Audit Reports

For

SCMS School of Engineering and Technology, Karukutty

Prepared by

SCMS School of Engineering and Technology, Karukutty, Ernakulam

January 2019-2020

Contents

1. Introduction

1.1 Background

SCMS School of Engineering and Technology (SSET) is a technological institute in Kerala which offers graduate and postgraduate programs in engineering and technology. The college was established in 2001 on a 29-acre (117,359 m^2) campus at Karukutty, Ernakulam District, Kerala. The campus has a total built up area of about 1,57,440 square feet which includes one administrative block, two academic blocks, ladies hostel, junior men's hostel, laboratories, canteen and auditorium. Senior men's hostel is outside the campus. The campus has strength of 210 staff and 1650 students, out of which 629 reside in the campus. The canteen is equipped to provide food for about 700-800 persons per day.

The major source of water for the campus is the bore wells. Electricity for the entire campus is provided by KSEB. In 2019 SCMS has applied for installation of solar panels with a capacity to generate 250 kW energy under scheme 1 and 2 of KSEB; the project is not yet implemented due to covid pandemic. The campus houses an effluent treatment plant and a power house with DG sets as backup during power failures.

Key facts about the site are provided in Table 1.1. Figure 1.1 provides a Google Earth bird's eye view of the area and location of the SSET campus.

Table 1.1 Key facts about the site

Name of Project	SCMS School of Engineering and Technology
Address	Karukuty, Angamaly, Ernakulam
Average Annual Rainfall	3159.76 mm
Water source	Bore well
Water harvesting system	Roof top system that collects rain water falling on roof and then send it for well recharge
Wastewater treatment system	Two stage anaerobic filter and Moving Bed Biofilm Reactor
Water harvesting potential	~7600 kilo litres
Average daily water demand	~170 kilo litres
Average daily energy demand	~7866 Units
Average daily waste produced	265 kg
Total built-up area	1,57,437.41 square feet

Figure 1.1 Location of SSET, Karukutty, Ernakulam

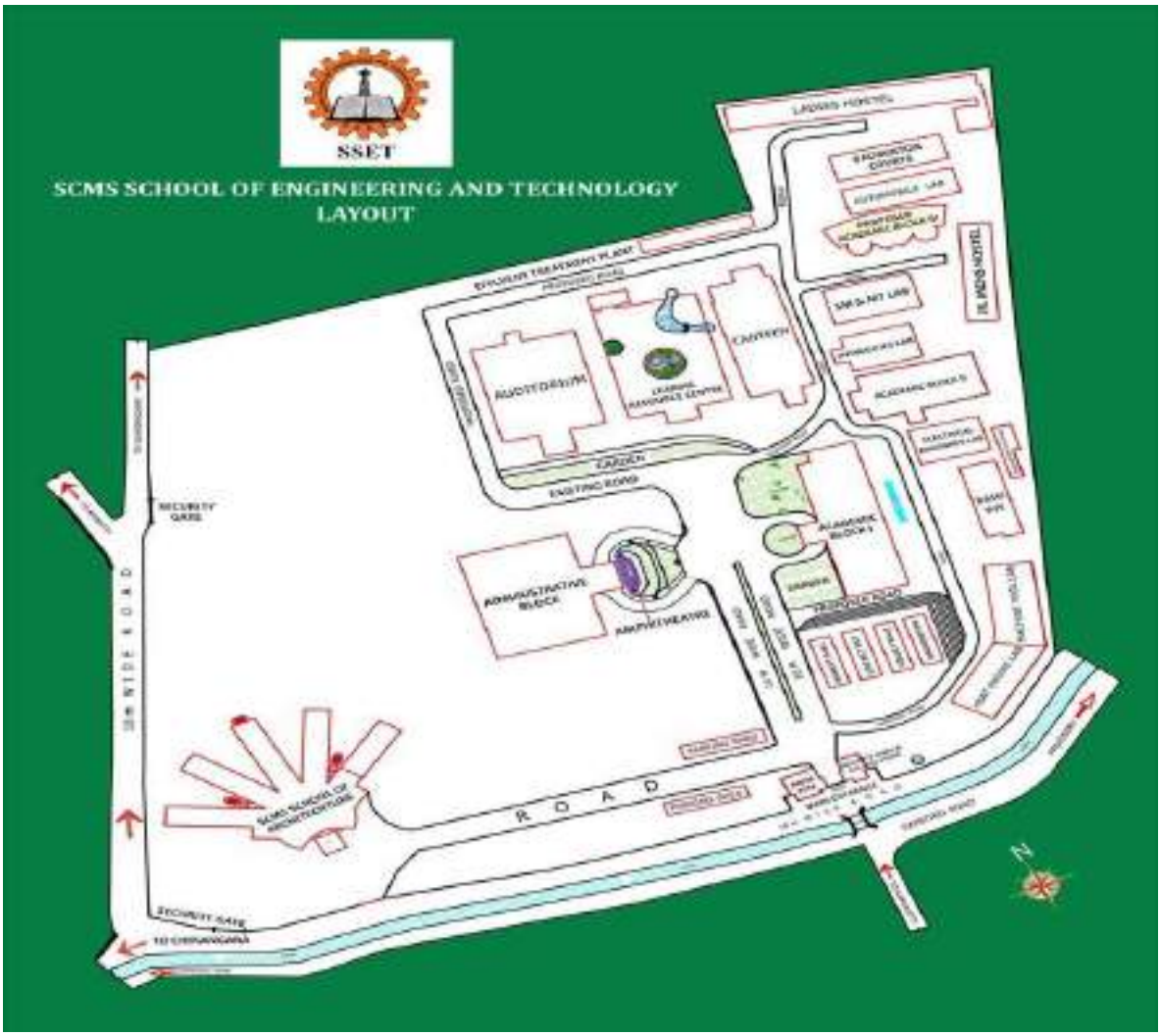


Figure 1.2 Detailed site plan of SSET campus

2019 - 2020

GREEN AUDIT REPORT

SCMS School of Engineering and Technology, Karukutty

Prepared by

Civil Department

SCMS School of Engineering and Technology, Karukutty, Ernakulam

2. Green Audit

Green audit is the process of assessing the environmental impact of an organization, process, project, product etc. Green Audit can be defined as a basic management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organisations, management systems and equipment are performing. The aim of the audit is to facilitate management control on environmental practices and to enable the organization to assess compliance with its policies including meeting regulatory requirements.

3. Methodology

Key components of green audit conducted at SSET, Karukutty campus included

(i) Pre-audit planning

a. Preliminary literature review of concepts and methodologies related to green audit
b. Discussion with the management staff on various systems installed in the campus
c. Awareness creation and interaction with the staff and student on the concept of green audit
d. Walk through the entire campus to understand the nature of water use, energy use and waste management systems in the campus

(ii) Data collection

a. Development of questionnaire format to identify all water/energy using fixtures/ equipments and examine water/energy use patterns for individual buildings in the campus
b. Collection of secondary data from compilation of electricity bills, collating records of pumps, generators, water quality analysis reports, waste water treatment equipment details, civil and electrical drawings etc.
c. Semi structured interview with maintenance manager, technicians, plumber, and housekeeping staffon current situation and the past trends in water consumption, electricity consumption, waste management, wastewater generation etc.

(iii) Data processing and analysis

The existing trends and patterns in water usage, energy usage and waste generation and management is analysed in this step from the data collected in the previous step.

(iv) Audit recommendations and reporting

Based on the understanding from green audit, recommendations are given to improve the existing environmental performance of the campus and are documented in a report format.

2. Carbon Footprint Estimation

Human activities are one of the main causes of greenhouse gas emissions. These increase the earth's temperature and are emitted from fossil fuel usage in electricity and other byproducts of manufacturing. Carbon footprint is the total greenhouse gas (GHG) emissions caused by an in- dividual, event, organization, service, or product, expressed as carbon dioxide equiv- alent. Greenhouse gases, including the carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, land clearance and the production and consumption of food, manufactured goods, materials, wood, roads, buildings, transportation and other services. Carbon footprint includes direct emissions, such as those that result from fossil- fuel combustion in manufacturing, heating, and transportation, as well as emissions required to produce the electricity associated with goods and services consumed. A Carbon footprint impression normally estimated by the sum of two parts: The Primary footprint and the Secondary footprint.

a. The Primary footprint is a measure of our direct emissions of CO2 from the burning of fossil fuels including domestic energy consumption and transporta- tion. We have direct control of these emissions.
b. The Secondary footprint impression is the proportion of the circuitous CO2 dis- charges from the entire lifecycle of items we use-those related with their pro- duction and inevitable breakdown.

A Carbon footprint (CF) impression study offers a way to calculate the human contribution to the carbon dioxide emissions that affect the earth's atmosphere. It measures the total amount of carbon production created by our energy consumption. Knowing the carbon footprint can show areas where the carbon footprint can be decreased by several activities like energy consumption etc., and in turn, reduce the production of carbon emissions. Educational institutions play a significant role in growth of a nation's economy. It is a growing field which consumes more energy next to the industries and information technology parks. So, it is important to calculate the carbon footprint assessment of educational institutions. $LCCO_2A$ (Life-cycle carbon emission assessment) is used to estimate the carbon footprint of SSET following the GHG Protocol for $LCCO_2A$.

2.1 Greenhouse Gas Protocol

The GHG accounting and reporting approach was undertaken in this study follows the guidance and principles set out in the greenhouse gas corporate accounting and reporting standards (GHG Protocol) developed by the Greenhouse Gas Protocol Ini- tiative. The GHG Protocol standard is widely recognized by large and medium-sized companies/institutions and is the most commonly used reference standard in different sectors worldwide. Findings from several studies and reports revealed that the method- ology based on the GHG Protocol is currently the most frequently used methodology in the all sectors for determining the organizational CF. The GHG Protocol requires emissions to be reported against the three different scopes described below:

Scope 1: Direct emissions from sources that are owned or controlled by the institu- tion. Direct emissions include the use of institution-owned vehicles for transportation (combustion of fuels in cars and vans), use of diesel aggregates, air conditioning the spaces the institution owns and controls directly. This also includes fuels combusted in laboratory equipment facilities.

Scope 2: Indirect emissions associated with the production of purchased electricity that was consumed by the institution.

Scope 3: All other indirect emissions as a consequence of the activities of the col- lege that occur from sources neither owned nor controlled by the institution (e.g. out- sourced distribution). According to the GHG Protocol, inclusion of scope 3 emissions is optional. Companies/institutions have discretion over which categories they choose to report. From the list of potentially relevant upstream and downstream emissions categories given in the GHG Protocol, those which are related to the institutions own recorded (collected) in-house data were selected. On the basis of the same protocol guidelines, we focused on the sources of GHG emissions where good quality data was available. In addition, the GHG Protocol states that the choice must be based on data availability and reliability, together with transparency with regard to the estimation approach. Due to the time and human resource constraints, it was decided to include only those scope 3 criteria which can be calculated on the basis of the institutions own in house accounting statistics.

Outside scope: Some activities fall outside these three scopes. An example is the combustion of biodiesel or other biomass-based fuels. GHG emissions associated with these activities are not derived from fossil sources and so are not adding to the net carbon dioxide load in the atmosphere. Emissions from burning biomass have been reported separately. Another example is accounting for the selling of excess power or from energy recovery resulting from waste incineration. In such cases the users of this energy avoid having to generate it from other sources which would have their own associated GHG emissions.

2.3 Base Year

A base year represents a reference year against which GHG emissions performance, tracked over subsequent years, can be compared. According to the GHG Protocol, a base year should be chosen on the basis of the earliest relevant point in time for which accurate, reliable and comprehensive data are available. Following this criterion, academic year starting from August 2018 and ending on June 2019 was chosen for a base year.

2.4 Emission Factors

Emission factors are that factors which convert activity data to actual GHG emission. Values were obtained from relevant literature, governmental and research institutions, and energy companies.

$$Energy\ emissions = Consumed\ energy\ x\ Emission\ f\ actor$$

In addition to this, the green cover within the campus will absorb certain amount of CO2 , which will reduce the overall CO2 emission, also the reduction in CO2 emission due to installed solar panels and waste water treatment must be taken into account.

$$Net\ emissions = Energy\ emissions - Absorbed\ CO2$$

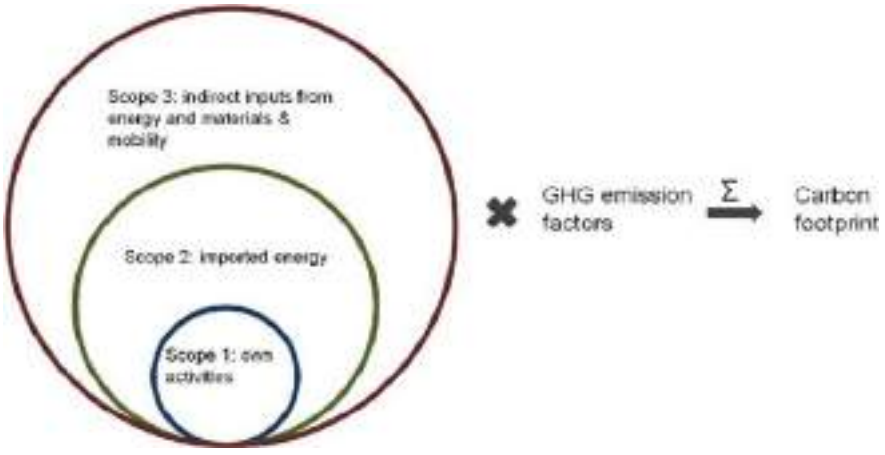


Figure 2.1: Calculation of Carbon Footprint (Source: www.researchgate.net)

Figure 2.1 shows a simplified methodology for carbon footprint assessments. The three scopes of emissions considered in the GHG Protocol and in the ISO 14064 stan- dard guidelines arise from different orders of inputs. The quantified inputs are then converted into GHG emissions and summed up to a final carbon footprint score.

2.5 Data Collection

The data are collected from existing records and interview are presented below.

2.5.1 Electricity Consumption

Energy consumption pattern of each building in the campus has been evaluated. There is an administrative block, two academic blocks, various engineering laboratories, library, canteen, Effluent Treatment Plant, ladies' hostel and junior men's hostel within the campus. The senior men's hostel is located outside the campus. From the collected data, it is found that Administrative Block consumes maximum amount of energy.

