

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT



DETAILS OF THE CLIENT

RAAK ARTS AND SCIENCE COLLEGE

No.1, Basheer Campus, Perambai Road, Perambai, Vanur (T.K.),
Villupuram District – 605 110



DATE OF AUDIT

23rd June 2023

(Audited and Accounted for the period of 2022-23)

AUDIT CONDUCTED AND SUBMITTED BY

P S QUALITY CERTIFICATION PVT LTD

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ACKNOWLEDGEMENT

P S QUALITY CERTIFICATION PVT LTD, No. 415, F4, I Floor, Asha Vignesh Apartment, Ambattur, Tamil Nadu 600 053 is thankful to the Management, Principal, Faculty and Technical team members of **RAAK ARTS AND SCIENCE COLLEGE**, No.1, Basheer Campus, Perambai Road, Perambai, Vanur (T.K.), Villupuram District – 605 110, for providing an opportunity to conduct a detailed Energy, Environment and Green Audit process for the college premises.

It is our great pleasure, which must be recorded here that the management of **RAAK ARTS AND SCIENCE COLLEGE** extended all possible support and assistance resulting in expeditious completion of the audit process. The audit team appreciates the cooperation and guidance extended during course of site visit and measurements. We are also thankful to all those who gave us the necessary inputs and information to carry out this very vital exercise of green audit.

Finally, we offer our sincere thanks to all the members in the technical/non-technical and office members who were directly and indirectly involved with us during collection of data and conducting field measurements.

<u>Management Team Members</u>	
Er. B. Mohamed Farouk	Chairman
Prof. Dr. Rabinder Henry	Director
Dr. A. RAMNATH	Principal

<u>Audit Team Members</u>	
Mr. G. ARIVARASAN	BEE Certified Energy Auditor (EA-21875) Lead Auditor – ISO 14001, EMS
Dr. K. SATHYANARAYANAN	Executive Director IRCA Registered Lead Auditor IRCA No: 73114



ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

1. INTRODUCTION TO ENERGY-ENVIRONMENT-GREEN AUDIT

A Thing which Burns Never Returns....



1.1 : Preface about the Institution:

RAAK Arts and Science College (RASC), Perambai, Tamil Nadu is currently affiliated to Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu, India. The college was established in the year 2009 under Farouk Educational Trust. Till 2020, it was affiliated to Thiruvalluvar University, Vellore, Tamil Nadu, India. It started with five Under Graduate degree Programs and 180 students. The college currently offers seven postgraduate programs and twelve undergraduate programs. Graduates in the fields of the arts, sciences, commerce, business administration, social work, information technology, and computer science have all been supported by the college. As a result, there is an interdisciplinary environment that encourages students to learn across disciplines and conduct research. RASC is located in a green campus with all the amenities that are required, such as labs, ICT classrooms, transportation options, etc.

RAAK Arts and Science College (RASC) boasts an excellent infrastructure and convenient college hours, operating from 9:45 AM to 3:30 PM. The college is staffed by well-experienced and highly qualified faculty members. It features a modern computer lab equipped with high-speed internet, well-ventilated chemistry and physics labs with modern equipment, and a digital library stocked with a vast collection of reference books, journals, and magazines. The campus includes a well-maintained playfield with separate courts for volleyball, kabaddi, Kho-Kho, badminton, and cricket. Additional amenities include a hygienic canteen, hostel, and transport facilities, 24×7 medical care support, a secure campus monitored by CCTV surveillance, and pure drinking water facilities provided by RO plant.

1.2 : Vision:

To achieve excellence in delivering quality education of global standards, coupled with innovative practice using advanced technology and expertise transforming the student community into potential global leaders with accountability to meet the social, national and dynamic global challenges.

1.3 : Mission Statement:

1. To create and nurture learning and knowledge based a environment, conducive to the pursuit of quality education which would transform a socially responsible generation to act on their professional values and beliefs.
2. To bring about their overall personality development, fostering a caring and creative environment that emphasizes physical, social and intellectual development.
3. To instill a sense of understanding, remarkable resilience and enduring adaption to a diverse, competitive and dynamic society.



4. The mission of the trust is to empower young men and women to face the challenges of life with courage and commitment to be builders of a human and a just society and to promote a learning community in which all, especially those from less privileged backgrounds, feel part of the collaborative high-quality educational process which is value based and leads to holistic growth.

1.4 : Programs Offered:

UG Programmes	PG Programmes
B.Com. General	M.Sc. Chemistry
B.B.A. Business Administration	M.Sc. Mathematics
B.Com. Corporate Secretaryship	M.Sc. Computer Science
B.Com. Computer Application	M.Com. (Computer Application)
B.Sc. Mathematics	M.Com. General
B.Sc. (IT)	M.S.W. (Master of Social Work)
B.Sc. Physics	M.B.A. (Master of Business Administration)
B.Sc. Chemistry	
B.Sc. Computer Science	
B.C.A.	
B.A. English	
B.A. Tamil	

1.5 : Major Activities in the Institution:



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1.6 : Scope of the Audit Process:

Energy Audit:

- Conduct a comprehensive energy audit on campus to identify the usage patterns of electrical and thermal energy, focusing on where, when, why, and how energy is being utilized.
- Determine the best practices for energy conservation, management, recommended safety measures, and establish a continuous energy monitoring system.

Environmental Audit:

- Review the history of activities, current environmental practices, monitoring records, and known sources of environmental issues within the college.
- Evaluate the adoption, processing, and utilization of natural resources (such as energy and water) and the generation of waste, including hazardous and toxic materials.
- Examine the handling, storage, transportation, reuse, recycling, and effective disposal of all types of waste (solid, liquid, and gaseous).
- Measure the effectiveness of pollution control measures (air, water, and soil), maintenance logs, emission test reports, and routine analytical reports.
- Provide ongoing awareness to all stakeholders about environmental impacts, risk analysis, and ecology.

Green Audit:

- Assess campus greenery in terms of matured trees, flowering shrubs, bushes, medicinal plants, adoption of green energy generation and utilization, and the reduction of CO₂ due to the green energy system.
- Identify potential implementations and enhancements of current greenery practices.

