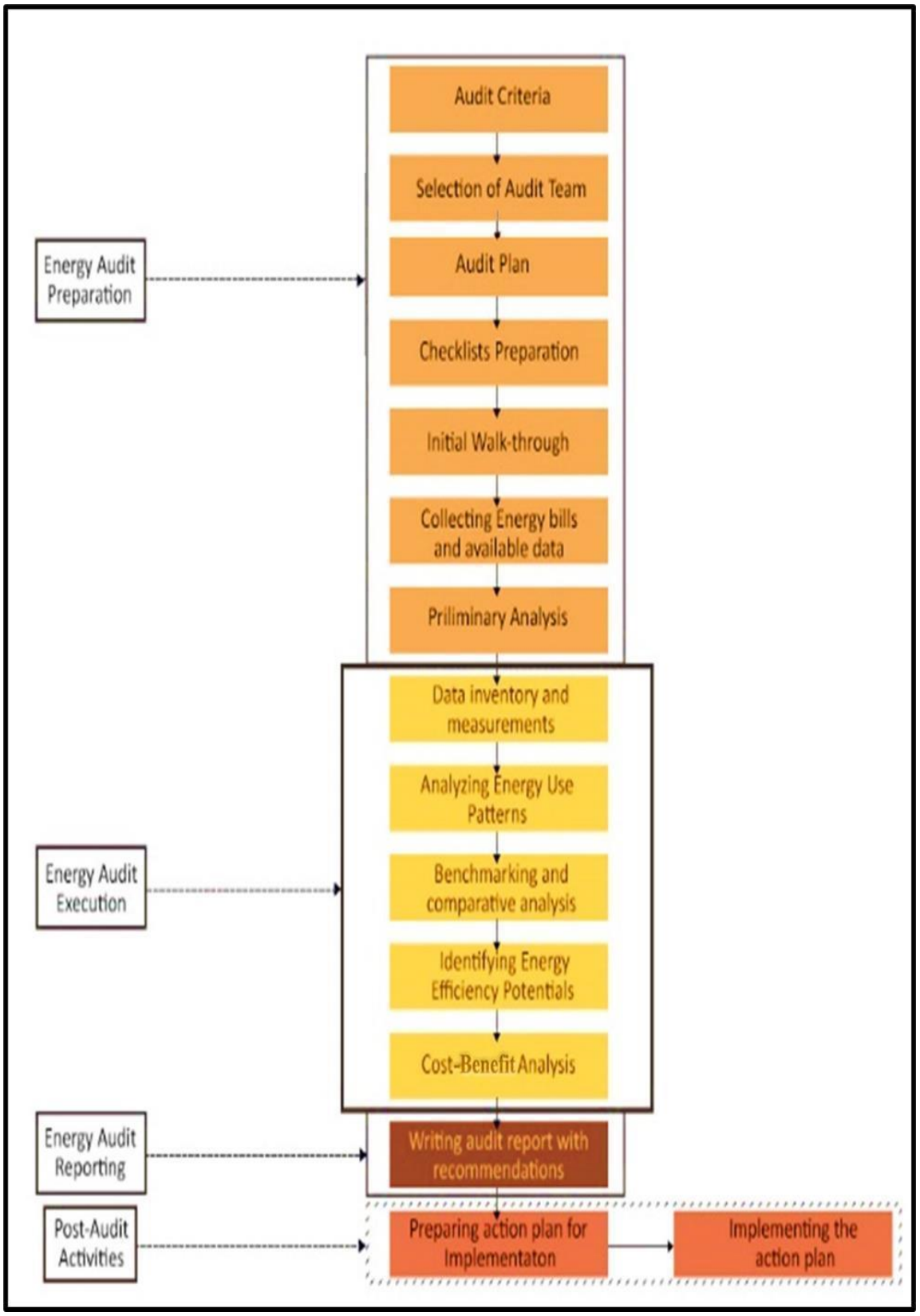
- Energy consumption by type of energy, by department/area, by type of process equipment, by end-use
- Energy cost and tariff data
- The distribution and generation of site services (eg. electricity, compressed air, steam).
- Sources of energy and its supply (e.g. electricity from the grid or self-generation)
- Potential alternative for fuel substitution, process modifications and the use of cogeneration systems (combined heat and power generation).
- Energy conservation and management awareness training programs within the Organization.
- Besides audit team collects a) major equipment details, process/technology used, b) water/fuel/steam, electrical energy consumption and c) yield efficiency.

The audit report includes a list of energy inputs and product outputs by major department or by major processing function and estimates the efficiency of each step of the Organization. The methods for improving the efficiency will be listed and it also includes preliminary assessment of the cost of the improvements and expected payback on any capital investment needed. The audit report concludes with specific recommendations for detailed engineering studies and feasibility analysis. The comprehensive energy audit is useful in identifying the major energy consuming areas to be surveyed during the audit and to identify any existing instrumentation/ additional metering required. Proper care should be taken while identifying the instrumentation required for carrying out the audit and to plan the time management for collecting the macro data from energy consuming areas.

1.3 Procedures Followed in an Energy Audit

Several methods are adopted in the energy audit, walk-through audit is one among them. 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 audit Manual. The production process flow is studied and electricity consumption is measured. Location of the electrical machines, conditions of them and their accessories are inspected through physical verification as per the regulation of Indian Green Building Council and World Green Building Council (IGBC, 2021). Physical verification of installed electrical appliances and when considering the cost or prospective cost savings in each of the above components, energy always wins and the energy management task becomes a key cost reduction area.

An energy audit is proposed and conducted to ensure that energy saving practices is implemented and followed in Educational Institutions and Industrial sectors in a sustainable way. Preparation and completion of a questionnaire, physical examination of the campus, observation and examination of documentation, key person interviews, data analysis, measurements and suggestions are all part of the audit process. Energy audit involves several facts including energy savings potential, energy management, finding alternatives, etc. (Cabrera *et al*., 2010; Rajalakshmi *et al.*, 202*1*; Leon- Fernandez and Dominguez-Vilches, 2015; Bae and Seol, 2006; Singh *et al*., 2012). It may be useful to check where carbon emission is prominent which could be taken into account to reduce. 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).



Flow chart of Energy Audit Methodology

1.4 Carbon Footprint

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 the 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 to a massive increase of carbon dioxide emissions by burning fossil fuels, deforestation, and other industrial activities. Methane (CH_4) is largely released by coal, oil and natural gas industries. Anthropogenic 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 (Peters and Romi, 2014).

Components of Carbon Footprint

1.5 Observations of the Energy Audit

1.5.1 Facilities Visited

During onsite audit following departments were verified for physical facility availability.