2.5.2 Water Consumption

Source of water for the entire campus is bore wells. There are three bore wells in the campus. Two bore wells are used to meet the water demand of the campus including canteen and hostels and one bore well is used exclusively for senior men's hostel which is outside the campus. Moreover around 100 litres of mineral water is used daily for drinking purpose in the academic blocks.

2.5.3 Wastewater Treatment

One administrative block, two academic blocks, five laboratory blocks, one library, one canteen, two hostels and one auditorium is present in the campus. The toilets, washbasins and urinals of two academic blocks, various laboratories, two hostels and the wastewater from cooking, dishwashing etc. from the canteen are the major wastewater sources of ETP. The wastewater generated from the administrative block alone is treated using a separate septic tank. The Sewage Treatment Plant at SSET campus treat 1 lakh litres (100 KLD) of waste water daily.

2.5.4 Waste Generation

Waste generated in the campus varies from paper, plastic, cloth, glass, food and sanitary items. Their sources include academic blocks, hostels, office, canteen and kitchen. The waste that is generated from all these sources if not handled properly may pose a serious health and environmental hazards. The wastes generated from various activities in the campus are mentioned below.

Canteen: Food and vegetable waste are generated daily from the canteen which are taken to a nearby pig farm. Other wastes including paper, plastic packings etc.

Administrative Block and Academic Blocks: Rubbish of about 2 kg is collected daily and burnt in incinerator. Mixed paper wastes including answer sheets, question papers, newspapers, magazines, office papers, used notebooks etc. is generated @ 4.5 ton per year. Mixed paper wastes are recycled by Plan@earth.

Hostels: Wastes including paper, plastic, sanitary items, bags etc. weighing around 10kg aredaily collected and burnt in the incinerator. Plastic bottles are sorted and taken by Plan @ Earth for recycling.

E-Waste: E-waste generated in the campus since 2001, which is around 1700kg has been stored in a room in Academic block - I.

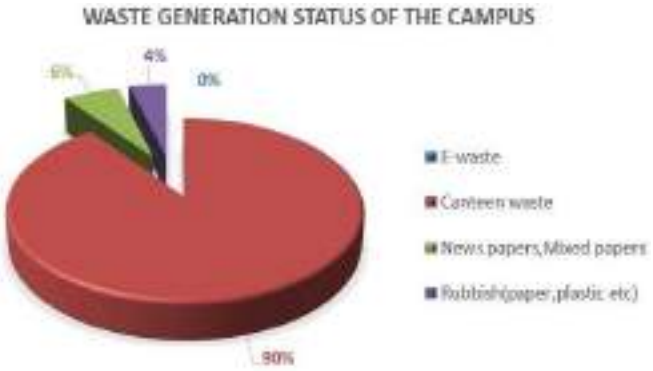


Figure 2.2: Waste generated in SSET (Source: Green Audit Report, SWI)

2.5.5 Transportation

Faculties, staffs and students use college bus or own vehicles for transportation to and from the campus. In SSET, 22 college buses use an average of 50 litres of diesel/day. An average of 120 staff and student vehicles are there at campus. Other purpose vehicles coming to college for the purpose of picking and dropping hostelers, to canteen, to office, etc is approximately 37 in number/day. College bus uses 16200L of diesel/year. Staff and student vehicles use 40320L of fuel in a year. And the other purpose vehicles use approximately 12432L of fuel/year.

2.5.6 Solar Energy

SSET has a 50kW Solar power plant in Administrative Block which can produce 225kWh/day.

2.5.7 Rainwater Harvesting

In the campus, rain water harvesting is done for administrative block, Academic block-I and senior men's hostel.

The total roof area available = 3413.31sq meter Average annual rainfall at Angamaly = 3.2 m

(Assuming 70% of the rain water collected is harvested)

Thus, the total potential for rainwater collection = 7600 kL

2.5.8 Tree cover

CO_2 absorbed by a tree with a crown diameter 15 m is 28.5 ton of CO_2 annually. So the CO_2

absorbed by a tree with average crown diameter of 10.76 m will be 20.44 ton of CO_2 annually.

No. of trees = 1006

Average crown diameter = 10.76 m

2.5.9 Fuel

SSET canteen uses 14824 kg of LPG per annum.

2.5.10 Human Factor

SSET campus has a strength of 233 staff and 2430 students, out of which 782 reside in the campus. And SSA has a total strength of about 80.

2.5.11Built-up area

SSET and SSA has a total built-up area of about 25007 m^2.

2.5.12 Concrete from Laboratory

1800 kg of concrete is directly produced from college laboratory per year by during various experiments.

2.6 Carbon Footprint Calculation

Carbon Footprint for the data collected are calculated by multiplying quantity of each material by corresponding emission factors. And the Carbon Footprint reductions are calculated by multiplying quantity of each material by corresponding reduction factors as shown in the table below.

Table 2.1 : Carbon Footprint

S NO	DESCRIPTION	QUANTITY/year	EMISSION FACTOR	CARBON FOOTPRINT (kg CO_2 EQUIVALENT)
1	**Power consumption**	721731.272 kWh	0.689 Kg/kwh	497272.85
2	**Total Water Consumption**	387000 L	0.376 kg/litre	145512
3	**Food Waste**	5220 kg	3.59 kg/kg of food waste	18739.8
4	**Fuel(LPG)**	14824 kg	1.5 kg/ kg of LPG	22236
5	**Transportation (Fuel)**			
	College Bus	16200 L	2.7 kg/litre	43740
	Staff and students	Petrol - 25251 L Diesel - 15069 L	2.3 kg/litre 2.7 kg/litre	58077.3 40686.3
	Others (Canteen, LH, BH, Office)	12432 L	2.7 kg/litre	33566.4
6	**Building materials**	25007 m2	660 kg CO_2/m^2 of GHG emission	16504620
7	**Solid Waste**	13270 kg/month	2.56 kg/kg CO_2-eq	33971.2
8	**Human factor**	2743 person	0.4 kg/person/day	1097.2
9	**From lab -Concrete**	1800 kg	0.36 ($kgCO_2$-eq/kg)	648
10	**Wastewater treatment**	205 kg BOD	0.6 kg CO_2/kg BOD	123
Carbon Footprint				**17400293.05**

2.6.1 Scope 1 Emissions

Scope 1 emissions include direct emissions which include emissions from transportation and LPG fuel.

Transportation (Petrol and Diesel) = 176070 kg CO_2 equivalent

Fuel (LPG) = 22236 kg CO_2 equivalent

Total = 198306 kg CO_2 equivalent

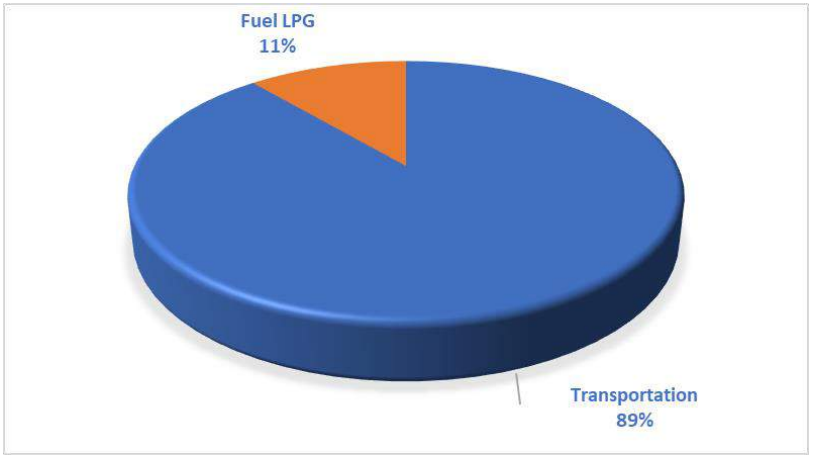


Figure 2.3: Scope 1 Emissions

2.6.2 Scope 2 Emissions

Scope 2 emissions include indirect emissions which include emissions from con- sumed electricity and water consumption.

Purchased electricity = 497272.85 kg CO_2 equivalent

Water consumption = 145512 kg CO_2 equivalent

Total = 642784.85 kg CO_2 equivalent

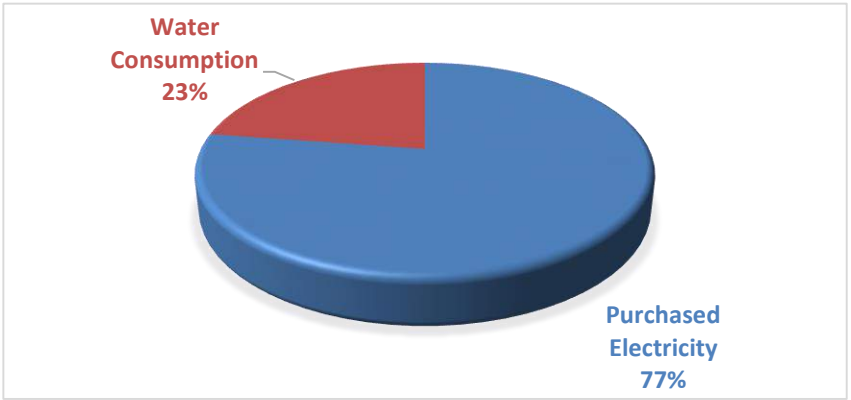


Figure 2.5: Scope 2 Emissions

2.6.3 Scope 3 Emissions

Scope 2 emissions include indirect emissions from sources outside the institutions control which include emissions from building materials, food waste, solid waste and wastewater treatment.

Building materials = 16504620.00 kg CO_2 equivalent

Food waste = 18739.8 kg CO_2 equivalent

Solid waste = 33971.2 kg CO_2 equivalent

Wastewater treatment = 123kg CO_2 equivalent

Total = 16557454 kg CO_2 equivalent

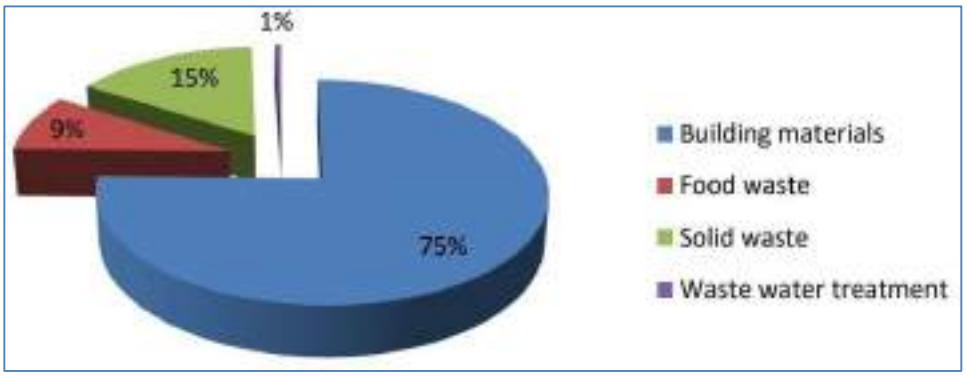


Figure 2.4: Scope 3 Emissions

2.6.4 Outside Scope

Outside Scope include emissions from concrete production in laboratory and human factor.

Human factor = 1097.2 kg CO_2 equivalent

From lab Concrete = 648 kg CO_2 equivalent

Total = 1745.2 kg CO_2 equivalent

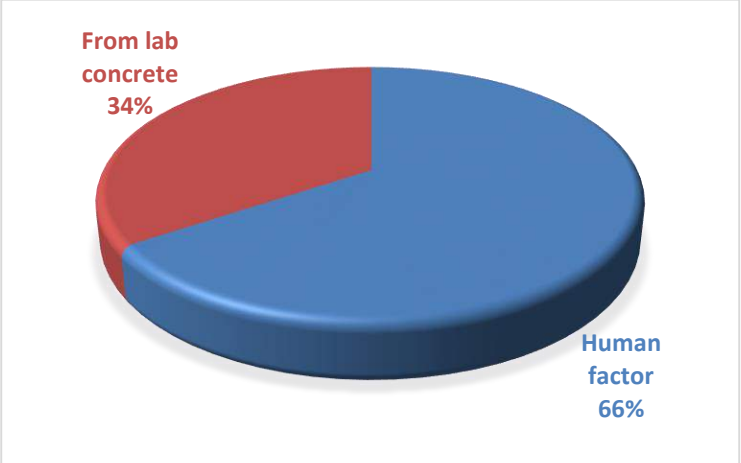


Figure 2.5: Outside Scope

2.6.5 Total Reductions

Table 2.2: Reductions

S NO	DESCRIPTION	QUANTITY/year	REDUCTION FACTOR	CARBON FOOTPRINT (kg CO_2 EQUIVALENT)
1	**Solar Energy**	82125 kWh	0.05 kg/kWh	4106.25
2	**Tree Cover**	1002 nos.	20.44 ton of CO_2	20562640
3	**Rainwater harvesting**	7.6 ML	0.173 ton of CO_2 /ML	1314.8
Reductions				**20486301.05**

Total reductions = 20568061.05 (kg CO_2 equivalent)

2.6.6 Total Carbon Footprint

The Carbon Footprint from Scope 1, Scope 2, Scope 3 and Outside scope accounts for about 17400293.05 kg CO_2 equivalent. The total reductions from Solar energy, tree cover and rainwater harvesting are 18677327.94 kg CO_2 equivalent. Hence, the total Carbon Footprint for SSET campus is - 1277034.89 kg CO_2 equivalent.

Carbon Footprint = 17400293.05 kg CO_2 equivalent

Total reductions = 18677327.94 kg CO_2 equivalent

Total Carbon Footprint = - 3167771.00 kg CO_2 equivalent

The negative value of carbon footprint indicates that SSET campus is carbon-negative pointing to the fact that the amount of CO_2 emissions removed from the atmosphere is bigger than the amount of CO_2.

Water Audit Report
for
SCMS School of Engineering and Technology, Karukutty

Prepared by

SCMS Water Institute (SWI),

SCMS School of Engineering and Technology, Karukutty, Ernakulam

2019 - 2020

2. Water Audit

A water audit is a systematic review of a site to identify opportunities to improve its water use efficiency. The site may be a public water utility, facility (institutional or commercial properties like malls, office, schools etc.) or a household. Audit recommendations are developed based on surveys and assessments of water-using hardware, fixtures, equipment, landscaping, and management practices at the site. Water audit involves tracking, assessing and validating all components of flow from the site of withdrawal or treatment through the water distribution system and into the consumer's properties. Water auditing examines the major areas of water use, including human consumption, personal hygiene & sanitation, washing, cleaning, laundry, gardening etc. Water auditing is an ongoing process and rarely stays consistent in a site or system over time. Therefore in order to gauge progress from adopted water conservation and cutbacks, water audit should be performed on a regular basis. In addition it provides convincing overview of the water use trends, effectiveness of conservation measures and potential cost and water savings.

