QUALITY AUDIT REPORT FOR ENVIRONMENT AND ENERGY

Sathyabama Institute of Science and Technology

Chennai, Tamil Nadu-600119

Prepared by,
WasmanPro Environmental Solutions LLP

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EXECUTIVE SUMMARY

A Nation's growth starts from its educational Institutions, where the ecology is taught as a prime factor of development associated with environment. In the pursuit for improving environmental quality and to maintain a pristine environment for the future generations of students, Eco campus concept is gaining prominence. Eco campus is a concept implemented in many educational Institutions, all over the world to make them sustainable because of their mass resource utilization and waste discharge in to the environment. Environmental and Energy auditing is a key requirement for an effective Institutional framework to check an Institutions adherence to Sustainable development agenda, one of the main themes at the United Nations Conference on Sustainable Development. The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory that all Higher Educational Institutions should submit an annual Environmental and Energy Audit Report. Environmental and Energy audit acts as tool for systematic, documented, periodic and objective evaluation of how well an organization is performing with the aim of safeguarding the environment and natural resources. This audit focuses on the Green Campus, Waste Management, Water Management, Air Pollution, Energy Management & Carbon Footprint etc. being implemented by the Institute. Environmental and Energy auditing is essential to find out the environmental performance of an educational Institution and to analyze the possible solutions for converting the educational campus to eco-campus. Eco-campus mainly focuses on the reduction of contribution to emissions, encourages and enhances energy conservation, promotes personal action, reduce the Institute's energy and water consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. Thus the Environmental and Energy auditing of an Institution enables it to assess where the resources are used the most, impact of various activities carried out in the Institution and take corrective actions to make it environmentally sustainable. These audits promote environmental awareness, better understanding of environmental impact in the campus among staff and students. It gives an opportunity for the development of ownership, personal and social responsibility for the students and teachers.

In Sathyabama Institute of Science and Technology, the audit process involved walk through inspections, initial interviews with management to clarify policies, activities, records and the co-operation of staff and students in the implementation of mitigation measures. This was followed by interviews with staffs and students, collection of data through the questionnaire, review of records, observation of practices and observable outcomes. In addition, the approach ensured that the management and staff are active participants in the Environmental and Energy Auditing process in the Institute.

The baseline data prepared for the Sathyabama Institute of Science and Technology will be a useful tool for campus greening, resource management, planning of future projects for such audit purpose, and a document for implementation of sustainable development of the Institute. Existing data will allow the Institution to compare its programs and operations with those of peer Institutions, identify areas in need of improvement, and prioritize the implementation of future projects. It is expected that the management will be committed to implement the Environmental and Energy Audit recommendations.

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CHAPTER 1

INTRODUCTION

1.1 About Sathyabama Institute of Science and Technology

Sathyabama Institute of Science and Technology is one of India's premier Academic and Research Universities that offers multi-disciplinary academic programmes in various fields of Engineering, Science, Technology, Law, Dental Science, Pharmacy, Nursing, and Management. The Institution is established under Sec.3 of UGC Act, 1956 and is been accredited with 'A' Grade by the National Accreditation and Assessment Council. The Institution has been ranked 39th position among the Universities in India for the year 2020, by the National Institutional Ranking Framework (NIRF), Government of India, and ranked one among the top 50 Universities for five consecutive years. Sathyabama is ranked among the Top 5 Institutions in the Country for Innovation by ATAL ranking of Institution for Innovation Achievements, Govt. of India. Times Higher Education and QS has ranked Sathyabama among the top Institutions worldwide.

This glorious Institution is functioning under the dynamic leadership of Dr. Mariazeena Johnson, Chancellor, Dr. Marie Johnson, President, Ms. Maria Bernadette Tamilarasi Johnson, Vice President. A team of dynamic and outstanding faculty, innovative pedagogical practices, state of the art infrastructure and world class research facilities add on to the attractions of the Institution. Sathyabama Institute of Science & Technology has alliances with leading Universities and Research Establishments at National and International Level. Sathyabama has been conferred with 12B status by University Grants Commission which has made the Institution eligible to receive assistance from Central Government to undertake more sponsored research projects. Sathyabama has undertaken various sponsored and collaborative R&D projects funded by National and International Organizations, as well.

Figure 1: Sathyabama Institute of Science and Technology

Figure 2: Layout Plan of the campus

1.1.1. Vision of the Institute

Sathyabama Institute of Science and Technology envision being an Effective and Competent Source of technical manpower for the current and future Industrial requirements.

1.1.2. Mission of the Institute

- Undertaking Research & Development activities in emerging thrust areas.
- Introducing new manpower innovative courses based on the Industry & Societal demands.
- Collaborating with National, International Institutes, Research and Development Organization and Industries.
- Serving the community at large.

1.1.3. Objectives of the Institution

The Institution endeavors to prepare its students for fulfilling careers by enabling them to realize their full potential and by inculcating in them the spirit of intellectual enquiry, independent thinking, self-reliance, leadership, co-operation, expression of cultural talents and service to society.

1.1.4. Core Values of the Institution

Sathyabama Institute of Science and Technology is committed in practices that are fair, honest and objective in dealing with students, faculty members and other stake holders, which fosters a climate of ethical conduct, respect, responsibility and trust. Sathyabama Institute of Science and Technology believes in stakeholder partnership for holistic Institutional development and to promote a healthier working atmosphere with the following core values.

- **Integrity:** The Institute emphasizes on high ethical standards in action and is committed in being transparent, responsible and accountable.
- **Nobility:** The Institute inculcates ethical values parallel to the curriculum enrichment to the student community, so that they outstand amongst their peers irrespective of the environment in which they are placed.
- **Sustainability:** The Institute develops, practice and emphasize protocols in academics and research enabling ourselves to be competitive, ensuring environmental and social sustainability.

- **Partnership and Collaboration:** The Institute encourages academic and research partnerships with organizations and universities at National and International level. The Institute values and applauds the relationships it has with their partners.
- **Inclusivity and Diversity:** The Institute is committed to facilitate diverse student and faculty culture and encourage multi-cultural learning in the Institution. It provides opportunity to work, learn and embrace the diversity of every individual irrespective of race, gender, religion, nationality, age, social background, physical ability and mental competence.
- **Responsibility**: The Institute believes in education for all. The Institute takes pride in owning responsibility and commitment towards society by supporting the education of students from rural, economically backward communities, differently abled and acid attack victims with full financial assistance.

1.2 About WasmanPro Environmental Solutions LLP

WasmanPro has in-depth understanding and practical experience with Environmental and Energy Audit, Green Practices, Environmental Policies, Regulatory Programs, and Remediation Strategies. The firm offers comprehensive regulatory consent and compliance support that address a full spectrum of air, water, wastewater and hazardous waste issues, regulations, and policies. Drawing up on the collective experience of the team, it has developed technically sound and cost-effective strategies to achieve environmental compliance. The development and implementation of these strategies have led to:

- Faster Consent Management Services
- Reducing waste streams
- Improving mechanisms to track consent conditions
- Executing effective monitoring programs
- Implementing phased compliance and cleanup strategies

1.2.1 Core Environmental Compliance & Remediation Services

WasmanPro helps clients in adopting advanced environmental sustainability, maintain environmental compliance, and reduce environmental risk and cleanup sites by providing a diverse set of core services including:

- Environmental Compliance
- Air Emission Inventories and Reporting
- Air Quality and Clean Air Act Compliance
- Environmental Due Diligence
- Environmental Impact Assessment
- Site Investigation and Feasibility Studies
- EHS Audits & Training
- Environmental Management System and Compliance Auditing
- Environmental Monitoring
- Ground water and Sub surface Investigations
- Green Audit
- Soil Management Plans
- Hazardous and Solid Waste Management Plans
- Remedial Design and Monitoring
- Brown field Cleanup
- Pollution Prevention Plans
- Environmental, Health and Safety Plans
- Hydro geological studies

M/S WasmanPro Environmental Solutions LLP has also undertaken several Environmental and Energy Audits as per NAAC requirements.

1.2.2 WasmanPro Team

M/S WasmanPro Environmental Solutions LLP is spearheaded by Dr. K. Karthikeyan, a certified Lead Auditor for ISO 14001, OSHA 18001 certified by CII-NABET certification program.

Dr. Karthikeyan was former Member Secretary of TNPCB and has vast experience in the field of Environmental Impact Assessment (EIA), Marine Impact Assessment (MIA), Solid Waste Management (SWM), Environmental and Social Management Framework (ESMF), Disaster Management Plan (DMP), Risk Assessment, Water and Wastewater treatment, Training of Engineers. The Company is also lead by senior retired professionals like G. Sathiamoorthi, Former Engineering Director Chennai Metropolitan Water Supply and Sewerage Board

(CMWSSB), V. Ganesan, Former Member State Environmental Impact Assessment Authority, Government of India, K.M.M. Annamalai, with more than 35 years of experience in EPC Project Management in various private sector companies, T. S. Murli with rich experience in various project executions and project management in several private sector companies. WasmanPro has talented & committed employees as engineers and scientists across multiple sectors.

CHAPTER 2

ENVIRONMENTAL AND ENERGY AUDIT

2.1 Introduction

Environmental or Green Audit is a management tool comprising systematic, documented, periodic and objective evaluation of how well an organization is performing with the aim of helping to safeguard the environment by facilitating management control of practices and assessing compliance with environmental policies.

Environmental and Energy Audit is a snapshot in time, in which one assesses campus performance in complying with applicable environmental laws and regulations. Though a helpful benchmark, the audit almost immediately becomes outdated unless there is some mechanism in place to continue the effort of monitoring environmental compliance. Environmental and Energy Audit forms a part of the resource management process. Although they are individual events, the real value of Environmental and Energy Audit is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time. Audit focuses on environmental cognizance, waste minimization and management, biodiversity conservation, water conservation, energy conservation and environmental legislative compliance by the campus. Target areas included in this audit are water, energy, waste, green campus and carbon footprint.

Eco-campus concept mainly focuses on the efficient use of energy and water, minimization of waste generation, pollution and to attain economic efficiency. All these indicators are assessed in process of "Environmental and Energy Audit of educational Institute". Eco-campus mainly focuses on the reduction of contribution to emissions, procures a cost effective and secure supply of energy, encourages and enhances energy use conservation, promotes personal action, reduce the Institute's energy and water consumption, reduce waste to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts.

2.2 Methodology for Environmental and Energy Auditing

The purpose of the audit was to ensure that the practices adopted by the Institution are in accordance with the Environmental Policy suggested by NAAC. In order to perform the audit, the methodology included different techniques such as physical inspection of the campuses, observation and review of the documents, interviewing key persons and data analysis, measurements and recommendations. The methodology adopted for this audit was a step by step process comprising of:

1. Data Collection – In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, conducting surveys, distributing questionnaires, communicating with responsible persons and measurements.

Following steps were taken for data collection:

- The team went to each department, Library, canteen, hostels, research centers etc.
- Data about the general information was collected by observation and interview.
- The power consumption of appliances was recorded by taking an average value in some cases.
- For Waste auditing details about types of waste generated and mode of disposal were collected.
- For Water auditing details about source of water for the Institution, various uses of water, mode of disposal of waste water were collected.
- For Energy auditing details about source of power for the Institution, major points of power usage, generation of power from non-conventional source were collected.
- For Carbon Foot Print auditing details about source of emission of greenhouse gases, details about major Carbon Foot Print reduction strategy were collected.
- For Green Auditing details about total campus area, area under green coverage, and area under Marshy land were collected.
- Five categories of questionnaires were distributed among the students and staff for data collection.

2. Data Analysis - Detailed analysis of data collected was done. It includes calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plan, analysis of various water usage and wastage points, analysis of water recycling and reusing methods implemented in the campus, analysis of types of waste being generated, studying various waste management strategy adopted in the campus, analyzing various Carbon Foot Print strategy being implemented in the campus.

3. Recommendation/Suggestions– On the basis of results of data analysis and observations, various suggestions that the Institution can implement were recommended.

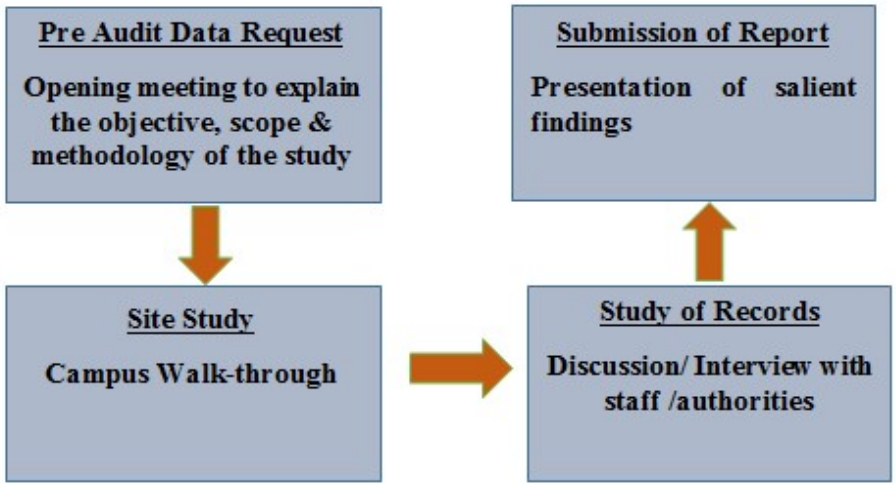


Figure 3: Audit Stages

2.3 Benefits of the Environmental and Energy Auditing

- ✓ More efficient resource management
- ✓ To provide basis for improved sustainability
- ✓ To create a green campus
- ✓ To enable waste management through reduction of waste generation, E-Waste management, solid-waste management and wastewater recycling

- ✓ To create plastic free campus and evolve health consciousness among the stakeholders
- ✓ Recognize the cost saving methods through waste minimizing and managing
- ✓ Authenticate conformity with the implemented laws
- ✓ Empower the organizations to frame a better environmental performance
- ✓ Enhance the alertness for environmental guidelines and duties
- ✓ Impart environmental education through systematic environmental management approach and Improving environmental standards
- ✓ Benchmarking for environmental protection initiatives
- ✓ Financial savings through a reduction in resource use
- ✓ Development of ownership, personal and social responsibility for the Institute and its environment
- ✓ Developing environmental ethics and value systems in youngsters.
- ✓ Environmental and energy auditing should become a valuable tool in the management and monitoring of environmental and sustainable development programs of the Institute.

2.4 Scope and Goals of Environmental and Energy Auditing

The environment has become a major consideration for any decision-making for the development of any organizations. There is growing recognition that environmental issues are associated with almost all activities of an organization. An effective way of addressing environmental issues in an organization is by conducting systematic Environmental and Energy audit. An Environmental and Energy audit can be considered as an internal examination conducted by an Institution with reference to its own environmental operations as a means of assessing its environmental compliance and performance. These are used to help improve existing activities, with the aim of reducing the adverse effects of these activities on the environment. It is necessary to conduct these audits in the Institution because students become aware of the Environment, advantages it offers, thereby become the warriors to save the planet. Thus, such quality audits become necessary at the Institution level.

A very simple indigenized system has been devised to monitor the environmental performance of Sathyabama Institute of Science and Technology. It comes with a series of questions to be answered on a regular basis. This innovative scheme is user friendly and totally voluntary. The aim of this is to help the Institution, identify their weak areas, and project their best practices and to set examples for the community, and to educate the young learners.

Environmental and Energy Auditing is done in three phases

Phase I - Pre Audit Stage

Phase II - Audit Stage

Phase III - Post Audit Stage

1. Pre Audit Stage
   - Plan and organize
   - Walk through audit
   - Macro data collection
   - First hand observation and assessment
   - Issue questionnaire for each department
2. Audit Stage
   - Primary data gathering
   - Analysis of energy use, water use, waste generation
   - Analysis of Annual Energy Bill, Water Bill, GHG Emission
   - Analysis of energy consumption pattern, water usage pattern
   - Identification of resource conservation opportunities
   - Select most promising techniques
   - Cost benefit analysis
3. Post Audit Stage
   - Implementation of ideas
   - Follow up and periodic review

2.5 Pre-Audit Stage

A pre-audit meeting provides an opportunity to reinforce the scope and objectives of the audit and to discuss on the practicalities associated with the audit. This meeting is an important prerequisite for the Environmental and Energy Audit because it is the first opportunity to meet the expert and deal with any concerns.

The pre-audit meeting was conducted successfully at Sathyabama Institute of Science and Technology, Chennai on 20th March 2021and necessary documents were collected directly from the Institution before the initiation of the audit process. The audit protocol and audit plan were handed over at this meeting and actual planning of audit processes was discussed. The WasmanPro team worked under the leadership of the lead auditor Dr. K. Karthikeyan, to ensure completion within the brief and scope of the audit.

Figure 4: Sathyabama Officials and WasmanPro Officials during Pre-Audit Stage Meeting held on 20th March 2021

2.6 Audit Stage

In Sathyabama Institute of Science and Technology, Chennai, Environmental and Energy Auditing was coordinated with WasmanPro Environmental Solutions LLP. The entire exercise was conducted by involving the Centre for waste Management team, along with different student groups, researchers, teaching and non-teaching staff. The Environmental and Energy Auditing began with the team conducting walk through inspections of all the different facilities at the Institute, determining the different types of appliances and utilities (lights, taps, toilets, fridges, etc.) as well as measuring the usage per item (Watts indicated on the appliance or measuring water from a tap) and identifying the relevant consumption patterns (such as how often an

appliance is used) and their impacts. Data collection was done in the sectors such as Water use, Energy, Waste, Green coverage and Carbon footprint. Various records and documents were verified several times to clarify the data received through survey and discussions.

The methodology adopted for this audit was a step- by- step process comprising of:

- Involvement of Student Clubs and Forums
- Site inspection
- Interviews
- Review of Policies
- Review of Documents and Records

2.7 Post Audit Stage

The base of any Environmental and Energy Auditing is that its findings are supported by documents and verifiable information. The audit process seeks, on a sampled basis, to track past actions, activities, events, and procedures to ensure that they are carried out according to systems requirements and in the correct manner. The real value of Environmental and Energy Auditing is when they are carried out at defined intervals, and their results and recommendations can bring improvement or change over time. Although Environmental and Energy Auditing are carried out using policies, procedures, documented systems and objectives as a test, there is always an element of subjectivity in an audit. The essence of any audit is to find out how well the organization, departments and equipment are performing keeping the environmental sustainability in mind. Each of the three components is crucial in ensuring that the organization's environmental performance meets the goals set in its green policy. The individual functioning and the success of integration will all play a role in the degree of success or failure of the organization's environmental performance.

2.8 Follow-up Action and Plans

Environmental Audits are exercises which generate considerable quantities of valuable information. The time and effort and cost involved in this exercise is often considerable and in order to be able to justify this expenditure, it is important to ensure that the findings and recommendations of the audit are considered at the correct level within the organization and that

action plans from the audit findings are implemented.

Audit follow up is part of the wider process of continuous improvement. Without follow-up, the audit becomes an isolated event which soon becomes forgotten in the pressures of organizational priorities and the passing of time.

CHAPTER 3

WATER AUDIT

3.1 Introduction

Water is life; virtually everything we do or use each day involves water. Yet, we do not give it the importance that is due to it. There is an increasing awareness around the globe of the centrality of water to our lives. This awareness crosses political and social boundaries. In many places people have difficulty in accessing the drinking water. Often it is polluted. We need to use water wisely to ensure that drinkable water is available for all, now and in the future. Water auditing is a mechanism for conserving water, which will grow in significance in the future as demand for water increases .Water Audit is a tool to quantify the total intake water in an Institution, to analyze its various uses, to observe wastage/ leakage, to examine waste water treatment methods and to suggest water conservation techniques. The water audit helps to arrive at a relevant method that can be adopted and implemented in an Institution to balance the demand and supply of water. It is therefore essential that any environmentally responsible Institution conducts a water audit and examines its water use practices.

3.2 Key Methodology adopted for Water Audit

a. Base Line data were collected by distributing online questionnaire through Google form to the students and staff and also by conducting interviews among the staff.

b. A walk through survey of the entire facility was conducted to identify the type of water fixtures and measuring water usage points based on flow rates. Survey was done to identify defective fixtures and to spot water leakage/wastage points.

c. Distribution of online questionnaire and walk through survey was carried out from 22th - 24th March 2021.

d. Based on the findings, calculation was done on overall water usage in the campus and methods for reducing the water footprint were suggested.

3.3 Water Audit Survey/Questionnaire

1. List various sources of water in your Institute.
2. How many wells are there in your Institute?
3. Does the Institute buy water from outside sources?
4. What is the depth of each well?
5. What is the present depth of water in each well?
6. No. of motors used for pumping water from each well?
7. What is the total horsepower of each motor?
8. Quantity of water stored in overhead water tank?(in liters)
9. Quantity of water pumped every day?(in liters)
10. List out various uses of water
11. No. of water coolers. Amount of water used per day?(in liters)
12. No. of water taps. Amount of water used per day?
13. No. of bath rooms in staff rooms, common area, hostels. Amount of water used per day?
14. No. of toilet, urinals. Amount of water used per day?
15. No. of water taps in the canteen. Amount of water used per day?
16. Amount of water used per day for gardening.
17. No. of water taps in laboratories. Amount of water used per day in each lab?
18. Total use of water in each hostel?
19. Is there any water used for agricultural purposes?
20. How many water fountains are there?
21. How often is the garden watered?
22. Quantity of water used to watering the ground?
23. Quantity of water used for bus cleaning?(liters per day)

24. Amount of water for other uses?(items not mentioned above)
25. At the end of the period, compile a table to show how many liters of water have been used in the Institute for each purpose
26. If there is water wastage, specify why.
27. How many of the taps are leaky? Amount of water lost per day?
28. Are there signs reminding people to turn off the water?
29. How many water fountains are leaky?
30. How can the wastage be prevented/stopped?
31. Locate the point of entry of water and point of exit of waste water in the Institute.
32. Where does waste water come from?
33. Where does the waste water go?
34. What are the uses of waste water in your Institute?
35. Is there any treatment for waste water?
36. What happens to the water used in labs? Whether it gets mixed with ground water?
37. Is there any treatment for the lab water?
38. Whether green chemistry methods are practiced in labs?
39. Write down four ways that could reduce the amount of water used in the Institute.
40. Record water use from the Institute water meter for six months.
41. Bimonthly water charges paid to water connections if any,
42. Is there any water conservation plan in the Institute?
43. Does your Institute harvest rainwater?
44. If yes, how many rain water harvesting units are there?(Approx .amount)
45. Is there any water less toilets?
46. Is drip irrigation used to water plants outside?

47. Area under green coverage.

48. Is there any water management plan in the Institute?

49. Are there any water saving techniques followed in your Institute? What are they?

50. Pleases share some idea on how your Institute could save more water.

3.4 Water Audit-Key Findings

Main water uses in the campus were noted to be for gardening, cleaning, drinking, toilet and bathroom usages, hostel uses, cooking, washing, laboratory uses, canteen uses, office uses, floor cleaning, etc.

Table 1: Source of Water for the Institution

Number of Tankers	2-5per day of 12,000litrescapacity
Number of bore wells	3 bore well within 25-30 Kms from Institution (One owned, two hired)
Number of ponds	Nil

Table 2: Water Storage Structure in the Campus

Number of Raw Water Tank	4
Number of Fire Water Storage Tank	1
Number of Treated Water Tank	3 (50,000 lts)
Number of Rain Water Collection Tank	1
Number of water tanks for storage	9
Total capacity of water storage tank	1 MLD

Note: All the Water storage structures were not fully utilized as usage was less due to pandemic

Table 3: Distribution Tanks in the Campus

Tank capacity Gents hostel Ladies Dental	**30-50 Thousand L** 3 tanks 4 tanks 2 tanks
Tank capacity Small blocks Other blocks	**25-50 Thousand L** 3 tanks 6 tanks
Tank capacity Syntax tanks	**5-20 Thousand L** 15

Note: All the Water storage structures were not fully utilized as usage was less due to pandemic

Table 4: Various points of Usage of Water

RO Plant40000 L Capacity	2 tanks (20000 L each)
Number of Urinals and Toilets	688,1475
Number of water less urinals	Nil
Number of bathrooms	975
Number of water taps	1685
Water taps in laboratories	114
Number of Washbasin	375
Water pumps–Nos. HP each	6 (10HP)
Quantity of water pumped	2-5 tanker lorries

Table 5: RO Plant Water Output Details

Parameter	Result
pH	7.8
Turbidity	1 NTU
TDS	86 mg/L

Table 6: Water Cooler Details

SL.NO	Location	Nos.
1	Block (Research)	6
2	Block (admin)	6
3	Block (hospital)	12
4	Block (academics)	9
5	Block (dental)	8
6	Hostel	5
7	Hostel	4
8	Work shop 3 & 4	2
9	Library	8
10	Ladies Hostel	7
11	Mess	11
12	Canteen	Nil
	Grand Total	78

Note: In 20 20-21 all coolers were not operated owing to pandemic. In February limited students came to the Institute so some coolers were operated.

