Green Audit Report

ETHIRAJ COLLEGE FOR WOMEN

(Affiliated to University of Madras, NAAC A Grade)

Prepared By

Chola MS Risk Services Limited, Chennai

(ISO 9001:2015 Certified & NABET Accredited Consulting Organization
GEE GEE Universal, 6th Floor, No.2, Mc Nichols Road, Chetpet, Chennai – 600031)

May 2022

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Executive Summary

Introduction

Ethiraj College for Women is situated in the heart of Chennai city (Egmore) in a 9-acre campus area. The college founded in 1948 has grown over the years to enroll about 7335 students and 421 staffs under undergraduate, postgraduate and Ph. D courses. The college has touched several achievements over the years such as higher education excellence award 2019, Guinness record for the world most extended drama, top ranks in many undergraduate and postgraduate courses, NAAC "A" grade accreditation etc.

Now, Ethiraj College aspires to upgrade its NAAC accreditation "A Grade" to "A+ Grade" and as a requirement under the Criteria 7.1: "Environmental Consciousness and Sustainability" the college has conducted the green audit through Chola MS Risk Services Limited (CMSRSL), Chennai "an ISO 9001:2015 and QCI NABET accredited organization".

Accordingly, CMSRSL team has conducted the green audit on 7th, 15th and 16th March 2022 covering aspects such as energy conservation and management, water consumption and management, waste management, sanitation, landscape and green belt etc. During the audit, qualitative and quantitative information on the current practices of the campus was noted and accordingly, recommendations to improve environmental performance have been suggested. Audit has wholly focused on aspects that can improve the campus's environmental performance, and no environmental parameters in this study have been scrutinized with respect to the environmental regulations.

Energy Consumption and Management

Ethiraj college consumes energy for lighting, fans, air conditioners, computers, printers and pumps, open ground lighting, etc. Electricity for the college is sourced from Tamil Nadu Electricity Board under tariff category "HT bulk supply". For emergency power, six numbers of DG set of different capacities are installed in the Campus. Also, the campus has renewable energy production of 37 kW through the rooftop solar panel. List of electric appliances used by campus and its connected load is summarized in Table below.

Sl. No	Appliances	Details (Nos.)	Total connected load (W)	Total connected load (W/m^2)	% of total connected load
1	Lights	2867	87200	2.21	9.81%
2	Fans	2129	164560	4.17	18.51%
3	Air Conditioner	110	330000	8.37	37.11%
4	Computers	602	120600	3.06	13.56%
5	Printers	90	17300	0.44	1.95%
6	Other appliances (Projector, pumps, RO plant, lab equipment etc)	-	169495	4.30	19.06%

- 75% of the old CFL lights have been replaced with LED lights. Few old fans have also been replaced with energy-efficient fans. The campus is in the process of replacing all old CFL lights and fans entirely in the future.
- The estimated energy load is 511365 W and 377790 W for campus 1 and 2 respectively. Therefore, the college has a total connected load of about 889155 W.

- The estimated energy consumption of the campus is 82284 kWh/month Vs the actual (for a typical month) consumption of 77920 kWh/month
- The total energy consumption of college per student is about 10.68 kWh/student.
- Currently, campus produces only 1.58% of renewable energy out of the total energy requirement.

Based on the study, it is understood that the average energy consumption of college is only about 25.03 kWh/m^2/year against the national benchmark of 150 kWh/m^2/year provided by the Bureau of Energy Efficiency, India.

Although current energy consumption is well within the national benchmark, based on the audit, few recommendations are given in the Table below to further reduce the existing energy consumption.

Equipment	Observation	Recommendation	Capital investment (Rs.)	Energy savings (kW)	CO_2 emissions mitigated (t/yr)	Payback years
Ceiling Fans (80 W)	Old fans were observed without star rating.	During audit it is observed that campus has already started replacing the old conventional fans with energy efficient fans. However, this shall be taken as a priority to reduce energy consumption of the campus specially at areas which are operating more than 5 hrs a day.	23,40,800	39.5	53.25	4.34
CFL lights	College has installed 25 to 40 Watts CFL lights.	Replacement of existing CFLs with LEDs of 12 W. Presently, about 75% of the old CFL lights have been replaced with LED lights. Rest of the lightings shall be also be replaced on priority basis.	68,400	16.1	20.1	0.34
AC settings	Noticed to set at very low temperature	Optimization of temperature between 23°C and 25°C shall be practiced. ACs were typically noticed at staff rooms, application-oriented laboratories, microbiology lab, conference rooms etc. Therefore, awareness among the AC operator and teaching staff shall be created.	Nil	1°C may decrease 3% energy consumption approximately.	-	0

Equipment	Observation	Recommendation	Capital investment (Rs.)	Energy savings (kW)	CO_2 emissions mitigated (t/yr)	Payback years
Tube lights and Fans	Unintentional energy wastage at times has been noticed.	Awareness shall be created among students to minimize energy wastage. Energy posters shall be placed at each block as part of the campaign. Student representatives shall be selected to control wastage of energy at class rooms.	Nil	-	-	-
		Total investment	**24,09,200**	**55.6**	**73.35**	-

Water Consumption and Management

The water at Ethiraj college is sourced from Chennai Metropolitan Water Supply & Sewerage Board (CMWSSB) and from the borewells installed within the campus. The metro and borewell water are stored in overhead tanks placed at unit blocks and distributed across the campus through a well-laid water pipeline network. Both borewell and CMWSSB supplied water has been used for various purposes like drinking (after treatment in RO plants), chemistry, physics and microbiology laboratories etc., canteen, mess and other cleaning activities in the campus.

Chennai Metropolitan Water Supply & Sewerage Board (CMWSSB) supply about 80,000 litres/day and the remaining water requirement has been wholly met from the existing borewells (8 Nos. of different capacity), which is about 410543 litres/day. Therefore, total water consumption of the campus is about 4,90,542 litres/day or 490.5 KLD. Water consumption of college by activity has been estimated and is given in the Table below.

Sl. No	Activity	Water consumption (LPD)	Percentage of total consumption	Remarks
1	Sanitation/domestic consumption including miscellaneous activities	230554	47%	About 47% of water consumption in the campus is consumed for sanitation and Hygiene (about 7756 individual use college per day).
2	Laboratories	68675	14%	Major consumption is in Chemistry labs & microbiology labs of campus 1 & visual communications labs in Campus 2.
3	Hostel	44148	9%	About 500 students use the water on an average basis.
4	Canteen	39243	8%	One main canteen each in campus 1 and campus 2 is available.

Sl. No	Activity	Water consumption (LPD)	Percentage of total consumption	Remarks
5	Production of drinking water	44148 (water goes into RO)	9%	Water from borewells are treated using RO units of different capacities and supplied to students. One RO tap per floor is available in the college.
6	Landscaping	49054	10%	Major water consumption was noted for the maintenance of Miyawaki forest, which is at growing phase.
7	Leakages	14716	3%	Leakage was noticed at common water taps and in restrooms at some locations.

- RO treated water is supplied for drinking purpose across the campus. Three RO plants are installed in the campus, which intakes about 44148 LPD to produce drinking water of about 17,600 LPD where in the brine reject generated will be about 26,548 LPD. RO water supply to unit buildings are ensured through tap supply in each floor.
- Campus has 20 overhead tanks with a total holding capacity of 1,61,000 litres.
- Water faucets installed in the campuses are mostly screw type faucets.
- Wastewater generated from the campus is connected to the municipal drainage system through a common drainage line.
- RO reject water is fed to barren land and green cover area. No reuse of RO reject has been noticed.
- Rain water harvesting systems (24 Nos) are constructed at various locations across campus to conserve water.
- Water conservation posters to promote awareness among students was noticed at hand wash and rest rooms.

Average water consumption per day students per day for the college is about 49.6 LPD against the national bench mark of 45 LPD given by CPHEEO/ISO 1172 (1993). Considering the amount of wastewater getting generated (about 331 KLD of grey water), reuse/recycling of water shall be considered by setting up Sewage Treatment Plant (STP), which will significantly reduce the freshwater consumed at flushing, floor wash, gardening activity etc. Few recommendations which can be taken up by campus to improve water usage is given in Table below.

Sl. No	Aspect	Observation	Recommendation	Capital investment (Rs.)	Remarks
1	Water leakage	Water leakage at some common areas/rest rooms were observed	Identify faulty/leaking faucets and replace them with aerator taps and water efficient plumbing fixtures like timed taps or motion sensors, push taps.	*	College shall consider replacement of old faulty taps with aerator taps to reduce water consumption. This

Sl. No	Aspect	Observation	Recommendation	Capital investment (Rs.)	Remarks
		during the audit.	Aerator taps can reduce water quantities fluxing from the aerator tap by 50% while still maintaining pressure.		activity shall be based on faulty units identified by campus supervisor.
2	Water meters	No water meters are available at campus to measure daily water consumption.	Water meters shall be installed at all borewells (8 Nos.) and CMWSSB intake line.	1, 35,000	Installation of water meters will help to quantity daily water consumption and also consumption of unit block. Further, this will help to identify problem areas and reduce water consumption.
3	Construction of STP	Wastewater is let off through a common drainage line to the municipal drainage system	STP with following scheme is recommended. Primary Treatment – Buffer Tank Secondary Treatment- Activated Carbon Filter Tertiary treatment – Chlorine Disinfection	75,00,000	Considering the estimated average wastewater generation, huge potential to reuse about 331 KLD of wastewater is envisaged. This will help to reduce water consumption in the areas such as urinals/toilet flushing, gardening, floor cleaning, washing lab equipment etc.
4	RO reject water	RO reject is let off into garden/open areas.	On an average about 26,548 LPD of RO reject has been generated. This shall be collected in a RO reject water tank (3 x 10,000 l capacity).	2,40,000	Collected RO reject can be reused for flushing, mopping of floors, rinsing lab equipment/ utensils before main wash, campus vehicle wash etc,
			Total Investment	**78,75,000**	

*Depends on number of leaky faucets planning to get replaced.