Table 1. Facilities Visited During the onsite Energy Audit

Date	Section where Energy audit is conducted
24.08.2022	Administrative Block
	Power House
	Faculty Rooms
	Classrooms
	Seminar Halls
	Auditorium
	Laboratories
	Computer Centers
	Well, Sump and pumps.
	Sewage Treatment Plant
	Hostel
	Library

In all these areas lighting systems form the major consumer of electrical energy. In all the sections lighting fixtures, installed energy efficient lighting systems/ safety systems were verified besides installed power backup systems (generators and UPS) were verified. The electricity consumption charges are audited and studied for the load demand requirement and efficient consumption of energy. The scope for improvement has been discussed with the auditees. Potential areas in which scope of energy conservation and saving opportunities available have been identified and suggested for implementation.

1.5.2 Qualitative Measures Available at the Campus According to the Checklist

It has been observed that except a criterion, all others satisfy the checklist prepared in accordance with National Building Code (Part - 11).

Table 2. Qualitative measures available at the Institute

S. No.	Part 11 clause as per the National Building Code	Audit Checklist / Parameters	Audit Findings (C / NC/ PC)
1.	3.5. Energy efficient design and process	Use of non-fossil fuel energy for all needs at the campus (solar, wind, etc.,)	C
2.		Examine the natural lighting, cooling and ventilation facilities	C
3.	6.2.8. Optimal day lighting	Whether the building ensures 25% of day lighting which will be measured using Lux meter during onsite audit.	C

4.	7.1.3.3. Landscape design for controlling solar gain	Observation on energy conservation activities through vegetation (more number of trees)	C
5.	7.4.2. Long term public and private transportation plan	Availability of electric vehicles	C
6.		Use of public transport by the stakeholders to reduce air pollution	C
7.	8.3.1. Integration of solar thermal technologies	Availability of solar panel, solar street light and solar water heater.	C
8.	11.3. Natural and mechanical ventilation strategies	Availability of spatial cooling techniques through windows	C
9.	11.8. HVAC system	Whether the campus has air cooler, air conditioners, refrigerants, exhaust air fans, ceiling, pedestal fans and provision of separate server room / data centre facilities.	C
10.	11.9. Electrical system	Availability of appropriate metering for energy consumption and replacing old electrical items with latest star rated gadgets / appliances	C
11.		Replacement of fluorescent (tube) lights, incandescent lamp, insect traps and sodium vapour lights with CFL / LED lamps, insect traps towards energy saving opportunities.	C
12.		Whether transformer, generators and UPS are protected properly with fencing and kept awareness boards as ‘Dangers’ and ‘Warnings’	C
13.		Use of Ultra-violet lights and any other harmful lights with safety precautions in the campus	C
14.		Sign boards indicating Switch OFF / ON, Danger at Electrical equipment and Power transformers	C
15.	12.3.4. Establishing energy consumption and creating bench marks	Database on annual energy consumption using cost profile	C
16.		Database on annual energy consumption of fuels (Diesel, petrol and LPG)	C
17.	12.4.4. Noise monitoring	Measure the noise level using Sound level meter during onsite audit	C
18.	13.3. Operation and maintenance Programme	Calculate carbon footprint using electrical energy and fuel consumptions.	C

19.	Energy saving opportunities	Availability of transformer, generators, UPS convertor, inverter, compressor, stabilizers, etc.,	C

1.6 Quantitative Measures

In this section, quantitative measures observed/verified and secondary data obtained from the management representative/ IQAC coordinator is presented.

1.6.1 Energy Consumption and Cost Profile

The following chart shows the profile of energy consumed and the cost for one year by the auditee.

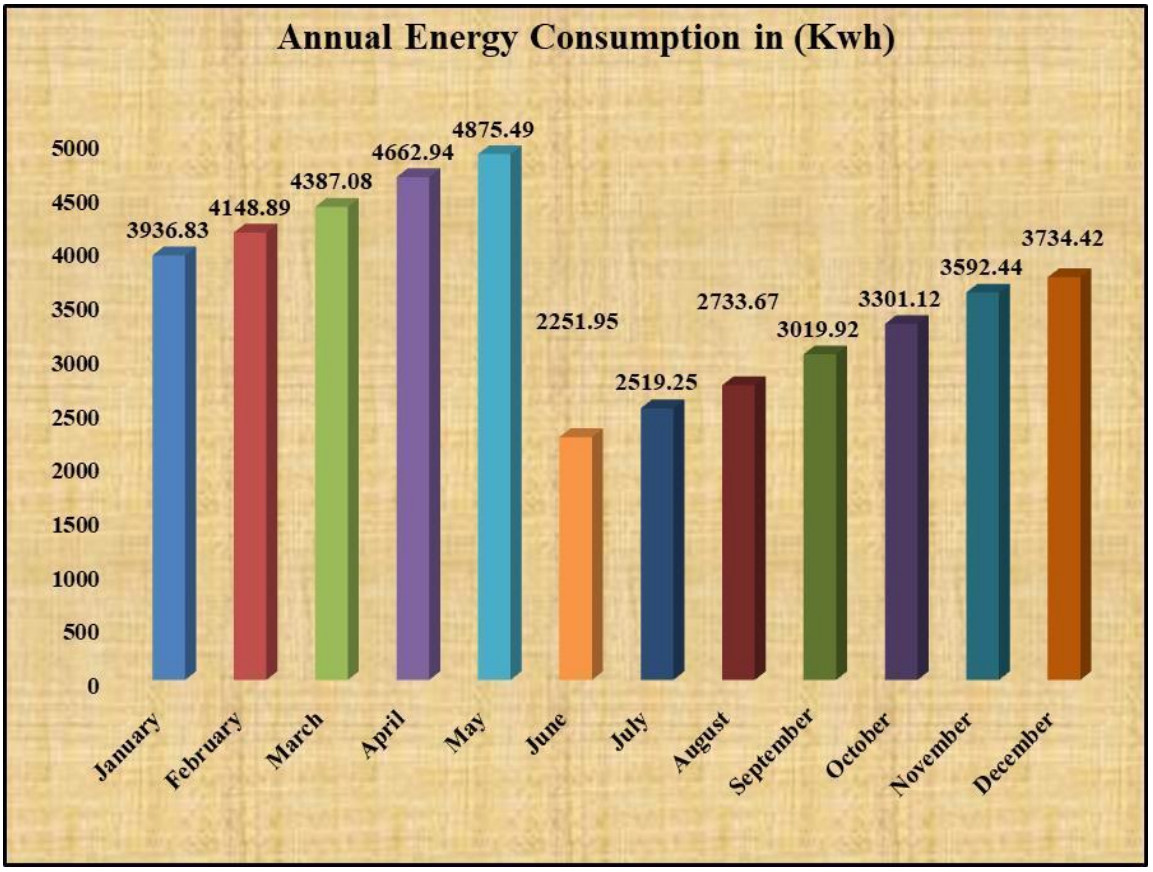


Figure 1. Electrical energy consumption profile (kwh)