Table 7: Various Points of Water Wastage

Number of Leaky Taps	Nil
Number of leaky pipes	Nil
Number of Urinals	Nil
Number of Leaky Tanks	Nil
Overflow water Wastage	Max 5 mts overflow-immediate switch off followed
Any Evaporation Loss from Storage Tanks	No Evaporation Loss as the Storage Tanks are completely covered

Table 8: Details of Water Treatment System

No. of water treatment system in place	1
Total Quantity of Water being treated	68.153 KLD
Total Quantity of Water Reused	54.52 KLD

Overall Utilization of water in the Institute

The water consumption by the Institution was minimum in the year 2020-21 owing to the pandemic. Also the Institution is using treated water from the STP for gardening and flushing which are the major water usage points. Since water for flushing is met by recycled water the intake water can directly be diverted for purposes like drinking, cooking, cleaning, bathing etc. So the intake water of 42 KLD per day seems adequate. As with the adoption of STP and reusing the recycled water for flushing and gardening the Institution could reduce their water footprint to a great extent.

Total fresh water consumption in the Institution = 42 KLD

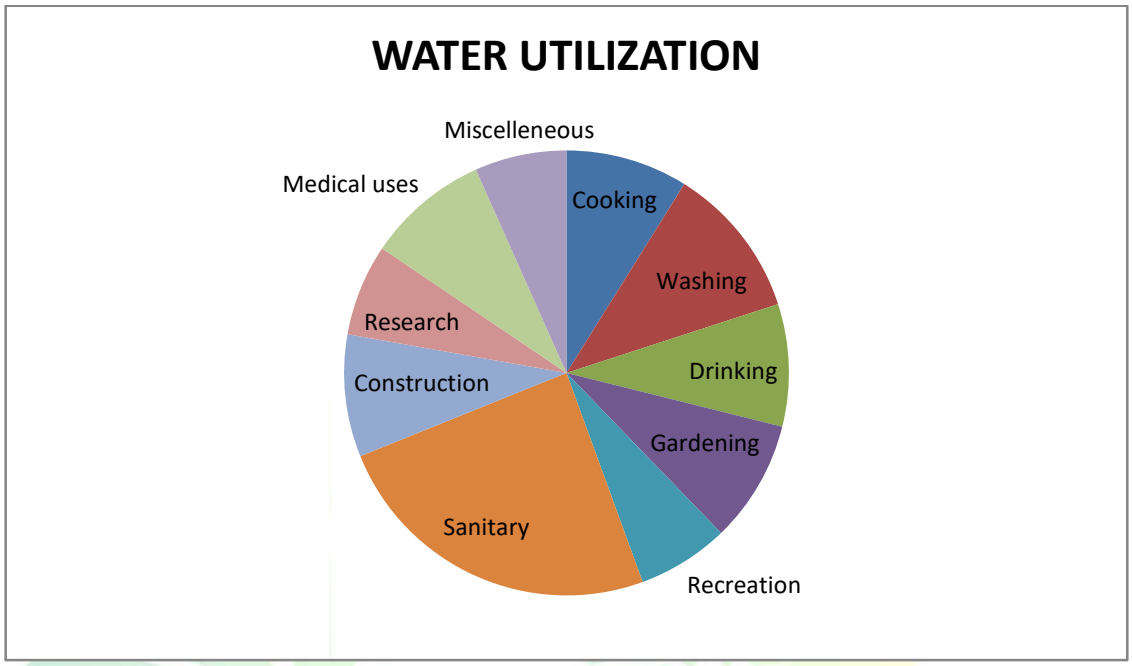


Figure 5: Water utilization at the Institute

3.4.1 Wastewater Treatment Unit Details

Sewage Treatment Plant at Sathyabama Institute Campus

(Capacity of 1.50 Million Liters per Day)

Total population	1703 persons
Input flow to STP	68.153 KLD
STP designed for	1.5 MLD

Note: Since the Institution was only partially working due to Covid pandemic, only the staffs (teaching and non- teaching) were coming to the college.

Table 9: Characteristics of Raw Sewage

Sl. No.	Parameters	Inlet character	Units
1.	Flow	68	m^3/day
2.	pH	8.12	-
3.	BOD_3	410	mg/l
4.	COD	685	mg/l
5.	TSS	362	ppm

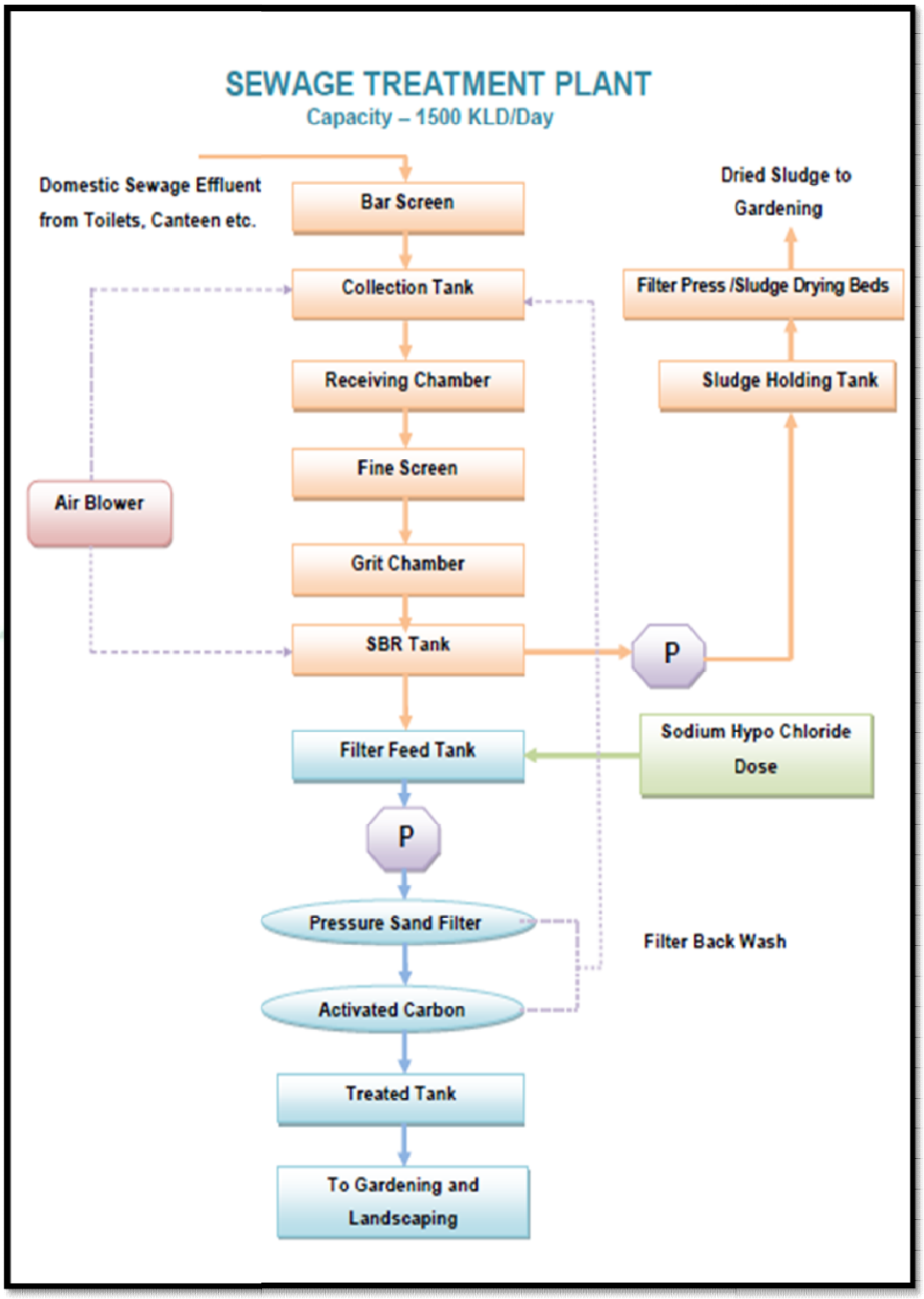


Figure 6: Flow diagram of the treatment process in the STP

Table 10:Size of Unit Operations of Sewage Treatment Plant

S.No	Description of unit operation of STP	Size/Capacity (M)	Liquid Volume (KL)	Free Board Volume (KL)
1	Bar Screen	2.5 × 1.5 × 1.0M (TD)	-	3.75
2	Raw Sewage Sump	15.0 × 12.0 × 4.0M (LD) + 1.0M (FB)	720	180
3	Receiving Chamber	2.5 × 1.5 × 0.7M (TD)	-	2.6
4	Fine Screen Channel	4.0 × 0.525 × 0.8M (TD)	-	1.7
5	Grid Chamber Manual	4.5 × 2.5 × 1.5M (LD) + 0.5M (FB)	16.875	5.625
6	SBR Basins – I	15.0 × 6.0 × 4.5M (LD) + 1.0M (FB)	405	90
7	SBR Basins – II	15.0 × 6.0 × 4.5M (LD) + 1.0M (FB)	405	90
8	Clarified Water Tank	15.0 × 12.0 × 2.8M (LD) + 2.2M (FB)	504	396
9	Treated Tank	15.0 × 12.0 × 4.5M (LD) + 0.5M (FB)	810	90
10	Sludge Sump	4.0 × 4.0 × 3.5M (LD) + 0.5M (FB)	56	8
11	Sludge Drying Beds (4 Nos)	3.0 × 3.0 × 1.5M (TD)	28.8	25.2

3.5 Water Audit – Evaluations and Recommendations

Water auditing was done for systematic & scientific examination of water usages of the Institution. Water auditing was used for categorizing all water use in the Institution and to act as a tool to overcome the shortage, leakages and losses in the system. With the help of water audit,

it was identified and quantified what steps can be taken to reduce water use and losses. Water audit and its analysis was done to identify methods to reduce the water foot print of the Institution thereby leading to saving the precious water resource and money associated with it.

Water audit was extensively done for the Sathyabama Institute of Science and Technology and the Audit findings are as follows.

Best Practices Observed in the Institution -Water Management

- Treatment of waste water using STP and reusing it for gardening and flushing
- Rainwater harvesting using Rooftop Rain water harvesting structures and rain water harvesting pits.
- Ledgers were maintained in various departments and hostels where students could make entry about leaky taps/ water wastage when-ever it comes to their notice
- Institution has own RO unit catering to drinking water requirement of the entire campus
- Institution is conducting periodic awareness camp for own students as well as for the members of the adopted village about water conservation, Sanitation and Hygiene
- Institution is also planning to conduct Water Audit training for its students in July 2021 to create more awareness among them
- Posters were displayed at various locations urging students to conserve water

3.5.1 Consolidation of Water Audit Findings-Evaluation

The Water audit was conducted in Sathyabama Institute of Science and Technology in three stages: pre-audit, an on-site audit and post-audit follow-up. In pre-audit stage, worksheet was developed and distributed among staff and facility manager to gather site specific information like source of water, presence of alternative source of water during summer season, presence of water storage structure, any Water meters and sub-meters installed in the campus, any existing water conservation techniques followed in the Institution. During on-site audit interviews were conducted with the staff in-charge of water division to gather site specific information including: water supply records to determine current water use and water costs; any alternative water supply

sources; size of the facility; and the population occupying the facility during various shifts of operation, details about pumping station, total water storage capacity in entire educational campus etc. The team did 'walk through survey and examined various buildings, visually identifying water pumping and conveyance points, water usage points, disposal point , recycling locations etc.

Upon completion of the on-site audit, the findings were processed. The audit reviewed how the water is managed throughout the campus and how water moves from its source points to the disposal point, various water usages, water loss from leaks, where the water ends up and how much of it got there were calculated. The audit also reviewed the water treatment system employed in the campus and also analyzed various water conservation methods implemented in the Institution.

The main source of water for the Institution is the water taken from the lorry tankers. The campus has storm water drainage channels that collects the storm water and diverts it to rain water harvesting pits. The Institution has also made facilities for roof top rain water harvesting structures and rain water harvesting pits which is highly appreciable. Institution has own RO unit catering to drinking water requirement of the entire campus. There is no water leakage as the leaky taps are repaired whenever such leaks come to the notice of the authority. This is made possible by the Institutes water maintenance division who are working round the clock to ensure there is no leakage. STP of 1.5 MLD capacity has been installed to treat the waste water which is then diverted to gardening and flushing.

The various usage points in the Institution was found to be water used for cooking, drinking, bathing, hand washing, toilet flushing, laboratory use, mopping and cleaning of the campus verandas, gardening, washing the buses etc. Since the Institution was only partially functioning in the year 2020-21 owing to pandemic, only the teaching and non- teaching staffs were coming to the Institution. So the water requirement for bathing was almost nil as there were no holsters. The water required for cooking was very meager as the cafeteria was cooking food only for minimum number of people, as the students were not coming to the Institution and the staffs were asked to bring own food to rule out any chance of Corona-virus Infection. Also the staffs were requested to bring own water during the pandemic time. The water required for flushing

and gardening was met by the recycled water coming out of STP. So the intake water 42 KLD which was used as the make- up water to meet the fresh water requirement seems sufficient. So it can be concluded that the Institution has been taking a great effort to decrease the water footprint by relying on the recycled waste water and water harvested during the rainy season. The Institution is also involved in conducting periodic awareness camp for own students as well as for the members of the adopted village about water conservation, Sanitation and Hygiene and is planning to conduct water audit training for its students. Hence it can be said that the Institution is taking the right steps towards water management and is on the path towards achieving Zero Liquid Discharge which is highly commendable.

Based on the above findings, few recommendations that the Institution can follow are suggested in the following section.

3.5.2 Recommendations

- Liquid waste generated from health care facilities shall be pre-treated before mixing with other wastewater
- Replace conventional flush system with latest dual model flush system to conserve water- as at present the toilet commodes have 10 liter flush which can be replaced with 3/6 liters or 2/4 liters dual flush cisterns. This can reduce water use by around 30-40%.
- Installation of water meter to analyze water consumption
- Installation of more Rainwater Harvesting pits is recommended in-order to reduce the water foot print of the Institution.
- Install artificial ground water recharge structures.
- Replace current fixtures with water-efficient fixtures
- Use recycled water for washing of Buses and cleaning of floors

Figure 7: STP overview

Figure 8: Water treatment unit

Figure 9: Site inspection at STP

Figure 10: Water transporting tanker

Figure 11: Lead auditor inspecting the blowers

Figure 12: Panel room

CHAPTER 4

ENERGY AUDIT

4.1 Introduction

Energy use is clearly an important aspect of campus sustainability and thus requires no explanation for its inclusion in the audit. Energy Audit provides a “bench-mark" for managing energy in the Institution and also provides the basis for planning a more effective use of energy throughout the Institution.The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. An old incandescent bulb uses approximately 60W to 100W while an energy efficient light emitting diode (LED) uses only less than 10 W. Thus Energy auditing deals with methods to reduce its consumption and conservation of energy. It is therefore essential that any environmentally responsible Institution examine its energy use practices.

4.2 Key Methodology adopted for Energy Audit

1. The Energy audit was focused on the study of all major energy consumption equipment and evaluation of operational efficiency of these equipments from the energy conservation point of view.
2. Base Line data were collected by distributing online questionnaire through Google form to the students and staff and also by conducting interviews among the staff.
3. A walk through survey of the entire facility was conducted for first hand observation and assessment of current level operation and practices
4. The walk through survey and base line data collection was carried out between 25th –27th March 2021
5. Based on the above findings, the base line data collected were analyzed along with annual Energy bill and analysis of major energy consumption pattern was carried out.

4.3 Energy Audit Survey/Questionnaire

1. List the ways of energy usage in the Institution. (Electricity, electric stove, kettle, microwave, LPG, Petrol, diesel and others).
2. The amount spent for petrol/diesel for the past one year?
3. Are there any energy saving methods employed in the Institution? If yes, please specify.
4. How much money does the Institution spend on energy such as electricity, gas, firewood, etc. in a month? (Record monthly)
5. How many CFL bulbs have been installed? Mention hours of usage (Hours used/day for how many days in a month)
6. Energy used by each bulb per month? Forexample-60watt bulb x 4hours x number of bulbs
7. How many LED bulbs are used in the Institution? Mention hours of usage (Hours used/day for how many days in a month)
8. Energy used by each bulb per month? (KWh).
9. How many incandescent (tungsten) bulbs have been installed? Mention hours of usage (Hours used/day for how many days in a month)
10. How many fans are installed in the Institution? Mention hours of usage (Hours used/day for how many days in a month)
11. Energy used by each fan per month?(kWh)
12. How many air conditioners are installed in the Institution? Mention hours of usage (Hours used/day, for how many days in a month)
13. Energy used by each air conditioner per month? (KWh).
14. How much electrical equipment including weighing balance is installed the Institution? Mention the use (Hours used/day for how many days in a month)
15. Energy used by each electrical equipment per month? (KWh).
16. How many computers are there in the Institution? Mention hours of usage (Hours used/day for how many days in a month)
17. Energy used by each computer per month?(kWh)

18. How many photocopiers are installed by the Institution? Mention hours of usage (Hours used/day for how many days in a month).
19. How many cooling apparatus have been installed in the Institution? Mention hours of usage (Hours used/day for how many days in a month)
20. Energy used by each cooling apparatus per month? Mention hours of usage (Hours used/day for how many days in a month)
21. Energy used by each photocopier per month? Mention hours of usage (Hours used/day for how many days in a month)
22. How many inverters have been installed? Mention hours of usage (Hours used/day for how many days in a month)
23. Energy used by each inverter per month?(kWh)
24. How many electrical equipment are used in different labs of the Institution? Mention hours of usage (Hours used/day for how many days in a month)
25. Energy used by each equipment per month?(kWh)
26. How many heaters are used in the canteen of the Institution? Mention hours of usage (Hours used/day for how many days in a month).
27. Energy used by each heater per month?(kWh)
28. No of streetlights in the Institution?
29. Energy used by each streetlight per month?(kWh)
30. No of TV in the Institution and hostels?
31. Energy used by each TV per month?(kWh)
32. Any other item that uses energy (Please write the energy used per month) Mention hours of usage (Hours used/day for how many days in a month)
33. Any alternative energy sources/non-conventional energy sources employed/installed in the Institution? (photovoltaic cells for solar energy, windmill, energy efficient stoves, etc.,)

34. Do you run switch off drills at Institution?

35. Are the computers and other equipment put on power-saving mode?

36. Does the machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby mode most of the time? If yes, how many hours?

37. What are the energy conservation methods adapted by the Institution?

38. How many boards are displayed for energy saving awareness?

39. How much ash is collected after burning fire wood per day in the canteen?

4.4 Energy Audit-Key Findings

4.4.1 List of Instruments

Following instruments were used to collect data related to energy audit:

- 3-phase power analyzer
- Lux meter
- Power Clamp meter
- Hygrometer
- Anemometer
- Measuring tape
- Ultra-sonic flow meter

Table 11: Major Utilities at Sathyabama Institute

S.NO	Particular	Quantity	Rating
1.	Transformer	3	1000kVA × 2 630kVA× 1
2.	Capacitor Bank	4	100 kVA × 4
3.	Diesel Generators	6	725 kVA × 1 625 kVA × 1 500 kVA × 3 185 kVA × 1
4.	Single phase load (lights, fan, power sockets, etc.)	Multiple	Total 440kW
5.	Electric Motor	Multiple	Total 526 HP
6.	Power Load in facility	Multiple	Total 570 kW
7.	Power Load for UPS	Multiple	Total 669 kVA

Note: All units were not fully utilized as usage was less due to pandemic

Table 12: Transformer Ratings

S.NO	Transformer	Transformer Rating (in kVA)
1	Transformer	1000
2	Transformer	1000
3	Transformer	630

Note: All transformers were not fully utilized as usage was less due to pandemic

4.4.2 Air-Conditioning Systems

Air-Conditioners are used to maintain comfort in working environment. People working in offices require a certain ambient condition to be comfortable to perform the task. Here at Sathyabama Institute, packaged type AC units are used. The units used are as follows:

- Split – High wall
- Split – Cassette
- Duct type

The units used are of different capacities, depending on the space and number of people occupying that space. Due to large number of ACs installed, auditors did the study on sample basis.

Table 13: Detailed performance assessment of Air-Conditioners

S.NO	Location	Rated Capacity in (TR)	Type	Compressed Load (in kW)
1	Auditorium AC unit 1	11.5	Ducted	10.85
2	Auditorium AC unit 1	11.5	Ducted	11.06
3	Auditorium AC unit 1	11.5	Ducted	10.97
4	Auditorium AC unit 1	8.5	Ducted	8.89
5	Auditorium AC unit 1	8.5	Ducted	8.93
6	Library Auditorium	2	Split	2.45
7	Library Auditorium	2	Split	2.2

Table 14: List of lighting load

Area	Equipment	Rating(W)	Quantity	Total load (in kW)
Block No.1	Tube Light	40	156	6.24
Block No.2	Tube Light	40	34	1.36
Block No.3	Tube Light	40	37	1.48
Block No.4	Tube Light	40	37	1.48
Block No.5	Tube Light	40	35	1.4
Block No.6	Tube Light	40	29	1.16
Block No.7	Tube Light	40	35	1.4
Block No.8	Tube Light	40	35	1.4
Block No.10	Tube Light	40	156	6.24
Block No. 11	Tube Light	40	136	5.44
Block No.12	Tube Light	40	156	6.24
Block No.14	Tube Light	40	156	6.24
Block No.15	Tube Light	40	156	6.24
Block No.16	Tube Light	40	156	6.24
Block No.18	Tube Light	40	156	6.24
Dr.MGRillam(Boys hostel)	Tube Light	40	320	12.8
Dr.Gopalakrishananillam (boys hostel)	Tube light	40	320	12.8
3rd year hostel(Boys hostel)	Tube light	40	203	8.12
Panimalarhostel(Ladies hostel)	Tube light	22	203	4.466
Janakiammalhostel(Ladies hostel)	Tube light	40	156	6.24

Janakiammal hostel-I(Ladies hostel)	Tube light	40	156	6.24
Janakiammal hostel-II(Ladies hostel)	Tube light	40	200	8
Janakiammal hostel-III(Ladies hostel)	Tube light	40	206	8.24
Administrative office	Tube light	40	156	6.24
Old office	Tube light	40	31	1.24
Ladies mess	Tube light	40	250	10
PG mess	Tube light	40	22	0.88
Boys mess	Tube light	40	250	10
CSC block	Tube light	40	80	3.2
ECE block	Tube light	40	80	3.2
E&C AND E&I block	Tube light	40	30	1.2
EEE block	Tube light	40	55	2.2
Machine shop	Tube light	40	30	1.2
CAD lab	Tube light	40	20	0.8
Production lab	Tube light	40	50	2
Welding lab	Tube light	40	60	2.4
Civil block	Tube light	40	97	3.88
Bio-tech block	Tube light	40	130	5.2
M.sc block	Tube light	40	30	1.2
ETC block	Tube light	40	90	3.6
Thermal lab	Tube light	40	30	1.2

Area	Equipment	Rating(W)	Quantity	Total load (in kW)
Mech & production	Tube light	40	30	1.2
Aeronautical lab	Tube light	40	156	6.24
B.Arch.	Tube light	40	156	6.24
Nano-tech block	Tube light	40	60	2.4
Auditorium	Tube light	40	156	6.24
Transport shed	Tube light	40	10	0.4
Library	Tube light	40	30	1.2
Play ground	Tube light	120	22	2.64
Sewage & drainage	Tube light	40	2	0.08
Dobi room	Tube light	40	4	0.16
Street light	Tube light	120	20	2.4
			Total	214.5

Note: All lights were not fully utilized as the Institution was only partially functioning due to pandemic

Table 15: Performance assessment of lighting system

LUX Measurement				
S.No	Location	Wattage	No. of Fittings	Avg. LUX
1	Library hall	1572	44	155
2	Library hall Ground floor (student sitting area)	3960	15	115

3	Library 2nd Floor (HR discussion panel)	180	10	64
4	Interview panel room	220	1	219
5	Auditorium	30	1	186
6	Janakiamal Hostel	36	2	85
7	St Mother tresaillum	72	2	47
8	Mother of Roseryillum	80	2	48
9	Immaculate Marry illum	44	2	85
10	Gopal Krishnan illum	44	2	189
11	MGR illum	72	2	66
12	Col Dr Jeppiarillum	72	2	72
13	Class Room Block 15	240	6	60
14	Class Room Block 18	320	8	85
15	Class Room Block 8 (Room 9)	108	6	95

Table 16: Standard lux level in different areas

Activity	Illumination (lux, lumen/$m^{2)}$
Public areas with dark surrounding	20-50
Simple orientation for short visits	50-100
Working areas where visual tasks are only occasionally performed	100-150
Warehouse, Homes, Theatres, Archives	150
Easy Office work, Classes	250
Normal Office work, PC work, Study library, Groceries, Show room, Laboratories	500
Supermarkets, Mechanical workshops, Office landscapes	750
Normal Drawing work, very detailed mechanical works	1000
Detailed Drawing work, very detailed mechanical works	1500-2000
Performance of visual tasks of low contract and very small size for prolonged periods of time	2000-5000
Performance of visual tasks of low contract and very small size for prolonged periods of time	2000-5000
Performance of very prolonged and exacting visuals tasks	5000-10000
Performance of very special visual tasks of extremely low contract and small size	10000-20000

Table 17: Assessment of Pumps

Particular	Location	Value	Unit
Pump No 1	Boys Hostel	15.00	HP
Pump No 2	Girls Hostel	15.00	HP

Table 18: Fans installed at the facility

Area	Equipment	Rating(W)	Quantity	Total load (in kW)
Block No.1	Fan	80	65	5.2
Block No.2	Fan	80	38	3.04
Block No.3	Fan	80	36	2.88
Block No.4	Fan	80	36	2.88
Block No.5	Fan	80	37	2.96
Block No.6	Fan	80	28	2.24
Block No.7	Fan	80	45	3.6
Block No.8	Fan	80	43	3.44
Block No.10	Fan	80	65	5.2
Block No. 11	Fan	80	65	5.2
Block No.12	Fan	80	55	4.4
Block No.14	Fan	80	55	4.4
Block No.15	Fan	80	65	5.2
Block No.16	Fan	80	65	5.2
Block No.18	Fan	80	65	5.2
Dr.MGRillam(Boys	Fan	80	180	14.4

hostel)				
Dr.Gopalakrishananillam (boys hostel)	Fan	80	180	14.4
3rd year hostel(Boys hostel)	Fan	80	155	12.4
Panimalarhostel(Ladies hostel)	Fan	80	155	12.4
Janakiammalhostel(Ladies hostel)	Fan	80	65	5.2
Janakiammal hostel-I(Ladies hostel)	Fan	80	50	4
Janakiammal hostel-II(Ladies hostel)	Fan	80	150	12
Janakiammal hostel-III(Ladies hostel)	Fan	80	150	12
Administrative office	Fan	80	8	0.64
Old office	Fan	80	12	0.96
Ladies mess	Fan	80	140	11.2
PG mess	Fan	80	13	1.04
Boys mess	Fan	80	140	11.2
EEE block	Fan	80	24	1.92
Machine shop	Fan	80	30	2.4
Production lab	Fan	80	20	1.6
Welding lab	Fan	80	10	0.8
Civil block	Fan	80	10	0.8
Bio-tech block	Fan	80	30	2.4

M.sc block	Fan	80	18	1.44
ETC block	Fan	80	20	1.6
Thermal lab	Fan	80	20	1.6
Aeronautical lab	Fan	80	65	5.2
B.Arch.	Fan	80	65	5.2
Nano-tech block	Fan	80	30	2.4
Auditorium	Fan	80	50	4
Transport shed	Fan	80	4	0.32
Library	Fan	80	12	0.96
Sewage & drainage	Fan	80	1	0.08
Dobi room	Fan	80	1	0.08
			2571	**205.7**

Note: All these fans were not fully utilized as the Institution was only partially functioning due to pandemic

Table 19: Generator Rating

S.NO	Generator	Generator Rating (in kVA)	No of Generator
1	Generator	720	1
2	Generator	625	2
3	Generator	500	3
4	Generator	320	1
5	Generator	185	1

Note: All generators were not fully utilized as usage was less due to pandemic

Table 20: Various solar devices installed in the Institute

Devices	Power output
Hetero junction oxide solar cells (lab scale)	3 W
Thin film solar cells (lab scale)	10 W
Perovskite solar cells (lab scale)	0.1 W
Si based solar cell panels	10 KW
Ceria based SOFC	0.3 W

The total energy utilization of the Institution for the year 2020-21 was 14,77,411 kWh/year.

