

Green audit



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Report



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GREEN AUDIT REPORT



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SAINTGITS COLLEGE OF APPLIED SCIENCES

2020-21

Executed by



OTTOTRATIONS
Energy-Engineering-Environment

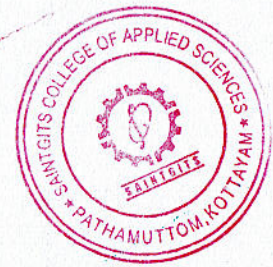


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GREEN AUDIT REPORT

SAINTGITS COLLEGE OF APPLIED SCIENCES

PATHAMUTTOM

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Green Audit Report
Saintgits College of Applied Sciences, Pathamuttom
Report No: EA 973A
2020-21

About OTTOTRACTIONS

OTTOTRACTIONS established in 2005, is an organization with proven track record and knowledge in the field of energy, engineering, and environmental services. They are the first Accredited Energy Auditor from Kerala for conducting Mandatory Energy Audits in Designated Consumers as per Energy Conservation Act-2001. Government of Kerala recognized and appreciated OTTOTRACTIONS by presenting its prestigious "The Kerala State Energy Conservation Award 2009" for the best performance as an Energy Auditor. Ottotractions is an ISO 9001-2015 and ISO 14001-2015 Certified organization, which ensures the quality of its services.



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Acknowledgment

We were privileged to work together with the administration and staff of Saintgits College of Applied Sciences, Pathamuttom especially Dr K K John, Principal for their timely help extended to complete the audit and bringing out this report.

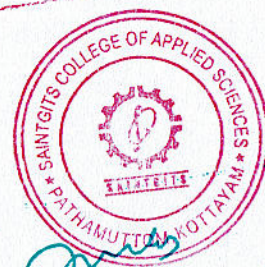
With gratitude, we acknowledge the diligent effort and commitments of all those who have helped to bring out this report.

We also take this opportunity to thank the bona-fide efforts of audit team for unstinted support in carrying out this audit.

We thank our consultants, engineers and backup staff for their dedication to bring this report.

Thank you.

B V Suresh Babu
Accredited Energy Auditor
AEA 33, Bureau of Energy Efficiency



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Preface

Educational institutions always had an important leadership role in society in demonstrating types of changes that used to occur with respect to the prime issues of the time. All around the world, educational institutions are taking steps to declare themselves the next carbon neutral school as a part of the global trend of becoming sustainable. In 2007, Victoria University School of Architecture and Design declared themselves the first carbon neutral campus in the world through the purchase of carbon credits. This concept is not a sustainable model as it does not guarantee the capture of carbon forever and also it is expensive.

The potential for any academic institution- (may be a school in a remote village or a university in an urban setting) - to become the driver for change is huge. Its role of practicing leadership in its community can be utilized to encourage and influence carbon neutral living.

The biggest factors that contribute towards emission are Energy, Transportation and Waste. Any reduction in the carbon emission by the above sectors, starts with the behavioral changes (Low cost) and/or technological investments (High cost). In order to make these changes, the students are to be educated properly on the concept of carbon neutral campuses and methods to reduce it.

In India, the concept of carbon neutral campuses is gaining momentum. Green Audit in Campuses measures the amount of Green House Gases (GHG) emissions produced as a result of its operations through an accounting like inventory of all the sources of GHGs and carbon sequestration in the school campus. Based on this, the total carbon footprint is estimated. Measures are recommended to bring down the carbon footprint of the campus and to make it a carbon neutral campus.

B Zachariah

Director, OTTOTRACTIONS



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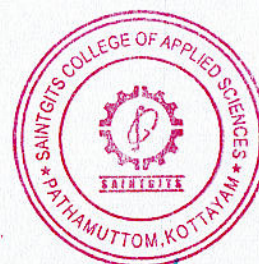
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Introduction





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Green Audit Report 2020-21
Saingits College of Applied Sciences

Background

All across the developed countries, educational institutions are now moving to a sustainable future by becoming carbon neutral and greener spaces. They are taking responsibility for their environmental impact and are working to neutralize those effects. To become carbon neutral, institutions are working to reduce their emissions of greenhouse gases, cut their use of energy, use energy efficient equipment, use more renewable energy, plant and protect green cover and emphasize the importance of sustainable energy sources. Institutions that have committed to becoming carbon neutral have recognized the threat of global warming and are therefore committing to reverse the trend. Studies on this line has not struck roots in most of the developing countries-especially among students.

