WAVOO WAJEEHA WOMEN'S COLLEGE OF ARTS & SCIENCE

Energy, Environment, Green Audit Report 2021-2022

Prepared by:

Department of Mechanical Engineering

National Engineering College,

K.R Nagar, Kovilpatti - 628 503.

Estd : 1984

NATIONAL ENGINEERING COLLEGE

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ENERGY AWARENESS & AUDIT CELL

TO WHOM SO EVER IT MAY CONCERN

This is to certify that the Energy, Environment and Green audit has been conducted at Wavoo Wajeeha Women's College of Arts and Science, Kayalpattinam has been conducted during 01.07.2022 & 02.07.2022. The recommendations for Energy, Environment and Green audit have been given in the report. We thank the management of Wavoo Wajeeha Women's College of Arts and Science, Kayalpattinam, Thoothukudi for providing the opportunity to conduct the audit and we also appreciate Wavoo Wajeeha Women's College of Arts and Science for taking these initiatives.

Er. K. SUDALAIYANDI	**Er. R. JAYA VENKATESH**	**Er. R. VIGNESH KUMAR**
ENERGY MANAGER	**ENERGY MANAGER**	**ENERGY MANAGER**
EM-34488/22	**EM-34505/22**	**EM-34502/22**

National Engineering College * K.R. Nagar * Dept. of Mech. Engg

ACKNOWLEDGEMENT

ENERGY AWARENESS AND AUDIT CELL (EAAC) of National Engineering College, K.R. Nagar, Kovilpatti, Thoothukudi district, Tamilnadu – 628503, is thankful to the management Principal, Faculty and Technical team members of **WAVOO WAJEEHA WOMEN'S COLLEGE OF ARTS & SCIENCE**, Kayalpatnam, Thoothukudi District, Tamil Nadu -628204, for providing an opportunity to conduct a detailed Energy, Environment and Green Audit process for the college promises.

It is our great pleasure which must be recorded here that the management of WAVOO WAJEEHA WOMEN'S COLLEGE OF ARTS & SCIENCE 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 the 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 energy division/ technical/non-technical and office members who were directly and indirectly involved with us during collection of data and conducting field measurements.

Audit Team Members	
Mr. K. Sudalaiyandi	BEE Certified Energy Auditor - EA34488/22
Mr. R. Vignesh Kumar	BEE Certified Energy Manager - EA 34502/22
Mr. R. Jaya venkatesh	BEE Certified Energy Auditor - EA 34505/22
Dr. R. Vijayakumar	Energy Consultant
Dr. W. Beno Wincy	Energy Consultant

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

1. INTRODUCTION TO ENERGY-ENVIRONMENT-GREEN AUDIT

1. 1. Preface about the Institution:

Alhaj Wavoo S. Seyed Abdur Rahman and his family founded the Wavoo Wajeeha Women's College of Arts and Science in Kayalpatnam in 2006 with the noble goal of bringing high-quality higher education to females in remote places where it was previously a privilege for a select few.

UG Programme:

- B.A., Tamil Literature,
- B.A., English Literature,
- B.A., Economics,
- B.Com., Commerce,
- BBA., Business Administration,
- B.Sc., Mathematics,
- B.Sc., Physics,
- B.Sc., Computer Science,
- B.Sc., Information Technology.

PG Programme:

- M.A., Tamil Literature,
- M.A., English Literature,
- M.Sc., Mathematics,
- M. Com., Commerce.

Diploma:

- Diploma in Islamic Theology (1 year)

1. 2. Vision

To give females in rural areas with higher education without regard to their caste, creed, or religion, bringing out their natural talents to create individuals who are highly qualified, morally upright, socially disciplined, and technically capable.

1. 3. Mission

1. Since our primary goal is to teach, we have made an effort to assemble a team of professors that are highly qualified, seasoned, and devoted. Students have the exceptional chance to learn from academics from various universities who routinely speak to them.
2. Getting the students to have huge aspirations and assisting them in realizing those dreams will undoubtedly help the college find its specialty. Additionally, the Trust intends to expand its educational initiatives in new directions.
3. By introducing student services, opportunities have been created to help kids from rural areas build integrated personalities.
4. May Allah grant us success in achieving the objectives set forth and a prosperous future for the pupils.

1. 4. Quality Policy:

Wavoo Wajeeha Women's College of Arts and Science is committed to improve the Quality Management System effectiveness in order to meet the regulatory requirements and expectations of students and relevant interested parties. This is achieved through quality placement support and students exposure to National level programs of practical relevance as well as Faculty Development.

1. 5. Major Activities in the Institution:

1. 6. Scope of the Audit Process :

Energy Audit:

- Conduct a detailed energy audit in the college campus with a main focus to identify judicious usage of electrical and thermal energy (where, when, why and how energy is being utilized).
- To ascertain the best practices to be followed in energy conservation, energy management, recommended safety measures and continuous energy monitoring system.

Environmental Audit:

- Identification of history of activities, present environmental practices followed, monitoring records and known sources of environmental issues inside the college.
- Adoption of natural resources as input (such as energy and water), processing and utilization and generation of wastes (including hazardous and toxic),
- Handling and storage of all types of wastes (Solid, liquid and grouses), transportation of waste from source to yard, reuse and recycling possibilities, storage mechanism and effective disposal.
- Measurement of effectives of pollution control (air, water and soil pollution), maintenance logs, emission test reports and routine analytical reports.
- Providing constant awareness to all stakeholders on Environment impacts, risk analysis and Ecology.

Green Audit:

- Assessment on Campus greenery in terms of matured trees, flowing shrubs, bushes, medical plants, adoption of green energy generation and utilization, reduction of CO_2 due to green energy system and identification of possible implementation and enhancement of current greenery practices.

1. 7. Outcomes of the Audit Process:

- Recommendations based on field measurement with achievable **Energy Conservation** (ENCON) proposals under **No cost/Low cost and Cost investment categories**.
- Minimization of present energy cost by adjusting and 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.

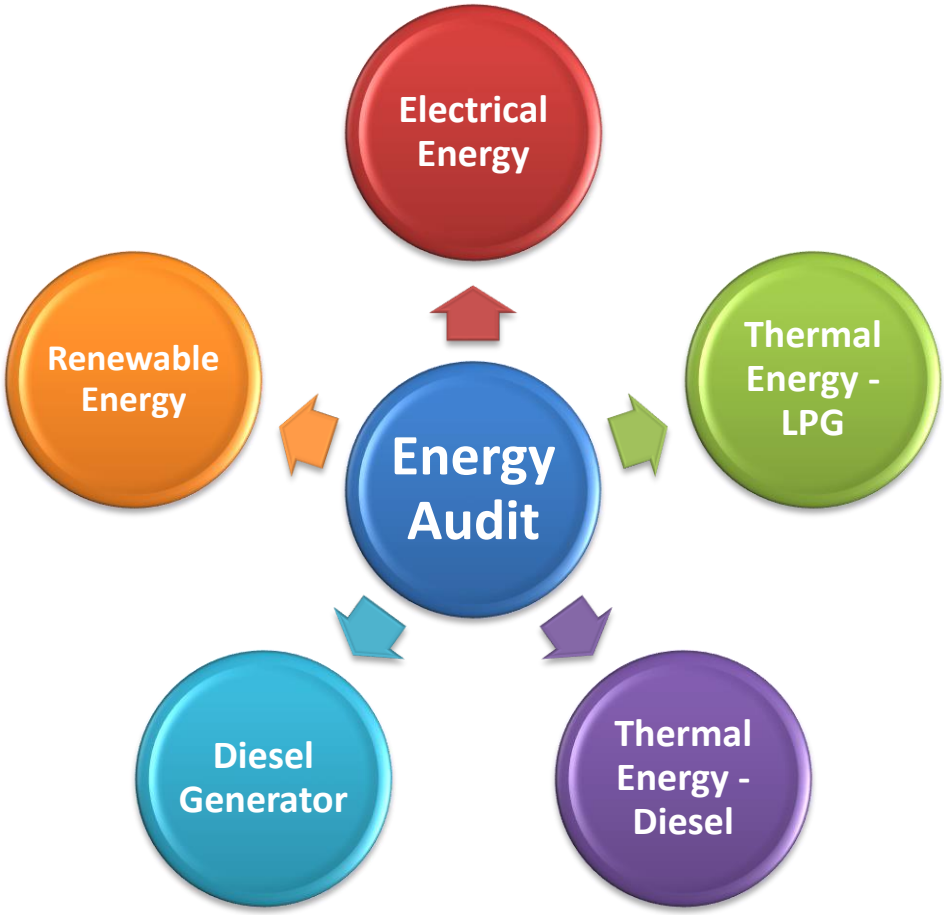
1. 8. Audit Approach:

The audit team completed the assessment of energy consumption in the College premises and operating hours of each systems, appliance and instruments in labs using two approaches namely i) Objective Approach in which a detailed measurement was taken and ii) Subjective Approach in which a field data collected from the maintenance department.