Waste Generation and Management

The college has placed an adequate number of waste collection bins in the class rooms, staff rooms, and other buildings, hostels, and canteen areas to collect waste generated from individual rooms. These

are being transferred to a common internal bin placed at common ways or areas and are finally disposed to municipal bins placed inside campus 2 for final processing/disposal to Chennai Municipal Corporation. While practice of segregation is being noticed at canteen and mess areas, practice of waste collection is based on single bin system at other areas. No separate bin system or identification of wet/dry waste bins was not evident.

Quantification of waste generated from the campus is given below.

Sl. No	Aspect	Quantity (kg/day)	Waste quantity (kg/student/day	Percentage of total waste generated
1	Food waste	504	0.065	27.5%
2	Paper waste	139	0.018	7.6%
3	Sanitary Waste	44	0.015	2.4%
4	Plastic waste	23	0.003	1.3%
5	Rubbish (sweeping+ garden & glass, other maintenance etc)	1020	0.132	55.7%
7	Total paper waste sent for pulping	100	0.013	5.5%
	Total	**1830**	**0.24**	100%

- Waste generated from campus has been disposed of through municipal corporation. Segregation is adopted for food waste and no dry & wet bin system is in place.
- Bulk paper waste generated from academic/administrative activities are sold to vendors for paper pulping.
- Food waste is currently managed using Vermi composting pits.
- Napkin incinerators were noticed at some rest rooms during the audit. However, no specific collection or management practices were followed. Common practice has been disposal through municipal corporation.
- No separate management measures or safe storage were followed for e-waste, hazardous waste and battery waste.
- Although collection procedure currently followed is not in line with Solid Waste Management Rules, 2016, Hazardous Waste Management Rules, 2016 and E-waste Management Rules, 2016, no unattended waste dumping was noticed during the audit. Campus has placed adequate number of bins of various capacities depending on the quantum of waste at appropriate locations.

Few recommendations that can improve the campus's waste management practices are outlined below.

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
1	Solid waste	**Installation of two bin system** (Wet and Dry waste bins) Waste shall be collected on a daily basis. Separate bins of different colours shall be	Canteens and Mess One common bin/floor near wash room in each building.	67,000

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
		placed to collect dry and wet waste. Currently no colour code-based bins are used for segregation. Place adequate number of bins at canteen areas (found inadequate/spilled bins during audit).		
2	Food waste	**Bio gas plant for food waste management** About 27.5% of the total waste from campus is generated from food wastes. Out of which about 128 kg/day is generated from mess. Total food waste from both canteen and mess from each campus is about 504 kg/day at rate of 0.065 kg/student/day. Therefore, as an initial management strategy campus shall consider setting up a 150 kg biogas plant*. Besides this existing vermi composting system shall also be maintained properly.	Installation of biogas plant of 150 kg capacity. About 6 kg of LPG/day can be produced from the plant and which can be stored and used for cooking.	2,50,000
3	Garden waste	**Composting for garden waste** Composting pits already exist in the campus shall be restored and used for garden waste compositing.	Across campus for effective garden waste management	20,000
4	Sanitary Napkins	**Installation of small-scale incinerators** Installation of small-scale incinerator and awareness to use biodegradable napkins (As per the SWM, 2016 Sanitary napkins shall be treated as dry waste and it shall be wrapped securely in	Existing non-working incinerators shall be repaired. Rest rooms of campus 1 and campus 2 shall have the following. At least 2 small napkins/unit building for campus 1 and 1 per floor for campus 2 shall be installed.	1,80,000

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
		the pouches provided in the wrappers before placing in dry waste bins. Educational institutes shall consider installation of small-scale incinerators to manage napkin wastes).	Also, campus shall promote and make students aware about biodegradable/ eco-friendly and sanitary napkins made from cotton, sugarcane, cassava, straw bale, bamboo fibres.	
5	E-waste	**Safe storage and disposal** E-waste such as old desktops, laptops, lab equipment etc shall be stored in a safe environment and shall be disposed off as per producer responsibility.	Campus 1 and Campus 2	-
6	Hazardous waste	**Safe storage and disposal** Designated HW storage area and disposal through authorized vendors. Collection and storage of hazardous waste generated across facility in a designated restricted access storage area shall be undertaken. It shall be only disposed off through authorized hazardous waste management dealers.	Campus 1 and Campus 2	-
7	Plastic waste	**Replacement of plastic garbage dust bags with biodegradable bags.** It has been noted that plastic garbage bags have been used to collect waste from dust bins. Considering the number of bins placed at campus, daily generation of plastic garbage bags to collect waste will be very high. Therefore, biodegradable garbage dust bin bags or gunny bags shall be used.	Across facilities - campus 1 and campus 2.	-
	Total cost for effective management of solid and hazardous waste			**5,17,000**

Landscaping and Green Cover

Campus has green cover over an area of 1676 m^2. The area consists of about 268 trees (represented by 45 species belonging to 23 families) with an average height of 3 to 4 m at 0.2 to 1.5 m diameter. Family Arecaceae was represented by 6 species followed by Fabaceae (4 species), Malvaceae (4 species), Apocyanaceae (3 species) and Moraceae (3 species). In addition to the existing green cover present in campus 1 and campus 2, college has recently established Miyawaki Forest Plantation in campus 2.
Initiatives on green cover taken by campus is highly appreciable. Based on the site observations, following action plans are recommended.

- Trees with more trunk girth are capable of sequestering more carbon. Therefore, for the future plantation, trees such as Diospyros melanoxylon, Pongamia pinnata, Gmelina arborea, Butea monosperma, Tectona grandis, Mimusops elengi, Ziziphus jujube, Artocarpus heterophyllus, Dalbergia latifolia and Bombax ceiba shall be considered.

- Trees such as Limonia acidissima, Syzium cumini, Aegile marmelus, Phoenix dactylifera, Ziziphus jujube, Leucaena leucocephala and Pterocarpus marsupium which are drought resistant (less water consumption) shall also be planted.

Green Initiatives and Best Practices

The list of few important green initiatives and good environmental practices adopted by the campus is given below.

- Rainwater harvesting pits of 24 Nos. are constructed at appropriate locations to improve the local ground water table.

- Installed solar panel of 37 kW at COE block to meet partial power requirement of the block.

- Replaced 75% of CFL lights with LED lights as part of energy conservation measures. Also, some of the old fans were replaced with energy efficient super fans.

- Engagement of authorized paper recycling vendor to manage bulk paper waste generated.

- Establishment of Miyawaki forest in Campus 2.

- Establishment of Enviro Club, Enviro student league for conducting awareness programs, events on environment conservation, plant propagation events, plantation drive and environmental virtual programs etc.

- Restricted movement of vehicles inside the campus. Parking space inside campus is provided for vehicles, however, no movement of vehicles inside campus is encouraged.

- Awareness posters on resource conservation, good sanitation and hygiene drive.

Summary and Conclusion

Green audit is a systematic approach to understand the existing environmental practices and identify areas of improvement for attaining an eco-friendly approach to the sustainable development of the college. The report is prepared based on the site visit observations and information provided by the campus.

Overall, Ethiraj college has taken many environmentally friendly approaches and campaigns in the area of energy, water, solid waste, sanitation and green cover, which is highly commendable. Green audit has

identified practices that can tremendously help the college improve the present environmental performance in responsible resource management and sustainable production. The recommendation arrived from the audit in a nutshell is outlined below.

Sl. No	Type of opportunity	Point of Implementation	Priority (High/Medium/Low)
1	Implementation of two bin system (Wet and Dry waste bins)	Canteens and Mess One common bin/floor near wash room in each building	High
2	Bio gas plant for food waste management	Canteens and Mess	Medium
3	Installation of small-scale incinerators	Rest rooms	High
4	Safe storage and disposal of Hazardous and E-waste	Across campus (DG sets area, chemistry labs, E labs etc)	High
5	Installation of water meters	Borewells and CMWSSB intake line	Medium
6	Construction of STP	For treatment of grey water collected from canteens, college restrooms, hostel etc.	High
7	Reuse of RO reject water	At RO points	High
8	Replacement of remaining old CFLs with LEDs	Across campus	Medium
9	Replacement of old Fans with energy efficient fans	Across campus	Medium
10	Renewable energy production through installation of solar panels	Across campus	High
11	Green cover enhancement through plantation of trees with more trunk and draught resistant	Across campus	Medium
12	Repair of leaky faucets	At common taps and rest rooms	High

1 Introduction

Ethiraj College is situated in the heart of the Chennai city in 9 acres area. The college is self-contained with all the infrastructures with a total plinth area of 3,48,751 sq. ft. The infrastructure built on institutes sound vision, its stellar Managements, Principals, Faculty and Students together has gained the college five-star status from NAAC and the College with Potential for Excellence (CPE) award from UGC.

The criteria-based assessment and accreditation of NAAC has been revised to include not only academic and administrative perspective but also the emerging issues in recent times. Assessment of institutional values and social responsibilities looks into the institutes environmentally friendly practices of energy conservation, rain water harvesting, waste management, climate change initiatives etc. This assessment is achieved through undertaking periodic Green/environmental audits.

Ethiraj College aspires to upgrade its NAAC accreditation "A Grade" to "A+ Grade" and as a requirement under it, the college has conducted the green audit. In this regard Ethiraj college has acquired services of Cholamandalam MS Risk Services limited (hereby referred as CMSRSL), an ISO 9001:2015 and QCI NABET accredited organization to undertake the green audit study. Through green audit CMSRSL has undertaken systematic identification, quantification, recording, reporting and analysis of environmental attributes of the institution. This report presents observations and recommendation to improve the environmental performance of the institute.