1.7 : Outcomes of the Audit Process:

- Provide recommendations based on field measurements with achievable Energy Conservation (ENCON) proposals under no cost, low cost, and cost investment categories.
- Minimize current energy costs by adjusting and optimizing energy usage and reducing energy wastage without impacting regular activities.
- Determine the operating efficiency of each electrical system (specifically individual machines), compare with design values, and identify feasible technical

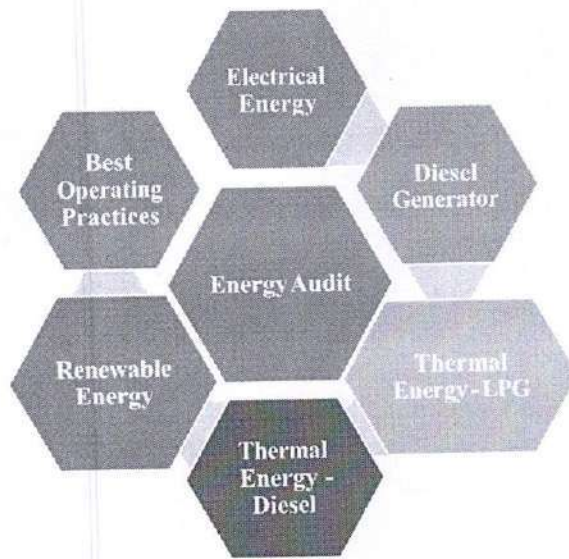


ways to improve efficiency cost-effectively.

- Develop a methodology for a long-term roadmap for energy savings and continuous improvements.
- Use findings to develop environmental management policies or improve existing systems.
- Identify potential cost and energy savings from energy conservation, waste reduction, reuse, and recycling.
- Develop a rule-based system to create a sustainable environment on campus, emphasizing the importance of reducing energy consumption and environmental impacts.
- Formulate a long-term roadmap for maintaining a green environment on campus and encourage stakeholders to pursue continuous improvements optimizing energy usage and reduction of energy wastage without affecting the regular activities.
- Determination of operating efficiency of each electrical system (more specifically on individual machines), comparison of design values and to identify feasible technical ways to improve it further in a cost-effective manner.
- Formation of methodology for long-term road map for energy savings and continuous improvements.
- Use as a basis for the development of environmental management policies or efforts to improve the existing plants.
- Identification of possible cost and energy saving from energy conservation, waste reduction, reuse and recycling.
- Development of rule-based system to become a sustainable environment inside the college campus and nurture the importance of less energy and less environmental impacts.
- Formation of methodology for long term road map for maintaining green environment within the campus and encourage the stakeholders for continuous improvements.

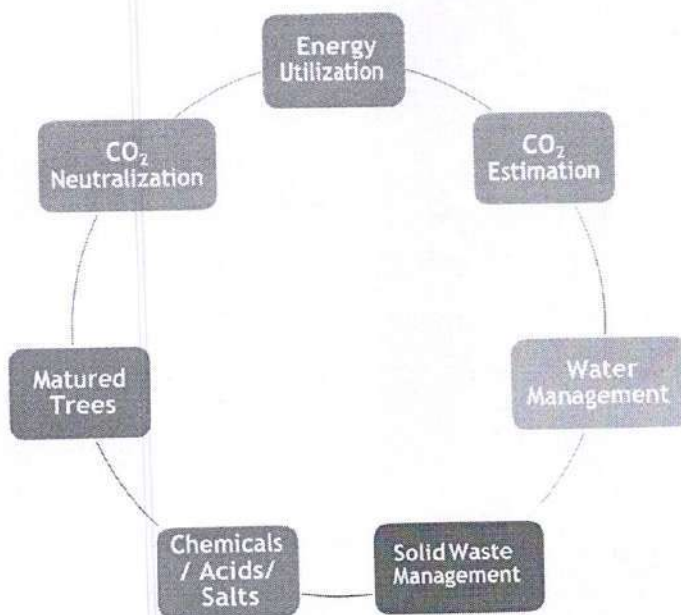


1.8 : Coverage in Energy Audit Process:




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1.9 : Focus Areas in the Environment & Green Audit Process:



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ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

PART-A: ENERGY AUDIT REPORT

2. EXECUTIVE SUMMARY

Leaks Make your Future Bleak....



EXECUTIVE SUMMARY

Electrical and Thermal Energy Analysis:

A detailed audit was conducted at RAAK ARTS AND SCIENCE COLLEGE, No.1, Basheer Campus, Perambai Road, Perambai, Vanur (T.K.), Villupuram District – 605 110, India. The audit team has identified six Energy Conservation Proposals (ENCONs), and the summary of these ENCONs is provided below:

Summary of Energy Conversion (ENCON) Proposals		
S. No.	Description	Parameters
1.	Present Annual Energy Consumption	1,12,328 kWh
2.	Present Annual Energy Cost	7.85 lakhs
3.	Proposed % of Energy Savings	15% Electrical
4.	Proposed Annual Energy Savings	16,849 kWh
5.	Proposed Financial Savings	1.18 lakhs
7.	Simple Payback Period	1.5 years

(* Audited and Accounted for June - 2022 to May - 2023)

Equipment's/Systems Audited:

• Electrical System & Network	• Diesel generators, pumps and motors
• Lighting, Fan & Air Conditioning System	• Inverter, UPS and Battery System

Audit Conducted, Compiled and Verified by,



(Mr. G. ARIVARASAN)

BEE Certified Energy Auditor (EA-21875)

Lead Auditor – ISO 14001, EMS



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Table-1: POSSIBLE ENERGY CONSERVATION PROPOSALS (ENCONS)

S. No.	Proposed Energy Conservation Measures	% Saving & Source	Remarks
1.	Reduction of kVA Demand and Active Power Consumption using Load End Capacitor Compensation	0.5 % on Total Consumption	Shift some of existing capacitors from PH and to load end
2.	Reduction of Energy Consumption in AC Compressors using Mist Pre-Cooler	10 % on HVAC	Try with low TR unitary AC and ensure energy and financial savings
3.	Replacement of Fluorescent Lamps with Energy Efficient Lamps (Swap FTL to LED Lamps)	50 % of FTL Consumption	Prepare the list of conventional FTL (of 36 W) and replace with LED of 18 W (one to one)
4.	Replacement of Existing Convection Ceiling Fans into EC - BLDC Fans	50 % of Fan Consumption	Replace the conventional ceiling fans with BLDC in a phased manner
5.	Preheat the boiling water using Solar thermal hot water system	5 % of LPG system	Try with a minimum Litre per day solar hot water generation (increasing water temperature from ambient to nearly 70 °C). Payback is less than 2 years.
6.	Expansion of Roof Top Solar Photovoltaic Power Plant (SPP) and Reduction in kWh Billing	50 kW roof top solar PV system	50 kW capacity of SPP roughly generates 200 to 250 units per day and generates nearly 64,000 to 80,000 units per Annum (considering 320 working days).