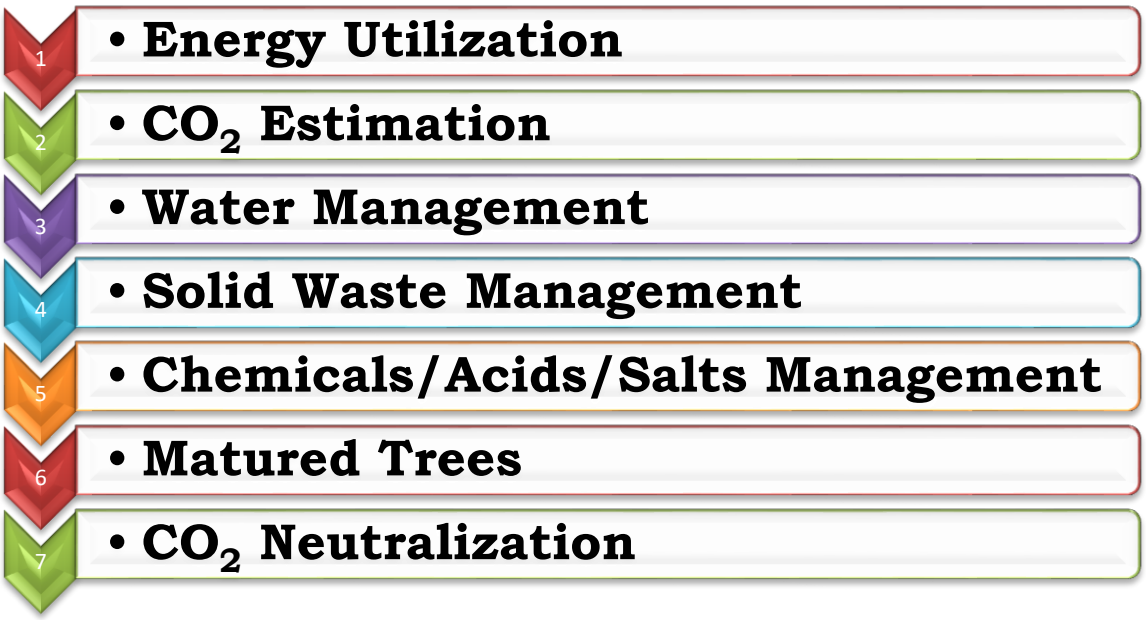
1. 9. Standards Used:

- Bureau of Energy Efficiency (BEE) Guidelines to conduct the detailed energy audit process.
- The Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard (Revised Edition) released by World Resources Institute & World Business Council for Sustainable Development – 2014.

1. 10. Coverage in Energy Audit Process:



1. 11. Focus Areas in the Environment & Green Audit Process:



1. 12. List of Members Involved in Data Collection & Audit Process:

Name of the Team Member	Role and Responsibility
Dr. R.ArunaJothi Head of the Department Department of Tamil Literature	Chemical, Acids, Salts data collection, Fuel consumption in canteen.
Mr. E.Maharajan Transport Manager Maintenance Department	DG and Fuel consumed, Campus greenery, RO and Solid waste management.
Mr. S.A.M. YasarArabath System. Admin Maintenance Department	System, UPS, E-waste, and Rain Water Harvesting
Mr.M.A.AbdulJabbar Tech.Support (Electrical) Maintenance Department	Electrical data collection, Lighting, Fan.

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

PART –A: ENERGY AUDIT REPORT

2. Study on Energy Consumption & Generation Pattern

GIST

1. Average power consumption of Wavoo Wajeeha Women's College of Arts & Science is Rs.55,581 /- per month in 2021 - 2022.
2. Major Energy consumption from the energy analysis is Diesel (Transport & Power), which is 89.77% of the overall Energy spent.
3. Electricity cost for Wavoo Wajeeha Women's College of Arts & Science is Rs.8.88 per unit for the year 2021-2022.
4. As a low hang fruit, by replacing older tube light with LED tube light, savings per year is about Rs.55,845/- with return on investment of 3 months.
5. As an easy picking, by replacing older fan with super fan, savings per year is about Rs.3,21,667/- with return on investment of 31 months.

Energy Consumption Pattern (Electrical and Thermal):

Sl. No.	Description	Details		
Electrical Energy (Consumption)				
1.	Name of the consumer	Secretary		
2.	Type of Utility Supply, Service No.& Tariff	Low Tension Consumer Sc. No: 07-470-364-835 Tariff II (LM2B2)		
3.	Tariff Structure	Rs.7.5/kWh		
4.	Energy Suppliers	Tamilnadu Generation & Distribution Corporation (TANGEDCO)		
5.	Permitted Demand	48 kW		
6.	Annual Electricity Consumption (kWh) (2022-23)	Bimonthly Min: 3990	Bimonthly Ave:6336	Bimonthly Max: 8080
		38020 kWh/Annum		
7.	Capacity of Diesel Generator (DG) Set	62.5 kVA-1 No.- Internal fuel tank (Air Cooled)		
		DGs are properly earthed (Body & Neutral)		
Thermal Energy (Consumption)				
8.	Types of Thermal Energy Used	Liquefied Petroleum Gas (LPG)		Cooking
		Diesel		Transport + DG
9.	Annual LPG consumption (2022-23)	Ave: 85.2 kg/ Bimonthly		
		511.2 kg/ Annum		
10.	Annual Diesel Consumption (22-23)	Bimonthly Min:321.42	Bimonthly Ave:2529.3	Bimonthly Max:5731
		30351.88 Litre/ Annum		

General Loads (Both Electrical and Thermal)		
11.	Lighting System	Indoor lighting: Florescent Tube Light (FTL)
12.	Fan Loads (Ceiling)	Most of the Indoor ceiling fans are conventional fans.
13.	HVAC System	Unitary air conditioning system installed in the computer labs
		Three AC units are Non BEE star rated and 1 AC is BEE 2-star rated.
		Outdoor Units are mostly placed in top of the window shades.
		A Welcome step in the energy conservation is- All the air conditioned rooms are set with 24^{o}C as room temperature as per BEE norms.
14.	Motors and Pump loads	Mainly used for water pumping.
15.	Uninterrupted Power System (UPS)	All the computer, server, surveillance system, telephonic units are connected with UPS
Renewable Energy Systems		
16.	Solar PV System	3.2 kW Standalone system is installed

Energy Contribution

Table 1 - Contribution of energy consumption & Energy conversion (Represented in MTOE)

Energy Carrier	Annual Consumption	Conversion Factor	Energy (M Cal)	MTOE	Contribution %
Electricity (TANGEDCO)	38020	860 kcal/kWh	32697.2	3.27	8.17
Electricity (Solar)	2150.4	860 kcal/kWh	1849.344	0.185	0.46
Diesel*	30351.88	11840 kcal/litre	359366.26	35.91	89.77
LPG	511.2	12500 kcal/kg	6390	0.64	1.60