1.1 NAAC Accreditation

Universities/higher educational institutes are vital to the Nation's success to sustainable journey. Higher institutes run various theoretical and practical activities which gives understanding and solutions to the environmental problems. National Assessment and Accreditation Council (NAAC) which is a self-governing organization believes that Nation's journey towards sustainable development starts with institutes and they can act as role models to the society and industrial units. Through proper education and awareness to teachers, staffs and students, the goal of sustainable developments and practices can be passed onto the future generation. Therefore, as an initiative to encourage the green practices of the higher institutes, NAAC has included environmental performance of educational institutes as one of the governing components.

Green audit has become mandatory procedure for educational institutes under Criterion VII (innovation and best practices) of NAAC. Intention of green audit is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like solid and hazardous waste management, water and wastewater, energy conservation, green belt, sanitation practices etc. for making the institution eco-friendlier.

1.2 Objectives and Benefits of Green Audit

Green audit is the most efficient ecological tool to solve environmental problems. It is a process of regular identification, quantification, documenting, reporting and monitoring of environmentally important components in a specified area. Through this process all the regular environmental activities can be monitored within and outside of the concerned sites which have direct and indirect impact on surroundings. Therefore, objectives of green audit include the following.

- Helps the organization to understand the baseline (data base) and problem areas.
- Suggest practices in line with National, State and Local rules and regulations.

- Formulate environmental policy and minimize operation impact on the environment.
- Identify areas of improvement to pave way for sustainable operation.

Major assessment components of green audit include i) Water and Waste water ii) Waste management iii) Energy Conservation iv) Landscape and green cover and v) Hygiene & Sanitation.

1.3 Audit Methodology

Summary of methodology adopted for the green audit of Ethiraj college is briefly discussed below.

1. Mapping of facilities through site visit and interview: Primary aspect of green audit was to map various unit buildings and collect qualitative information on environmental aspects such as water, wastewater, energy, waste management etc.
2. Quantification of data collected such as water consumption, wastewater generation, energy consumption, solid and hazardous waste generation etc., based on the audit conducted.
3. Develop environmental indicators and compare with national benchmarks.
4. Identify areas of improvement and develop recommendations to enhance environmental performance.

1.4 Checklist and Site Assessment

Pre-audit Data Collection: As a prerequisite to conduct the green audit, a detailed data checklist was shared with Ethiraj college to capture descriptive data about the college and its physical structure, resource utilization and their management (water, energy, waste), green initiatives, green belt and other good practices.

On site Observation & Data Validation: Prior to commencing on-site observation, a brief presentation was given by the CMRSL green audit team to the Ethiraj college representatives focused on elaborating objectives and requirement of undertaking green audit along with certain key problem areas that are invoked during green audit. Thereon the data shared as per the pre audit data checklist was reviewed and discussed with the college representatives for further clarity.

Through onsite observation the college and the buildings within the campus were assessed (qualitative and quantitative) on campus water and wastewater, hygiene and sanitation, overall transportation and emissions, green campus, energy consumption and management, maintenance and initiatives taken for carbon footprint and reduction. Accordingly, collected onsite details were concluded and recommendation for enhancing the environmental performance as given in this report.

1.5 Green Audit Team

Cholamandalam MS Risk Services Limited (CMSRSL) offers Comprehensive Risk Management & Engineering Solutions in the field of Environment and sustainability, Health and Safety. The company is a 50:50 joint venture between the Murugappa Group and Mitsui Sumitomo Insurance Group, Japan. CMSRSL has pioneered many specialized services caterings to the needs of national and international markets. In the past two decades, CMSRSL executed more than 9000+ consulting assignments helping organizations to optimize their EHS performance and set new benchmarks in this field. The company has well established experience in safety and environmental studies in India and overseas over last decade. CMSRSL has 25 years of experience in addressing effective solutions for complex, safety and environmental risks of industrial, commercial, retail, infrastructure and utility operations across India and

the middle east. Chola MS Risk has executed more than 500 plus complex environmental & sustainability studies. The organization is an ISO 9001:2015 company, and is a certified "Environment Impact Assessment" Consultant organization by NABET EIA Accreditation committee, a constituent of Quality Council of India. Following experts were involved in the green audit.

Table 1-1 Green audit team (CMSRL)

Sl. No	Name	Qualification	Designation	Function
1	Mr. V S Bhaskar	M Tech (Environmental Engineering)	Sr. General Manager (Env & Sustainability)	Guidance and Report review
2	Mr. Rajadurai	M. Tech (Coastal Management), B.E (Civil Engineering)	Manager (Env & Sustainability)	Audit/Site assessment and report review
3	Mr. Akhil Babu	M.E (Environmental Engineering) B. Tech (Civil Engineering)	Deputy Manager (Env & Sustainability)	Audit/Site assessment and report preparation
4	Mrs. Pavithra	M. Sc (Environmental Studies & Resource Management) B Tech (Bio-technology)	Engineer (Env & Sustainability)	Coordination with green audit team, audit/Site assessment and report preparation
5	Dr. Balakrishnan T	Ph. D (Zoology)	Manager (Env & Sustainability)	Ecology and Biodiversity survey

The Green audit team was supported by representatives from Ethiraj college in terms of data collection and coordination. Environmental representatives from the college are listed in **Table 1-2**.

Table 1-2 Green audit representatives from Ethiraj College

Sl. No	Name	Designation
1	Dr.S. Kothai	Principal
2	Dr. D.B. Usha Rani	Vice Principal (Aided)
3	Dr T. Usha Priya	Vice Principal (Self-supporting)
4	Dr. S. Kavitha	Enviro club convenor & Green audit coordinator
5	Dr. S. Priya	Enviro club in charge & Green audit coordinator
6	Dr. S. Lathakumari	IQAC Coordinator
7	Dr. Pankajam	Staff in charge of Green Enviro League
8	Dr. Archana	Staff in charge of Disaster Management League
9	Mr. Bhaskar	Administrative Officer
10	Mr Shankar	Project Management Consultant
11	Mr Bhupathi	Engineer

2 About Ethiraj College

Ethiraj college is situated in the heart of Chennai city in a pleasant environment of 9 acres. College was founded in 1948, the formative years witnessed a strong foundation through introduction of undergraduate (UG) courses in Economics, Botany, Chemistry, History, Zoology and English Literature along with the infrastructural facilities, resulting in the construction of the Science Block, Hostel, Open Air Theatre and the Old Library Block. The landmark development of this decade was the auditorium, which to this day remains the pride of the College. The decade of 1968 – 1978 saw the growth of the College with the introduction of Commerce, Mathematics and Physics at the UG level, and a number of post-graduate (PG) courses and the construction of the PG block.

73 years old legacy of academic excellence

Higher Education Excellence Award 2019

Guinness book of world records for longest drama

A significant development of the next phase was the introduction of Evening College in 1981. Now, the thrust was on research with the introduction of M.Phil. and Ph.D. programmes. The addition of the Annexe Campus of 59 grounds augured a new direction in the growth of the College. 1990-2000 saw a steady growth with the introduction of a variety of job oriented self-funded UG courses like Corporate Secretary ship, B.Com (Bank Management), BBA (Business Administration), B.Sc. Biochemistry, B.Sc. Microbiology and M.Sc. Plant Biology & Plant Bio-technology and the introduction of post-graduate AICTE approved courses, MBA and MCA, which was an important milestone in the growth of the College. The construction of New Science Block and dormitories for the hostel marked this new phase of development.

The beginning of the next decade, witnessed the Day College becoming autonomous along with a momentous growth of the College in its infrastructure: N & D block, COE block, New Library, New hostel, Business Studies and Information Technology Block. Besides these, the College acquired a Language Lab and an Instrumentation Centre besides establishing online access to the holdings in the Library, Internet Centre and Computer Labs. The College entered the global arena by signing a MOU with the British Council for teaching Business English Certificate and First Certificate in English. The core competency has been strengthened in many ways to suit the changing scenario. In the Aided stream, Botany was converted into Plant Biology and Plant Biotechnology, one section of History into Tourism and Travel Management, two sections of Zoology into Advanced Zoology and Biotechnology. In the Self-supporting stream, Economics was converted into Business Economics and one section of English to English and Communication Skills. At the PG level, a course in Human Rights and Duties Education was introduced during 2002. New courses namely, B.Sc. Clinical Nutrition, M.Sc. Physics, M.Sc. Foods & Nutrition were also introduced from 2005 in the Self-supporting stream. In 2006, B.Sc. Visual

Communication, M.Sc. Biochemistry and M.Sc. Microbiology were introduced. At present college has enrolment of about 7335 students and 421 staffs.

2.1 Vision and Mission

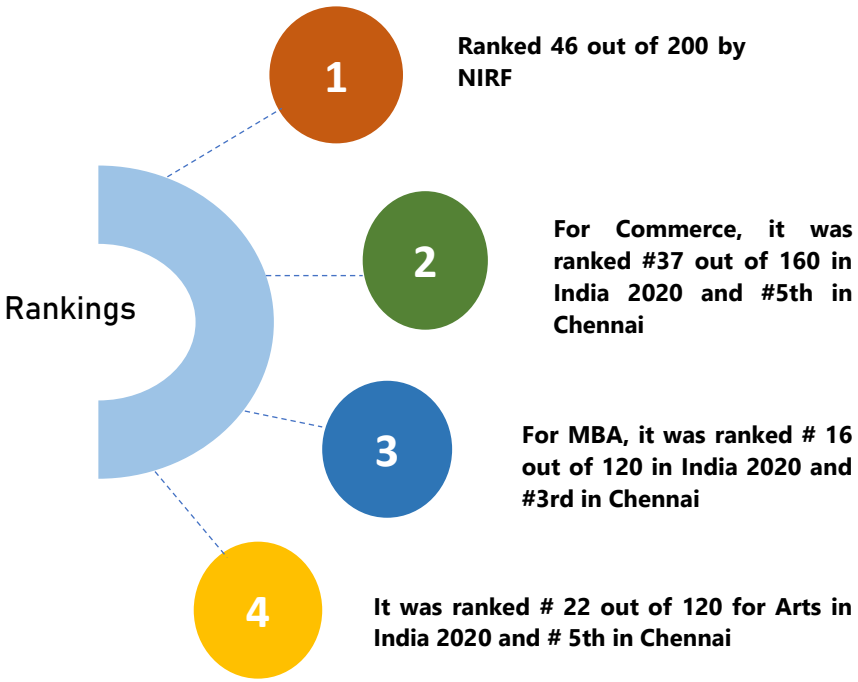
Vision of College

- To holistically develop women, by imparting knowledge, value systems, technological competencies and global skill sets.
- To harness their full potential to prepare them to be responsible citizens, compassionate leaders, agents of social change and participants in the National Development.