ENCON-I:

- In general, the college type loads are having wide variation especially i) during day & night time, ii) week days to weekend and iii) college working days and holidays. For this type of loads, it is highly recommended to connect the FC at the load end distribution panels and dedicated APFC must be fixed and function at the transformer end to maintain the PF close to unity.
- All the individual motor loads above 5 HP to be load end compensated with PF compensating capacitor along with isolation MCB for the capacitor at the motor end or at its motor panel end.



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ENCON-II:

- It is recommended to install the mist cooling system in higher power and continuous running AC system and ascertain the performance (especially CoP).
- Implement the mist pre-cooler system and coupling of water mist with condenser reduces the compressor power up to 25%. The application of water mist condenser, inlet air pre-cooling could decrease the Specific Energy Consumption (SEC).
- Install a kWh meter, observe the result before and after the installation and ensure the specific power consumption. Compare the results and ensure the saving.

ENCON-III:

- In a phased manner, the college administration has to replace the FTL to LED of 18 W (20 W with choke) of branded round LED tube fitting without Blue Tinge.
- Retrofit a Surge Protection Device (SPD) at the lighting DB incoming so as to avoid failures in lighting due to micro second duration transients.
- Visual tasking is important aspect of productivity and we must give steady level of lighting.
- Improve data management: Energy management and other asset management tasks will be simplified if records of lamp and luminaries types are kept up to date.

ENCON-IV:

- Recommended to replace the existing conventional fans into EC-BLDC fans in a phased manner and ensure good energy saving.
- Further implementation of EE fans not only saves the kWh; but also saves kVA demand. A conventional fan draws nearly 100 VA, whereas the EE fan draws only 40 VA.

ENCON-V:

- The hybrid PTC model produces steam (assumed as saturated at 5-bar pressure) + hot water system.
- A steam separator inbuilt in the system separates the steam and the hot water is either taken separately through pipe system or stored in a hot water tank (later taken for application).



ENCON-VI:

- All the electricity consumers (irrespective of their tariff structure) are eligible to install SPP in their roofing; start generating power and being fully utilized by the consumer (connecting the inverter output to any of the SSB or in the MV panel).
- Installation of renewable energy based power generation might be mandatory in future (as per the government policies). Some bankers are now insisting that the customer has to install renewable energy system to reduce their carbon footprint.
- Further, during the environment assessment; power generation from the solar plant is being utilized to neutralize the CO₂ emission. Hence, it will be value added utility for the college.




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PART-A: ENERGY AUDIT REPORT

3. STUDY ON ENERGY CONSUMPTION & GENERATION PATTERN

Take Control of your Energy Bills....



3.1: Energy Consumption Pattern (Electrical and Thermal):

S. No.	Description	Details	
Electrical Energy (Consumption)			
1.	Name of the customer (As per the utility bill)	M/S. RAAK ARTS AND SCIENCE COLLEGE	
2.	Type of Utility Supply, Service No.& Tariff	HT - C Rs. 5.60/- per unit	
3.	Energy Suppliers	Tamilnadu Generation and Distribution Corporation	
4.	Permitted Demand (PD)	HT SC. No: 0244700624 420	
5.	Types of Thermal Energy Used	Diesel (Ordinary)	Transport
General Loads (Both Electrical and Thermal)			
6.	Lighting System	Indoor lighting: Conversion of Florescent Tube Light (FTL) into LED in a phased manner	
		Outdoor lighting: All the street lightings are LED based energy efficient lamps as well as solar based lamps	
7.	Fan Loads (Ceiling)	<ul style="list-style-type: none"> All the ceiling fans are conventional fans. 	
8.	HVAC System	<ul style="list-style-type: none"> Unitary air-conditioning system installed in the required places. Most of the AC units are BEE star rated and the outdoor units are mostly placed in shade. A welcome step in the energy conservation is; all the air-conditioned rooms are set with 24° C as room temperature as per BEE norms. 	
9.	Motors and Pump loads	<ul style="list-style-type: none"> Mainly used for water distribution, purification, waste water treatment. Small motors used in kitchen equipment' s. 	
10.	Uninterrupted System (UPS)	Power	<ul style="list-style-type: none"> All the computers, server, surveillance system, projectors, telephonic units are connected with UPS with nominal back up time of 15 - 30 min.



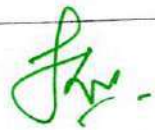

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Table-1: Annual Consumption of Electrical & Thermal Energy Parameters (2022-23)

S. No.	Month	Units Consumed (kWh)
1.	Jun-22	9409
2.	Jul-22	9323
3.	Aug-22	9218
4.	Sep-22	9105
5.	Oct-22	8992
6.	Nov-22	8882
7.	Dec-22	8780
8.	Jan-23	9984
9.	Feb-23	9822
10.	Mar-23	9717
11.	Apr-23	9598
12.	May-23	9498
Average		9360.667
Total		112328



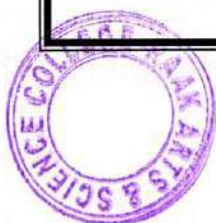
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ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

PART-B: ENVIRONMENT & GREEN AUDIT REPORT

4. ESTIMATION OF CO₂ EMISSION AND NEUTRALIZATION (ELECTRICITY, DIESEL)

Reduce, Reuse, Recycle



4.1: Assessment of Annual Energy Usage:

Table-2 shows the types of energy carriers used for their regular operation in the college campus along with application area and their source.

Table-2: Energy Carriers, Application area and their sources used for College Operation

S. No.	Type of Energy Carrier	Application Area	Source of Procurement
1.	Electricity	Powering to all electrical / electronic / HVAC equipment's	From authorized distributor
2.	Diesel	Transport vehicles	From authorized distributor
3.	Matured Trees	The college has nearly 109 no's of varieties of matured trees with more than 10 years old.	

4.2: Environmental System: CO₂ Balance Sheet (2022 - 23):

Environment audit is the best tool to assess the CO₂ emission and neutralization and chalk out the plans to reduce it from the present values.

Table-3 provides the balance sheet indicating various energy carriers associated with the regular activities of the college and their CO₂ mapping.

