# SATHYABAMA
## INSTITUTE OF SCIENCE AND TECHNOLOGY

# ENVIRONMENT FRIENDLY PRACTICES

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# SATHYABAMA
## INSTITUTE OF SCIENCE AND TECHNOLOGY
**DEEMED TO BE UNIVERSITY**
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# ENVIRONMENT FRIENDLY PRACTICES

## 1.1 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.

## 1.2 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.

## 2. Waste Audit

Waste audit is a valuable step in managing an organization's waste in a more environmentally friendly manner, while helping in the reduction of waste disposal costs. The institution with the active involvement of Centre for Waste Management has facilitated the pursue of Waste audit which is one of the primary Waste Management Policies. Waste Audit is done by an authorized Auditor who is involved in the assessment of the waste generated by the Institution with the support of his team and an Internal Waste Audit Committee.

### 2.1 Waste Audit Committee (WAC)

#### 2.1.1 Internal Waste Audit Committee

The institution has formulated a Waste Audit Committee nominated by the Vice Chancellor and approved by the Chancellor. The committee comprises of members from different Engineering and Science background to eventually evaluate and assess the management strategies of the different types of waste generated within campus followed by the External Agency audit.

### 2.2 Waste Management Policy

The institution practices a step-by-step process to conduct Waste Audit and monitors waste generated within campus prioritizing it as an important policy. Various records and documents are verified several times to clarify the waste data received through survey and discussions. Following are the policies governed in the institution to manage the Waste.

- Involvement of Student Eco Clubs supervised by the Internal Waste Audit Committee (WAC)
- Waste Source/ Site inspection pursued by the members of the WAC dividing the student members into groups led by the members of the WAC to audit the various types of waste generated inside the institution.
- Interviews held and Questionnaire responses collected from the in-charges of different waste generation locations. For example, mess supervisor for food waste, STP Head for waste water data, Systems Administrator for E-waste etc.,
- Creating Awareness on the importance of waste segregation at the source among the students, teaching, non-teaching, and research faculties in the Institution.
- Generating and Maintaining Waste Records in duly available forms published in Solid

Waste Management Rules by the Central Pollution Control Board governed by the Ministry of Environment Forest and Climate Change.

- 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 Auditing is when they are carried out at defined intervals, and their results and recommendations can bring improvement or change over time. Hence Periodic Review of Documents and Records by Internal Waste Audit Committee and Annual Waste Audit conducted at the end of every financial year by the Authorized External Waste Audit Committee.

## 3.0 Solid Waste Management

Solid waste often includes wasted material resources that could otherwise be channelized into better service through recycling and reuse. Several 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. Solid waste generated in the Institution comprises 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. The composition of solid waste generated in the institution is given in Figure 2.