The Sustainable Development Goals (SDGs), launched by the United Nations in 2015, are an excellent vehicle for driving this change. They represent an action plan for the planet and society to thrive by 2030. The SDGs provide a window of opportunity for creating multidimensional operational approaches for climate change adaptation. They address poverty, hunger and climate change, among other issues central to human progress and sustainable development, such as gender equality, clean water and sanitation, and responsible consumption and production.



SUSTAINABLE DEVELOPMENT GOALS



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The Green Audit of **Saingits College of Applied Sciences, Pathamuttom** aims to assist campus to reduce their carbon footprint and educate tomorrow's leaders about strategies for carbon mitigation using their campus as a model. Also, this audit covers institutes responses towards SDGs by covering SDG 3,6,7,11,13,15. The green audit also aims to educate students and teachers on the concept of carbon footprint and to enable the students to collect data pertaining to the carbon emissions and carbon sequestration in their campus and to calculate the specific carbon footprint of the campus.

The project also suggests plans to make the campus carbon neutral or even carbon negative by implementing carbon mitigation strategies in areas such as,

- a. Energy
- b. Transportation
- c. Waste minimisation
- d. Carbon Sequestration etc.

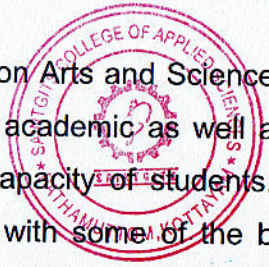
The major objectives of the audit are:

- To make aware students and teachers on the concept of carbon footprint.
- To calculate the specific carbon footprint of the campus and classify it as carbon negative, neutral or positive.
- To create carbon mitigation plans to reduce their footprint based on the data generated.

SAINTGITS COLLEGE OF APPLIED SCIENCES,

Saingits College of Applied Sciences is a new generation Arts and Science college launched in 2004. It has maintained high standards in academic as well as extra-curricular activities ever since it launched with a full capacity of students. With a scientifically planned teaching methodology, combined with some of the best and experienced faculty and state-of-the-art infrastructure, the institute has set a benchmark in graduate studies.

In addition to the syllabus, the institution always caters to the all-round growth of the youth and with this objective in mind we offer value-added programmes. This

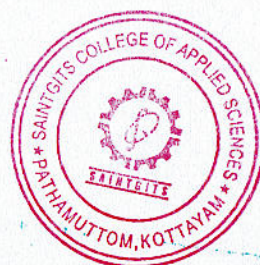


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institution is well known for campus placement and ensures higher education in esteemed national and international universities and institutes.

Occupancy Details	
Particulars	2020-21
Total Students	1017
Staffs	54
Total Occupancy of the college	1071

For calculating per capita carbon emission estimation, only the student strength is taken into account.



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Form-A						
BASELINE DATA SHEET FOR GREEN AUDIT						
1	Name of the Organisation	Saintgits College of Applied Sciences, Pathamuttom				
2	Address (include telephone, fax & e-mail)	Kottukulam Hills, Pathamuttom P.O, Kottayam, Pin – 686532, Kerala Tel:+91 481 2433787, +91 9544327772, Email: scas@saintgits.org				
2	Year of Establishment	2004				
3	Name of building and Total No. of Electrical Connections/building	Old Building, Deceinial block				
4	Total Number of Students	Boys		Girls		Total
5	Total Number of Staff	54				
6	Total Occupancy	1071				
7	Total area of green cover	50%				
8	Type of Electrical Connection	HT	1	LT		
9	Total Connected Load (kW)	88				
10	Average Maximum Demand (KVA)	36				
11	Total built up area of the building (M ²)	7400				
12	Number of Buildings	2				
13	Average system Power Factor	1.00				
14	Details of capacitors connected	NA				
15	Transformer Details (Nos., kVA, Voltage ratio)	TR 1				
15	DG Set Details (kVA,)	DG1	DG2	DG3	DG4	DG5
		30				
16	Details of motors	Rating	Nos.		Remarks	
		5 to 10	3			
		10 to 50				
		Above 50				
17	Brief write-up about the firm and the energy/environmental conservation activities already undertaken.	Installed LED Bulbs, Solar power plant etc.				
18	Contact Person & Telephone number	Principal Tel:+91 481 2433787, +91 9544327772,				