Table-3: Environmental System: CO₂ Balance Sheet (2022 - 23)

S. No.	Energy Consumption & CO ₂ Emission			CO ₂ Neutralization		
	Description	Annual Usage	CO ₂ Emission (Tons/Annum)	Description	Annual Usage	CO ₂ Neutralized (Tons/Annum)
1.	Electrical Energy	112328 kWh	92.1	Matured Trees	109 Nos.	2.38
2.	Total Emission		92.1	Total Neutralized		2.38

Balance CO₂ to be Neutralized = 89.72 Tons/Annum & CO₂ accountability for RASC campus = 1310.7 Tons/Annum¹

(¹ Total strength of students, Teaching & technical staff = 1040)

4.3: Observations:

- From the above table; it is evident that the college is now trying to neutralize their CO₂ emission through various initiatives like i) Installation of additional roof top solar PV system, ii) Planting more no. of trees and iii) implementing various energy conservation measures (FTL to LED conversion, conventional fan to BLDC fans, Energy efficient motor replacement, judicious use of all types of energy etc.,).




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4.4: Calculation Table:

For Electricity = $\left[\text{kWh} \times \frac{0.82 \text{ kg of CO}_2 \text{ emission}}{\text{kWh}} \right]$
For Diesel = $\left[\text{Diesel Consumption (Litre)} \times \frac{2.64 \text{ kg of CO}_2 \text{ emission}}{\text{Litre of Fuel Consumption}} \right]$
For LPG = $\left[\text{LPG Consumption (kg)} \times \frac{3.0 \text{ kg of CO}_2 \text{ emission}}{\text{kg of LPG Consumption}} \right]$
A matured tree can able to absorb nearly CO ₂ at a rate of 48 lbs./year (nearly 21.8 kg); hence total CO to be neutralized is $\frac{(21.8 \times 10^9)}{1000}$ _____

4.5: References:

¹ <https://ecoscore.be/en/info/ecoscore/co2>

³ <http://www.tenmilliontrees.org/trees/#:~:text=A%20mature%20tree%20absorbs%20carbon,t he%20average%20car's%20annual%20mileage>



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ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

PART-B: ENVIRONMENT & GREEN AUDIT REPORT

5. TRANSPORT & REFRIGERANT GASES IN AIR CONDITIONING SYSTEM

**Air Pollution does not need a Visa
to travel across the Border**



5.1 : List of Transport Vehicles:

The college is committed to provide green environment not only in the campus; but also to the entire atmosphere. The list of transporting vehicles available in the college campus along with their type of engine are represented in Table-4.

Table-4: List of Transporting Vehicles available in the College

S.No.	Type of Vehicle	Type of Engine	Fuel Used	No. of Vehicles	Non-pollution certificate
1.	Bus – Ashok Leyland AL FBV 6/1 BS III	PCV	Diesel	1	Yes
Total No. of Vehicles				01	

5.2: List of Air Conditioning System along with its Refrigerant:

The list of AC available is shown in Table-5: indicating their quantity, tonnage, type of refrigerant, GWP and ODP.

Table-5: List of Multi-variant AC System, Type of Refrigerant, GWP and ODP Values

S. No.	Location	TR Capacity	Quantity	Refrigerant Used	Global Warning Potential (GWP)	Ozone Depletion Potential (ODP)
1.	Principal room	3	1	R32	1,810	Medium
2.	Director room	3	1	R32	1,810	Medium
3.	Office and Accounts Section	3	2	R32	1,810	Medium
4.	Computer Lab	3	2	R32	1,810	Medium
5.	MBA Department	3	2	R32	1,810	Medium
6.	Chairman room	3	2	R32	1,810	Medium

- Note:** The most environment-friendly refrigerants that are available in Indian market currently are “R-290” and “R-600A”. They are Hydrocarbons and their chemical names are “Propane” for R-290 and “Iso-Butane” for R-600A.
- They are completely halogen free, have no ozone depletion potential and are lowest in terms of global warming potential. They also have high-energy efficiency but are highly flammable as they are hydrocarbons. (Kindly refer: <https://www.bijlibachao.com/air-conditioners/comparison-of-various-refrigerants-r-410a-r-22-r-290-r-134a-used-for-air-conditioners-and-refrigerators.html>).




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PART-B: ENVIRONMENT & GREEN AUDIT REPORT

6. WATER UTILIZATION, CONSERVATION & WATER MANAGEMENT

Our Earth, Our Habitat, Our Home



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6.1 : Source of Water, Storage and Distribution:

Water is one of the main consumables in the college campus. **RAAK ARTS AND SCIENCE COLLEGE** gets the water from different sources i) Fresh water from the bore well and ii) Rain Water Harvesting (RWH). Table-6 shows the source of water, location of storage.

Table-6: Source of Water, Location of Storage

Type of Water	Source	Location of Storage
Fresh water	Borewell	Stored in separate tanks located in each building.
Rain Water	Rain Water collected through i) buildings run offs, ii) road run-offs	Percolated to underground

6.2 : Reverse Osmosis (RO) and Treated Water for Drinking Application:

The college management is keen on providing uninterrupted, safe and healthy drinking water to all; throughout the year. The college is equipped with one RO plant with capacity of 500 LPH

The RO plant filter & membrane, the overhead tanks storing the drinking water are cleaned at regular intervals.

6.3 : Rain Water Harvesting (RWH) – from Building Roof Area & Run-off Area:

- The audit team appreciates the efforts taken by the management of **RAAK ARTS AND SCIENCE COLLEGE** for harvesting the rainwater almost in all buildings.

The roof area is so arranged to collect the rainwater, then passed through proper piping system, and then bring back to the RWH pits which is located close to each pits.



Fig.1: Rain Water Harvesting (RWH) system implemented in the College



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6.4: General Recommendations for Rain Water Harvesting:

- ❑ Numbering must be done each RWH pits. All the RWH pits must be properly numbered (based on location like 1/7, 2/7 and so on).
- ❑ Similar to numbering, all the RWH has been fitted with their specifications indicating their i) year of installation, ii) approximate average rainfall and duration in the RWH location and iii) type and layers of filters along with their dimension
- ❑ Conduct a GIS based study on the improvement of ground water table especially before the rainy session and after rainy session. Compare the data and ensure that the water table improves due to percolation of rainwater.



Fig. 2: Sample Rain Water Harvesting (RWH): Storage and Name Board Representation




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PART-B: ENVIRONMENT & GREEN AUDIT REPORT

7. USAGE OF CHEMICALS, SALTS & ACIDS (STORAGE, HANDLING, AND BEST OPERATING PRACTICES)

Say no to pollution & Yes to Recycle

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7.1 : Policy of Chemicals/Salts/Acids used in the Laboratory:

The science department uses chemicals for experimental applications and are having strict safety rules of thumb for handling and storage as follows.