Contribution of Energy consumption represented in MTOE and Percentage

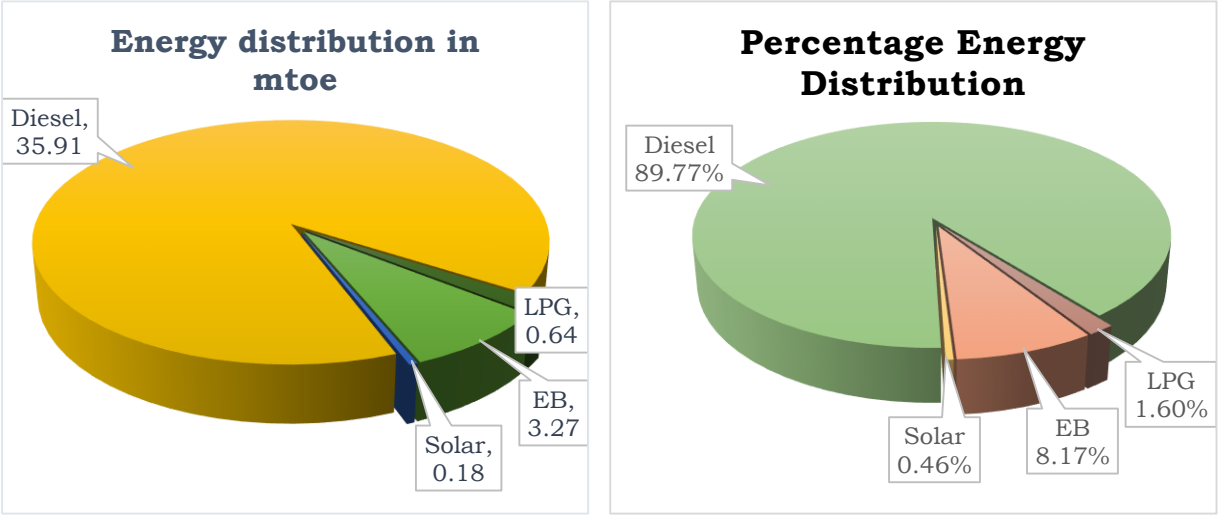


Fig. 1&2 describes the energy distribution of the college in metric tonne of oil equivalent (MTOE) and Percentage wise

Table 2 - Electricity bill analysis

Month	kWh	Contract Demand (kW)	Recorded Demand (kW)	Power Factor	CC Charges(Rs.)	Electricity Tax (Rs.)	Fixed Charges(Rs.)	Total bill (Rs.)	Unit Charges as per TNEB (Rs./kWh)
July-Aug 2021	3990	48	13.16	0.75	29925	1580	5760	37265	9.34
Sep-Oct 2021	7600	48	23.22	0.82	57000	2994	5760	65754	8.65
Nov-Dec 2021	6940	48	25.74	0.89	52050	2758.5	5760	60568.5	8.73
Jan-Feb 2022	4440	48	25.74	0.89	33300	1821	5760	40881	9.21
Mar-Apr 2022	8080	48	29.19	0.92	60600	3210	5760	69570	8.61
May-Jun 2022	6970	48	34.27	0.9	52275	2823	5760	60858	8.73

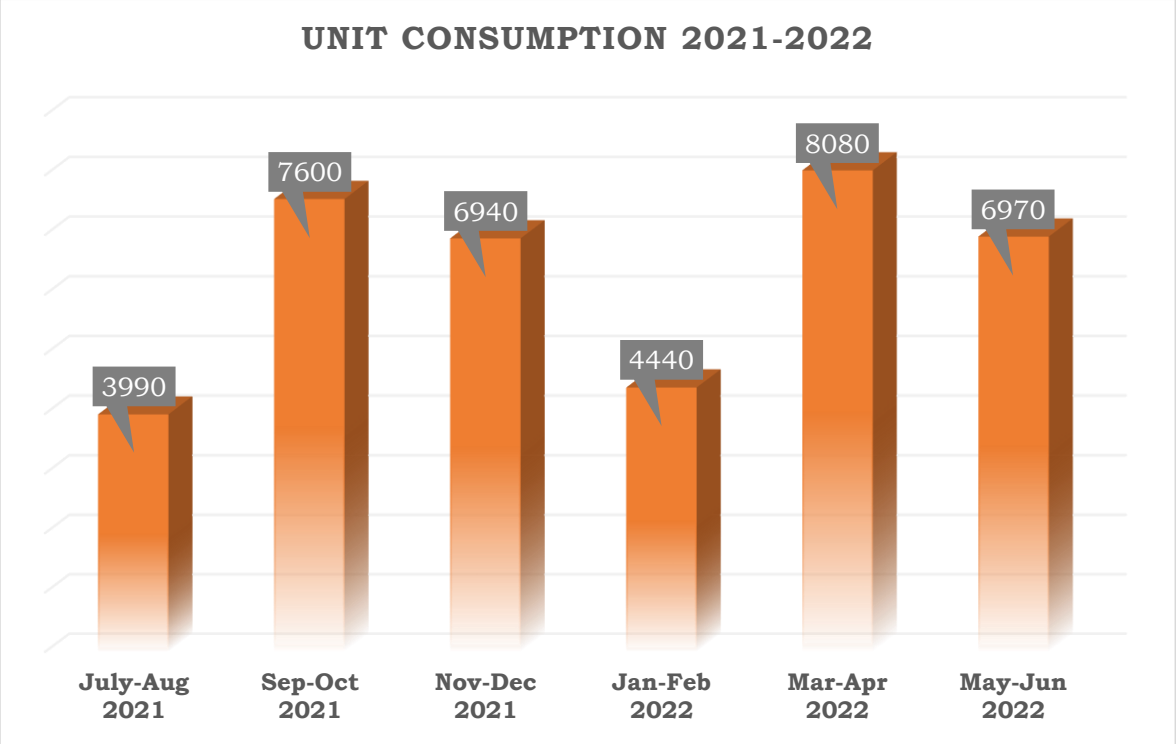


Fig.3: Unit consumption for the year 2021-2022

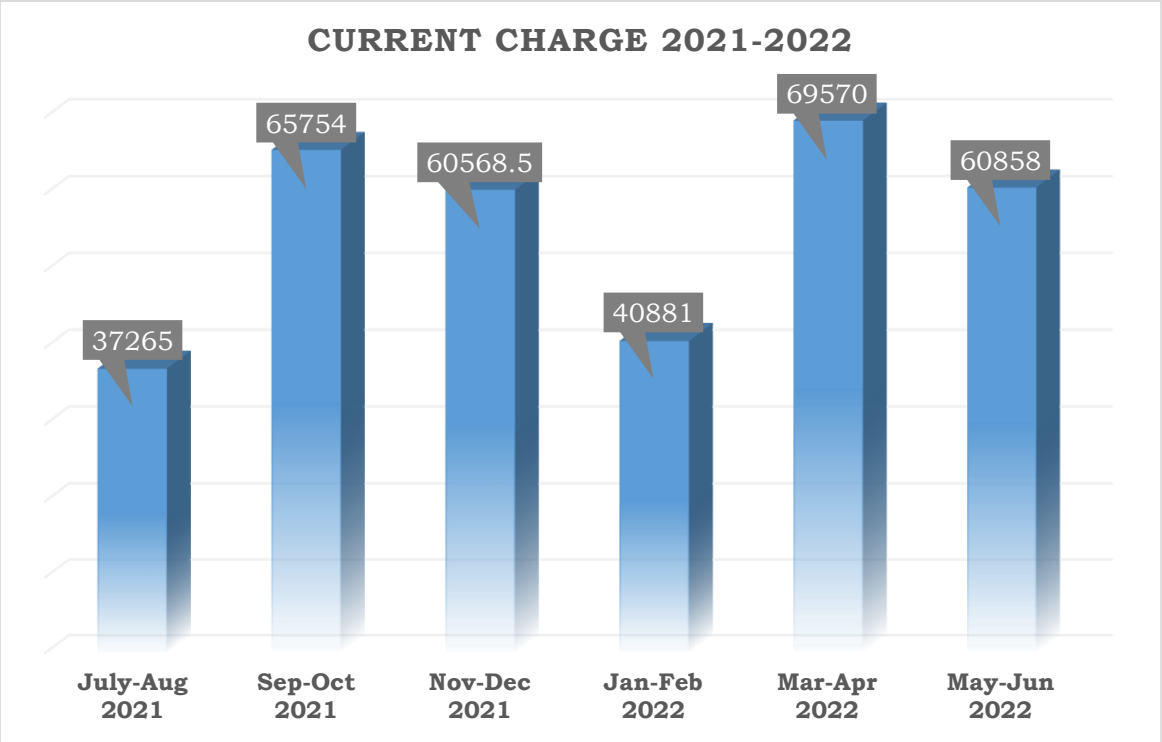


Fig.4: Power consumption charges for the year 2021-2022

Table-3: Annual Consumption of Electrical & Thermal Energy Parameters (2021-22)