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METHODOLOGY



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2.1. Sensitisation

Low Carbon campus initiatives are successful when everyone in the campus is engaged including students, teachers and staff. A team of students, teachers and staff were formed to participate in the audit. A sensitisation among students and teachers on the concept of carbon footprint was conducted.



During the audit the students and staffs were sensitised on the project and trained to be a part of the data collection team. This helped in conducting the survey in a participatory mode so that the awareness will penetrate to the grass root level. During the data collection field visit it was stressed that the team will spread these ideas to their homes and friends. This will help in a horizontal and vertical spread of the message to a wider group. It is assumed that through 1071 occupants of this campuses will reach same number of households. This message will spread to at least 4000 individuals approximately.

2.2 Estimation of carbon footprint

A carbon footprint is the amount of greenhouse gases—primarily carbon dioxide—released into the atmosphere by a particular human activity. A carbon footprint can be a broad measure or be applied to the actions of an individual, a family, an event, an organization, or even entire nation. It is usually measured as tons of CO₂ emitted per year, a number that can be supplemented by tons of CO₂-equivalent gases, including methane, nitrous oxide, and other greenhouse gases.

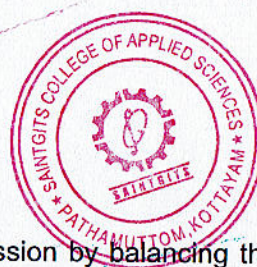
Global Warming Potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide. The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of one ton of a gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide (CO₂).

Global Warming Potentials (IPCC Second Assessment Report)					
Species	Chemical formula	Lifetime (years)	Global Warming		
			20 years	100 years	500 years
Carbon dioxide	CO ₂	variable §	1	1	1
Methane *	CH ₄	12±3	56	21	6.5
Nitrous oxide	N ₂ O	120	280	310	170
HFC-23	CHF ₃	264	9100	11700	9800
HFC-32	CH ₂ F ₂	5.6	2100	650	200
HFC-41	CH ₃ F	3.7	490	150	45
HFC-43-10mee	C ₅ H ₂ F ₁₀	17.1	3000	1300	400
HFC-125	C ₂ H ₂ F ₅	32.6	4600	2800	920
HFC-134	C ₂ H ₂ F ₄	10.6	2900	1000	310
HFC-134a	CH ₂ FCF ₃	14.6	3400	1300	420
HFC-152a	C ₂ H ₄ F ₂	1.5	460	140	42
HFC-143	C ₂ H ₃ F ₃	3.8	1000	300	94
HFC-143a	C ₂ H ₃ F ₃	48.3	5000	3800	1400
HFC-227ea	C ₃ H ₂ F ₇	36.5	4300	2900	950
HFC-236fa	C ₃ H ₂ F ₆	209	5100	6300	4700
HFC-245ca	C ₃ H ₃ F ₅	6.6	1800	560	170
Sulphur hexafluoride	SF ₆	3200	16300	23900	34900
Perfluoromethane	CF ₄	50000	4400	6500	10000
Perfluoroethane	C ₂ F ₆	10000	6200	9200	14000
Perfluoropropane	C ₃ F ₈	2600	4800	7000	10100
Perfluorobutane	C ₄ F ₁₀	2600	4800	7000	10100
Perfluorocyclobutane	c-C ₄ F ₈	3200	6000	8700	12700
Perfluoropentane	C ₅ F ₁₂	4100	5100	7500	11000
Perfluorohexane	C ₆ F ₁₄	3200	5000	7400	10700

The methodology for carbon footprint calculations are still evolving and it is emerging as an important tool for green house management. In the present study carbon emission data from the campus is estimated under four categories viz.