4.5 Energy Audit – Evaluations and Recommendations

Energy Audit was used as the key for decision-making in the area of energy management in the Institution. Energy Audit attempted to balance the total energy input with its uses, and served as a tool to identify all the energy streams in the facility. It quantified energy usage according to its discrete functions. Thus energy audit was an effective tool in defining and pursuing comprehensive energy management program.

Energy audit was extensively done for the Sathyabama Institute of Science and Technology and the Audit findings are as follows:

Best Practices Observed in the Institution - Energy Management

- Periodic maintenance of electrical/electronic equipment is done to optimize the power usage.
- Usage of Star rated Electric/Electronic Appliances
- Air conditioners are set at optimum temperature with fans on to conserve energy
- Use of Solar -Wind Hybrid system to power laboratory
- Use of Solar Lamps to light the Walkways
- Use of Solar power to Run the Kitchen
- Energy saving through the replacement of incandescent bulbs, CFL lamps and tube lights to LED light

- Since 2014 Earth Hour has been organized in the Sathyabama Institute of Science and Technology to create awareness among the upcoming generation that electricity is being wasted and we all have the sole responsibility to conserve it.
- To enhance awareness among students about energy efficiency and energy conservation various training and seminars were conducted at Sathyabama Institute of Science and Technology.
- Installation of Motion sensors in various areas of the main campus building to conserve electricity-as it turns on the connected lighting system when it detects motion, and turns off the light when there is no motion.
- The generators was run with 12% biodiesel blend to reduce the dependence on conventional power
- The Centre of Excellence for Energy Research of developed various types of solar cells and fuel cells like heterojunction solar cells, perovskite based solar cells, intermediate temperature solid oxide fuel cell, oxide and nitride-based super-capacitors for energy production and storage.
- Centre of Excellence for Energy Research is conducting research on the production of hydrogen using titanium oxide as photo catalyst for water splitting
- The Institute also has signed MoUs with Foreign Institutes to collaborate on research activities in the field of clean energy.

4.5.1 Consolidation of Energy Audit Findings-Evaluation

The Energy audit was conducted in Sathyabama Institute of Science and Technology in three stages: pre-audit, on-site audit and post-audit follow-up.

In pre-audit stage worksheet, was developed and distributed among staff –in-charge of electricity department to gather site specific information like source of power, presence of alternative source of power, presence of any renewable source of energy, any existing energy conservation techniques followed in the Institution. During on-site audit interviews were conducted with the staff –in-charge of electricity department to gather site specific information including: Electricity bill records to analyze the total electricity use in the campus and to know cost per unit; presence of any renewable source of energy; watts generated by such units, annual financial saving

achieved by incorporating various energy saving techniques. Walk through survey was done to visually observe various electrical equipment's used in the campus, and to analyze various operating Parameters, their energy efficiency and their star rating etc

Based on the above observation and analysis it was found that the total energy utilization of the Institution for different purposes was approximately 1477411 kWh/year. The main source of power is the electricity purchased from Tamil Nadu Electricity Board. This is considerably less when compared to the previous year as the Institution was only partially working in 2020-21 due to Covid-pandemic.

The Institution has already implemented many measures to decrease the dependence on Conventional power; few initiatives taken in this direction are solar powered lights along the campus as a replacement to conventional street lights. The Institution had installed World's Largest Solar Steam Cooking System with 110 concentrator dishes to power the Institution mess. This solar powered kitchen consumes less power and time than conventional LPG powered kitchen. By replacing LPG with solar dishes the Institution was able to save nearly Rs 20 lakhs per annum. But these solar panels got damaged during the floods of 2018. Now efforts have been taken to re-commission the solar cooking system.

The Institution has also taken an effort to power its laboratory using the Solar-Wind Hybrid system. The Institution has installed various types of solar cells like thin film solar cells, Si-based solar cell panels, Perovskite Solar Cells, Hetrojunction Oxide solar cells. These solar units all together generate 141 W per annum. Efforts have been taken to scale up these initiatives. Smart motion sensors have been installed in various areas of the administrative building, which automatically switch off the light when there is no movement and turn on the light when it detects any motion. By installation of smart sensors, the total load in corridors, main building could be reduced considerably. This initiative had to be stopped in between owing to the pandemic. By replacing 2571 Conventional Fans with BLDC fans, the Institution could save nearly 127 KW per day. The Institution replaced Conventional single star AC with five-star AC, this could save nearly 2KWper day. The Institution also replaced its 5371 Conventional FTLs with LED Tube lights leading to saving of nearly 97 KW per day. By replacing CFL lights with LED Light, the Institution was able to save nearly 15W per light. The Institution took initiatives

to replace the CRT Monitors with LCD Monitors, leading to saving of nearly 270 W per monitor. The Institution is using solar powered heaters to run the geysers of the hostel, by this it was able to save considerable amount of energy as lot of power is wasted while running the geysers. The Institution is also involved in various research activities focusing on developing cost effective, efficient and sustainable technologies for meeting the energy needs of the Institute. The Institute has signed MoUs with various Foreign Institutes to collaborate on research activities in the field of clean energy.

The Electrical audit of the Institution shows efforts are being taken up to reduce non-renewable energy consumption by focusing more on renewable sources of energy. It can be concluded that the Institution is taking a great effort in energy conservation and management.

Based on the above finding few recommendations that the Institution can follow are:

4.5.2 Recommendations

- ❖Use of Solar power to run the STP as it can lead to decrease in the overall power consumption.
- ❖Utilize the full potential of built up area in the campus by installing more number of solar rooftop panels- as it can reduce up to 20% of power consumption from substations
- ❖Install more number of motion sensors especially in bathrooms to automatically turn off the lights when not in use.
- ❖Use of solar water heaters to run geysers in the Hospital and to meet other hot water requirements at the Hospital.
- ❖Observe a power saving day every week where in the Institution is run on minimal power with not so important Equipment's/ Air Conditioners /Lights in switch off mode as step towards conservation / reduction of energy consumption.
- ❖Use an all-in-one printer/scanner/copier instead of three separate power consuming devices

Figure 13: Windmill in the campus

Figure 14: Solar cells on roof top

Figure 15: Roof top Solar Panel

Figure 16: Solar powered walk way

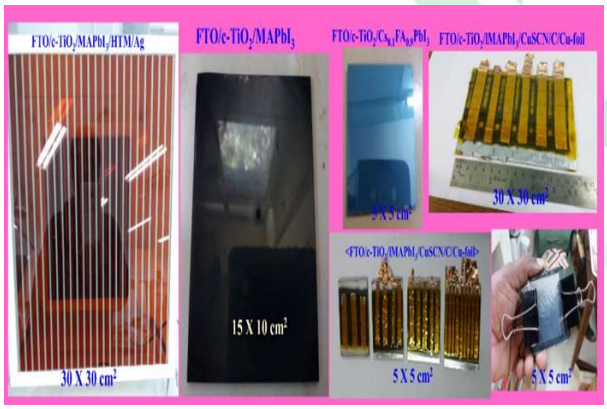


Figure 17: Large area Pervoskite Solar Cells

Figure 18: Solar panels with controller

CHAPTER 5

WASTE AUDIT

5.1 Introduction

A waste audit is a methodically thought out process which is used to determine the amount and types of waste that are generated by an Institution. Information generated from the Waste Audit can help the Institution to determine how it can reduce the amount of waste that it generates and devise a better waste management strategy. In most Institutions, cardboard, paper, plastics, tetra packs, metals and food constitute the majority of what goes into the garbage as Solid waste. Solid wastes may include both organic and inorganic waste materials produced by various activities in the Institution. Solid wastes have the potential to pollute all the vital components of living environment - air, land and water. Regardless of the origin, content, or hazard potential, solid waste must be managed systematically to eliminating adverse impacts of waste materials on human health and the environment. The solid waste management is a critical aspect of environmental hygiene hence it clearly indicates the need for proper waste management by following the 3 Rs of waste management- Reduction, Reuse, Recycle.

5.2 Solid Waste

Solid waste often includes wasted material resources that could otherwise be channelized into better service through recycling and reuse. A number of processes are involved in effectively managing waste generated in an Institution. These include monitoring, collection, transport, processing, recycling and disposal. Proper solid waste management in the campus reduces or eliminates the adverse impact on the environment. Thus the minimization of solid waste being generated and their effective management is essential for maintaining a sustainable environment inside the campus.

The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems. It is therefore essential that any environmentally responsible Institution examine its waste processing practices.

5.2.1 Key Methodology adopted for Solid Waste Audit

1. Base Line data were collected by distributing online questionnaire through Google form to the students and staff and also by conducting interviews among the staff
2. A walk through survey of the entire facility was conducted to identify various waste generation points and to estimate the quantity of waste generated.
3. The walk through survey and base line data collection was carried out between 29th - 31st March 2021
4. Based on the observation, the waste was categorized into different types and the current waste management, recycling and disposal systems were analyzed and suitable recommendations were suggested for adhering to 3R s (reduce, reuse, recycle) of waste management strategy.

5.2.2 Solid Waste Survey

1. Does the Institution generate any waste? If so, what are they? How much quantity? Number/weight.
   - ❖ Paper Waste
   - ❖ Plastic Waste
   - ❖ Metal Waste
   - ❖ Glass Waste
   - ❖ Organic Waste
   - ❖ Bio-Medical Waste
   - ❖ E- Waste
   - ❖ Hazardous Solid Waste
   - ❖ Others(Specify)
2. What is the approximate quantity of waste generated per day?(In Kilograms)
3. Why waste is a problem?
4. Whether waste is polluting ground/surface water? How?
5. Whether waste is polluting the air around the campus?

6. Is there any waste treatment system in the Institution? Methods
    - ❖ Composting
    - ❖ Recycling
    - ❖ Reusing
    - ❖ Others(specify)
7. How many separate boxes do you think you would need to put into a classroom to start a waste segregation and recycling campaign?
8. What should be the use for each box?(Develop a color code with reasons)
9. Do you use recycled paper in Institution?
10. Is there any waste wealth program implemented in the Institution?
11. How would you spread the message of recycling to others in the community? Have you taken any initiatives? If yes, please specify.
12. Is there any zero garbage policy followed in the Institution? (Reduce, Recycle, Reuse, Refuse)
13. What is the total strength of students, teachers and Non- teaching staff in the Institution?
14. Which of the following are found near the Institution?
    - ❖ Municipal dump yard/Garbage heap
    - ❖ Sewer line/stagnant water/Open drainage
    - ❖ Presence of Bus station/Railway station/Industry
    - ❖ Market/shopping complex/public halls

5.2.3 Solid Waste Audit-Key Findings

- ❖ Paper Waste like Newspaper, Magazines, Card Board, Box Board were disposed by selling it to vendor in exchange of recycled papers.
- ❖ Plastic waste like milk covers, plastic covers were segregated at the source and was disposed by selling it to the vendor

- Other Solid waste like clothing, tetra cups, dried leaves were disposed by giving away to Corporation
- Food wastes generated in the canteen and mess were disposed by giving away to Pig farm as feed to pigs which falls under highest strata of waste reduction strategy as per the Solid Waste Management Hierarchy. The average quantity of food waste generated 41250 kg/ year.
- Laboratory Wastewater was sent directly to STP for further treatment.
- Glass waste generated was recycled and reused, non- recyclable glass waste was given to Corporation.
- The average quantity of biodegradable wastes generated (Paper, dried leaves, vegetation, garden waste, except food waste was 804 kg/year.
- Worn out flowers used for decoration and paying homage to memorial of Col Dr Jeppiaar was converted to Incense Sticks

Table 21: Various Types of Waste Generated

Type of Waste	Quantity	Disposal Mechanism adopted
Paper Waste , tea cups, tetra packs, juice bottles	Collected in bin of 4.5 * 3.5*3.5 - 6 such bins get filled in three days	1)Of the total waste collected 1-3% is recycled through recyclers who take recyclable papers and return A4 sheets in return of 50% lesser weight 2) Other wastes are being collected by Corporation vehicles once in three days; which can be accounted as one bin.
Plastic Waste	Major quantum is diverted to architecture department for sustainable building research	Remaining wastes were given away to corporation along with paper waste

Metal Waste : Steel chairs, scrap cupboards, racks	In 2020-2021 Metal racks-3 Steel cupboards-20, Plastic chairs :50 Wooden tables : 50 Wooden racks :30	Metal waste generated was disposed by selling to Scrap dealers
Food Waste including vegetable/fruit peels, waste food	100 to 150 kg per day	Food waste was diverted to pig farms as feed for pigs

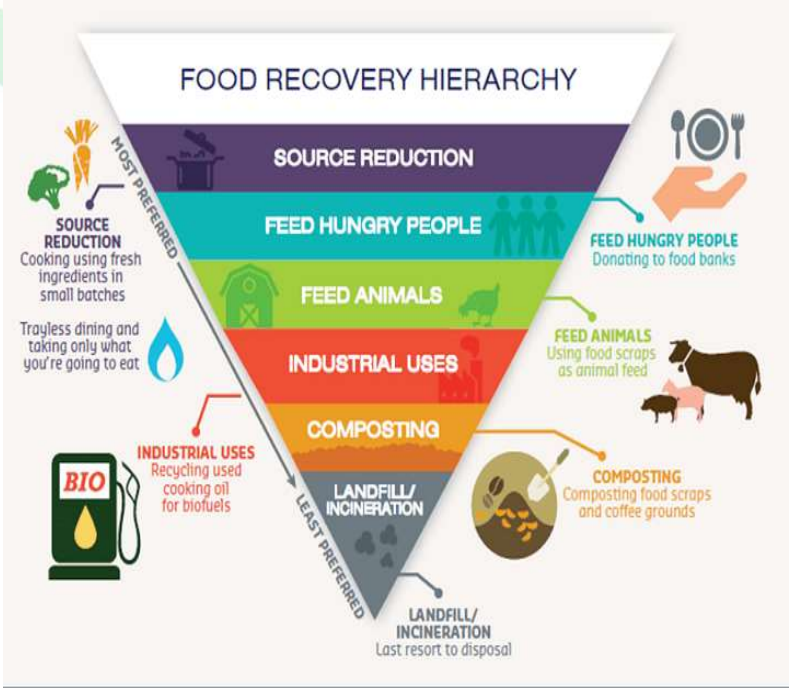


Figure 19: Food Waste Management Hierarchy

5.2.4 Solid Waste Audit-Evaluations and Recommendations

Solid wastes generated in the Institution comprised of both organic and inorganic waste materials produced by various activities in the Institution. These wastes have the potential to pollute all the vital components of living environment - air, land and water. Waste audit involved the assessment of the waste generated by the Institution and also identified the source and amount of waste that is generated and disposed. The waste audit was used as the baseline data to determine priorities and establish waste reduction recommendations. Thus waste audit was a valuable step in managing an organization's waste in a more environmental friendly manner, while helping in the reduction of waste disposal costs.

Waste audit was extensively done for the Sathyabama Institute of Science and Technology and the Audit findings are as follows:

Best Practices Observed in the Institution –Solid Waste Management

- Segregation of waste at the source was done-such Segregation was carried out in each and every building in the campus
- Disposal of waste into color coded bins
- Recycling of Paper Waste
- Diversion of Plastic Waste to architecture department for sustainable building research
- Diversion of Food Waste including vegetable/fruit peels, waste food to Pig farms as feed, which is one of most preferred form of disposal of food waste management
- Technology Development for conversion of food waste to organic pots
- Technology Development for conversion of used up ornamental flowers to Incense Sticks
- Technology development for conversion of organic waste into electricity
- Technology Development for production of organic sanitary pads
- Smart Compost development from solid waste
- Generation of Biodiesel from Waste Cooking Oil to Run Biodiesel powered buses
- Technology Development for Generation of Bio diesel from Waste Cooking Oil to run the pump sets for farmers

- Production of Eco Friendly soap from waste cooking oil
- Students prepared paper bags and distributed to various shops in exchange for plastic bags to create awareness on the detrimental effects of plastic bags.
- Students made an eco-market by making products out of recycled waste products.
- Eco club students conducted a workshops on making useful things from waste pet bottles, paper, glass, cardboards, ice cream sticks etc.
- Students cultivated Mushrooms and Ladies finger in waste pet bottles
- Girl students were exclusively called upon to make value added and fashionable products from waste scraps, and those were shelved for sale.

5.2.4.1Consolidation of Solid Waste Audit Findings-Evaluation

The solid waste audit was conducted in Sathyabama Institute of Science and Technology in three stages: pre-audit, on-site audit and post-audit follow-up. The waste collection system is a fundamental part of an efficient and cost-effective waste management system. The audit reviewed how the waste materials are managed throughout the campus and how waste moves from its generation points to the loading/ disposal point. The team did 'walk through survey and examined various buildings, visually identifying solid waste generation point, disposal point and recycling practices followed.

In the Institution, general wastes are generated from the Garden, Mess, College, Hostel, Sweeping areas, Kitchen, Laboratories, Stores sections etc. The source segregation of the waste from the entry level at each stage was done. In each and every block like administrative areas, classrooms, cafeterias, library as well in each and every room in both the boys and girls hostel were provided with the color coded bins. In the campus verandas, drums are kept for the collection of waste. Large trolleys are operated by the each section for the collection of waste from their source to transport it the disposal point.

The data compiled during the audit included quantity and composition information. It was found that the largest component in the solid waste stream is compostable materials – making up to 90 per cent. The break-up of the composition of the biodegradable waste generated shows that food waste represents the largest proportion and is around 80%. The second largest fraction of biodegradable waste is mixed paper waste accounting to nearly 7%. The garden and other

organic waste accounts to 2% and 1% of total biodegradable waste, respectively. Composite plastic represents 6% of the non-biodegradable waste stream by weight. Metal and glass wastes constituted 2% of non-biodegradable wastes, each.

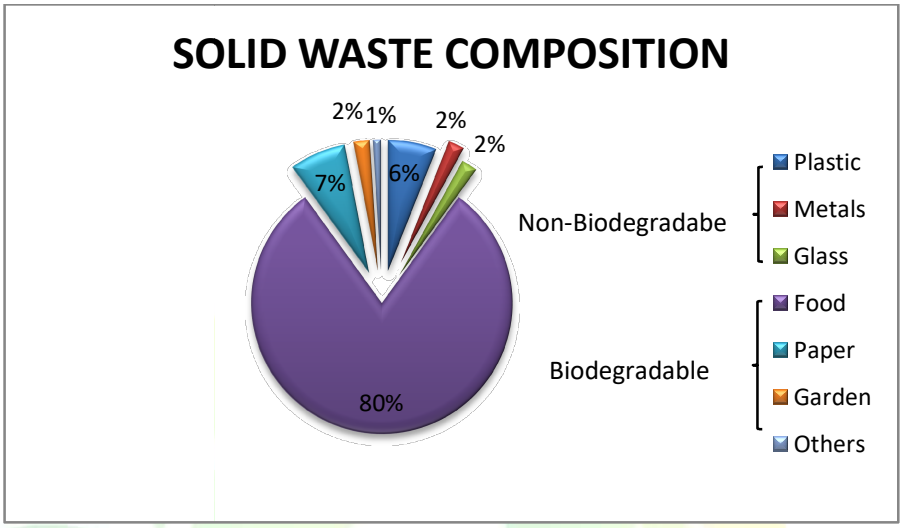


Figure 20: Solid waste composition of the Institute

Food waste formed the largest portion of solid waste generated in the campus. The food waste category consisted primarily of leftover cafeteria waste. The Food waste generated at the cafeteria was given to the pig farms on a daily basis, which is one of most preferred form of disposal in food waste management hierarchy. Paper and cardboard represented a large percentage of the solid waste generated in Institution. This can be justified as this is a general trend seen across all the academic Institution. The mixed paper waste was composed of office paper, newspaper, cardboard paper, white paper, paper plates etc. These were sold to a recycler who recycled these paper waste and A4 sheets were given to the Institution in return.

The composite plastic waste generated was diverted to Architecture department for sustainable building research activities and few left out waste was given away to Corporation. Few plastic bottles, plastic covers, cans, broken glass wares, tins were recycled for planting saplings and also to create decorative items to be displayed in the campus. The Institution is also developing technology for conversion of food waste to organic pots, for generation of electricity from organic waste, for smart Compost development from solid waste. Metal waste generated in the campus is sold to scrap dealers who further recycles and reuses it for various purposes. So metal recycling is happening, this represents a significant volume of material diverted from landfill.

Few key operational staff was interviewed to obtain further insight into new technologies developed by them to covert waste to useful products. It was noted that the Institution developed a trans-esterification process to generate biodiesel out of waste cooking oil. These biodiesel generated was blended with conventional fuel to run buses and generators. The Institution has also developed technology for development of Incense Sticks from waste ornamental/ ritual flowers and also developed the technology for production of organic sanitary pads. This knowledge was imparted to rural women of the villages adopted by Sathyabama Institute. This provided a means of livelihood for these rural women. This initiative was recognized by the Government under Unnat Bharat Abhiyan Scheme.

The current waste management strategies implemented by the Institution were fully evaluated during the audit process. It can be concluded that the Institution has well-established solid waste reduction, management and recycling programs and the Institution is highly successful in executing waste reduction and recycling strategies. There seems to be a balance between quantum of waste being generated in the campus and the quantum being recycled, reused and disposed. The solid waste data illustrates that overall quantum of the waste generated in the year 2020-21 was lesser than the previous year as the Institution was only partly functional due to Covid-pandemic.