2.1 Water supply

Around 170 kilo litres of water is used in the campus daily. Source of water for the entire campus is bore wells. There are four bore wells in the campus. Three bore wells are used to meet the water demand of the campus including canteen and hostels and one bore well is used exclusively for senior men's hostel which is outside the campus. Moreover around 2000 litres of water per month is used for drinking purpose in the academic blocks. Table 2.1 shows the characteristics of water from the bore well of the campus.

Table 2.1 Drinking water quality parameters (As per IS 10500-2012)

PARAMETERS	UNIT	VALUE	DESIRABLE	RELAXABLE
pH		7.1	6.5 – 8.5	No relaxation
Odour		Odourless	Unobjectionable	
Taste		Tasteless	Unobjectionable	
Turbidity	NTU	0.2	5	10
Total Hardness (as $CaCO_3$)	mg/l	60	300	600
Total Dissolved Solids	mg/l	118	500	2000
Iron (as Fe)	mg/l	0.12	0.3	1.5
Chlorides (as Cl)	mg/l	28	250	1000

2.2 Water use diagram

SSET campus were closed due to Covid-19 from March 2020 to August 2021. Classes where conducted in online mode and only few staff were present at the campus due to Covid protocol restrictions. Due to these cant able to conduct a survey using questionnaire; so the water consumption is calculated based on the semi structured interview conducted with technicians and staff in the campus. Figure 2.5 shows the water usage by various activities of SSET campus based on the survey. It can be seen that toilet flushing (27%), floor wash (21%) and bathing (17%) are the activities that dominates water usage. Figure 2.6 shows the water consumption by different blocks of SSET campus. There were no leakages that were observed or reported during the audit exercise at SSET.

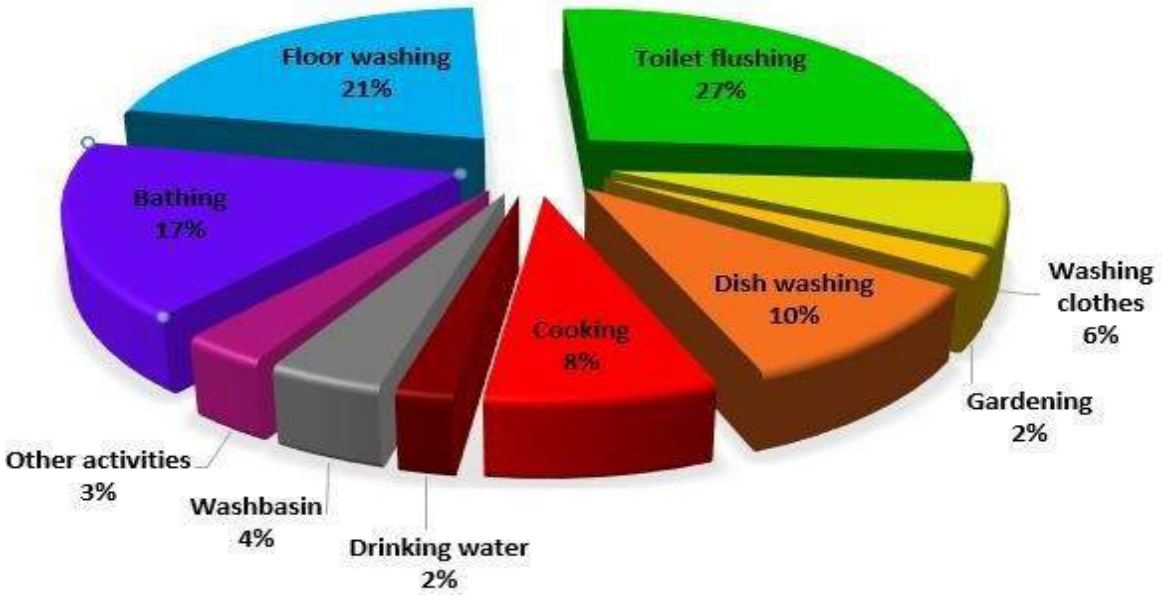


Figure 2.1 Activity wise water consumption at SSET

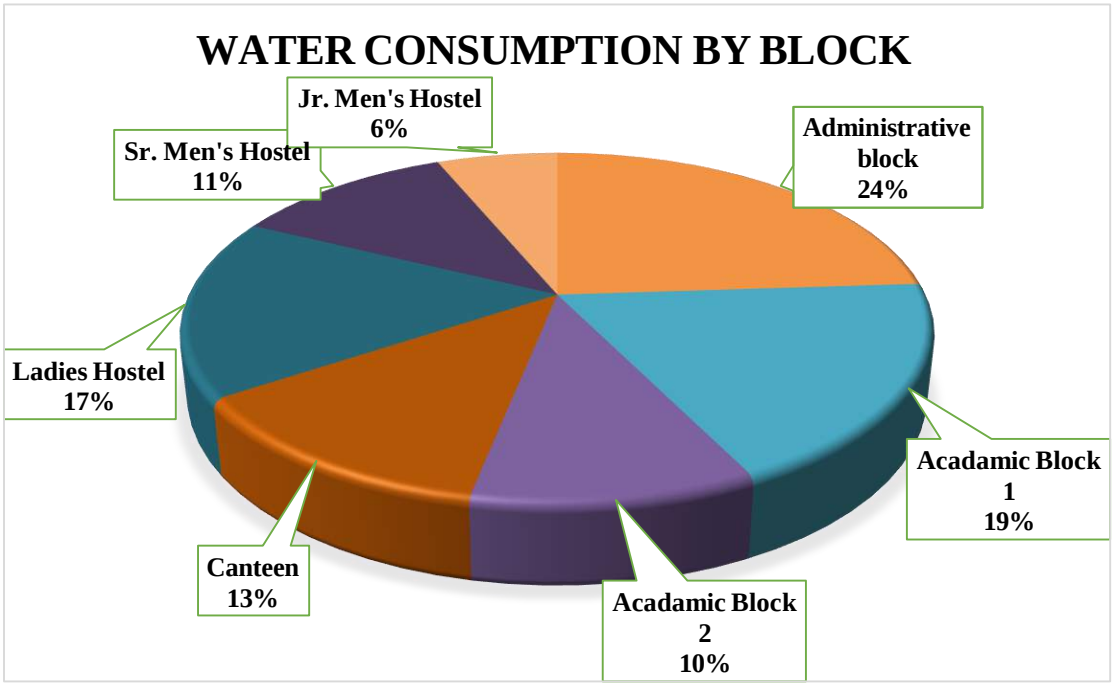


Figure 2.2 Composition of total water (170 kilo litres) use by different blocks of SSET

Figure 2.3 Interviewing hostel staff for water demand calculation

2.3 Water circuit diagram

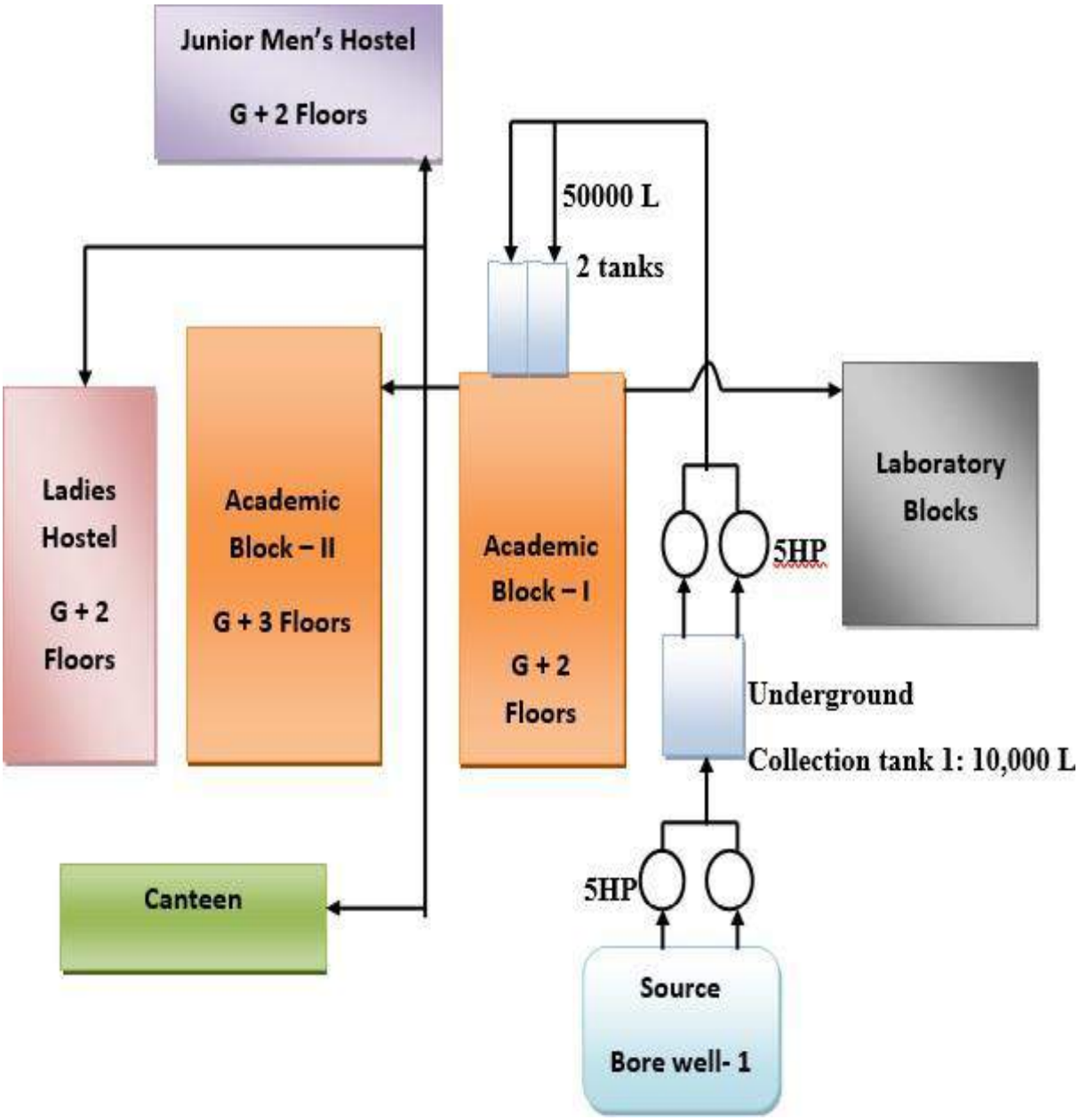
Water circuit diagram shows how the water flows from the source to the consumers. It also identifies the position of pumps and tanks. Based on the walk through surveys, discussions with staff and managing committee, a water circuit diagram has been prepared and is shown in the figure 2.4.

The source of the water for the entire campus is three bore wells. From the bore well near Academic block-I, the water is pumped into an underground collection tank having a capacity of 1, 10,000 L using two 5HP pumps. From there, the water is pumped to the two overhead

tanks of academic block -I having a capacity of 50,000 L each. From these tanks, the water is distributed to the academic block–II, ladies hostel, junior men's hostel, canteen and laboratories using the natural flow.

From the bore well near administrative block, the water is pumped directly to two overhead tanks of capacity 1000 L each and one overhead tank of capacity 2000 L using two 5HP pumps. The water from these tanks is used by the administrative block alone.

From the bore well near senior men's hostel, water is pumped to two overhead tanks of capacity 25,000 L each using two 5HP pumps. Presently this water is used exclusively by the senior men's hostel. Among the 2 pumps in all cases, one serves as a stand-by.



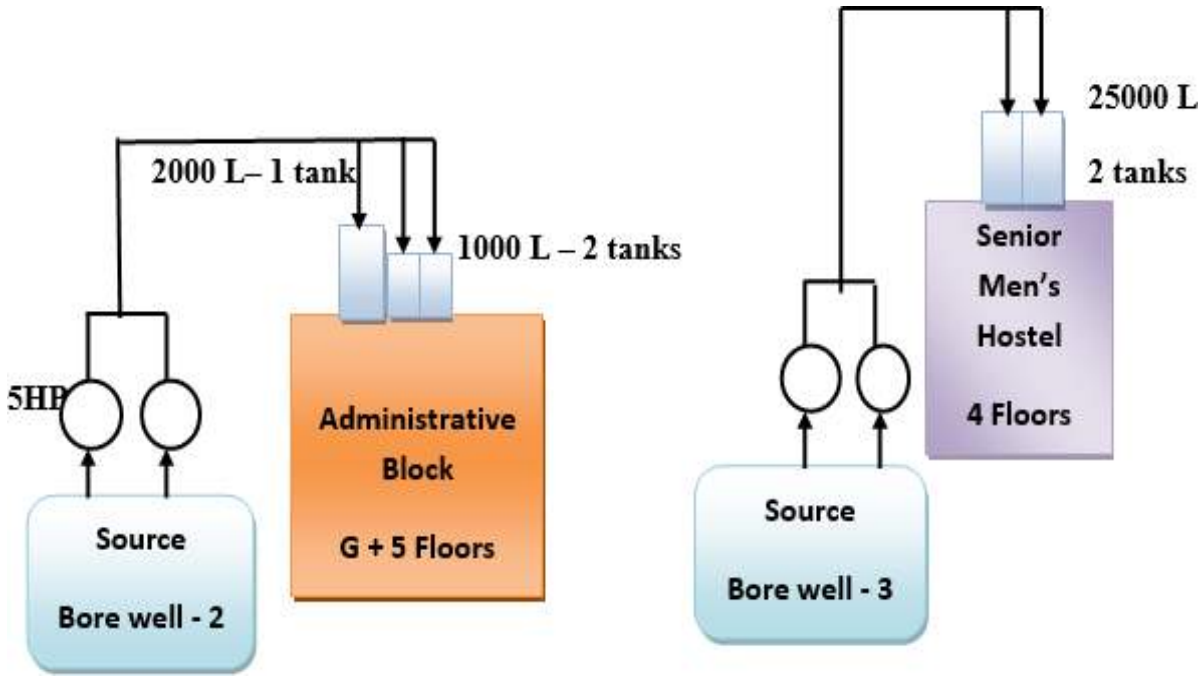


Figure 2.4 Water distribution network of SSET campus

2.4 Wastewater sources

One administrative block, two academic blocks, five laboratory blocks, one canteen, two hostels and one auditorium is present in the campus. The toilets, washbasins and urinals of two academic blocks, various laboratories, two hostels and the wastewater from cooking, dishwashing etc. from the canteen are the major wastewater sources of ETP. The wastewater generated from the administrative block alone is treated using a separate septic tank.