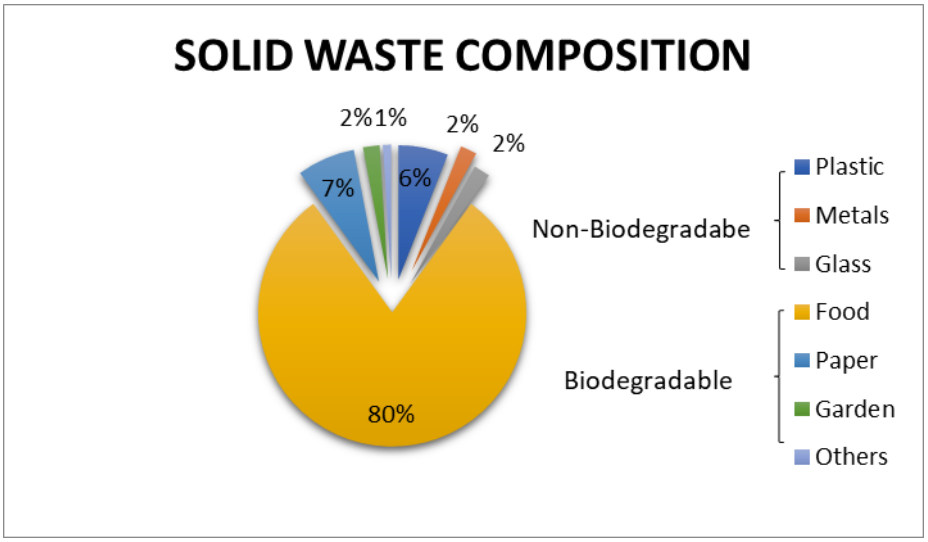

Figure 2: Solid waste composition of the Institute

### 3.1 Strategies adopted to handle solid waste in campus

- The average quantity of biodegradable wastes generated (Paper, dried leaves, vegetation, garden waste, except food waste) is 804 kg/year. Paper Waste like Newspaper, Magazines, Cardboard, Box Board are disposed by selling it to vendors in exchange of recycled papers. Other Solid waste like clothing, tetra cups, dried leaves are disposed by giving away to the Corporation.
- Metal waste including Steel chairs, scrap cupboards, racks generated is disposed by selling to Scrap dealers.
- Glass waste generated was recycled and reused, non- recyclable glass waste was given to Corporation.

### 3.2 Plastic Waste Management

The projection of plastic wastes generated in low-income countries, lower middle income and upper-middle-income countries increase by 1% barely from 2009 to 2025. The quantity of plastic wastes generated in lower-middle-income countries has been estimated to be around 124 MMT per year in 2025, would be a record as the highest when compared to the low income, upper middle income as well as high income countries .In India, 43% of plastics used in packaging enter the landfills after the first use. The average per capita consumption of plastic in India is about 11 kg, which is considerably low as compared to the global average of 28 kg.

From the 'consumption' point of view, secondary resources fall under the 'pre' and the 'post' consumer category. Pre-consumer resources are also known as post-industrial and include the wastes generated during the extraction and the manufacturing process of any product. Commodities or materials discarded by the public after consumption or use; worn out or old fashioned that do not meet the living and changing aspirations of the people fall under the post-consumer wastes.

- Plastic waste like milk covers, plastic covers are segregated at the source and are disposed by selling it to the vendors who are involved in recycling the plastic covers into granules as shown in the Figure 3 below for the manufacture of dust bins made

from recycled plastic.


**Figure 3 Plastic granules from different sources**

- Major quantum of PET bottles is diverted to the architecture department for sustainable building research as shown in Figure 4.


**Figure 4** PET bottles covers is used as sustainable building research for the department of Architecture

Filled with water and bundled together | vertically Interlocked and bundled | Cut petaloid bases as fillers | Randomly tied to a vertical support

Physically modified and interlocked

**(d)**

**Figure 4 (a) Decorative display of PET bottles, (b) Size reduced PET bottles ready for grinding, (c ) PET flakes, (d) Sustainable Building Models with waste Plastic bottles**

### 3.3 Food Waste Management

Current estimates put global food loss and waste between one-third and one-half of all food produced. Food loss or food waste is food that is discarded or lost uneaten. However, precise definitions are contentious, often defined on a situational basis (as is the case more generally with definitions of waste). Food wastage cripples a country's economy to an extent that most of us are unaware. If food is wasted, there is so much waste of water used in agriculture, manpower and electricity lost in food processing industries and even contributes to deforestation. Taking all of into consideration, the actual worth of money per year in India from food wastage is estimated to be Rs. 58,000 crore. Apart from the financial loss, food waste causes immense environmental deterioration and health hazards being a host for

several disease causing microbes. Being a cosmopolitan country holding 6th position in tourism and hospitality industries according to the reports released in March,2018 generation of food waste will always be an issue to be looked into and needs serious attention.

- Food waste generated in the mess are 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 as represented in Figure 5. The average quantity of food waste generated is 41250 kg/ year.
- A portion of the food waste is diverted for research to the Centre for Waste Management where its potential to derive value added products including organic pots, activated carbon for wastewater treatment and microbial fuel cells for biohydrogen production are explored as shown in Figure 6.

