Stella Mary's College of Engineering

Kanyakumari - 629 202

Green Audit Report

2018 - 2019

Conducted by

C. Daniel

Green Auditor

GREEN AUDIT REPORT (2018APRILto-2019 MARCH) OF STELLA MARYS ENGINEERING COLLEGE

INTRODUCTION

Global warming has been fast emerging as a threat to the livelihood of human beings as well as the eco system. Climate change is attributed to the direct effect of global warming. Taking into consideration of the warning signals given by scientists and United Nations, the Government of India has made it mandatory on all carbon emitting industrial establishments and business concerns to conduct regular Green Audit and implement carbon reduction measures to ensure carbon neutrality in the near future.

In line with this thinking, National Assessment and Accreditation Council – NAAC- also made it mandatory from 2017 onwards for all Higher Educational Institutions, particularly colleges providing professional courses and Arts/Science Colleges to conduct Green Audit of their campuses to ensure that they enjoy the status of being the green campus. Moreover, the Green Audit should measure the quantity of CO_2 emission by the institutions concerned and various carbon foot print reduction measures being implemented to ensure zero carbon emission. Stella Marys Engineering College, therefore, conducted the survey of the flora/fauna in the campus, energy auditing which includes green energy production measures and assessed the carbon reduction measures implemented since its inception during the academic year 2018 – 2019. This report is intended to be submitted to NAAC, New Delhi during the current academic year.

During the year 2018 to – 2019, Stella Marys Engineering College, therefore, has taken a step further ahead to conduct a scientific method of assessing the green status of the campus employing scientific tools to measure carbon emission equivalent of total energy consumption, the quantum of carbon absorption (CO_2) and oxygen emission by flora, Carbon Foot Print reduction in the atmosphere, though very marginal, by various energy saving measures, water audit etc. In this regard, the Chairman of the Stella Marys Engineering College entered into an agreement with Mr. C. Daniel, Development Consultant and Green

Auditor who has been conducting such scientific Green Audits in colleges in Kanyakumari District to conduct the green audit of the campus of the college.

The period taken for auditing is from 25/02/2019 to 30/03/2019

The concept, structure of the audit, its objectives, methodology, tools of analysis, time frame of the Audit, themes and cross cutting themes are detailed below.

THE CONCEPT

The term environmental audit or green audit means different things to different people. Terms like assessment, survey and review are also used to describe the same type of activities. Furthermore, some organizations believe that an "environmental audit" addresses only environmental matters, whereas others use the term to mean an audit of health, safety and environmental related matters. Although there is no universal definition, green auditing, as practiced by many leading companies/institutions, follows the same basic philosophy and approach summarized by the broad definition adopted by the International Chambers of Commerce (ICC) in its publication Environmental Auditing (1989). The ICC defines Environmental Auditing as:

"A management tool comprising a systematic, documented periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of safeguarding the environment and natural resources in its operations/projects".

The European Commission in its proposed regulation on environmental auditing also adopts the ICC definition of environmental audit. However, the outcome of Green Audit should establish with concrete evidence that the measures undertaken and facilities in the institution under green auditing reduces carbon foot print in the atmosphere. Carbon Foot print is historically defined as the total set of greenhouse gas emissions caused by an individual, event or organization, and expressed as carbon dioxide equivalent.

STELLA MARYS ENGINEERING COLLEGE– A BRIEF PROFILE

Stella Marys Engineering College located in Kanyakumari District is a co-education college established and administered by the Nova Educational Trust. Mr. Charles Nazarene is the founder and Chairman of the College.

Stella Mary's Engineering College was inaugurated in 2012 promoted by Nova Educational Trust to impart technical education par excellence and prepare professionals for serving the industry and nation. It offers and facilitates academic excellence, leadership qualities, nurturing environment, and cutting edge infrastructure - everything students need to succeed. Ever since its inauguration, the college has been maintaining a continual development in terms of infra-structure, courses offered, student / faculty strength and recognition by Universities concerned and NAAC.

The College was affiliated to the Anna University, Chennai and has been offering the following courses;

1. B.E – Computer Science and Engineering
2. B.E – Electronics and Computer Engineering
3. B.E – Electrical and Electronics Engineering
4. B.E – Civil Engineering
5. B.E – Mechanical Engineering
6. M.E – Computer Science and Engineering

Total student strength of all the seven courses stand at 814 during the 2019 academic year. There are 58 teaching staff and an equal number of non-teaching staff.

Physical infra-structure

The college has four blocks which covers class rooms, laboratories and hostels for boys and girls.

Out of the total built up area of 2, 43, 484.24 square feet, the administrative block covers 18,719.6 sq. ft., S&H Block covers 14,440.9 sq. ft., Engineering Block covers 1,43,259 sq. ft., Mechanical Block covers 17,332 sq. ft., Ladies Hostel 24,506 sq. ft. and the gents

hostel covers 24,702 sq.ft. Besides, watchman shed consumes a small area of 524.74 sq ft.

The college has adequate class rooms well ventilated with windows and there are 14 laboratories providing practical training to the seven department students. The labs are constructed and equipped with instruments, machines, tools, fittings and furniture to comply with the norms of NAAC and UGC.

Vision

The founder visualizes an egalitarian society where highly disciplined and well trained workforce shall play a proactive role to sustain peace and prosperity.

Mission

Stella Marys Engineering College aims at promoting technocrats with social commitment to work for the integrated development of the marginalized poor communities through their technical skills and commitment.

Objectives

i) To facilitate integrated development of the students, thereby enabling them to become citizens with social commitment

ii) To enable the students with adequate technical skills so that they become agents of social and economic change in India.

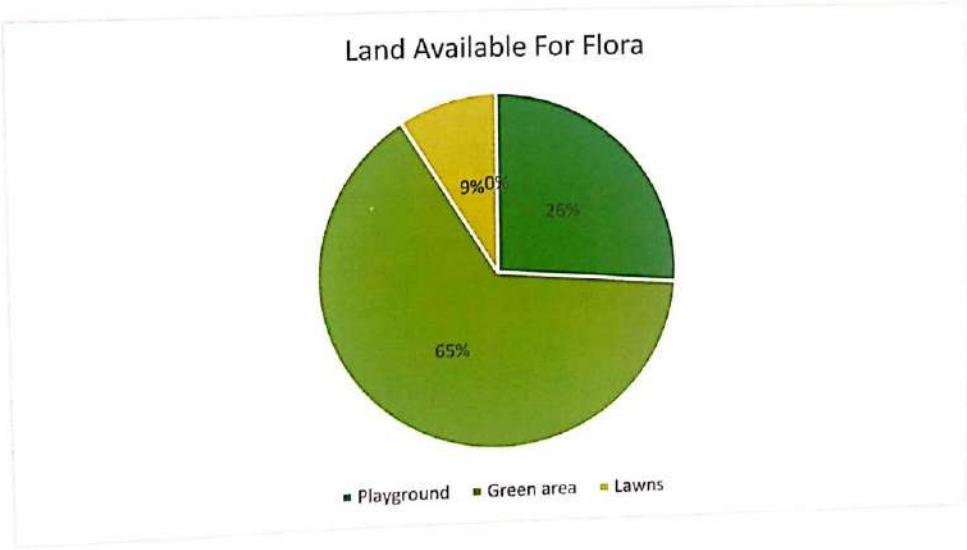
iii) To strengthen the life skills social awareness among the staff and students to protect the earth from global warming. .

iv) To inculcate ecological rights of the students that will enable them to protect the environment and eco system of their villages.