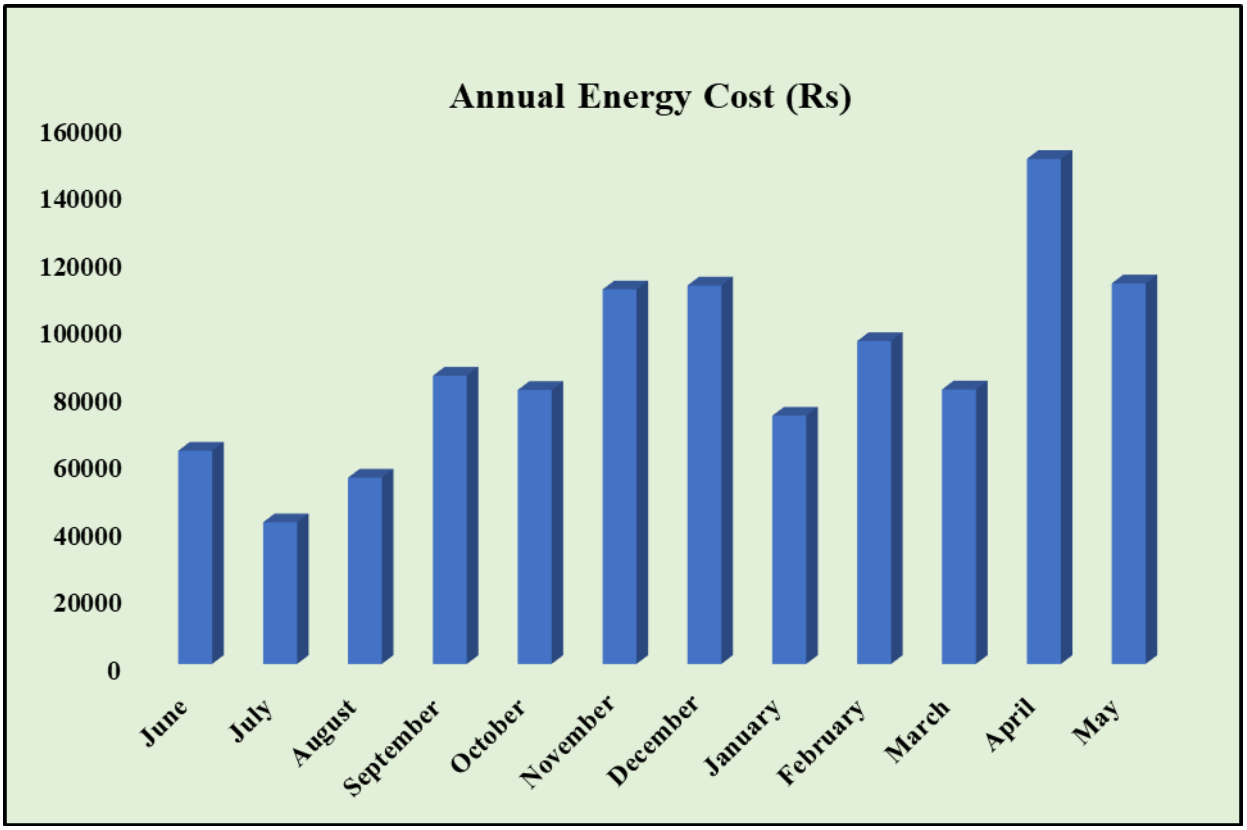


Figure 2. Annual Electrical Energy Consumption Cost (Rs.)

Table 3. Electrical Energy Consumption and Cost Profile in the Institution

S.No	Months	Energy Consumption (Kwh)	Energy Cost Amount (Rs)
1.	June (2021)	7528.6	63303
2.	July (2021)	4913.1	42049
3.	August (2021)	6974.1	55307
4.	September (2021)	14581.2	85549
5.	October (2021)	10434.3	81311
6.	November (2021)	18206.9	111175
7.	December (2021)	14664.7	112345
8.	January (2022)	8845.84	73692
9.	February (2022)	11969.3	95860
10.	March (2022)	10647.6	81478
11.	April (2022)	19905.8	149935
12.	May (2022)	14976	112971

1.6.2 Power Consuming Equipment and Electrical Appliances

The following Table reveals the number of energy consuming electrical appliances available in the auditee's physical facility.

Table 4. Major equipment related to electrical energy utilization in campus

S.No	Major and Minor Equipment, Instruments and Machineries Utility on day-to-day basis	Rating Capacity	Quantity
1.	LED Lights	10 – 15 Watts	150
2.	LED Focusing Light	18 Watts	100
3.	UV Lamps	Nil	Nil
4.	CFL	36Watts	69
5.	Solar Water Heater	500 Liter	1
6.	Solar Panel	30 kw	55
7.	UPS	1KVA	137
8.	LCD Projectors	Nil	100
9.	Refrigerators	200 Liter	5
10.	Solar Street Lights	40Watts	5
11.	Lift	1-8 members 13 members	2
12.	RO Water Plant & Water Purification System	1000 L -1	5
13.	AC (Split, Window and Centralized AC)	Centralized AC 1- 5.5 ton 2- 8.5 ton Split AC 1.5 ton Split AC 1ton Window AC 0.75 Ton	 2 17 2 2
14.	Stabilizers	5KVA	28
15.	Inverters & Converters	Nil	Nil
16.	Generators	100 KVA 30 KVA	3
17.	Air Coolers	Nil	Nil
18.	Ceiling Fans	50 Watts	1240
19.	Pedestal Fans	100 Watts	10
20.	Table Fans	Nil	Nil
21.	Motor Pumps	2hp single Phase 5hp 3phase 2 hp single phase	3
22.	Compressors	3hp -3phase 1.5 hp single phase	2
23.	Vacuum Cleaner	2 liters	1
24.	Ventilators	windows	Natural ventilation

25.	Exhaust Fans	50 CFM	4
26.	Insect Trap	40 W	1
27.	Automatic Sensor Lights	Nil	Nil
28.	Internet Connectivity	100 MBs	BSNL-1

1.6.3 Power Consuming Equipment and Electrical Appliances

Other than electrical energy from the grid, energy generated using fossil fuels for the year 2022 are presented in the Table.

Table 5. Annual Energy Consumption of Fuels in the Institute

S.No	Month	Diesel consumption (Liters)	Petrol consumption (Liters)	LPG consumption (kg)
1	June (2021)	Nil	3.75	304
2	July (2021)	10.5	5.83	304
3	August (2021)	11	8.94	304
4	September (2021)	10.5	13.04	304
5	October (2021)	8	8.72	304
6	November (2021)	Nil	7.73	304
7	December (2021)	168.68	14.7	304
8	January (2022)	87.06	9.31	304
9	February (2022)	10.5	10.3	304
10	March (2022)	28.38	14.54	304
11	April (2022)	10.5	5.38	304
12	May (2022)	Nil	14.02	304

1.6.4 Energy Consuming Vehicles

Institutions run the e-vehicles for the benefit of its stakeholders.