- Well-trained faculty and lab assistants are only allowed to handle the chemicals safely and have knowledge about the hazardous nature of each and every chemicals.
- Strictly following the manufacturer's instruction on the container in order to prevent accidents.
- Volatile or highly odorous chemicals, fuming acids are stored in a ventilated area.
- Chemicals are stored in eye level and never on the top shelf of storage unit.
- All stored chemicals; especially flammable liquids are kept away from heat and direct sunlight. In addition, reactive chemicals are not stored closely.
- Hazardous and corrosive chemicals are kept on sand platform to avoid corrosion.
- First aid box and fire extinguishers are readily available in the laboratory.

7.2 : Storage of Chemicals/Salts/Acids:

Less concentrated chemicals, salts and acids are stored in proper racks, cupboards and high concentrated acids are stored in separate area filled with sand. Storage practices are represented below in Fig. 3 & 4.





Fig.3: Chemicals, Salts and Agents are separately placed for laboratory application



Fig4: Concentrated acids are stored in sand bed (Best practice)



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Practice	Storage and Handling of Chemicals
Best Practices Adopted	
<ul style="list-style-type: none"> • Most of the chemical, salts and acids used in the science department are inorganic in nature and no harmful effects were created during the experiment process. • Only trained teaching and non-teaching staffs are handling the chemicals and are well trained to handle any abnormal situations. • Laboratories using chemical are well ventilated with proper emergency exits. Adequate and correct sequence of fire extinguishers are placed near to all the laboratories. • As a best practice, some of the chemicals required for the most of the experiment are being prepared by the respective department itself, which reduces the chemical inventory. • The chemical/acid outcome of some of the experiments is being used as input for another experiments which also reduces the annual requirement of the chemicals/acids. 	
Best Practices to be Adopted	
<ul style="list-style-type: none"> • After completion of each experiment, the wastes are washed in the water sink and are rooted to sewage treatment plant which is designed to handle only sewage; not the effluent. • It is recommended to create a separate policy for Chemical handling and usage indicating various measures involved starting from procurement of chemical to disposal (Cradle to Grave approach). Ascertain that the chemicals/salts/acids used in the college campus for their academic/research application does not pollute the mother earth. • The policy must be approved by any regularly convened apex committee (may be Governing Council) and must be disseminated to all stakeholders. Also, paste the content of the policy in vulnerable points inside the college campus. • Though the quantity of the chemical wastes generated in an annum is small, it is appropriate to divert and treat this effluent to some other means. • One of the best way to treat this is; <ol style="list-style-type: none"> 1. Design a dedicated system and collect the chemical wastes in a separate tank with suitable backup facility. Once the tank fills; then transfer the effluent to nearby authorized Effluent Treatment Plant (ETP). An agreement may be made between the college and the ETP authorities over a certain period of time. 	

7.3 : Cleaning Agents (Soap & Powders) used for Vessel & Floor Cleaning:

In order to maintain hygiene in the College campus; the administration regularly clean the floors and restrooms. In addition to this, the hostel management has to clean i) the vessels, kitchen floor, dining hall, storeroom and gas station. Table-7 shows the cleaning agents used to clean the above area.




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Table-7: Cleaning Agents used for Floor and Vessel Cleaning

S. No.	Cleaning Agent	Application
1.	Cleaning Powder & Vessel Cleaning Soap	Vessel Cleaning
2.	Soap Oil & Bleaching Powder	Floor Cleaning

7.4 : Recommendations: Eco Friendly – Green Cleaning Agents:

- ❑ On an average, the cleaning agents used today have about 62 harmful chemicals like Paraben, Phosphates or Chlorides. A lot of them come from multi-purpose cleaners.
- ❑ It is recommended to use natural ingredients like orange peel extract & vinegar. It leaves a mild and pleasant fragrance after use. The formula is free from all harmful chemicals & toxins. It is pH-neutral, gentle on the skin as well as the surface on which it is used.
- ❑ Also these products are **IGBC GreenPro** certified. GreenPro is a mark of guarantee that the product is environment friendly throughout its life cycle.
- ❑ Fig. 5 shows the sample eco-friendly Green Pro certified cleaning agents.

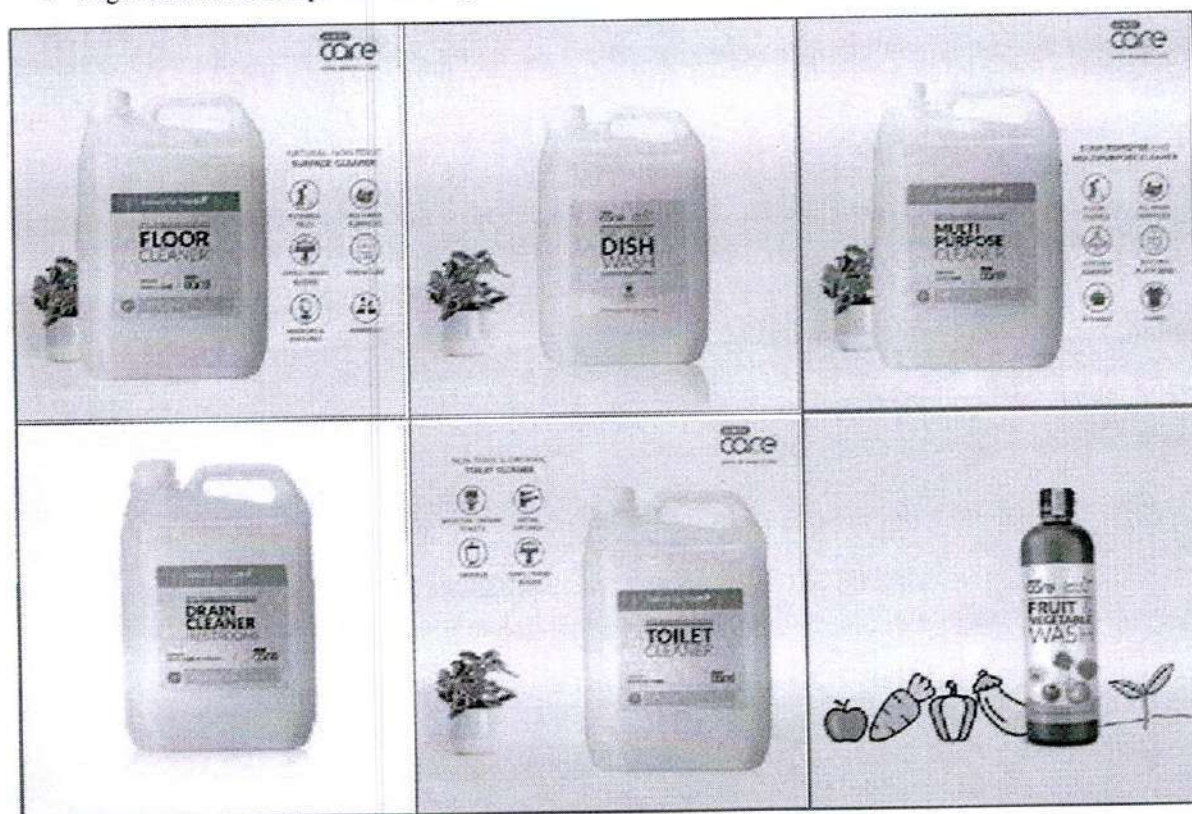


Fig.5: Green Pro Certified Eco-Friendly Cleaning Agents (ZERODER)