Mission of College

- To achieve our vision by creating a student centric learning environment that is driven by passion for excellence, research culture and an eco-system for innovation and creativity.
- To encourage a participatory approach among staff, students, alumni and other stakeholders.
- To provide adequate opportunities to engage in multitude of interests of our diverse student community in academic, co-curricular and extra-curricular activities.
- To offer a campus of excellence with world class infrastructure, technology and support services to our staff and students.
- To have a management that would uphold the highest levels of transparency, accountability and governance in meeting the ideals of the founder of the college.

Standings of college amongst arts colleges and various demanding courses are indicated below.

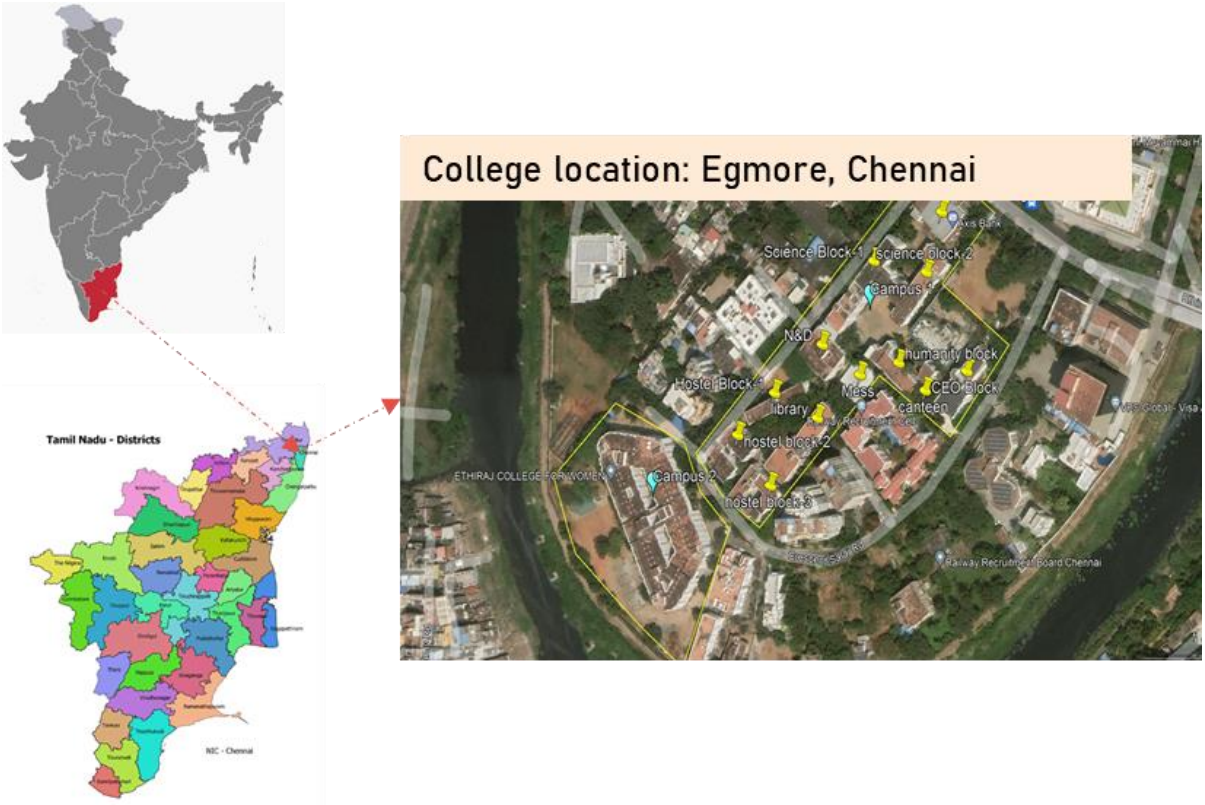


2.2 Location and Area

Ethiraj college is an autonomous college which is situated in Egmore, Chennai. College is well connected with road, rail and air network. Cooum river is flowing adjacent to the campus 2. Location map of college

is given in **Figure 2-1**. The campus total plot area is 3,92,040 sq ft, in which built up area constitutes an area of 1,22,870 sq ft.

Figure 2-1 Location map



2.3 Building Infrastructure

Ethiraj college basically has two campus, namely, Campus 1 and Campus 2. Map representing different blocks of the college is given in **Figure 2-2**. Campus 1 and Campus 2 are located adjacent to each other separated by internal city road. Both the campus contains all basic amenities such as adequate drinking water, sanitation facilities, waste management facilities, electricity, hostels, library, recreation center, canteen etc. Campus 1 has been basically divided into different blocks and it covers majority of the area and courses offered by the college. Blocks present in each campus in brief are listed in **Table 2-1**.

Table 2-1 List of blocks in Campus 1 and Campus 2

Block Name (Campus 1)	Block Name (Campus 2)
Auditorium and Admin Block	Ground floor (class rooms, conference hall & canteen)
Science Block-1	Ist floor (class rooms & labs)
Science Block-2	2nd Floor (class rooms & labs)
Humanity Block	3rd Floor (class rooms, mini auditorium & labs)
N&D Block	
CEO Block	
Mess	
Canteen	

Block Name (Campus 1)	Block Name (Campus 2)
Library	
Hostel Block-1	
Hostel Block-2	
Hostel Block-3	

Figure 2-2 Map representing different blocks of the college

Photographs of unit buildings are presented as **Annexure I**.

2.4 Courses Offered

College provides courses under undergraduate, post graduate and research levels. Detailed list of courses provided by the college are presented as **Annexure II** of this report.

Table 2-2 Summary of courses offered by the college

Aspect	Details
Total number of students	7335 Nos.
Total number of faculty	421 Nos.
Total number of departments	32 Nos.
Number of UG courses (aided)	12 Nos
Number of PG courses (aided)	12 Nos.
Number of UG courses (SS)	18 Nos.
Number of Ph. D (aided) courses	08 Nos.
Number of PG courses (SS)	11 Nos.
Number of M Phil courses (aided)	10 Nos.
Number of M Phil courses (SS)	02 Nos.

3 Green Audit Findings and Recommendations

NAAC has prescribed seven assessment criteria to evaluate the performance of the higher educational institutes in India. Revised NAAC criteria has not only considered academic and administrative aspects but also has focused on emerging recent issues under NAAC criteria 7: Innovation and best practices. Each criterion has developed with key indicators. Green audit forms part of criteria number 7, which is evaluated using the following three key indicators.

1. Institutional Values and Social Responsibilities: Gender equity promotion, climate actions, concerns for human values and professional ethics etc.
2. Best Practices: Any practices which have a positive impact on the function of the college.
3. Institutional Distinctiveness: factors which make the organization distinct or one of its kind in all its activities in focus and practice.

[1]Under NAAC key indicator 7.1: "Institutional Values and Social Responsibilities", scoring metrices are subdivided into various categories. One criterion is "Environmental Consciousness and Sustainability", which includes the following.

a) Requirement to conduct green audit, energy audit or environmental audit (Metric 7.1.6)
b) Alternate sources of energy and energy conservation measures (Metric 7.1.2)
c) Management of biodegradable and non-biodegradable wastes (Metric 7.1.3)
d) Water conservation facilities (Metric 7.1.4)
e) Green campus initiatives (Metric 7.1.5)
f) Disabled-friendly, barrier free environment (Metric 7.1.7)

Therefore, as suggested in the NAAC manual, we have undertaken environmental audit to cover key indicators prescribed under Environmental Consciousness and Sustainability. The study has been divided into energy, water, waste and climate audit, which are detailed below.

3.1 Energy Consumption and Management

The Indian energy requirements are likely to grow at a faster rate than world growth rate of 2%. It is important to conserve energy and maximize energy efficiency considering the limited energy reserves and pathway towards sustainable development. Educational institutes can effectively handhold in the energy conservation programs by implementing simple concepts which may save in energy bills by 5 to 20%.

Energy audit is a systematic approach to identify the energy consumption of an institute or organisation and set opportunities for reduction and renewable energy consumption. Setting up bench marks for higher educational institutes is particularly important considering the higher energy consumption at various levels.

3.1.1 Source of Energy

Basically, Ethiraj college consumes energy for lighting, fan, air conditioners, operation of computers, printers and pumps and open ground lightings etc. Electricity for the college is sourced from Tamil Nadu Electricity Board under tariff category "HT bulk supply". For emergency power, six numbers of DG set of different capacities are installed in Campus 1 and Campus 2. Details of DG sets is given as **Annexure III** of this report. Also, campus has renewable energy production of 37 kW through roof top solar panel.

[1] http://www.naac.gov.in/images/docs/Manuals/Revised-University-Manual_1.pdf

3.1.2 Energy Audit

In order to channelize and identify opportunities for energy reduction, an energy audit for the whole campus was undertaken on 07.03.2022, 15.03.2022 and 16.03.2022. The field study included preparation of energy inventory, physical verification of connected load, collection of earlier electricity bills and identification energy intensive units. Main aim of the study was to understand the connected load of unit buildings in Campus 1 and Campus 2, prepare and compare the energy bench mark of the college and identify and propose potential opportunities for improvement.

Summary electric appliances in the campus is given in **Table 3-1**. Connected load of unit buildings of campus 1 and 2 is given in **Table 3-2**.