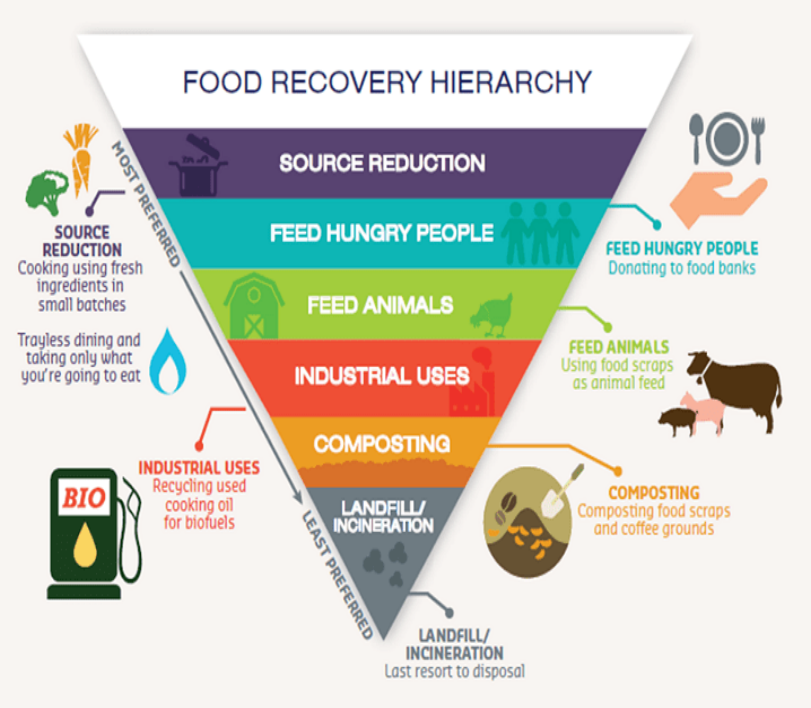


**Figure 5: Food Waste Management Hierarchy**

**(a)**


**Figure 6 (a) Organic Pot from Food Waste, (b) Activated Carbon from Food Waste**

### 3.4 Ritual Waste Management

In India, people show their religious devotion by offering flowers to the deity. Every year around 800 million tons of blossoms of red roses, prickly xanthiums, and yellow marigolds are used for worship at the temples, churches, mosques and gurudwaras, which creates waste deposition problems. The faith and emotions underlying these ritual wastes should make one prevent from throwing these wastes to the landfills. However, practically this does not happen; the ritual waste is either disposed on to the lands or thrown into water. This action leads to contamination of land and water thus becoming a breeding ground for mosquitoes spreading foul odour and diseases. The spent ritual waste may contain pesticides or other chemicals sprayed on to them to retain freshness, that when disposed on to the land or water bodies leach into the environment. Most places of worship have no mechanism to effectively dispose this ritual floral waste. To avoid additional pollutant load on landfills and water bodies recovery of ritual flower rejects becomes very important.

This ritual waste is very common throughout India. Centre for Waste Management, Sathyabama Institute of Science and Technology, Chennai has taken steps to collect ritual waste and has succeeded in making incense sticks adapting the 3R concept of Recovery, Recycle and Reuse. Collecting the ritual waste and processing it to obtain a value added material does not only provide options to make the environment clean but also serves as a potential for Rural Industrialization and entrepreneurship development, by initiating this objective in smaller demographic zones. Hence, to go in line with the Unnat Bharat Abhiyan, of bringing technologies to community for societal benefit, Centre for Waste Management at Sathyabama Institute of Science and Technology is submitting this Technology Development proposal to benefit economically backward women of the Kumizhi village.

Worn out flowers used for decoration and worship converted to Incense Sticks as shown in Figure 7 through the Microenterprise POOMANAM established in KUMIZHI, Sathyabama Institute of Science and Technology adopted village for the UNNAT BHARAT ABHIYAN, Govt. of India Scheme.


**Figure 7 POOMANAM Incense sticks from Ritual waste**

### 3.5 Biomedical Waste Management Policies

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. 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.

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.

Sathyabama Dental College and Hospital is using color coded bins for all types of Bio Medical Wastes being generated as shown in Figure 8 and the quantity generated in each category is represented in Figure 9.