2.5 Waste water collection network

The waste water collection network shows the path flow of the waste water from the various blocks into the Effluent Treatment Plant. The sullage from canteen is passed through an oil trap and is then collected in a collection tank. The sewage from academic block- I, academic block- II, ladies hostel and junior men's hostel is also collected in the collection tank, from where it is sent to the ETP. The sewage from administrative block alone is treated by a separate septic tank.

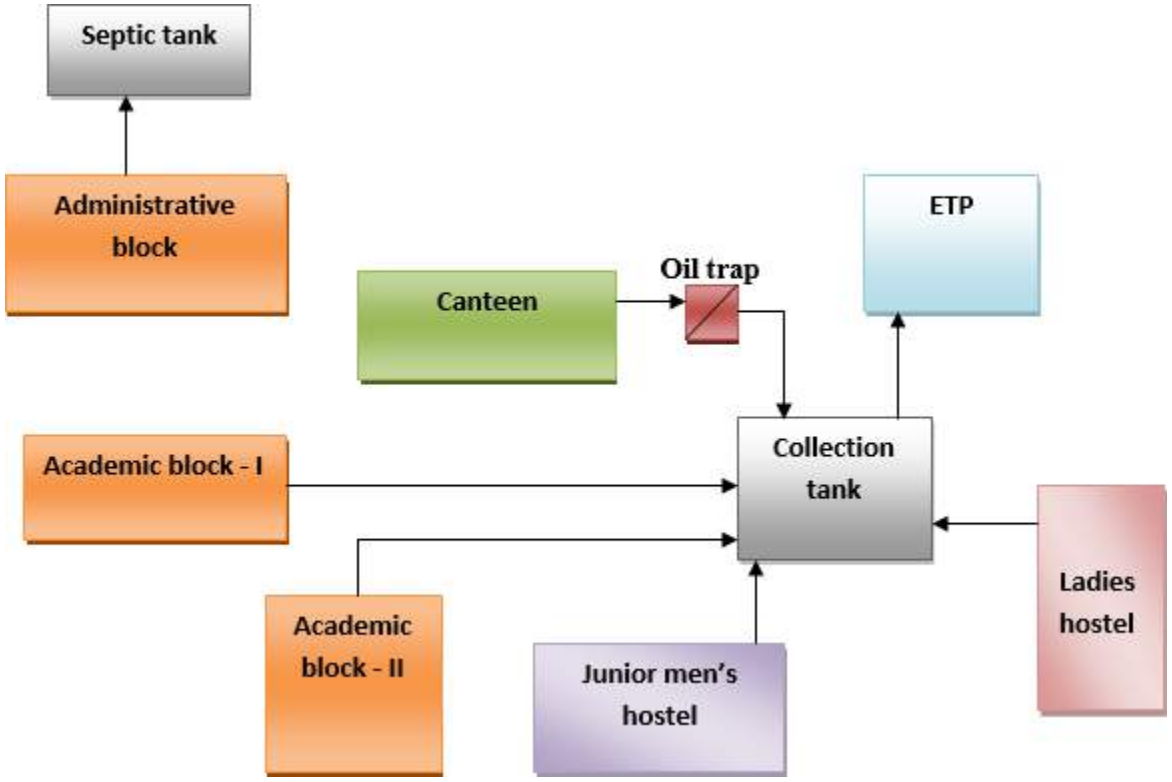


Figure 2.5 Wastewater circuit diagram of SSET campus

2.6 Waste water treatment facility

The ETP in the campus incorporates various treatment units that can be adopted in the treatment of waste water. It includes the tertiary treatment of sewage using Reverse Osmosis and UV sterilization unit, so that other than irrigation purposes the treated wastewater can be used for drinking purposes. A process diagram of the effluent treatment plant in the campus is shown in figure 2.1. The effluent treatment plant in SSET campus consists of the following units:

2.6.1 Screen and Oil Trap (OT)

2.6.2 Septic Tank

2.6.3 Two staged anaerobic filter

2.6.4 Moving bed bio-film reactor (MBBR)

2.6.5 Secondary clarifier

2.6.6 Disinfection Tank (DT)

2.6.7 Pressure sand filter (PSF), Activated carbon filter (ACF)

2.6.8 Reverse Osmosis unit (RO)

2.6.9 UV sterilization unit

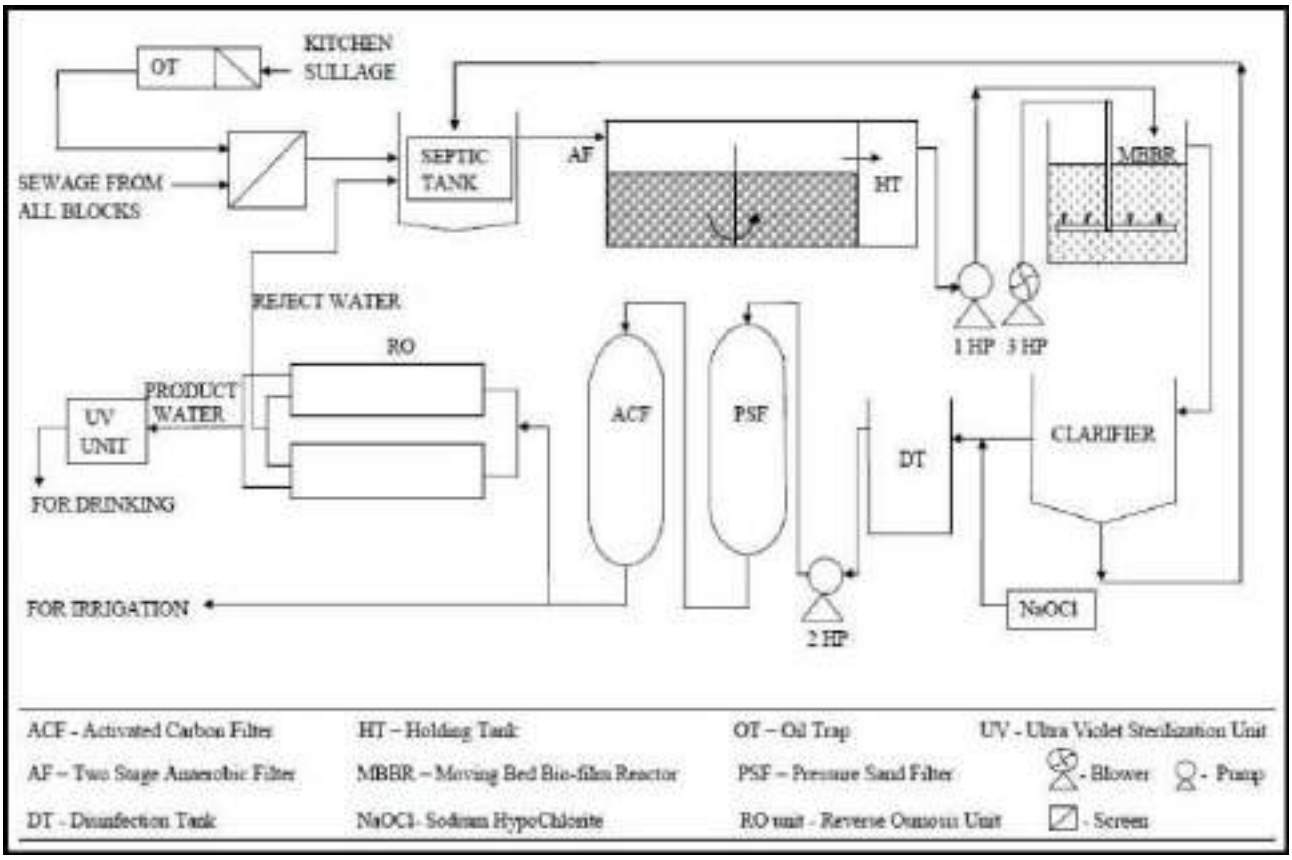


Figure 2.6 Process diagram of ETP at SSET campus

Figure 2.7 Green audit team inspecting the ETP of SSET campus

Figure 2.8 Reverse Osmosis unit in ETP of SSET campus

Figure 2.9 Green audit team inspecting the clarifier of ETP

Table 2.2 Characteristics of influent and effluent of ETP, SSET campus

Parameter	Influent of STP	Outlet of STP	Standard (Environmental (Protection) Rules, 1986)	Standard BIS (ISI)
pH	6.6	6.9	5.5 - 9.0	5.5 - 9.0
Temperature (ºC)	27.7	27.6	NA	NA
TDS (mg/l)	605	404	NA	2100
Suspended Solids (mg/l)	190	20	200	NA
Free Chlorine (mg/l)	0	0.7	NA	NA
Oil & Grease (mg/l)	51.5	0	10	30
COD (mg/l)	352	70	NA	NA
BOD_5 at 20ºC (mg/l)	205	30	100	500
Sulphate (mg/l)	12.3	4	NA	1000
Phosphate (mg/l)	33	5.7	NA	NA

2.7 Rain water harvesting status and potential

Rain water harvesting is the accumulation and deposition of rainwater for reuse on site rather than allowing it to runoff. Proper rainwater harvesting can conserve huge amount of fresh water. In the campus, presently rain water harvesting is done for Administrative block, Academic block–I and senior men's hostel.

Rain water collected in the open terrace of administrative block is carried to a well and a bore well for ground water recharge. Inorder to prevent aquifer contamination, the rainwater is passed through a pressure sand filter before passing into the bore well. Rain water collected by the roof of academic block-I is carried to a tank at ground level. Presently, this water is used for various construction activities that are going on in the campus.

The total roof area available = 3413.31 sq meter

Average annual rainfall at Angamaly = 3.2 meters

(Assuming 70% of the rain water collected is harvested)

Thus, the total potential for rainwater collection = 7600 KL

Inclusion of the roof area of academic block- II, canteen and hostels can increase the rain water being harvested.

Figure 2.10 Salient locations of well recharging system at SSET

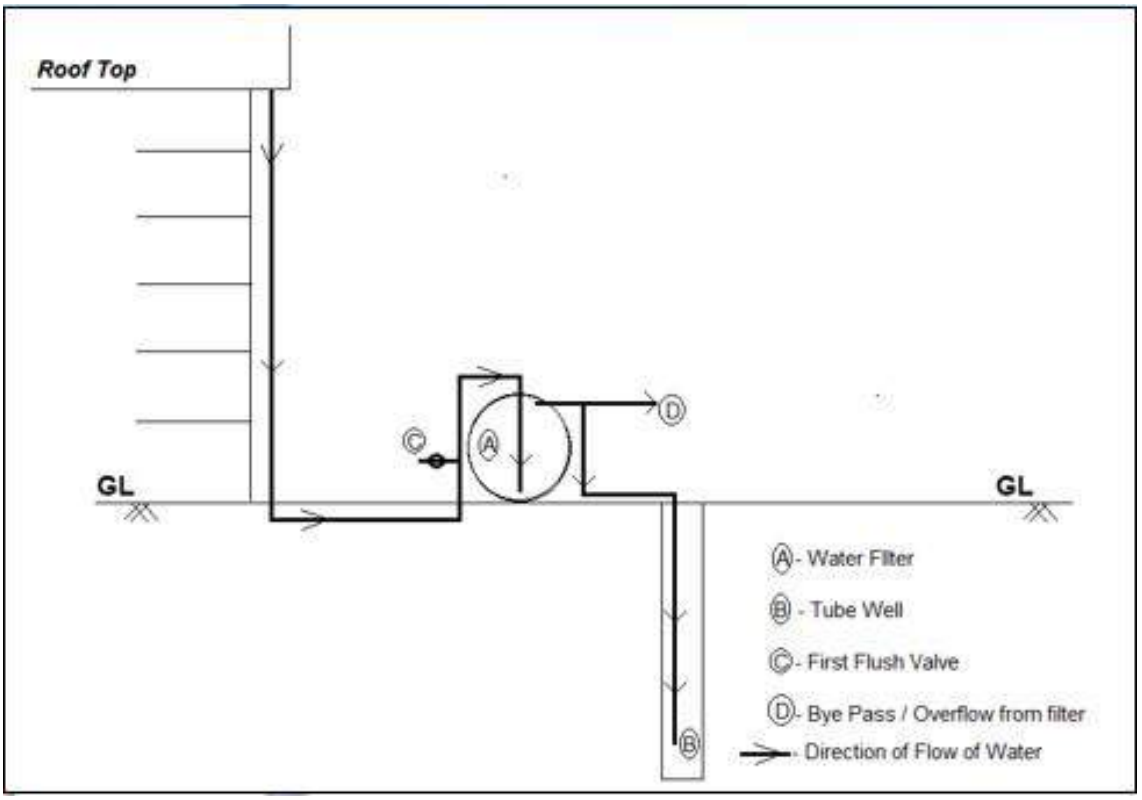


Figure 2.11 Schematic diagram showing recharge to bore well from roof top at SSET

Figure 2.12 Rain water collected at rooftop is treated using Pressure sand filter before taken for bore well recharge