Now a glance at the physical structures of the College

Sl.no	Particulars	Area in square feet
1	Total land area	3,68,351. 24
2	Built up area/open terrace	2, 43, 484. 24
3	Road and parking area	18,039.66
4	Playground/ open land area	96, 439.94
5	Green area (bushy plants and wild grass)	2,38,958.02
6	Areas of grass land/lawns	32, 953. 28

Area available for Flora Development



The academic strength of the college is best illustrated through the following table. The shaded courses are self-financed.

S. No	Departments	Students	Staff
1	B.E. Computer Science and Engineering	112	10
2	B.E. Electronics and Communication Engineering	76	8
3	B.E. Electrical and Electronic Engineering	72	8
4	B.E. Civil Engineering	152	8
5	B.E. Mechanical Engineering	170	10
6	B.E. Science and Humanities	215	12
7	M. E. Computer Science and Engineering	17	2
	Total	**814**	**58**

OBJECTIVES OF GREEN AUDITING

Objectives are needed to define quantitative and qualitative level of the achievement of Stella Marys Engineering College – herein after referred to as institution - in terms of Carbon Foot Print reduction. Hence the following objectives are worked out in consultation with the Principal and the faculty members.

THE OBJECTIVES:

- To measure through documentation materials and observation the quantity of carbon emission, both directly and indirectly, by the institution.
- To assess quantitatively the carbon foot print reduction through development of flora, energy saving measures, water auditing and other the measures implemented by the institution.

- To find out the positive impact created on electricity power management, biodiversity and environment consciousness among the students through investment made by the institution to achieve there quired result in carbon reduction
- To assess whether the non-academic activities of the institution support the collection, recovery, reuse, recycling of the solid waste that harms the environment.
- To identify the gaps and suggest recommendations to improve the green campus status of the institution.

METHODOLOGY ADOPTED

The methodology adopted to conduct the Green Audit of the Institution has the following components;

ONSITE VISIT

The auditor visited the institution on 14/02/2019 and spent three days in the campus to observe and assess the greenhouse gas emissions from the institutions, through interaction with the faculty and verification of the records. The sub focus of the onsite visit is also to verify physically various carbon foot print reduction measures such as production of green energy and installation of energy efficient devices. The key focus was on assessing the green cover, the flora, status of the institution, energy consumption and energy saving measures.

FOCUSED GROUP DISCUSSION

The institution has formed and trained a group of dynamic and pro active green auditors from among the students. They conduct regular energy saving measures in their own villages through household survey and sensitize the families to reduce consumption of high energy consuming apparatus and devices.

They constitute the Focussed Group which include the students as well as the staff in charge of Green Auditing. The discussion focused on identifying the attitudes and awareness towards environmental issues at the institution level, village, district level, national level and global level. The discussion revolved around three key questions; Do they consider

themselves eco-conscious? Do they consider the organization to be eco-friendly? What do they think are the top priorities that should be tackled?

THE OFFICE/BUILDING SURVEY

Focussed Group discussion was followed by gathering informationand statistics on the office-based environmental impacts, like square footage, utility bills, energy saving devises, and IT equipment. This information is added to the carbon footprint data, giving us an accurate picture of the organization'sannual greenhouse gas emissions and reduction measures.

THE CARBON FOOTPRINT

- The data collected from the following sources are taken into consideration to calculate Carbon Foot Print emissions and reductions; the flora status of the campus - say total number of plants, trees, shrubs –alternate green energy production and consumption to reduce fossil fuel based energy, and number of Fluorescent bulbs, CFL, LED tube lights and Electronic Chokes to improve energy efficiency in the campus/building through our carbon footprint calculator.
- The carbon foot print calculator will enable the institution to measure annual tons of carbon emissions by the institution. Besides, it will enable the institution to break it down by key "carbon drivers" so that the institution knows how much of carbon footprint comes from which type of behaviour (e.g. high power consuming incandescent bulbs vs. LED lights, LPG cylinder vs. Bio Gas etc.).

Green Audit Assessment Team was constituted by the Principal, Dr. Suresh Kumar Premil to facilitate the Green Audit conducted by the Green Auditor. Moreover, the involvement of the faculty of the Stella Marys Engineering College ensured the participatory approach towards Green Audit. The Green Audit will be finally reviewed and submitted by the Principal to any organizations or institutions concerned.

GREEN AUDIT ASSESSMENT TEAM

Sl. No.	Name	Designation
1.	Mr. C. Daniel	Green Auditor/ Development Consultant
2.	Dr. Freeda	Head, Science and Humanities
3.	Mr. Michael Franklin	Head, Electronic Communication and Engineering
4.	Mr. Saravanan	Head, Electronics and Electrical Engineering
5.	Edward John	Head, Mechanical Engineering

GREEN AUDIT

CARBON AUDIT TOOLS AND ANALYSIS

CARBON FOOT PRINT REDUCTION IN THE ATMOSPHERE THROUGH FLORA

A **carbon footprint** is historically defined as "the total set of greenhouse gas emissions caused by an individual, event, organization or product expressed as **carbon** dioxide equivalent."

Calculation of carbon absorption by Flora in Stella Marys Engineering College.

The Flora status of the institution

Green area (bushy plants and grass) = 2, 38,958.02 sq. ft.

Area of lawns = 32,953 sq. ft.

Open land area = 96, 439 sq. ft.

The area taken into consideration for data collection of Flora is the projected area.

FAMILIES OF FLORA IN THE PROJECTED AREA.

There are 28 families, 12 Genus and 76 Species of trees, potted plants and shrubs in the college campus. The college land area is under development to accommodate high carbon absorbing trees and equally high oxygen emitting trees through innovative branch rooting technology. Hence the low figure of families, Genus and Species.

CALCULATION CALENDAR FOR TREES

560 to 700 fully grown trees is taken up for calculating carbon absorption by trees. This depends on the type of soil, the species/family type of the tree and spacing. However, with the normal spacing of 6 x 10 feet. These trees do not have huge canopy cover such as indigenous Tamarind Tree or Neem Tree.