#### 3.5.1 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.


**Figure 8: Colour coded dustbins and bags used in the institution**

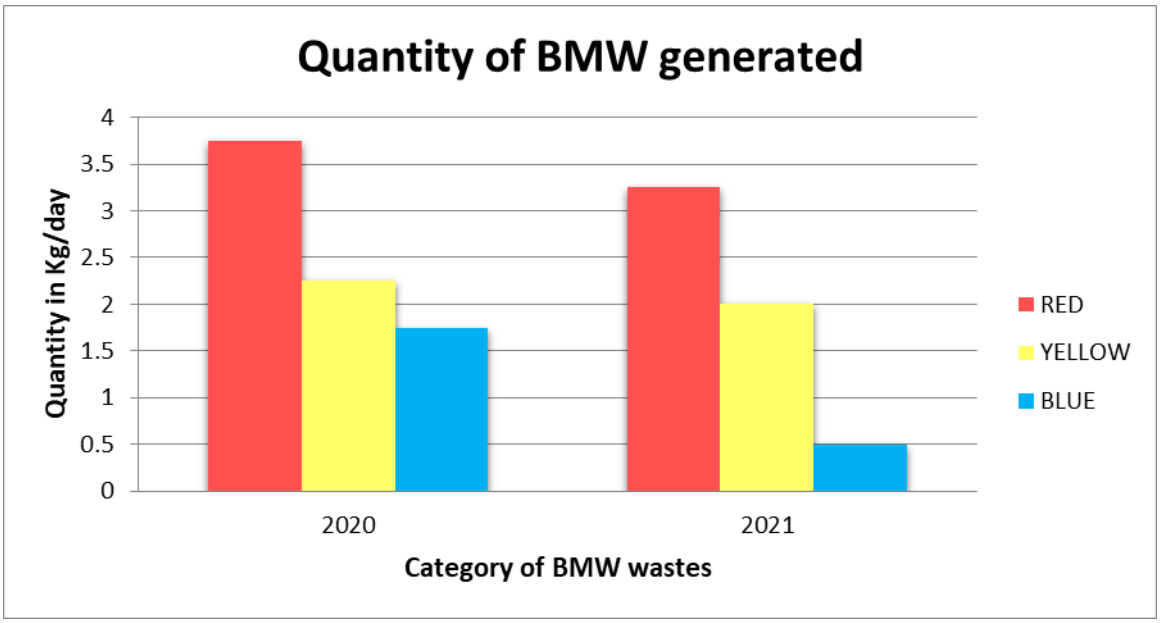


**Figure 9 Quantity of Biomedical Waste Generated**

### 3.5.2 Biomedical Waste Handling Policies

- 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

### 3.5.3 Institutional Best Practices

- 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 research.
- 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

## 3.6 E-Waste Management

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.