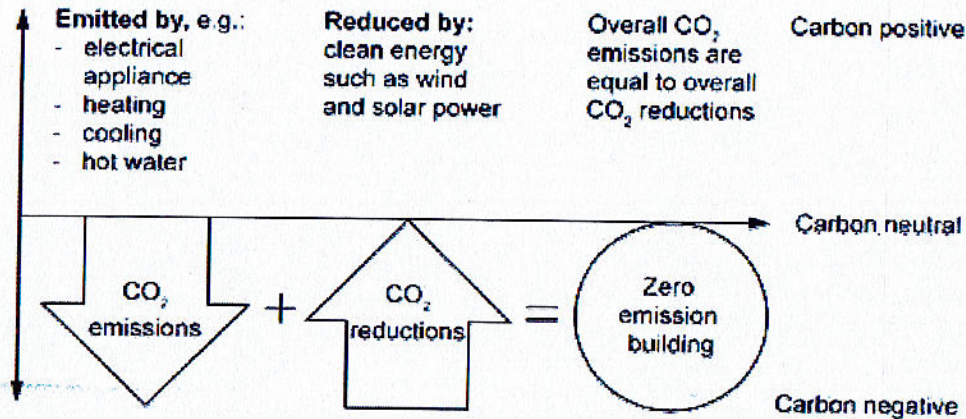
- Energy
- Transportation
- Waste minimisation
- Carbon Sequestration

Carbon neutrality refers to achieving net zero GHG emission by balancing the measured amount of carbon released into atmosphere due to human activities, with an equal amount sequestered in carbon sinks. It is crucial to restrict atmospheric concentrations of GHGs released from various socio-economic, developmental and life style activities using biological or natural processes. It is recognized that addressing climate change is not as simple as switching to renewable energy or offsetting GHG emissions. Rather providing an opportunity



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for innovation in new developmental activities for viable and effective approach to address the problem.



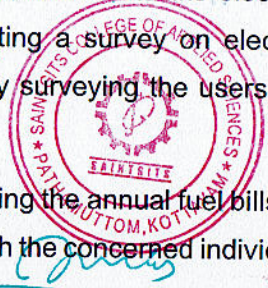
Energy

In the campus carbon emission from energy consumption is categorised under two headings viz. energy from Electrical and Thermal. Energy used for transportation is calculated under transportation sector.



A detailed energy audit is conducted to understand the energy consumption of the campus. Information on total connected loads, their duration of usage and documents like electricity bills are evaluated. Connected loads are calculated by conducting a survey on electrical equipment on each location. Duration of usage was found out by surveying the users. The survey of equipment was conducted in a participatory mode.

The fuel consumption for cooking, like LPG, was studied by analysing the annual fuel bills and usage schedules during the study. Discussions were carried out with the concerned individuals who actually operate the cooking system.


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 Saintgits College of Applied Sciences

Transportation

Carbon emission from transportation to be calculated by using the following formula:

Carbon Emission = Number of each type of vehicles × Avg. fuel consumed per year ×

Emission factors (based on the fuel used by the vehicle)

Waste Minimisation

The waste generated from the campus is also responsible for the greenhouse gas emission. So, in order to calculate the total carbon foot print of the campus it is necessary to estimate the greenhouse gas emission from the waste generated in the campus by the activity of the students, teachers and staffs.

The calculation of the waste generated has been conducted by keeping measuring buckets for collecting the waste generated in a day. This waste so generated was calculated by weighing it.



