# Report on Energy Audit

NATURE SCIENCE FOUNDATION
A Unique Research and Development Centre for Society Improvement
(An ISO 9001:2015 Certified Organization)
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Regd. No. 114 / 2017

Certificate of Energy Audit

NSF/ENERGY AUDIT/ NCW/2021/16

This is to certify that Kovai kalaimagal Educational Trust, Coimbatore – 641 109, Tamil Nadu, India has successfully undergone 'Energy Audit' on 16th December, 2021 to assess the Electrical energy conservation, Energy saving measures and sustainability incompliance with the applicable regulations, policies and standards in the Campus was found to be excellent.

*This Certificate is valid till 17th December, 2024.*
*Ref. No: ISO/NSF/SER/R/07*

(Mrs. Rajalakshmi Jayaseelan)
Chairman of NSF
Certified ISO QMS & EMS Auditor

(Dr. B. Mythili Gnanamangai)
Certified Auditor IGBC AP & ASSOCHAM
Indian Green Building Council

(Er. B. Vijayalakshmi)
Certified Energy & Environment Auditor
Environmental Management System
(ISO 14001:2015)

(Er. D. Dinesh Kumar)
BEE Certified Energy Auditor
Bureau of Energy Efficiency

15/11/2023
Principal
Coimbatore Institute of Management & Technology
Narasipuram, Coimbatore - 641 109.

# REPORT OF ENERGY AUDIT


***Submitted to***

## KOVAI KALAIMAGAL EDUCATIONAL TRUST

**(Kovai Kalaimagal Arts and Science College)**
**(Coimbatore Institute of Engineering and Technology)**
**(Coimbatore Institute of Management and Technology)**
**(School of Architecture - CIET)**

**Coimbatore – 641 109, Tamil Nadu, India.**

***Date of Audit: 16.12.2021 (Thursday)***

***Submitted by***


## NATURE SCIENCE FOUNDATION

***(A Unique Research and Development Centre for Society Improvement)***

**An ISO 9001:2015 Certified Organization**

**LIG -II, 2669, Gandhi Managar, Peelamedu**
**Coimbatore – 641 004, Tamil Nadu, India.**
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# Report on Energy Audit

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# Report on Energy Audit

## 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 extend. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of 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). The need for an energy audit is to identify the savings potential and cost reducing methods, understand the ways in which fuel is used, where, the waste occurs and find the scope for improvement.

An energy audit is proposed and conducted to ensure that energy saving practices are 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) With these facts in mind, the audit's specific objectives are to assess the competence of the sustainability management and control system, as well as the departments' compliance with applicable rules, policies and standards. It has the potential to have a significant influence on the organization's operational cost as well as the environmental impact (Singh *et al.*, 2012).

Energy Conservation Building Code (ECBC) is 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 (Gnanamangai *et al.*, 2021). 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, 2014). BEE has developed a scheme for energy efficiency labelling of buildings coinciding with the star ratings of the building at accelerating energy efficiency activities. 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 labelled items used which will be useful for energy savings in a sustainable manner (Mishraand 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. In general, an energy audit process dealt with the driving conservation concepts into reality by giving technically possible solutions within a specified time

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. Needfor 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 (Wang *et al.*, 2013). 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 (Wang *et al.*, 2013).

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 (Vinothkumar *et al.*, 2021). 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 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).

## Report on Energy Audit

- 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 auditevaluation:** 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 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) and Vinothkumar *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: Tamil Nadu Electric Generation and Distribution Corporation Limited, Chennai) 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.

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The audit involves visiting physical position of load & carry out inventory of load. Due measurement of electrical load of equipment and circuit is carried out. Energy bill received from TNEB 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:

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

## 6.2. 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 (Rajalakshmi *et al.*, 2021). 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

## 6.3. 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.

# Report on Energy Audit

***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: -

- Discuss with the site's senior management the aims of the energy audit.
- Discuss economic guidelines associated with the recommendations of the audit.
- Analyse the major energy consumption data with the relevant personnel.
- Obtain site drawings where available – building layout, steam distribution, compressed air distribution, electricity distribution etc.
- Tour the site accompanied by engineering/production

***The main aims of this visit are:***

- To finalise Energy Audit team
- To identify the main energy consuming areas to be surveyed during the audit.
- To identify any existing instrumentation/ additional metering required.
- To decide whether any meters will have to be installed prior to the audit eg. kWh, steam, oil or gas meters.
- To identify the instrumentation required for carrying out the audit.
- To plan with time frame
- To collect macro data on major energy consuming centers
- To create awareness through meetings/ programme.

## 6.4. 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 (Bae and Seol, 2006). 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 and also useful for the green campus and environment management audits. Due to energy audit process, cost effective savings may be benefitted by the auditee.

***The information to be collected during the detailed audit is:***

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

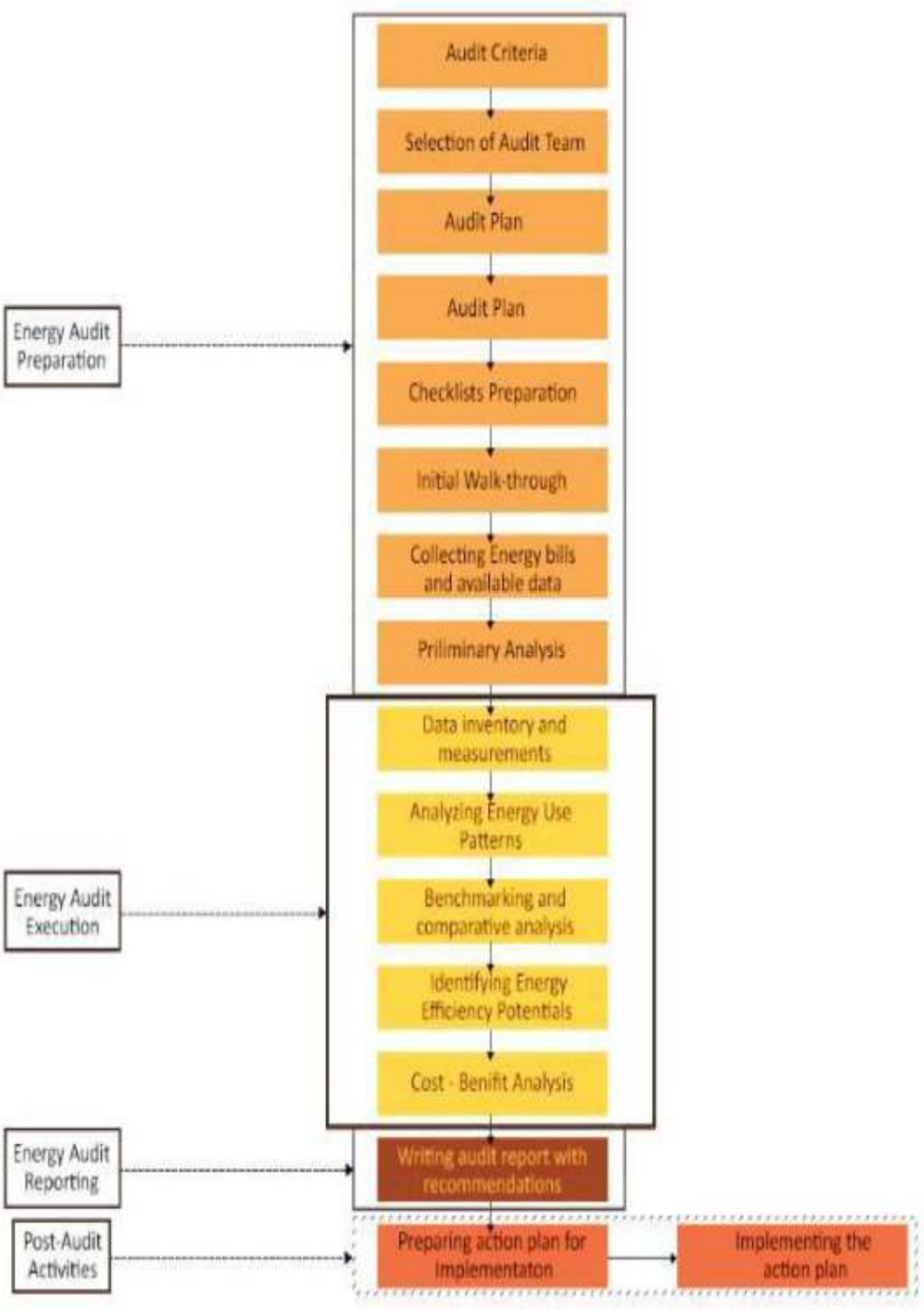
**7. CarbonFootprintby measuring Carbon dioxide level in the Campus**

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 ($CH_4$) 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 (Peters and Romi, 2014).