### 3.6.1 Best Practices 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

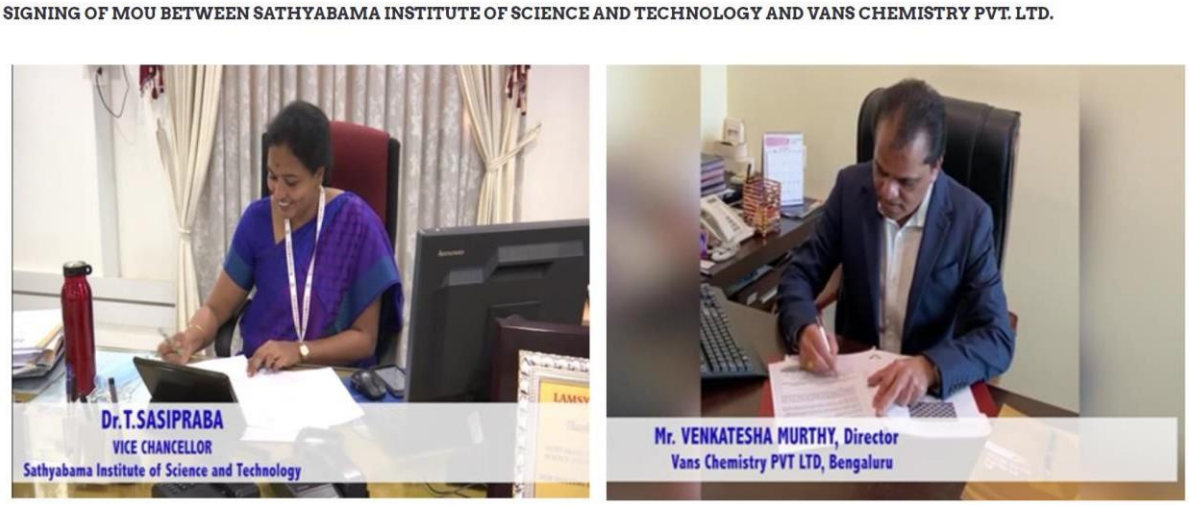


**Figure 10 Signing of MoU for E-Waste Mangement**

- 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. (A E-Waste Management Company) is 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 for which a Memorandum of Understanding has been signed as shown in Figure.
- Institution is conducting periodic awareness programs for safe dismantling of E-Waste for students, faculties, children and general public as shown in Figure 11.

**Figure 11 An Awareness on E-Waste to inmates of a residential complex in Navallur**

The participants were given an overview of the sources, harms and impacts of Waste Electrical Electronic Equipments. Questionnaires were distributed and instructions were given to them to enable them collect and giveaway the household generated E-Waste during the Collection drive planned shortly. Kids participated enthusiastically in the games organized. Aloe Vera, Basil and Coleus ( Karpooravalli) saplings were given to emphasize the medicinal effects they have in treating the health hazards associated with the exposure of E-Waste (Figure 12).


**Figure 12 Distribution of Medicinal plants to the prize winners in the E-Waste Management Questionnaire competition**

## 4. Liquid Waste Management

Sathyabama Institute of Science and Technology has adopted a comprehensive approach to water management with strong emphasis on re-use. The campus operates a 1.5 MLD Sewage Treatment Plant (STP) that treats wastewater from all buildings, and the treated water is systematically re-used for gardening, landscaping, and toilet flushing, thereby reducing dependence on fresh water sources. In addition, storm water is collected through drainage channels and diverted into rainwater harvesting pits, while roof-top harvesting structures further enhance conservation and re-use. The institution's RO unit ensures safe drinking water, while its water maintenance division actively prevents leakage, reinforcing the culture of efficiency and re-use. Waste cooking oil from the mess is converted into biodiesel, which is re-used to partially fuel buses, generators, and pump sets, showcasing a circular approach to liquid waste management.

The major liquid waste generated in campus is

i) Sewage from all buildings in campus

ii) Waste Cooking Oil from the Institution Mess Kitchen

Measures have been taken to handle both the waste by establishing a Sewage Treatment Plant in campus to handle the wastewater and obtain treated water for toilet flushing and gardening. The waste cooking oil generated is converted into biodiesel used for fueling buses partially and for the operation of Generators and pump sets.

### 4.1 Wastewater management

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 rainwater harvesting pits. The Institution has also made facilities for roof to rainwater 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.

#### 4.1.1 Wastewater management policies

- The various usage points of water 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. Sewage Treatment Plant (STP) of 1.5 MLD capacity (Figures 13,14) has been installed to treat the wastewater which is then diverted to gardening and flushing.
- 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.


**Figure 13: STP Overview**

**Figure 14 Water treatment Plant**

The treatment of the sewage is explained in Figure 15. The water quality obtained after treatment is checked and is found to meet the pollution control board standards for gardening and toilet flushing requirements. The report is shown in Figure 16. The Standard Sewage treated water quality is also shown for comparison.