However, the Green Audit Team members made an approximate survey of the number of flora in the area.

Table - I

Sl.No.	Status of trees/plants/ bush trees	Number/area
1	Total number of fully grown trees	160
2	Total number of semi grown trees	1,240
3	Total number of bush/shrub /grassy plants	5.5 lakhs
4	Total number of ornamental plants	560
5	Grass lawn	3.080 sq.mt

Plant/tree calculator methods employed

The line of demarcation to differentiate between fully grown and semi grown trees is a tough and challenging task. This difficulty is more pronounced in the tropical countries as the canopy cover of each tree differs widely as this is subsequently determined by the circumference of the trunk, number of branches, sub branches and foliage sprouting from the sub branches. Therefore, the Green Audit Team of Stella Marys Engineering College has adopted the universally recognized criteria to enumerate fully grown and semi grown trees. Trees with a life span of above ten years and with more than ten main branches shall be categorized as fully grown trees. Trees with more than ten years life span but without branches or trees having life span of less than five years with braches shall be categorized under semi grown category.

Another problematic area is enumeration of bushy plants in a given area. Here too, different tools are employed for different geographical regions such as hilly areas and forests where wild bush plants and grasses jostle together without respecting scientific calculation of spacing. But here we are calculating the bush plants and grasses in the controlled plot, say

college campus. Hence the following formula is taken up for enumeration of bush plants per square meter.

Take the numberof plants on the border line and multiply by 100 then divide by the seed row spacing in cm to get plants per square metre. For example, 25 plants per metre multiplied by 100 then divided by 25 cm (10" row spacing) is 100 plants per square metre. If we take up this formula to enumerate the total number of bush plants in 22,332 square meters, then the total number of bush plants in the campus is 22, 33,200 or about 2.2 million plants. However, the college administration is involved in land development program to plant high level of carbon absorption and oxygen emission plants and trees, the total number of bush plants stand at about 5.5 lakh only.

TOOL TO MEASURE CARBON ABSORPTION

ASSUMPTIONS

One fully grown large tree with wide canopy cover inhales 20 Kg carbon dioxide per year. Such trees are quite often found in the forests. In households and educational institutions, large canopy covers are pruned to accommodate smaller revenue earning trees and plants. Hence it is appropriate to adopt the following formula to calculate carbon absorption.

1. Average number of mature trees in one acre is 700 trees
2. Carbon absorption capacity of 700 trees is equivalent to carbon emitted by a speeding car in travelling for 41,843 km
3. Average kilometre covered by a car per litre of petrol is 20 km
4. Total quantity of petrol consumed by the car for travelling 41,843 km is 2092 litres

The carbon emission for a litre of petrol is 2.3 kg of CO_2. At this rate, the total quantity of carbon emitted by 2092 litres of petrol is 4812 kg of CO_2 or 4.8 tons of CO_2. Hence the carbon absorption of one fully grown tree is 4812/700 = 6.8 kg of CO_2.

CARBON ABSORPTION OF FLORA IN THE INSTITUTION

Carbon absorption of one fully grown tree = 6.8 kg of CO_2.

1. Therefore, the carbon absorption of 160fully grown trees in campus of the institution is (160x6.8Kg. CO_2) = **1,088 kg of CO_2 or 1.088 tons of CO_2**
2. At this rate, the carbon absorption of 1,240 semi grown trees ishalf or 50% of the carbon absorption capacity of fully grown trees. Hence the carbon absorption is**(1,240x3.4 kg of CO_2) = 4,216 kg of CO_2 or 4.2 tons**
3. The ornamental plants raised in pots and in the gardennumber 560. Apart from that approximately 5.5 lakhs of bushy plants and wild grasses have been raised by Nature with very small intervention by the College authorities. We prefer to name them as gift of Nature. This is based on the standard bushy plant counting formula mentioned above.
4. Carbon absorption of plants, bushes and shrubs vary widely according to the species, Genus and Family. Certain bush plants absorb as high as 49,000 grams CO_2 per plant where as some other bush plants absorb as low as 150 g of CO_2 per plant. It is very difficult to measure specifically the carbon absorption and oxygen emission of each family of plants and grasses. Therefore, it is fixedthat per plant carbon absorption at 200 g per plant in consultation with environment scientists.
5. Based on this the total carbon absorption of 560ornamental plants is calculated at 560x 200 g = 1, 12,000 gram or 112kg.
6. It is enumerated that 5, 50,000wild bushy plants and grasses are raised by Nature in the 22,332 square meter area. It is not possible to apply the formula used to measure the carbon absorption different species of bushy plants with clinical accuracy. Hence the above 200 gram per plant capacity is taken up to calculate the carbon absorption of 5, 50,000 bushy plants. Thus (5, 50,000x200) = 110000000 grams or 1, 10,000 kg. If it is converted into tons it **is 110 tons of CO_2**
7. The grass lawns account for 32,953 square feet land. The lawns have different measurement toll for carbon absorption and oxygen emission. The carbon absorption capacity of 1,000 sq.mt area of grass lawn is 1 Kg. CO_2. Per day Therefore, the

carbon absorption capacity of 32,953sq. area or 3,079 sq.mt is 3 Kg x 365 = **1 ton CO^2**

8. The grant total of carbon absorption of the flora in the campus of Stella Marys Engineering College in tons is (1.088+4.2+112 Kg+110+1ton Kg) = **115.4 tons.**

This is the sink effect of the Flora in the campus and the proactive Carbon Foot Print reduction measures.

TOOL TO MEASURE OXYGEN EMISSION BY FLORA IN THE INSTITUTION

According to the Arbor Day Foundation, "a mature leafy tree produces as much oxygen in a season as 10 people inhale in a year."

The air that is inhaled is about 20-percent oxygen, and the air that is exhaled is about 15-percent oxygen, so about 5-percent of the volume of air is consumed in each breath and converted to carbon dioxide. Therefore, a human being uses about 550 liters of pure oxygen (19 cubic feet) per day.

Calculation of oxygen emission by flora

The number of *liters* in 1 *kilogram* depends on the density of the substance being measured. The *liter* is a unit of volume, and the *kilogram* a unit of mass. **Liters** and **kilograms** are approximately equivalent when the substance measured has a density close to **1 kg** per **litre.**

"On average, one fully grown tree produces nearly 260 pounds or 117.6 kg of oxygen each year. Two mature trees can provide enough oxygen for a family of four persons."