In order to further its progress towards waste minimization few recommendations are given below:

5.2.4.2 Recommendations

- Install Composting plant to compost organic waste like coffee mud, tea waste, vegetable cuttings, dried leaves generated in the campus that can't be diverted to pig farm. The energy so generated can be diverted to power the kitchen and the compost generated can be used as a fertilizer. This can further reduce the dependence on conventional power and artificial fertilizer.
- Aim to achieve zero garbage policy which refers to producing, consuming, reusing and recycling products without throwing anything away.
- Encourage students and staff to donate used good like clothes, electronic items, books and frequently conduct such donation camps.

Figure 21: Biodiesel from kitchen waste

Figure 22: Decorative item using plastic waste

Figure 23: Organic pots made from food wastes

Figure 24: Generator run on biodiesel

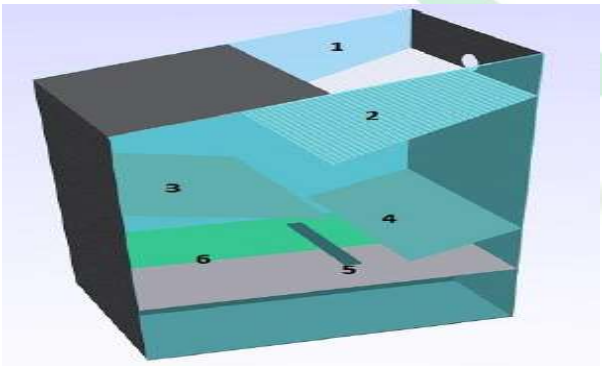


Figure 25: Automatic smart waste segregator

Figure 26: Eco friendly soap from waste cooking oil

5.3 Biomedical Waste Audit

Biomedical waste is any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological. Medical care is vital for our life and health, but the waste generated from medical activities represents a real problem of living nature and human world. Improper management of waste generated in health care facilities causes a direct health impact on the community, the health care workers and on the environment. Every day, relatively large amount of potentially infectious and hazardous waste are generated in the health care hospitals and facilities. It is of at most importance that biomedical waste is managed in an environmentally sound manner with proper scientific disposal method being followed during proper segregation, storage, handling, treatment and disposal of biomedical waste. Proper management of Biomedical waste (BMW) generated in a healthcare facility is one of the most important responsibilities of the Institution.

The auditor analyzes whether biomedical waste management practices were satisfactory and in accordance with BMW rule 2016.

The auditor diagnoses the prevailing Biomedical waste are segregated at source and put in color coded bags as per Schedule I of BMW RULE 2016 and sealed before giving it to Common Biomedical Waste treatment facility for treatment, processing and disposal. The auditor also looks into the fact whether the awareness on biomedical waste segregation, management and disposal amongst the doctors and the paramedical staff are adequate. The auditor will suggest the methods to be followed while disposing the Biomedical waste and record to be maintained in the Institution.

5.3.1 Key Methodology adopted for Biomedical Waste Audit

1. Base Line data were collected by online questionnaire through Google form to the students and staff also by conducting interviews among the staff.
2. A walk through survey was done for assessing the knowledge of doctors and paramedical staff regarding biomedical waste handling and management.

3. A walk through survey was done for observing the real time practices of the biomedical waste management in the various departments of Dental College and Hospital and to formulate details of Biomedical waste (infectious and non-infectious) being generated.
4. The walk through survey and base line data collection was done on 6th April 2021
5. Based on the observation and surveys, analysis was done to see whether Biomedical Waste Management Rules were followed and suitable recommendations were also suggested.

5.3.2 Bio Medical Waste Audit-Survey/Questionnaire

1. Whether Bio medical waste are segregated at source and put in color coded bags as per Schedule I of BMW RULE 2016? Is Color coding practiced?
2. Whether Performa of the label used on container/bag?
3. How much waste is generated per day/week/month/year?
4. Whether the Standard for treatment and disposal of waste is been followed?
5. Whether there is any mixing of general waste with bio-medical waste?
6. Is there adequate awareness on biomedical waste segregation, disposal, effect and management amongst the doctors and the paramedical staff?
7. Whether the workers involved in the biomedical waste handling were provided with gloves, face mask and head cap?
8. Is there Pre-treatment of the laboratory waste, microbiological waste, blood samples, and blood bags through disinfection or sterilization on-site in the manner as prescribed by WHO or NACO ?
9. Whether the liquid waste generated from health care facilities pretreated before mixing with other wastewater?
10. Whether training to all its health care workers and others, involved in handling of biomedical waste at the time of induction and thereafter at least once every year?
11. Whether Regular checkup of Healthcare workers are conducted?

12. Whether health care workers and others, involved in handling of bio-medical waste are given immunization for protection against diseases that are likely to be transmitted by handling of bio-medical waste?

5.3.3 Biomedical Waste Audit-Key Findings

Sathyabama Dental College and Hospital established in 2009 is an autonomous Institution affiliated to Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India. The Institution has gained an unsavory reputation and has been accredited by the National Assessment and Accreditation Council (NAAC) with 'A' grade.

Sathyabama Dental College and Hospital has 18 functioning departments and has its own pharmacy. These departments are under the supervision of 60-90 doctors and 20-35 paramedical staff. The total numbers of patients coming to have treatment are about 150-250 per day.

Sathyabama Dental College and Hospital is using color coded bins for all types of Bio Medical Wastes being generated.

GJ Multiclave (India) Pvt. Ltd Adyar, Chennai is the authorized recycler who collects the biomedical waste being generated in the Institution for further treatment and disposal.

Table 22: Generation of waste (infectious and non-infectious) in different departments of Sathyabama Dental College and Hospital

Source of BMW	Types Of Waste Generated	No Of Person Involved In Waste Handling
Department of oral maxillofacial pathology	Sharps, body fluids, Discarded medicine	>5
Department of public health dentistry	Gloves, mask, washed water	+2
Department of oral medicine and Radiology	Gloves ,mask, instrument pouches	3

Department of oral maxillofacial surgery	Sharps, outdated Medicine	2
Department of prosthodontics and implantology	Plaster of paris, Alginate	4
Department ofPedodontics	Cotton, gloves, needles, bandages	2
Department of Conservative dentistry and endodontics	Soiled cotton, needles, syringes, amalgam	4
Casualty	Sharps, plastics container , anatomical organs	2

Colour Coding of Biomedical Waste

- **Yellow-**Human &Animal Anatomical Waste, Discarded Chemicals, Chemical Waste, Lab Waste
- **Red-** Contaminated Waste (Recyclable) – Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (syringe without needle)
- **Blue**-Broken or discarded and contaminated glass vials including medicine vials and ampoules
- **White**-Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades.

Table 23: Quantity of Bio-Medical waste generated

Years	Red			Yellow			Blue		
	Avg/ day	Avg/ Week	Avg/ month	Avg/ day	Avg/ week	Avg/ Month	Avg/ Day	Avg/ week	Avg/ month
2020	3.75	26.25	112.5	2.25	15.75	67.5	1.75	12.25	52.5
2021	3.25	22.75	97.5	2	14	60	0.5	3.5	15

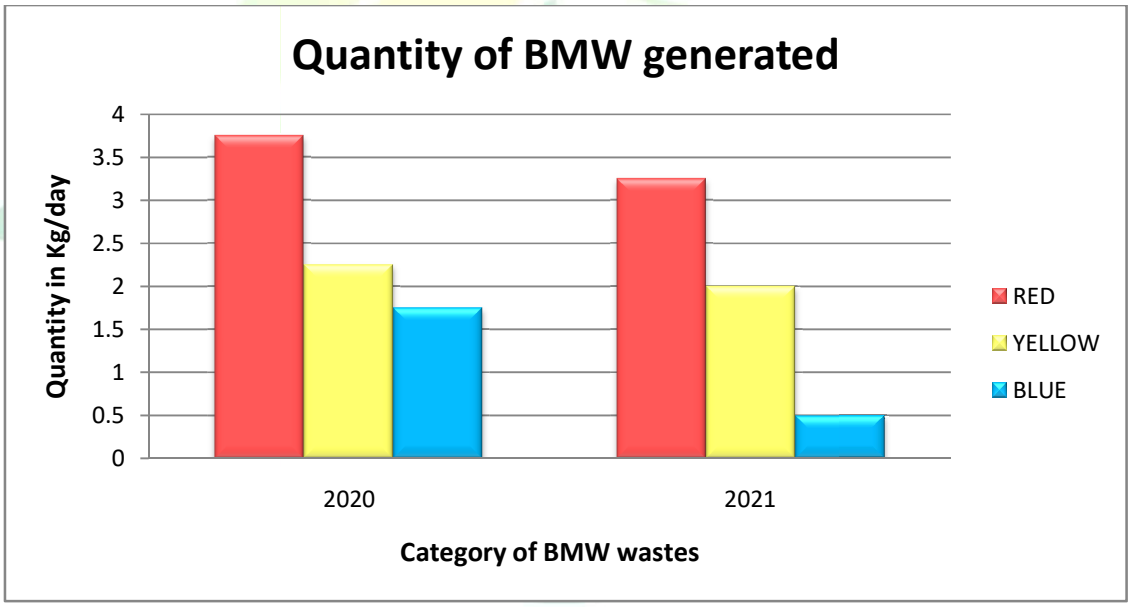


Figure 27: Quantity of BMW generated in the Institute

5.3.4 Biomedical Waste Audit-Evaluations and Recommendations

Biomedical wastes generated from Dental College and Hospital are potentially hazardous, toxic and highly infectious because of their high potential for disease transmission. Indiscriminate disposal of such waste can pose health risk to human population, especially to health care personnel, sanitary workers and students in and around the campus. Audit was done to see if biomedical wastes are managed with at most importance in an environmentally sound manner.

Audit was done to analyze whether proper understanding of risk associated with the disposal of such waste exist among the staff. Audit was done to analyze the level of awareness about proper segregation, storage, handling, and disposal among staffs and doctors.

Biomedical Waste audit was extensively done for the Sathyabama Institute of Science and Technology and the Audit findings are as follows:

Best Practices Observed in the Institution –Biomedical Waste Management

- Biomedical waste are segregated at source and put in color coded bags
- Compliance with the BMW Management Rules, 2016
- Sealing of the color coded bags before giving it to Common Biomedical Waste treatment facility for treatment processing and disposal
- Adequate awareness level amongst the doctors and the paramedical staff on biomedical waste segregation, disposal and management exist.
- Records of the Biomedical waste generation is maintained
- The Institution has its own General hospital and Dental Hospital that offers free of cost medical treatment to its students, staff and their family members
- General Hospital and Dental College of Sathyabama University conducted vaccination camps, blood donation camps, and dental camps.
- General hospital and Dental Hospital offers medical treatment to nearby community at a very reasonable rate.
- Mobile health monitoring facility is run by the Institution and conducts regular health checkup for the members of its adopted villages.
- Psychological counseling is offered on a regular basis to its students to reduce the stress of students and to help them not to fall into depression
- Medical camps are held regularly in the college campus as well as in the adopted villages and the schools
- The Institution has signed MoU with various Universities and Hospitals to strengthen research partnership and to collaborate in various researches.

- The Hospital conducted Corona- vaccination drive in two phases which was open to local people.
- The Institution provided both the doses of Corona-vaccination to its staffs to ensure their safety
- The institution is maintaining separate bins for the collection of infectious waste and Covid-related waste

5.3.4.1 Consolidation of Biomedical Waste Audit Findings-Evaluation

Sathyabama Institute of Science and Technology has its own Dental College and Hospital with 18 functioning departments and own pharmacy. The Hospital has nearly 100 beds the various departments are under the supervision of 60-90 doctors and 20-35 paramedical staff. This Dental College and Hospital are the main source of Biomedical Waste Generation. The average quantity of biomedical waste generated is2434kg/year.

For conducting BMW audit, audit sheet consist of checklist containing several parameters related to various aspects of BMW management like segregation, collection, storage and transport of biomedical waste was prepared. This study was aimed to generate quantitative data from audit sheet and analyse the different aspects of biomedical waste management in the Institution. These audit sheets helped to evaluate the biomedical waste management practices and to take appropriate action to achieve improvement in different steps of BMW management.

Various factors that were analysed were cleanliness in waste storage area, availability of colour coded waste bins, whether waste bins are lidded and foot operated, whether expired and cytotoxic drugs were segregated according to BMW rule 2016, whether BMW register maintained and updated on a regular basis, availability of monthly record of BMW generated in terms of category as specified in BMW rule 2016, level of awareness among Doctors and staff.

The BMW waste generated in the Hospital and Dental College segregated into colour coded bags and sealed before handing over to the authorized handler. Score for availability of colour coded bins and proper segregation of waste was 96.6% which was satisfactory. This shows that this aspect of waste management is appropriately addressed.

Segregation score in white category bag is relatively less as compared to other categories which indicates that still more focus has to be laid down regarding proper segregation of sharps. Score for 'Cleanliness of waste storage area' was 94.3%. The person handling BMW had proper PPE, masks, gloves and bags were labelled with duly filled up information and stickers, so score for this section was significantly high around 96.2%. PPE were made available to waste handlers as well as they were adequately trained regarding importance of using PPE as they were at greater risk of acquiring infections especially during Covid times. So this section scored around 97.3%.Induction training program on BMW management and immunisation are done regularly for the healthcare workers as specified under BMW rules 2016. As a result score for these parameters are excellent. The Doctors and the staffs in the Hospital and Dental College are well aware of the safe handling and disposal methods of Biomedical Waste. Score for level of awareness among Doctors and staffs were 95.9%.Biomedical Waste so generated was handed over to authorized handler at periodic intervals as mentioned in the BMW Management Rules, 2016 for further treatment and disposal. Hence the overall mean percentage score for BMW management in Dental College and Hospital was 96.8%.

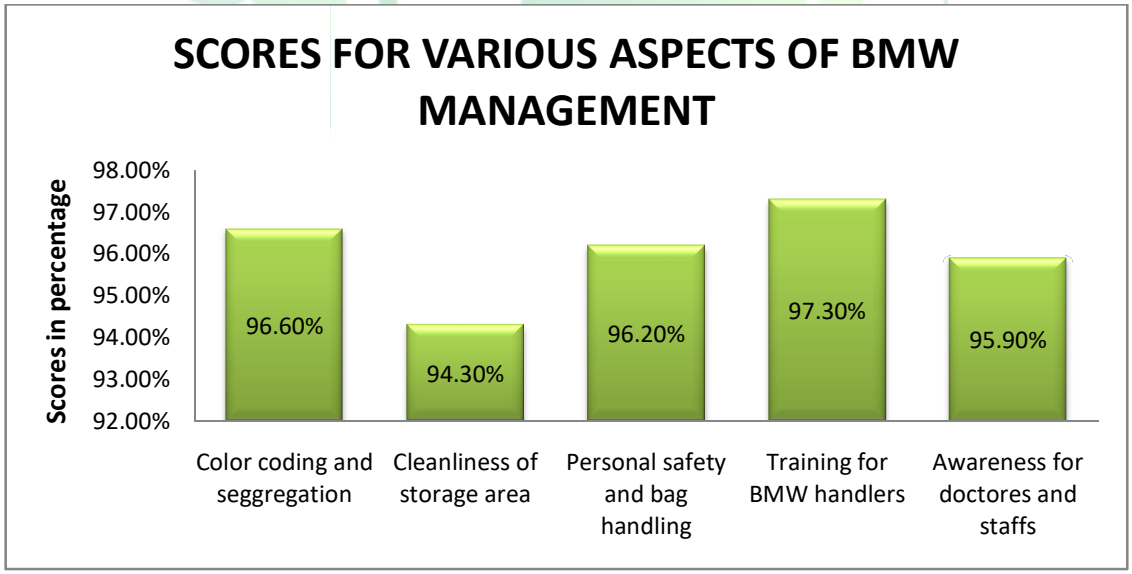


Figure 28: Scores provided for various aspects of BMW management at hospital

Based on the above finding few recommendations that the Institution can follow are

5.3.4.2 Recommendations

- ❖ Phase-out the use of chlorinated plastic bags, gloves, and blood bags as soon as possible (as per BMW Management Rules, 2016)
- ❖ Pre-treatment of the laboratory waste, microbiological waste, blood samples, and blood bags through disinfection or sterilization n-site in the manner as prescribed by WHO or NACO needs to be done
- ❖ Treatment of liquid waste generated from health care facilities due to use of chemicals in production of biological and used or discarded disinfectants, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, housekeeping and disinfecting activities etc. shall be pretreated before mixing with other wastewater.
- ❖ Maintain separate bins for the collection of infectious waste and Covid-related waste
- ❖ BMW register should be maintained and updated on day to day basis
- ❖ During increased patient load during Covid time ensure there is adequate PPE, mask and gloves for the staff and Doctors
- ❖ In case of a major accident, report the same along with the remedial action taken and make it available during inspection.
- ❖ Maintain monthly record of BMW generated in terms of category as specified in BMW management Rule 2016.

Figure 29: Colour coded dustbins

Figure 30: Color coded bags

Figure 31: Audit at Dental College and Hospital

Figure 32: Team leader at hospital during site visit

Figure 33: Doctors with PPE for attending Covid patients

Figure 34: Covid wastes- masks and gloves

5.4 E -Waste Audit

E-Waste can generally be defined as any electrical powered appliance that has reached its end-of-life. Electronic waste or E-waste is generated when electronic and electrical equipment become unfit for their originally intended use or have crossed the expiry date. Computers, servers, mainframes, monitors, compact discs (CDs), printers, scanners, copiers, calculators, fax machines, battery cells, cellular phones, TVs, iPods, medical apparatus, refrigerators, and air conditioners are the general type of E-Waste generated in the campus. E-waste consists of toxic elements such as Lead, Mercury, Cadmium, Chromium etc. The unscientific disposal of E-Waste can generate a threat to the environment as well as to human health. Due to the presence of these toxic substances in E-Waste, recycling and disposal of E-Waste becomes an important issue. The Institution themselves can be the key players in management of E-Waste if they follow initiatives such as Extended Producer Responsibility (EPR); Design for Environment (DfE); Reduce, Reuse, Recycle (3Rs), technology platform for linking the market facilitating a circular economy aiming correct disposal of the e-waste, with increased reuse and recycling rates, and adopt sustainable consumer habits.

The auditor will analyze whether E-waste generated is channelized through authorized producer or dismantler or recycler. Auditor will also diagnose whether the records of E-waste generated are maintained as per Form-2 and whether such records are produced for scrutiny by the concerned State Pollution Control Board. Auditor will ensure that all steps are taken to manage the E-waste in a manner which shall protect the health and environment against any adverse effects.

5.4.1 Key Methodology adopted for E-Waste Audit

1. Base Line data were collected by distributing online questionnaire through Google form to students and staff and also by conducting interviews among staffs.
2. A walk through survey was done for assessing the types of E-Waste being generated, for quantification of E-waste Generated, for analyzing the existing E-waste Management Strategy in the Institution, for analyzing whether Extended Produce Responsibility is being followed in the Institution.

3. Walk through survey and base line data collection was done on 7th April 2021
4. Based on the observation and surveys, analysis was done to see whether E-Waste Management Rules were followed and suitable recommendations were also suggested

5.4.2 E-Waste Audit-Survey/Questionnaire

1. What the Institution does with electronic/electrical products that are no longer in use?
2. What the Institution does with broken electronic/electrical products?
3. How many electronic/electrical products does the Institution purchase a year?
4. On average, how many electronic/electrical products does the Institution choose to repair in a year?
5. Awareness about E-waste Laws among the students?
6. Awareness about what happens to E-waste if not recycled through proper channels?
7. What is the approximate quantity of E-waste generated per day?
8. Whether E-waste generated by them is channelized through authorized producer or dismantler or recycler?
9. Whether records of e-waste generated are maintained in Form-2?
10. Whether end-of-life electrical and electronic equipment are admixed with e-waste containing radioactive material?
11. Whether the annual returns are filed in Form-3, to the concerned State Pollution Control Board?

5.4.3 E-Waste Audit- Key Findings

- Sathyabama Institute being an educational Institution will fall under the category of Bulk Consumer as per E-Waste Management Rules 2016.

- Main source of E- Waste in the campus includes used Electric/ Electronic equipments like Laptops, PC, desktops, monitors, circuit boards, old mobile phones, printers, scanners, damaged electrical/electronic equipments used in the laboratories etc.
- Nearly one tonne of E-Waste is being generated in an year in the Institution which is sold to the recycler and generating a revenue of 3 lakhs per annum
- M/S Earth Sense Recycle Pvt Limited ,Chennai is the authorized recycler who collects the E-waste being generated in the Institution for further dismantling, recycling and disposal
- Name & Address of authorized collection centre /dismantler/recycler / refurbisher who collects E- waste from the Institution is --M/S Earth Sense Recycle Pvt Limited, Thenmelpakkam Village, Chengalpattu, Chennai
- Major types of E Waste generated in the campus are batteries- nearly 2400 to 2500 batteries are are used in the UPS units across the Institute. These batteries are refilled frequently. Old batteries are exchanged upon replacement of new batteries.
- Other e-waste generated in the campus includes A/C, Laptops, Desktops, Tab, Old Phones, Damaged Laboratory Equipments, Switch Boards and Circuits, Printer and Scanner Scraps, Tubes and Bulbs, etc.
- Earlier 500 new systems were bought in a year and nearly 200 old systems were getting repaired.
- Extended producer responsibility is been followed for equipments like batteries and UPS.

Table 24: Various Pollutants present in E-Waste generated in the Campus

Pollutant	**Occurrence**
Arsenic	LEDs (light emitting diodes), Solar cells
Lithium	Mobile telephones, Photographic equipments, Video equipments, Batteries
Mercury	Batteries in Clocks and Pocket Calculators, Switches, LCDs

Nickel	Batteries, Semiconductors
PCBs (poly chlorinated biphenyls)	Transformers, Capacitors,
Selenium	Photo Copiers, Fax Machines
Silver	Capacitors, Switches (contacts) batteries, Resistors
Zinc	Disposable and Rechargeable Batteries
Cadmium	Computer Batteries, Monitor,
Lead	Lead Reachable Batteries, Solar, Transistors, LEDs, Thermo Electrical Elements, Circuit Boards

5.4.4 E-waste Audit- Evaluations and Recommendations

The existing practices of E-waste management in India suffer from quite a few disadvantages like appropriate inventory, unhealthy conditions of informal recycling, inadequate legislation, poor awareness, dumping of E-Waste. These results in toxic materials entering the waste stream causing adverse effects on the environment and human health and wasting recoverable valuable by-products. The audit attempts to analyse the level of awareness about E-Waste generation, storage, disposal, environmental and health concerns among the members of the Institution. The audit was done to analyze whether E-waste management rule is followed and whether Extended Producer Responsibility (EPR) is implemented in the campus. The audit was done to analyze whether Institution has safe storage area for storing the e-waste before its disposal.

E-Waste audit was extensively done for the Sathyabama Institute of Science and Technology and the audit findings are as follows

Best Practices Observed in the Institution -E-Waste Management

- Effort to utilize the Extended Producer Responsibility
- Use of reusable resources in all possible areas
- E-Waste generated is channelized through authorized recycler for treatment, dismantling and disposal
- Compliance with the E-Waste Management Rules 2016
- Adequate efforts put in to ensure that no damage is caused to the environment during storage and transportation of the E-Waste
- The Institution signed MoU with VANSCHEMISTRY PVT. Ltd., an E-Waste Management Company for teaching students the safe dismantling of E-Waste. Also there is a proposal to establish a dismantling facility in the Institution for knowledge transfer.
- The Institution along with VANSCHEMISTRY PVT. Ltd. are planning to jointly develop a technology in handling the hazardous e-waste by translating the preliminary work done on recovery of Mercury from Compact Fluorescent Lamps part from establishing an E-Waste Collection hub.
- Institution is conducting periodic awareness programs for safe dismantling of E-Waste

5.4.4.1Consolidation of E-Waste Audit Findings-Evaluation

Main source of E- Waste in the campus includes used Electric and Electronic equipments like Laptops, PC, desktops, monitors, circuit boards, old mobile phones, printers, scanners, damaged electronic equipments used in the laboratories etc.

Recycling is the key to reduce the e-Waste. Recycling has environmental benefits at every stage in the life cycle of an electronic product-from the raw material from which it is made to its final method of disposal. Apart from reducing greenhouse gas emissions, which contribute to global warming, recycling also reduces air and water pollution associated with making new products from raw materials. The Institution is well aware of this fact and has entered into an agreement with a recycler to recycle the E-Waste generated in the campus. E-Waste is generated from

various Department/Schools especially electric and electronics department, Mechanical department, IT department, Administrative Building. Institution is generating nearly one tonne of E-Waste in a year which is sold to the recycler and generating revenue of nearly 3Lakhs from it. The recycler is in turn utilizing the unwanted or obsolete materials generated out of the E-Waste as industrial feedstock. This arrangement as a whole is helping to reduce the burden of E-Waste generated by the Institution. The Institution is adhering to EPR while buying electric/electronic items. The batteries and UPS are taken back by the vendor once it reaches its end of life.

The Institution has also signed MoU with VANS CHEMISTRY PVT. Ltd., an E-Waste Management Company for teaching students the safe dismantling of E-Waste. Also there is a proposal to establish a dismantling facility in the Institution for knowledge transfer. It can be concluded that the Institution is taking adequate efforts while handling the E-Waste especially while collection, storage, transportation and disposal of E-Waste.