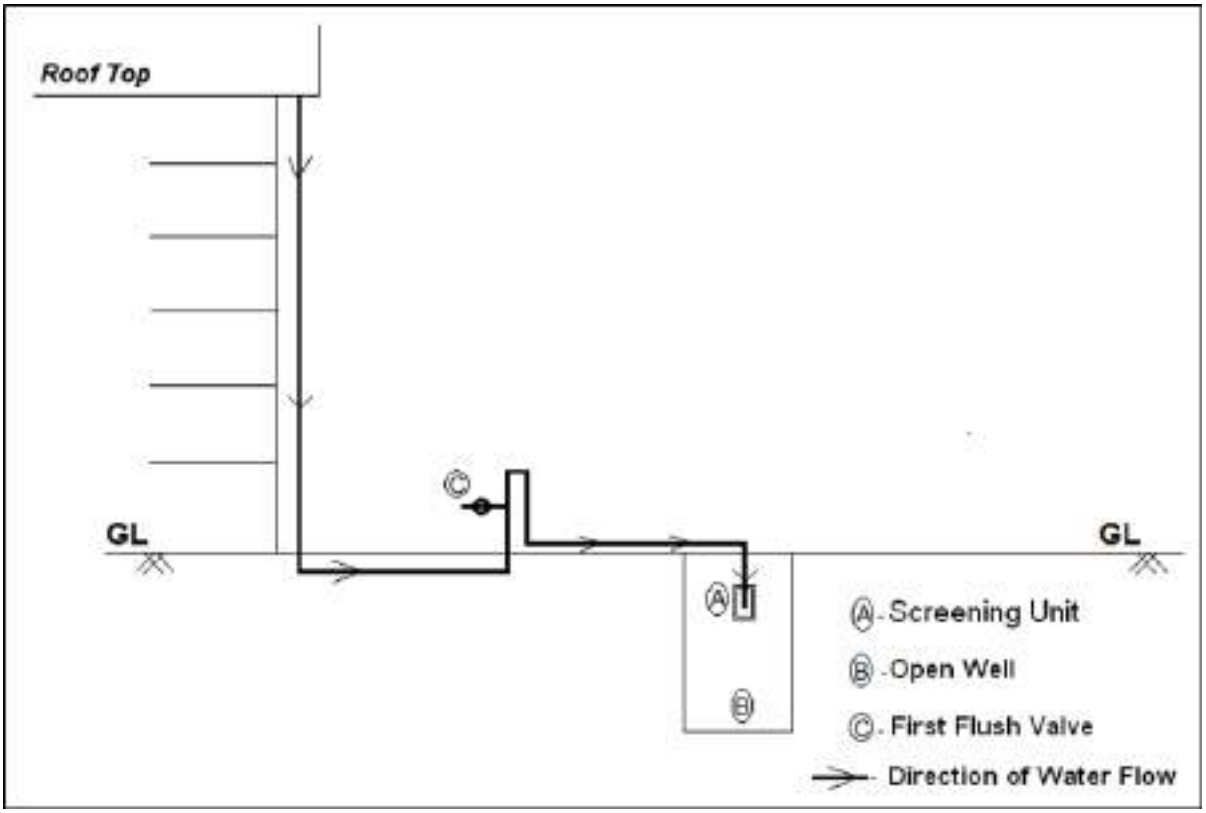


Figure 2.13 Schematic diagram showing recharge to open well from roof top at SSET

Fig. 2.14 Rain water collected at rooftop directed open well for recharging

ENERGY AUDIT REPORT

2019 - 2020

SSET

Prepared By:
Electrical
&
Electronics
Engineering
Department

3. Energy Audit

An energy audit is an inspection, survey and analysis of energy flows for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output(s).Reducing energy consumption while maintaining or improving human comfort, health and safety are of primary concern. The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy Audit provides a “bench-mark"(Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

3.1 General descriptions about energy consuming appurtenances/activities in the campus

There is an administrative block, two academic blocks, various engineering laboratories, canteen, Effluent Treatment Plant, ladies hostel and junior men’s hostel within the campus. The senior men’s hostel is located outside the campus.

The Administrative Block facilitates a Principal’s room, guest room, office room, mini conference hall, placement cell, cafeteria, faculty room, and main computer lab, which are fully air conditioned. It also provides space for first year B.Tech classes, M.Tech classes, MCA classes, faculty rooms, manager’s room, examination cell, reading room, exhibition gallery, drawing halls and PG computer lab. A gym is also functioning in the ground floor.

All the rooms are provided with ceiling fans and tubes. Projectors are used mainly by PG classes. Toilets are provided in each floor and are lighted with tubes and fluorescent lamps. Since the building has good ventilation and natural lighting, no artificial lighting is required for the corridors.

The Academic block-I facilitates B.Tech classes, faculty room, SCMS Water Institute, CAD lab, 3D printer lab, Computer lab, seminar hall, Communication & Microwave Lab, Digital and Advanced Microprocessor Lab, and Electronic Circuits Lab.

The Academic block –II facilitates B.Tech classes, faculty rooms, Survey lab, Transportation lab, Geotechnical lab, Environmental engineering lab, Computer lab, Basic EEE Measurement Lab, Electrical workshop, and Control and Power Electronics Lab.

The laboratory blocks include Automobile workshop, Strength of Materials and Material

Testing lab, Basic Workshop, Machine Tools lab, Hydraulics lab, Heat Engine/ Heat Transfer Mechanical Engineering lab, and Electrical Machines lab.

Ladies hostel has 3 floors with 42 rooms in each floor. Presently there are 370 inmates. Each room can accommodate 3 students. There are 2 tubes, one ceiling fan and 2 plug points in each room. Apart from that there is a wardens' room, a study room and one computer room having 4 computers with LCD monitors...Two washrooms are provided in each floor which is equipped with heaters. Corridors are artificially lighted with fluorescent lamps.

Junior men's hostel has a total of 64 rooms in 3 floors. Presently 149 inmates are occupied in 57 rooms. Each room has 2 tube lights, 1 fan and 2 plug points. Wash rooms are provided on each floor. Terrace is now converted to a common study area with 6 tubes and 8 fans.

Senior men's hostel has 4 floors. All rooms are bath attached. Each room has 2 fans, 2 tubes and 2 plug points. Presently 36 rooms are occupied by 274 inmates.

There is a 24 hours working Effluent Treatment Plant in the campus which has a capacity to treat one lakh litres of waste water per day. Effluent from all the blocks except administrative block is treated in the ETP.

3.2 Methodology

- Data collection
    - Walk through audit- collection of type and number of energy consuming appurtenances
    - Informal interviews with staffs and students- usage pattern, lab and class timings, office working hours
- Data analysis- Identification of major energy consuming areas
- Identification of energy conservation opportunities

3.3 Energy consumption status of the campus

Energy consumption pattern of each building in the campus has been evaluated. Calculation criteria are described below.

3.3.1 Administrative Block

Administrative block consists of G + 5 floors. The elevator of this block consumes around 120kWh per day. Detailed power consumption of each floor is given in the below tables.

GROUND FLOOR				
Room	**Tube**	**Fan**	**Computer**	**Power consumption/month (kWh)**
FAB lab	20	10	5	282.3
Class room	7	6		81.89
Class room	7	6		81.89
Class room	7	6		81.89
Class room	7	6		81.89
Examination cell	24	11+ 2 exhaust		70.9
Toilet	4			24.192
Total				**704.952**

GYMNASIUM			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Sports Treadmill	1	0.9	54
Sports Recumbent Bike	1	0.75	11.25
Sports Upright Bike	1	0.75	11.25
Elliptical Trainer	2	0.75	22.5
Fan	3 + 2 exhaust	0.05	22.5
Tube	14	0.036	45.36
Total			**166.86**

FIRST FLOOR										
Room	**Tube**	**T.V**	**Printer**	**CFL**	**Projector**	**Fan**	**Computer**	**AC**	**Others**	**Power consumption/ month (kWh)**
Reception	8	1				1	1			56.53
Principal's room	12	1	1		1	1	1	3 t		713.14
Guest room	6							3 t		43.17
Office	15			3			8	8.5 t	1 photostat, 1 printer, telecom,1 scanner	1960.12
Mini conference	12			6				8.5 t		238.182
Placement	8						2	3 t		1205.24

Cafeteria	6							3 t		36.81
Staff room	12						27	8.5 t	2 printer	1993.25
Manager's room	2					1	1			34.75
Class room	8					8				100.02
Class room	8					8				100.02
Class room	8					8				100.02
Class room	8					8				100.02
Class room	8					8				100.02
Staff toilet	2			3						19.656
Ladies toilet	4			6						39.312
Total										6514.986

SECOND FLOOR

Room	Tube	CFL	Fan	Computer	Projector	Printer	AC	Others	Power consumption/month (kWh)
Computer Lab Main	86			115		2	4*8.5 t + 1*1.5 t	4 server, 12 LAN switches, 1 dot-matrix, 1 acer	161038.345
Conference hall	36			1	1		4*8.5 t	8speaker	990.35
Classroom	9		7		1				81.345
Classroom	9		7		1				81.345
Classroom	9		7		1				81.345
Classroom	9		7		1				81.345
Gents staff toilet	2	3	1						28.056
Gents toilet	4	3	1						40.152
Total									**154648.018**

THIRD FLOOR

Room	Tube	Projector	Fan	Power consumption/month (kWh)
Classroom	9	1	7	119.56
Classroom	9	1	7	119.56
Classroom	9	1	7	119.56
Classroom	9	1	7	119.56
Classroom	6	1	6	96.88
Classroom	6		5	80.12
Classroom	20		17	50.23
Drawing hall	16		13	180.12
Ladies toilet	2			1.519
Ladies room	2		2	0.924
Total				**843.991**

FOURTH FLOOR							
Room	**Tube**	**CFL**	**Fan**	**Printer**	**Computer**	**Projector**	**Power consumption/month (kWh)**
Faculty room	24		12	2	27		259.23
PG lab	42		5		60		245.23
Classroom	6		7			1	100.23
Classroom	9		7			1	121.234
Classroom	9		7			1	121.234
Classroom	9		7			1	121.234
Classroom	9		7			1	121.234
Classroom	9		7			1	121.234
Classroom	6		6			1	98.688
Girl's common room	8		3				2.408
Ladies toilet	2	3	2 exhaust				1.519
Ladies staff toilet	2	4					0.924
Total							**1226.355**

FIFTH FLOOR					
Room	**Tube**	**Fan**	**Projector**	**Computer**	**Power consumption/month (kWh)**
Classroom	85	47			301.324
Seminar hall 2	18	13	1		113.232
Boys common room	9	7			108.576
Counselling Centre	6	6		1	12.384
Store room	8	4			134.4
Seminar hall 3	37	14	1		201.233
Wash room(gents)	4				1.519
Staff toilet	2				0.924
Total					**844.608**

A 5 HP motor is used to draw water from bore well – 2 to the overhead tanks of administrative block. Total power consumption by the motor is 13kWh/day; i.e., 390 kWh/month.

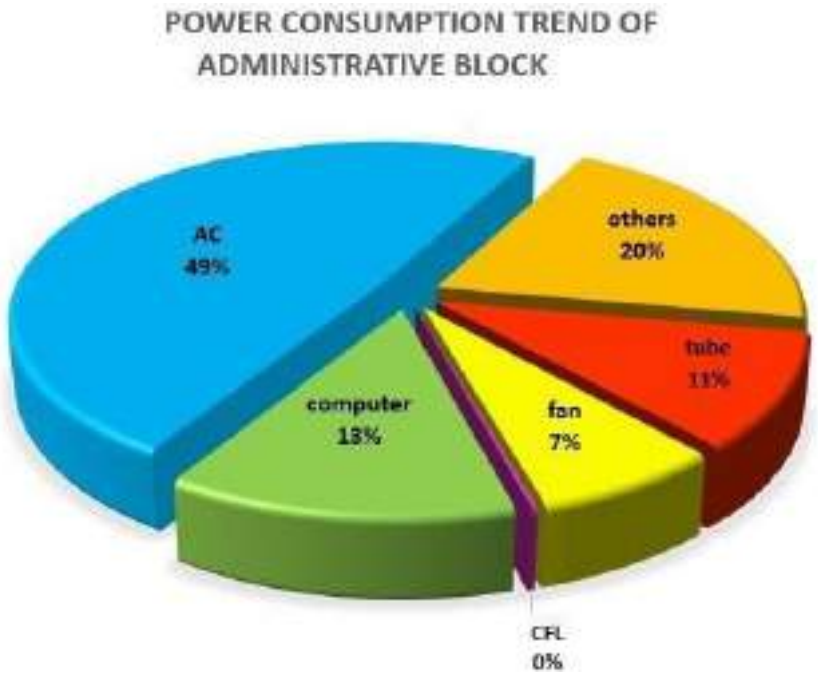


Figure 3.1 Power consumption trend of administrative block

From the pie chart above it can be seen that the major power consuming equipment in administrative block is air conditioner (49%).

3.3.2 Academic Block – I

The Academic Block- I consists of G + 2 floors.

GROUND FLOOR								
Room	**Tube**	**Fan**	**Computer**	**Exhaust fan**	**AC**	**Printer**	**Projector**	**Power consumption/month (kWh)**
Mech faculty	20	12	30	2		1		670.23
Mech HOD	3	1	1		2*1.5t			711.984
SWI	12	5	4	2				141.83
CAD lab	36	14	38	2				995.23
Class room	8	5					1	96.342
Class room	8	5					1	96.342
Class room	8	5					1	96.342
Class room	10	5					1	107.85
Class room	10	5					1	107.85
3D printer lab	4				2*1.5t			628.992
Dept. of Sports & Physical Education	1	1						12.384
Total								**3637.44**

FIRST FLOOR						
Room	**Tube**	**Fan**	**Computer**	**projector**	**AC**	**Power consumption/month (kWh)**
Class room	4	5		1		102.29
Faculty (EC)	4	4	1			101.36
Class room	4	5		1		102.29
Automobile	4	5				102.29
Staff	4	4	1			103.72
Class room	4	5		1		104.73
Faculty (ME)	4	4	1			101.23
Class room	4	5		1		102.26
Computer lab (1 & 2)	32		56		5* 1.5t	4161.024
Computer lab – 5	18		50		3*1.5t	2923.776
Ladies toilet	2					12.096
Total						**7889.456**

SECOND FLOOR					
Room	**Tube**	**Fan**	**Projector**	**Others**	**Power consumption/month (kWh)**
Class room	4	5	1		72.15
Class room	4	5	1		72.15
Class room	4	5	1		72.15
Class room	4	5	1		74.235
Class room	4	5	1		74.235
Gents toilet	5				74.235
Seminar hall	9	10	1	1mic, 5*1.5t A.C	323.21
Total					**677.22**

Communication & Microwave Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Digital storage oscilloscope		0.05	108
3 MHz multiwaveform signal generator with modulation	15	0.1	216

DC regulated power supply single	15	0.03	64.8
DC regulated power supply dual	15	0.06	129.6
Microwave bench	4	0.1	57.6
Universal IC tester	1	0.1	14.4
Soldering iron	1	0.05	2.4
Table lamp	1	0.02	0.48
Computer	1	0.24	1.8
Tube	8	0.036	43.534
Fan	8	0.05	57.6
Total			**696.214**