1. Total mass (kg) of oxygen emitted by 160 fully grown trees per year is (117.6x160) = 18,816kg of O_2 or **18.8 tons of CO_2**
2. Total oxygen emitted by semi grown trees (1,240×58.8) =72,912 kg of CO_2 or **72.9 tons** (oxygen emission is half or 50% of the fully grown up tree)
3. Total oxygenemitted by 5, 50,560 (5, 50,000 wild bushy plants + 560 ornamental plants in pots and in garden) bushy plants is calculated on the basis of oxygen

inhaling requirement per person/day. One normal human being requires 550 liters o oxygen per day to avoid airlock. 400 bush plants produce enough oxygen per day t enable a person to breathe adequate quantity of oxygen. Total quantum of oxyge produced by 400 plants per day is 550 litres of oxygen.

4. If we take 400 plants as one unit, then the number of units of bush plants in th campus is (5, 50,560/400) = 1,376.4 units. Total quantity of oxygen produced by 1376.4 units is (1,376.4 x 550 litres) =, 7, 57,020litres of oxygen per day or 75 tons.The annual production of oxygen at this rate is(757 tonsx365) = **2,76,305tons o oxygen.**
5. The*grass lawns* are incredible *oxygen* making machines. A 25 sq. ft area will supply enough *oxygen* to support one person for a day. In other words, quantitatively speaking, 25 square foot area of grass produces 550 litres of oxygen per day. Hence, we take 25 square foot area as one unit which is equivalent to 550 litres of oxygen.
6. Total area of grass land is 32,953sq.ft. If we calculate units it is 32,953/25 = 1,318 units which produces (1,318 x 550 litres of oxygen) = 7, 24,900litres of oxygen per day. Total quantity of oxygen produced per year is 7, 24,900x365= 26, 45, 88,500litres of oxygen. If it is converted into tons, **they stand at 2, 64,588 tons of** oxygen.

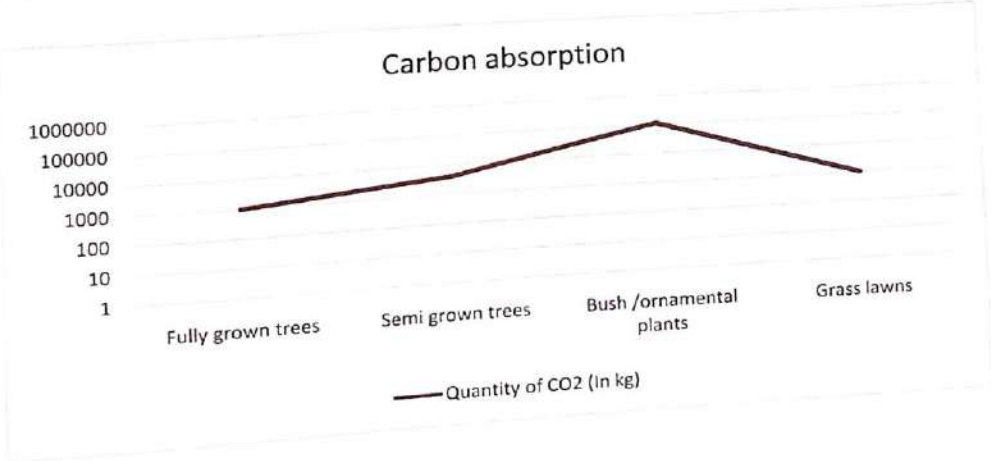
CARBON FOOT PRINT REDUCTION TABLE

CARBON DIOXIDE ABSORPTION

Table – II

Sl. No.	Types of trees/bush	Quantity of CO_2 (In kg)
1	160 fully grown trees	1000
2.	1,240 semi grown trees	4000
3	5,50,560 bush /ornamental plants	110000
4	32,953 sq.ft. of grass lawns	1000
	Total	**116000 tons**

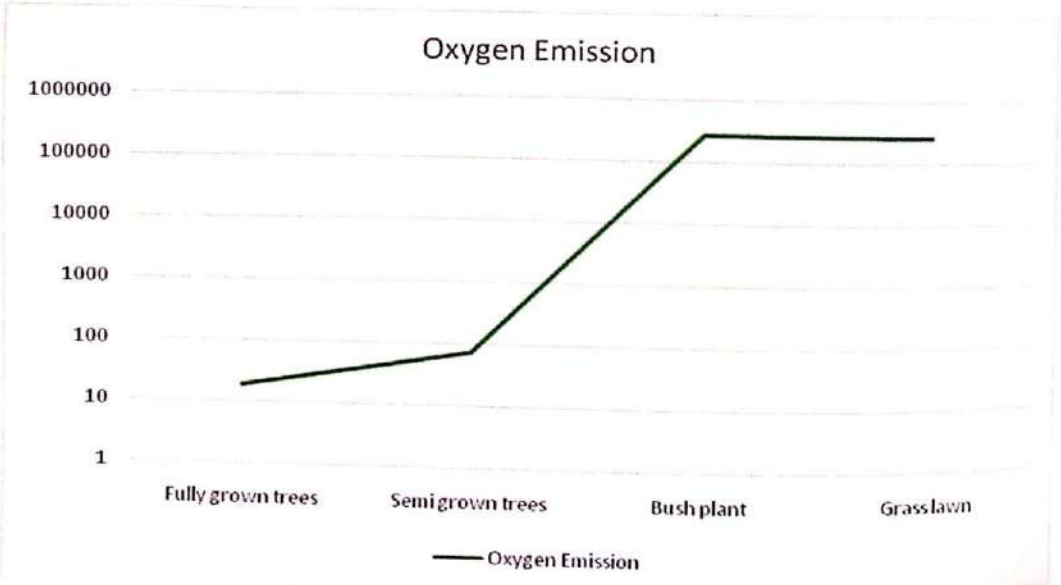
DIAGRAM



OXYGEN EMISSION BY FLORA

Table - III

Sl. No	Type of trees/plants	Oxygen in tons
1	160 fully grown trees	18.8
2	1,240 semi grown trees	72.9
3	5,50,560 bushy/ornamental plants	2,76,305
4	32,953 sq.ft. of grass lawns	2,64,588
	Total	**5,40,984.7**



ENERGY SAVING MEASURES AND CARBON FOOT PRINT REDUCTION

The Energy Audit report of the college during the period - 2018 January to -2018 December reveals that the total consumption of electricity is 1, 01,678 units.This includes the energy consumption of air conditioners which consumes huge quantities of electricity. One unit equals to 1000 watts hour (1kWh). It requires 0.538 kg or approximately ½ kg of coal to produce one unit of electricity. Therefore, the total quantity of coal required to produce 1, 01,678 units of electricity is (1,01,678 x 0.538 kg of coal) = **54,702.7 kg coal or 54.7 tons of coal.** This is the indirect coal consumption through electricity consumption.

One kg of coal emits 2.86 kg of CO^2 into the atmosphere and thereby increasing the Carbon Foot print which in turn results in proportionate global warming. Therefore, 54.7 tons of coal consumed indirectly by the institution through consumption of 1, 01,678 unit of electricity emits (54.7 tons of coal x 2.86 kg of CO^2) = **156.4 tons of CO_2** into the atmosphere.