Table 6. Transportation Facilities available in the Campus

S.No	Type of Vehicle	Fuel Used (Diesel in litres)	No. of Vehicles	Non-Pollution Certified (Y/N)
1.	Bus	Diesel	1	Y
2.	Bike	Petrol	1	Y
3.	Trucks	Diesel	1	Y

1.6.5 Calculation of Carbon Footprint

The carbon footprint analysis can be calculated based on the earlier reports as stated in www.carbonfootprint.com which is the sum of electricity usage per year (Padmini, 2007). According to the data provided by the Management, carbon emission due to electricity consumption and fossil fuels are presented hereunder.

The CO_2 Emission from Electricity

= (electricity usage per year in kWh/1000) x 0.84, where 0.84 is the coefficient to convert kWh to metric tons
= (148444 kWh/1000) x 0.84
= 124.69 metric tons

According to the above calculations, carbon emission due to electricity usage per year accounts for 124.69 metric tons.

Transportation per Year (Shuttle)

= (Number of the shuttle vehicle in the campus (2) x total trips for shuttle bus service each day approximate travel distance of a vehicle each day inside campus only (20 km)x 365/100) x 0.01
= ((1 x 20 x 1 x 365)/100)) x 0.01
= 0.8 metric tons

200 is the number of working days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for bus

a. Transportation per Year (Car)

= (Number of cars entering the campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.02
= ((15 x 20 x 1 x 365)/100)) x 0.02
= 21.9 metric tons

365 is the number of working days per year
0.02 is the coefficient to calculate the emission in metric tons per 100 km car

b. Transportation per Year (Motorcycles)

= (Number of motorcycles entering the campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.01
= ((2500 x 20 x 1 x 365)/100)) x 0.01
= 584 metric tons

365 is the number of working days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for motorcycles.

c. Total Carbon emission per Year

= total emission from electricity usage + transportation (bus, car, motorcycle)
= (124.69+ 0.8 + 21.9 + 584)
= 731.39 metric tons

1.6.6. Ways to Reduce Carbon Footprint

Evaluating and understanding the CO_2 emission can reduce the negative impact on the environment. Tiny changes can bring good impacts like when it comes to transportation, food, clothing, waste, etc., the following tips help in reducing the carbon footprint (Vinoth Kumar *et al*., 2021).

Food: Consumption of local and seasonal food products, limiting the consumption of meat, adopting sustainable fishing, avoiding plastic packed food products and practicing the use of reusable bags and sense of buying only necessary things that can impact on carbon emission.

Clothing: Taking good care of clothes, avoiding buying second hand products or borrowing and using the clothes made from recycled products with eco labels can also improve the reduction in carbon emission.

Transport: Adopting carpooling practice, using cycles and public transport and usage of "No Pollution" certified vehicles also contribute reduction in carbon emission.

Energy and Waste: Turning down the heating, short showers, proper usage of water while brushing teeth or cleaning the dishes, proper care while charging the batteries, selecting star rated equipment and EU Energy labeled products and reducing and recycling of wastes can also contribute to reduction in carbon emission.

1.7 Noise Level Measurements

Noise is all unwanted sound or set of sounds that causes annoyance or can have a health impact and noise level is measured in decibels (dB). Noise pollution is defined as consistent exposure to elevated sound levels that may cause adverse effects in humans or other living organisms. World Health Organization (WHO) defined environmental noise (sound produced by transport, industrial activities, construction sites, public works and services, cultural, sporting and leisure activities and neighborhood) as noise from all sources with the exception of workplace noise and recognizes that noise pollution is an increasing problem. Prolonged exposure to loud noises (>75 dB (A) over eight hours a day for years) can lead to hearing loss.

The body can also respond to lower noise levels. Level of noise is expected to be within 55 dB in residential areas, including institutions. Class room noise levels are supposed to be around 50 db. From the graph, it is evident that most of the noise level values across campus are above the normal or permissible range. Within the auditorium the noise levels were within range. Sound levels in other areas of campus are largely due to the interactions of people on campus than any other causes like construction or traffic. Sound Level Meter / Noise Thermometer are used to measure the noise level in the surroundings which converts the sound signal to an equivalent electrical signal and the resulting sound pressure level in decibels (dB) referenced to 20 μPa. Noise level prescribed by Central Pollution Control Board was presented in the Table.

Level of Noise in Various Locations and Working Place

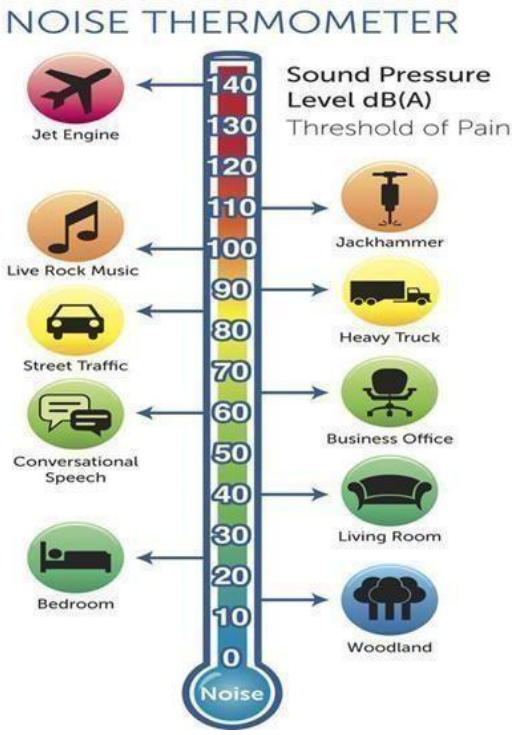


Table 7. Noise Level at Various Locations in the Campus

S.No	Locations	Measurements (dB)	Major Noise Sources	Remarks
1.	Classroom	33.33±1.5	Students and Staff members	No Noise Pollution
2.	Auditorium	31.77±0.4	Students	No Noise Pollution
3.	Seminar hall	25.67±0.4	Students	No Noise Pollution
4.	Library	24.93±1.2	Staff members	No Noise Pollution
5.	Laboratory	30.13±1.8	Students	No Noise Pollution
6.	Canteen	26.20±0.7	Publics	No Noise Pollution
7.	Open area	28.13±1.2	Students and staff members	No Noise Pollution
8.	Parking area	33.33±1.4	Vehicles	No Noise Pollution
	Mean	29.4		
	SE	1.12		
	CD	1.84		

Table 8. Noise level standard prescribed by Central Pollution Control Board, Government of India

Area Code	Zone	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence	50	40

Measurement of Noise level at various places

1.8 Light Intensity Measurement at the Campus

Light intensity or light output is used to measure whether a particular light source provides enough light for an application needed. There is a well-established light level recommendation for a wide range of applications in the lighting industry and also for the type of space. Understanding the light intensity helps to properly evaluate whether the space has adequate lighting conditions or not. Light intensity is measured in terms of lumens per square foot (foot-candles) or lumens per square meter (lux). Measuring the amount of light that falls on a surface allows us to evaluate if the particular space has sufficient light to perform the tasks.