Sl. No.	Month	Units Consumed (kWh)	Energy Generated (kWh) from Solar	Total Energy Consumed (kWh)	LPG consumed (kg)	Diesel Consumed (Litres)	Electricity Charges with solar (Rs.)	Electricity Charges without solar (Rs.)	Diesel Charges (Rs)	LPG Charges (Rs)	Total Expenses (Rs)		Total No of Students	Expenses/Student (Rs.)	
											With solar	without Solar		With solar	without Solar
1	July-Aug 2021	3990	0	3990	85.2	1411.55	37265	37265	133673.8	6710.352	177649.1	177649.1	1191	149.16	149.16
2	Sep - Oct 2021	7600	0	7600	85.2	4083.46	65754	65754	386703.7	6710.352	459168	459168.0	1191	385.53	385.53
3	Nov-Dec 2021	6940	236	7176	85.2	9055.39	60568	62628.2	857545.4	6710.352	924824.3	926883.9	1191	776.51	778.24
4	Jan - Feb 2022	4440	591	5031	85.2	5753.13	40881	46322.6	544821.4	6710.352	592412.8	597854.4	1191	497.4	501.98
5	Mar-Apr 2022	8080	605	8685	85.2	4947.96	69570	74779.1	468571.8	6710.352	544852.2	550061.3	1191	457.47	461.85
6	May- Jun 2022	6970	589	7559	85.2	5100.39	60858	66000.8	483006.9	6710.352	550575.3	555718.1	1191	462.28	466.6

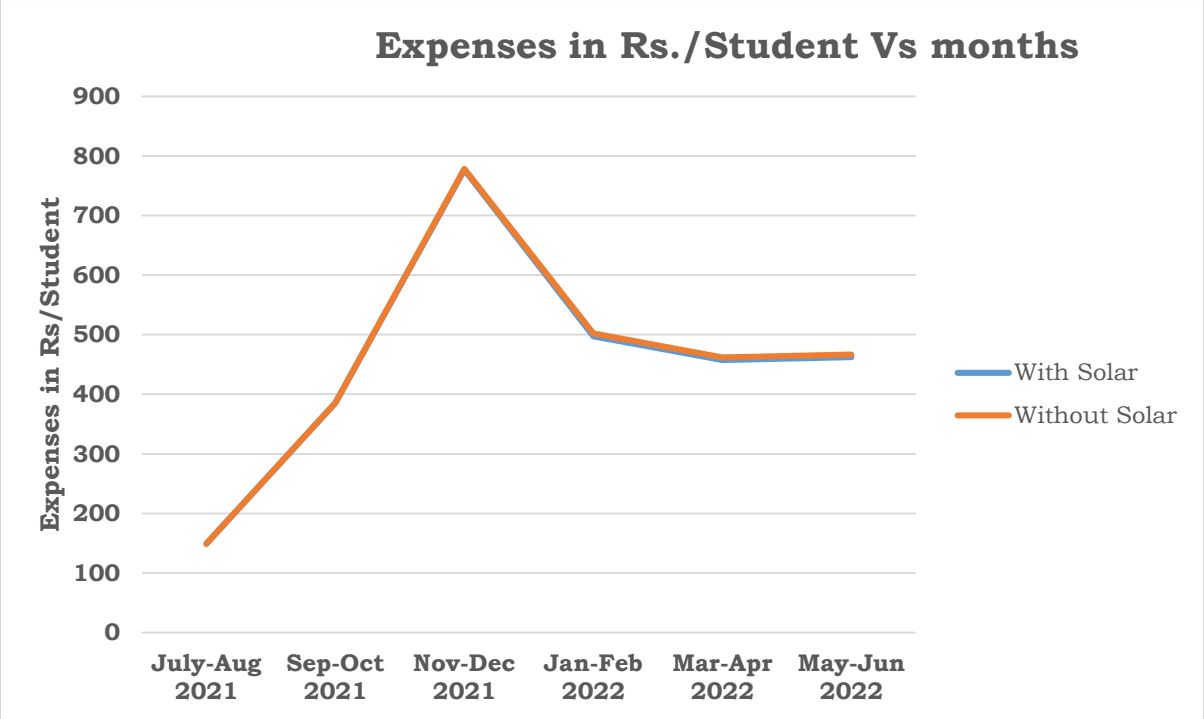


Fig.5: Per Capita Energy Expenses for the year 2021-2022

Maximum demand

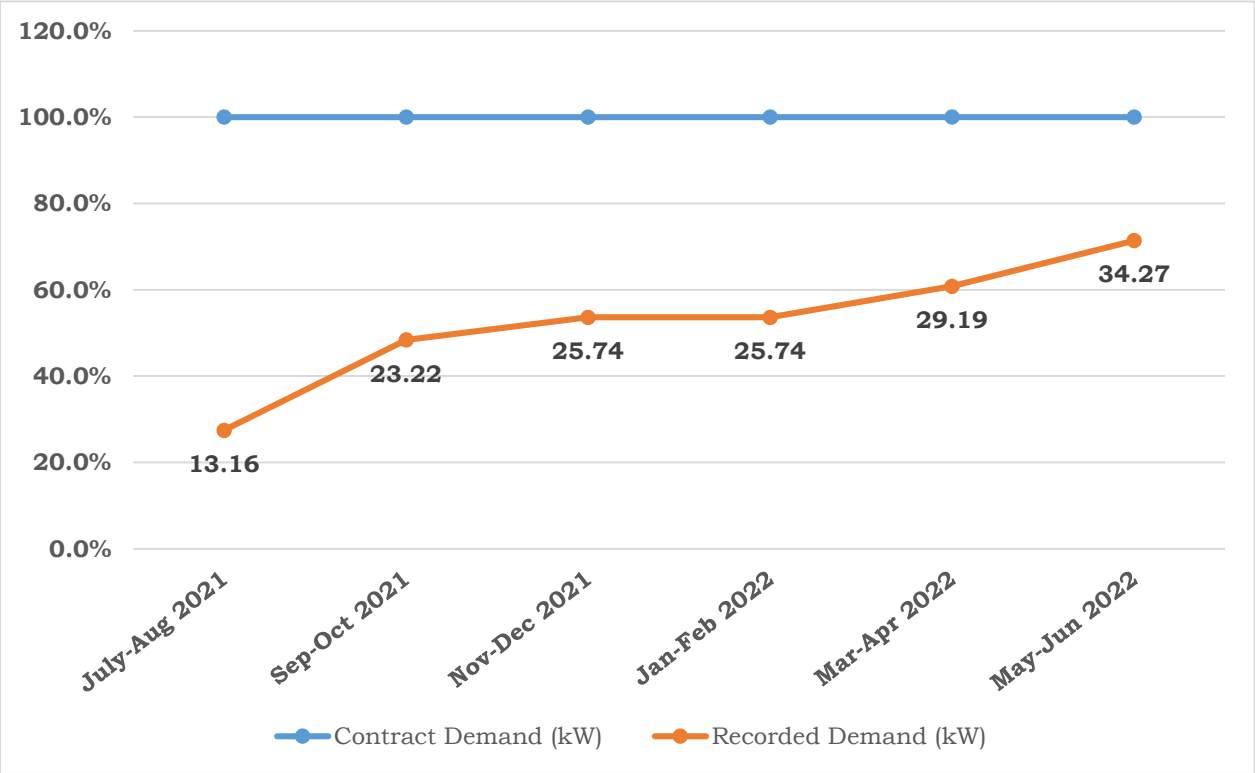


Fig.6: EB Power Demand details for the year 2021-2022

Connected Load details:

Table-4: Lighting and Fan Connected Load details for all locations

LOCATION	T8 (30 W)	Tube light (40 W)	SUPER FAN (28 W)	Fan (75 W)	LED tube (20 W)	LED BULB (15 W)	WALL FAN (55W)	CFL (11W)	WATTAGE
PRINCIPAL	1	2	0	7					635
PRINCIPAL+ INNER					1		1		75
OFFICE				7					525
RECORD ROOM	1	1		2					220
DIRECTOR ROOM		2		2					230
CAREER GUIDANCE	1	1		2					220
CR 108	2			5	1				455
CR 109		2		5	2				495
TOILET GROUND FLOOR		4							160
PRAYER HALL		4		6	2				650
CR 112	1	4		5					565
CR 113	1	2		2					260
CR 110	3	3		5					585
DEPT CS 114		1		3	1	1			300
CR 115	2	4		5					595
INFO TECH LAB				7					525
CS LAB	4	2		7					725
CR 118	2	2		5					515
CR 119	2	2		4					440
CR 120		4		9					835
Toilet						1			15
Sick room	1			1					105
RECPTION 102 A	1	2		3					335
MD ROOM 102				6		1			465
ELECTRICIAN ROOM 103				1	1				95
CR 202		1		4	1				360
CR 201				2	4				230
AUDITORIUM		12		12					1380
STAFF ROOM		1		2	1				210
CR 214				3		2			255

CR 213				3		2			255
Toilet						1		1	26
CR 211				5		2			405
CR 210	1			4		1			345
DEPT OF BBA	2			2					210
PRAYER HALL				2					150
LIBRARY 208	4	10		15		2			1675
CR 206	1	1		3	2				335
CR 205	1			3	1				275
DEPT OF PHYSICS 204	1			2					180
PHYSICS LAB 203 A	1	2		6				1	571
SEWING MACHINE LAB 212				4	2				340
Toilet						1			15
CR313	1	1		5					445
CR312				5	1				395
CR311	1			6					480
CR310									0
CR309	1	1		5					445
CR308		2		5					455
Toilet						2			30
CR307				3	2				265
CR306		1		4		1			355
Dept of economics		1		2		1			205
CR304		1		4		1			355
Tamil dept 303		1		4					340
CR302		1		3					265
CR301		2		4					380
Toilet						1			15
CR318		2		3					305
CR317		1		4					340
ENGLISH DEPT 316	1	2		3					335
Dept of Commerce				3				2	247
CR314	1			3					255
CR320 NAAC Room	1			3					255
PG									
135				6	3				510
133				3	2				265
132				3	2				265

131				3	2				265
130				3	2	1			280
129				3	2	1			280
128				3	2	1			280
127				3	2				265
126				3	2				265
VARANDA	2			2	6	15		15	720
PG VARANDA						4			60
PG Toilet						3			45
Total	**41**	**85**	**0**	**272**	**47**	**45**	**1**	**19**	**26909**

Table-5: Other Connected Load details

Sl. No.	APPLIANCE DETAIL	QTY	WATTAGE
1	Induction stove-1600W	6	9600
2	Computer	124	22320
3	Printer	12	480
4	Wifi Modem & LAN	28	280
5	Scanner cum printer	4	160
6	Scanner	1	40
7	Xerox machine	1	300
8	Fridge	1	250
9	Amplifier with mic	3	450
10	AC	4	6000
11	TV-50 inch	4	400
12	Ceiling lightn(2 CFL)	15	150
13	Projector	2	600
14	CCTV camera	38	190
15	Kettle	1	1500
16	TV-35 inch	1	40
17	Ceiling light LED	6	90
18	CCTV system	1	200
19	Table fan	1	55
20	Focus light-200W	3	600
21	Speaker big	2	160
22	Ahuja speaker-10W	16	160

23	Street light-30W	11	330
24	LED bulb in surrounding	6	90
25	Street light-60W	2	120
26	LED tube in surrounding	1	20
TOTAL			**44585**

Total Connected Load = 26909+44585 = **71494 Watts**

Energy Performance Assessment of lighting system:

Sl. No.	Type of fitting	Wattage	Total Quantity	Load in kW	Daily working hrs	Monthly working days	Monthly kWh
1.	T8	30	41	1.23	4	30	147.6
2.	LED tube	20	47	0.94	4	30	112.8
3.	LED BULB	15	45	0.68	4	30	81.6
4.	CFL	19	19	0.21	4	30	25.2
5.	Tube light	40	85	3.4	4	30	408

Type wise lighting Distribution

Type	Quantity	kW load	% Load
LED lights	152	367.2	47.4
FTL	85	408	52.6

Type wise Fan Distribution

Type	Quantity	kW load	% Load
Super Fan (28W)	0	0	0
Normal Fan (75W)	272	20.4	100%

Observations: Energy Saving Opportunity still exists in Fans.

ECM 1 – Replace Older Tube lights to Energy efficient LED lights

Present Scenario		Proposed Scenario	
Total Number Tube Lights	85	Total Number of LED	85
Wattage	40W	Wattage	20W
Total hours of operation	10hrs	Total hours of operation	10hrs
Total Units consumed	34	Total Units consumed	17
Total Unit savings per day		17	
Electricity Cost		Rs.9/Unit	
Annual Cost savings		Rs.55845/-	
Initial Investment(Rs.150/LED lamp)		Rs.12750/-	
Payback period		**3 months**	

ECM 2- Replace Old fans to BLDC

Present Scenario		Proposed Scenario	
Total Number Fans	272	Total Number of Super Fans	272
Wattage	75W	Wattage	30W
Total hours of operation	8 hrs	Total hours of operation	8 hrs
Total Units consumed	163.2	Total Units consumed	65.28
Total Unit savings per day		97.92	
Electricity Cost		Rs.9/Unit	
Annual Cost savings		Rs.321667/-	
Initial Investment(Rs.3000/Super Fan)		Rs.816000/-	
Payback period		**31 months**	

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

PART –B: ENVIRONMENTAL AUDIT REPORT

3. ESTIMATION OF CO_2 EMISSION AND NEUTRALIZATION (ELECTRICITY, DIESEL & LPG)

3.1: Assessment of Annual Energy Usage:

Table-7 shows the types of energy carriers used for their regular operation in the college campus along with the application area and their source.

Table-6: Energy Carriers, Application area and their sources used for college operation

S. No.	Type of Energy Carrier	Application area	Source of procurement
1.	Electricity (HT)	Powering to all electrical/electronic / HVAC equipment	From TANGEDCO
2.	Diesel	Transport vehicles and Diesel Generator (Captive Generation)	From authorized distributor
3.	Liquefied Petroleum Gas (LPG)	Used only for cooking	
4.	Matured Trees	The college is located in a lush greenery and nearly 107 no's of various varieties of matured trees are available with more than 10 years old.	

3.2: Environmental System: CO_2 Balance Sheet (2021-22):

Environment audit is to assess the CO_2 emission and neutralization in the college and is a best tool to chalk out the plans to reduce it from the present values. Table-8 provides the balance sheet indicating various energy carriers associated with the regular activities of the college and their CO_2 mapping.

Table-7: Environmental System: CO_2 Balance Sheet (2021-22)

S. No.	Energy Consumption & CO_2 Emission			CO_2 Neutralization		
	Description	**Energy Quantity (Annum)**	**CO_2 Emission (Tons/Annum)**	**Description**	**Energy Usage**	**CO_2 Neutralized (Tons/Annum)**
1.	Electrical Energy	38,020 kWh	34.98	CO_2 Neutralized due to Matured Trees	107 nos.	2.33
2.	Diesel (Transport + DG)	30,351.88 liters	81.95	CO_2 Neutralized due to Solar PV system	2,150.4 kWh	1.98
3.	LPG Consumption	511.2 kg	1.53			
4.	**Total-Emission**		**118.46**	**Total-Neutralized**		**4.31**
Balance CO_2 to be Neutralized = 114.15 Tons/Annum & Per Capita CO_2 Consumption = 0.087 Tons/Annum [1]						

([1] Total strength of students - 1191 + Teaching and technical staff – 117 = 1,308)

Observations:

1. In the campus, the CO_2 emission from the diesel usage is the highest which is of 81.95tons/annum.
2. The total electrical consumption in the college campus is 38,020 kWh per annum which contributed to the CO_2 emission of 34.98 tons/annum.
3. Due to the less LPG consumption, the CO_2 emission from LPG is low which is of 1.53tons/annum. However, it is suggested to use an efficient firewood stove to cook food using biomass which could reduce the emission from the LPG.
4. Due to the management's effort, 3.2 kW capacity solar PV panel has been installed to contribute 10% of the total energy consumption in 2021-22. This had led to the CO_2 neutralization up to 1.98tons/annum.
5. The campus has grown several varieties of trees which have contributed to the CO_2 neutralization of 2.33 tons/year. They had initiated to reduce the CO_2 emission by planting many trees. Unfortunately many of those newly planted trees are died due to highly salt ground water. Since the site is located near to south east of Bay Of Bengal Sea.
6. The college is now trying to neutralize its CO_2 emission through various initiatives like i) Installation of rooftop solar PV systems, ii) Reduction of LPG consumption, iii) Planting more no. of trees and iv) implementation of various energy conservation measures (FTL to LED conversion,judicious use of all types of energy etc.,).