However, there is another source of carbon emission. It is the transport system of the college.

Transport system in India accounts for 9% of the total CO_2 emissions in India. Considering the vast number of vehicles owned by the public sector and private sector, India enjoys the dubious distinction of holding the third rank in the world in terms of carbon emission from transport sector.

Therefore, is appropriate to calculate the carbon emissions from the transport buses, cars and two wheelers owned by the institution, staff and the students.

The following table illustrates the number of vehicles.

College bus	-11 numbers
Four wheelers	- 8 numbers
Two wheelers	- 36 numbers

The fuel consumption by vehicles is determined by the type of vehicle, year of manufacturing, maintenance status, traffic congestion in a particular area etc. Considering these factors, it is estimated through trip sheets that the average mileage covered by each college bus is 4 KM/Litre of diesel. The eleven buses make only two trips per day – the point of departure from various places of the district to the college in the morning and reaching the destination from the college in the evening. Based on this, the total of one way distance covered by the eight buses are 1,27,200 KMs per year or 180 days. The total diesel consumption of the transport system of the colleges per month is **4,506 litres.** At this rate, the annual consumption of diesel is 4,506 x 6 = **27,036 litres.**

The 8 four wheelers are used for various personal purposes. Hence we take into consideration the average distance covered by the four wheelers to the college and from the college to the homes of the owners. The average is worked out in consultation with the owners of the vehicle and arrived at 12KM (two way) per vehicle per day. Thus the total distance covered for 180 days is **12x 8 x180 = 17,280 KMs.**

36 two wheelers come to the college from various destinations – the nearest is **2** KM and the distant destination is 12 KM. Hence, we worked out the average of 7 KM (two way) per day. The total distance covered by 36 two wheelers are **36 x 7x 180 = 1,45,360 KMs.**

Thus the total distance covered by 8 buses, 7 cars and 204 two wheelers is (1,27,200+ 17,280 + 45,360) = **1,90,360 KMs**

The fuel/ distance ratio of the three types of vehicles are given below

College buses	- 4KM/ per litre
Four wheeler (cars)	- 12 KM/ litre
Two wheelers (scooters)	- 30 KM/ litre

Total quantity of fuel (diesel and petrol) consumed by the vehicles are calculated below based on the above ratio;

1. College buses (11) - 5,088 = 27,036 litres of diesel
2. Four wheeler (8) - 17,280 = 1,440 litres of petrol
3. Two wheelers (36) - 45,360 = 1,512 litres of petrol

Thus the total quantity of fossil fuel (both diesel and petrol) consumed by the three categories of vehicles is (=**29,988 litres of liquid fuel.**

There are various tables and calculation methods to convert fossil fuel into CO_2 emission into atmosphere. They are confusing and complicated in view of the local variables taken for calculation.

Therefore, we have adopted a simple and universally acceptable calculation method to calculate emission of CO_2 by various types of fossil fuel, particularly petrol and diesel. As per this calculation method, one litre of petrol/diesel emits 2.68 kg of CO_2. Thus the total quantity of CO_2 emitted by 29,988 litres of fossil fuel is (29,988x 2.68) = **80,367.8 kg CO_2. Converted into tons it is 80.3 tons of CO_2**

The following table illustrates the CO_2 emission by category wise of vehicles.

Sl.no	Types of vehicle	Litres of fuel consumed	CO_2 emission kg
1	College buses (11)	27,036	72,456.4
2	Four wheelers (8)	1,440	3,859.2
3	Two wheelers (36)	1,512	4,052.1
	Total	**29,988**	80,367.8

There is another source of carbon emission by the college. This is consumption of LPG cylinder for cooking food for hostel students and canteen purposes. The following table shall illustrate the month wise break up of LPG cylinders during the period January 2018 to December 2018.

Sl.no	Months	No. of LPGs	Cost in Rs
1	January	9	13047
2	February	11	15948
3	March	9	12567
4	April	9	13047
5	May	9	13047
6	June	6	8698
7	July	9	13545
8	August	9	13545
9	September	12	18660
10	October	9	14895
11	November	14	24573
12	December	6	9390
	Total	**112**	**170962**

Apart from that 4 LPG cylinders have been used by the canteen. Thus the total number of LPG cylinders is **116 and the total cost is Rs. 1, 76,982.**

Now the carbon emission through LPG cylinders

FORMULA TO CALCULATE CARBON EMISSION BY LPG

LPG: Input value (in Kg/Yr.) x 2.983 (Emission Factor) = Output value (in Kg of CO^2.

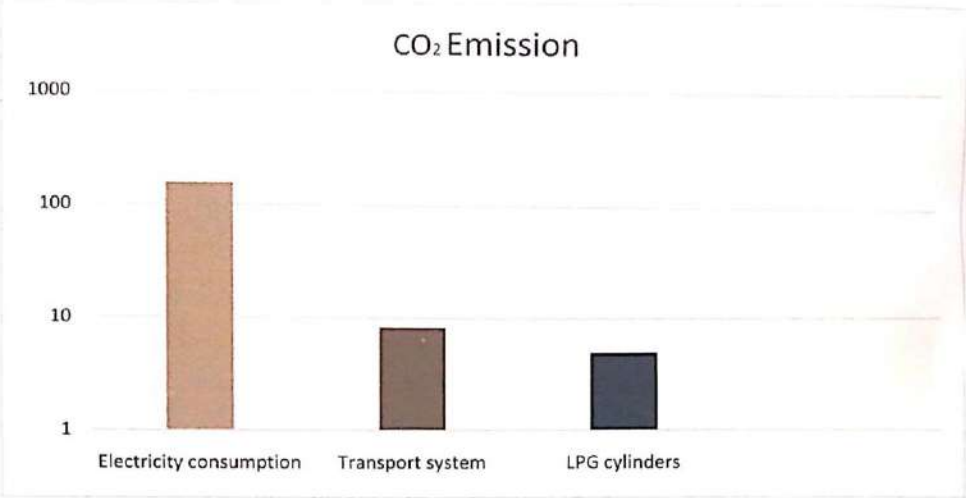
The input value of one LPG cylinder is 14.2 Kg.

Based on this formula, the carbon emission from 116 LPG cylinders is; (116x14.2 Kg) x (2.983 Emission Factor) = 4913.5 Kg or **4.9 tons of CO^2**

The total CO_2 emission by the college from consumption of electricity, LPG cylinders and fuel by transport system are calculated below;

CO_2 EMISSIONS

Sl.no	Source	CO^2 Emission in tons
1	Electricity consumption	156.4
2	Transport system	80.3
3	LPG cylinders	4.9
	Total	**241.6**



The Stella Marys Engineering College is conscious of this damage to the atmosphere and has been implementing various programs/ activities to reduce energy consumption on the one hand and increasing green energy sources on the other hand to achieve carbon neutrality or zero carbon emission.