Digital and Advanced Microprocessor Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Digital IC logic trainer	15	0.05	108
Microprocessor 8085	15	0.05	108
DC regulated power supply single	15	0.06	129.6
DC regulated power supply dual	15	0.05	108
Micro controller kit	5	0.045	32.4
CR oscilloscope	1	0.05	7.2
Digital IC tester	1	0.075	10.8
Universal programmer and IC tester	1	0.05	7.2
Soldering iron	1	0.05	7.2
Table lamp	1	0.02	2.88
Tube	4	0.036	25.38
Fan	4	0.05	28.8
Total			**575.46**

Electronic Circuits Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Oscilloscope	15	0.045	56.7
Function generator	15	0.025	31.5
DC regulated power supply single	15	0.03	37.8
DC regulated power supply dual	15	0.06	75.6
Tube	8	0.036	24.192
Fan	8	0.05	33.6
Total			**259.392**

A 5 HP pump is used to draw water from the bore well - 2 to the collection tank and another 5 HP pump is used to pass this water to the overhead tanks of Academic Block- I. The total power consumption by the motors is 97kWh per day; i.e., 2910kWh per month

3.3.3 Academic Block –II

GROUND FLOOR			
Survey Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Tube	12	0.036	24.34
Computer	1	0.24	12.48
Fan	6	0.05	14.4
Total			**51.22**

Transportation Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
ductility testing machine	1	3.2	32
abrasion testing machine	1	2	20
CBR testing apparatus	1	1.1	11
Penetrometer	1	0.025	0.125
Tube	12	0.036	53.23
Fan	6	0.05	36
Total			**152.355**

Geotechnical lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Light compaction test apparatus	10	0.372	3.72
Sieve shaker	1	0.18	0.18
Electronic weighing balance 2kg	1	0.015	0.045
Electronic weighing balance 10kg	1	0.015	0.045
Hot air oven	1	2	40
Vane shear apparatus	1	0.372	0.372
Direct shear apparatus	1	0.372	0.372
Unconfined compression tester	1	0.372	0.372
Tube	10	0.036	19.234
Fan	6	0.05	14.4
Total			**78.74**

Environmental Engineering Lab

Equipment	No:	Power (kW)	Power consumption/month (kWh)
Hot air oven	1	2	20
BOD incubator	1	1.5	15
Digital spectrophotometer	1	0.006	0.03
Autoclave	1	3	30
Magnetic stirrer	1	0.015	0.075
Refrigerator	1	0.04	30
Jar test apparatus	1	0.037	0.222
Single distillation unit	1	3	72
Electronic weighing balance	1	0.015	2.16
Tube	12	0.036	43.2
Fan	4	0.05	20
Total			**160.687**

FIRST FLOOR			
Computer Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Computer (LCD)	80	0.24	460.8
20 port network switches	4	0.28	188.16
Printer	2	0.1	0.1
Managed network switch	4	0.35	235.2
Tube	14	0.036	74.48
Projector	1	0.20	4.8
Fan	14	0.05	100.8
Total			**1064.34**

Basic EEE Measurement Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Miscellaneous			10
Tube	10	0.036	52.76
Fan	5	0.05	36
Total			**98.76**

Electrical Workshop			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Tube	7	0.036	28.3
Fan	4	0.05	20
Total			**48.3**

Control and Power Electronics Lab			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Amplydyne	1	3.7	29.6
CR Oscilloscope	8	0.045	252
Trainer's kit	5	0.1	12
Microprocessor kit	1	0.12	192
Computer (LCD)	5	0.24	172.8
Computer (CRT)	1	0.28	40.32
Tube	13	0.036	74.75
Fan	6	0.05	43.2
Total			**816.67**

SECOND FLOOR				
Room	**Tube**	**Fan**	**Computer**	**Power consumption/month (kWh)**
EEE faculty	11	7	6	178.19
CE faculty	10	7	6	161.31
EEE faculty	5	4		65.12
HOD EEE	4	4	6	99.23
Class room	6	6		92.13
Class room	6	6		93.38
Class room	6	6		93.38
Class room	6	6		92.13
Total				**874.87**

THIRD FLOOR				
Room	**Tube**	**Fan**	**Computer**	**Power consumption/month (kWh)**
Civil faculty	6	6	9	78.541
Class room	6	5		82.34

Class room	6	5		82.34	78.288
Class room	6	5		82.34	78.288
Class room	6	5		82.34	78.288
Class room	6	6		88.18	86.688
Class room	6	6		88.18	86.688
Class room	6	6		88.18	86.688
Total				**672.441**	**648.96**

3.3.4 Laboratory Blocks

PRODUCTON ENGINEERING LAB			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
All grade head lathe	20	2.25	900
CNC lathe	1	1.5	30
CNC mill	1	1.5	30
Mechanical Surface grinder	1	0.75	75
Shaping machine	9	1.5	270
Slotting machine	6	1.1	132
Universal milling machine	2	2.25	90
All geared slotted machine	6	1.1	132
Tool and cutter grinding machine	1	0.37	7.4
Geared drilling machine	1	1.1	22
Hydraulic back saw machine	1	0.75	15
Motorised grinder	1	0.75	15
Drilling machine	1	0.75	15
Fan	16	0.05	16
Tube	66	0.036	56.45
Total			**1820.85**

HYDRAULICS LAB			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Centrifugal pump	2	10	100
Different pumps	1	12	60
Total			**160**

BASIC MECHANICAL WORKSHOP			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
HF Muffle furnace	1	5	100
Grinder	1	0.375	7.5
Circular sloth	1	1.5	30
Cutter	1	1.5	30
Water Filter	1	0.28	5.6
Fan	7	0.05	7
Tube	44	0.036	45.45
Total			**225.55**

HEAT ENGINE LAB/ HEAT TRANSFER LAB/ MECH ENGG LAB			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Heat transfer in forced convection	1	0.21	10.92
Emmissivity measurement apparatus	1	0.21	10.92
Heat transfer in natural convection	1	0.21	10.92
Thermal conductivity of insulating powder	1	0.21	10.92
Heat transfer through lagged pipe	1	0.21	10.92
Parallel flow / counter flow heat exchanger	1	3	156
Refrigeration test rig	1	0.25	13
Air conditioning test rig	1	1	52
Hartnel governor	1	0.18	9.36
Porter governor	1	0.18	9.36
Gyroscope	1	0.062	3.224
Static and Dynamic balancing	1	0.05	2.6
Variable speed air blow motor	1	2.2	114.4
Two stage air compressor motor	1	2	104
Rotameter tranier	1	0.1	5.2
Centrifugal pump	1	0.37	19.24
Filter	1	0.23	11.96
Tube	53	0.036	111.34
Fan	17	0.05	44.2
Total			**710.484**

AUTOMOBILE WORKSHOP			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Fan	17	0.05	136
Tube	46	0.036	43.23
Projector	1	0.204	4.08
Total			**91.51**

STRENGTH OF MATERIALS & MATERIAL TESTING LAB			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
Compression testing machine 1000kN	1	0.7457	14.914
Compression testing machine 2000kN	1	1.4	28
UTM 400kN	1	0.9694	19.388

UTM 1000kN	1	2.23	44.6	
Vibration machine with digital timer	1	0.3728	7.456	
Sieve shaker	1	0.3728	7.456	
Mixer machine	1	1.11	22.2	
Tube	18	0.036	13.76	
Fan	13	0.05	13	
Total			**170.774**	**1**

ELECTRICAL MACHINES LAB			
Equipment	**No:**	**Power (kW)**	**Power consumption/month (kWh)**
DC compound generator	1	3.7	133.2
DC compound motor	1	3.7	133.2
DC shunt motor	1	3.7	133.2
DC series motor	1	3.7	133.2
DC series motor + DC series generator set	1	3.7	133.2
DC shunt motor + DC series generator set	1	3.5	126
DC shunt motor + DC shunt generator set	1	3.5	126
Alternator + DC compound motor	1	4.5	162
Single phase induction motor	1	0.75	27
Slipring induction motor	1	3.7	133.2
Squirrel cage induction motor	2	3.7	266.4
Induction generator	1	3	108
Double cage	1	3.7	133.2
Pole changing motor	1	3.7	133.2
Cascade Induction motor	2	3.7	266.4
Synchronous induction motor	2	3.7	266.4
Tube	33	0.036	42.768
Fan	18	0.05	32.4
Total			**2488.968**

3.3.5 Canteen

Working hours:

- Hall - 7:30am to 10am; 12:00 to 2:00pm; 3:30pm to 5:20pm; 7:00pm to 9:00pm (9hrs)
- Kitchen – 5:00am to 10:00pm (17hrs)

CANTEEN				
Equipment	**No:**	**Power (kW)**	**Working time**	**Power consumption/month (kWh)**
Mixer grinder	2	0.75	30 mins/day	22.5
Grinder (20l)	2	1	4hrs/day	240
Fresh Juicer	1	0.6	30 mins/day	9
Deep freezer	2	0.175	24hrs/day	252
Refrigerator	1	0.042	24hrs/day	30.24
Freezer	1	0.042	24hrs/day	30.24
Dough mixer	1	1.1	20min/day	9.9
Cutting machine	1	0.55	90mins/ day	24.75
Weighing balance	1	0.015	10mins/day	0.075
Billing machine	1	0.023	9hrs/day	6.21
Tube	28	0.036	20 nos-9hrs/day, 8 nos- 17hrs/day	358.19
Fan	17	0.05	9hrs/day	229.5
Total				**1212.605**

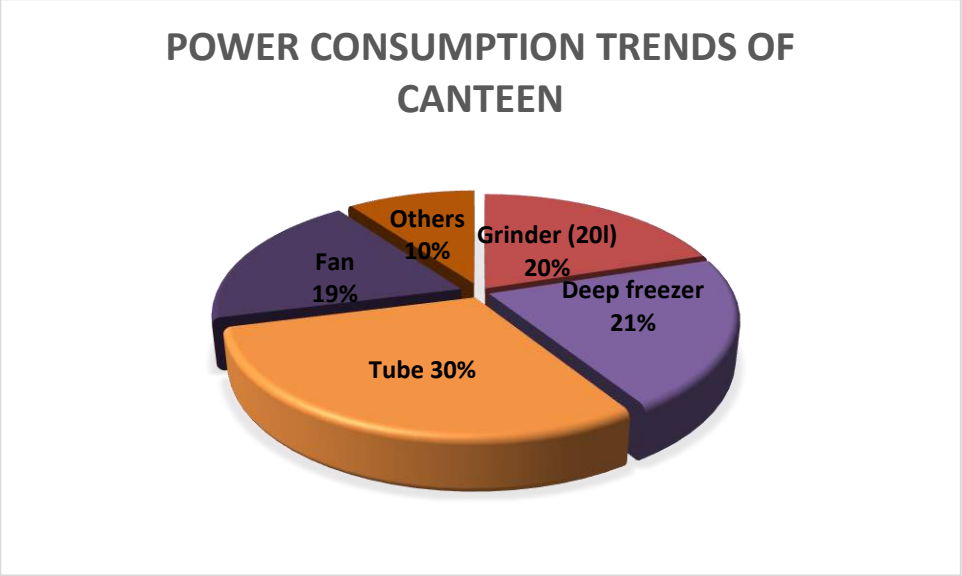


Figure 3.2 Power consumption trend of canteen

From the pie chart shown above it is seen that major power consuming component is tube lights (29%) followed by deep freezer (21%).

3.3.6 Ladies Hostel

Number of rooms occupied = 103

Number of inmates = 296

Students per room = 3(approx.)

Working days = 30

Holidays = nil

Ceiling fan (capacity: 50w)

Total number =103(1 per room + 2 common)

Working hours = 15 hrs (working days)

22 hrs (holidays)

Lighting

Tubelight (36w)

Total number = 224 (2 per room + 22 common)

Working hours = 10hrs (rooms, working days)

8 hrs (rooms, holidays)

15 hrs (common, per day)

LED (15w)

Total number = 12 (bathrooms)

Working hours = 8hrs per day

Plug point

Total number = 206(2 per room)

Laptop charging (50w)

Working hours = 8 hrs

Holidays = 10hrs

Iron box (1100w)

Total number = 30

Working hrs = 15 mins per day (only on working days)

Solar Heater

LCD monitor system (240w)

Total number = 4

Working hours = 4hrs (working days)

8hrs on holidays

Television (128.22 kWh/yr)

Total number = 2

Working hours = 1hrs per day

Water filter (280w)
Number = 2
Working hrs = 5hr

Fridge (360 unit/yr)

Total number = 1

Working hrs = 24hr

Computer

Total number = 1

Equipment	Power consumption/month (kWh)
Ceiling fan	2461.7
Tube light	6123.724
LED	43.2
Plug point	831.6
LCD monitor system	130.56
Computer	138.24
Fridge	360
Water filter	84
Television	384.66
Total	**10557.684**

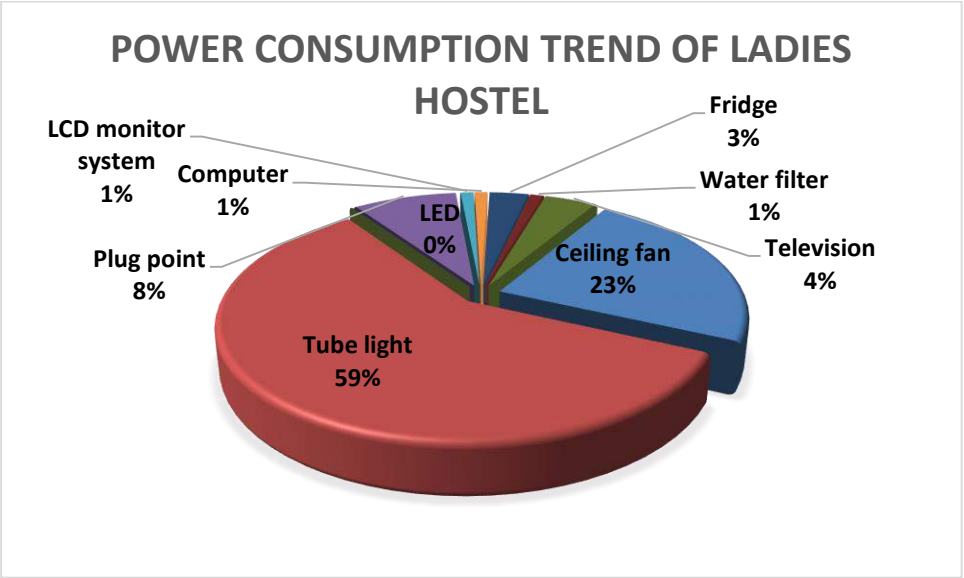


Figure 3.3 Power consumption trend of ladies hostel

From the pie chart above we can see that major power consuming component is laptop followed by tube lights and fans.