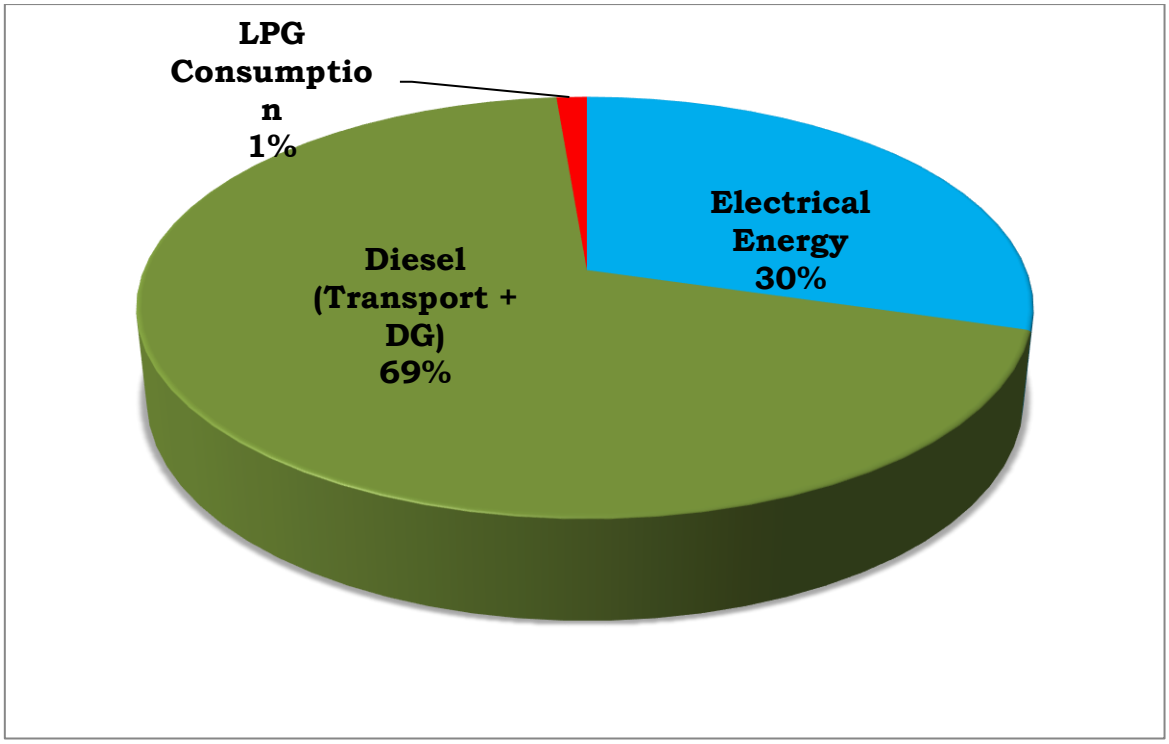


Fig.7: Percentage of CO_2emission in the college campusfrom various sources

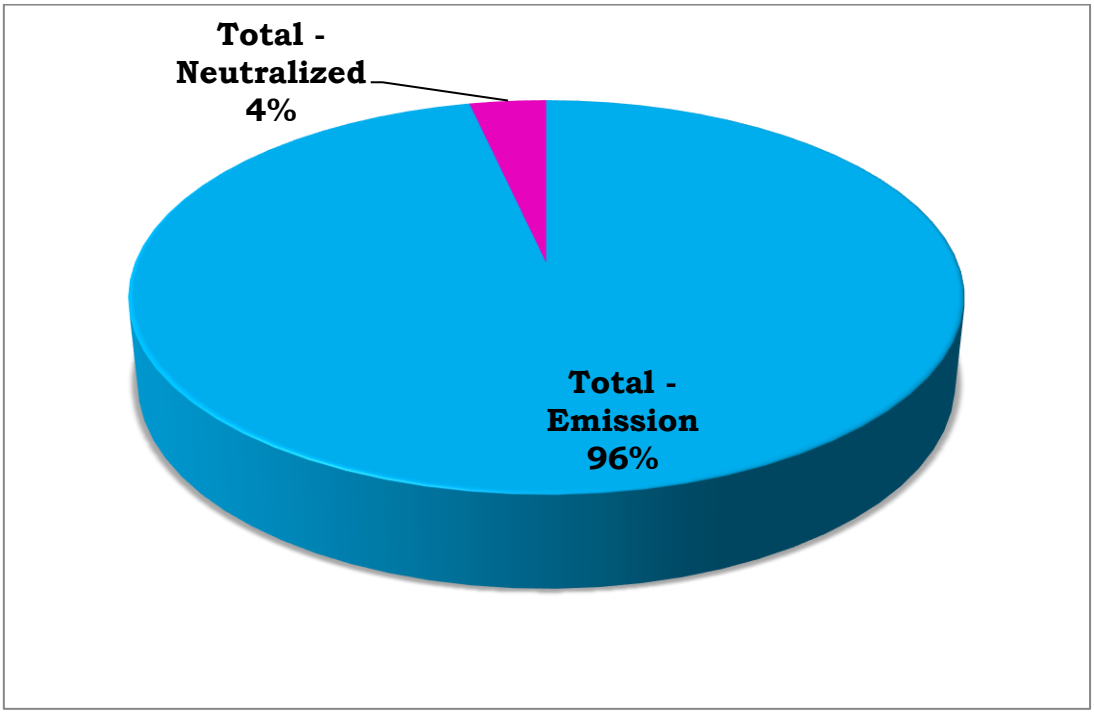


Fig.8: Percentage of CO_2emitted and CO_2 neutralized inside the campus

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

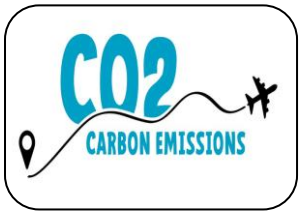
4. TRANSPORT & REFRIGERANT GASES IN AIR CONDITIONING SYSTEM

4.1. 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 fuel type and usage are represented in Table.

Table 8: List of Transporting Vehicles available in the College.

S.No.	Type of Vehicle	Make, Model & Year of Manufacture	Vehicle Number	Date of FC	Non Polluting Vehicle
1	Van	EICHER & 2018	TN B 9022	3/1/2024	Yes
2	Van	SML T 3500 & 2014	TN 69 AR 1877	4/26/2024	Yes
3	Van	SML T 3500 & 2007	TN 69 U 8589	4/20/2024	Yes
4	Bus	ASHOK LEYLAND & 2008	TN 69 S 2333	4/25/2024	Yes
5	Van	SML T 3500 & 2009	TN 69 S 6051	3/30/2024	Yes
6	Bus	ASHOK LEYLAND &2009	TN 69 S 6078	2/21/2024	Yes
7	Van	SML T 3500 & 2010	TN 69 AY 1401	4/20/2024	Yes
8	Bus	ASHOK LEYLAND & 2010	TN 69 AY 1402	5/9/2024	Yes
9	Van	SML T 3500 & 2011	TN 69 AY 8377	4/19/2024	Yes
10	Van	SML T 3500 & 2011	TN 69 AY 8380	3/30/2024	Yes
11	Bus	ASHOK LEYLAND & 2013	TN 69 AT 5830	1/30/2024	Yes
12	Bus	SML S7 & 2014	TN 69 AR 1872	3/30/2024	Yes
13	Bus	MORCOPOLO & 2015	TN 92 0416	3/29/2024	Yes
14	Bus	ASHOK LEYLAND & 2017	TN 92 8107	3/23/2024	Yes
15	Bus	ASHOK LEYLAND & 2017	TN 92 A 8566	3/30/2024	Yes
16	Van	TATA 407 & 2006	TN 69U 5578	7/19/2024	Yes



Annual fuel consumption for transport (**2021 - 22**) is **30,351.88 Litres** which contributes CO_2 Emission of **81.95 Tons/Annum**

4.2. List of Air Conditioning System along with its Refrigerant:

The list of ACs indicating their quantity, tonnage, refrigerant, GWP and ODP are shown in Table-14.