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**A SYNOPSIS OF
ENERGY, ENVIRONMENT &
GREEN AUDIT REPORT**

**PART-B: ENVIRONMENT &
GREEN AUDIT REPORT**

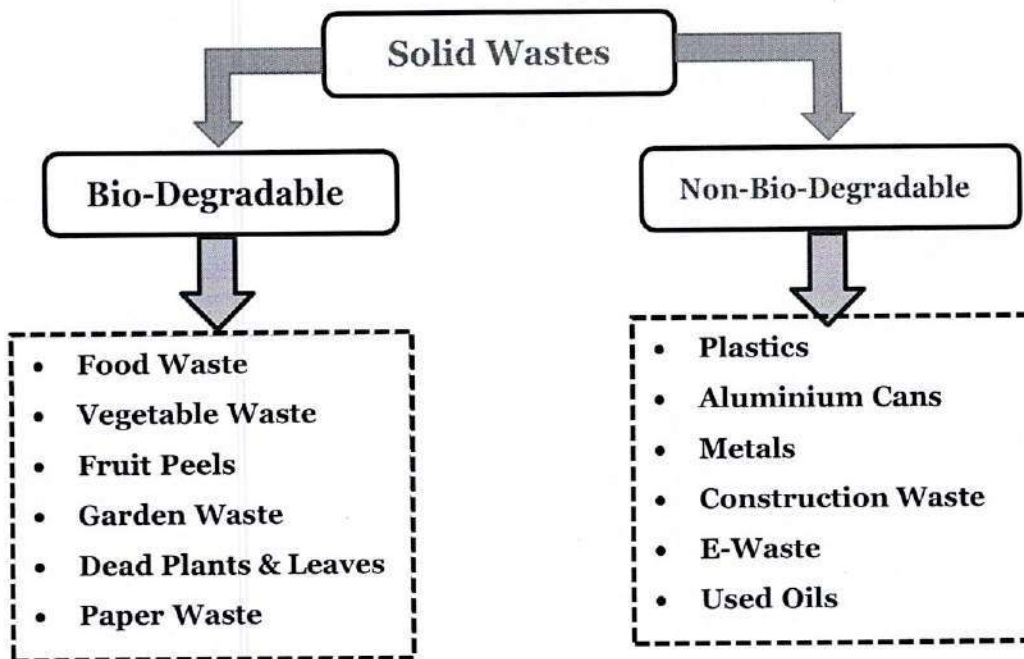
**8. WASTE HANDLING &
MANAGEMENT**

**Save the environment in present for
better life in future**



8.1 : Solid Waste Management System:

Different types of wastes generated inside the college premises are represented in the below block diagram.



8.2 : Process of Waste Management:

The college management practiced some methods to treat the waste generated and Table-8 shows the process of treating the solid waste generated inside the college campus.

Table-8: Process of Waste Management

S. No.	Waste Type	Waste Treatment
Bio-Degradable Waste Management		
1.	Food and Vegetable Waste	Collected and fed to nearby farming
2.	Garden Wastes and Plant Leaves	Daily collected and dumped in a yard
3.	Paper Waste	Collected and stored in a separate place.
		Sale to third party for recycling
Non-Bio-Degradable Waste Management		
4.	Plastics	Banned in the college campus (Welcome step). However, the chemical/salt storage plastic containers being disposed to third party.
5.	Construction Waste	Mostly used by their own construction and used for internal land filling
6.	Metals	Construction metals or from any other sources are stored in a separate place.
		Sale to third party for recycling



7.	Transport Oil + Tyres	Stored in a separate place and sale to third party.
8.	Transport Vehicle and Computer Batteries	Procuring new batteries with buyback offer (old battery replacement)
9.	Used edible oil	Almost zero waste. Mostly used for internal cooking and frying.
10.	E-Waste Management	Separately given below. Sale to third party for recycling

8.3 : List of Approved E Waste:

E-Waste – Electrical	E-Waste – IT & Communication
<ul style="list-style-type: none"> • Motors and Starters • Fans, Lamps and Luminaries • Electrical Drives • Heater Coils • Broken/Fired Cables • Air Conditioning System • Power Distribution Panels • Electronic Music Instruments • Electronic GYM Equipment's • Electronic Attendance System • Analog & Digital Measuring Instruments 	<ul style="list-style-type: none"> • Copier/Printers & Fax Machines • Power Stripes & Power Supplies • UPS/Servo Stabilizers/Inverters • Batteries • Wi-Fi-Modems, Routers, Toggle • Network Cables, Switches, Hubs • Phone, Intercom & PBX • Audio & Video Equipment's/Remote Controls, Projectors • Printed Circuits Boards • Barcode/QR scanners

8.4 : General Note:

- Prepare a flow chart for collection of E-waste from Generation to Disposal and paste it on appropriate places
- An electronic weighing scale (with suitable capacity) must be installed in the storage yard and should be properly calibrated.
- One emergency lamp (with UPS supply) must be installed along with suitable fire extinguisher. Ensure proper ventilation in theyard.
- Form rule for declaring the waste as E-Waste & Assign the signing authorities
- Identify a third-party vendor to procure the E-waste from the college.
- Establish MoU with that party. Disseminate the following information at appropriate places i) E-Waste Policy, ii) Process Methodology, iii) Copy of MoU with third party vendor, iv) Contact person's mobile no. and E-mail.
- Identify certain vehicle to carry the waste from generation to storage yard.
- Provide training to the manpower who are handling the waste.
- Maintain separate Delivery Challan, Billing, Weighing mechanism for handling the E-Waste.
- Update the status of E-waste (through digital circular) to all the concerned management representatives, faculty members and staff at regular interval (month wise is good).