Based on the above finding few recommendations that the Institution can follow are

5.4.4.2 Recommendations

- Records of E-waste generated shall be maintained as per Form-2 mentioned in E-Waste Management Rules 2016
- Ensure that electrical and electronic equipment are not admixed with e-waste containing radioactive material
- Maintain a record of collection, sale, transfer and storage of wastes and make these record available for inspection
- The E-waste storage area shall have separate containers for storage of batteries, capacitors containing PCBs (Poly Chlorinated Biphenyls) or PCTs (Poly Chlorinated Terphenyls)
- The E-waste storage area shall have water proof roofing and impermeable surface

CHAPTER 6

GREEN AUDIT

6.1 Introduction

Green Campus is an environment which improves energy efficiency, conserves resources and enhances environmental quality by educating about sustainability and creating healthy, living and learning environments. Achieving an Eco-friendly Green Campus is long term commitment to continuous environmental improvement from the campus community. Green college makes a point to account for sustainable living when designing and operating their buildings. Many of their facilities incorporate natural lighting, improve air quality, and reduce energy and water use. Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. Trees in a college yard improve air quality and can reduce temperatures with their cool shade. They are a small environmental investment that will pay dividends for decades to come. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. So while you are busy studying and working on earning those good grades, all the trees on campus are also working hard to make the air cleaner for us. Trees on our campus impact our mental health as well. Studies have shown that trees greatly reduce stress, which is a huge deal considering that many students are under some amount of stress. In this note, every educational Institution must conduct green audit as a form of self-assessment to reflect the role the Institution has been playing in mitigating the environmental impacts caused by its various activities.

6.2 Key Methodologies adopted for Green Audit

1. A walk through survey of the entire campus was done to observe the total area under green coverage, presence of marshy land, ponds and to identify various types of trees and plants.
2. The base line data was collected by distributing online questionnaire through Google form to the students and staff and also by conducting interviews among the staff.

3. Walk through survey and base line data collection was done between 8th -9th April 2021
4. Based on the findings, the total Green Coverage area in the campus was calculated and suggestions were given about better green management practices.

6.3 Green Audit-Survey/Questionnaire

1. Is there a garden in the Institution? Area?
2. Do students spend time in the garden?
3. List the plants in the garden, with approx. numbers of each species.
4. List the species planted by the students, with numbers.
5. Whether scientific names of the trees are displayed in the campus?
6. Is there any plantation in the campus? If yes specify area and type of plantation.
7. Is there any vegetable garden in the Institution? If yes how much area?
8. Is there any medicinal garden in the Institution? If yes how much area?
9. What are the vegetables cultivated in the vegetable garden? (Mention the quantity of harvest in each season)
10. How much water is used in the vegetable garden and other gardens? (Mention the source and quantity of water used).
11. Whether recycled water is used for gardening?
12. Whether organic farming is done in the Institution? How?
13. Is there any composting pit in the Institute? If yes what is being done with the compost generated?
14. Is there any student market in the Institute?
15. Give the number and names of the medicinal plants in the Institution campus.
16. Any threatened plant species planted/conserved?
17. Is there a nature club in the Institute? If yes what are their activities?

18. Is there any arboretum in the Institution? If yes details of the trees planted.
19. Is there any fruit yielding plant in the Institution? If yes details of the trees planted.
20. Is there any grove in the Institution? If yes details of the trees planted.
21. Is there any irrigation system in the Institution?
22. What is the type of vegetation in the surrounding area of the Institution?
23. What are the nature awareness programs conducted in the campus?
24. What is the involvement of students in the green cover maintenance?
25. What is the total area of the campus under tree cover? Or under tree canopy?
26. Share the IDEAS for further improvement of green cover.

6.4 Green Audit- Key Findings

Area under green cover is approximately 40469.445 sq.m and efforts are taken to increase the green cover by terrace farming, planting of saplings, roof top gardening, vegetable gardening etc. The Institution also has a marshy land area of 5120 sq.m. The various tree/plant/shrub species observed in the campus are listed below.

Table 25: Campus Trees

S.No	Tamil Names	Botanical Names
1	Pungai	*Millettiapinnata*
2	Neem	*Azadirachtaindica*
3	Thoongumoonjimaram	*Samaneasaman*
4	Like coconut-	*Cocosnucifera*
5	Idly poo	*Ixoracoccinea*
6	Savukku	*Casuarinaequisetifolia*
7	Badam	*Terminaliacatappa*
8	Hibiscus	*Hibiscus rosa-sinensis*
9	Jasmine/mullai	---

10	Coconut	*Cocosnucifera*
11	Australian babul plant	*Acacia auriculiformis*
12	Ashokamaram	*Saracaasoca*
13	Munkil	*Bambusoideae*
14	kagitha poo	*– Bougainvillea*
15	Tamanumaram	*Calophylluminophyllum*
16	Mayilkondraimaram	*Delonixregia*
17	Koyyamaram	*Psidiumguajava*
18	Kondraimaram	*Cassia fistula*
19	Elumiccai	*Citrus × limon*
20	Mhaliammaram	*Mimusopselengi*
21	Veppammaram	*Azadirachtaindica*
22	Badammaram -	*Terminaliacatappa*
23	Pungaimaram -	*Millettiapinnata*
24	Thoongumoonjimaram -	*Samaneasaman*
25	Perunkondraimaram -	*peltophorum-pterocarpum*

6.5 Green Audit-Evaluations and Recommendations

The environment where we live within is of utmost concern since it is directly related to the survival. Keeping it healthy is the responsibility of each and every individual. Green audit was done to analyze whether the Institution is taking adequate steps for protection and conservation of the environment in and around the campus. Green audit was done to analyze whether the concept of sustainable environment is adhered to while undertaking various construction and expansion activities in the campus.

The audit was done to suggest methods and practices that can be followed for environmental protection. During the audit, various trees and plant species were observed, and area under green coverage was analyzed to ensure that the campus conform to green standards. The audit was done to ensure that the practices followed in the campus are in accordance with the Green Policy recommended by NAAC.

Green audit was extensively done for the Sathyabama Institute of Science and Technology and the audit findings are as follows:

Best Practices Observed in the Institution –Green Campus Management

- Planting and caring of trees in and around the campus
- Various plantation drives involving the students were held in the campus
- Institution is maintaining Marshy Land in its natural form, thereby helping in Ground Water Recharge and even act as a habitat for the birds nearby.
- Eco-club developed an eco-farm in the Institution campus, for growing vegetables using organic fertilizers.
- Terrace garden was inaugurated at the Chemical Engineering Department
- Eco club along with Rotaract club of Sathyabama Institute arranged for a 100sq.ft.terrace garden in Administration building, International Research Centre, ECE Block, CSE Block, 14th classroom Block, Biotechnology Department and Chemical Engineering Department.
- Fifth phase of terrace gardening incorporated 'PET-bottle-watering method'
- Various seminar were conducted to give awareness about various gardening practices
- With the coordination of staffs and students at the Institution, students were demonstrated the scientific methodology for preparation of Bio Manure and organic pots
- Workshops were conducted to generate awareness regarding Vermi Composting practices, Carbon Credits and for generating Wealth out of Waste (WOW).
- Workshop on seed balls, a permaculture technique for growing seeds in an easy and effective way was conducted.

6.5.1 Consolidation of Green Audit Findings-Evaluation

The green audit was conducted in three stages-pre audit, onsite audit and post audit stage. Before visiting the Institute a set of questionnaires were circulated among the staff and students to gather information regarding the types of tress seen around the campus, their numbers, presence of any endangered species, any horticulture plantation in the campus etc. During on-site walk though survey presence of various species of plants and trees were noted along with their scientific name. Area under green coverage was calculated and various eco-friendly activities held by the Institution was noted.

During Green Audit it was observed that the Institution has green cover of 34,133 sq.m and Marshy Land of 5,120 m^2 area. This will help in absorption of pollutant and nullifying the GHG emitted in the campus. The Institution is maintaining Marshy Land having an area of 5,120 m2 undisturbed which will acts as a habitat for the aquatic birds and a source of drinking water to small animals and birds in the nearby area. This Marshy land also acts as a natural rain harvesting structure. The Institution is trying to increase the area under green cover by conducting various plantation drives involving the students. The Institution has an active Eco-Club that conducts various plantation drive, awareness programmes, seminars etc. Institution is also promoting terrace gardening by motivating the students to do gardening on the roofs of various building. The campus has several plant, tree and shrubs species that contribute to aesthetics and overall greening of the campus. The Institution is also conducting various seminars and workshops to give awareness about Vermi-Composting, seed balls, preparation of Bio-Manure, making of Organic pots. The Institution is also taking great effort to ensure knowledge transfer to the people of the villages that the Institution has adopted. This clearly displays the Institutions endeavour to exercise leadership in addressing the fundamental problems of resource exploitation, by reversing the trends of environment degradation, and in promoting sustainability and to become stewards of Mother Nature.

Based on the above finding few recommendations that the Institution can follow are-

6.5.2 Recommendation

- Form a Green Monitoring Forum. The priority of this forum is to exchange ideas about latest developments happening around the world with respect to maintaining a sustainable environment and implement the most feasible idea. The Green Monitoring Forum may consist of members from teaching staffs, non-teaching staffs, and students and if possible include some local interested people.
- Install Vermicomposting facility, the output of which can be used as manure for plantation purpose.
- Promote Indoor Gardening-Indoor plants are commonly used for their aesthetics benefits but they also have vital role reducing airborne pollution. The right choice of plants can be an excellent way of improving indoor air quality and general health. List of indoor plants are shown below.
- Prepare and maintain a Green Book of the campus where details of all the plants and trees available in the campus must be recorded along with their counts, so that any variations in the same can be evaluated periodically and necessary actions can be taken.

Figure 35: Garden at the institution

Figure 36: Trees along the campus road

Figure 37: Banana plantation at the Institute

Figure 38: Green coverage

Figure 39: Ariel view of roof top gardening

Figure 40: Ariel view of roof top gardening

CHAPTER 7

CARBON FOOT PRINT AUDIT

7.1 Introduction

Carbon Footprint is a measure of total quantity of greenhouse gases being emitted by an individual or an Institution as a result of its daily activities. Carbon Footprint tells the impact on the environment due to various activities inside the campus and quantifies the same in the form of total greenhouse gases being emitted. The most common greenhouse gases are carbon dioxide, water vapor, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 402 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. The question is what should be done to reduce carbon emissions. Many colleges want to reduce their carbon dioxide (CO2) emissions but it is a difficult task, given a range of factors determine carbon emissions, including mobility, waste, and energy consumption. So, gaining insight into CO2 emissions is extremely important. An important aspect of doing a carbon foot print audit is to account the carbon foot print of the campus by determining the net amount of greenhouse gas emitted from various activities in the campus so that the Institution can adopt better ways to reduce its carbon foot print. One aspect is to consider the distance travelled and mode of travel used to commute between home and Institution every day by the students and staffs. So the carbon foot print auditing determine the total carbon foot print of the campus and analyzes whether the campus is eco-friendly and follows environmentally sustainable practices. It is therefore essential that any environmentally responsive Institution shall examine its carbon footprint.

7.2 Key Methodologies adopted for Carbon Footprint Audit

1. A walk through survey was conducted in the entire campus to observe various greenhouse gas emission points.
2. Base Line data was collected by distributing online questionnaire through Google form to the students and staff also by conducting interviews among staff.

3. Walk through survey and base line data collection was done between was done between 12th-13thApril 2021
4. Based on the data collected, the Green House Gas Emission as CO2 Eq from the various sources was calculated.
5. Observation was done to see whether if the authorities have implemented any Carbon Footprint Reduction Strategy
6. Recommendations were given for further Green House Gas Emission Reduction strategy.

7.3 Carbon Footprint Audit-Survey/Questionnaire

1. What is the total strength of students and teachers in the Institution?
2. Total Number of vehicles used by the stakeholders of the Institution. (per day)
3. No. of cycles used?
4. No. of two wheelers used (average distance travelled and quantity of fuel and amount used per day)
5. No. of cars used (average distance travelled and quantity of fuel and amount used per day)
6. No. persons using common (public) transportation (average distance travelled and quantity of fuel and amount used per day)
7. No. of persons using Institution conveyance by the students, non-teaching staff and teachers (average distance travelled and quantity of fuel and amount used per day)
8. Number of parent-teacher meetings in a year? Parents turned up(approx.)
9. Number of visitors with vehicles per day?
10. Number of generators used per day (hours). Give the amount of fuel used per day.
11. Number of LPG cylinders used in the canteen (Give the amount of fuel used per day and amount spent).
12. Quantity of kerosene used in the canteen/labs (Give the amount of fuel used per day and amount spent).

13. Amount of taxi/auto charges paid and the amount of fuel used per month for the transportation of vegetables and other materials to canteen.
14. Amount of taxi/auto charges paid per month for the transportation of office goods to the Institution.
15. Average amount of taxi/auto charges paid per month by the stakeholders of the Institution.
16. Use of any other fossil fuels in the Institution (Give the amount of fuel used per day and amount spent).
17. Suggest the methods to reduce the quantity of use of fuel used by the stakeholder's /students/ teachers / non-teaching staff of the Institution.

7.4 Carbon Footprint Auditing-Key Findings

Feasible emission inventories were selected to analyze the carbon footprint of the campus. The inventory survey was done for one academic year. The selected inventories are Human Factor, Transportation, Electricity, Solid Waste, Production and Consumption of Food, LPG & Natural Gas.

Data keepers are identified and the primary details were collected. Parameter wise and zone wise details were also collected. The received data were assembled and the missing gaps were recognized.

7.4.1 Human factor

Carbon dioxide emitted by a person per day is not negligible. It is equivalent to the emission of a car in a 5km stretch. Humans emit 26 giga tons of carbon dioxide per year while CO_2 in the atmosphere is rising by only 15 giga tones per year. Just for breathing, humans emit per person each day 1140 grams of CO_2, assuming that they eat normally and follow a mean diet of 2800kcal.

The population details of each zone include the total number of teaching faculty; non-teaching staff and students were collected. The carbon dioxide emissions will be larger in the Zone having highest population.

7.4.2 Transportation

Fossil fuels are used for transportation. The carbon dioxide emitted by different fuels is in different amounts. The engine of the vehicle burns fuel and creates a certain amount of CO_2, depending upon its fuel type, fuel consumption and the driving distances. One liter of petrol and diesel emits 2.3kg and 2.7kg of carbon dioxide, respectively. Travelling by car for1000km can produce about 200-230kg of carbon dioxide into the atmosphere. If a person travels by a bus for 1000km, it can add 1075kg of CO_2 to his/her Carbon foot print. Worldwide, the fossil fuels used for transportation contribute over 13% of GHG emissions.

The transportation details for the Institution campus like the type of vehicle, No. of vehicles and the fuel used were collected. The carbon dioxide emitted from petrol is less compared to that of diesel. The Carbon footprint by the emission inventory transportation will be quite high.

It was noted that the Institution run buses with 15% biodiesel blends along with the diesel. The buses were reported to run smoothly with lesser emissions and noise and improved mileage on average of 5 to 7 km/L which was about 4 to 6 km/L with Diesel alone.

7.4.3 Electricity

Electricity is one emission inventory which contributes much to the Carbon footprint of the Institution. On an average, electricity sources emit 1.297lbs CO_2 per kWh i.e. 0.0005883 metric tons of CO_2 per kWh. The emission factor given by GRID 2010 version 1.1 for hydroelectricity is 6.8956 x10-4 metric tons CO_2/kWh. 50 grams of CO_2 is emitted from1 unit of solar power.
The details of the consumption of electricity and the use of generators in different zones were surveyed. If the number of classrooms and labs are more in a zone, consumption of electricity in that zone is more.
It was noted that the Institution uses a lot of Renewable power especially Solar and Solar-Wind Hybrid Model as a supplement to conventional power there by reducing emission of GHG to the atmosphere also contributing to the INDC commitment pledged by Government of India.

7.4.4 Solid waste

Generally, 1kg of solid waste is generated per capita per day. For high income countries, the solid waste generation is 1.1-5kg per capita per day. For middle income countries, it is 0.52-1kg and for low income countries the value is 0.45-0.89kg/capita/day. One kilogram of solid waste can emit about 0.125kg of carbon. The details regarding the solid waste generated in each zone is collected including the waste produced in canteen and hostels.

The solid waste generated in the canteen and hostel which is taken out of the campus comes under other indirect emissions. Solid Waste emits less amount of carbon dioxide compared to other emission inventories considered.

7.4.5 LPG And Natural Gas

The consumption of 1L of LPG can release 1.5kg of CO_2 to the atmosphere. Also, burning of wood (250kg) can add 33kg of CO_2 to the Carbon footprint. The consumption details of LPG and Natural Gas in canteen and hostels were surveyed. It was noted that the Institution uses the solar power to run the kitchens. It is Asia's largest solar powered Kitchen.

Carbon Footprint Analysis

Carbon footprint analysis can be done by suitably combining data collected with respective emission factor of the selected emission inventories. Table represents emission factors of the selected inventories.

Table 26: Emission Inventory

S.No	Emission Inventory	CO_2Emitted
1	Human Factor	1.14kgper person per day
2	Petrol	2.3 kg per liter
3	Diesel	2.7kgper liter
5	Electricity	0.93kgper kWh
6	Solid Waste	0.125kgperkg
7	LPG	1.5kgperkg

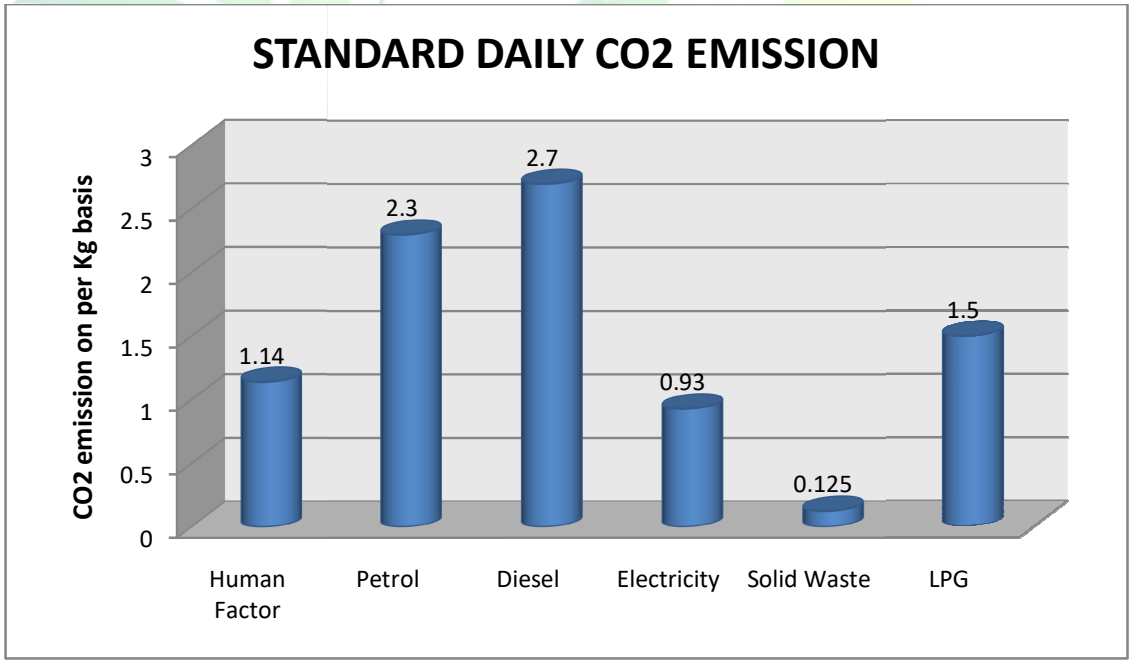


Figure 41: Standard daily CO_2 emitted by different emission inventories at the Institute

Table 27: Details for Carbon Foot Print Auditing

S.No	Details	Data for 2020-2021
1	Total number of Students	nil
2	Total number of Faculty Members	1063
3	Total number of Non-teaching staff	640
4	Total number of Four wheelers	143
5	Total number of Two wheelers	150
6	Total number of Generators used	6
7	Total number of LPG cylinders	2-5 for 2days
8	Any Carbon Footprint reduction strategy battery powered vehicles biodiesel run buses	 4 (overnight charge battery capacity) 5 (12%)

The total carbon foot print of campus is determined, and tabulated below.

Table 28: Total CO_2 Emission from the Institution Campus

S.No	Emission Inventory	Total(Kg of CO_2/Month)
		2020-2021
1	Human Factor	51.06
2	Transportation	16661.328
3	Electricity	114499.35
4	Solid Waste	31390.716
5	Food	8568.261
6	LPG	5514.69
	TOTAL	**176685.4**

Total CO_2 emitted from the whole campus was estimated to be 2120.23tons/year during the year 2020-2021.

7.5 Carbon Footprint Audit-Evaluations and Recommendations

Carbon Footprint Audit was done to measure the total quantity of greenhouse gases being emitted by the Institution as a result of its daily activities. Carbon Footprint was done to analyze the impact of various activities on the environment and it was quantified in the form of total greenhouse gases being emitted. Hence Carbon Footprint Audit was able to identify areas wherein intervention can be done to reduce the impact and optimize the usage of resources.

Carbon Footprint audit was extensively done for the Sathyabama Institute of Science and Technology and the Audit findings are as follows:

Best Practices Observed in the Institution –Carbon Footprint Reduction

- Restriction of personal vehicle inside the campus enhancing reduction of carbon foot prints
- Use of battery operated Vehicles to commute inside the campus
- Blending of Conventional fuel with biodiesel generated from Waste Cooking Oil thereby reducing the carbon footprint
- Use of Solar and Wind Hybrid system power the laboratory thereby reducing dependence on Conventional power
- Use of Solar Lamps to light the Walkways
- Use of Solar power to Run the Kitchen
- Use of Walkways to commute short distances
- Area under Green cover is 33,705sq.m and Marshy Land of 5,120 sq m area in the Institution.

7.5.1 Consolidation of Carbon Footprint Audit Findings-Evaluation

Carbon Footprint audit was extensively done for the Sathyabama Institute of Science and Technology and inventories selected for the audit were Human Factor, Transportation, Electricity, Solid Waste, Food, LPG, etc. Carbon Footprint audit took into account energy consumption, food consumption, waste disposal, water supply, transportation.

The project was carried out in three phases namely, Planning, Collection of data and Estimation of CO2 following with suggestive measures for reduction. Several site visits and face to face interactions were done with the departments to collect the required data. The study included extensive research on latest emission factors for computing the footprint.

Survey responses, combined with utility data and emissions calculations, indicated that the average annual carbon footprint was a relatively modest 2120.23 tons of CO2 equivalent per annum. Major Co_2 emission was from Electricity with 64.8%, 17.76% from solid waste, and 4.84% from food waste, 9.42% due to transportation and 3.12% from use of LPG. Though the

standard CO_2 emission from electricity is much lesser when compared to other inventories, the quantum of electricity consumed in the Institute is much higher which is implicated as the highest CO_2 emission contributing factor in the graph.

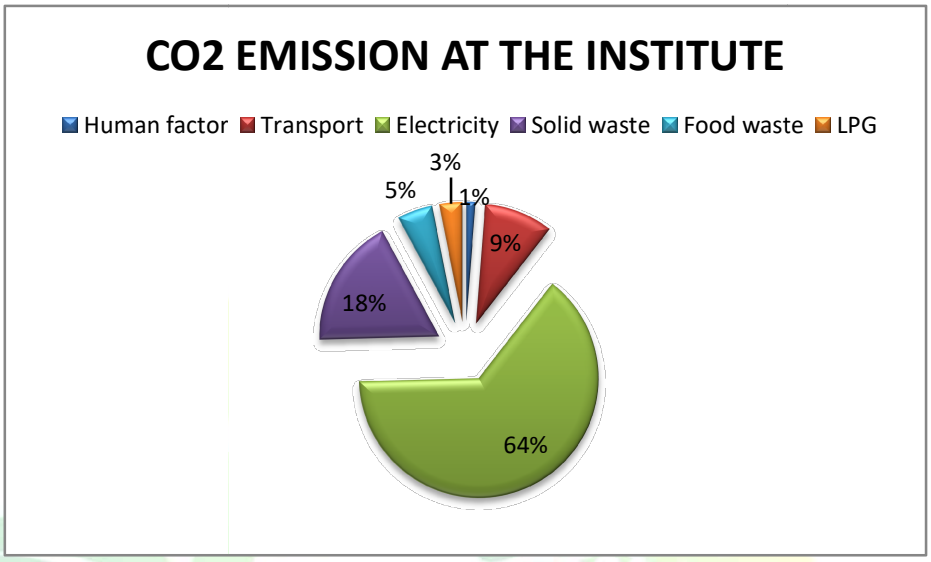


Figure 42: Percentage contribution of CO_2 emitted from various sources of the Institute

The LPG cylinders are used in canteen for food preparation and chemistry lab for research purposes. It was estimated that a total of 1080 commercial cylinders (19kg capacity) were used in the canteen during FY 2020-21. The number of cylinders used in the year 2020-21 is much lesser when compared to the previous year, the reason being the Institution was only partially working due to Covid-pandemic and hence students were not coming to the Institution and the staffs were requested to bring own food to rule out any chance of spread of Corona virus-Infection. Hence, the total emissions computed for LPG cylinders were just 5514.69kg/ month of CO_2 equivalent. The LPG consumption will get reduced in the future with the re-commissioning of Solar powered kitchen, for which efforts have been initiated.