Table-9: List of Multi-variant AC System, Type of Refrigerant, GWP and ODP Values

S.No.	Location	Tonnage (TR)	Quantity	Refrigerant Used	Global Warming Potential (GWP)	Ozone Depletion Potential (ODP)
1	Computer Lab	2	2	R22	1810	Medium
2	Electronics Lab	2	2	R22	1810	Medium
3	Secretary Room	1.5	2	R22	1810	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.

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

5. WATER UTILIZATION, CONSERVATION & WATER MANAGEMENT

5.1. Source of Water, Storage and Distribution:

Water is one of the main consumable in the college campus. WAVOO WAJEEHA WOMEN'S COLLEGE OF ARTS AND SCIENCE gets the water from three different sources i) Fresh water from the bore well, ii) Rain Water Harvesting (RWH) and iii) Purified water can from third party. Different source of water, location of storage along with their application is given in the table.

Table 10: Types of water used in college campus along with application.

Type of water	Source	Location of storage	Application
Fresh water	Well water (Near	3 HP under water pump used to lift the water to overhead tank of 1,50,000 litre capacity	Utensil Cleaning, Hand wash, toilet, labs and also for gardening purpose.
Fresh water	Bore water (Near transport) – 01 No. with 20 feet depth.	3HP pump is used to store water in separate sump with a capacity of 1200 litre capacity	Gardening and drip irrigation purpose.
Rain water	Rain Water collected through i) buildings run offs and ii) road runoffs	Percolated to underground	Used to increase the ground water level
Purified water	Purchased from third party	Purchased as 30L water can	Cooking and drinking purpose

5.2. Purified Water for drinking applications:

- The college management is keen on providing uninterrupted, safe and healthy drinking water to all students and faculty members throughout the year.
- In order to fulfill the drinking water need management purchased purified water can from third party with sufficient quantity.
- Quality of the water (TDS value) is being checked frequently and ensures that the water is potable.
- Details about purified water are given in the table.

S. No.	Description	Quantity
1.	Purified water can (30L) per Month	835 Nos.
2.	Cost per unit purified water can	Rs. 30
3.	Drinking water cost per month	=(water can quantity *unit price) = (835*30) = Rs. 25,050/-
4.	Drinking water cost per Annum	= (25,050 * 12) = **Rs. 3, 00, 600/-**

Fig9. Storage of purified water can for drinking application

Fig10. Fresh water distribution to wash rooms and toilet

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

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

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

The science department uses chemicals for experimental applications and is 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 chemical.
- 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. Also 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.

6.2: General Instructions given to the Students while working in the Laboratory:

- Never work in the lab unless a demonstrator or a teacher is present.
- Never taste any chemicals and don't allow chemicals to come in contact with your skin.
- Don't throw waste into the sink; rather they must be thrown into the waste pins.
- Keep all the doors and windows open while working the laboratory.
- Sulphuric acid must be diluted only when it is in cold condition.
- Reagent bottles must never be allowed to accumulate on the work bench.
- Containers used for reactions must be properly labeled.

- Working space should be cleaned immediately.
- Protection and safety is most important.
- While entering the laboratory, everyone must wear lab coat and shoes.
- Prior knowledge on hazardous property of the chemicals is must.
- Seek the advice of faculty and technical staffs during emergency.
- Know the location of first aid box and fire extinguishers located in the laboratory.
- Don't attend any self-medical practices either for you or for your fellow students.

6.3: 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. 11, 12 & 13.

Fig. 11: Chemical vessels storage

Fig. 12: Dilute acid Storage

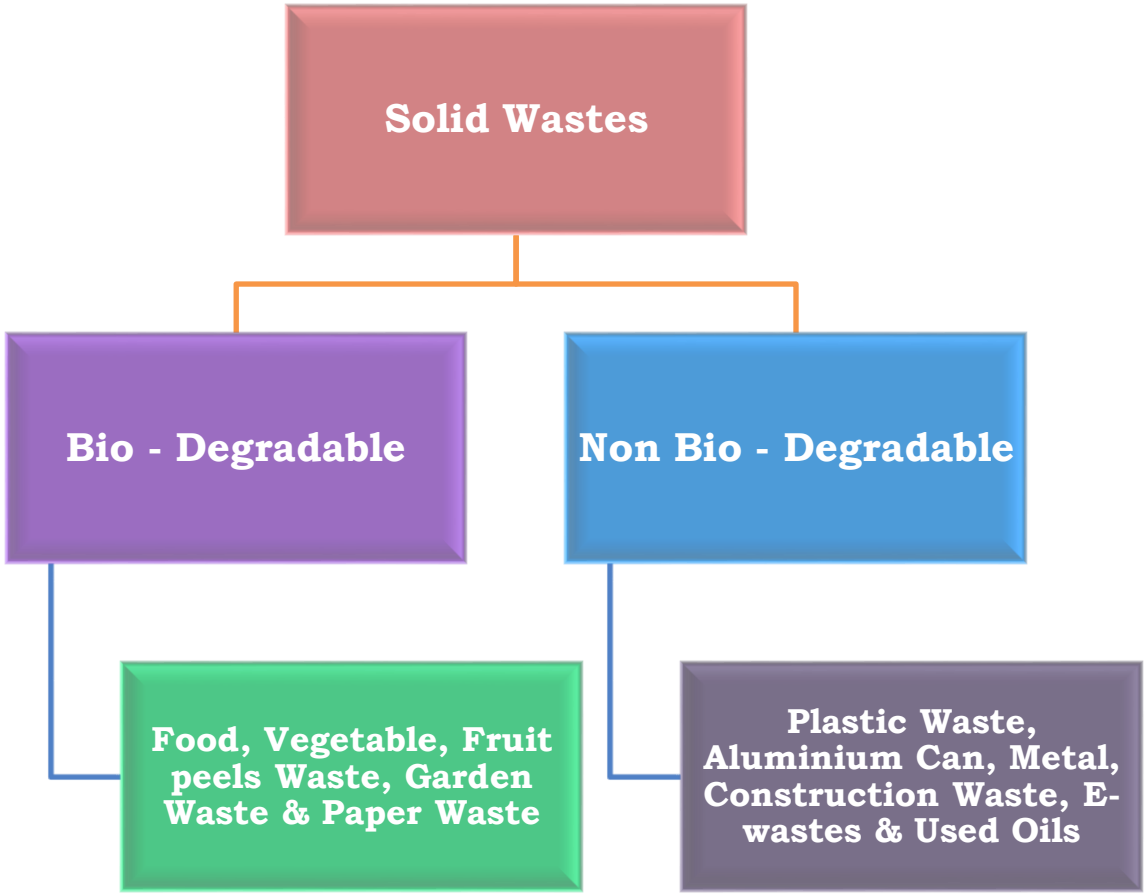
Fig. 13: Concentrated acid Storage

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

7. WASTE HANDLING & MANAGEMENT

7.1. Solid Waste Management System:

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



7.2. Process of Waste Management:

The college management practiced some methods to treat the waste generated and Table-17 shows the process of treating the solid waste generated inside the college campus.

Table-11: Process of Waste Management

S. No.	Waste Type	Waste Treatment
	Bio Degradable Waste Management	
1.	Food & Vegetable Waste	Collected & given to Farming Plan to produce Biogas from food waste.

