

Energy – Environment – Green Audit Process for University and College Campus

(Recommended by NAAC under criteria 7.1.6)

Dr .S.R. SIVARASU, BEE Certified Energy Auditor, Lead Auditor: ISO-14001:2015

Er. S. Ashok, BEE Accredited Energy Auditor

I. Introduction:

National Assessment and Accreditation Council (NAAC) released Institutional Accreditation manual for self-study report (2019) for i) Universities, ii) Autonomous Colleges and iii) Affiliated/Constituent Colleges. In that report; under Criteria 7.1.6; the institutional environment and energy initiatives are to be confirmed through submitting the report for i) Energy audit, ii) Environment audit and iii) Green audit. This step insists all university/college has to conduct the above audits through auditing agency which must have BEE Certified Energy Auditor cum Environment and Greet Auditing Professionals. After conducting the audits; the institution has to upload, i) the one report copy (containing Energy – Environment – Green Audit findings) duly signed by the BEE Certified Auditing Professional and ii) Individual Certificates for Energy Audit – Environment Audit – Green Audit process.

II. More Details on Criteria 7.1.6:

Among overall criteria's; criteria-VII deals with Institutional Values and Best Practices which has the following Key Indicators (KI) represented in Table-1:

Table-1: Key Indicators and Distribution of Weightages for Criteria-VII

Criteria	Key Indicators	Distribution of weightages for Key Indicators ¹
7.1	Institutional Values and Social Responsibilities	50
7.2	Best Practices	30
7.3	Institutional Distinctiveness	20

(¹ common for University, Autonomous Colleges and Affiliated/Constituent Colleges)

Criteria 7.1.6 comes under Institutional Values and Social Responsibilities and NAAC clearly classified this criteria under **Quantitative metrics (QnM)**. In general quantitative metrics has a goal which can be counted, measured, and expressed using statics. The detailed description of 7.1.6 as specified by NAAC is represented in the following Table-2.

Table-2: Detailed Description of Criteria 7.1.6

S. No.	Criteria Description	Weightage	
		Max.	Individual
1.	Green Audit	5	1
2.	Energy Audit		1
3.	Environment Audit		1
4.	Clean and green campus recognitions/awards		1

5.	Beyond the campus environmental promotional activities		1
Options (For earning the weightage)			
A	All the above or any 4 of the above		
B	Any 3 of the above		
C	Any 2 of the above		
D	Any 1 of the above		
E	None of the above		
Documents to be uploaded in the NAAC website			
• Reports in standard format submitted by the auditing agency		• Provided by the auditing agency along with BEE Certified Energy Auditor's registration copy.	
• Certification by the auditing agency		• Three individual certificates	
• Certificates of the awards received		• Awards received by the institution from recognized organization ²	
• Any other relevant information		• Information pertaining to beyond the campus environmental promotional activities	

⁽² Awards received from Central Govt. /State Govt. /Reputed Private organization & NGOs may be used)

III. Objectives of the Audit Process:

- **Management perspective:** Primary objective of the audit is to analyse the present utilization of all types of energy, reduce the amount of energy utilization, reduction of water consumption and improve the green coverage without negatively affecting the comfort level.
- **Faculty perspective:** Knowing the ways to proceed the audit process; the faculty members has to take this initiative further to strengthen the institutional values through a comprehensive energy management and environmental improvements.
- **Student perspective:** As a major stockholder of the educational institution; they can implement the same energy audit process in their homes and hence achieve good amount of energy and water savings. This improves our nation's energy security and sustainability.
- **Win-win situation:** By taking this audit process, the institution can able to identify varieties of energy and water conservation measures showcase to the students in practising their study and also to satisfy the obligations proposed by the NAAC.

IV. Auditor's Approach on Energy Audit in Educational Institution:

As per Energy Conservation Act-2001; Energy Audit means the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis & an action plan to reduce energy consumption. A BEE Certified Energy Auditor has to identify judicious usage of

various energy services used in an education institution. Table-3 provides various energy services that may be utilized in any institution.

Table-3: Various Energy Services and their Application

S. No.	Type of Energy Services	Application Area
Electrical Energy³		
1.	Electricity (From utility service)	All electrical loads
2.	Solar PV Plant	
Thermal Energy⁴		
3.	Liquefied Petroleum Gas (LPG)	Cooking
		Science laboratories
4.	Diesel and Petrol	Transport vehicles
		Captive power generation (DG)
5.	Wood and Pellets	Cooking
6.	Solar Hot Water Generation	Bathing
		Preheating of boiler feed water
7.	Solar Steam Generation	Cooking

(³ other electricity generation sources also considered)

(⁴ Any other renewable and non-renewable sources may also considered if applicable)

During the audit process; the audit team has to identify Energy Conservation (ENCON) proposals in the following category;

No cost measures – Zero Investment (Low energy conservation)	Low cost measures - Less than Rs. 2 Lakhs (Considerable energy conservation)
Medium cost measures – Between Rs. 2 – 5 Lakhs (Medium energy conservation)	High cost measures – More than Rs. 5 Lakhs (High energy conservation)

Auditor has to propose all types of ENCONs indicating i) Annual energy savings, ii) Annual financial savings, iii) Initial investment, iv) Simple payback and v) CO₂ emission after implementing the respective ENCONs.