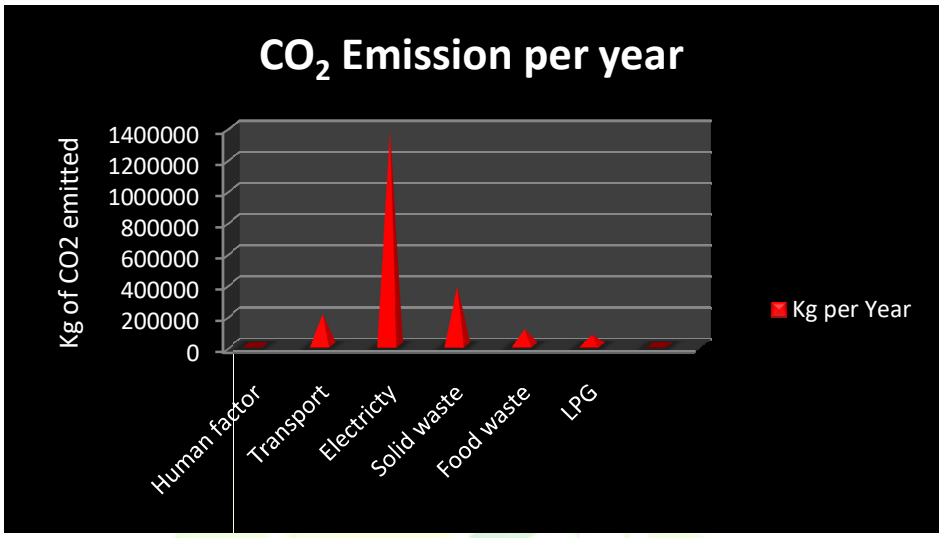


Figure 43: Kg of CO_2 emitted per year by various inventories at the Institute

The emissions due to transportation is considerably lower due the fact that the buses are run with biodiesel blended fuel and the Institution is using battery operated vehicles to commute inside the campus and have restricted the use of personal vehicles. Also Institution is promoting carpooling to reduce the overall number of vehicles used for commuting.

The CO_2 emission from conventional electricity is very high as the electricity is used to power the entire Institution. To decrease the dependence on conventional source of power and reduce the carbon footprint from this source, the Institution has already installed Roof Top solar panels, and is using Solar-Wind Hybrid system to power its laboratory. Also the Institution is using solar lamps to light the walk ways across the campus. These initiatives can be scaled up in the future to decrease the dependence on conventional source of power thereby decreasing the overall CO_2 emission.

The dependence on Conventional source of power will decrease further with the re-commissioning the solar cooking system which got damaged during the floods of 2018.The emission from Diesel Generator (DG) is much lesser as it is run only when there is a power shortage also the DG set is run with biodiesel blended fuel owing to further decrease in GHG emission. The CO_2 emission from the solid waste is very high, having knowledge about this, the Institution is doing great initiatives to properly dispose the solid waste by keeping the 3-R

principle in its mind. The majority of food waste is given away as feed to pigs, the paper waste is recycled. Plastic wastes are diverted to Architecture Department for research purposes and metal wastes are sold to scrap dealers. The Institution is maintaining a good amount of green cover in terms of trees, plants and shrubs, which will in turn help in nullifying a great amount of CO_2 emission that is occurring in the campus. All these are appreciable efforts put in by the Institution to reduce the overall carbon foot print by decreasing the dependence on conventional source of power and properly managing the waste being generated.

Based on the above finding few recommendations that the Institution can follow are-

7.5.2 Recommendations

- Try to go Digital and reduce the use of paper, decreasing the CO_2 that comes from paper production.
- Use ENERGY STAR certified products that protect the environment through superior energy efficiency.
- Encourage to reduce dairy and meat intake- No Meat Mondays! Animal products make up 18% of greenhouse gas emissions. By replacing one or two of weekly meat and dairy meals to a vegetarian option, can help reduce emissions.
- Encourage use of Bicycles.

Figure 44: Battery car

Figure 45: Solar lamps

Figure 46: Solar panels with controller

Figure 47: Biodiesel(12%) run bus

Figure 48: Roof top solar panel

Figure 49: Solar-Wind Hybrid system

CHAPTER 8

AUDIT CONCLUSION

The Educationists all over the world believes that it is important for Institutions to go green not only from the point of view of protecting the environment but also from teaching the youth the importance of maintaining ecological balance and ensuring sustainable development. Environmental and Energy auditing is used as a tool to investigate, understand, identify impacts of various activities on the environment against set criteria or standards. These are used to help improve existing activities, with the aim of reducing the adverse effects of these activities on the environment. Environmental and Energy audit provides an opportunity to create a clean and healthy environment in the campus. The audit involves the assessment of the energy management, water management, waste management, use of renewable energy sources, implementation of rainwater harvesting structures and efforts for carbon foot print reduction. This assessment requires data collection from the Institute and an analysis of the components related to sustainable development. Before visiting the Institute, a set of questionnaires was shared for data collection under Environmental and Energy audit study. Subsequently, a pre audit meeting was conducted with the staff and explained the overall requirements under the audit. This meeting held in the Institute also provided an opportunity for data collection and also gave a chance to have discussion on the realities associated with the audit. The meeting also provided an opportunity to gather information. The audit process began on 23rdMarch 2021 in the Institution.

The Environmental Audit conducted in Sathyabama Institute of Science and Technology, endorsed the commitment of the Institution towards the environment with a greater involvement, action plans and their implementation at every stage by the management and teaching professionals and the student community.

The Institution has done a significant work for scientific disposal and management of E-waste, Biomedical Waste, Solid Waste and generation of energy from the waste. This Institute with more than 10,000 occupants has a huge cooking facility that generates on an average 750 liters of waste cooking oil on a weekly basis. The Institute is following trans-esterification of Waste Cooking Oil for the production of biodiesel, which used for the running of their buses with 15%

biodiesel blends. This will help in reduction of GHG as the biodiesel blended fuel emits less CO2 than the conventional fuel. The buses were reported to run smoothly with lesser emissions and noise and improved mileage on average of 5 to 7 km/l which was about 4 to 6 km /l with Diesel alone. The Biodiesel powered buses in the Institution has lead the team to step further to test the Waste Cooking Oil Biodiesel for the agricultural pump sets to cater to the needs of farmers who were looking for an alternative to the costlier crude based fuel. This initiative was successful and the farmers could operate the pump sets with Biodiesel generated from Waste Cooking Oil. The farmers reported that the pump sets gave a good pickup with less noise during operation. This initiative will definitely boost the Climate Resilient agriculture in providing a Sustainable, Eco friendly fuel to the farmers Mittappalli village and promote them on the economic grounds and motivate them to contribute towards Greener India.

The Food waste generated in the Institution was given to the pig farms on a daily basis, which is one of most preferred form of disposal in food waste management hierarchy. Major quantum of plastic waste was diverted to architecture department for sustainable building research and few left out waste was given away to Corporation. Few plastic bottles, plastic covers, cans, broken glass wares, tins were recycled for planting saplings and also to create decorative items to be displayed in the campus. The Institution is also developing technology for conversion of food waste to organic pots, for generation of electricity from organic waste, for smart Compost development from solid waste. So that it can be concluded the Institution is putting a great effort towards the management of solid waste generated in the campus. Hence it can be said that Institution is following the 3 Rs- Reduce, Reuse, Recycle- the core of ideals of sustainable waste management, to the core.

The Institution is having own STP to which all the waste water is been sent. The water is been treated using Sequential Batch Reactor and the treated sewage water is further reused for gardening, flushing and other purposes. The Storm water is also diverted to this unit so the proper reuse of rain water is happening. This initiative of the Institution has helped them to reduce their water foot print by a great extent. At present the Institution is taking only moderate amount of water from outside as the Institution is using treated water from the STP for flushing which is the major water usage point. Since water for flushing is met by recycled water the

intake water can directly be diverted for purposes like drinking, cooking, cleaning, bathing etc. As with the adoption of STP and reusing the recycled water for flushing and gardening the Institution was able to reduce their water footprint considerably. So it can be concluded that the Institution is moving towards achieving Zero Discharge Goals.

The Institution has installed many Solar Panels and Solar-Wind Hybrid system and the power generated is used for lightning of the walkway and laboratory. The Institute had Asia's largest kitchen run using Solar Power. But these panels got damaged during the floods of 2018, and now efforts have been taken to re-commission it. Hence the Institution is taking a great effort towards substituting non-renewable power with renewable source of power, thereby contributing to the INDC commitment made by Government of India which is highly appreciable. As the campus is spread over 134 acres of land, installation of more solar systems is a good choice of action towards harnessing more renewable source of energy. Adopting the roof top solar panelling technology can contribute to this even more. This solar energy can be used for running pumps and blowers at the STP which in turn help to manage the expenditures on electricity as well.

The Institution is using battery operated vehicles to commute inside the campus and have restricted the use of personal vehicles. The Institution is promoting carpooling to reduce the overall number of vehicles used for commuting. The Institution is also using biodiesel to blend with conventional fuel to run the campus buses. Pedestrian pathways are also promoted that will encourage students to walk preventing them from using vehicles for commuting. These are great initiatives taken by the Institution in reducing the overall carbon footprint of the Institution.

The Institution has green cover of 34,133 sq.m and Marshy Land of 5,120 sq m area. This will help in absorption of pollutant and nullifying the GHG emitted in the campus. The Institution is maintaining Marshy Land having an area of 5,120 m^2 undisturbed. This will help in Ground Water Recharge and help in maintaining the ground water table in the nearby areas. It also acts as a habitat for the aquatic birds and a source of drinking water to small animals and birds in the nearby area. This Marshy land also acts as a natural rain harvesting structure. Seeing the green campus with different plant species will motivate the staffs and the students to maintain

tranquillity and become stress free. Efforts are taken to increase the green cover by terrace farming, planting of saplings, roof top gardening, vegetable gardening etc.

Recycling is the key to reduce the e-Waste. Recycling has environmental benefits at every stage in the life cycle of an electronic product-from the raw material from which it is made to its final method of disposal. Apart from reducing greenhouse gas emissions, which contribute to global warming, recycling also reduces air and water pollution associated with making new products from raw materials. By utilizing used, unwanted, or obsolete materials as industrial feedstock or for new materials or products, the burden on resources can be reduced drastically. The Institution is well aware of this fact and has entered into an agreement with a recycler to recycle the E-Waste generated in the campus. The Institution is adhering to EPR while buying electric/electronic items.

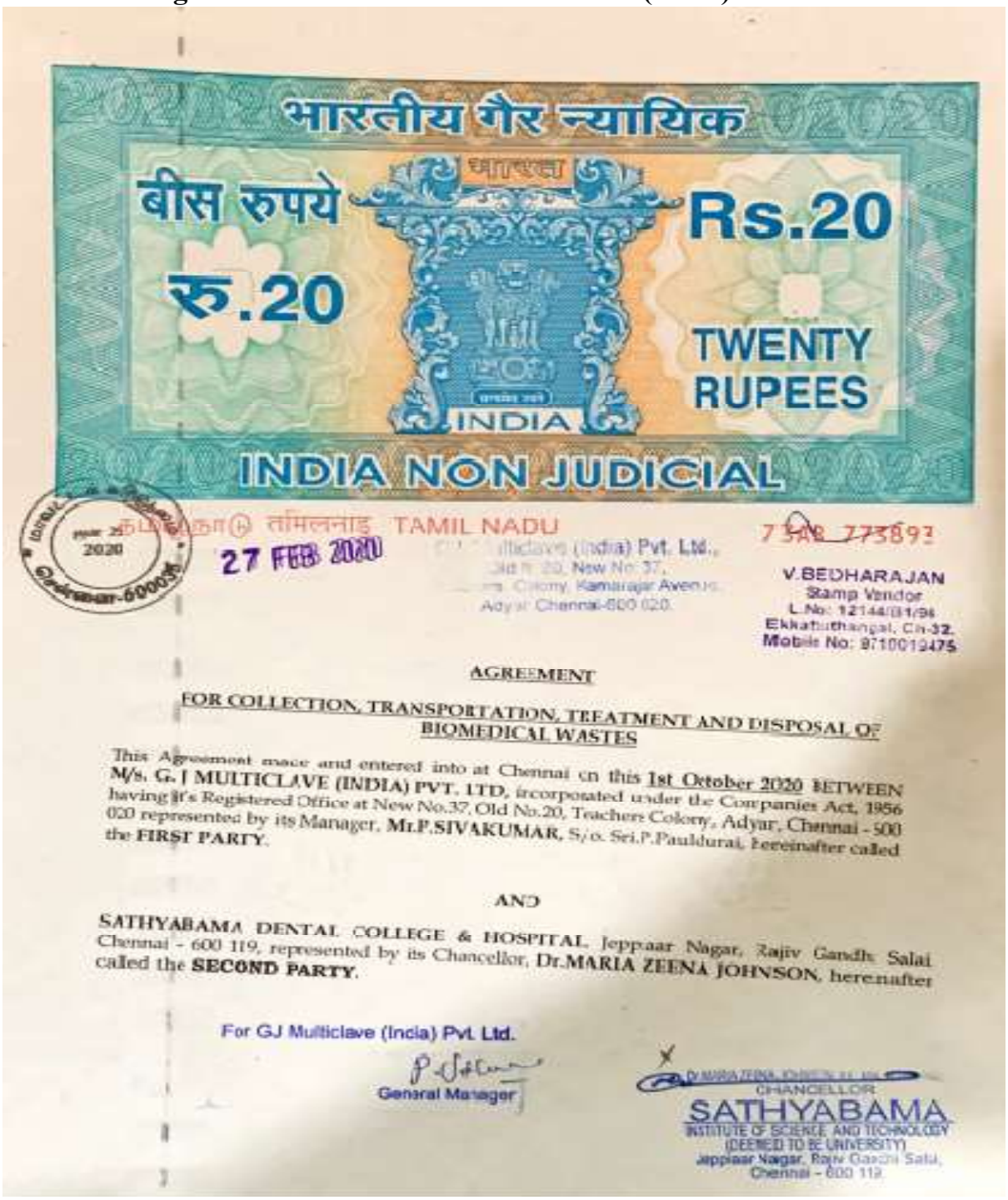
The Institution has also signed MoU with VANS CHEMISTRY PVT. Ltd., an E-Waste Management Company for teaching students the safe dismantling of E-Waste. Also there is a proposal to establish a dismantling facility in the Institution for knowledge transfer. It can be concluded that the Institution is taking adequate efforts while handling the E-Waste especially while collection, storage, transportation and disposal of E-Waste

Thus it can be concluded that the Institution has already implemented many environmentally friendly initiatives in the like a rooftop solar plant, biogas plant, and rainwater harvesting structure. The LPG consumption will get reduced in the future with the re-commissioning of Solar powered kitchen, for which efforts have been initiated. The Institute also believes in eco-friendly infrastructure that facilitates natural ventilation which helps in reducing the overall temperature by bringing a cooling effect, thus reducing the power consumption. Other initiatives taken at the campus include few rooms in administrative buildings are fitted with motion sensors to save electricity. The Institution uses battery operated buses to ferry students inside the campus.During the course of study and investigation, it was observed that the entire Institution has well planned Greenery, Garden, Marshy Land and Open grounds. All these shows the significant effort was put in by the Institution in Waste Management, Water Management and Conservation, in maintaining a Green and Eco friendly Campus focusing on reduction in Carbon Foot Print and Water Footprint. This Climate Resilient Infrastructure in the Institute makes the

Institute a Green and Eco friendly campus. Also the Institution is playing an active role in educating its young population about sustainable environment by conductingperiodic training programmes, awareness camps, seminar, group activities to inculcate in them a sense of deep responsibility among them to become stewards of Mother Nature. The Institution has also developed several technologies to generate wealth out of waste and reduce dependence on conventional source of power. The Institution has also signed several MoUs with leading Universities all over the world and also with several companies in India for technological collaboration and for knowledge transfer. The Institution is also taking great effort to ensure knowledge transfer from lab to land. The Institution has adopted five villages and is empowering the villagers with the sustainable technology the Institution develops in its laboratories. This technical knowledge that the villagers have gained have helped them to become entrepreneurs'. All these show the Institution's commitment towards its environmental and social responsibility and its commitment towards protecting the earth's resources in its perpetuity. This environmental audit conducted is not only significant for the Institution, but also for the other Institutions to emulate and adopt as a model and therefore contribute in this endeavour of sustainable environment for all. This clearly displays the Institutions endeavour to exercise leadership in addressing the fundamental problems of resource exploitation, by reversing the trends of environment degradation, and in promoting sustainability and to become stewards of Mother Nature.

ANNEXURES

Biomedical Waste Collection, Transportation, Treatment and Disposal Agreement with M/S G.J Multiclave (India) Pvt. Ltd.



भारतीय गैर न्यायिक

बीस रुपये

रु.20

Rs.20

TWENTY RUPEES

INDIA

INDIA NON JUDICIAL

தமிழ்நாடு तमिलनाडु TAMIL NADU

27 FEB 2020

V.BEDHARAJAN
Stamp Vendor
L.No: 12144/81/96
Ekkattuthangal, Ch-32.
Mobile No: 9710019475

AGREEMENT

FOR COLLECTION, TRANSPORTATION, TREATMENT AND DISPOSAL OF BIOMEDICAL WASTES

This Agreement made and entered into at Chennai on this 1st October 2020 BETWEEN M/s. G. J MULTICLAVE (INDIA) PVT. LTD, incorporated under the Companies Act, 1956 having it's Registered Office at New No.37, Old No.20, Teachers Colony, Adyar, Chennai - 600 020 represented by its Manager, Mr.P.SIVAKUMAR, S/o. Sri.P.Paulduraj, hereinafter called the FIRST PARTY.

AND

SATHYABAMA DENTAL COLLEGE & HOSPITAL, Jeppaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119, represented by its Chancellor, Dr.MARIA ZEENA JOHNSON, hereinafter called the SECOND PARTY.

For GJ Multiclave (India) Pvt. Ltd.

General Manager

CHANCELLOR
SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Jeppiaar Nagar, Rajiv Gandhi Salai,
Chennai - 600 119

WHEREAS the **FIRST PARTY** has set up a Common Off-site Biomedical Waste Treatment Facility for Chennai in accordance with the standards prescribed in Biomedical Waste (Management & Handling) Rules, 2016 as amended to date for treatment and disposal of Biomedical Wastes generated by various Health Care Establishments in and around Chennai.

WHEREAS the **SECOND PARTY** is a Health Care Establishment, engaged in the service of providing various types of Health Care treatment facilities and generates Biomedical Wastes as defined under the Biomedical Waste (Management & Handling) Rules, 2016 in the course of such medical services to people.

WHEREAS the **SECOND PARTY** is enrolled with the **FIRST PARTY** for collection, transportation, treatment and final disposal by the **FIRST PARTY**, of such Biomedical Wastes generated in the **SECOND PARTY's** Health Care Facility.

WHEREAS now the **SECOND PARTY** enters into an Agreement with the **FIRST PARTY** as per the following terms and conditions:-

1. The **SECOND PARTY** declares that its bed strength operational is 100 Beds.

2. The **SECOND PARTY** will segregate the Biomedical Wastes as per Schedule II of the Biomedical Waste (Management & Handling) Rules, 2016 at the point of generation in its Health Care Facility and store such segregated Medical Wastes in designated Colour Coded Containers/Bags prior to collection, transportation, treatment and final disposal by the **FIRST PARTY**.

3. The **SECOND PARTY** shall also label the Bio-Medical Waste consumable bags and containers with the service providers name with BAR CODE according to Schedule III of Biomedical Waste (Management & Handling) Rules, 2016.

4. The **FIRST PARTY** shall collect the Biomedical Wastes from **SECOND PARTY** everyday at a specified time to suit the convenience of collection mechanism of the **FIRST PARTY** and the **SECOND PARTY** shall render all assistance to the **FIRST PARTY** in this regard.

5. The **SECOND PARTY** agrees to pay a Service Charge of Rs.20000/- per month for the waste collected by the **FIRST PARTY**. In addition to the service charges, the **SECOND PARTY** has to pay any government taxes and levies as applicable on date to the **FIRST PARTY** for the services rendered by the **FIRST PARTY**.

6. Both the parties agree that the rate of service charges mentioned in Clause 5 above will be in force for a period of 1 year from the date of this agreement and thereafter the rate shall be revised by mutual consent after deliberations with Indian Medical Association Nursing Home Board.

7. Notwithstanding the above, the **SECOND PARTY** agrees to consider an increase in the rate if and when there is an increase in the fuel tariff by more than 20% over the prevailing rate. The prevailing rate now is Rs.77.49 per litre for diesel.

8. The **SECOND PARTY** has paid an amount of Rs.20000/- interest free advance for the service charges payable by it. Such advance amount shall not be adjusted against the recurring service charges payable by **SECOND PARTY** to the **FIRST PARTY** and shall remain intact during the period of the agreement.

For GJ Multiclave (India) Pvt. Ltd.

General Manager

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
DEEMED TO BE UNIVERSITY
Jeppiaar Nagar, Rajiv Gandhi Salai,
Chennai - 600 119

9. The **FIRST PARTY** shall submit its bills towards Service Charges referred in Clause 5 above on a monthly basis to the **SECOND PARTY** at the end of each month and the SECOND PARTY shall pay the same before or on the 5th of the following months.

SECOND PARTY agrees to permit such authorised person/persons of the **FIRST PARTY** duly indicated in writing as and when the **FIRST PARTY** demands visual inspection of the segregated wastes stored in its premises before the same is collected by the **FIRST PARTY** from the said premises of the **SECOND PARTY**.

The **FIRST PARTY** agrees to provide Training on segregation of Biomedical Wastes to the **SECOND PARTY** Free of cost.

This agreement is subject to force majeure i.e. –

i. war invasion, mobilization, requisition or embargo;
ii. rebellion, revolution, insurrection or military or usurped power, or civil war;
iii. Government orders restrictions, riots, fire, epidemics, sabotage, act of God like earthquake, floods, accidents, breakdown of machinery or any other reasons whatsoever beyond the reasonable control of **FIRST PARTY**.

If any force majeure event outside the control of both parties arises during the currency of this agreement, which renders it impossible or unlawful for the **FIRST PARTY** to fulfil its agreement obligations, the **SECOND PARTY** shall not seek any remedy – legal or financial from the **FIRST PARTY**. However, the terms of this agreement shall be restored as far as both the parties are concerned, once the force majeure events cease to exit.

This Agreement shall be in force initially for valid upto 31st March 2022 and can be renewed thereafter for such period and on such terms and conditions as the parties mutually agree thereon.

If any dispute arises between the parties herein, or if any controversies or difference of opinion arises out of or in connection with the recitations of this agreement, the same shall be settled amicably. The jurisdiction shall be restricted to **CHENNAI ONLY**.

IN WITENESS WHEREOF the parties herein set out their hands on the day, date and place above written.

For GJ Multiclave (India) Pvt. Ltd.

General Manager

FIRST PARTY

SECOND PARTY

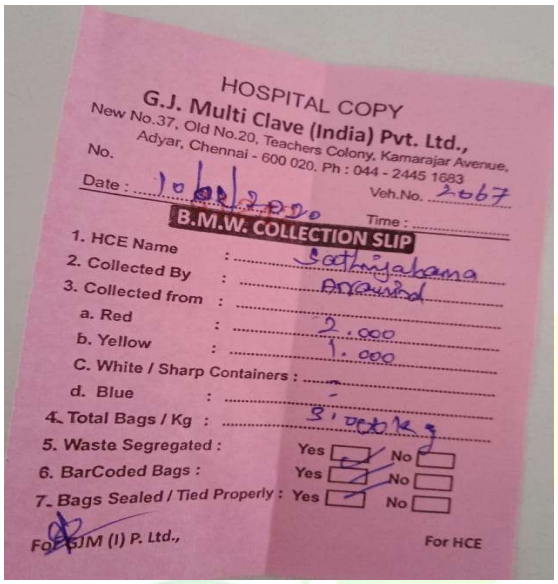
Dr. MARIAZEENA JOHNSON
CHANCELLOR
SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
DEEMED TO BE UNIVERSITY
Jeppiaar Nagar, Rajiv Gandhi Salai,
Chennai – 600 119

WITNESSES:

1.

2.