## Report on Energy Audit




**Flow-chart ofthe Energy Audit Methodology**

## Report on Energy Audit


**Diagrammatic representation of 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.



**Audit Team of the NSF executing the energy audit process**

# Report on Energy Audit


**Walk-through Energy Audit by the NSF Audit Team**

## 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

- Physical verification of lighting, fan a/c machines, ventilators load fixtures.
- Verification of installed energy efficient systems.
- Inspection of Solar panel, Generators, Uninterrupted power supply machines.
- Inspect and verify the maintenance aspects of installed Generators and additional backup power sources.
- Analyse the electricity consumption through the supply utility company (Example: Tamil Nadu Electric Generation and Distribution Corporation Limited, Chennai).
- Review the potential usage of alternative energy resources.
- Review the energy conservation awareness among the stakeholders for optimum use of electricity and its savings.

## 8.3. 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 (Shriberg, 2002).

## 8.4. Walk-through Energy 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.

### 8.5. 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 electrical load in each building are calculated with respect to the usage of various equipment and utility current bills in each component including usage of power on terms of electrical energy. The power ratings of each component and their respective hours of operation are also observed and documented for preparing the recommendations to the Organization.

### 8.6. 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 such as $CO_2$, $O_2$, CO, $SO_x$, $NO_x$, combustion efficiency are the mechanical, thermal and other parameters that are analysed during the audit depending upon the requirements (Pramanik, 2013).

## 9. About the Institute

### Kovai Kalaimagal Educational Trust

The Kovai Kalaimagal Educational Trust established in the year 1992 with an aspiration to quench the educational thirst of the poor and the needy strata of the society particularly from rural area. It sprouted with the establishment of a school and soon extended to add Kovai Kalaimagal College of Arts and Science in the year 1996 – 1997, Coimbatore Institute of Management and Technology in 1996 – 1997, Coimbatore Institute of Engineering and Technology in 2001 – 2002 and School of Architecture CIET in 2013 – 2014. The trust is managed by the dedicated team of trustees Dr. T. Banumathi, Dr. T. Namradha, Dr. K. A. Chinnaraju, Tmt. P. Shanmugadevi, Thiru. S. Subramanian and Thiru. M. Thangavelu who fully devotes their time for the development of the institutions under the trust and it is due to their tireless efforts, the colleges have carved a name for themselves in the academic circle.

### Coimbatore Institute of Engineering and Technology

### About the College

Coimbatore Institute of Engineering and Technology offers the students with an advantageous atmosphere with state-of-the-art facilities, distinguished mentors, and pleasant educational environment. The institution provides employability and communication skills for the development of students. It provides quality education in an atmosphere of discipline. The focus is on shaping students to become self-disciplined, self-dependent and self-confident individuals. Coimbatore Institute of Engineering and Technology pulls out all the stops to mold the students' career in such

a way that they excel in all subtle distinction of life. The College's stand is not only on the mere acquisition of course knowledge and its application but also on all-round personality development of the student and his value system. The infrastructure facilities have also been made to allow detailed learning ambience for the students. The full-fledged eco-friendly offers a quality environment to the students

Towards fulfilling the above objectives, the Kovai Kalaimagal Educational Trust established Coimbatore Institute of Engineering and Technology in the year 2001 following the general policy of the Govt. of Tamil Nadu to give high priority to Technical Education. The campus is spread over a vast area of about 26.5 acres and has 2.25 Lakh sq. ft. of the constructed area which includes classrooms, drawing halls, laboratories, workshops and associated facilities. CIET is located about 25 km from Coimbatore city, the institute has a very picturesque and serene atmosphere surrounded by green hillocks.

**Courses Offered**

1. B.E. – Civil Engineering
2. B.E. – Computer Science and Engineering
3. B.E. – Electronics and Communication Engineering
4. B.E. – Electrical and Electronics Engineering
5. B.E. – Mechanical Engineering
6. B.E. – Mechatronics Engineering
7. B. Tech. – Information Technology
8. M.E – Computer Science and Engineering
9. M.E. – Communication Systems
10. M.E. – Engineering Design
11. MBA

**Kovai Kalaimagal College of Arts and Science**

**About the College**

Kovai Kalaimagal College of Arts and Science (KKCAS) Narasipuram, Coimbatore is founded by Kovai Kalaimagal Educational Trust, in the year 1996 with a noble mission to educate the students from rural areas. It is a co-educational institution with an eon of 25 golden years. The institution is a concoction of eco-friendly atmosphere and fine edification. Located at the serene and picturesque view of Vaidehi falls, Adiyogi and scenic mountains in Vellimalaipattinam, the college has a tranquil setting to impart the students with holistic education.

The Trust lays emphasis on the all-round development of the students. The institution primarily focuses on enlightening students from rural areas who have a less prospect of acquiring a proficient learning with nominal fee. Importance is given to creativity, self-confidence, assertiveness, communication skills, leadership qualities and ethical values of the individual. Besides these, the college specially focuses on the development of knowledge, skill and attitude of the students. Separate in-campus hostels are offered for both boys and girls. Students can utilize college buses for their hassle-free conveyance.

**Courses Offered**

1. B.Com
2. B.Com (CA)
3. B.Com (PA)
4. BBA (CA)

5. B.Sc. (CS)
6. B.Sc. (IT)
7. BCA

8. B.Sc. Mathematics (CA)
9. B A English Literature
10. M.Com (CA)
11. M.Com (IB)
12. M.Sc. (CS)
13. M.Sc. (IT)

**Coimbatore Institute of Management and Technology**
**About the College**

Coimbatore Institute of Management and Technology (CIMAT) was established in 1996, by Kovai Kalaimagal Educational Trust. The institute is approved by All India Council for Technical Education (AICTE), New Delhi, approved by the Ministry of Human Resource Development (MHRD), New Delhi, affiliated to Bharathiar University, Coimbatore and has been granted autonomy by the University Grants Commission.

It is located at the foothills of Western Ghats and South India's Manchester -Coimbatore sprawling over a land area of about 10 acres, surrounded by green hillocks, we are in close proximity to some of the leading manufacturing hubs in the city, pioneers in manufacturing Mechanical components, Textiles, Automobile and consumer product companies, giving us the added advantage of integrating classroom knowledge with practical experience. We have centres of excellence that offer courses and conduct research on interesting questions facing various sectors of industry.

**Courses Offered**

1. MBA
2. MCA
3. M. Phil
4. Ph.D.

**School of Architecture, Coimbatore Institute of Engineering and Technology**
**About the College**

School of Architecture – CIET Coimbatore, Tamilnadu, India was established in the year 2013 by the Kovai Kalaimagal Educational Trust (KKET) with the motto of "Light the Light Within." Emphasis is placed on the holistic development of the students coupled with value based education through sound ethics.

- Though we nurture and are working towards a futuristic vision, we strongly believe in sustained growth and progress. Presently the college offers Bachelors of Architecture (B.Arch) five year full-time under graduate degree programme.
- The college is an example of cultural unity with students drawn from most of the districts in the state and the neighbouring states. The teaching learning Process is highly innovative with presentations and interactions for curriculum enhancement.
- School of Architecture-CIET is affiliated to Anna University, Chennai and approved by Council of Architecture, New Delhi.

## Report on Energy Audit

- The serene and resplendent mountainous locality of heart-warming atmosphere is an additional boon as it improves the conduciveness for the academic pursuit of the students.

**Courses Offered**

1. B. Arch

**10. Audit Details**

| | |
|---|---|
| **Date/Day of Audit** | **: 16.12.2021 (Thursday)** |
| **Venue of Audit** | **: Kovai Kalaimagal Educational Trust**<br>Coimbatore, Tamil Nadu, India. |
| **Audited by** | **: Nature Science Foundation,**<br>Coimbatore, Tamil Nadu, India. |
| **Audit type** | **: Energy Audit** |
| **Name of ISO EMS Auditor** | **: Mrs. S. Rajalakshmi,**<br>Chairman & ISO EMS Auditor, NSF. |
| **Name of Lead Auditor** | **: Dr. R. Mary Josephine,**<br>Board of Directors, NSF.<br>**Er. B. Vijayalakshmi,**<br>Deputy Director & Certified Energy Auditor, NSF. |
| **Name of Energy Auditors** | **: Dr. P. Thirumoorthi,**<br>Professor in Electrical & Electronics Engineering<br>Kumaraguru College of Technology, Coimbatore.<br>**Dr. Shahida A. T.,**<br>MES MAMPAD COLLEGE, Kerala.<br>**Dr. ANAS E.,**<br>MES MAMPAD COLLEGE, Kerala. |
| **Name of IGBC AP Auditor** | **: Dr. B. Mythili Gnanamangai,**<br>IGBC AP, Indian Green Building Council. |