Table 3-1 List of electric appliances and connected load

Sl. No	Appliances	Details (Nos.)	Total connected load (W)	Total connected load (W/m^2)	% of total connected load
1	Lights	2867	87200	2.21	9.81%
2	Fans	2129	164560	4.17	18.51%
3	Air Conditioner	110	330000	8.37	37.11%
4	Computers	602	120600	3.06	13.56%
5	Printers	90	17300	0.44	1.95%
6	Other appliances (Projector, pumps, RO plant, lab equipment etc)	-	169495	4.30	19.06%

Table 3-2 Block wise total connected load for Campus 1 and Campus 2

Sl. No	Block	Ground floor	Ist Floor	2nd floor	3rd Floor	Total connected load (W)
Campus 1						
1	Library block	-	-	-	-	44945
2	COE block	11660	17970	21160	4070	54860
3	PG Block	13025	17970	21160	4070	56225
4	Science block II	11140	4570	39010	16890	71610
5	Science block I	32725	19550	16580	16580	85435
6	N and D block	12160	33810	15870	16890	78730
7	Auditorium	10750	-	-	-	10750
8	Mess	4360	-	-	-	4360
9	Hostel	77625	-	-	-	77625
10	Admin	25785	-	-	-	25785
11	Canteen	1040	-	-	-	1040
	Total connected load Campus 1 (W)					**511365**
	Total connected load Campus 2 (single building) (W)					**377790**
	Total connected load of college (W)					**889155**

3.1.3 Energy Indicators

Summary of estimated average energy consumption based on connected load and operational hours versus actual energy consumption is given in **Table 3-3**. Electricity bill for 2021 (Covid'19 pandemic period and the college were operational only for 74 days) is attached as **Annexure IV**. Therefore, a typical monthly consumption when the college is fully operational (March 2022 electricity bill) is compared with the estimated average consumption and is indicated **Table 3-3**. Typical energy consumption bill when the college is fully operational is given in **Annexure V**.

Table 3-3 Summary of energy indicators of the college

Sl. No	Aspects	Details
1	Estimated total energy consumption of the campus (kWh/month)	82284
2	Actual typical energy consumption of the campus (kWh/month)	77920
3	Total energy consumption college per student (kWh/Student)	10.68
4	Total energy consumption of college (kWh/m^2/year)	25.03
5	Bench mark consumption for educational institutes in India as per Bureau of Energy Efficiency, India (kWh/m^2/year)	150
6	Current renewable energy production as % of total consumption	1.58%

3.1.4 Recommendations

Baseline evaluation of the campus indicate that the current level of energy consumption is well within the energy consumption bench mark of 150 kWh/m^2/year for educational institutes in India. However, few observations and recommendations are listed below to further reduce the energy consumption and improve energy efficiency.

a) Replacement of existing old fans and lights with LEDs and energy efficient super fans to reduce existing energy consumption. Details are given in **Table 3-4**.

Table 3-4 Energy conservation measures

Sl. No	Equipment	Observation	Recommendation	Capital investment (Rs.)	Energy savings (kW)	CO_2 emissions mitigated (t/yr)	Payback years
1	Ceiling Fans (80 W)	Old fans were observed without star rating.	During audit it is observed that campus has already started replacing the old conventional fans with energy efficient fans. However, this shall be taken as a priority to reduce energy consumption of the campus specially at areas which are operating more than 5 hrs a day.	23,40,800	39.5	53.25	4.34

Sl. No	Equipment	Observation	Recommendation	Capital investment (Rs.)	Energy savings (kW)	CO_2 emissions mitigated (t/yr)	Payback years
2	CFL lights	College has installed 25 to 40 Watts CFL lights.	Replacement of existing CFLs with LEDs of 12 W. Presently, about 75% of the old CFL lights have been replaced with LED lights. Rest of the lightings shall be also be replaced on priority basis.	68,400	16.1	20.1	0.34
3	AC settings	Operating at very low temperature	Optimization of temperature between 23°C and 25°C shall be practiced. ACs were typically noticed at staff rooms, application-oriented laboratories, microbiology lab, conference rooms etc. Therefore, awareness among the AC operator and teaching staff shall be created.	Nil	1°C may decrease 3% energy consumption approximately.	-	0
4	Tube lights and Fans	Unintentional energy wastage at times has been noticed.	Awareness shall be created among students to minimize energy wastage. Energy posters shall be placed at each block as part of the campaign. Student representatives shall be selected to control wastage of energy at class rooms.	Nil	-	-	-
			Total investment	**24,09,200**	**55.6**	**73.35**	-

b) Increase renewable energy production by installation of solar panels: Presently, campus has solar power connected load of 37 kW and a potential production of about 1300 kWh/month. Considering the remaining available roof top area of about 5857 m^2 (considering about 60% total roof area will be available for solar panel installation), campus can potentially have following connected load and production at unit buildings of the campus.[2] Solar roof top calculator used for the calculation is given as **Annexure VI**.

[2] https://solarrooftop.gov.in/rooftop_calculator

Table 3-5 Potential solar power production from the campus

Sl. No	Block	Available roof top area	Feasible plant size (kW)	Cost of installation without GST/kW (Rs.)	Expected electricity generation from the unit (kWh/Yr)	Potential annual savings (Rs)	CO_2 emissions mitigated (tonnes)
Campus 1							
1	Library block	503	50	19,23,271	75450	603600	1547
2	COE block	Installed 37 kW Solar Power					
3	PG Block	334	33	12,77,082	50100	400800	1027
4	Science block II	438	44	16,74,737	65700	525600	1347
5	Science block I	643	64	24,58,575	96450	771600	1977
6	N and D block	348	35	13,30,613	52200	417600	1070
7	Auditorium	383	38	14,64,439	57450	59600	1178
8	Mess	-	-	-	-	-	-
9	Hostel	832	83	31,81,235	124800	998400	2558
10	Admin	-	-	-	-	-	-
11	Canteen	-	-	-	-	-	-
Campus 2							
1	Campus 2	2940	294	1,05,50,484	441000	3528000	9041
	Total	**6421**	**-**	**2,38,60,436**	**9,63,150**	**7305200**	**19745**

Therefore, the campus has a potential solar yield of about 9,63,150 kWh/yr which may lead to an annual savings of Rs. 7305200/- and CO_2 reduction of 19745 tonnes.

3.2 Waste Generation and Management

Solid Waste Management Rules, 2016 provides frame work for scientific management of waste generated due to any activity or an operation. The rule mandates bulk generator (waste generation of 100 kg/day or more/ facility area greater than 5000 m^2) to segregate waste at source and disposed of through authorized waste dealers or municipality. Educational institutions generate waste such as solid waste, plastic waste, hazardous waste, e waste and battery waste. Typically, educational institutes generally contribute to high quantum of paper waste, food waste and e-waste.

3.2.1 Waste Audit

Waste audit for the campus was conducted on 07.03.2022 and 15.03.2022 on regular working days. In order to study the type of waste generated and its management practice, non-teaching staffs (waste management supervisor) of unit building, teaching staffs and canteen/mess employees were interviewed. Photographs of existing waste management system is given in **Annexure VII**.

Basically, college has placed adequate number of waste collection bins in the class rooms and other buildings, hostels and canteen areas to collect waste generated from individual rooms. These are being transferred to a common internal bin placed at common ways or areas and are finally disposed to municipal bins placed inside campus 2 for final processing/disposal of Chennai Municipal Corporation. While practice of segregation is being noticed at canteen and mess areas, practice of waste collection

shall be strengthened at other areas. No separate bin system or identification of wet/dry waste bins was not evident.

During audit, no unattended waste dumping was noticed. Campus was seen to clean and pleasant. Waste mapping and current waste management practices of campus are summarized in **Table 3-6**.

Table 3-6 Waste mapping and present management practices

Sl. No	Type of waste	Areas of waste generation	Rule attracted	Present practice by campus
1	Food waste & Gardening waste (Wet waste)	Canteens, Mess, Hostels and Class rooms	*SWM, 2016	Food waste generated from the canteen and mess area is collected using 60 L and 20 L bin system respectively. Separate bins are allocated for kitchen wastes and unused food wastes (segregation of food waste is being practiced). Collected food wastes are disposed of through municipal corporation on a daily basis. College has been adopting Vermi composting and composting (Refer Annexure VII). Garden waste such as fallen leaves, dust etc are collected directly in municipal bins for disposal.
2	Paper, glass/metallic and plastic waste	<u>Campus 1</u> Admin & Auditorium Science block 1 & 2 Library COE & Humanities block Hostel <u>Campus 2</u> All classrooms & library	SWM, 2016 PWM, 2016	Paper waste is one of the dominant waste class generated from the campus. Regular waste generated from class rooms are being collected in a 10 L bins and are transferred to 40 L bins placed (typically 4 to 5 nos.) at the walkways. Collected waste from 40 L bins are then transferred to the municipal bins placed inside the campus. Typically, 40 L bins are mixed with paper, plastics and metallic waste (occasionally). Plastic wastes are typically generated from canteen areas (covers of food products). Canteen paper and plastic wastes are collected in a 40 L bin, which is transferred to municipal bins for disposal. Non regular paper wastes such as evaluation sheets, other academic

Sl. No	Type of waste	Areas of waste generation	Rule attracted	Present practice by campus
				sheets, papers from admin work etc are sent for pulping for which agreement is available.
3	Sanitary Napkins	Hostel, Campus 1 & Campus 2	SWM, 2016	Napkin incinerators were noticed at some rest rooms during the audit. However, no specific collection or management practices were followed. Disposal through municipality is dominantly followed.
4	Hazardous waste (chemicals from lab, DG set filters, used oils etc)	Science block 1 & 2 Campus 2 laboratory	HWM, 2016	No separate management measures were followed.
5	E-waste (lights, TVs, monitors etc)	Campus 1, Campus 2 & Hostel	EWM, 2016	No separate management measures were followed.
6	Battery waste	Campus 1 and Campus 2	Battery waste management Rules, 2016	No separate management measures were followed.
7	Bio-medical waste	Campus 1 – Medical care room	BMW, 2016	Not Applicable. Quantity of waste generated is very minimal.