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. Chemical/salt storage plastic containers being disposed to 3rd Party.
5.	Construction Wastes	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 thirty party for recycling.
7.	Transport Oil + Tyres	Stored in a separate place and sale to 3rd party.
8.	Transport Vehicle and Computer Batteries	Procuring new batteries with buyback offer (old battery replacement)
9.	Used edible oil	Used cooking oils are kept in separate place and sold to 3rd party for recycling.
10.	E-Waste Management	Separately given below.

7.3. List of Approved E-Wastes:

E-Waste – Electrical	E-Waste – IT & Communication
• Motors and Starters • Fans, Lamps and Luminaries • Electrical Drives • Broken/Fired Cables • Power Distribution Panels	• Copier/Printers • Power Stripes & Power Supplies • UPS/Servo Stabilizers/Inverters • Batteries • Wi-fi-Modems, Routers, Toggle Network

• Analog & Digital Measuring Instrument	Cables, Switches, Hubs • Audio & Video Equipment's/Remote • Printed Circuits Boards

Fig 14: Food waste collected in bucket

Fig 15: Collected Food waste is stored in storage tank for farming

Fig.16: Metal, Wooden and Carton Box wastes stored in a separate place

Fig. 17: Manure preparation from garden waste

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

PART –C: GREEN AUDIT REPORT

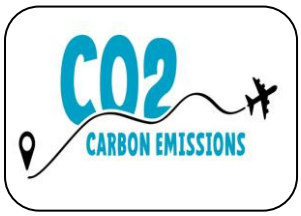
8. ASSESSMENT ON LIST OF MATURED TREES AND GREEN ENERGY GENERATION

8.1. 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 107 with 9 varieties of trees. Apart from the mature trees; preserving the ecology; the entire college campus is planted with various flowing shrubs and pushes. Table-15 shows the list of matured trees available inside the college campus.

Table-12: List of Matured Trees Available in the College Campus

S.No.	Location (Wing/Block /Area)	Name of the Tree	Botanical Name	Quantity
1	Right side	Neem tree	Azadirachta Indica	12
2	Backside	Neem tree	Azadirachta Indica	7
3	Left side	Neem tree	Azadirachta Indica	9
4	Front side	Neem tree	Azadirachta Indica	17
5	Right side	Coconut-tree	Cocos Nucifera	6
6	Front side	Coconut-tree	Cocos Nucifera	10
7	Right side	Portia tree	Thespesia Populnea	1
8	Left side	Portia tree	Thespesia Populnea	8
9	Front side	Vatanarayani	Delonix Elata	4
10	Left side	Vatanarayani	Delonix Elata	4
11	Front side	Fig tree	Ficus Carica	5
12	Backside	Teak tree	Tectona Grandis	4
13	Front side	Java plum tree	Syzygium Cumini	4
14	Front side	Casuarina tree	Casuarina Equisetifolia	10
15	Left side	Palmyra palm	Borassus Flabellifer	6
			Total	**107**



Total No. of Matured Trees available in the college campus is 107 which contributes for reduction of 2.33 Tons of CO_2 emission/Annum

In addition to the existing matured trees a total of 31 nos. of shrubs of 7 varieties are planted to increase the green source and also reduce the carbon emission per capita. List of shrubs with count is given in the table.

Table 13: List of Shrubs (Bushes)

S. No.	Location (Wing/Block /Area)	Name of the Shrubs	Botanical Name	Quantity
1	Left side	Caesalpinia	Caesalpinia pulcherrima	4
2	Front side	Nanthiya Vattam	Ervatamia Coronaria	5
3	Front side	Rose Shoe plant	Hibiscus rosa-sinensis	3
4	Right side	Basella	Basella rubra	6
5	Backside	Jasmine	Jasminum sambac	4
6	Left side	Maruthani	Lawsoniainermis	5
7	Left side	Swollen fingergrass	Chloris barbata	4
Total				**31**

Fig. 18: Geographical View of the college

8.2. Power Generation using Solar Photovoltaic System:

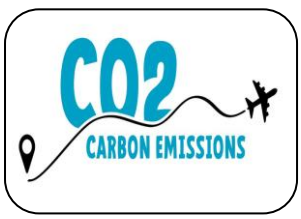
- In order to promote more green generation inside the college campus, the management has installed 3.2 kW Solar Photovoltaic systems in college roof top and generates energy for computer system application.
- Indeed it is good practice to use renewable energy based system for energy generation by avoiding conventional methods (electricity based).

❖ The specifications of the solar photovoltaic system installed on the college roof top are provided in the table below:

Total plant Capacity	3.2 kW
Panel Capacity	8 Nos. of 400W panel
Location	College roof tap
Panel Orientation (Direction)	South Facing
Type of PV panel	Polycrystalline
Application	Computer System applications
No. of Unit generated/Month (Approx.)	298 Unit (kWh)
Year of Installation	December 2021

Table 14: Energy Generation through Solar PV System

S. No.	Description	Parameters
1.	Average solar radiation per Day for (latitude, longitude: 8.53, 78.1)	5.185 kW/m^2/Day
2.	Active work hours/day	04 hours
3.	Electrical Energy production per day	= (Plant Capacity * No. of working hours/day * SPV plant efficiency) = (3.2 kW * 04 * 0.8) = 10.24 kWh
4.	Electrical Energy production per month	= (10.24 * 30) = 307.2 kWh
5.	Electrical Energy production per Annum (**This energy is Saving**)	= (307.2 * 7) = **2150.4 kWh**



Annual energy saved from the roof top solar photovoltaic system (with electrical equivalent) is 2,150.4 kWh which reduces 1.978 Tons of CO_2 Emission/Annum.

ENERGY, ENVIRONMENT & GREEN AUDIT REPORT

9. AUDIT SUMMARY & CONCLUSION

SUMMARY OF THE AUDIT PROCESS:

In order to make the WAVOO WAJEEHA WOMEN'S COLLEGE OF ARTS AND SCIENCE campus 100 % energy efficient, Environmental sustainability and lush Greenery the audit team recommends to implements the following measures:

I. Energy Conservation & Management:

- Regularly clean the solar PV system as per the prepared schedule and improve the efficiency.
- In a phased manner, ceiling fans may be converted from conventional into **BLDC fans**. Also change the FTL into LED with adequate illumination levels.
- It is recommended to reduce the demand based on actual requirement.
- Prepare a policy plan to convert the distributed UPS layout into centralized UPS and save energy. This step also saves the maintenance time due to reduction in no. of batteries.
- 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.
- Regularly conduct i) Illumination study, ii) Thermal comfort study, iii) Flue gas study on DG, iv)Water quality assessment (for all type of water utilized) and v) Indoor and ambient air quality study.

II. Water Conservation & Management:

- Quantity the amount of water utilized by each buildings / each floors by connecting **digital water flow meter** and optimize the water usage.
- It is highly recommended to install **Sewage Treatment Plant** (STP) for reuse the treated water for toilet flushing system as this is much essential for the AICTE, UGC norms of treated water usage.
- Paste water and energy savings slogans at appropriate places.
- Retrofit aerator based water taps for good water savings.
- Captures almost 100 % rain water harvesting.

- Properly follow method of handling chemicals/Acids/Salts and safe disposal through 3rd party.
- Water treatment log recorded with inlet, treated and outlet water quantity.
- Awareness camp must be conducted to all the stakeholders at regular interval. Through this initiative; Painting, Photography, Slogan and Poster making contest are conducted to create consciousness among the students and faculties.

III. Impart Training to Faculty and Technical Staffs:

- Energy Conservation & Management
- Training on Environmental impact and assessment
- Fire and Safety (Operation and Handling)
- Electrical maintenance & Safety
- E-Waste and Chemicals Handling
- Training for Transport employees (Improvement in fuel economy, reduce accidents, vehicle cleanness, 100 % attendance, student friendly approach and overall maintenance of the vehicle).

IV. Way Forward towards Energy & Environmental Sustainability:

- Prepare an exclusive Energy and Environment Policy based on the energy and environment practices followed in the campus.
- 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).