3.3.7 Junior Men's Hostel

Number of rooms occupied = 59

Number of inmates = 104

Students per room = 3(approx.)

Working days = 24

Holidays = 6

Ceiling fan (capacity: 55w)

Total number = 70(1 per room + 8 in terrace)

Working hours = 15 hrs (working days)

22 hrs (holidays)

6 hrs (terrace)

Lighting

Tubelight (36w)

Total number = 165 (2 per room + 39 common)

Working hours = 10hrs (rooms, working days)

8 hrs (rooms, holidays)

10 hrs (common, per day)

Plug point (50w)

Total number = 114(2 per room)

Working hours = 8 hrs

Iron box (1100w)

Total number = 57

Working hrs = 15 mins per day (only on working days)

Water filter (75w)

Total number = 1

Working hrs = 5hr

Cooler (90w per day)

Number = 1

Equipment	Power consumption/month (kWh)
Ceiling fan	2079
Tube light	1805
Iron box	376.2
Plug point (mobile)	1368
Water filter	11.25
Cooler	2.16
Total	**5641.61**

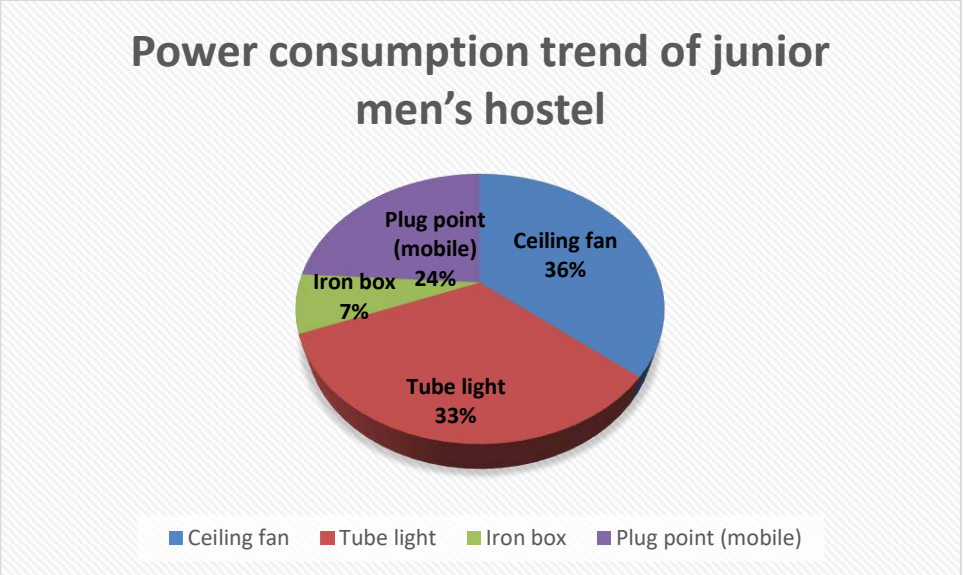


Figure 3.4 Power consumption trend of junior men's hostel

3.3.8 Senior Men's Hostel

Number of rooms occupied = 70

Number of inmates = 191

Students per room = 2 -3 (approx.)

Working days = 24

Holidays = 6

Ceiling fan (capacity: 50w)

Total number = 140 (2 per room)

Working hours = 15 hrs (working days), 22 hrs (holidays)

Lighting

Tubelight (36w)

Total number = 225(2 per room + 85 common)

Working hours = 10hrs (rooms, working days)

8 hrs (rooms, holidays)

8 hrs (common, per day)

CFL (15w)

Total number = 70 (bathrooms)

Working hours = 3hrs per day

Plug point

Total number = 140 (2 per room)

Laptop charging (50w)

Working hours = 8 hrs (working days)

10hrs (holidays)

Iron box (1100w)

Total number = 36

Working hrs = 15 mins per day (only on working days)

Water filter (75w)

Number = 1

Working hrs = 5hr

Cooler (90w per day)

Number: 1

Pump

Number = 1

Working hours = 1.5hrs

Equipment	Power consumption/month (kWh)
Ceiling fan	3080
Tube light	1944

CFL	94.5	9
Iron box	237.6	2
Plug point (laptop)	907.2	9
Water filter	11.25	1
Cooler	2.16	2
Pump (5 HP)	5.59	5
Total	**6438.3**	**62**

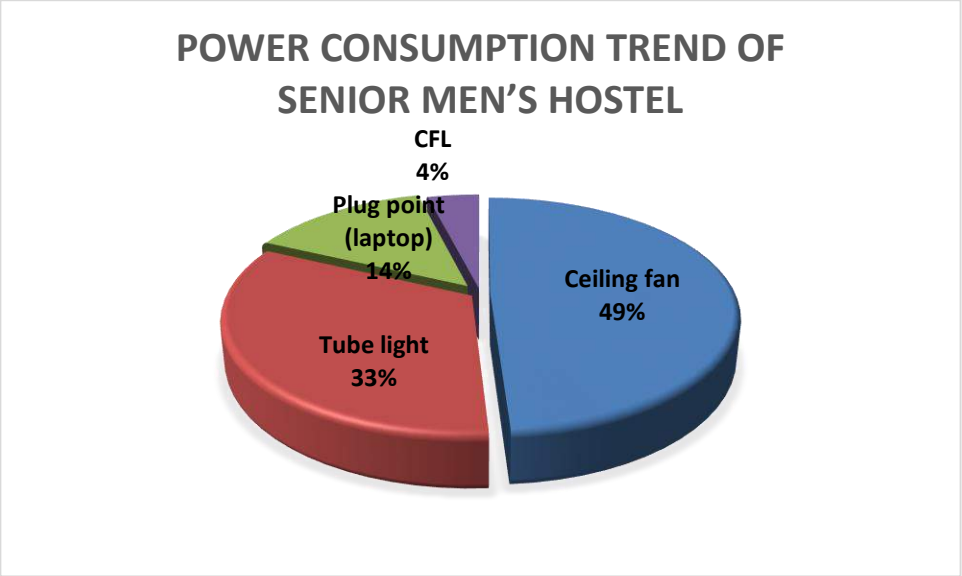


Figure 3.5 Power consumption trend of senior men's hostel

3.3.9. Library

Equipment	No:	Power (kW)	Power consumption/month (kWh)
AC	10	3.6	604.8
Computer	18	0.24	40.32
Printer	1	0.1	7.2
Scanner	2	0.1	7.2
CCTV	28	120	8400
Table fan	7	50	5280
Invertor	1	10KV	720

Fan	116	0.05	8.4
Tubelight	103	0.036	6.048
Total			**15073.968**

3.3.10 Effluent Treatment Plant

Equipment	No:	Power consumption/month (kWh)
Motor (3 HP)	1	1610.71
Motor (2 HP)	4	4295.23
Total		**5905.94**

TOTAL POWER CONSUMPTION DATA

BUILDING	POWER CONSUMPTION/MONTH (kWh)
Administrative Block	173165.158
Academic Block- I	13875.801
Academic Block – II	3922.628
Laboratory Blocks	5194.608
Canteen	1212.605
Ladies hostel	10557.684
Junior Men’s Hostel	5725.610
Senior Men’s Hostel	6282.300
Library	15074.585
ETP	5905.940
TOTAL	**240916.919**

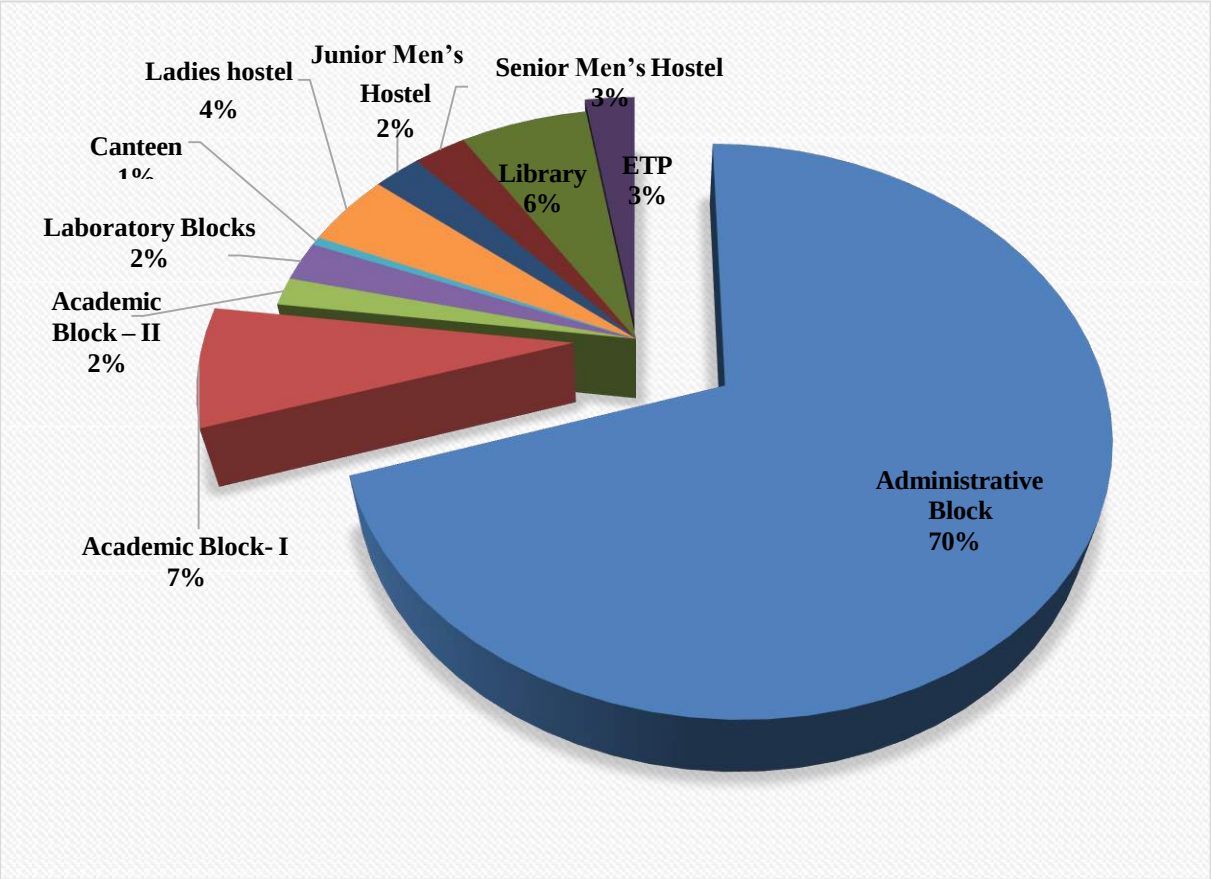


Figure 3.6 Power consumption pattern of different blocks of SSET Campus

Solid E-Waste Management Audit Report

Prepared by Electrical & Electronics Engineering Department

2019 - 2020

SCMS School of Engineering and Technology, Karukutty

4. SOLID WASTE AUDIT

4.1 Scope of Waste Audit

Waste audit encompasses the entire spectrum of waste collection, segregation, reuse, recycle, incineration and landfill. Appropriate suggestions and justifications would be put forth to improve the efficiency of the system as a whole.

4.2 Waste Generation in the Campus

Waste generated in the campus varies from paper, plastic, cloth, glass, food and sanitary items. Their sources include academic blocks, hostels, office, canteen and kitchen. The waste that is generated from all these sources if not handled properly may pose a serious health and environmental hazards. The wastes generated from various activities in the campus are mentioned below.

- **CANTEEN**

  Food waste of 206 kg and vegetable waste of around 32 kg are generated daily from the canteen which are taken to a nearby pig farm. Other wastes including paper, plastic (milk cover = 100 nos., curd cover = 40 nos., masala cover = 25 nos.) and special wastes of 6 kg is generated per day within the canteen.

- **ADMINISTRATIVE BLOCK AND ACADEMIC BLOCKS**

  Rubbish of about 7 kg is collected daily and burnt in garbage burner. Mixed paper wastes including answer sheets, question papers, newspapers, magazines, office papers, used notebooks etc. is generated @ 4.5 ton per year. Mixed paper wastes are sent to SCMS Muttom campus, from where it is taken by Plan@earth for recycling.

- **HOSTELS**

  Wastes including paper, plastic, sanitary items, bags etc. weighing around 9 kg are daily collected and burnt in the garbage burner. Plastic bottles are also taken by Plan @ Earth for recycling.

- **E-WASTE**

  E-waste generated in the campus, which is around 500 kg has been stored in a room in Academic block - I.

4.3 Methodology

SSET campus includes an Administrative block of 6 floors, Academic block-I of 3 floors, Academic block-II of 4 floors, engineering laboratories and workshops, ladies' hostel of 3 floors, junior boys' hostel of 3 floors and a full time working canteen which provides food for around 1000 people at a time. To evaluate the trends of waste generation and waste management techniques adopted at campus, interviews were conducted with the cleaning staff, administrative officers and students. The amount of waste generated, major sources of waste and frequency of waste collection were enquired from the cleaning staff. The details about the sources of waste generation in the campus are shown in Table 4.1.