V. Challenges in Energy Audit Process:

- The audit team has to collect at least one year energy consumption data (both electrical and thermal energy utilization).
- Study of the Electricity bill (either HT or LT services) and scope for optimizing the Electricity billing part.

- Collect the list of electrical loads like i) Lighting system, ii) Fan load, iii) Uninterrupted Power Supply (UPS), iv) Inverter/Servo stabilizer, v) Computer/Printer/Internet equipment's, vi) Surveillance system, vii) Air conditioner, viii) Water pump, ix) Water dispenser, x) Reverse Osmosis (RO) Plant, xi) Sewage Treatment Plant (STP) and xii) Firefighting system.
- Assess the i) Power capacity of higher power consuming loads, ii) no. of operating hours/day, iii) maintenance practices and schedule and iv) best/safe operating practices.
- Measure important electrical and thermal energy usage using suitable measuring instruments for a specified duration.
- Collect the design parameters (from the manufacturer's data sheet) of all electrical and thermal system. This must be used to compare with the measured values; so that percentage of deviation can be evaluated.

VI. Possible Energy Conservation Areas:

After making the detailed assessment on overall energy system utilized in the institution; the audit has to identify following ENCONs measures;

- Reduction of electrical distribution by load end compensation
- Energy reduction kitchen equipment's usage
- Energy conservation in air conditioning system
- Energy efficient lighting and fan system
- Energy optimization and fuel reduction in boiler operation
- Input fuel savings using improvement in steam system insulation
- Savings due to energy efficacy in LPG system

VII. Auditor's Approach on Environmental Audit Process:

Following are the major outcomes of the environment audit process;

1. Pollution for Environment - Assess the regular activities of the educational institution and ensure that they should not pollute i) Soil, ii) Water and iii) Atmospheric air.
2. Potable drinking water treatment - water distribution, taps, basins, water control methods and regular testing carried out.
3. Proper treatment of sewage generated inside the institution, waste water treatment, treated water treatment (application for gardening and toilet flushing), sludge collection and usage.
4. Usage of Chemical/Salt/Acid Usage including storage, application and disposal
5. Assessment on transport system (Convention for better kmpl and E-vehicles)
6. Investigations on waste management system includes solid wastes (both bio-degradable and non-bio-degradable)
7. Study on Rain Water Harvesting (RWH)
8. Indoor and outdoor air quality and lighting illumination study

9. Investigation on refrigerant gases and Halons used in fire extinguishers with respect to Global Warming Potential (GWP) and Ozone Depleting Potential (ODP).

VIII. Auditor's Approach on Campus Greenery Audit Process:

During the campus greenery audit process; the following points must be assessed:

- Assessment of renewable energy generation (Roof top Solar PV plants, small wind turbines, bio-gas generation etc.)
- Evaluation of solar thermal system (both for bathing and cooking application)
- Assessment of no. of matured trees, flowering bushes and shrubs
- Landscape gardening area
- Methods adopted to reduce air, water and soil pollution

IX. Best & Safe Operating Practices in the Electrical and Thermal Energy system:

1. The earth grid at the power house has to be checked at regular interval and the value must be written on each pit as well the ELCB check at the points of usage by staff & students.
2. Plan for maintenance free earthing instead of the conventional earthing as the ohmic values are being maintained in the long run over decades.
3. In DG - separate log book on diesel consumption should be maintained. Also observe the kWh generated from each DG and compare with the UPL. Further the premises of diesel storage must be free from spillage.
4. Safety must be ensured in usage of LPG storage and handling in the kitchen.
5. Occupational Health and Safety Practices in Electrical, Mechanical workshops etc must be guaranteed.
6. Building Infrastructure to ensure the occupational safety to the students in college and hostels.
7. Use of Personal Protective Equipment is showcased wherever required.
8. Good and proper lightning arrestor (Early streamer emission type) must be provided to avoid lightning struck on the high rise buildings and cover the entire area of the campus to be protected against the Lightning surges that come in the vicinity of the campus.
9. All the staff holders should know the facts of daily water usage along with its financial debits. Hence display the water consumption at appropriate places and encourage everyone to save water.
10. Jal Shakti Ministry issued (July 2019) a memorandum recently to install aerators in the taps of government offices to conserving water. The same has to be followed in educational institutions also to conserve water. This conserves upto 70 % of water consumption.