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PART-B: ENVIRONMENT & GREEN AUDIT REPORT

9. ASSESSMENT ON MATURED TREES & GREEN ENERGY GENERATION

Trees are life, don't cut them



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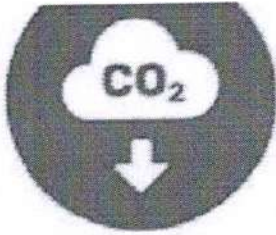
9.1: Campus Greenery:

The college is completely covered with matured trees grown for more than 10 years. The total number of matured trees available in the college campus is 109 with more than 20 varieties of trees. Apart from the mature trees; preserving the ecology; the entire college campus is planted with various flowing shrubs.

Table-9: List of Matured Trees available in the College

S. No.	Location (Wing/Block/Area)	Name of the Tree	Botanical Name	Quantity
1.	Main Block	Coconut Tree	Cocos nucifera	25
2.	Main Block	Mango Tree	Magnifera indica	15
3.	Main Block	Tamarind Tree	Tamarindus indica	2
4.	Main Block	Guava Tree	Psidium Guajava Linnaeus	4
5.	Main Block	Jackfruit Tree	Artocarpus heterophyllus	5
6.	Canteen Area	Custard Apple Tree	Annona squamosal	2
7.	New Building	Fig Tree	Ficus Carica	5
8.	Garden area	Banana Tree	Musa paradisiaca	12
9.	Canteen Area	Neem Tree	Azadirachta indica A.	5
10.	New Building	Cutch Tree	Senegalia catechu	2
11.	Garden area	Moringa Leaves	Moringa oleifera	2
12.	New Building	Acacia senegal	Senegalia senegal (L.)	2
13.	New Building	Portia Tree	Thespesia populnea	3
14.	Main Block	Tree jasmine	Jasminum officinale	2
15.	Garden area	Sandalwood	Santalum album Linn	2
16.	Parking Area	Teak Tree	Tectona grandis	8
17.	New Building	Albizia Saman	Samanea saman	5
18.	Garden area	Pomegranate Tree	Punica granatum	2
19.	Garden area	Lemon Tree	Citrus limon	2
20.	Garden area	Jujube Tree	Ziziphus mauritiana	2
21.	Canteen Area	Indian Gooseberry	Phyllanthus emblica	2





Total No. of Matured Trees available in the college campus is 109 which contributes for reduction of 2.38 **Tonsof CO₂ emission/Annum**



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ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

10. AUDIT SUMMARY & CONCLUSION

Save Energy: Save Future Generation....



SUMMARY OF THE AUDIT PROCESS:

In order to make the **RAAK ARTS AND SCIENCE COLLEGE** campus 100 % energy efficient; Environmental sustainability and lush Greenery; the audit team recommends to implement the following measures:

I. Energy Conservation & Management – Electrical Energy:

1. Highly recommended to revamp the powerhouse with proper Energy Monitoring System (EMS) and fitted with adequate Automatic Power Factor Controller (APFC) & Fixed Capacitors in order to maintain the supply power factor near to unity.
2. Conduct Infrared Thermography audit at regular interval on all electrical panels, joints, cables, switchgears, boilers skin, steam pipes, and other external parts producing heat. Practice the audit in the maintenance schedule.
3. Also, conduct voltage drop test for the longest electrical path and determine the voltage regulation at each points. This regulation must be within the limit of 5 %.
4. Maintenance logbook must have the installation details like date of installation, fault history, repair/replacement of system, Mean Time between Failure (MTBF), repetitive faults etc.
5. All SSB must be fitted with digital energy meters and are the readings must be taken daily or connect those meters with EMS and monitor the energy pattern of each building.
6. Replace the existing analog meter located in each distribution panels from powerhouse side with smart kWh meter and connect them through networking. This must enable the user to monitor the energy pattern of each block remotely.
7. Energy consumption for seminar hall, auditorium and library must be separately noted
8. Block wise maintenance checklist of electrical and thermal system
9. In a phased manner, ceiling fans must be changed from conventional fans into BLDC fans. Also, change FTL into LED with adequate illumination levels.
10. Implement automatic street light controller to turn on and off based on different time in a day. Use astrological timer for better results and energy savings.

11. Essentials in PH

- Place the Single Line Diagram (SLD) –Available
- Details of connected load in the campus.
- Name of the PH officials along with their contact mobile number & E-mail.
- Name of the nearest substation, emergency contact no. of Puducherry Electricity Board officials and fire officials.

12. Best Practices of Earth Pit Maintenance:

- Earth pits must be visible for easy access, regular maintenance and yearly measurement.
- Numbering of individual earth pits and maintain along with a diagram is always preferred.



- It is always good practice to represent the earth resistance value (last check value) either on the earth pit or inside the earth pit for ready reference.
13. **Retrofit of AIRCON Energy Saver, AC House Keeping and Optimization of Air Conditioning Operation.** Install AIRCON energy saver gadget which works on dynamic un-saturation principle with the sensor algorithms so that the air conditioners run hours are cut by 20 to 25 %.
 14. **BLDC AC System:** Similar to Fan, now BLDC based AC is available in the market which consumes less amount of energy (Power) during its starting and running condition. This AC operates at same tonnage capacity and offer 100 % same cooling effect compared to conventional inverter AC.
 15. **Replacement of Existing Water Pumps into BEE Star Labelled EE Pumps:** BEE star labelled pump system has i) High efficiency motor, ii) Lightweight materials and iii) Optimized suction-delivery system, ensures greater energy saving.
 16. **Implementation of Servo-Stabilizer (SS) for Lighting Load Application:** Lighting loads are most sensitive to voltage variations and supplying a constant voltage provides two major advantages namely i) Reduction of breakdown of lamps and luminaries and ii) considerable amount of energy saving.
 17. **Formation of Green Energy Team (GET):** In order to train the students to conserve the energy, each sections of the loads may be allotted with some group of students with a faculty mentor. These groups may fix up with a target for energy conservation and start working to achieve it. An incentive mechanism to the group of students conserving less energy will be moral example for other student.

II. Water Conservation & Management:

1. Amount of water utilized by each building by connecting digital water flow meter and optimize the water usage.
2. Prepare and maintain a Single Line Diagram (SLD) for water distribution network.
3. Try to reduce water tapped from the ground water source, since it is not environmental friendly.
4. Paste water and energy savings slogans at appropriate places.
5. Generate your own power and water for regular activities and move towards Net Zero Energy and Net Zero Water Building.
6. Retrofit aerator based water taps for good water savings. For hand washing applications, all the pipes must be fitted with aerators.
7. In future, install Bio-Sewage Treatment Plant as it reduces the amount of energy required to operate the plant and environmental friendly operation.
8. Capture almost 100 % rain water harvesting through i) Recharging pits and ii) Open well type storage pits.