They are:

1. Replacing high energy consuming lighting system with energy efficient lighting systems
2. Replacing Air Conditioners in Computer labs with Energy Efficient Fans

Analysis of CO_2 reduction through the above measures.

INSTALLINGENERGY EFFICIENT LIGHTING SYSTEM

Based on the recommendations of the Energy Audit conducted in the past by the faculty of the college, the institution has reduced the CO_2 emissions indirectly by installing electric bulbs with energy efficient CFL light systems and LED bulbs of different Watt capacity.

How much units of electricity is saved through energy efficient lighting system shall be assessed through calculating the units of electricity consumption by incandescent lamps of similar watts value. The watts value of the bulbs are given below

CFL Bulbs

Sl.no	Watts value	Quantity
1	7 Watts	480
2	9 Watts	61
3	12 Watts	4
4	15 Watts	3
5	18 Watts	3
	Total	551

LED Bulbs

Sl.no	**Watts value**	**Quantity**
1	3	216
2	7	3
3	15	94
4	20	1
5	25	2
6	30	1
7	80	5
	Total	**322**

The energy saving comparison is worked out on two assumptions;

Each Incandescent bulb taken up for comparison has uniform 60 watt value

The duration of electric supply to bulbs is 5 hours per day.

CARBON REDUCTION ANALYSIS

Total number of CFL and LED bulbs in the campus are 871. Out of these three LED bulbs with 80 watts, one LED bulb with 25 watt and another one with 30 watts are used as focus lamps burning for an average of 10 hours per day.

Electricity consumption in units by 871 incandescent bulbs with 60 watts power burning @ 5 hours day for 180 days = 871x 60x 5x 180 = **47,034 units.**

Coal consumption to generate 47,034 units of electricity is 23,517 kg. Carbon emission by 23,517 Kg of coal is (23,517x2.86 Kg) = 67,258.6 Kg CO^2

If converted into tons, it is **67.2 tons of CO^2.**

ENERGY CONSUMPTIONREDUCTION THROUGH ENERGY EFFECUENT BULBS

Table –IV

The following table reveals the total number of units of electricity consumed by CFL and LED bulbs with diverse watts value.

Energy consumption by CFL bulbs in 180 days.

Sl.No.	Contents	Value
1	480 CFL bulbs.	7 Watts
2	Energy consumption per year (480x7x5 hrsx180 days)	3,024 units
3	61 CFL bulbs	9 Watts

4	Energy Consumption per year (61x9x5x180)	494.1 units
5	4 CFL bulbs	12 Watts
6	Energy consumption per year (4x12x5x180)	43.2 units
7	3 CFL bulbs	15 Watts
8	Energy consumption per year (3x15x5x180)	40.5 units
9	3 CFL bulbs	18 Watts
10	Energy consumption per year (3x18x5x180)	48.6 units
	Total Units	**3,650.4 units**

Table – V

Energy consumption by LED bulbs in 180 days

Sl. No	Contents	Value
1	216 LED bulbs	3 Watts
2	Energy consumption of per year (216x3x5x180)	583.2 units
3	3 LED bulbs	7 Watts
4	Energy consumed per year (3x7x5x180)	18.9 units
5	94 LED bulbs	15 Watts
6	Energy consumed per year (94x15x5x180)	1,269 units

7	1 LED bulb	20 Watts
8	Energy consumed per year (1x20x5x180)	18 units
9	2 LED bulbs	25 Watts
10	Energy consumed per year (2x25 x10x180)	90 units
11	1 LED bulb	30 Watts
12	Energy consumed per year (1x30x10x180)	54 units
13	5 LED bulbs	80 Watts
14	Energy consumed per year (5x80x10x180)	720 units
	Total	**2,753.1 units**

Grant Total of units of electricity by CFL and LED bulbs = (3,650.4+ 2,753.1) = **6,403.5 units**

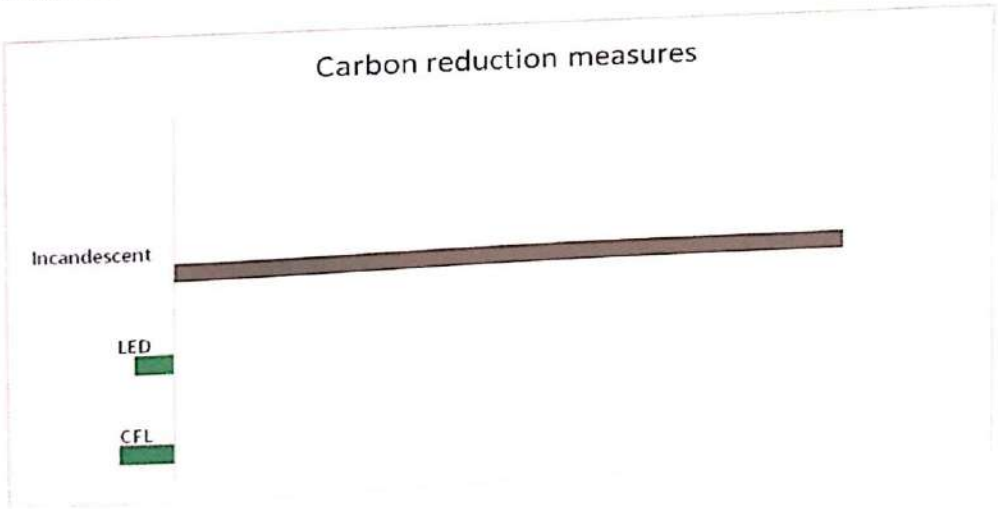
Coal required to generate 6,403.5 units of electricity is 6,403/2 = 3,201 Kg

The above quantity of coal emits (3,201 x 2.86) = **9145.8 Kg CO^2**

The carbon reduction calculation is = quantity of CO^2 emitted by incandescent bulbs – quantity of CO^2 emitted by LED and CFL bulbs

Thus 67.2 ton – 9.1 ton = **58.1 ton carbon reduction is achieved.**

Diagram



WATER AUDIT

The water audit conducted by the College is very much impressive and scientific. Water management is conducted at two levels.

1. **Rain Water Harvesting.**

During rain, water from the main buildings and hostels flow into a reservoir and is utilized. Apart from that, a wall is constructed near the western tip of the campus where water normally flows during heavy rains due to natural topography to prevent loss of water. Thus every single drop of rain water from the campus is enabled to permeate into the soil to replenish the ground water table.

Soil Organic Carbon

Environmental scientists tend to neglect the vital role of soil in the context of climate change. However, it is now recognized by the scientific fraternity that soils can serve as a sink for carbon dioxide. Improving the soil organic carbon capacity of the soil assumes significance in the context that atmospheric concentrations of carbon dioxide have crossed 410 parts per million and oceans are already turning acidic. Therefore, increasing soil organic carbon proportionately increases the carbon sink effect of the soil.