**11. Observations of the Energy Audit**

**11.1. Facilities visited during the Energy Audit**

| Date | Section where Energy Audit is conducted |
|---|---|
| 16-12-2021 | Administrative Block |
| | Power House |
| | Faculty Rooms |
| | Classrooms |
| | Seminar Halls |
| | Auditorium |
| | Laboratories |
| | Computer Centres |
| | Well, Sump and pumps. |

| | |
|---|---|
| | canteen |
| | Hostel |
| | Library |

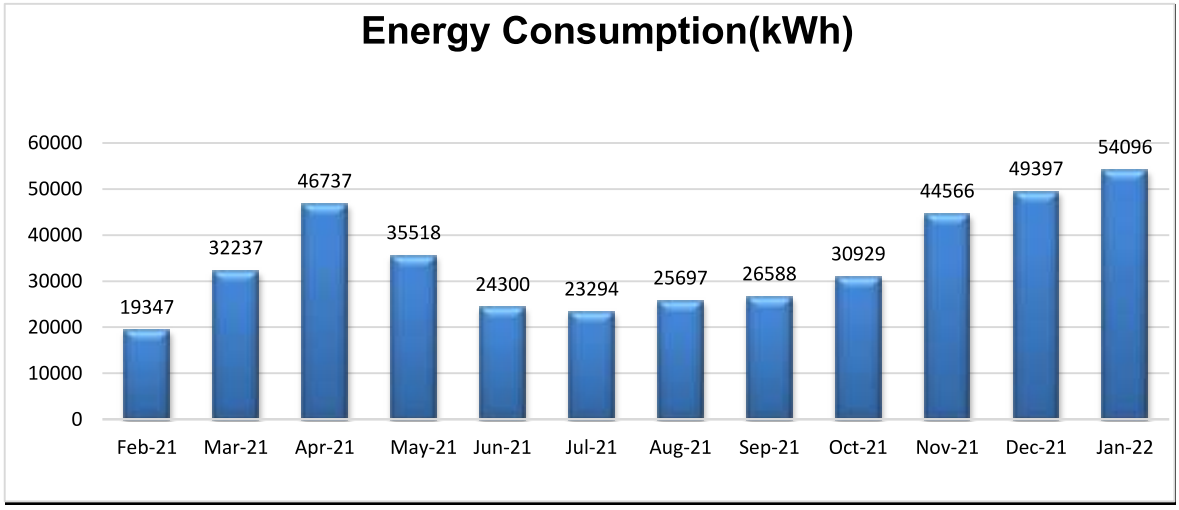
In the sections, the services offered are monitored, verified and analysed on the aspects of energy consumption. In all these areas lighting systems forms the major consumer of electrical energy. Three phase electricity service connections available in the campus are provided by Tamilnadu Generation and Distribution Corporation Limited (TANGEDCO Sr.No.542). 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.

## 11.2. Systems Studied during the Energy Audit

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

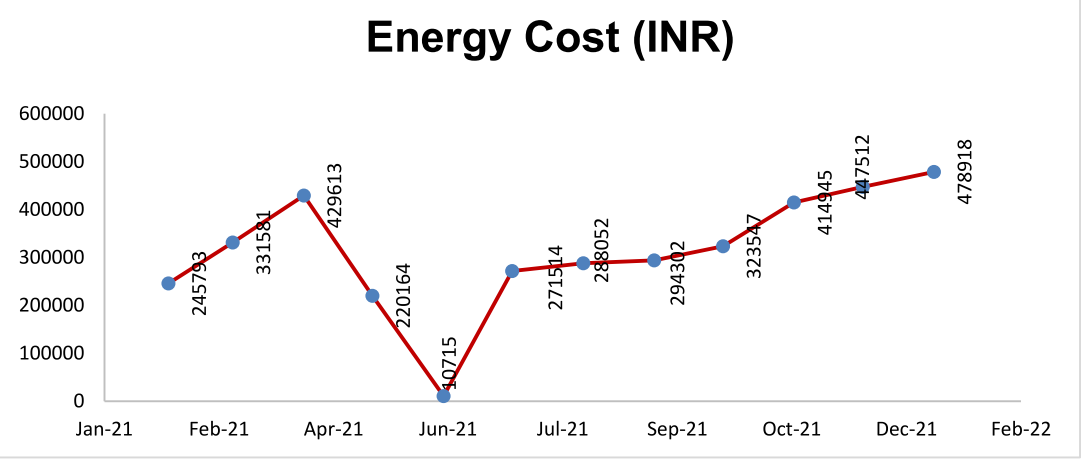
## 11.3. Energy Consumption and Cost Profile

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




Energy Consumption Profile

Report on Energy Audit




Energy cost profile

### 11.4. Power supply Equipment and Major Loads

Transformer : 630 KVA.
Sanctioned MD : 500 KVA.
Generator : 500 kVA- 1No., 320 kVA- 1No., 140 kVA- 1No.

**Table 1 Major Equipment related to Electrical energy utilization**

| S. No. | Equipment / utility | Rating / Capacity | Quantity |
|---|---|---|---|
| 1 | LED Lamps | 0.5W | 330 |
| 2 | Fluroscent Light (Tube Lights) | 40W | 2688 |
| 3 | CFL | 22W | 220 |
| 4 | Focus Lamp | NIL | NIL |
| 5 | Generator | 500 KVA | 1 |
| | | 320KVA | 1 |
| | | 140KVA | 1 |
| 6 | Pump 1- Borewell | 5 HP | 3 |
| 7 | Pump 2 | 7.5 HP | 1 |
| 8 | Solar Water Heater | | 4 |
| 11 | UPS - 1(CIMAT) | 10 KVA | 4 |
| 12 | UPS - 2(ARTS) | 10 KVA | 2 |
| | | 30 KVA | 1 |
| 13 | UPS - 3(CIET) | 10 KVA | 15 |
| | | 20 KVA | 1 |
| 14 | UPS - 4( B.Arch) | 40 KVA | 2 |
| | | 10 KVA | 1 |
| 16 | Water doctors | 380W | 19 |
| 17 | RO plant | 5HP/ 5000 LPH | 1 |
| 18 | Refrigerator in Kitchen | | 5 |
| 19 | Refigerator in Laboratories | - | 3 |

| | | | |
|---|---|---|---|
| 20 | Varanda light load | LED-9W | 422 |
| 21 | Fans | 60W | 1903 |
| 22 | Acs | 2 Tons | 82 |
| | Split Acs | 0.5 Ton | 2 |
| 23 | Printers | | 27 |
| 24 | Copiers | | 2 |
| 25 | Computers | | 523 |

**Table 2. AnnuaEnergy Consumption of Fuels**

| S.No | Month | Units Consumed (kWh) | Diesel Consumption (Liters) | Petrol Consumption (Liters) | LPG Consumption (kg) |
|---|---|---|---|---|---|
| 1. | Feb-21 | 19347 | NA | NA | Approximately 9 cylinders (21 kg) per day with full load of 6000 students for both Hostel and canteen at institute |
| 2. | Mar-21 | 32237 | | | |
| 3. | Apr-21 | 46737 | | | |
| 4. | May-21 | 35518 | | | |
| 5. | Jun-21 | 24300 | | | |
| 6. | Jul-21 | 23294 | | | |
| 7. | Aug-21 | 25697 | | | |
| 8. | Sep-21 | 26588 | | | |
| 9. | Oct-21 | 30929 | | | |
| 10. | Nov-21 | 44566 | | | |
| 11. | Dec-21 | 49397 | | | |
| 12. | Jan-22 | 54096 | | | |

**Table 3.Transportation Facilities available in the campus**

| S.No | Type of Vehicle | Fuel Used | No. of Vehicles | Non Pollution Certified (Y/N) |
|---|---|---|---|---|
| 1. | All are hired busses only | Diesel | 20 busses from 3rd Party And 7 busses from TSRTC | Yes, all busses have pollution certificate |

### 11.5. Quantitative and Qualitative Measurement

| S.No. | Requirements and checklists of the audit | Conformity | | |
|---|---|---|---|---|
| | | Yes | No | NA |
| 1. | Have internal Energy audit procedures been developed and implemented in the Organization? | √ | | |
| 2. | Have programmes for the achievement of energy efficiency and conservation objectives been established and implemented as on today in the campus? | √ | | |
| 3. | Has a Management Representative, Electrical | √ | | |