Biomedical Waste Collection Slip



HOSPITAL COPY

G.J. Multi Clave (India) Pvt. Ltd.,

New No.37, Old No.20, Teachers Colony, Kamarajar Avenue, Adyar, Chennai - 600 020. Ph : 044 - 2445 1683

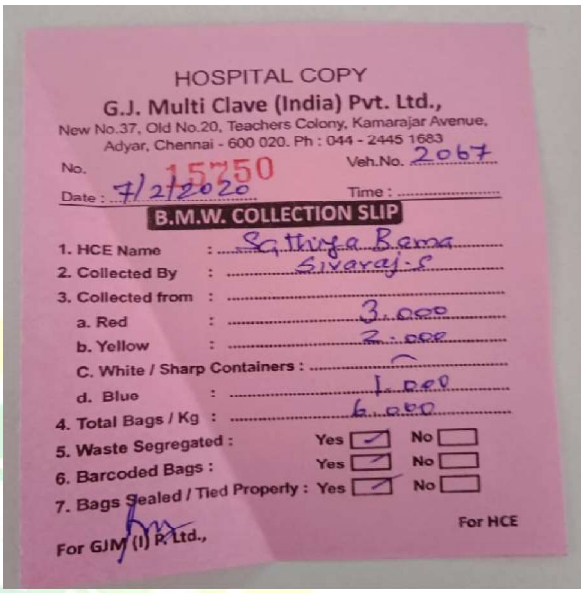
No. Veh.No. 2067

Date : Time :

B.M.W. COLLECTION SLIP

1. HCE Name : Sathiyabama
2. Collected By : Aravind
3. Collected from :
   a. Red : 2.000
   b. Yellow : 1.000
   C. White / Sharp Containers :
   d. Blue :
4. Total Bags / Kg : 3.000 kg
5. Waste Segregated : Yes ☑ No ☐
6. BarCoded Bags : Yes ☑ No ☐
7. Bags Sealed / Tied Properly : Yes ☑ No ☐

For GJM (I) P. Ltd., For HCE



HOSPITAL COPY

G.J. Multi Clave (India) Pvt. Ltd.,

New No.37, Old No.20, Teachers Colony, Kamarajar Avenue, Adyar, Chennai - 600 020. Ph : 044 - 2445 1683

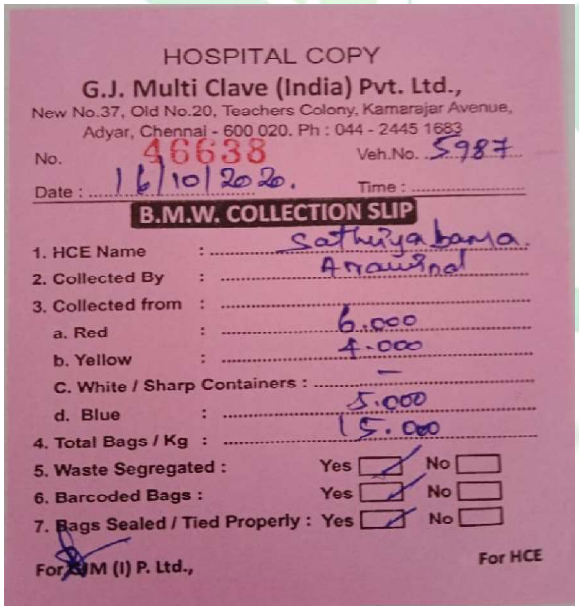
No. 15750 Veh.No. 2067

Date : 7/2/2020 Time :

B.M.W. COLLECTION SLIP

1. HCE Name : Sathiya Bama
2. Collected By : Sivaraj.S
3. Collected from :
   a. Red : 3.000
   b. Yellow : 2.000
   C. White / Sharp Containers :
   d. Blue : 1.000
4. Total Bags / Kg : 6.000
5. Waste Segregated : Yes ☑ No ☐
6. Barcoded Bags : Yes ☑ No ☐
7. Bags Sealed / Tied Properly : Yes ☑ No ☐

For GJM (I) P. Ltd., For HCE



HOSPITAL COPY

G.J. Multi Clave (India) Pvt. Ltd.,

New No.37, Old No.20, Teachers Colony, Kamarajar Avenue, Adyar, Chennai - 600 020. Ph : 044 - 2445 1683

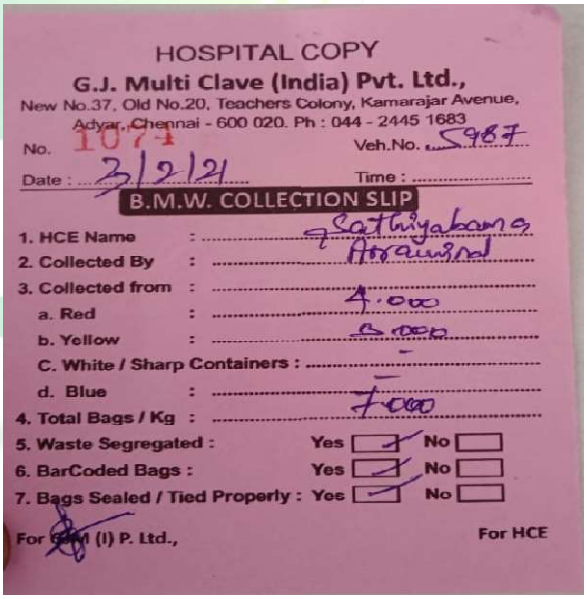
No. 46638 Veh.No. 5987

Date : 16/10/2020. Time :

B.M.W. COLLECTION SLIP

1. HCE Name : Sathiyabama
2. Collected By : Aravind
3. Collected from :
   a. Red : 6.000
   b. Yellow : 4.000
   C. White / Sharp Containers : —
   d. Blue : 5.000
4. Total Bags / Kg : 15.000
5. Waste Segregated : Yes ☑ No ☐
6. Barcoded Bags : Yes ☑ No ☐
7. Bags Sealed / Tied Properly : Yes ☑ No ☐

For GJM (I) P. Ltd., For HCE



HOSPITAL COPY

G.J. Multi Clave (India) Pvt. Ltd.,

New No.37, Old No.20, Teachers Colony, Kamarajar Avenue, Adyar, Chennai - 600 020. Ph : 044 - 2445 1683

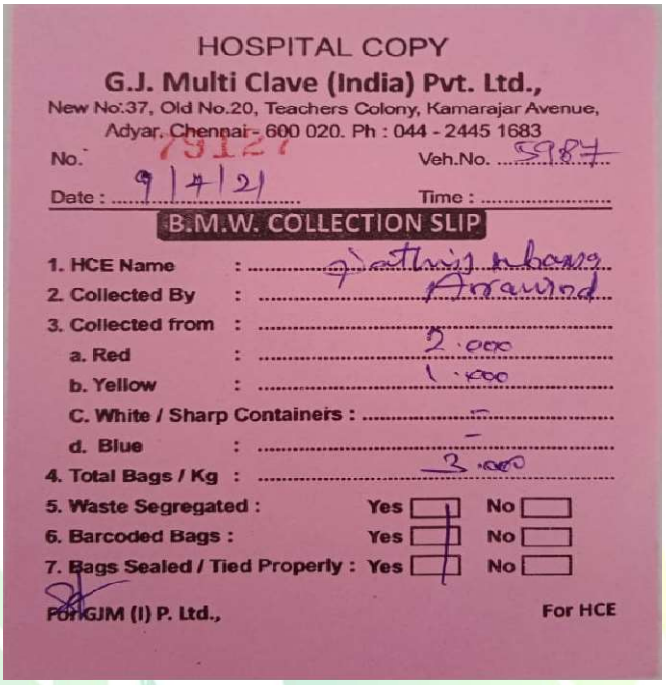
No. 1074 Veh.No. 5987

Date : 3/2/21 Time :

B.M.W. COLLECTION SLIP

1. HCE Name : Sathiyabama
2. Collected By : Aravind
3. Collected from :
   a. Red : 4.000
   b. Yellow : 3.000
   C. White / Sharp Containers : —
   d. Blue : 7.000
4. Total Bags / Kg :
5. Waste Segregated : Yes ☑ No ☐
6. BarCoded Bags : Yes ☑ No ☐
7. Bags Sealed / Tied Properly : Yes ☑ No ☐

For GJM (I) P. Ltd., For HCE



HOSPITAL COPY

G.J. Multi Clave (India) Pvt. Ltd.,

New No:37, Old No.20, Teachers Colony, Kamarajar Avenue,
Adyar, Chennai - 600 020. Ph : 044 - 2445 1683

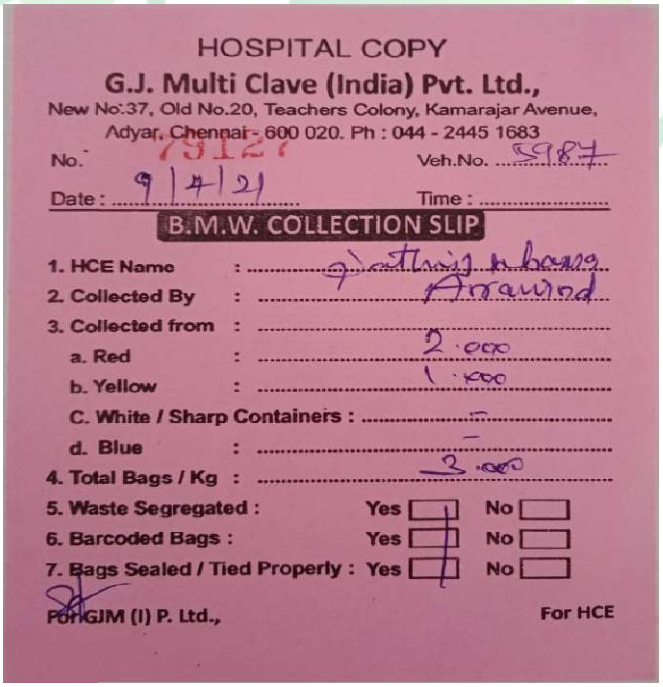
No. 75127 Veh.No. TN87

Date : 9/4/21 Time :

B.M.W. COLLECTION SLIP

1. HCE Name : Sathya Bama
2. Collected By : Aravind
3. Collected from :
   a. Red : 2.000
   b. Yellow : 1.000
   C. White / Sharp Containers : -
   d. Blue : -
4. Total Bags / Kg : 3.000
5. Waste Segregated : Yes ☑ No ☐
6. Barcoded Bags : Yes ☑ No ☐
7. Bags Sealed / Tied Properly : Yes ☑ No ☐

For GJM (I) P. Ltd., For HCE



HOSPITAL COPY

G.J. Multi Clave (India) Pvt. Ltd.,

New No:37, Old No.20, Teachers Colony, Kamarajar Avenue,
Adyar, Chennai - 600 020. Ph : 044 - 2445 1683

No. 75127 Veh.No. TN87

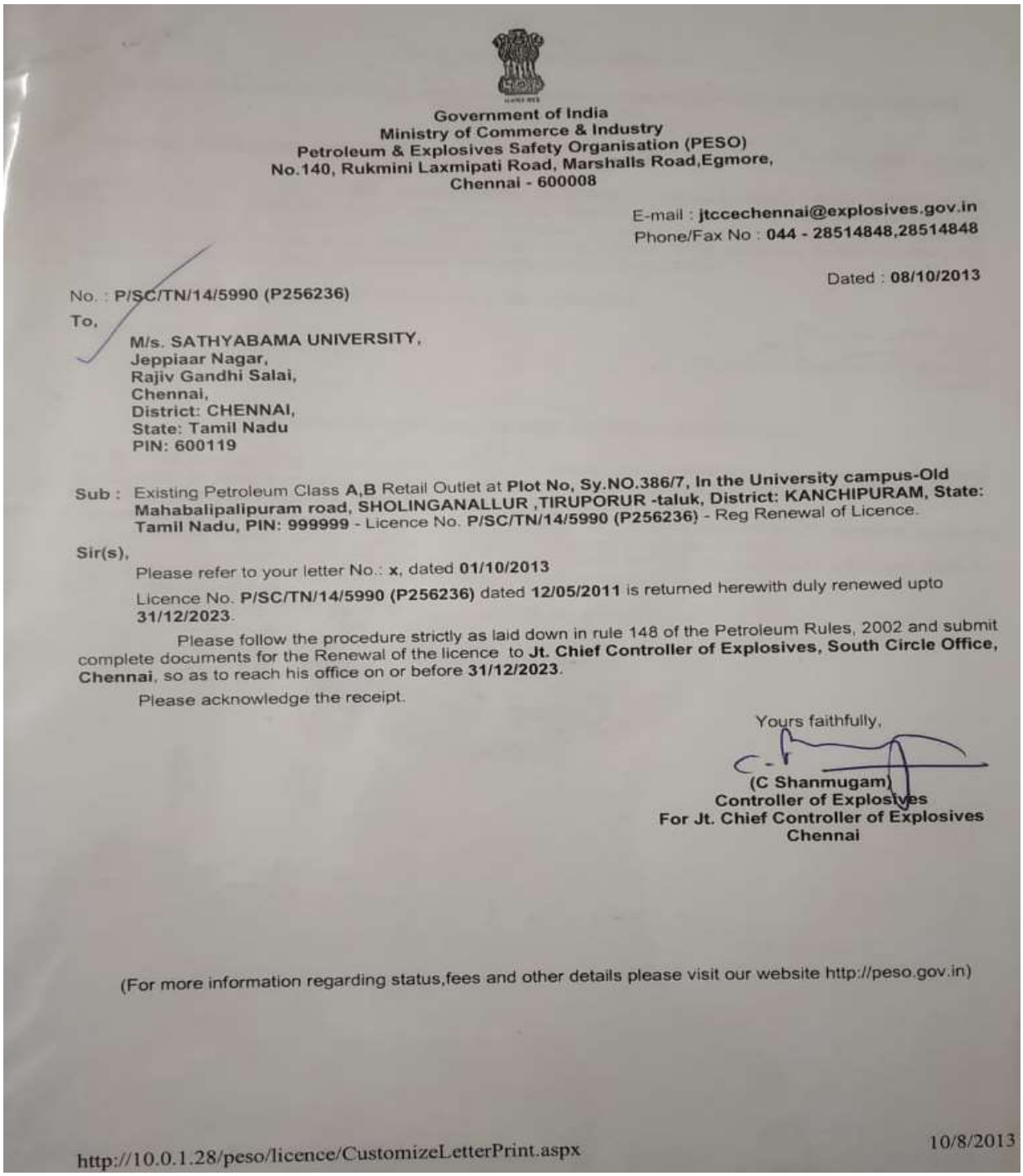
Date : 9/4/21 Time :

B.M.W. COLLECTION SLIP

1. HCE Name : Sathya Bama
2. Collected By : Aravind
3. Collected from :
   a. Red : 2.000
   b. Yellow : 1.000
   C. White / Sharp Containers : -
   d. Blue : -
4. Total Bags / Kg : 3.000
5. Waste Segregated : Yes ☑ No ☐
6. Barcoded Bags : Yes ☑ No ☐
7. Bags Sealed / Tied Properly : Yes ☑ No ☐

For GJM (I) P. Ltd., For HCE

Petroleum & Explosives Safety Organisation (PESO) Approval for Petrol Pump



Government of India
Ministry of Commerce & Industry
Petroleum & Explosives Safety Organisation (PESO)
No.140, Rukmini Laxmipati Road, Marshalls Road,Egmore,
Chennai - 600008

E-mail : jtccechennai@explosives.gov.in
Phone/Fax No : 044 - 28514848,28514848

Dated : 08/10/2013

No. : P/SC/TN/14/5990 (P256236)

To,

M/s. SATHYABAMA UNIVERSITY,
Jeppiaar Nagar,
Rajiv Gandhi Salai,
Chennai,
District: CHENNAI,
State: Tamil Nadu
PIN: 600119

Sub : Existing Petroleum Class A,B Retail Outlet at **Plot No, Sy.NO.386/7, In the University campus-Old Mahabalipalipuram road, SHOLINGANALLUR ,TIRUPORUR -taluk, District: KANCHIPURAM, State: Tamil Nadu, PIN: 999999** - Licence No. **P/SC/TN/14/5990 (P256236)** - Reg Renewal of Licence.

Sir(s),

Please refer to your letter No.: **x**, dated **01/10/2013**

Licence No. **P/SC/TN/14/5990 (P256236)** dated **12/05/2011** is returned herewith duly renewed upto **31/12/2023**.

Please follow the procedure strictly as laid down in rule 148 of the Petroleum Rules, 2002 and submit complete documents for the Renewal of the licence to **Jt. Chief Controller of Explosives, South Circle Office, Chennai**, so as to reach his office on or before **31/12/2023**.

Please acknowledge the receipt.

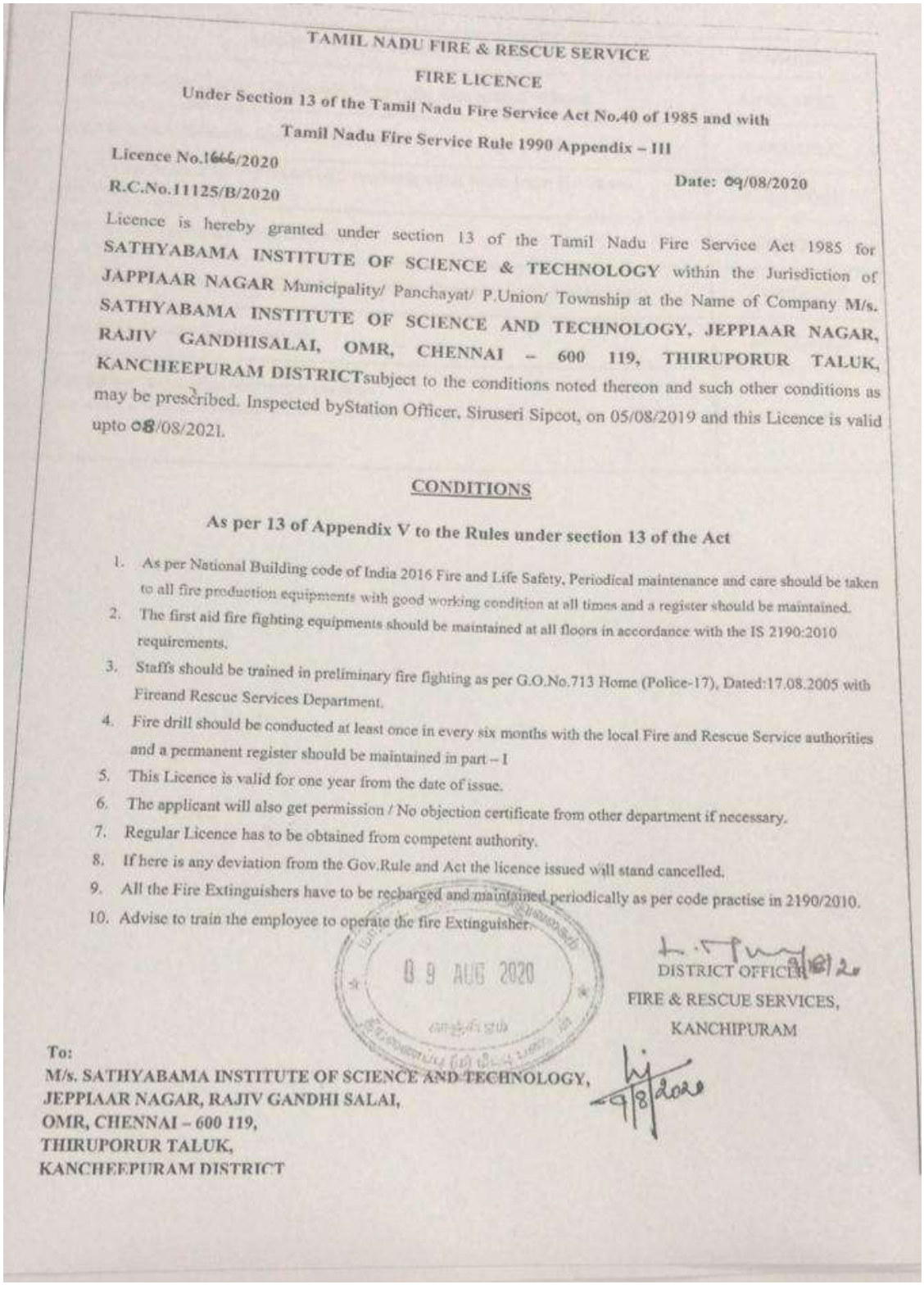
Yours faithfully,

(C Shanmugam)
Controller of Explosives
For Jt. Chief Controller of Explosives
Chennai

(For more information regarding status,fees and other details please visit our website http://peso.gov.in)

http://10.0.1.28/peso/licence/CustomizeLetterPrint.aspx 10/8/2013

Fire License



TAMIL NADU FIRE & RESCUE SERVICE

FIRE LICENCE

Under Section 13 of the Tamil Nadu Fire Service Act No.40 of 1985 and with Tamil Nadu Fire Service Rule 1990 Appendix – III

Licence No.1666/2020

R.C.No.11125/B/2020

Date: 09/08/2020

Licence is hereby granted under section 13 of the Tamil Nadu Fire Service Act 1985 for SATHYABAMA INSTITUTE OF SCIENCE & TECHNOLOGY within the Jurisdiction of JAPPIAAR NAGAR Municipality/ Panchayat/ P.Union/ Township at the Name of Company M/s. SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, JEPPIAAR NAGAR, RAJIV GANDHISALAI, OMR, CHENNAI – 600 119, THIRUPORUR TALUK, KANCHEEPURAM DISTRICTsubject to the conditions noted thereon and such other conditions as may be prescribed. Inspected byStation Officer, Siruseri Sipcot, on 05/08/2019 and this Licence is valid upto 08/08/2021.

CONDITIONS

As per 13 of Appendix V to the Rules under section 13 of the Act

1. As per National Building code of India 2016 Fire and Life Safety, Periodical maintenance and care should be taken to all fire production equipments with good working condition at all times and a register should be maintained.
2. The first aid fire fighting equipments should be maintained at all floors in accordance with the IS 2190:2010 requirements.
3. Staffs should be trained in preliminary fire fighting as per G.O.No.713 Home (Police-17), Dated:17.08.2005 with Fireand Rescue Services Department.
4. Fire drill should be conducted at least once in every six months with the local Fire and Rescue Service authorities and a permanent register should be maintained in part – I
5. This Licence is valid for one year from the date of issue.
6. The applicant will also get permission / No objection certificate from other department if necessary.
7. Regular Licence has to be obtained from competent authority.
8. If here is any deviation from the Gov.Rule and Act the licence issued will stand cancelled.
9. All the Fire Extinguishers have to be recharged and maintained periodically as per code practise in 2190/2010.
10. Advise to train the employee to operate the fire Extinguisher.

09 AUG 2020

DISTRICT OFFICER
FIRE & RESCUE SERVICES,
KANCHIPURAM

To:
M/s. SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY,
JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
OMR, CHENNAI – 600 119,
THIRUPORUR TALUK,
KANCHEEPURAM DISTRICT

9/8/2020

Electricity Bill (2021)

TamilNadu Generation and Distribution Corporation Ltd.

High Tension Bill (Provisional) for the Month of January 2021

TANGEDCO CIN No:U40109TN2009SGC073746 GST No:33AADCT4784E1ZC

HSN : 27160000 SAC : 996912

**** Electrical Energy & Distribution Services are exempted under GST ****

To:	SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY	Service No.	09909401060
	JEPPIAAR NAGAR,RAJIV GANDHI SALAI,OLD MAMALLAPURAM ROAD CHENNAI	Bill No.	F401106001231 1
		Date of Bill	09-Feb-21
	SHOLINGANALLUR - 2	Due Date	09-Feb-21
	Sholinganallur	Tariff Agg. / Bill.	HT IIB / HT IIB
	Kancheepuram - 600119	GST No :	33111111111111Z

Permitted MD	2500 KVA	Transformer Loss	0units/0KVA	Tr. CAP.	0KVA

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs)
1. Industrial Consumption	6.35 per unit	69681	4,42,474.35
2. Peak Hour Consumption	1.27 per unit	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per unit	0 (-)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	8.05 per unit	24	120.00
6. Temp. Supply Consumption	12 per unit	70	840.00
7. Total Energy Charges			4,43,434.35
8. Demand Charges	350 per KVA	2250	7,87,500.00
9. Total Demand and Energy Charges			12,30,934.35
ADD			
10.For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs/Unit			
11. Meter Rent(including 9 %SGST&9 %CGST)			3,068.00
12. Belated Payment Surcharge for Govt service @0.5%			
13. Extra Levy for exceeding limits (Incl. 18% GST)			
a) Contracted Max. Dmd at	0 per KVA	0	0.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges (Incl. 18% GST)			0.00
16. Cross Subsidy Surcharge (Incl. 18% GST)			0.00
17. Electricity Tax			29,080.00
18. Adjustment Charges(Affecting) (Incl. 18% GST)			0.00
Rounding off			0.00
19. Assessment Amount			12,63,082.00
20. Adjustment Charges(Not Affecting) (Incl. 18% GST)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset @10 /unit			0.00
Net Total			12,63,082.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Tax collected at source			12,681.00
Net Amount Payable			12,75,763.00

Rupees : Twelve Lakhs Seventy Five Thousand Seven Hundred and Thirteen Only

Amount Payable after due date & upto 24-Feb-21 12,85,068.00 (i.e 15 days Notice Period)

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

RTGS Payment should be made for the exact Bill Amount. Any Par/Excess/Short Amount will be rejected.