Carbon Sequestration

Carbon sequestration is the process involved in the long-term storage of atmospheric carbon dioxide. Trees remove carbon dioxide from the atmosphere through the natural process of photosynthesis and store the carbon in their leaves, branches, stems, bark, and roots.

Carbon sequestered by a tree can be found out by using different methods. Since this study is employed the volumetric approach, the calculation consists of five processes.

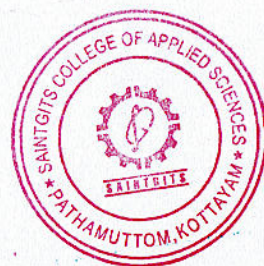
- Determining the total weight of the tree
- Determining the dry weight of the tree
- Determining the weight of carbon in the tree
- Determining the weight of CO₂ sequestered in the tree



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- Determining the weight of CO₂ sequestered in the tree per year

Detailed calculations and results are given in the technical supplements of this document.



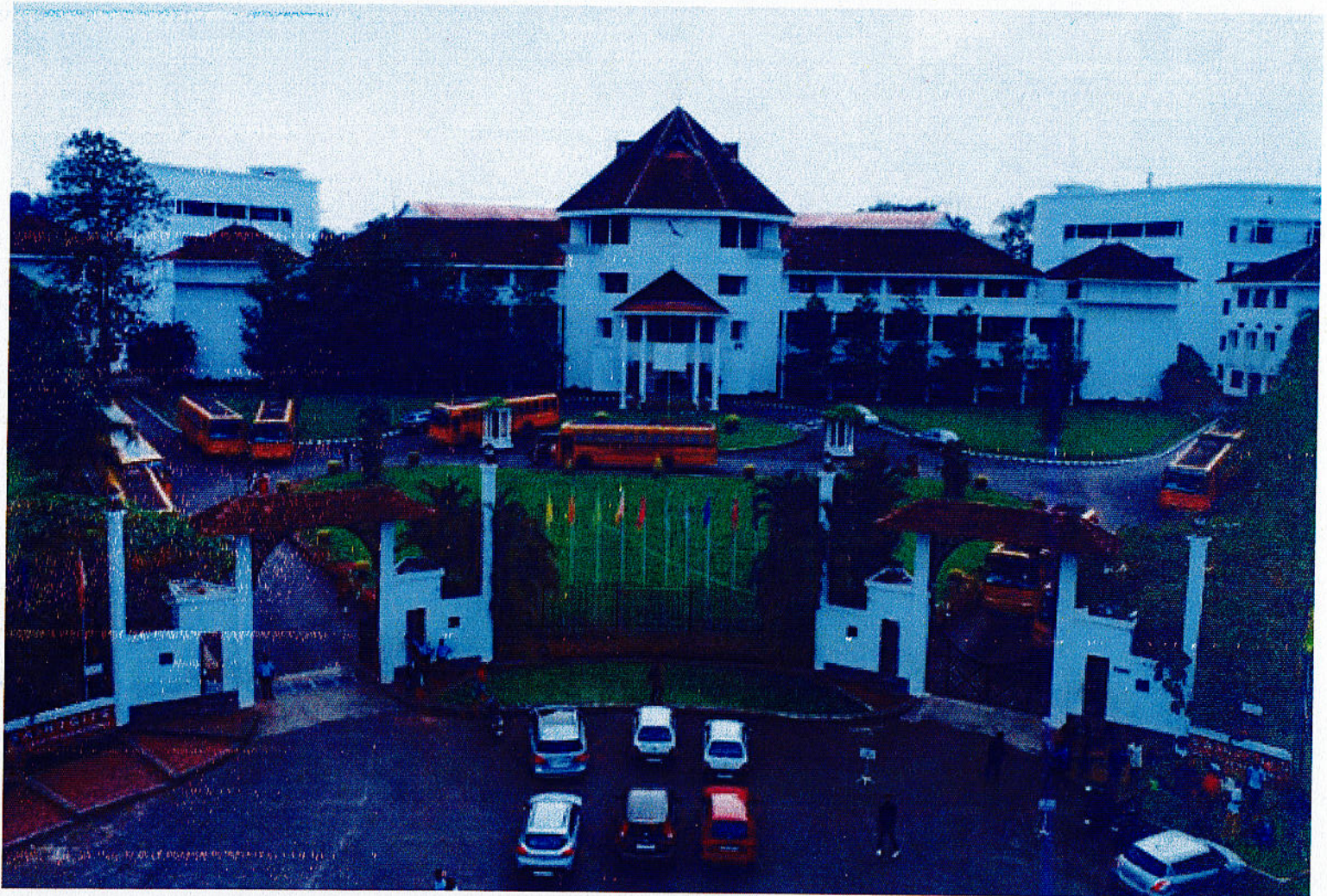

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3

RESULTS AND DISCUSSIONS



3.1 CARBON FOOTPRINT ESTIMATION

3.1.1 ENERGY

a. Electricity

Electricity is purchased from KSEB under HT Connections, the details are given below.

Base line Data (Electricity Bill)	
Code	EA 973A
Facility	Saintgits College of Applied Sciences
Provider	KSEB
Contract Demand (kVA)	80
Connected Load (KW)	88
Tariff	HT II (B) GENERAL
Consumer Number	1346370050721
Energy Charge Rs/ kWh Z1	6.2
Energy Charge Rs/ kWh Z2	9.3
Energy Charge Rs/ kWh Z3	4.65
Demand Charge Rs/ kVA	440
Excess Demand Rs/kVA	220
Energy Bill Analysis interval	2020-21

Electricity Bill Analysis

Electricity Bill Details (2020-21)												