## Report on Energy Audit

| | | | | |
|---|---|---|---|---|
| | Engineer, Staff incharge been assigned for energy savings on power consumptions? | | | |
| 4. | Have programmes for the achievement of prescribed financial outlay for current bills for each building in the campus towards power consumptions? | | √ | |
| 5. | Has the organization ensured that personnel performing environmental specific tasks have the required knowledge on energy audit (e.g. education, training programme, seminar, workshop, camp, etc.)? | √ | | |
| 6. | Are objectives and targets documented towards energy audit periodically and any Register is made? | √ | | |
| 7. | Any analysis of energy flows for energy conservation in terms of the amount of energy input into the system without negatively affecting the output in buildings | | √ | |
| 8. | Implications of alternative energy efficiency measures sufficient to satisfy the financial criteria of sophisticated investors | √ | | |
| 9. | Identification of the most efficient and cost-effective Energy Conservation Opportunities (ECOs) or Measures (ECMs) taken by the Management | | √ | |
| 10. | Are the following energy efficiency and conservation aspects considered in sufficient detail? | | | |
| | a. Fluorescent (tube) lights, Incandescent lamp and sodium vapour lights are replaced with CFL / LED | √ | | |
| | b. Number of Uninterruptible power supply (UPS) and Power generators for power back-up to alternative current supply facility in each building | √ | | |
| | c. Number of solar panels, solar lights, solar water heaters, electric water heater installed | √ | | |
| | d. Automatic sprinkler system used for irrigation purpose | | √ | |
| | e. Ultra-violet lights and any other harmful lights used with safety precautions | | √ | |
| | f. Attempt in reducing the energy expense and carbon footprint | | √ | |
| | g. Disposal facility for hazardous arise from electrical gadgets, equipment and installation | | √ | |
| | h. Renewable energy utilization (solar panel, wind mill) | √ | | |
| | i. Natural / Mechanical air ventilation at Indoor / Outdoor auditorium, stadium, seminar halls, etc. | √ | | |

## Report on Energy Audit

| | | | | |
|---|---|---|---|---|
| | j. Sign boards indicating Switch OFF / ON, Danger at Electrical equipment and Power transformers in the campus | √ | | |
| 11. | Signing of MoU with Govt. and NGOs to ensure about the energy conservation and efficiency in the campus | √ | | |
| 12. | Conduction of awareness programmes and outreach programmes on the energy conservation and efficiency | | √ | |
| 13. | The details of public transport, battery operated / electric vehicles, biofuel use, exhaust fans, boiling water system, chillers and geysers on energy savings mode | | √ | |
| 14. | Projects and Dissertation works on the energy conservation and efficiency carried out by students and staff members | | √ | |
| 15. | Steps taken to take care of daylighting, AC machines heat emission and ecofriendly Refrigerators, etc. | √ | | |
| 16. | Use of water metering, IoT based energy efficiency practices, remote waterlines, automation of electrical fittings and gadgets to save energy | | √ | |
| 17. | Are all monitoring electrical equipment appropriately maintained and calibrated? | √ | | |
| 18. | Are any energy conservation technologies and retrofit for energy conservation equipment being implemented? | √ | | |
| 19. | Skylight roof ratio, fenestration plan and Daylight illuminance in building construction towards energy efficiency* | | √ | |
| 20. | Any Automatic Lighting Shutoff with occupancy Sensors and Timers, Exterior / Interior lighting control facility* | | √ | |
| 21. | Have any rooms and guest suites a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles* | √ | | |
| 22. | Total electricity usage divided by total campus' population (kWh per person) | √ | | |
| 23. | The ratio of renewable energy production divided by total energy usage per year | √ | | |
| 24. | Total carbon footprint divided by total campus' population (metric tons per person) | √ | | |
| 25. | Elements of green building implementation as reflected in all construction and renovation policies | | √ | |
| 26. | Greenhouse gas emission reduction awareness programme to the stakeholders | | √ | |

## 11.6. 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 the campus. 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.

Carbon footprint, amount of $CO_2$ emissions associated with all the activities of the institute or other entities like building construction and anthropogenic activity hy 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.

**Table 6. Measurement of $CO_2$ Concentration in KKET College Campus**

| S.No. | Different locations of th Organization's Campus | Carbon dioxide level (ppm) | Remarks |
|---|---|---|---|
| 1. | CIMAT | 416 | $CO_2$ level is low |
| 2. | Car Parking | 497 | $CO_2$ level is low |
| 3. | Department of Chemistry Laboratory | 465 | $CO_2$ level is low |
| 4. | Playground | 397 | $CO_2$ level is low |
| 5. | Classroom without students | 429 | $CO_2$ level is low |
| 6. | Classroom with students | 546 | $CO_2$ level is low |
| 7. | Garden | 413 | $CO_2$ level is low |

***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 Per Year at Kovai Kalaimagal Educational Trust

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 and transportation (shuttle bus services and Car and Motorcycles) per year.

### a. Electricity usage per year

The $CO_2$ emission from electricity

= (electricity usage per year in kWh/1000) x 0.84
= (6533477 kWh/1000) x 0.84
= 5488.12 metric tons

*Notes:*

Electricity usage per year= 5488.12 kWh
0.84 is the coefficient to convert kWh to metric tons.

## 11.7. 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

- Consume local and seasonal products.
- Limit meat consumption, especially beef.
- Select fish from sustainable fishing.
- Bring reusable shopping bags and avoid products with excessive plastic packaging
- Make sure to buy only what you need, to avoid waste

### Clothing

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

### Transport

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

### Energy and waste

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

**Light Intensity Measured at various Locations of KKET Campus**

| S.No | Location | Light Intensity (Lux) | Recommended Level (as per NBC 2016) (Lux) |
|---|---|---|---|
| 1. | Principal office (1st floor) | 290 – 315 | 200 – 500 |
| 2. | Reception area | 56 – 72 | 150 – 300 |
| 3. | Faculty room | 179 – 192 | 200 – 500 |
| 4. | Library & Information Centre | 300 – 345 | 200 – 500 |

| | | | |
|---|---|---|---|
| 5. | Auditorium (500 capacity – ground floor) | 455 – 500 | 200 – 500 |
| 6. | Geotechnical lab | 315 - 370 | 300 – 750 |
| 7. | Environmental Engineering lab | 120 – 135 | 300 – 750 |

## 12. 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, inverters, and stabilizers are properly covered without any damage not to cause any problems to the staff and student members.
- Solar water heaters are installed and they are functioning well.
- Installed automatic switches with sensors.
- Power factor is maintained near to unity with APFC.
- VFDs based Lift and ACs.
- Drip and Sprinkler irrigations
- Replaced old generation computers and TVs with LED monitors.

**APFC, Solar Light in the campus**

## 13. 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.

- Submeters in the buildings for energy monitoring.
- Procurement of equipment with energy efficiency (4-5 star rated equipment) during replacement may be considered.
- 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
- Use energy efficient light-emitting diode (LED) bulbs instead of incandescent and CFL bulbs
- 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
- Inclusion of on campus e-vehicle.
- Assessment of electrical load calculation is yet to be done.
- 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.

## 14. Recommendations on Carbon Footprint in the Organization

- Installation of 150 kW solar power plant o roof top is recommended to reduce the monthly EB bill.
- Encourage students and staff members to use cycles and battery operated vehicles.
- Establish a more efficient cooking system to save gas in hostel kitchen and canteen.
- 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.

## 15. 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 drip and sprinkler irrigation and solar street-lights 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.

## 16. Acknowledgement

Nature Science Foundation, Coimbatore, Tamil Nadu, India is grateful to the Management, IQAC Coordinator and faculty members of Kovai Kalaimagal Educational Trust Institutions, Coimbatore, Tamil Nadu 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 NSF 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 the Campus.

## 17. References

Asnani, J. and Bhawana, S. 2015. Study of awareness and habits among home makers during purchasing electrical household equipment. *International Journal of Applied Home Science*, **2**(7&8): 201-206.

Backlund, S. and Thollander, P. 2015. Impact after three years of the Swedish energy audit programme. *Energy*, **82**: 54-60.

Bae, S.H. and Seol, I. 2006. An exploratory empirical investigation of environmental audit programs in S&P 500 companies. *Management Research News*, **29** (9): 573-579.

Buckman, A.H., Mayfield, M. and Beck, S.B.M. 2014. What is a smart building?. *Smart Sustainable Built Environment*, **3**(2): 92-109.

Cabrera, E., Pardo, M.A., Cobacho, R. and Cabrera, Jr, E. 2010. Energy audit of water networks. *Journal of Water Resources Planning and Management*, **136**(6): 669-677.

Cardozo, N.H., da Silveira Barros, S.R., Quelhas, O.L.G., Filho, E.R.M. and Salles, W. 2019. Benchmarks analysis of the higher education institutions participants of the Green Metric World University Ranking. Springer, Universities and Sustainable Communities: Meeting the Goals of the Agenda 2030, World Sustainability Series. pp. 667-683.

Choy, Er.A. and Karudan, R. 2016. Promoting campus sustainability: A conceptual framework for the assessment of campus sustainability. *Journal of Social Sciences and Humanities*, **1**1 (2): 112-118.