Approaches to increase SOC include reducing soil erosion, no till farming, use of cover crops, nutrient management, applying manure and sludge, water harvesting and conservation etc.

Stella Marys Engineering College is applying all these measures in the 2,71,911 sq. ft areas in the campus to improve the sink effect of the sol.

CARBON NEUTRALITY ANALYSIS

All across the world, colleges and universities are looking to a sustainable future by working to become carbon neutral. Educational institutions are taking responsibility for their environmental impact and are working to neutralize those effects. To become carbon neutral, these institutions are working to reduce their emissions of greenhouse gases, cut their use of energy, use more renewable energy, and emphasize the importance of sustainable energy sources.

Carbon neutrality, or having a net zero carbon footprint, refers to achieving net zero carbon emissions by balancing a measured amount of carbon released with an equivalent amount sequestered or offset. Carbon neutral, also called carbon neutrality is a term used to describe the action of organizations, businesses and individuals taking action to remove as much carbon dioxide from the atmosphere as each put in to it. The overall goal of carbon neutrality is to achieve a zero carbon footprint.

In this regard, the net CO_2 emission through electricity, transport system and consumption of LPG cylinders is 241.6 tons of CO^2.This is achieved after installing energy efficient LED and CFL bulbs. **The College needs to generate another 250 tons CO_2 equivalent of green energy** from various carbon foot print reduction measures to achieve carbon neutrality or zero carbon emission.

However, the consoling aspect of the Green Audit is that the Flora in the campus absorbs 115.4 tons of CO_2. This is a very low level of CO^2 absorption in the context of 2,71,911 sq. ft. of lands having bushy plants, grass and 96,440 sq. ft. open land area.

ENVIRONMENT CONSCIOUSNESS

The college faculty has taken proactive and student friendly environment awareness education program at grass root level and at the college level.

First the boys and girls are sensitized about global warming and its effect on the livelihood of the people, particularly the poor living near the coastal areas. They are thus motivated to educate the poor and middle class families about the per capita consumption of fossil fuel by each members of the family, the high energy consuming electrical appliances in the household, the energy saving measures to be adopted by the family members etc. The environmental education is the need of the hour for three reasons. They are; (a) if people need be sensitized of the need for and the ways of protecting the environment they will act to preserve it, (b) student community should assume responsibility for educating about environmental protection and (c) environmental education can be effective as a part of a college curriculum. Hence the institution stresses increased concern about the environment education.

In this regard, the College faculty has promoted Energy Saving Club with students from first and second year. There are about forty students in the Energy Saving Club.

METHODOLOGY

42 questions related to green environment, electricity consumption, electrical appliances and their energy consumption pattern, meter reading and high energy consuming appliances had been given to the members to assess the level of understanding the environment related issues by the families.

The questions focused on three concerns which are;

1. Whether the families consider themselves eco-conscious?
2. Do they consider their homes to be eco-friendly?
3. What do they think are the top priorities that should be tackled to reduce carbon emission in the household?

Out of the 280 respondents, 82 % of the families arenot eco conscious as they are not aware of the effects of green gas emissions into the atmosphere and the negative impact of global warming on the mother earth and the life forms in the earth. 64 % of them are not well informed of the simple carbon emission mitigation measures to be carried out in their homes.

The data gathered by the students are analysed, documented and follow up actions are given to the students once in three months.

A participatory evaluation conducted by the staff revealed that 56% of the families surveyed have removed incandescent bulbs and replaced them with low watt value LED bulbs.

IMPRESSIONS

The overall impression one gets while green auditing the campus is that the carbon deficit is very high. The carbon reduction measures are carried out only in the installation of energy efficient bulbs such as LED and CFL bulbs.

Considering the vast area of land at the disposal of the college as well as the 2, 43,484 square feet of open terrace, there exists vast opportunities for the college to implement programs to ensure carbon neutrality and generate surplus green energy within the next five years. The next section, titled Suggestions and Recommendations outlines the measures to be taken up in this regard.

SUGGESTIONS &RECOMMENDATIONS

SUGGESTIONS AND RECOMMENDATIONS

The findings of the Green Audit of the campus is positive considering the period of establishment of the college. The college has just completed five years of its life and has entered into the sixth year. Still it is able to construct vast infrastructure facilities, say 2,43,484 square feet built up area. Besides, it has 2,71,911 square feet of land to develop high carbon absorbing and oxygen emitting flora. Therefore, the College has vast potential to further improve the green status of the campus through the following measures.

1. Production of Green Energy

1.1 open solar energy

Green energy is the only alternative to fossil fuel based energy to ensure carbon neutrality. Considering the vast built up area along with the open terrace -2, 43. 482 square feet – the viable and feasible source of green energy is open solar energy. The electricity bill of the college shows that 1,01,678 units of electricity was consumed in 2018. The college management has finalized plans to improve the strength of the college in terms of new courses which will demand new buildings and infra-structure facilities. It is projected that the energy demand of the college in the next five years may reach more than 3,00,000 units of electricity.

Therefore, it is the need of the hour to solar panels on the top of the open terrace in inverted V shape facing east and west to ensure uninterrupted generation of green energy throughout the year, except the monsoon season. Adequate solar panels shall be installed to generate at least 1,500 units of solar electricity per day. This will ensure that 3,00,000 units of green energy shall be generated for 200 days to neutralize the dependence of fossil fuel based electricity. This electricity will be connected to a grid to distribute it throughout the buildings in the campus. The electricity generated during the holidays shall be stored in the advanced Lithium battery for use during the working days.

1.2 Bio gas energy

At present the Boys Hostel, Girls Hostel and the college canteen consume 116 LPG cylinders per year and this figure is likely to increase three fold in the next five years. The profitable and eco-friendly alternative to LPG gas based fuel is bio gas from cow dung and hostel toilet waste. Hence it is highly recommended to start a institution based dairy unit with 200 lactating cows. The hostel and canteen shall get milk at much cheaper price from the unit and the surplus milk shall be sold to the Kuzhithurai Catholic Diocese managed Nanjil Dairy unit. The profit shall be used as scholarship for the poor students. The LPGs will be completely removed by cow dung based bio gas that shall be converted into alternate current energy and saved in batteries and supplied to the kitchens as and when required.

2. Development of Flora

This is another important component for carbon reduction and mitigating global warming. The college campus has adequate space to develop 120 families, 400 Genus and 580 Species of fully grown fruit bearing trees, semi grown trees, bush plants/ornamental plants and Mexican or Buffalo Grasses.