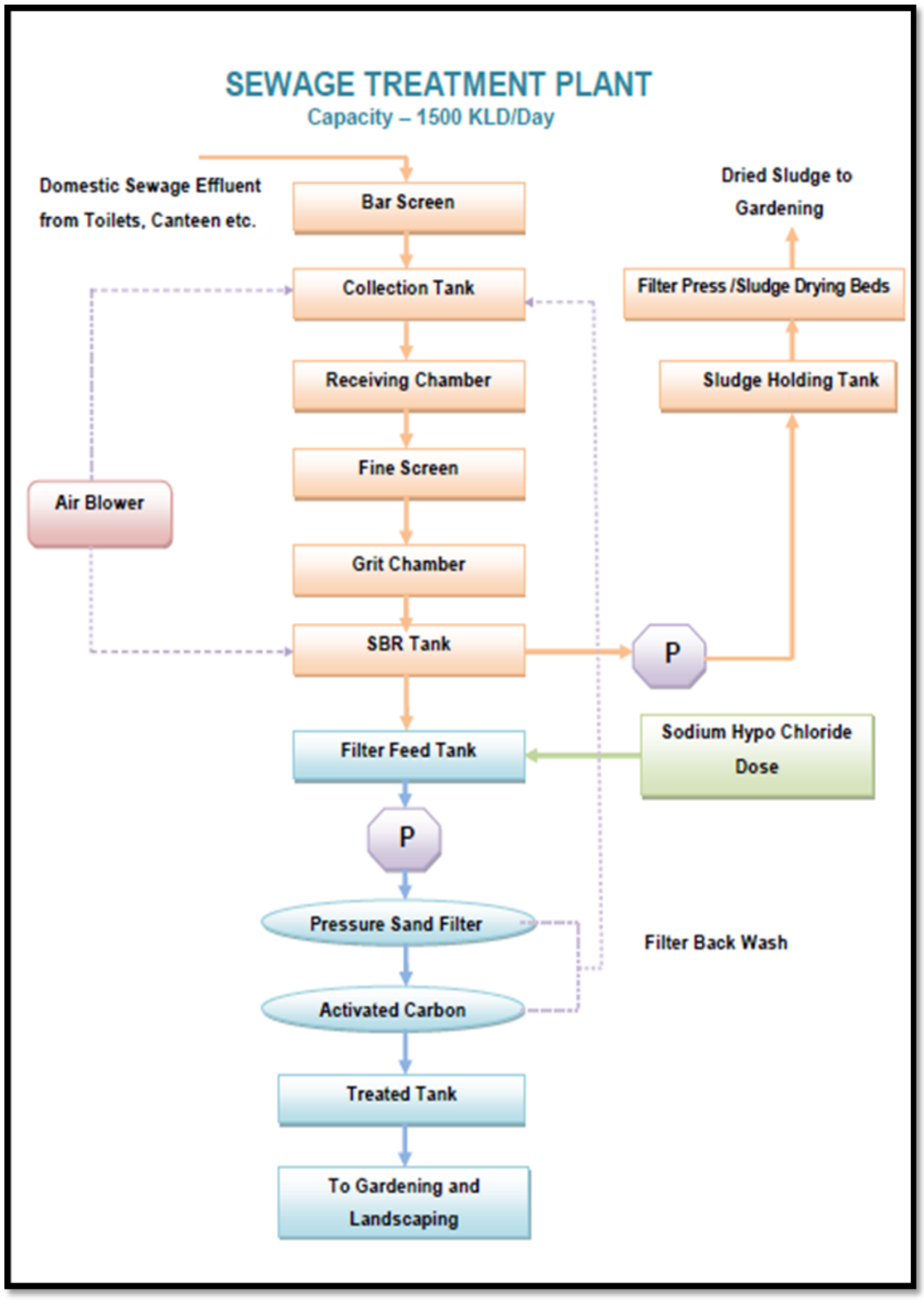


**Figure 15 Sewage Treatment Plant Process Flow Diagram**

### 4.2 Waste Cooking Oil Managment

The other major liquid waste generated is the waste cooking oil (WCO) is converted into biodiesel with its quality further improved by blending WCO with the algal oil and further converted into biodiesel with improved cold flow properties and oxidation stability. Waste Cooking Oil biodiesel is also provided for irrigation water pump sets. Experiments were also done to use the biodiesel made to operate gensets and proved effective. This measure was taken to divert the biodiesel produced as buses were not operated due to the pandemic situation.


**Figure 17 Pilot Scale Biodiesel Production Unit at CWM, Sathyabama**


**Figure 18 Biodiesel powered water pumpset**

**Figure 19 Biodiesel Powered Institution bus**

## 5. Carbon Footprint

Carbon Footprint is a measure of total quantity of greenhouse gases being emitted by an individual or an Institution because 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 organizations and institutions want to reduce their carbon dioxide ($CO_2$) 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 $CO_2$ 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 staff. 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.

## 5.1 Policies to reduce Carbon Footprint

Feasible emission inventories are selected to analyze the carbon footprint of the campus. 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 are collected and maintained. Parameter wise and zone wise details are also collected. The received data are compiled, analysed and the missing gaps are recognized.