Gnanamangai, B.M., Murugananth, G. and Rajalakshmi, S. 2021. *A Manual on Environment Management Audits to Educational Institutions and Industrial Sectors*. Laser Park Publishing House, Coimbatore, Tamil Nadu, India, p. 203.

Fachrudin, H.T., Fachrudin, K.A. and Utami, W. 2019. Education activities to realize green campus. *Asian Social Science*, **15** (8): 18-27.

IGBC, 2021. Indian Green Building Council. https://igbc.in/igbc/

Ingle, A., Moezzi, M., Lutzenhiser, L. and Diamond, R. 2014. Better home energy audit modelling: incorporating inhabitant behaviours. *Building Research & Information*, **42** (4): 409-421.

Lauder, A., Sari, R.F., Suwartha, N. and Tjahjono, G. 2015. Critical review of a global campus sustainability ranking: Green Metric. *Journal of Cleaner Production* **108**: 852–863.

Leon-Fernandez, Y. and Dominguez-Vilches, E. 2015. Environmental management and sustainability in higher education: The case of Spanish Universities. *International Journal of Sustainability in Higher Education* **16**: 440-455.

Mishraand, U. and Patel, S. 2016. Awareness regarding energy efficiency star labelling on household appliances amongst the consumers of Vadodara city. *International Journal of Applied Home Science* **3**(9&10): 330-338

Padmini, E. 2007. *Biocharacterization Calculations and Biostatistics*. Books and Allied (P) Ltd, Kolkata, India.

Peters, G.F. and Romi, A.M. 2014. Does the voluntary adoption of corporate governance mechanisms environmental risk disclosures? Evidence from greenhouse gas emission. *Journal of Business Ethics* **125** (4): 637-666.

Pramanik A.K. 2013. *Environmental Audit and Indian Scenario, Environmental Accounting and Reporting*. Deep and Deep Publications, New Delhi, India. p.312.

Rajalakshmi, S., Kavitha, G. and Vinoth kumar, D. 2021. *Energy and Environment Management Audit*. AkiNik Publishing, New Delhi, India.

Shriberg, M. 2002. Institutional assessment tools for sustainability in higher education: strengths, weaknesses, and implications for practice and theory. *International Journal of Sustainability in Higher Education* **3**(3): 254-270.

Singh, M., Singh, G. and Singh, H. 2012. Energy Audit: A case study to reduce lighting cost. *Asian Journal of Computer Science and Information Technology* **2**(5): 119-122.

Vinothkumar, D., Sreenivasan, P.V., Rajalakshmi, S., Vanitha, S. and Gnanamangai, B.M. 2021. Environment and Green Campus Audits Procedures. AkiNik Publishing, New Delhi, India.

Wang, Y., Shi, H., Sun, M., Huisingh, D., Hanssonn, L. and Wang, R. 2013. Moving towards an ecologically sound society? Starting from Green Universities and environmental higher education. *Journal of Cleaner Production* **61**: 1-5.

WGBC, 2021. World Green Building Council. https://www.worldgbc.org.

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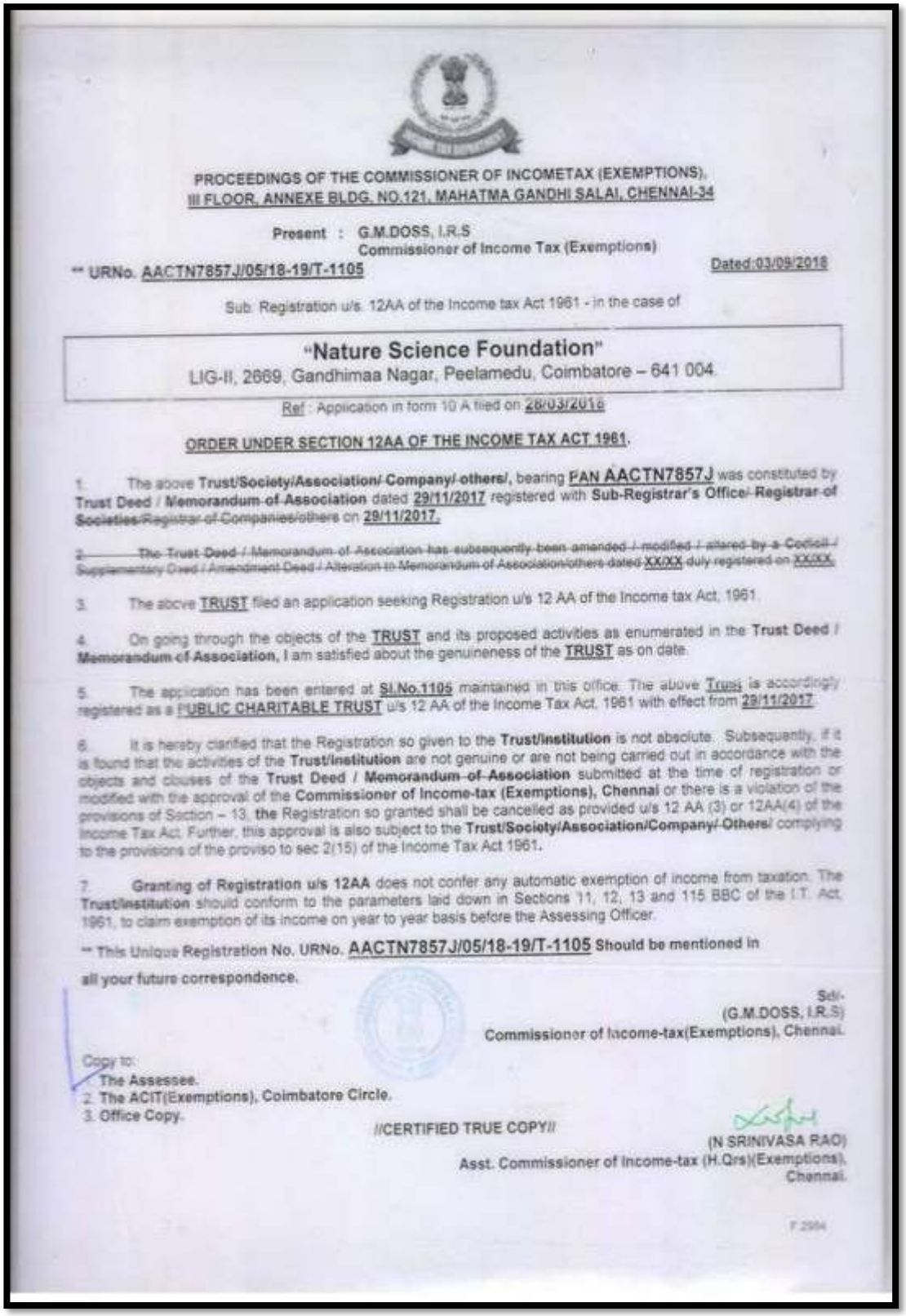
# Certificates of Nature Science Foundation, Coimbatore, Tamil Nadu.

1. ISO Certificate
2. 12A Certificate
3. 80G Certificate
4. 10AC Form

# Report on Energy Audit

# Report on Energy Audit



PROCEEDINGS OF THE COMMISSIONER OF INCOMETAX (EXEMPTIONS),
III FLOOR, ANNEXE BLDG. NO.121, MAHATMA GANDHI SALAI, CHENNAI-34

Present : G.M.DOSS, I.R.S
Commissioner of Income Tax (Exemptions)

** URNo. AACTN7857J/05/18-19/T-1105 Dated:03/09/2018

Sub: Registration u/s. 12AA of the Income tax Act 1961 - in the case of

"Nature Science Foundation"
LIG-II, 2669, Gandhimaa Nagar, Peelamedu, Coimbatore – 641 004.

Ref : Application in form 10 A filed on 28/03/2018

ORDER UNDER SECTION 12AA OF THE INCOME TAX ACT 1961.

1. The above **Trust/Society/Association/ Company/ others/**, bearing PAN AACTN7857J was constituted by **Trust Deed / Memorandum of Association** dated 29/11/2017 registered with **Sub-Registrar's Office/ Registrar of Societies/Registrar of Companies/others** on 29/11/2017.

2. ~~The Trust Deed / Memorandum of Association has subsequently been amended / modified / altered by a Codicil / Supplementary Deed / Amendment Deed / Alteration to Memorandum of Association/others dated XX/XX duly registered on XX/XX.~~

3. The above TRUST filed an application seeking Registration u/s 12 AA of the Income tax Act, 1961.

4. On going through the objects of the TRUST and its proposed activities as enumerated in the **Trust Deed / Memorandum of Association,** I am satisfied about the genuineness of the TRUST as on date.

5. The application has been entered at Sl.No.1105 maintained in this office. The above Trust is accordingly registered as a PUBLIC CHARITABLE TRUST u/s 12 AA of the Income Tax Act, 1961 with effect from 29/11/2017.