Bio technologies have developed to such an extent that within two years, ten year old trees shall be raised in the garden through branch rooting technology. For example, the joint of a ten feet long branch of a ten year old mango tree will be covered with manure to allow it to sprout roots into the manure. Then the branch is cut off from the mother tree, the foliage removed and planted in the Stella Marys Engineering College. Within two years, the college will have a ten year old fully grown tree.

Similarly, ten verities of tree branches will be raised in the campus to develop about 900 – 1,000 fully grown trees.

The following table shall illustrate the flora development program in brief

Sl.no	Type of Flora	Quantity
1	Fully grown trees	1,000
2	Semi grown trees	6,500
3	Bush plants/ wild grasses	40,00,000
4	Mexican/ Buffalo grass	20,000 square feet

It will take three years to develop the flora mentioned in the above table.

The carbon absorption or sink effect of the flora is discussed below;

One fully grown tree absorbs 6.8 Kg CO^2 and at this rate 1,000 fully grown trees absorbs (1,000x 6.8 Kg) = **6,800 Kg or 6.8 ton CO^2**

The carbon absorption of 6,500 semi grown trees is (6,500x3.4) = **22,100 Kg or 22 tons of CO^2**

Carbon absorption of 40, 00,000 bushy plants and wold grasses is (40, 00,000 x 200 grams) = 80, 00, 00,000 grams. If converted into tons it is **800 tons of CO^2**

Carbon absorption of 1,000 square feet of Mexican or Buffalo grass is one Kg of CO^2. At this rate 20,000sq.ft of grass absorbs 20 Kg of CO2. The annual sink effect is 20Kg x 365 = **7,300 Kg or 7.3 tons of CO^2**

3. Organic manure

The proposed flora development program in the campus will be carried out in eco-friendly and organic manure based cultivation practices. In this regard, therefore, it is imperative to make organic manure in the colleges. The proposed dairy unit with 200 cows shall provide 2,000 Kg or two tons of cow dung per day and the monthly feeder for bio gas plant will be 2 ton x30 days = .60 tons. This is adequate enough to produce 2.4 million litres of bio gas per

month. It is proposed to produce only that much bio gas needed for the hostels and canteens. Four bio gas plants will be installed in four areas in the campus. The slurry from the feeder tank will be taken out to make organic manure.

Apart from that the food waste from midday meals of 814 students for 180 days is 486 to 500 Kg

The hostel food waste accounts for 210 Kg per month and for six months it is 1260 Kg or 1.2 ton. Thus the food waste in the college is between 1.7 to 2 tons per year.

The slurry from the bio gas plants and the food waste will be used to produce organic manures of rich nutrient content. This manure will be used for the flora to be developed in the campus.

This practice has another environment friendly side effect. The soil organic content of the soil will be enriched further and consequently the sink effect of the soil be much higher in future.

The production of organic manure has its own pro active role in reducing carbon emission into the atmosphere.

For example, 1.7 tons of coal is required to produce one ton of ammonia or urea. The assumption is that 1 ton of organic fertilizer/ vermin compost almost equals one ton of ammonia or urea in providing plant nutrition. The college shall produce not less than 100 tons of organic manure. At this rate, 100 tons of ammonia requires (100x1.7) = 170 tons of coal. As one ton of coal emits 2.86 tons of CO^2, the quantity of CO^2 emitted by 170 tons of coal is (170x 2.86) = **486.2 tons of CO^2**

This is the positive contribution of Carbon Foot Print Reduction through solid waste management and organic manure production of Stella Marys Engineering College.

4. Water Audit

Water Audit is another important component in the Green Audit of any institution. Water Audit shall be conducted at two levels.

1. Rain Water Harvesting

During the monsoon rains, the rain water from the 2,43,482 square feet open terrace area flows into the open ground and becomes run off water. This water needs be properly harvested and stored to water the plants and trees during non-rainy season. The project idea is to fix PVC pipes along the floor level edges of the parapet walls of the terraces of all the buildings. The pipes will be connected to mini dome shaped water reservoirs.

The following is the specification of the mini water reservoir. Cylindrical shaped 20 feet depth and 10 feet diameter size ground level water tanks will be constructed and the top will be covered by dome shaped concrete cover to avoid evaporation.

The PVC pipes above the open terraces will be connected to six such water reservoirs.

During the rainy season, the rain water will thus be harvested and stored. During non-rainy seasons, the trees, plants and grasses get water through drip irrigation.

2. Water Treatment system

The surplus water received during the monsoon season and the daily used water from the hostels and canteens will be treated for various productive purposes.

The following is the water treatment method;

- Open channels with cement bottom will be constructed at ground level to facilitate free flow of waste water and run off water.
- The floated waste will be filtered through sand bags which will serve as medium of filtration.
- The filtered water is further purified through septic tank method.
- The channelized water will flow through PVC pipes.
- The toxins in the water are removed through natural water treatment method of Typha grass filtration process.

  The water thus purified and collected is used for the culture of aquatic weeds, fish and frog. Besides, the water will be used for the development of horticulture also.

This scientific method of water treatment and application of organic manure will ultimately improve the Soil Organic Carbon or soil sink effect.

The improved SOC will reduce the soil erosion level, facilitate no till farming and enable the inmates of the hostel get poison free vegetables and fruits.

To ensure that the students get high quality drinking water, it is imperative that water quality testing lab will be installed in one part of the laboratory to test the quality of the drinking water so that the students are free from water borne diseases

Diploma Course for Green Auditors

National Assessment and Accreditation Council – NAAC - has made it mandatory for all the educational institutions to conduct Green Auditing not only to discharge their Corporate Social Responsibility but to retain their registration Certificate since 2017. It is unfortunate that adequate number of Green Auditors are not available to green audit all the educational institutions in India.

Hence it is the felt need of the hour to train at least 60 Green Auditors in a year through Diploma Course on Green Auditing. The duration of the course shall be six months and in one course 30 students of the institution shall be enrolled and trained in all aspects of environment protection which includes biodiversity promotion, carbon emission reduction measures, energy auditing, water auditing and individual responsibility to reduce carbon foot print.

The Diploma Course will be affiliated to the MSME of the Govt. of India and the students who completes the course shall get govt. certificates that qualifies them to become professional Green Auditors, thereby earning a livelihood income through green auditing the educational institutions.

C. DANIEL

Green Auditor / Consultant

C. DANIEL

Green Auditor / Consultant

Vision

The founder visualizes an egalitarian society where highly disciplined and well trained workforce shall play a proactive role to sustain peace and prosperity.

Mission

Stella Mary's Engineering College aims at promoting technocrats with social commitment to work for the integrated development of the marginalized communities through their technical skills and commitments.

STELLA MARY'S COLLEGE OF ENGINEERING

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Aruthenganvilai, Kallukatti Junction, Azhikkal Post
Kanyakumari District, Tamilnadu - 629 202
Ph.: 04652-239122 | Mob.: 7402707773