*SWM – Solid Waste Management Rules, 2016; PWM – Plastic Waste Management Rules, 2016
HWM – Hazardous Waste Management Rules; 2016, EWM – E Waste management Rules 2016; BMW – Bio Medical Waste Management Rules, 2016.

3.2.2 Quantification of Waste Generated and Indicators

Total waste generated from the campus is estimated and presented in **Table 3-7**. Composition of waste generated from campus is given in **Figure 3-1**. About 27.5% of waste generated from the campus is food waste (biodegradable waste).

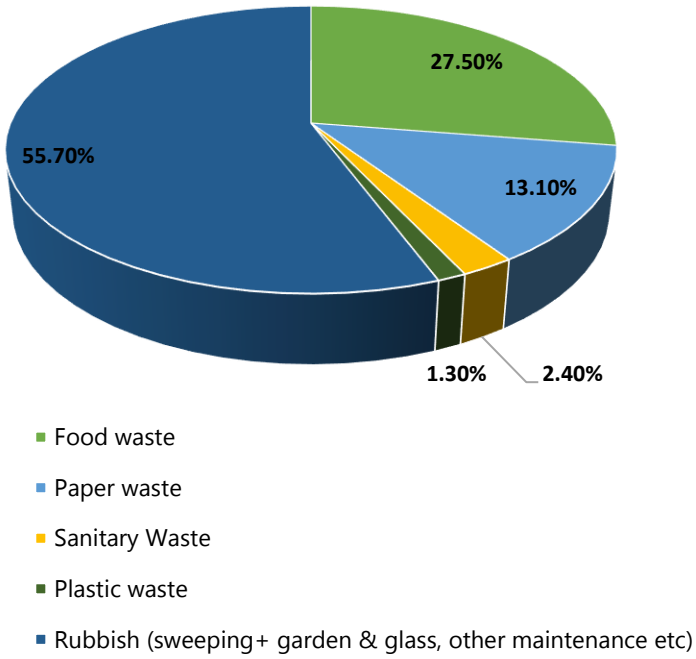
Table 3-7 Quantification of solid and plastic waste generated

Sl. No	Aspect	Quantity (kg/day)	Waste quantity (kg/student/day	Percentage of total waste generated
1	Food waste*	504	0.065	27.5%
2	Paper waste	139	0.018	7.6%
3	Sanitary Waste	44	0.015	2.4%
4	Plastic waste	23	0.003	1.3%
5	Rubbish (sweeping+ garden & glass, other maintenance etc)	1020	0.132	55.7%
7	Total paper waste sent for pulping	100	0.013	5.5%

Sl. No	Aspect	Quantity (kg/day)	Waste quantity (kg/student/day	Percentage of total waste generated
	Total	**1830**	**0.24**	100%

*Out of the total food waste generated from campus 1 and campus 2, about 128 kg/day of food waste is generated from the mess, which serve about 410 student each time.
*E-waste, Battery waste and Hazardous waste generated from the campus has not been quantified.

Figure 3-1 Composition of waste generated from the campus



3.2.3 Recommendations

Following recommendations (Table 3-8) are given based on the types of waste generated and existing waste management practices.

Table 3-8 Recommendations for effective management of waste

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
1	Solid waste	**Installation of two bin system** (Wet and Dry waste bins) Waste shall be collected on a daily basis. Separate bins of different colours shall be placed to collect dry and wet waste. Currently no colour	Canteens and Mess One common bin/floor near wash room in each building.	67,000

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
		code-based bins are used for segregation. Place adequate number of bins at canteen areas (found inadequate/spilled bins during audit).		
2	Food waste	**Bio gas plant for food waste management** About 27.5% of the total waste from campus is generated from food wastes. Out of which about 128 kg/day is generated from mess. Total food waste from both canteen and mess from each campus is about 504 kg/day at rate of 0.065 kg/student/day. Therefore, as an initial management strategy campus shall consider setting up a 150 kg biogas plant*. Besides this existing vermi composting system shall also be maintained properly.	Installation of biogas plant of 150 kg capacity. About 6 kg of LPG/day can be produced from the plant and which can be stored and used for cooking.	2,50,000
3	Garden waste	**Composting for garden waste** Composting pits already exist in the campus shall be restored and used for garden waste compositing.	Across campus for effective garden waste management	20,000
4	Sanitary Napkins	**Installation of small-scale incinerators** Installation of small-scale incinerator and awareness to use biodegradable napkins (As per the SWM, 2016 Sanitary napkins shall be treated as dry waste and it shall be wrapped securely in the pouches provided in the	Existing non-working incinerators shall be repaired. Rest rooms of campus 1 and campus 2 shall have the following. At least 2 small napkins/unit building for campus 1 and 1 per floor for campus 2 shall be installed.	1,80,000

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
		wrappers before placing in dry waste bins. Educational institutes shall consider installation of small-scale incinerators to manage napkin wastes).	Also, campus shall promote and make students aware about biodegradable/ eco-friendly and sanitary napkins made from cotton, sugarcane, cassava, straw bale, bamboo fibres.	
5	E-waste	**Safe storage and disposal** E-waste such as old desktops, laptops, lab equipment etc shall be stored in a safe environment and shall be disposed off as per producer responsibility.	Campus 1 and Campus 2	-
6	Hazardous waste	**Safe storage and disposal** Special HW storage area and disposal through authorized vendors. Collection and storage of hazardous waste generated across facility in a special restricted access storage area shall be undertaken. It shall be only disposed off through authorized hazardous waste management dealers.	Campus 1 and Campus 2	-
7	Plastic waste	**Replacement of plastic garbage dust bags with biodegradable bags.** **Awareness on limited plastic usage shall be promoted** It has been noted that plastic garbage bags have been used to collect waste from dust bins. Considering the number of bins placed at campus, daily generation of plastic garbage bags to collect waste will be very high. Therefore, biodegradable garbage dust bin bags or gunny bags shall be used.	Across facilities - campus 1 and campus 2.	-

Sl. No	Waste type	Recommendation	Area of implementation	Cost of implementation (Rs.)
	Total cost for effective management of solid and hazardous waste			**5,17,000**

3.2.3.1 Biogas Plant

Broad details of biogas plant that can be installed in the campus and envisaged output is given in Table 3-9.

Table 3-9 Typical details of food waste-based biogas plant

Sl. No	Aspect	Details
1	Plant capacity	150 kg (as an initial step towards management of biodegradable waste, it is recommended to install 150 kg biogas plant near to mess/canteen of campus 1).
2	Approximate area required	3 x 3 x 2.5 m^3 (L x W x H)
3	Digester volume	9 m^3
4	Cost of installation	Rs. 2,50,000
5	Average biogas production/day	15 m^3/day
6	Average LPG production/day	6 kg LPG/day
7	No of LPG commercial cylinders that can be replaced	12 Nos.
8	Net investment return/year	Rs. 1,39,000
9	Payback period	1.8 years
10	Net CO_2 reduction due to RE production/year	60,480 kg CO_2 e (due to replacement of fossil fuel/RE production)

3.3 Water and Wastewater Management

3.3.1 Water Consumption

The water at Ethiraj college is sourced from Chennai Metropolitan Water Supply & Sewerage Board (CMWSSB) and from the borewells installed within the campus. The metro and borewell water are stored in overhead tanks placed at unit blocks and are distributed across the campus through a well laid network of water pipelines. Currently the college does not have water meters to measure the actual water consumption. Therefore, water audit was conducted on 15th and 16th March 2022 to estimate the water consumption by activity, type of fixtures, wastewater generation etc.

Chennai Metropolitan Water Supply & Sewerage Board (CMWSSB) supply about 80,000 litres/day and the remaining water requirement has been completely met from the existing borewells. A summary of water source and storage facilities is given in **Table 3-10**.

Table 3-10 Summary of water source and storage facilities

Sl. No	Aspect	Details

1	Source of water	Chennai Metropolitan Water Supply Borewells (09 nos.)
2	Water usage areas	Domestic (drinking, rest rooms, canteen, labs etc) and gardening
3	Borewells	Total 8 nos. of different capacities have been installed in the campus 1 and campus 2
4	Overhead tanks	8 metro water sumps and 21 overhead tanks
5	RO	2 Sintex tanks (10,000 L each)

Details of borewells present in the college is summarized in **Table 3-11**.

Table 3-11 Details of borewell and estimated water withdrawal

S.No	Borewell	No. of. Units	Depth (ft)	Location	Pump capacity (HP)	Average operational hours (H)	Total estimated water withdrawal (LPD)
Campus 1							
1	Borewell 1	1	100	Near physics block	2	5	64471
2	Borewell 2	1	150	Near OAT ground	2	5	47449
3	Borew	1	100	Near indoor stadium	2	5	64471

S.No	Borewell	No. of. Units	Depth (ftt)	Location	Pump capacity (HP)	Average operational hours (H)	Total estimated water withdrawal (LPD)
	ell3						
Campus 2							
1	Borewell4	1	150	Near commerce building	2	4	37959
2	Borewell5	1	150	Near basketball court	2	4	37959
3	Borewell6	1	100	Near MBA department	1.5	4	38683
4	Borewel	1	100	Near garden	1.5	4	38683

S.No	Borewell	No. of. Units	Depth (ftt)	Location	Pump capacity (HP)	Average operational hours (H)	Total estimated water withdrawal (LPD)
	I7						
5	Borewell8	1	50	Near founder statute	1.5	3	80868
	Total water extracted by borewells (Litre per day)						**410543**

Total estimated water withdrawal per day is 4,10,543 litres in addition to the daily water supply of 80,000 litres from CMWSSB. Therefore, total water consumption of the campus is about 4,90,542 litres/day or 490.5 KLD. Both borewell and CMWSSB supplied water has been used for various purposes like drinking (after treatment in RO plants), chemistry, physics and microbiology laboratories etc., canteen, mess and other cleaning activities in the campus.