6. It is hereby clarified that the Registration so given to the **Trust/Institution** is not absolute. Subsequently, if it is found that the activities of the **Trust/Institution** are not genuine or are not being carried out in accordance with the objects and clauses of the **Trust Deed / Memorandum of Association** submitted at the time of registration or modified with the approval of the **Commissioner of Income-tax (Exemptions), Chennai** or there is a violation of the provisions of Section – 13, the Registration so granted shall be cancelled as provided u/s 12 AA (3) or 12AA(4) of the Income Tax Act. Further, this approval is also subject to the **Trust/Society/Association/Company/ Others/** complying to the provisions of the proviso to sec 2(15) of the Income Tax Act 1961.

7. **Granting of Registration u/s 12AA** does not confer any automatic exemption of income from taxation. The **Trust/Institution** should conform to the parameters laid down in Sections 11, 12, 13 and 115 BBC of the I.T. Act, 1961, to claim exemption of its income on year to year basis before the Assessing Officer.

** This Unique Registration No. URNo. AACTN7857J/05/18-19/T-1105 **Should be mentioned in all your future correspondence.**

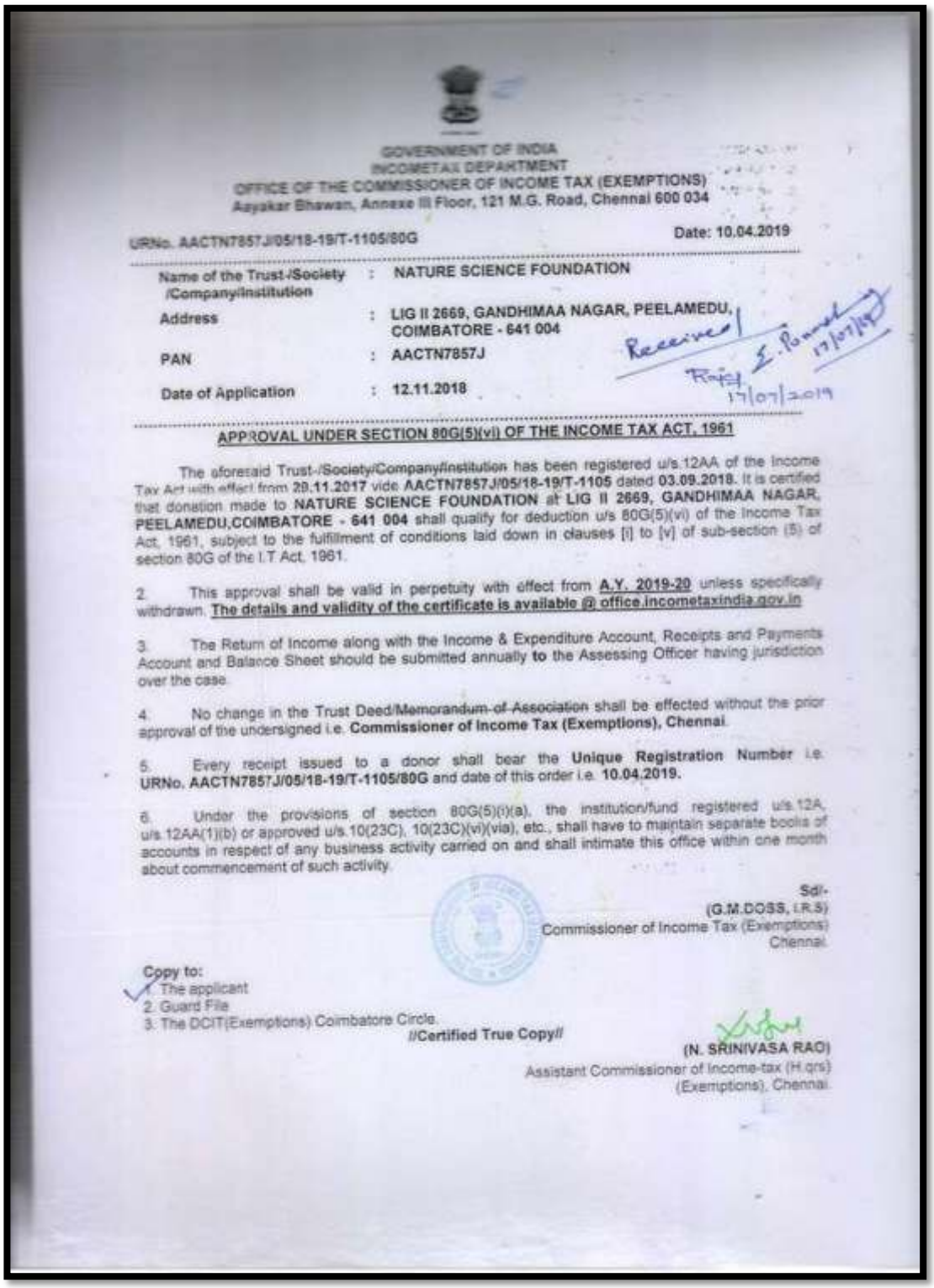
Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income-tax(Exemptions), Chennai.

Copy to:
1. The Assessee.
2. The ACIT(Exemptions), Coimbatore Circle.
3. Office Copy.

//CERTIFIED TRUE COPY//

(N SRINIVASA RAO)
Asst. Commissioner of Income-tax (H.Qrs)(Exemptions),
Chennai.

## Report on Energy Audit



GOVERNMENT OF INDIA
INCOMETAX DEPARTMENT
OFFICE OF THE COMMISSIONER OF INCOME TAX (EXEMPTIONS)
Aayakar Bhawan, Annexe III Floor, 121 M.G. Road, Chennai 600 034

URNo. AACTN7857J/05/18-19/T-1105/80G Date: 10.04.2019

| | | |
|---|---|---|
| Name of the Trust /Society /Company/Institution | : | NATURE SCIENCE FOUNDATION |
| Address | : | LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU, COIMBATORE - 641 004 |
| PAN | : | AACTN7857J |
| Date of Application | : | 12.11.2018 |

Received
17/07/2019

APPROVAL UNDER SECTION 80G(5)(vi) OF THE INCOME TAX ACT, 1961

The aforesaid Trust-/Society/Company/Institution has been registered u/s.12AA of the Income Tax Act with effect from **29.11.2017** vide **AACTN7857J/05/18-19/T-1105** dated **03.09.2018**. It is certified that donation made to **NATURE SCIENCE FOUNDATION** at **LIG II 2669, GANDHIMAA NAGAR, PEELAMEDU,COIMBATORE - 641 004** shall qualify for deduction u/s 80G(5)(vi) of the Income Tax Act, 1961, subject to the fulfillment of conditions laid down in clauses [i] to [v] of sub-section (5) of section 80G of the I.T Act, 1961.

2. This approval shall be valid in perpetuity with effect from **A.Y. 2019-20** unless specifically withdrawn. **The details and validity of the certificate is available @ office.incometaxindia.gov.in**

3. The Return of Income along with the Income & Expenditure Account, Receipts and Payments Account and Balance Sheet should be submitted annually **to** the Assessing Officer having jurisdiction over the case.

4. No change in the Trust Deed/Memorandum of Association shall be effected without the prior approval of the undersigned i.e. **Commissioner of Income Tax (Exemptions), Chennai**.

5. Every receipt issued to a donor shall bear the **Unique Registration Number** i.e. **URNo. AACTN7857J/05/18-19/T-1105/80G** and date of this order i.e. **10.04.2019.**

6. Under the provisions of section 80G(5)(i)(a), the institution/fund registered u/s.12A, u/s.12AA(1)(b) or approved u/s.10(23C), 10(23C)(vi)(via), etc., shall have to maintain separate books of accounts in respect of any business activity carried on and shall intimate this office within one month about commencement of such activity.

Sd/-
(G.M.DOSS, I.R.S)
Commissioner of Income Tax (Exemptions)
Chennai

Copy to:
1. The applicant
2. Guard File
3. The DCIT(Exemptions) Coimbatore Circle.