A light meter (lux meter) is used to measure the amount of light in a space/on a particular work surface. The light meter consists of a sensor that measures the light falling on it and provides the user with a measurable illuminance reading. Light meters are an especially useful tool for measuring light for safety or over-illumination.

The light intensity is usually measured by taking initial reading, where the lightings are turned off (Baseline measurement) and the final reading is taken by turning on the lights in the particular space (illuminated level) Subtracting the baseline measurement from illuminated level gives the light intensity of the particular room.

Table 9. Standards for Comparison

S.No	Building Type	Space Type	Illuminances (LUX)
1.	Barracks / Dormitories	Bed Rooms	300
		Laundry Rooms	
2.	Educational Buildings	Play Room, Nursery, Classroom, Lecture Hall	400
		Computer Practice Rooms	300
3.	Office Buildings	Single Offices, Open plan Offices	400
		Conference Rooms	300
4.	Hospitals	General ward Lighting	300
		Simple Examination	500
		Examination and Treatment Ward	1000
5.	Hotels and Restaurants	Kitchen	500
		Buffet	100
6.	Sports Facilities	Sports halls	300
7.	Circulation areas	Corridors and Stairs	500
		Cloak Rooms, Wash Rooms,	
		Bath Rooms, Toilets	300
8.	Industrial areas	Metal working / Welding	300
		Simple Assembly	300
		Difficult Assembly	1000
		Exacting Assembly	3000-10000

Reference set of values for LUX

Source: lumitronlighting.com www.lumitronlighting.com/lighting_nowledge/LUX

Table 10. Light Intensity Measured at Various Locations in the Institute

S.No	Type of Spaces	Illuminances (LUX)
1.	Classroom	352.67±8.0
2.	Auditorium	538.00±4.4
3.	Seminar hall	503.33±8.1
4.	Library	528.00±3.6
5.	Laboratory	388.33±3.2
6.	Canteen	430.67±3.8
7.	Open area	448.67±9.5
8.	Parking area	475.67±7.5
	Mean	535.2
	SE	7.01
	CD	12.49

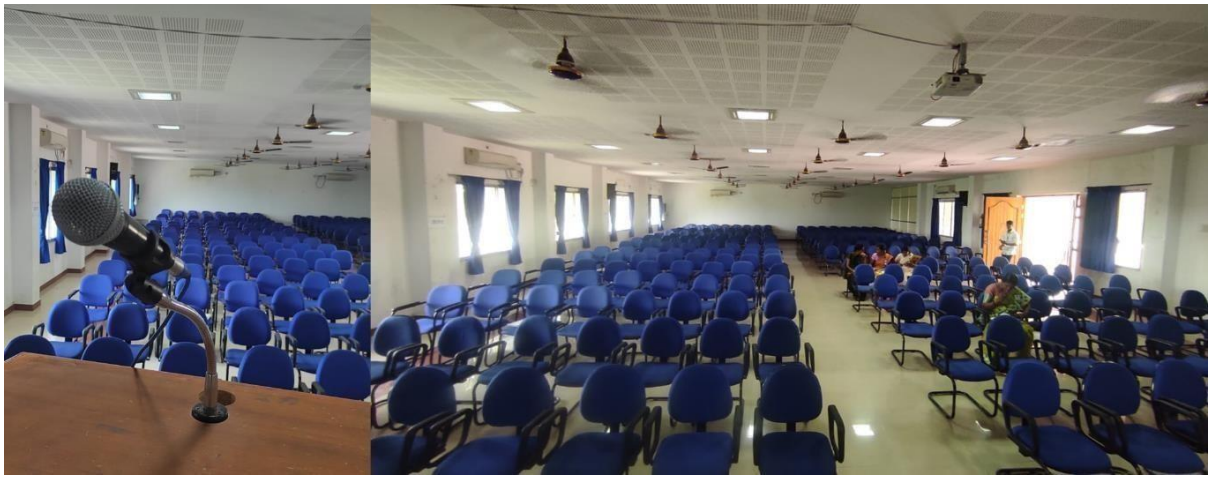
1.9 Other Facilities

Within the auditees premises, there are other facilities are available that are depicted as glimpses of photographs

Solar Panel Junction and Lift Facility in the Mannar Thirumalai NaickerCollege

Power Room Facility and DG set are well Maintained in the Mannar Thirumalai Naicker College, Tamil Nadu.

Solar Unit Panels Facility Available in the
Mannar Thirumalai Naicker College, Madurai, Tamil Nadu



Auditorium Facility Available in Mannar Thirumalai Naicker College, Madurai, Tamil Nadu

1.10 Compliances

- Transformer, generators and UPS are protected properly with fencing and kept by awareness boards.
- Most of places, sign boards of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the users.
- Electrical wires, switch boxes and stabilizers are properly covered which will cause any problems to the staff and students.

- Solar power plants were installed on rooftop of two buildings and power generated through solar power plants is exported.
- Usage energy efficient light-emitting diodes, bulbs instead of incandescent and CFL bulbs and replaced old generation computers and TVs with LED monitors.
- Maintenance of appliances and replaced old appliances in all laboratories
- HVLS fans are fitted in the auditorium.
- Water level controllers are used besides STP for water recycling which is functioning well.
- Establishment of a system of carpooling among the staff members and students to reduce the number of four wheelers coming to the College.
- Discouraging the students and research scholars using two wheelers for their commutation in the campus.
- Promoting ECON awareness and practice among the stakeholders are being conducted periodically through Association, Clubs, Forums and Chapters.
- Value added / Non-formal / Certificate / Diploma courses on 'Energy and Environment Management Audits' are being conducted for the benefit of students and research scholars.

1.11 To Improving the Energy Efficiency within the Organization

- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- Daylight sensors can be implemented in future Star rated fan can be used and DG set Automatic sync can be implemented
- 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 a dedicated team may be planned within the campus.
- Internal energy policy such as preventive maintenance and breakdown maintenance policy should be implemented.
- Energy meter in each building to be implemented
- Establish more efficient cooking systems like biogas operated machineries to save fossil gas in hostel kitchen and canteen.
- More use of generators, inverters, and UPS every day should be discouraged which could save electrical energy.