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9. Properly follow scientific method of handling chemicals/Acids/Salts and safe disposal through 3rd party.
10. Water treatment log must be maintained indicating the water inlet, treated and outlet water quantity.
11. Install sensor based water controller in each Over Head Tanks and reduce the water waste and power required to operate the pump.
12. Energy required to process the water treatment must be calculated.
13. Overall cost of treated water by accounting i) consumables, ii) manpower iii) energy and iv) other conventional expenses
14. Use the treated water to the maximum in whatever possible areas and try to minimize the fresh water intake (from any source).
15. Set a policy and fix a target for usage of treated water; ensure that the plan is being executed without any deviation. Increase the % of usage of treated water year by year.
16. With advent of smart technologies, it is possible to have centralized monitoring in real-time using Internet of Things (IoT), Geographic Information System (GIS) software, etc. as per **Jal Jeevan Mission**, Department of Drinking Water & Sanitation, Ministry of Jal Shakti.
17. In hostel building, try to introduce “**Emergency Water Line**” during day time (usually from 9.00 AM to 4.00 PM). The gate valve of the common line is closed during that time and hence water wastage is being avoided in the knowingly or unknowingly opened taps.
18. Introduce **Power Wash** floor cleaning mechanism which removes the stains easily with reduced water usage.
19. **Awareness camps** must be conducted to all the stakeholders at regular interval. Through this initiative Painting, Photography, Slogan and Poster making contests are conducted to create consciousness among the students and faculties.

III. Waste Management:

1. **Yellow dustbins** must be placed to collect the bio-medical wastes.
2. After the COVID mask, sanitizer bottles, gloves and other medical items must be trashed only through the yellow bins.
3. This must be informed to all the students and stakeholders. Suitable steps has to be taken to disseminate this information.
4. All the solid wastes are properly stored in a separate place and record is maintained by mentioned its quantity.
5. Install biogas plant, revamp the bi-manure facility and utilize the same.
6. The food waste must be weighted and marked in a record before kept into the digester unit. This must be checked with the amount of gas generated using suitable calculation and check with the designed output.
7. Any waste items given to trust office or to the third party must have a record on the respective .



department.

8. **Reduction of Paper:** Workout a policy to move towards paperless office. Present system of paper usage may be reviewed and wherever possible; digitalize the activities and reduce the paper
9. Use bar code scanning to identify the location, row and seat no. of a candidate during examination and avoid paper information pasted in the notice board.
10. Publish the internal marks, model examination marks through student ERP.
11. Also, make attendance report, feedback, payments, salary slip may be converted to digital platform and if necessary take prints (only office copy).
12. Adopt some College Management System (CMS) and try to automate.
13. Automation leads to save energy, save manpower, save paper which leads to better transparency, efficient man power utilization and thus saves cost.

IV. Impart Training to Faculty and Technical Staffs:

1. Energy Conservation and Management
2. Environmental impact and assessment
3. Fire and Safety (Operation and Handling)
4. Electrical maintenance, AC, Battery Maintenance & Safety
5. Emergency Preparedness
6. E-Waste, Chemicals Handling & Solid waste management
7. Training for Transport employees (Improvement in fuel economy, reduce accidents, vehicle cleanness, 100 % attendance, student friendly approach and overall maintenance of the vehicle)
8. Training for Faculty and Students on Vehicle Operation (Preferably by PCRA or any other authorized service providers)
9. General medical camps for employees
10. Training on Stress management and Yoga

V. Way Forward towards Energy & Environmental Sustainability:

- Prepare an exclusive **Energy and Environment Policy** based on the energy and environment practices followed in the campus. This must reflect the i) Present energy consumption & generation, ii) Projection of energy need iii) Commitment by the college to conserve energy (in terms of percentage) iv) Road map to achieve the commitment v) Facilities required to achieve the same vi) Roles and responsibilities of all stake holders vii) Interim and final review mechanism viii) Corrective measures if the results deviates from the committed value and ix) Benchmarking, Case study preparation, Knowledge sharing and rewards.
- Implement ENCONs and best operating practices proposed in the audit report and measure the results.

Adopt effective waste management policy and reduce the food print of waste generation



(Net zero waste campus).

- Practice appropriate ISO standards for system management. The audit team highly recommend to follow i) ISO-9001 (Quality Management System), ISO-14001 (Environmental Management System) and ISO-50001 (Energy Management System).
- Working towards Net Zero Energy and Net Zero Water Campus and achieve **Platinum rated Global Leadership campus (as per IGBC rating)** and/or **5-star rated campus (as per GRIHA rating)** and/or **GEM-5 rated campus (as per ASSOCHAM GEM rating)**.

COMPLETION OF THE REPORT

This synopsis report is prepared as a part of the Energy, Environment and Green Audit process conducted at **RAAK ARTS AND SCIENCE COLLEGE**, No.1, Basheer Campus, Perambai Road, Perambai, Vanur (T.K.), Villupuram District – 605 110 by **P S QUALITY CERTIFICATION PVT LTD**, No.415, F4, 1 Floor, Asha Vignesh Apartment, Ambattur, Tamil Nadu 600 053.




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ANNEXURE:
AUTHORISED CERTIFICATES OF THE AUDITOR



Regn No. EA-21875

Certificate No. 8963



National Productivity Council
(National Certifying Agency)
PROVISIONAL CERTIFICATE

This is to certify that Mr. / Mrs. / Ms. Arivarasan G
son / daughter of Mr. Gopalakrishnan R
has passed the National certification Examination for Energy Auditors held in September 2016, 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 : 10th March, 2017

Controller of Examination




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NATIONAL POWER TRAINING INSTITUTE

An ISO 9001 : 2000 & 14001 Certified Institution
(Ministry of Power, Govt. of India)
Sector- 33, Faridabad - 121 003, India



No. SR/ 06

**Post Graduate Diploma in
Thermal Power Plant Engineering**

Issued under Rule 3(2-A) of Indian Electricity Rule, 1956 amended in 1981

*This is to certify that Mr./Ms. ARIVARASAN. G
Son/Daughter of Shri R. GOPALAKRISHNAN has successfully
Completed one year Post Graduate Diploma in Thermal Power Plant
Engineering from the National Power Training Institute, Southern
Region, Neyveli in the Year 2010 - 2011*

Date : 21 - 09 - 2011

Director

Principal Director

Director General

This Diploma authorizes the holder to operate or undertake maintenance of any part or whole of a
generating station of capacity of 100 MW and together with the associated sub-station

18:07



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