//Certified True Copy//

(N. SRINIVASA RAO)
Assistant Commissioner of Income-tax (Hqrs)
(Exemptions), Chennai

## Report on Energy Audit

# FORM NO. 10AC

(See rule 17A/11AA/2C)
Order for registration

| | | |
|---|---|---|
| 1 | PAN | AACTN7857J |
| 2 | Name | NATURE SCIENCE FOUNDATION |
| 2a | Address | |
| | Flat/Door/Building | LIG-II, 2669 |
| | Name of premises/Building/Village | GANDHIMAA NAGAR |
| | Road/Street/Post Office | Coimbatore South |
| | Area/Locality | COIMBATORE |
| | Town/City/District | Gandhimaanagar S.O |
| | State | Tamil Nadu |
| | Country | INDIA |
| | Pin Code/Zip Code | 641004 |
| 3 | Document Identification Number | AACTN7857JE2021501 |
| 4 | Application Number | 739995830271021 |
| 5 | Unique Registration Number | AACTN7857JE20215 |
| 6 | Section/sub-section/clause/sub-clause/proviso in which registration is being granted | 01-Sub clause (i) of clause (ac) of sub -section (1) of section 12A |
| 7 | Date of registration | 03-11-2021 |
| 8 | Assessment year or years for which the trust or institution is registered | From AY 2022-23 to AY 2026-2027 |
| 9 | Order for registration: | |
| | a. After considering the application of the applicant and the material available on record, the applicant is hereby granted registration with effect from the assessment year mentioned at serial no 8 above subject to the conditions mentioned in row number 10. | |
| | b. The taxability, or otherwise, of the income of the applicant would be separately considered as per the provisions of the Income Tax Act, 1961. | |
| | c. This order is liable to be withdrawn by the prescribed authority if it is subsequently found that the activities of the applicant are not genuine or if they are not carried out in accordance with all or any of the conditions subject to which it is granted, if it is found that the applicant has obtained the registration by fraud or misrepresentation of facts or it is found that the assessee has violated any condition prescribed in the Income Tax Act, 1961. | |
| 10 | Conditions subject to which registration is being granted | |
| | The registration is granted subject to the following conditions:- | |

## Report on Energy Audit

| | | |
|---|---|---|
| | o. This certificate cannot be used as a basis for claiming non-deduction of tax at source in respect of investments etc. relating to the Trust/ Institution. | |
| | p. All the Public Money so received including for Corpus or any contribution shall be routed through a Bank Account whose number shall be communicated to Office of the Jurisdictional Commissioner of Income Tax. | |
| | q. The applicant shall comply with the provisions of the Income Tax Act, 1961 read with the Income Tax Rules, 1962. | |
| | r. The registration and the Unique registration number has been instantly granted and if, at any point of time, it is noticed that form for registration has not been duly filled in by not providing, fully or partly, or by providing false or incorrect information or documents required to be provided under sub-rule (1) or (2) of rule 17A or by not complying with the requirements of sub- rule (3) or (4) of the said rule, the registration and Unique Registration Number (URN), shall be cancelled and the registration and URN shall be deemed to have never been granted or issued. | |
| | Name and Designation of the Registration Granting Authority | Principal Commissioner of Income Tax/ Commissioner of Income Tax<br><br>(Digitally signed) |

Digitally signed by SIBICHEN K MATHEW
Date: 2021.11.03 15:52:36 IST

# Certificates of Energy Auditors

1. ISO Environment Management System (14001:2015) of Mrs. S. Rajalakshmi, Founder & Chairman of NSF.

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

3. Associated Chambers of Commerce and Industry of India (ASSOCHAM), of Dr. B. Mythili Gnanamangai, and Er. Ashutosh Kumar Srivastava, Board of Directors (North Zone) of NSF.

4. Energy and Environment Engineering (EEE Auditor) of Er. B. Vijayalakshmi, Deputy Director of NSF.

5. Bureau of Energy Efficiency (BEE) Certificates of Er. D. Dineshkumar and Dr. N. Balasubramanian, Energy Auditors of NSF.

6. LEED AP and GRIHA, Tamil Nadu Fire and Rescue Service Certificates of Er. D. Dinesh kumar and Er. S. Srinivash, Energy Auditors of NSF.

## Report on Energy Audit

Certificate of Training

TNV hereby certifies that

**S. Rajalakshmi**

has successfully completed the 5 days
Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- EM: Environmental Management System
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 14001:2015**

Issue Date: 17th Jun. 2021
Training Date : 20th to 24th May. 2021
Certificate Number : 2106170721010105

Authorised Signatory
(Pragyesh Singh)

This course is certified by Exemplar Global vide registration number TN006062

Note: The course conforms to the principles and practices ... systems for compliance with standards. This certificate ... this certificate is recognized by Exemplar Global ... please write to Mail: info@cisoindia...

## Report on Energy Audit

## Report on Energy Audit


GEM Certificate

ASSOCHAM hereby certifies that

Mr. Ashutosh Kumar Srivastava

has successfully passed the

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

with

"Good Performance"

on

03 September, 2021

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

Pankaj R. Dharkar
Chairman, GEM

GEM CP 20648

Deepak Sood
Secretary General, ASSOCHAM


TAMILNADU FIRE & RESCUE SERVICES

THIRUVALLUR DISTRICT

THIRUVALLUR

CERTIFICATE

This is to certify that Mrs. / Mr. S. SRINIVASH S/o B. SWAMIYAPPAN
H/ESS. St. Xavier's Street, Poonur, 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: 26-9-16

## Report on Energy Audit

Sl.No.: 0010669

TAMIL NADU AGRICULTURAL UNIVERSITY
COIMBATORE

On the recommendation of the
Academic Council and the Board of Management
hereby admits

VIJAYALAKSHMI, B.

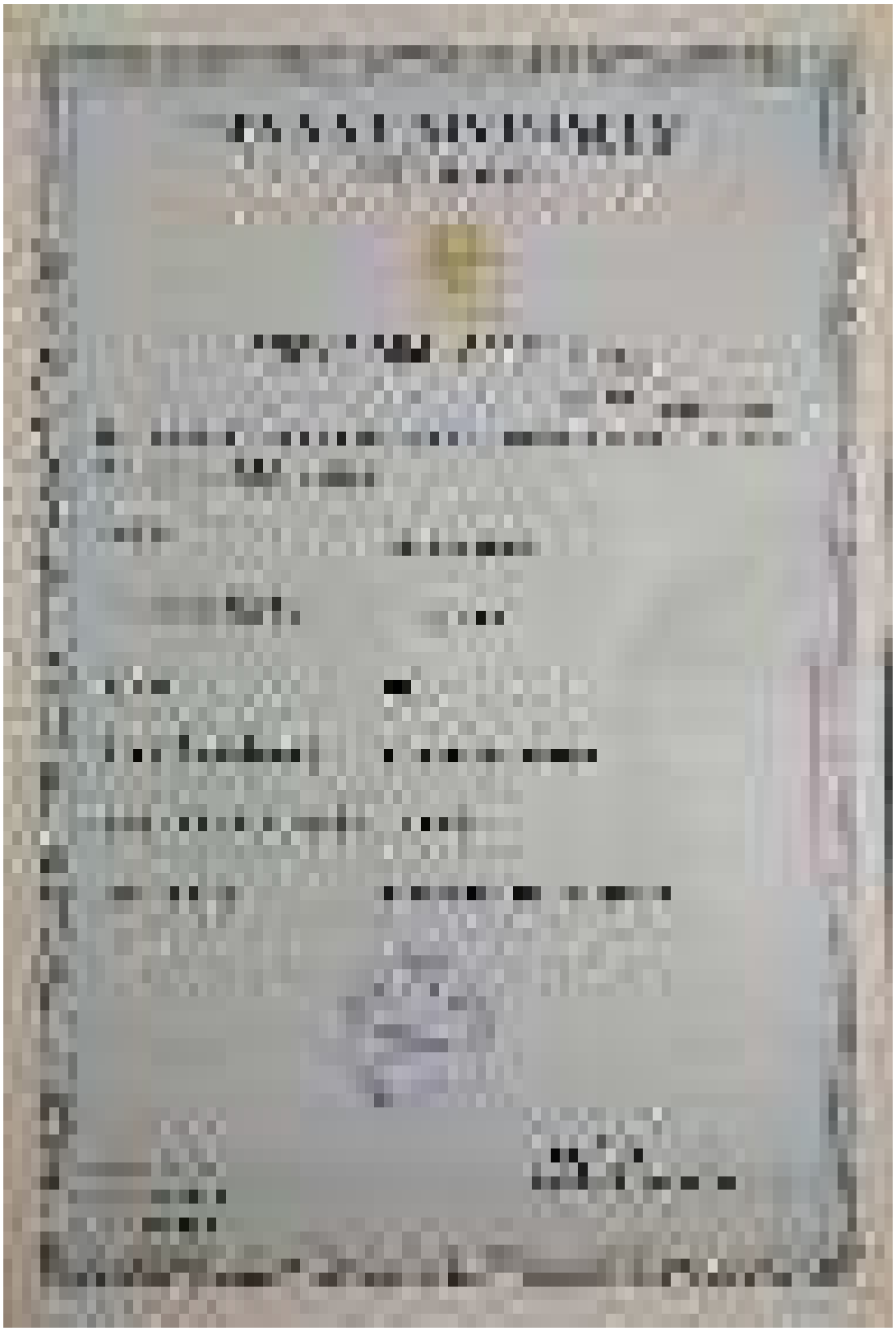
to the degree of
Bachelor of Technology
(Energy and Environmental Engineering)

he / she having qualified to receive the same
securing an Overall Grade Point Average
of 7.61 out of 10.00 in the year 2017
together with all the honours and distinctions belonging
to this degree given under the seal of the University