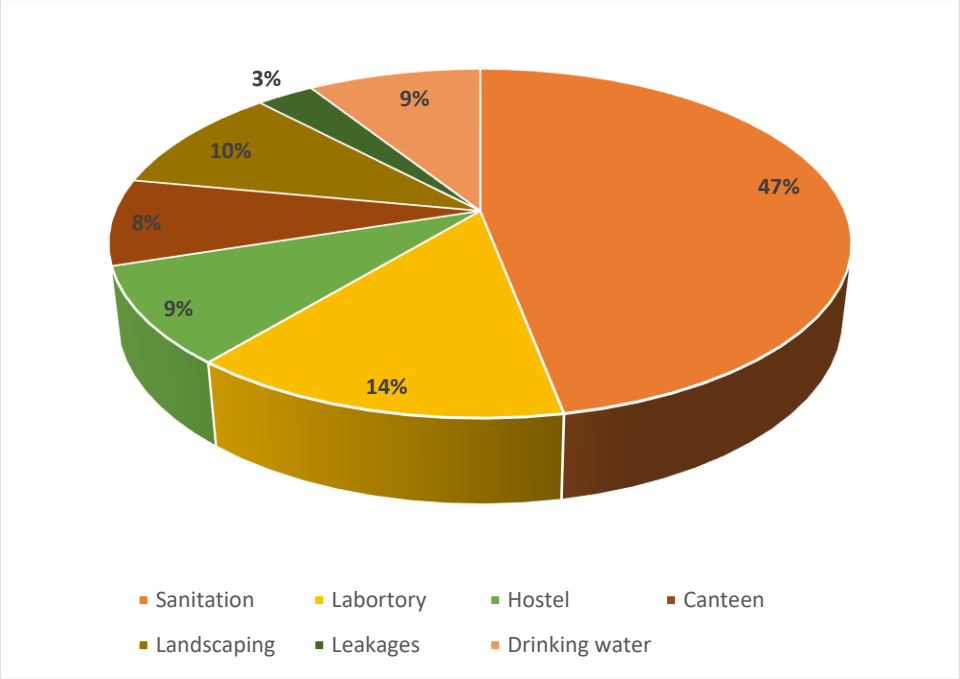
Through user point survey and water supply scenario, overall utilization of water by activity is classified in **Table 3-12**.

Table 3-12 Estimated water consumption by activity

Sl. No	Activity	Water consumption (LPD)	Percentage of total consumption	Remarks
1	Sanitation/domestic consumption including miscellaneous activities	230554	47%	About 47% of water consumption in the campus is consumed for sanitation and Hygiene (about 7756 individual use college per day).
2	Laboratories	68675	14%	Major consumption is in Chemistry labs & microbiology labs of campus 1 & visual communications labs in Campus 2.

Sl. No	Activity	Water consumption (LPD)	Percentage of total consumption	Remarks
3	Hostel	44148	9%	About 500 students use the water on an average basis.
4	Canteen	39243	8%	One main canteen each in campus 1 and campus 2 is available.
5	Production of drinking water	44148 (water goes into RO)	9%	Water from borewells are treated using RO units of different capacities and supplied to students. One RO tap per floor is available in the college.
6	Landscaping	49054	10%	Major water consumption was noted for the maintenance of Miyawaki forest, which is at growing phase.
7	Leakages	14716	3%	Leakages was noticed at common water taps and in restrooms at some locations.
Total consumption/day		**490542 litre per day**		
Water consumption/day students/day		**49.6 litre per day**		
Bench mark water consumption/day students/day (as per CPHEEO manual)		**45 litre per day**		

Figure 3-2 Estimated water consumption for various activities



Water pumped from borewells and CMWSSB are stored in concrete overhead tanks located at each blocks. Details of overhead tank available in the campus is given **Table 3-13**.

Table 3-13 Details of overhead tanks

S. No	Location	Capacity (L)	No of units	Total capacity (L)
1	Science Block II	12000	2	24000
2	COE Block	4000	1	4000
3	Library	8000	2	16000
4	Campus 2 Block	12000	4	48000
5	Fire line tank	10000	2	20000
6	Science Block II (RO storage)	1000	1	1000
7	PG Block (RO storage)	4000	1	4000
8	Campus 2 block (RO Storage)	2000	2	4000
9	Hostel (Cinter tank)	8000	2	16000
10	Hostel (Concrete tank)	8000	3	24000
			Total	**1,61,000**

Reverse osmosis plant has been in operation to provide uncontaminated drinking water to students and Staffs. Two RO units in campus 1 (at Science block II and near mess area) and one RO in campus 2 has been installed. Details of RO units are given in **Table 3-14**. On an average about 7 to 8 hrs, RO units are operated. Photographs of borewells, RO units and overhead tanks are given as **Annexure VIII**.

Table 3-14 Details of RO units

Sl. No	Unit	Location	Purification capacity (Permeate flux) (LPH)	Brine water (Concentrate flux) (LPH)	Remarks
1	RO 1	Near mess	600	1080	Mainly, water is supplied to mess/hostel, PG block, library block of campus 1
2	RO 2	Science block II	800	1200	Drinking water to the rest of the blocks are supplied.
3	RO 3	Campus 2	800	1200	Meets drinking water requirement of whole campus 2

Therefore, on an average RO unit consumes about 44148 LPD (Intake) to produce drinking water of about 17,600 LPD where in the brine reject will be about 26,548 LPD.

3.3.2 Faucets and Fixtures

Water faucets installed in the campuses are mostly screw type faucets. Table representing type of faucets and plumbing fixtures in Campus 1 and Campus 2 is given in **Table 3-15**.

Table 3-15 Details of plumbing fixtures/faucets

Aspect	Type of plumbing Fixture/Faucet	No. of Faucets
Campus 1		
Common Restrooms	Screw Type	65
Department Restrooms	Screw Type	130
Gents	Screw Type	40
Drinking Water Area	Screw Type	22
Laboratories	Screw Type	55
Campus 2		
Common Restrooms	Screw Type	112
Department Restrooms	Screw Type	154
Gents	Screw Type	22
Drinking Water Area	Screw Type	10

3.3.3 Wastewater Generation

Presently, wastewater generated from the campus are connected through a common drainage line to the municipal drainage system. No treatment has been practiced by campus. It is estimated that about 4,41,487 LPD (441 KLD – about 90% of water consumed) of wastewater will be generated from the

campus. About 10% will account for direct water loss due to landscaping, evaporation loss etc. About 25% of the total wastewater generated will be black water (toilet water) and remaining forms grey water from canteen, mess, hostel laundry and other domestic uses. Therefore, campus on an average will be generating grey water of about 331115.25 litres/day (about 331 KLD).

3.3.4 Water Conservation Practices – Rainwater Harvesting

Campus has taken water positive initiative through properly designed and located rain water harvesting system across the campus. Roof top rainwater collected in pipes are designed directly to transfer water to the harvesting pits. Photographs of rainwater harvesting pits are provided in **Annexure IX.** There are about 16 and 8 nos. of harvesting pits are available in Campus 1 and Campus 2 respectively. Average size of a pit is 0.5 to 2 m wide by 1 to 3 m deep.

3.3.5 Other Water Conserving initiatives

- During the site visit it was noticed that the college has put up awareness posters across the campus, in handwash area, drinking water area, mess, laboratories to conserve water. Photographs of resource conservation posters placed at various locations in the campus is given in **Annexure X**.

- Throughout the campus, Indian toilet seats have been installed in majority. As an alternative to regular flushes, buckets have been placed in individual toilets to save water. Bathrooms in hostels and academic blocks do not have shower heads for bathing purposes, instead bucket system is being promoted. Water conserving faucets have been installed throughout the campus.

3.3.6 Recommendations

Based on the brief data summarized above, observations/recommendations given in **Table 3-16** shall be considered for further reduction of water consumption and conservation measures in the campus.

Table 3-16 Recommendation to reduce water consumption

Sl. No	Aspect	Observation	Recommendation	Capital investment (Rs.)	Remarks
1	Water leakage	Water leakage at some common areas/rest rooms were observed during the audit.	Identify faulty/leaking faucets and replace them with aerator taps and water efficient plumbing fixtures like timed taps or motion sensors, push taps. Aerator taps can reduce water quantities fluxing from the aerator tap by 50% while still maintaining pressure.	*	College shall consider replacement of old faulty taps with aerator taps to reduce water consumption. This activity shall be based on faulty units identified by campus supervisor.
2	Water meters	No water meters are available at	Water meters shall be installed at all borewells	1, 35,000	Installation of water meters will help to quantity

Sl. No	Aspect	Observation	Recommendation	Capital investment (Rs.)	Remarks
		campus to measure daily water consumption.	(8 Nos.) and CMWSSB intake line.		daily water consumption and also consumption of unit block. Further, this will help to identify problem areas and reduce water consumption.
3	Construction of STP	Wastewater is let off through a common drainage line to the municipal drainage system	STP with following scheme is recommended. Primary Treatment – Buffer Tank Secondary Treatment- Activated Carbon Filter Tertiary treatment – Chlorine Disinfection	75,00,000	Considering the estimated average wastewater generation, huge potential to reuse about 331 KLD of wastewater is envisaged. This will help to reduce water consumption in the areas such as urinals/toilet flushing, gardening, floor cleaning, washing lab equipment etc.
4	RO reject water	RO reject is let off into garden/open areas*.	On an average about 26,548 LPD of RO reject has been generated. This shall be collected in a RO reject water tank (3 x 10,000 l capacity).	2,40,000	Collected RO reject can be reused for flushing, mopping of floors, rinsing lab equipment/ utensils before main wash, campus vehicle wash etc,
			Total Investment	**78,75,000**	

*Investment depends on the number of faulty faucets identified (Photographs are provided in Annexure XV)
*Present RO reject water management practice is shown in Annexure XVI.