Table 4.1 Sources of wastes

Sl. No.	Source	Types
1	Hostels	Paper, plastics, cloth, electronic items, leather, rubber, sanitary.
2	Academic Areas	Paper, plastic, electronic items, sanitary items, food
3	Canteen	Food, vegetable wastes, plastics, paper, gunny bags
4	Office	Paper, plastic
5	Labs	Concrete blocks, electronic items, paper

Table 4.2 Frequency of Waste Collection from Various Sources

Sl. No.	Source	Frequency of Collection
1	Academic Blocks	Once a day
2	Hostels	Once a day
3	Canteen	Twice a day
4	Road Side Dustbins	Once a week

Table 4.3 Daily Waste Generated

Sl. No.	Waste Type	Weight (Kg Per day)	Percentage by Weight
1	Food waste, Kitchen wastes	244	90.3
2	Newspaper/mixed papers	10	3.8
3	Rubbish (Paper waste, Plastic etc)	16	5.9
4	E-waste	0.25 (90 kg per annum)	0.0009
	Total	**270**	**100**

WASTE GENERATION STATUS OF THE CAMPUS

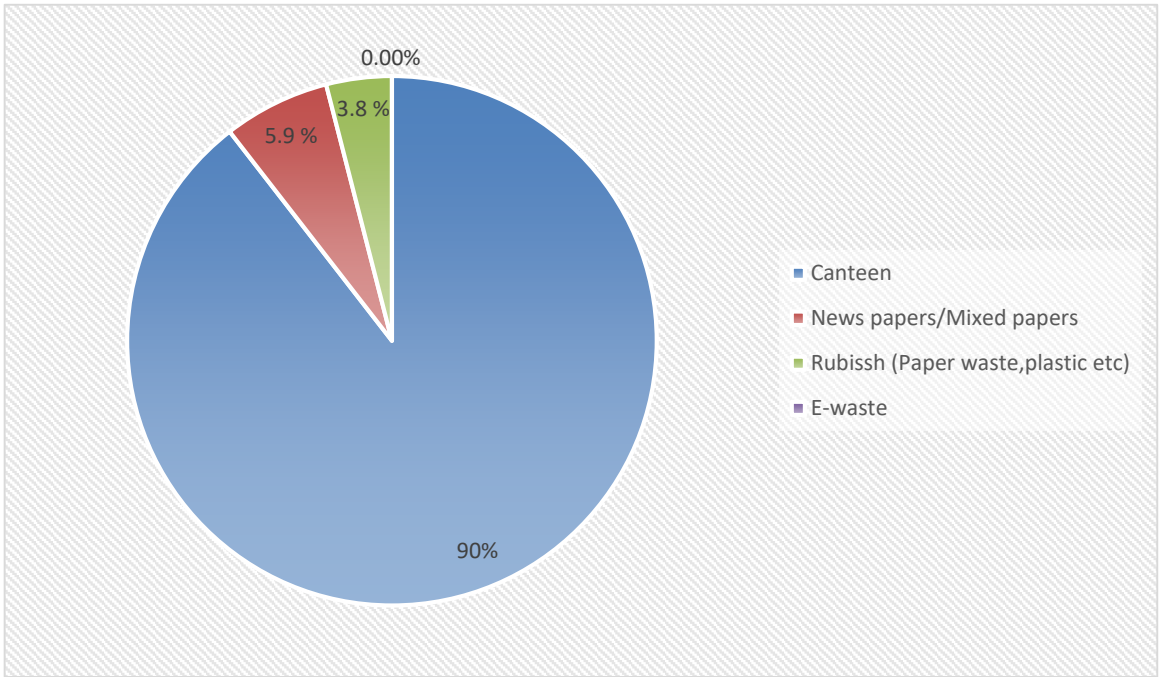


Figure 4.1. Percentage by weight of yearly waste generated

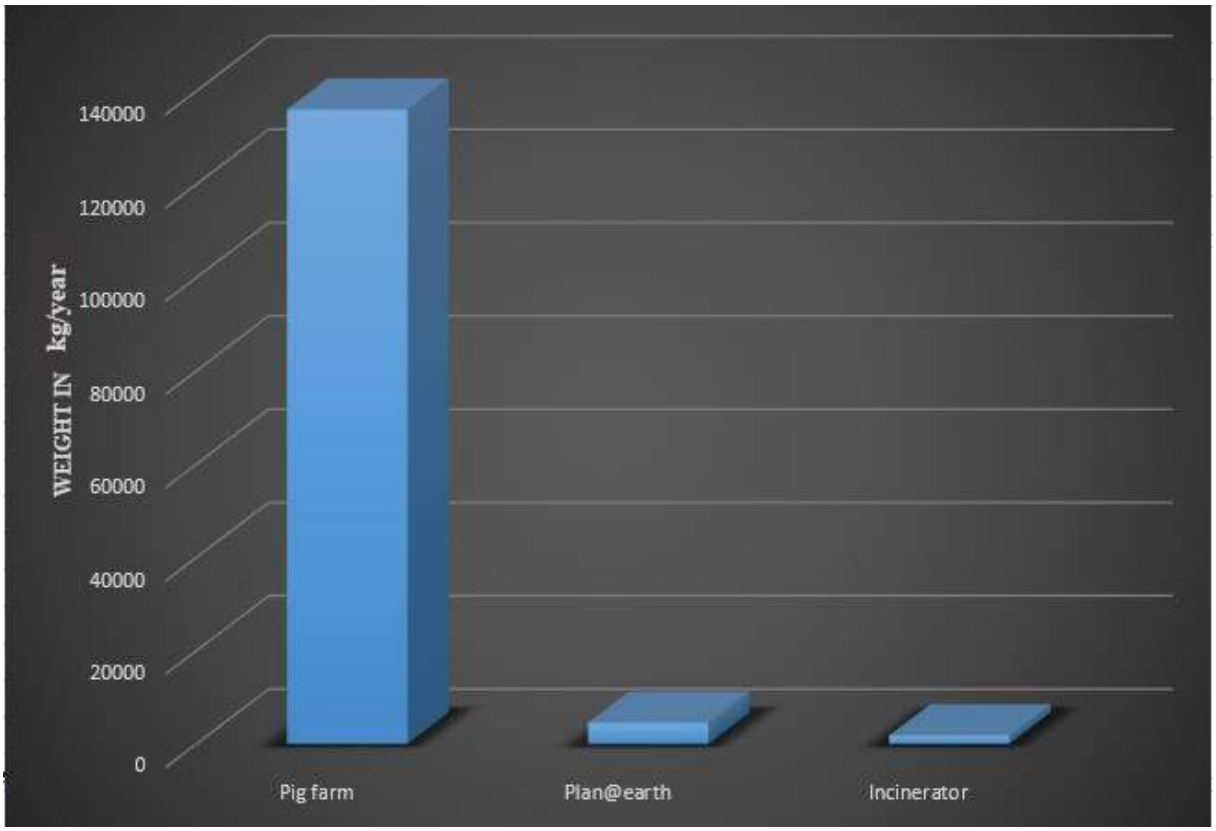


Figure 4.2 Waste disposal trend at SSET campus

The SSET, Karukutty campus serves as a living laboratory of sustainable practices by integrating academia, student life and campus operations, researching new solutions through campus practices for sustainable waste management. Students have played a vital role in encouraging environmental consideration in every functional facet of the institution. An efficient management of waste starts with regular collection of waste generated. This task has been made easier by placement of dustbins at appropriate places. Dustbins are placed at canteens, each corridor of all the buildings, roadsides, etc. Covered dustbins are used in order to prevent breeding of infectious vectors. The plastic bottles from the hostels, canteen and campus are sorted by the workers which is further collected by plan @ Earth for recycling. Campus wastes dominantly paper, plastic, thermocole, sanitary, ceramic, etc. which can neither be reused nor recycled and other combustible wastes from each buildings are collected by the cleaning staffs of the campus which is later on burnt in the garbage burner each day.

The SSET, Karukutty campus is now making a conscious effort to establish the campus as a **'zero waste'** zone, through a slew of scientific and environment-friendly measures. A number of initiatives have been put in place to promote the concept of **'reduce, reuse and recycle'** and contribute mite to protecting the environment.

A) Management of Paper Waste

Papers are segregated based on the following basic paper grade categories:

- Magazines
- Mixed Paper
- Old Newspapers
- Carton

Mixed paper is a broad category that often includes items such as discarded mail, telephone books, paperboard and catalogues. High grade deinked paper is made of high grade paper such as letterhead, copier paper, envelopes, and printer and convertor scrap that has gone through the printing process. One-sided used papers are collected and sent back to offices, dispensaries, provisional stores, etc. for reuse as scratch pads. Double-sided used papers are collected, accumulated and sold for recycling by Plan @ Earth.

B) Management of Food Waste.

Food wastes and all other organic wastes from canteen are taken daily to a pig farm located at Idukki. The amount of organic matter being retained at the campus is nil.

Figure 4.3 Tank for removing sediments and floating matter from canteen waste water before reaching ETP

C) Management of Combustible Waste

A garbage burner of capacity 150 kg is installed at the campus in which the combustible wastes like paper, plastic, wrappers, gunny bags, paper bags, clothes, sanitary waste etc are burnt daily. The ashes and residues from the garbage burner are removed once in a month which is used for gardening. No fuel is used for burning the waste.

Figure 4.4 Garbage burner at SSET, Karukutty

Figure 4.5 Green audit team inspecting garbage burner

D) Management of Recyclable Waste

Wastes including newspapers, magazines, cartons, mixed papers and plastic bottles and are collected by Plan @ Earth periodically for recycling. E-wastes from the campus like cabinets, monitors, keyboards, mouse, motherboard, hard discs, switch ports, UPS, CDs, SMPS, LCD projectors, printers, battery etc are presently stored in a room in Academic Block - I

About PLAN @ EARTH

Plan @ Earth is a non-profit organization registered as an NGO at Travancore Cochin Literary. Plan @ earth collects waste paper, plastic and E wastes from the campus and recycles them. Recycling of one ton of paper wastes saves 17 trees, 3.3 cubic metre landfill space and 7000 gallons of water.

SCMS group of educational institutions received a green certificate for saving 144 trees on 2015, 23 trees on 2017, 155 trees on 2019 and 155 trees on 2020 by ensuring recycling of 8482 kg, 1381 kg, 9121 kg and 9112 kg of used paper respectively; also 1250 kg E-waste recycled in 2019 through WOW (Wealth Out of Waste) project by Plan @ Earth.

5. Summary of Findings & Recommendations

5.1 Audit recommendations for potential water saving

Based on the information collected and observations, the following can be recommended to reduce water use and increase its efficiency.

- Replacement of single flush cisterns with dual flush cisterns - At present the toilet commodes have 10 litre flush which can be replaced with 3/6 litres or 2/4 litres dual flush cisterns. Dual flush WCs operate on a split button with the user having the option of which one to use. Usually the smaller button operates the shorter flush of 3 litres which is adequate for flushing liquid waste, while the larger button is for 6 litres flush for more substantial waste. This can reduce water use by around 30-40%.
- Extent the rainwater harvesting facility to academic blocks one and two which helps to increase the water quality, especially to reduce the iron content.
- Separate treatment facility for kitchen sullage and recycle treated water-
  The water use diagram shows that kitchen sullage is a dominant fraction of waste water, which if sought a separate treatment, can be recycled for flushing purposes with more acceptance from the staff and students.
- Flush with grey water: Use runoff water for flushing purpose.
- Establish a water budget for the building and, set and monitor performance criteria.
- Awareness to the students and staff regarding the importance of conservation of water.
- Install treatment facility for the removal of excess iron from ground water.
- Introduce water meters in the flush water line: Flushing is a major water use activity as found from the household survey. However, SSTM is not metering the flush water line at the moment. Meters may be introduced in the flush water line to prevent any misuse. It is better to utilize the excess rainwater collected than let it go wasted.
- Awareness to the students and staff regarding the importance of conservation of water.
- Incentives for those who consumes less water.
- Use of vacuum cleaners for housekeeping.

5.2 Audit recommendations for potential Energy saving

- All air conditioned rooms can be provided with doors having automatic closing mechanism and windows with tinted glass to reduce load on the air conditioning system.
- Good light ventilation and Air ventilation to classrooms without air conditioning system to avoid the use of tube lights and minimize the use of ceiling fans at high speed. Currently most of the classrooms are having window curtains. Avoid using curtains to facilitate entry of sunlight.
- It is recommended that fluorescent lamps in corridors and toilets may be replaced with CFL or LED light at the end of utility period of currently installed fluorescent lamps as it consumes much less energy compared to fluorescent lamps.
- Install ceiling fans in faculty rooms which currently have only air conditioning system. Use air conditioners only during summer.
- Let the good practice of replacing of CRT monitor with LED monitors to be continued. LED monitors typically require about 20% of the power required for a CRT monitor with the same screen area. In addition, the amount of heat generated by an LED monitor is considerably less than a CRT monitor, resulting in a lower load on air conditioning. Building cooling needs may be decreased by up to 20%.
- Switch off the photocopier machine at the main outlet itself when not in use or in other words machine should not be kept in stand by and sleep mode which consumes power.
- Do not leave laptop/ mobile charger on throughout the night.
- Reduce wastage of water and thereby the power required to pump up the water can be cut down.
- Switch on heater only when required.
- Switch of water cooler during night time.
- If the elliptical trainer or treadmill in the gym is connected to a device that can convert the output into electricity, it might deliver 10 Calories per minute, which translates to 700 watts or the power consumption of seven good light bulbs.

- If the sports bike of the gym is connected to a device that can convert the output into electricity, we can generate about 50 watt-hours per half-hour of cycling at a moderate pace. That is good enough to keep an efficient light bulb illuminated for an hour.
- Since a large amount of food waste is generated in the canteen, installation of a biogas plant can be a better solution for waste disposal as well as energy recovery.
- From the discussions with the authorities, it is understood that the institution has already initiated steps with KSEB for installing solar panels which will reduce power consumption.

5.3 Audit recommendations for waste management

- Place dustbins with different colour codes, so that waste can be separated into different types like (plastic, paper, food etc.) at source itself.
- Provide more dustbins in gardens, corridors, roadsides, and canteen and make students more aware of using it effectively.
- Use covered dustbins instead of open dustbins in order to prevent breeding of infectious vectors.
- The waste collected from various places in the campus for burning in garbage burner, may be kept in closed pits or in storage rooms.
- May think of steps to recycle the plastic waste generated in campus by collaborating with Kerala government's 'Suchitwa Mission' project.
- Awareness among students and staff to reduce wastage of food in the canteen.
- Encourage reuse of one-side printed papers for less important documentation or for reuse as scratch pads in offices and faculty rooms.
- Sorting the waste before garbage burning should be given utmost priority.
- Existing initiative for recycling paper and e-waste in association with plan@earth in very good and may be sustained.

Action Taken Report

For waste management requested to:

- Place dustbins with different colour codes, so that waste can be separated into different types like (plastic, paper, food etc.).
- Provide more dustbins in gardens, corridors, roadsides, and canteen and make students more aware of using it effectively.
- Use covered dustbins instead of open dustbins.
- The waste collected from various places in the campus for burning in garbage burner, must be kept in closed pits or in storage rooms.

- Take steps to recycle the plastic waste generated in campus by collaborating with Kerala government's 'Suchitwa Mission' project.
- Give awareness among students and staff to reduce wastage of food in the canteen.
- Encourage reuse of one-side printed papers for less important documentation or for reuse as scratch pads in offices and faculty rooms.
- Sorting the waste before garbage burning should be given utmost priority.
- Existing initiative for recycling paper and e-waste in association with plan@earth in very good and may be sustained.