X. Case Study – Achieving towards Net Zero Energy Building:

We have conducted a detailed energy audit in one of the renowned educational institution in Coimbatore. The overall energy analysis of the institution audited and accounted for the year 2019 and 2020 is being represented in the below Table-4:

Table-4: Annual Energy Analysis for the year 2019 and 2020

S. No.	Description	Energy/Fuel Consumed	Energy Generated/Adjusted/Saved	
			Electricity (kWh)	LPG (kg)
1.	Energy from TANGEDCO	17,43,168 kWh	-	-
2.	LPG Consumption	67,080 kg	-	-
3.	Energy Generated by SPV Plant	-	1,75,617	-
4.	Energy Adjusted in the Wind	-	12,42,337	-
5.	Biogas Implementation	-	-	8,218
6.	Steam Generation from PTC	-	-	3,560
7.	Implementation of LOT	-	-	354
8.	Solar Hot Water (Cooking)	-	-	290
Total		17,43,168 kWh + 67,080 kg	14,17,954	12,422

From the above table, the following observations are made:

1. Percentage of energy adjusted in the wind mill is nearly about 71%. (Brown colour) of the annual electricity consumption.
2. Energy generated using rooftop solar PV plant contributes nearly 10 % of overall energy procured from TANGEDCO (Blue colour).
3. The college management has implemented various energy savings measures to conserve LPG; which saves nearly 20% of the annual LPG consumption.
4. We have given the Audit report suggesting, the college has scope to save further, as nearly 10 % of overall energy consumption.
5. The management shows keen interest to implement all the energy conservation measures proposed in the audit report and hence in all aspects, this college is now moving towards achieving Net Zero Energy Building.
6. **Brief about Net Zero Energy Buildings (NZEB):** Any buildings can become self-sufficient by generating their own energy requirements economically, through the use of onsite/ offsite renewable energy sources. As per IGBC rating system; Net Zero Energy Building is a tool which enables the management (or designer) to apply energy efficiency concepts and adopt appropriate renewable sources by design to achieve Net Zero Energy Status.
7. **Every institution has to audit to achieve NZEB:** It is the right time that all the institutions has to conduct similar audit process in their institution and plan for their future to achieve NZEB.

XI. Conclusion:

After completion of the audit; the audit team has to provide a comprehensive audit report covering i) energy conservation proposal with acceptable payback period, ii) best/safe operating practices in energy conservation and management, iii) environmental practices and iv) campus greenery. The audit team has cover 100 % in all aspects of the institution and provide a hope the management to get maximum weightage in this category. The Audit reporting to be well-presented to the Management and Staff of the institution as all the members are collectively responsible to maintain the energy, environment and greening the premises as per the norms.

Abbreviations:

BEE	Bureau of Energy Efficiency	NAAC	National Assessment and Accreditation Council
DG	Diesel Generator	NZEB	Net Zero Energy Building
ENCON	Energy Conservation Proposals	ODP	Ozone Depletion Potential
GWP	Global Warming Potential	PV	Photovoltaic
IGBC	Indian Green Building Council	QnM	Quantitative metrics
KI	Key Indicators	RWH	Rain Water Harvesting
LPG	Liquefied Petroleum Gas	STP	Sewage Treatment Plant
TANGEDCO - Tamilnadu Generation and Distribution Corporation			

About the Authors:

	<p>Dr. S.R. Sivarasu: BEE Certified Energy Auditor, Lead Auditor – ISO-14001-2015: EMS, IGBC-AP, GRIHA-CP with nearly 10 years in the field of energy & environmental audit out of total 15 years of Industry, Academic, Training and Energy Auditing Experiences. He has conducted more than 75 energy audits in various manufacturing, process, service industries, high rise buildings, airports, railway colonies and educational institutions. He is a Managing Partner, Ram-Kalam Centre for Energy Consultancy and Training (RK-CECT), Coimbatore.</p> <p>ramkalamcect@gmail.com</p>
	<p>Shri. S. Ashok: BEE Accredited Energy Auditor and energy professionals with more than 40 years of experience, completed more than 400 energy audits in all type of industries. He also conducted lectures in Industrial Seminars conducted by PCRA, Textile Committee, SISI, SIPCOT, Textile & Foundry association & in Engg colleges etc. Published many articles in www.energymeasuretosave.com in section 'User Technical Articles'. He has published book titled “Practical Guide to Energy Conservation & Management” and “Energy Conservation & Management in Textile Mills”.</p> <p>ashok@energymeasuretosave.com</p>