3.4 Landscaping and Green Cover

Development and maintenance of green belts in educational institutes are as important as for the industries to maintain better air quality and noise quality inside the campus. Development of planned green belt and landscape around the campus will help the educational institutes to shield the outside pollutions in addition to providing a pleasant environment. This is particularly important for colleges like Ethiraj situated in the heart of Chennai City.

Green cover audit study has been conducted on 7th March and 11th April 2022. Campus has green cover over an area of 1676 m^2. The area consists of about 268 trees (represented by 45 species belongs to 23

families) with an average height of 3 to 4 m at 0.2 to 1.5 m diameter. List of trees present in the campus is attached as **Annexure XI** and photographs of green cover is given in **Annexure XII**.
In addition to the existing green cover present in campus 1 and campus 2, college has recently established Miyawaki Forest Plantation in campus 2. The approach will ensure that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual. Twenty different species have been planted under this program and list of Miyawaki trees are presented in **Annexure XII**.

3.4.1 Observations and Recommendations

- College has a green cover of 1676 m^2 area consisting of about 264 trees. Family Arecaceae was represented by 6 species followed by Fabaceae (4 species), Malvaceae (4 species), Apocyanaceae (3 species) and Moraceae (3 species).

- Biodiversity indices estimated for the college is given below. The overall distribution of trees in the campus has noted to be satisfactory. Evenness of trees across campus is found to be low.

S. No.	Indices	Details	Remarks
1	Taxa_S	46	-
2	Individuals	268	-
3	Simpson Index	0.91	Indicates good distribution of trees.
4	Shannon Index	3.068	Indicate moderate species richness.
5	Evenness Index	0.467	Indicate low evenness of trees across campus.

- Estimated average carbon sequestration potential of the campus will be about 5996 kg/year.

- Available species within the campus shall be labelled.

- Initiatives on green cover taken by campus is highly appreciable. Based on the site observations, following action plans are recommended.

    - Trees with more trunk girth are capable of sequestering more carbon. Therefore, for the future plantation, trees such as Diospyros melanoxylon, Pongamia pinnata, Gmelina arborea, Butea monosperma, Tectona grandis, Mimusops elengi, Ziziphus jujube, Artocarpus heterophyllus, Dalbergia latifolia and Bombax ceiba shall be considered.

    - Trees such as Limonia acidissima, Syzium cumini, Aegile marmelus, Phoenix dactylifera, Ziziphus jujube, Leucaena leucocephala and Pterocarpus marsupium which are drought resistant (less water consumption) shall also be planted.

3.5 Sanitation and Hygiene

Unsafe operation of educational institution can lead to transmission of diseases. It can cause negative impacts to students, their families, institute reputation and overall development. Therefore, good health and sanitation practices are very important especially considering the ongoing Covid'19 pandemic.

The provision of safe water and sanitation facilities is a first step towards a healthy physical learning environment. However, the mere provision of facilities does not make them sustainable or ensure the desired impact. Hygiene practices are employed as preventative measures to reduce the incidence and spreading of disease. Hygiene education aims to promote those practices that will help prevent water and sanitation-related diseases as well as inculcating healthy behaviours in the future generation of

adults. Therefore, the combination of facilities, correct behavioural practices and education are meant to have a positive impact on the health and hygiene conditions of the community as a whole, both now and in the future.

1. **Drinking water**: Clean water as per drinking water standards have been ensured to students through Reverse Osmosis plant. RO plants of different capacity (3 nos.) have been installed.

2. **Water Supply:** Adequate and clean water supply through Chennai Metropolitan Water Supply and borewell system has been ensured.

3. **Sanitation:** Adequate number of urinals/toilets have been operational in main Campus, Hostel, and Other areas. No open and flowing latrines were noticed. Sanitation facilities are found to be proper and adequate.

4. **Waste Management:** Waste management bins are placed at each block to store and dispose through municipality. During audit, no unattended waste dumping was noticed.

5. **Awareness:** Hygiene awareness posters especially related to Covid'19 is displayed at various locations in the campus. Overall, campus follows very good sanitation practices.

3.6 Green Initiatives and Best Practices

The list of few important green initiatives and good environmental practices adopted by the campus is given below.

- Rainwater harvesting pits of 24 Nos. are constructed at appropriate locations to improve local ground water table.

- Installed solar panel of 37 kW at COE block to meet partial power requirement of the block.

- Replaced 75% of CFL lights with LED lights as part of energy conservation measures. Also, some of the old fans were replaced with energy efficient super fans.

- Engagement of authorized paper recycling vendor to manage bulk paper waste generated.

- Establishment of Miyawaki forest in Campus 2.

- Establishment of Enviro Club, Enviro student league for conducting awareness programs, events on environment conservation, plant propagation events, plantation drive and environmental virtual programs etc. Photographs of green awareness campaigns and green programs by campus is given in **Annexure XIV**.

- Restricted movement of vehicles inside the campus. Parking space inside campus is provided for vehicles, however, no movement of vehicles inside campus is encouraged.

- Awareness posters on resource conservation, good sanitation and hygiene drive.

4 Summary and Conclusion

Based on the green audit observations, summary of recommendations for improving the current practices of the campus based on its importance has been classified and presented **Table 4-1**. Definition of activity against "high, medium and low category is described in the Table given below.

Sl. No	Aspect	High	Medium	Low
1	Capital cost	Investment above 5 lakhs	Investment between 2 – 5 lakhs	Investment <2 lakhs
2	Priority	Activities which can significantly improve resource conservation and operational cost.	Activities which can improve resource conservation but has slightly less effect compared to higher priority activities.	Environmental activities which can improve local environment but has less significant effect.
3	Ease of implementation	Less investment, easy and quick implementation of recommended measure.	Relatively high investment and takes time to implement recommended measure.	High investment and takes time (long term) to implement recommended measure.
4	Lead time required	Time period >2 years	Time period between 6 months – 2 years	Time period <6 months

Table 4-1 Summary of observations and recommendations

Sl. No	Type of Opportunity	Point of implementation	Environmental benefit	Capital Cost (High/Medium/Low)	Priority (High/Medium/Low)	Ease of implementation (High/Medium/Low)	Lead time required (High/Medium/Low)	Remarks
I. Energy Conservation								
1	Replacement of remaining CFL with LEDs	Across campus	Energy savings (Reduction in global warming)	Low	Medium	High	Low	Expected capital investment is Rs. 68,400/-. This will save energy by 16.1 kW and eliminate CO_2 emissions by 20.1 tonnes/year.
2	Replacement of old fans with energy efficient fans	Across campus	Energy savings (Reduction in global warming)	High	Medium	High	High	Expected capital investment is Rs. 23,40,800/-. This will save energy by 39.5 kW and eliminate CO_2 emissions by 53.25 tonnes/year. Anticipated payback period is 4.34 years.
3	Installation of Solar panel	Across campus	Energy savings (Reduction in global warming)	High	High	Low	High	As per the estimate, campus has a potential solar yield of about 9,63,150 kWh/yr which may lead to an annual savings of Rs. 7305200/- and CO_2 reduction of 19745 tonnes.
II. Water Conservation								
1	Installation of water meters	Borewells and CMWSSB intake line.	Resource conservation and less wastewater generation	Medium	Medium	High	Low	Installation of water meters will help to quantity daily water consumption and also consumption of unit blocks. Further, this will help to identify problem areas and reduce water consumption. Estimated capital cost is Rs. 1,35,000

Sl. No	Type of Opportunity	Point of implementation	Environmental benefit	Capital Cost (High/Medium/Low)	Priority (High/Medium/Low)	Ease of implementation (High/Medium/Low)	Lead time required (High/Medium/Low)	Remarks
2	Reuse of water - Construction of STP	For treatment of wastewater generated from campus	Reduction in freshwater consumption through reuse of water	High	High	Low	Medium	About 331 KLD wastewater is anticipated from campus. Therefore, installation of STP can tremendously reduce fresh water consumption especially at areas such as flushing, mopping of floors, laboratory washings etc
3	Reuse of RO reject	At RO points	Reduction in freshwater consumption through reuse of water	Low	High	Medium	Low	Installation of RO reject water collection tank can save water and reuse it for flushing, mopping of floors, laboratory washings etc
4	Minimize leaky areas through replacement by water efficient fixtures	Across water taps/faucets etc	Reduction in freshwater consumption	Medium	High	High	High	College shall consider replacement of old faulty taps with aerator taps to reduce water consumption. This activity shall be based on faulty units identified by campus supervisor.
III. Waste Management								
1	Installation of two bin system	Canteen & mess, One common bin/floor near wash room in each building	Offset waste to landfill	Low	High	High	Low	Waste shall be collected on a daily basis. Separate bins of different colours shall be placed to collect dry and wet waste.

Sl. No	Type of Opportunity	Point of implementation	Environmental benefit	Capital Cost (High/Medium/Low)	Priority (High/Medium/Low)	Ease of implementation (High/Medium/Low)	Lead time required (High/Medium/Low)	Remarks
2	Biogas plant for food waste	Canteen & mess	Offset waste to landfill Bio gas production/offsetting LPG	Medium	Medium	Medium	Medium	Installation of biogas plant of 150 kg capacity shall be considered. About 6 kg of LPG/day can be produced from the plant and which can be stored and used for cooking.
3	Installation of small-scale incinerators	Across rest rooms	Offset waste to landfill	Low	High	High	Low	Installation of two small napkins/unit building for campus 1 and 1 per floor for campus 2 shall be considered.
4	Safe storage of HW, E-waste	Across campus	Offset waste to landfill	Low	High	High	Low	Restricted access Safe storage shall be identified.
IV. Green Cover								
1	Plantation of trees	Across campus	Helps to mitigate global warming – carbon sequestration	Medium	Medium	Medium	High	High carbon sequestration potential trees/draught resistant trees shall be planted as per the recommendations.