1.12 Conclusion

Considering the fact that the organization is a well-established, 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. There are some best practices followed as listed above. Consideration provided in this report can further improve energy savings of the organization which in turn reduce the carbon emissions effectively. 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.

Certificates of Nature Science Foundation Coimbatore, Tamil Nadu.

1. ISO Certificate (QMS 9001:2015)
2. ISO Certificate (EMS 14001:2015)
3. ISO Certificate (OHSMS 45001:2018)
4. ISO Certificate (EnMS 50001:2018)
5. MSME Certificate

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This is to Certify That The Quality Management System of

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has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

PROVIDING ENVIRONMENT, ENERGY, GREEN AND HYGIENE AUDITS
TO ACADEMIC INSTITUTIONS AND ORGANISATIONS
AS PER THE OWN CHECKLIST AND AWARDS TO
MERITORIOUS CANDIDATES.

Certificate No	**20DQHY90**		
Initial Registration Date	: 08/01/2021	Issuance Date	: 08/01/2021
Date of Expiry*	: 07/01/2024		
1st Surve. Due	: 08/12/2021	2nd Surve. Due	: 08/12/2022

DIRECTOR

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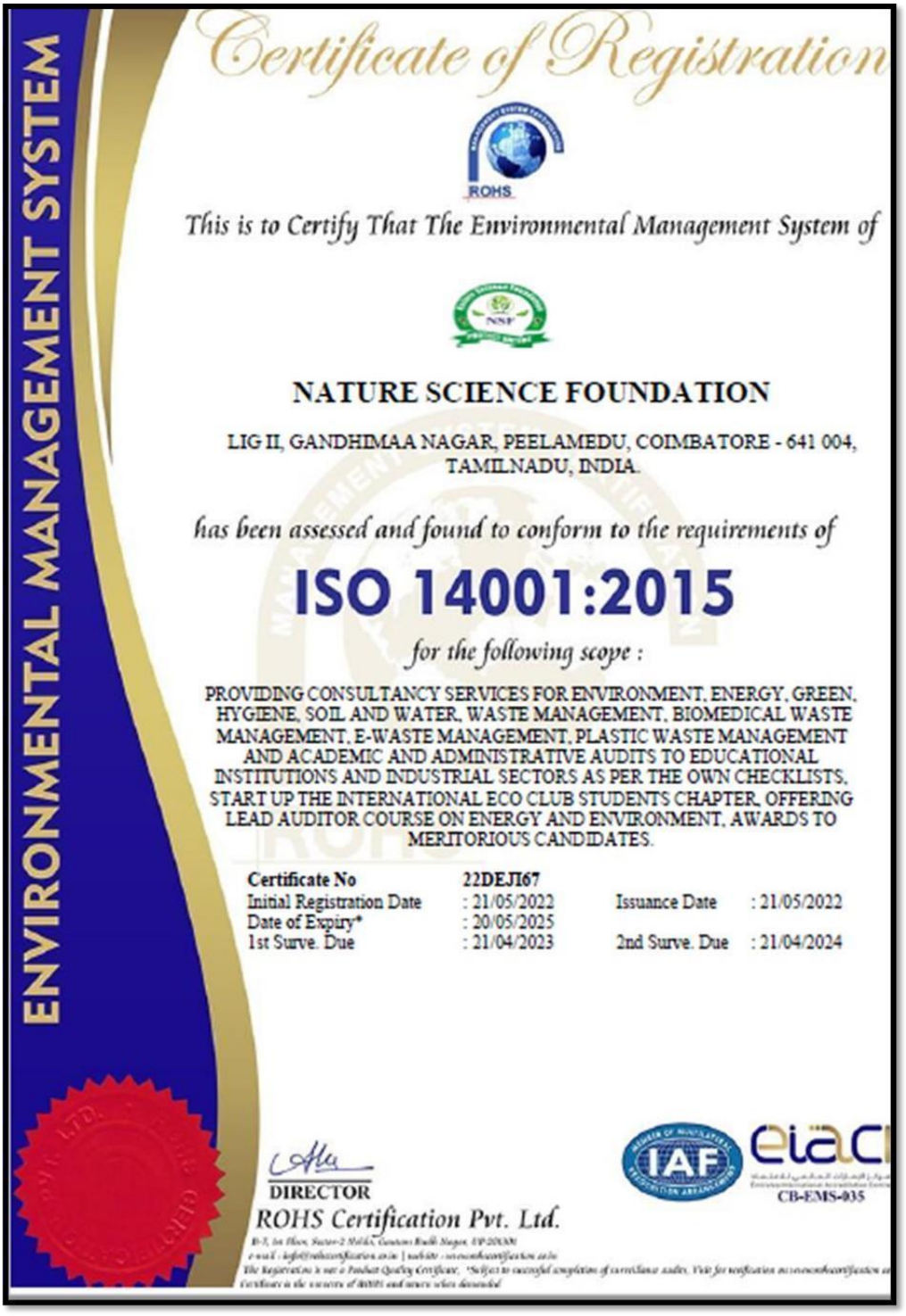
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Certificate of Registration
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for the following scope :
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Certificate No 22DEJI67
Initial Registration Date : 21/05/2022
Issuance Date : 21/05/2022
Date of Expiry* : 20/05/2025
1st Surve. Due : 21/04/2023
2nd Surve. Due : 21/04/2024
DIRECTOR
ROHS Certification Pvt. Ltd.
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CB-EMS-035

QCS MANAGEMENT PVT. LTD.

MANAGEMENT SYSTEMS CERTIFICATION

Certificate of Registration

ISO 45001:2018 (Occupational Health & Safety Management System)

NATURE SCIENCE FOUNDATION

ADDRESS: NO. 2669, LIG-II, GANDHI MANAGAR PEELAMEDU COIMBATORE - 641 004 TAMIL NADU, INDIA.

Scope of Certification:

PROVIDING TRAINING AND AUDITING SERVICES IN THE FIELD OF GREEN CAMPUS, ENVIRONMENT, ENERGY, OCCUPATIONAL HEALTH AND SAFETY, HYGIENE AND WASTE MANAGEMENT AT EDUCATIONAL INSTITUTES AND INDUSTRIAL SECTOR.

Certificate Number : QCS/EUAS/OHS/002

		1ST Surveillance Audit Within	: 02/07/2023
Issue Date	: 03/08/2022	2nd Surveillance Audit Within	: 02/07/2024
Expiration Date	: 02/08/2023	Re-certification Due Date	: 02/08/2025

Partha Bagchi
(Managing Director)

Validity of this Certificate is subject to Surveillance Audits to be conducted before scheduled due dates of surveillance audits as mentioned on the certificate, failing which the certificate will stand to be withdrawn and need to be treated as an initial certification process to reactivate its continuity on the register of EUAS and QCS . This Certificate is valid when confirmed by data listed on the (Euro Universal Accreditation Systems) EUAS" www.euas-ac.org. The authenticity & validity of this certificate may be re-affirmed by referring to our company website - www.qcspl.com . Lack of fulfillment of conditions as set out on the 'Certification Contract' (Annex 13) may render this certificate invalid. Any alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of law. This certificate remains the property of QCS and to be returned on request.