COIMBATORE
Date : 26.02.2019

N. KUMAR
Vice Chancellor

# Report on Energy Audit



## Report on Energy Audit

# 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).

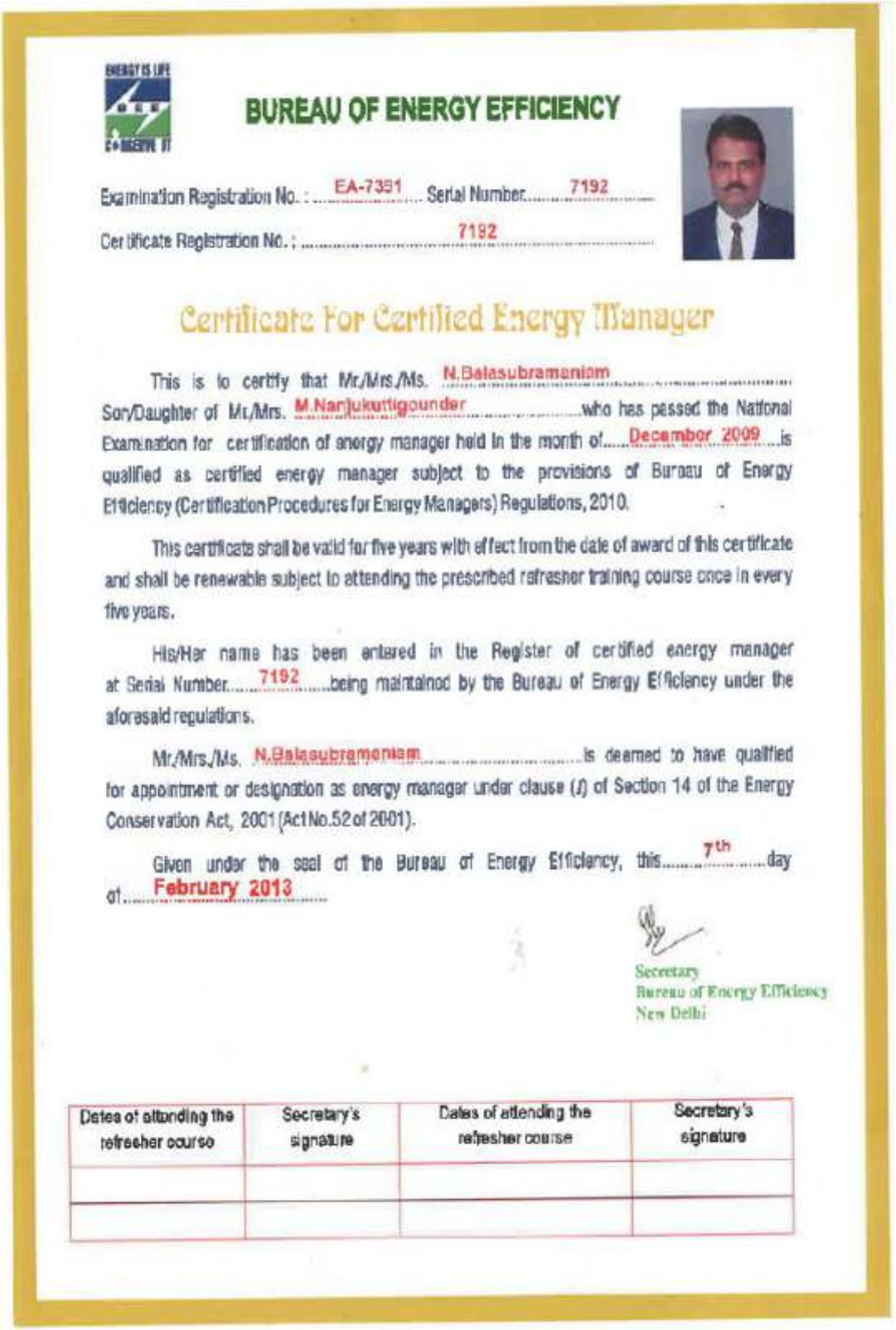
Given under the seal of the Bureau of Energy Efficiency, this 7th day of February, 2013

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 | | | |
| | | | |

## Report on Energy Audit



BUREAU OF ENERGY EFFICIENCY

Examination Registration No. : EA-7351 Serial Number 7192

Certificate Registration No. : 7192

# Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. N.Balasubramaniam Son/Daughter of Mr./Mrs. M.Nanjukuttigounder who has passed the National Examination for certification of energy manager held in the month of December 2009 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 7192 being maintained by the Bureau of Energy Efficiency under the aforesaid regulations.

Mr./Mrs./Ms. N.Balasubramaniam is deemed to have qualified for appointment or designation as energy manager under clause (*l*) 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

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 |
|---|---|---|---|
| | | | |
| | | | |

## Report on Energy Audit

Regn. No. EA-7391 Certificate No. 5093

**National Productivity Council**
(National Certifying Agency)

**PROVISIONAL CERTIFICATE**

This is to certify that Mr. / Ms. N.Balasubramaniam
son / daughter of Mr. M.Nanjukuttigounder
has passed the National Certification Examination for Energy Auditors held in December - 2009, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

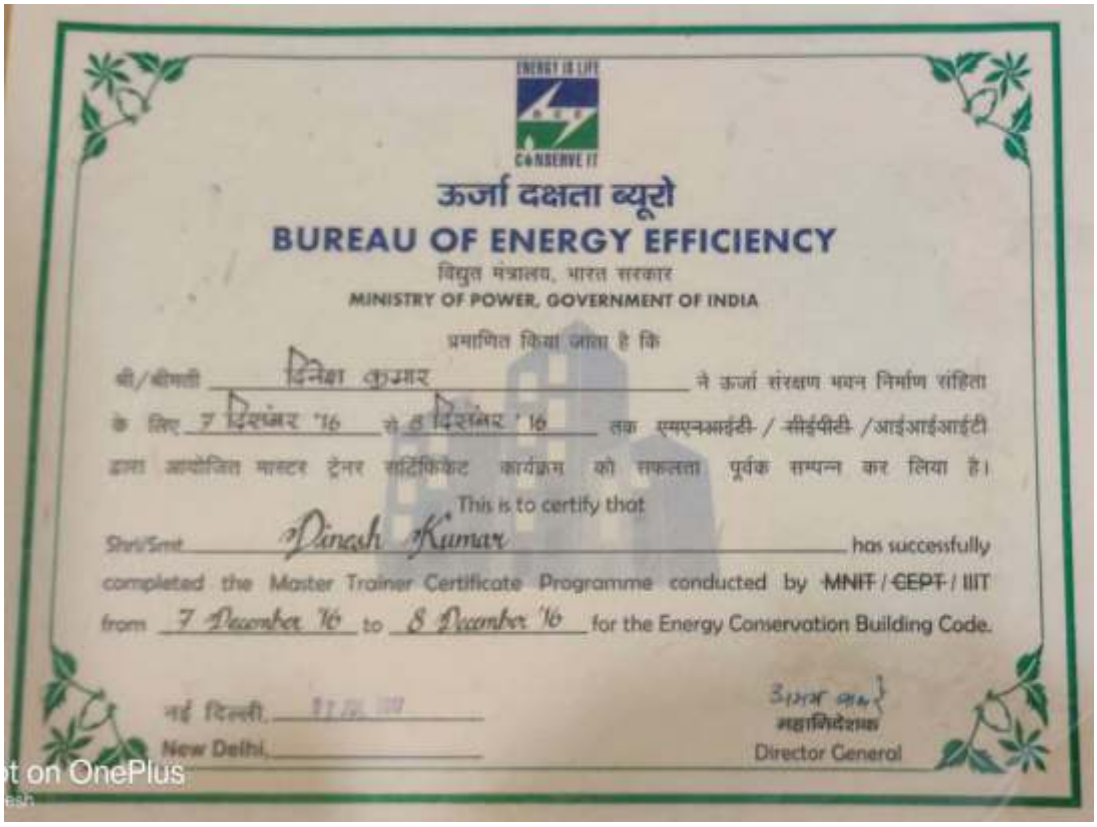
He / She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He / She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India
Date : 11th February 2010

Controller of Examination



# Report on Energy Audit

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

26 DEC 2016

25 DEC 2022

Mahesh Ramanujam

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

15/11/2023

Principal
Coimbatore Institute of Management & Technology
Narasipuram, Coimbatore - 641 109.