This Bill is subject to the Audit, Outcome of the Court Cases, etc., if any, before the appropriate forum.

E.& OE FOR DEPUTY FIN. CONTROLLER

TamilNadu Generation and Distribution Corporation Ltd.

High Tension Bill (Provisional) for the Month of February 2021

TANGEDCO CIN No:U40109TN2009SGC073746 GST No:33AADCT4784E1ZC

HSN : 27160000 SAC : 996912

**** Electrical Energy & Distribution Services are exempted under GST ****

To:	SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY	Service No.	099094011060
	JEPPIAAR NAGAR,RAJIV GANDHI SALAI,OLD MAMALLAPURAM ROAD CHENNAI	Bill No.	H4011060022111
		Date of Bill	03-Mar-21
	SHOLINGANALLUR - 2	Due Date	09-Mar-21
	Sholinganallur	Tariff App. / Bld.	HT IIB / HT IIB
	Kancheepuram - 600119	GST No :	111111111111111

Permitted MD :	2500 KVA	Transformer Loss :	0units/0KVA	Tr. CAP.	0 KVA

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per unit	118224	7,50,722.40
2. Peak Hour Consumption	1.27 per unit	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per unit	0 (-)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	8.05 per unit	173	1,392.65
6. Temp. Supply Consumption	12 per unit	678	8,136.00
7. Total Energy Charges			7,60,251.05
8. Demand Charges	350 per KVA	2250	7,87,500.00
9. Total Demand and Energy Charges			15,47,751.05
ADD			
10.For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs./unit			
11. Meter Rent(Including 9 %SGST&9 %CGST)			3,068.00
12. Belated Payment Surcharge for Govt service @0.5%			
13. Extra Levy for exceeding limits (Incl. 18% GST)			
a) Contracted Max. Dmd at	0 per KVA	0	0.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges (Incl. 18% GST)			0.00
16. Cross Subsidy Surcharge (Incl. 18% GST)			0.00
17. Electricity Tax			45,853.00
18. Adjustment Charges(Affecting) (Incl. 18% GST)			0.00
Rounding off			0.00
19. Assessment Amount			15,96,672.00
20. Adjustment Charges(Not Affecting) (Incl. 18% GST)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset 0.10 /unit			0.00
Net Total			15,96,672.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Tax collected at source			15,967.00
Net Amount Payable			16,12,639.00

Rupees : Sixteen Lakhs Twelve Thousand Six Hundred and Thirty Nine Only

Amount Payable after due date & upto	24-Mar-21	16,24,390.00	(i.e 15 days Notice Period)

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

RTGS Payment should be made for the exact Bill Amount. Any Part/Excess/Short Amount will be rejected.

This Bill is subject to the Audit, Outcome of the Court Cases, etc., if any, before the appropriate forum.

TamilNadu Generation and Distribution Corporation Ltd.

High Tension Bill (Provisional) for the Month of March 2021

TANGEDCO CIN No:U40109TN2009SGC073746 GST No:33AADCT4784E1ZC

HSN : 27160000 SAC : 996912

**** Electrical Energy & Distribution Services are exempted under GST ****

To:			
	SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY	Service No.	099094011060
	JEPPIAAR NAGAR,RAJIV GANDHI SALAI,OLD MAMALLAPURAM ROAD CHENNAI	Bill No.	H4011060032111
		Date of Bill	07-Apr-21
		Due Date	13-Apr-21
	SHOLINGANALLUR - 2	Tariff App. / Bld.	HT IIB / HT IIB
	Sholinganallur		
	Kancheepuram - 600119	GST No :	111111111111111

Permitted MD :	2500 KVA	Transformer Loss :	Units/0KVA	Tr. CAP.	0 KVA

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per unit	165547	10,51,223.45
2. Peak Hour Consumption	1.27 per unit	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per unit	0 (-)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	8.05 per unit	399	3,211.95
6. Temp. Supply Consumption	12 per unit	854	10,248.00
7. Total Energy Charges			10,64,683.40
8. Demand Charges	350 per KVA	2250	7,87,500.00
9. Total Demand and Energy Charges			18,52,183.40
ADD			
10.For Non-Availing the supply at the Required Voltage 11 KV at 0.10 Rs./unit			
11. Meter Rent(Including 9 %SGST&9 %CGST)			3,068.00
12. Belated Payment Surcharge for Govt service @0.5%			
13. Extra Levy for exceeding limits (Incl. 18% GST)			
a) Contracted Max. Dmd at	0 per KVA	0	0.00
14. Compensation Charges for low PF			0.00
15. Harmonics Compensation Charges (Incl. 18% GST)			0.00
16. Cross Subsidy Surcharge (Incl. 18% GST)			0.00
17. Electricity Tax			65,361.70
18. Adjustment Charges(Affecting) (Incl. 18% GST)			0.00
Rounding off			0.30
19. Assessment Amount			19,20,613.00
20. Adjustment Charges(Not Affecting) (Incl. 18% GST)			0.00
21. SD Refund amount / ASD amount if any			
22. Self Generation Tax			0.00
23. Self Generation Tax for Diesel Genset 0.10 /unit			0.00
Net Total			19,20,613.00
Less: Amount Deductable due to Court Case			0.00
Less: Amount Deductable due to Advance CC			0.00
Tax collected at source			
Net Amount Payable			19,20,613.00

Rupees : Nineteen Lakhs Twenty Thousand Six Hundred and Thirteen Only

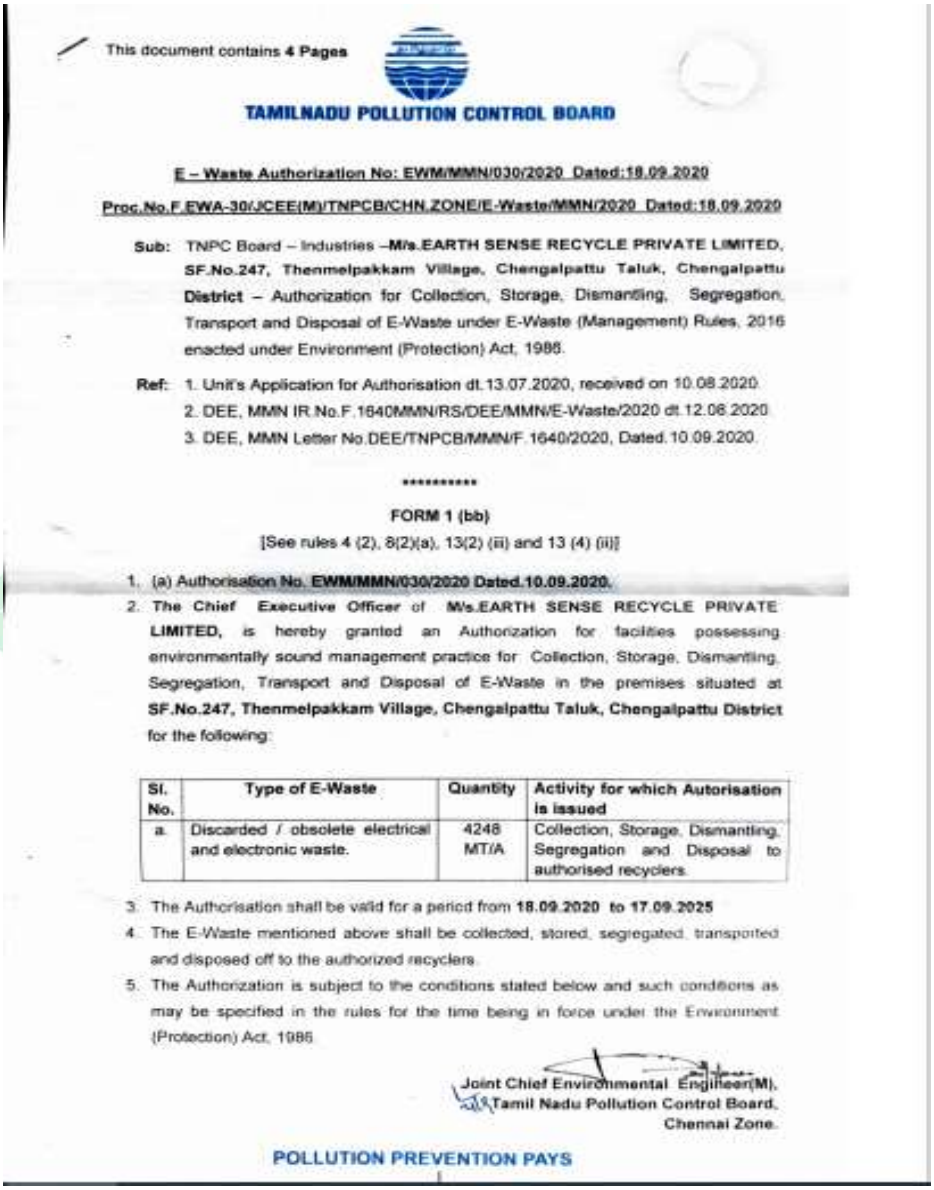
Amount Payable after due date & upto	28-Apr-21	19,34,527.00	(i.e 15 days Notice Period)

If the last day of the due date happens to be a holiday, the due date shall be extended till the next working day.

RTGS Payment should be made for the exact Bill Amount. Any Part/Excess/Short Amount will be rejected.

This Bill is subject to the Audit, Outcome of the Court Cases, etc., if any, before the appropriate forum.

E-WASTE AUTHORIZATION



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TAMILNADU POLLUTION CONTROL BOARD

E – Waste Authorization No: EWM/MMN/030/2020 Dated:18.09.2020

Proc.No.F.EWA-30/JCEE(M)/TNPCB/CHN.ZONE/E-Waste/MMN/2020 Dated:18.09.2020

Sub: TNPC Board – Industries –**M/s.EARTH SENSE RECYCLE PRIVATE LIMITED, SF.No.247, Thenmelpakkam Village, Chengalpattu Taluk, Chengalpattu District** – Authorization for Collection, Storage, Dismantling, Segregation, Transport and Disposal of E-Waste under E-Waste (Management) Rules, 2016 enacted under Environment (Protection) Act, 1986.

Ref: 1. Unit's Application for Authorisation dt.13.07.2020, received on 10.08.2020.
2. DEE, MMN IR.No.F.1640MMN/RS/DEE/MMN/E-Waste/2020 dt.12.08.2020.
3. DEE, MMN Letter No.DEE/TNPCB/MMN/F.1640/2020, Dated.10.09.2020.

****

FORM 1 (bb)

[See rules 4 (2), 8(2)(a), 13(2) (ii) and 13 (4) (ii)]

1. (a) Authorisation No. **EWM/MMN/030/2020 Dated.10.09.2020.**
2. **The Chief Executive Officer** of **M/s.EARTH SENSE RECYCLE PRIVATE LIMITED,** is hereby granted an Authorization for facilities possessing environmentally sound management practice for Collection, Storage, Dismantling, Segregation, Transport and Disposal of E-Waste in the premises situated at **SF.No.247, Thenmelpakkam Village, Chengalpattu Taluk, Chengalpattu District** for the following:

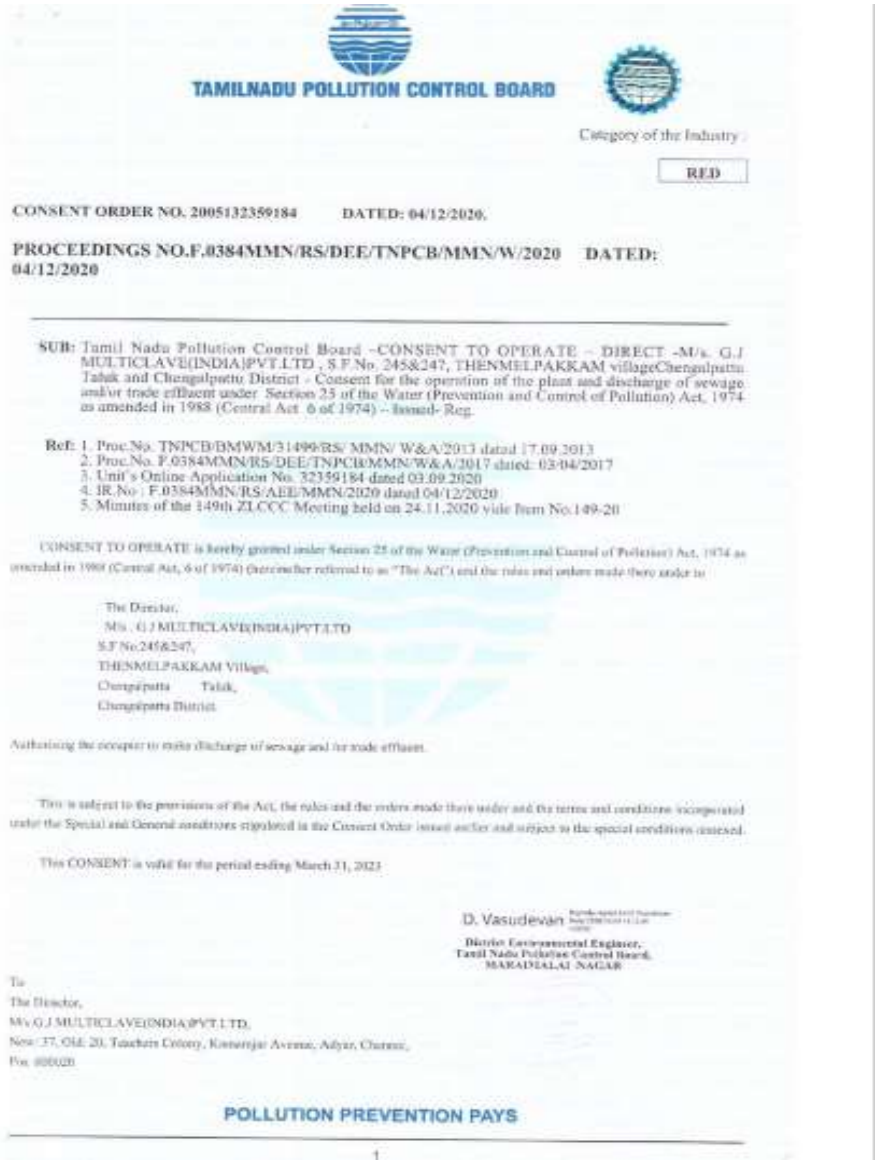
Sl. No.	Type of E-Waste	Quantity	Activity for which Autorisation is issued
a.	Discarded / obsolete electrical and electronic waste.	4248 MT/A	Collection, Storage, Dismantling, Segregation and Disposal to authorised recyclers.

3. The Authorisation shall be valid for a period from **18.09.2020 to 17.09.2025**
4. The E-Waste mentioned above shall be collected, stored, segregated, transported and disposed off to the authorized recyclers.
5. The Authorization is subject to the conditions stated below and such conditions as may be specified in the rules for the time being in force under the Environment (Protection) Act, 1986.

Joint Chief Environmental Engineer(M),
Tamil Nadu Pollution Control Board,
Chennai Zone.

POLLUTION PREVENTION PAYS

TNPCB - CONSENT TO OPERATE



TAMILNADU POLLUTION CONTROL BOARD

Category of the Industry

RED

CONSENT ORDER NO. 2005132359184 DATED: 04/12/2020.

PROCEEDINGS NO.F.0384MMN/RS/DEE/TNPCB/MMN/W/2020 DATED: 04/12/2020

SUB: Tamil Nadu Pollution Control Board -CONSENT TO OPERATE - DIRECT -M/s. G.J MULTICLAVE(INDIA)PVT.LTD , S.F.No. 245&247, THENMELPAKKAM villageChengalpattu Taluk and Chengalpattu District - Consent for the operation of the plant and discharge of sewage and/or trade effluent under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988 (Central Act 6 of 1974) -- Issued- Reg.

Ref: 1. Proc.No. TNPCB/BMWM/31499/RS/ MMN/ W&A/2013 dated 17.09.2013
2. Proc.No. F.0384MMN/RS/DEE/TNPCB/MMN/W&A/2017 dated: 03/04/2017
3. Unit's Online Application No. 32359184 dated 03.09.2020
4. IR.No : F.0384MMN/RS/AEE/MMN/2020 dated 04/12/2020
5. Minutes of the 149th ZLCCC Meeting held on 24.11.2020 vide Item No.149-20

CONSENT TO OPERATE is hereby granted under Section 25 of the Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988 (Central Act, 6 of 1974) (hereinafter referred to as "The Act") and the rules and orders made there under to

The Director,
M/s. G.J MULTICLAVE(INDIA)PVT.LTD
S.F No.245&247,
THENMELPAKKAM Village,
Chengalpattu Taluk,
Chengalpattu District

Authorizing the occupier to make discharge of sewage and /or trade effluent.

This is subject to the provisions of the Act, the rules and the orders made there under and the terms and conditions incorporated under the Special and General conditions stipulated in the Consent Order issued earlier and subject to the special conditions annexed.

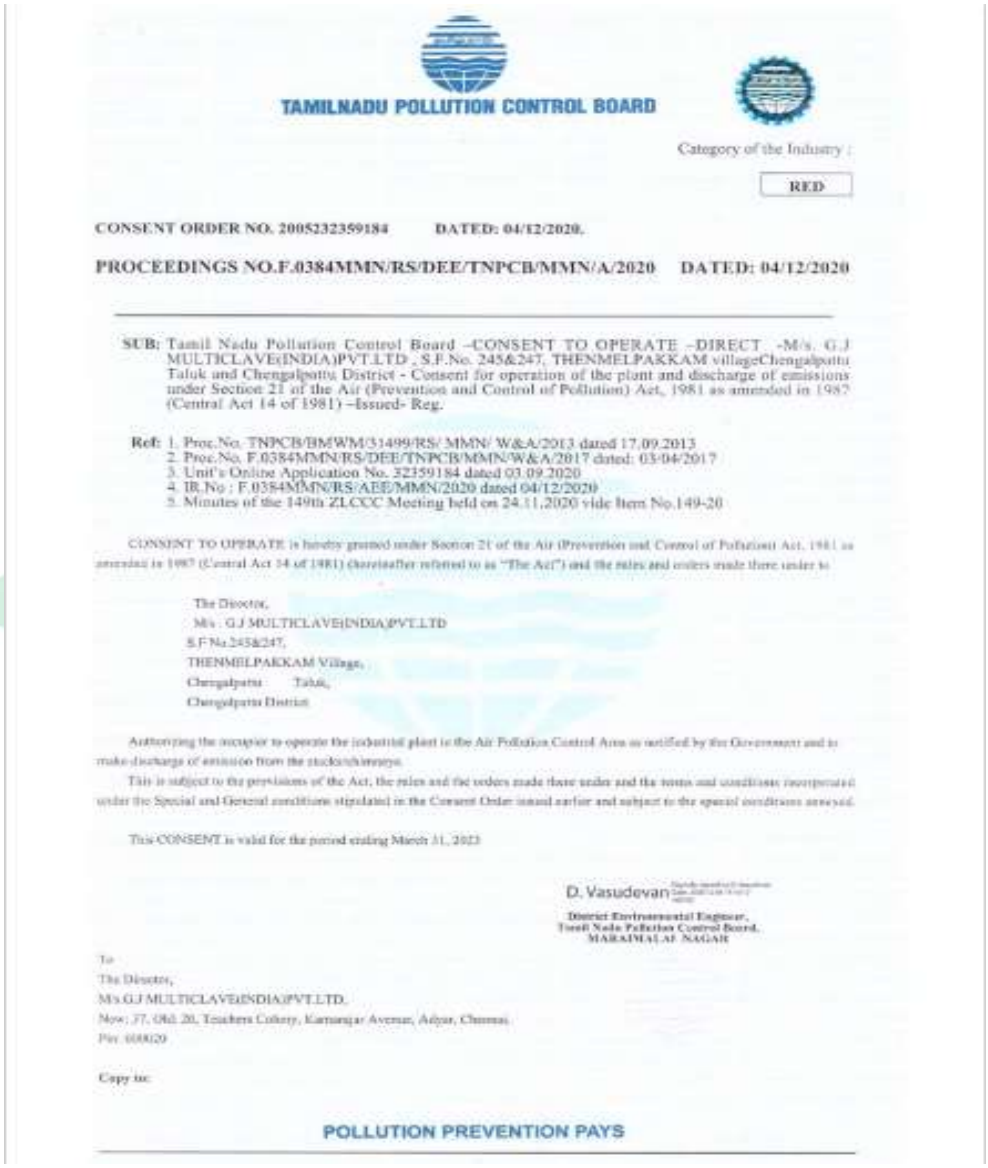
This CONSENT is valid for the period ending March 31, 2021

D. Vasudevan
District Environmental Engineer,
Tamil Nadu Pollution Control Board,
MAMALLAI NAGAR

To
The Director,
M/s G.J MULTICLAVE(INDIA)PVT.LTD,
New: 37, Old: 20, Teachers Colony, Kasturiba Avenue, Adyar, Chennai,
Pin: 600020

POLLUTION PREVENTION PAYS

1



TAMILNADU POLLUTION CONTROL BOARD

Category of the Industry :

RED

CONSENT ORDER NO. 20052323591184 DATED: 04/12/2020.

PROCEEDINGS NO.F.0384MMN/RS/DEE/TNPCB/MMN/A/2020 DATED: 04/12/2020

SUB: Tamil Nadu Pollution Control Board –CONSENT TO OPERATE –DIRECT -M/s. G.J MULTICLAVE(INDIA)PVT.LTD , S.F.No. 245&247, THENMELPAKKAM villageChengalpattu Taluk and Chengalpattu District - Consent for operation of the plant and discharge of emissions under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 as amended in 1987 (Central Act 14 of 1981) –Issued- Reg.

Ref: 1. Proc.No. TNPCB/BMWM/31499/RS/ MMN/ W&A/2013 dated 17.09.2013
2. Proc.No. F.0384MMN/RS/DEE/TNPCB/MMN/W&A/2017 dated: 03/04/2017
3. Unit's Online Application No. 32359184 dated 03.09.2020
4. IR.No : F.0384MMN/RS/AEE/MMN/2020 dated 04/12/2020
5. Minutes of the 149th ZLCCC Meeting held on 24.11.2020 vide Item No.149-20

CONSENT TO OPERATE is hereby granted under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 as amended in 1987 (Central Act 14 of 1981) (hereinafter referred to as "The Act") and the rules and orders made there under to

The Director,
M/s . G.J MULTICLAVE(INDIA)PVT.LTD
S.F No.245&247,
THENMELPAKKAM Village,
Chengalpattu Taluk,
Chengalpattu District

Authorizing the occupier to operate the industrial plant in the Air Pollution Control Area as notified by the Government and to make discharge of emission from the stacks/chimneys.

This is subject to the provisions of the Act, the rules and the orders made there under and the terms and conditions incorporated under the Special and General conditions stipulated in the Consent Order issued earlier and subject to the special conditions annexed.

This CONSENT is valid for the period ending March 31, 2023

D. Vasudevan
District Environmental Engineer,
Tamil Nadu Pollution Control Board,
MAHAMALAI NAGAR

To
The Director,
M/s.G.J MULTICLAVE(INDIA)PVT.LTD.
New: 37, Old: 20, Teachers Colony, Kamarajar Avenue, Adyar, Chennai.
Pin: 600020

Copy to:

POLLUTION PREVENTION PAYS

Sewage Treatment Plant Test Report for Treated Sewage Sample (2020)

ECES
Eco Care Engineering Systems

TEST REPORT

Report No	: ECES/LAB/2019-20/067	Report Date	: 27.01.2020
Sample Description	: Treated Sewage sample	Received on	: 23.01.2020
Sample Collected from	:M/s.Sathyabama Institute of Science and Technology Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 119		
Sample Drawn by	: M/s. Eco Care Engineering Systems	Commenced on	: 23.01.2020
		Completed on	: 27.01.2020

S.No	Test Parameters	Protocol	Results	TNPCB Tolerance Limit for Sewage
1.	pH at 25° C	IS:3025 Part: 11-1983 (Reaff:2012)	7.85	5.5 - 9.0
2.	Total Suspended Solids	IS:3025 Part 17-1984 (Reaff:2012)	17 mg/l	30 mg/l
3.	Total Dissolved Solids	IS:3025 Part 16-1984 (Reaff:2012)	1012 mg/l	--
4.	BOD @ 27° C for 3 days	IS:3025 Part 44-1993 (Reaff:2014)	11 mg/l	20 mg/l
Note: BDL: Below Detection Limit, DL: Detection Limit.				

Note: This report relates only to the particular sample submitted for test. Any correction not attested shall invalidate this report. Retention period of tested sample is one month only. This report is strictly confidential. Its use for publicity, arbitration or as evidence in legal disputes is strictly forbidden.

Chemist

Eco Care Engineering Systems CHENNAI 600 016.

for Eco Care Engineering Systems

Authorized Signatory

No.10/25, Egambara Dabedhar Street, Alandur, Chennai - 600 016. Tel : 044-22311125 Telefax : 044-22311125 E-mail : ecocare.cp@gmail.com