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Email: info@qcspl.com. Call: +91 8697724963,+91 8902447427. Website: www.qcspl.com

QRO
QUALITY RESEARCH ORGANIZATION

Certificate of Registration

This is to certify that

NATURE SCIENCE FOUNDATION

LIG II, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004, TAMILNADU, INDIA.

has been independently assessed by QRO

and is compliant with the requirement of:

ISO 50001:2018

Energy Management Systems

For the following scope of activities:

PROVIDING CONSULTANCY SERVICES FOR ENVIRONMENT, ENERGY, GREEN, HYGIENE, SOIL AND WATER, WASTE MANAGEMENT, BIOMEDICAL WASTE MANAGEMENT, E-WASTE MANAGEMENT, PLASTIC WASTE MANAGEMENT AND ACADEMIC AND ADMINISTRATIVE AUDITS TO EDUCATIONAL INSTITUTIONS AND INDUSTRIAL SECTORS AS PER THE OWN CHECKLISTS, START UP THE INTERNATIONAL ECO CLUB STUDENTS CHAPTER, OFFERING LEAD AUDITOR COURSE ON ENERGY AND ENVIRONMENT, AWARDS TO MERITORIOUS CANDIDATES.

Date of Certification: 9th August 2022
1st Surveillance Audit Due: 8th August 2023
2nd Surveillance Audit Due: 8th August 2024
Certificate Expiry: 8th August 2025

Certificate Number: 305022080903EN

QRO QUALITY RESEARCH ORGANIZATION

EGAC CAB # 119005

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

Head of Certification

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भारत सरकार
Government of India
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय
Ministry of Micro, Small and Medium Enterprises

UDYAM
REGISTRATION CERTIFICATE

UDYAM REGISTRATION NUMBER	UDYAM-TN-03-0073706
NAME OF ENTERPRISE	M/S NATURE SCIENCE FOUNDATION
TYPE OF ENTERPRISE *	MICRO
MAJOR ACTIVITY	SERVICES
SOCIAL CATEGORY OF ENTREPRENEUR	GENERAL

NAME OF UNIT(S)

S.No.	Name of Unit(s)
1	Green Campus, Energy and Environment Management Audits

OFFICAL ADDRESS OF ENTERPRISE

Flat/Door/Block No.	LIG-II,2669	Name of Premises/ Building	GANDHIMAA NAGAR
Village/Town	Gandhimaanagar S.O	Block	LIG-II
Road/Street/Lane	Peelamedu	City	Coimbatore South
State	TAMIL NADU	District	COIMBATORE , Pin 641004
Mobile	9566777255	Email:	chairmannsf@gmail.com

DATE OF INCORPORATION / REGISTRATION OF ENTERPRISE	28/11/2017
DATE OF COMMENCEMENT OF PRODUCTION/BUSINESS	12/03/2020

NATIONAL INDUSTRY CLASSIFICATION CODE(S)

SNo.	NIC 2 Digit	NIC 4 Digit	NIC 5 Digit	Activity
1	69 - Legal and accounting activities	6920 - Accounting, bookkeeping and auditing activities; tax consultancy	69201 - Accounting, bookkeeping and auditing activities	Services
2	85 - Education	8542 - Cultural education	85420 - Cultural education	Services
3	85 - Education	8549 - Other education n.e.c.	85499 - Other educational services n.e.c.	Services

DATE OF UDYAM REGISTRATION	26/02/2022

* In case of graduation (upward/reverse) of status of an enterprise, the benefit of the Government Schemes will be availed as per the provisions of Notification No. S.O. 2119(E) dated 26.06.2020 issued by the M/o MSME.

Disclaimer: This is computer generated statement, no signature required. Printed from https://udyamregistration.gov.in & Date of printing - 26/02/2022

For any assistance, you may contact:

1. District Industries Centre: COIMBATORE (TAMIL NADU)

2. MSME-DI: CHENNAI (TAMIL NADU)

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1. Bureau of Energy Efficiency (BEE), LEED AP and GRIHA Certificates of Er. D. Dineshkumar, Energy and Environment Auditor of NSF.

2. Indian Green Building Council (IGBC AP) Accredited Professional of Dr. B. Mythili Gnanamangai, Vice-Chairman of NSF.

3. Tamil Nadu Fire and Rescue Service Certificate of Er. S. Srinivash, Energy Auditors of NSF.

4. Energy Management System ISO 50001:2018 Certificate of Dr. D. Vinoth Kumar, Joint Director of NSF.

5. ISO 17020:2012 certificate of Ms. V. Sri Santhya, Assistant Director of NSF.

BUREAU OF ENERGY EFFICIENCY

Examination Registration No. : EA-14056 Serial Number. 9176

Certificate Registration No. : 9176

Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. Dinesh Kumar D Son/Daughter of Mr./Mrs. R M Dhanasekaran who has passed the National Examination for certification of energy manager held in the month of October 2011 is qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency (Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate and shall be renewable subject to attending the prescribed refresher training course once in every five years.

His /Her name has been entered in the Register of certified energy manager at Serial Number 9176 being maintained by the Bureau of Energy Efficiency under the aforesaid regulations.

Mr./Mrs./Ms. Dinesh Kumar D is deemed to have qualified for appointment or designation as energy manager under clause (/) of Section 14 of the Energy Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this 7th day of February, 2013

Digitally Signed: RAKESH KUMAR RAI
Sun Mar 01 10:58:55 IST 2020
Secretary, BEE New Delhi

Secretary
Bureau of Energy Efficiency
New Delhi

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature
22.12.2019			

ENERGY IS LIFE
BEE
CONSERVE IT

ऊर्जा दक्षता ब्यूरो
BUREAU OF ENERGY EFFICIENCY

विद्युत मंत्रालय, भारत सरकार
MINISTRY OF POWER, GOVERNMENT OF INDIA

प्रमाणित किया जाता है कि

श्री/श्रीमती दिनेश कुमार ने ऊर्जा संरक्षण भवन निर्माण संहिता के लिए 7 दिसंबर '16 से 8 दिसंबर '16 तक ~~एमएनआईटी~~ / ~~सीईपीटी~~ /आईआईआईटी द्वारा आयोजित मास्टर ट्रेनर सर्टिफिकेट कार्यक्रम को सफलता पूर्वक सम्पन्न कर लिया है।

This is to certify that

Shri/Smt. Dinesh Kumar has successfully completed the Master Trainer Certificate Programme conducted by ~~MNIT~~ / ~~CEPT~~ / IIIT from 7 December '16 to 8 December '16 for the Energy Conservation Building Code.