### 5.1.1 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 $CO_2$, if 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.

### 5.1.2 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 are 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.

The Institution runs 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.

### 5.1.3 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 are surveyed. If the number of classrooms and labs are more in a zone, consumption of electricity in that zone is more.

The Institution is moving towards use 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.

### 5.1.4 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 mess and hostels.

The solid waste generated in the mess 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.

### 5.1.5 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 mess and hostels are surveyed. The Institution implemented the solar power to run the kitchens. It is Asia's largest solar powered Kitchen.

### 5.2 Carbon Footprint Analysis

Carbon footprint analysis is done by suitably combining data collected with respective emission factor of the selected emission inventories as shown in Figure 20.

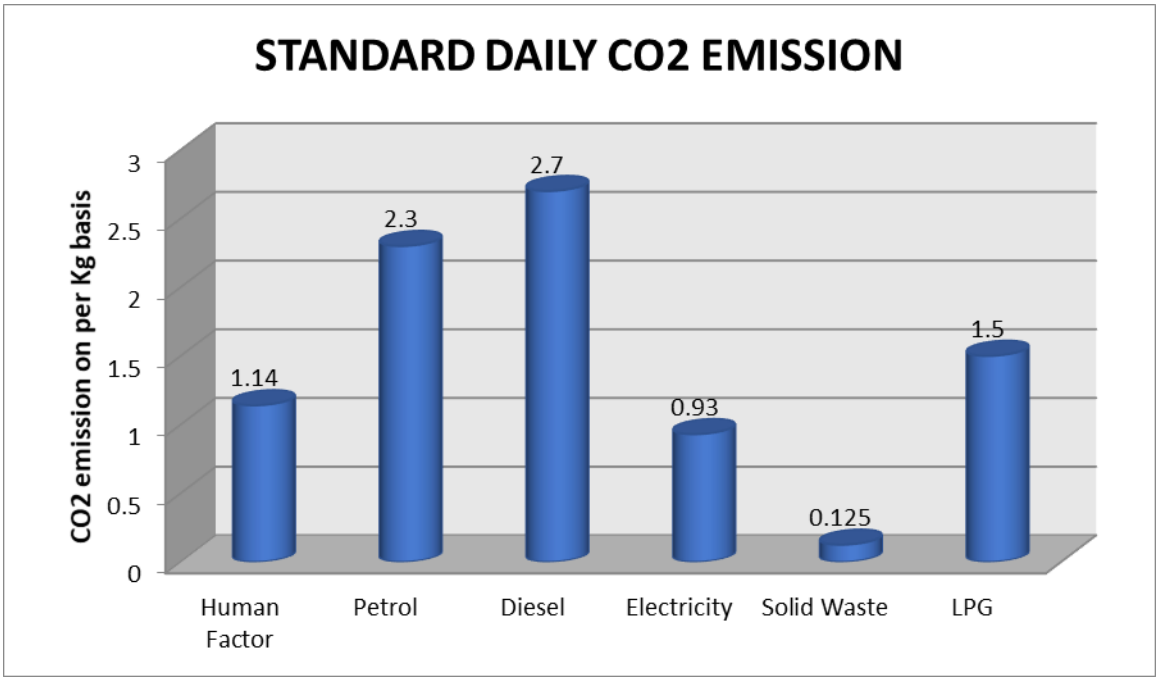


**Figure 20 Standard daily $CO_2$ emitted by different emission inventories at the Institute**

### 5.3 Carbon Footprint Reduction Policies

- Restriction of personal vehicle inside the campus enhancing reduction of carbon foot prints
- Use of battery operated Vehicles to commute inside the campus (Figure 21)
- Blending of Conventional fuel with biodiesel generated from Waste Cooking Oil for operating buses thereby reducing the carbon footprint (Figure 24)
- Use of Solar and Wind Hybrid system power the laboratory thereby reducing dependence on Conventional power
- Use of Solar Lamps to light the Walkways (Figure 22, 23)
- 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.


**Figure 21 Battery car**

**Figure 22 Solar lamps**

**Figure 23 Solar panels with controller**


**Figure 24 Biodiesel (15%) run bus**

**Figure 25 Wind Mill**