नई दिल्ली, 07 JUL 2017
New Delhi,

महानिदेशक
Director General

ot on OnePlus
esh

TAMILNADU FIRE & RESCUE SERVICES
THIRUVALLUR DISTRICT
THIRUVALLUR

CERTIFICATE

This is to certify that Mrs. / Mr S. SRINIVASH S/o B. SWAMIYAPPAN 4/855, ST. XAVIER'S Street, Pannur, Thiruvallur District has under gone the "Basic Fire Fighting & Rescue Operation" Training course conducted from 11.08.2016 to 26.08.2016 by Tamil Nadu Fire & Rescue Services Department at Thiruvallur District, Thiruvallur as per G.O.M.S. No.713, dated 17.08.2005 Home (Police XVII) Department, Government of Tamil Nadu.

Station: Thiruvallur.
Date: 20.9.16

District Officer 20.9.16
Fire & Rescue Services
Thiruvallur District.
Thiruvallur

GEM Certificate

ASSOCHAM

ASSOCHAM hereby certifies that

Dr. B. Mythili Gnanamangai

has successfully passed the

Green and Eco-friendly Movement Certified Professional Test (GEM CP)

with

"Excellent Performance"

on

16 July, 2021

He/she is now eligible to execute the GEM Sustainability Certification Projects.
ASSOCHAM feels proud to award the GEM Certified Professional title to him/her.

Pankaj R. Dharkar
Chairman, GEM

GEM CP 20/649

Deepak Sood
Secretary General, ASSOCHAM

IGBC

CII
Confederation of Indian Industry

The Indian Green Building Council

hereby certifies that

B Mythili Gnanamangai

has successfully demonstrated knowledge on the Green Building Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts, required to be awarded the title of

IGBC Accredited Professional

K S Venkatagiri
Executive Director
CII-Godrej GBC

V Suresh
Chairmar
Indian Green Building Council

Gurmit Singh Arora
Vice-Chairman
Indian Green Building Council

210122

17 April 2021

TAMILNADU FIRE & RESCUE SERVICES

THIRUVALLUR DISTRICT

THIRUVALLUR

CERTIFICATE

This is to certify that Mrs. / Mr S. SRINIVASH S/o B. SWAMIYAPPAN 4/855, ST. Xavier's Street, Paanur, Thiruvallur District has under gone the "Basic Fire Fighting & Rescue Operation" Training course conducted from 11.08.2016 to 26.08.2016 by Tamil Nadu Fire & Rescue Services Department at Thiruvallur District, Thiruvallur as per G.O.M.S. No.713, dated 17.08.2005 Home (Police XVII) Department, Government of Tamil Nadu.

Station : Thiruvallur.

Date : 20.9.16

District Officer 20.9.16
Fire & Rescue Services
Thiruvallur District.
Thiruvallur

GRIHA

GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT

GRIHA CERTIFIED PROFESSIONAL CERTIFICATE

This is to certify that

Dinesh Kumar Dhanasekaran

has qualified as a **GRIHA** Certified Professional For V. 2015

Date of issue: 19th June 2020

Note : This certification is valid only for GRIHA version 2015.

Chief Executive Officer
GRIHA Council

LEED AP BD+C

GREEN BUSINESS CERTIFICATION INC. CERTIFIES THAT

DINESH KUMAR D

HAS ATTAINED THE DESIGNATION OF

LEED AP® Building Design + Construction

by demonstrating the knowledge and understanding of green building practices and principles needed to support the use of the LEED® green building program.

10531234-AP-BD+C
CREDENTIAL ID

26 DEC 2016
ISSUED

25 DEC 2022
VALID THROUGH

MAHESH RAMANUJAM
PRESIDENT & CEO, U.S. GREEN BUILDING COUNCIL
PRESIDENT & CEO, GREEN BUSINESS CERTIFICATION INC.

QCS MANAGEMENT PVT LTD

The CPD Accreditation Office

Certificate of Successful Attainment

This is to certify that

DR. D. VINOTH KUMAR

HAS SUCCESSFULLY COMPLETED THE FIVE DAYS (40 HOURS)

LEAD AUDITOR COURSE

BY PASSING THE WRITTEN EXAMINATION BASED ON

ISO 50001:2018

ENERGY MANAGEMENT SYSTEMS

Examination Date: 15/07/2022
Certificate issue Date: 22/07/2022
Certificate registration number: QCS/TR/C/0056
Total Course duration: 40 hours CPD Credits Earned: 32

Remarks: Roughly one hour of study time equals to 1 CPD Credit.

This certificate can be validated online from the industry wide Global Professional Register at www.qcspl.com.

Partha Bagchi
(Managing Director)

QCS MANAGEMENT PVT LTD

Accredited by "CPD Accreditation Office UK"

H.O: 37E/1(310) 2ND STREET, MODERN PARK, SANTOSHPUR, KOLKATA-700075, WEST BENGAL, INDIA
BRANCHES: INDONESIA, BANGLADESH, QATAR, SAUDI ARABIA, TURKEY, UAE
WHATTS APP: +918697724963/+918902447427,
EMAIL:info@qcspl.com, WEB: www.qcspl.com

Accredited Centre
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NATURE SCIENCE FOUNDATION

A Unique Research and Development Centre for Society Improvement
(ISO 9001:2015, 14001:2015, 45001:2018 & 50001:2018 Certified Organization
& Ministry of MSME Registered Organisation)
Coimbatore - 641 004, Tamil Nadu, India. [www.nsfonline.org.in]

Regd. No. 114 / 2017

Ministry of MSME, Govt. of India

Certificate of Energy Audit

NSF/ENERGY AUDIT/MTNC/2022/43

This is to certify that Mannar Thirumalai Naicker College, Madurai – 625 004, Tamil Nadu has successfully undergone 'Energy Audit' on 24th August 2022 and assessed the electrical energy conservation, energy saving measures and sustainability in compliance with the applicable regulations, policies and standards in the campus were found to be excellent.

This Certificate is valid till 25th August 2025.

Ref. No: ISO/NSF/SER/R/43

(Dr. S. RAJALAKSHMI JAYASEELAN)
Chairman of NSF
Certified ISO QMS, EMS, EnMS, OHMSMS

(Mr. BSC. NAVEEN KUMAR)
Faculty, Mahatma Gandhi National Council for Rural Education Ministry of Higher Education,
New Delhi.

(Dr. B. MYTHILI GNANAMANGAI)
Certified Auditor IGBC AP & ASSOCHAM
Indian Green Building Council

(Er. D. DINESH KUMAR)
BEE Certified Energy Auditor
Bureau of Energy Efficiency