Month	Name of the Consumer				Saintgits College of Applied Sciences							
	Contract Demand(kVA)		80		Consumer number & Section			1346370050721				
	Tariff		HT II (B) GENERAL					Vakathanam				
	kWh				kVA			PF	PF Incentive/ Penalty	Rs (Total)	Rs/kwh	
	Z1	Z2	Z3	Total	Z1	Z2	Z3					
Apr	819	327	614	1760	6	6	6	1	0	38691	21.98	
May	875	294	547	1716	6	4	4	1	0	38505	22.44	
Jun	1933	289	549	2771	31	5	4	1	0	45429	16.39	
Jul	2098	315	602	3015	22	5	5	1	0	46955	15.57	
Aug	1604	308	598	2510	20	6	5	1	0	43611	17.37	
Sep	1708	312	622	2642	20	4	4	1	0	44487	16.84	
Oct	2535	401	698	3634	23	9	6	1	0	51324	14.12	
Nov	3497	417	758	4672	25	5	6	1	0	58644	12.55	
Dec	2853	422	829	4104	27	5	9	1	0	54517	13.28	
Jan	3814	438	869	5121	32	5	9	1	0	61310	11.97	
Feb	3935	397	801	5133	36	13	18	1	0	61523	11.99	
Mar	3525	419	814	4758	30	7	10	1	0	57463.6	12.08	

Diesel

Diesel Consumption Details 2020-21				
	Transportation	Generator	Total	cost
	in L	in L	in L	in Rs
20-21	3615	423	4037	375487

Base Line Energy Data		
Saintgits College of Applied Sciences, Pathamuttom		
		2020-21
1	Electricity KSEB (kWh)	41836
2	Electricity Solar - Off grid (kWh)	0.00
3	Electricity (KSEB + Off grid) kWh	41836
4	Electricity Grid Tied (kWh)	6388
5	Diesel (L)	4037
6	LPG (kg)	0.00
7	Biogas (m3)	0.00

Renewable Energy

Solar Power Plant

Capacity (kWp)	Annual Generation (kWh)
5	6388

A 5kWp solar power plant is installed in the campus.

Specific Energy Consumption

OTTOTRACTIONS- ENERGY AUDIT	
Saintgits College of Applied Sciences, Pathamuttom	
Energy Performance Index (EPI)	
SI No	Particulars
1	Total building area (m ²)
2	Annual Energy Consumption (kCal)
3	Annual Energy Consumption (kWh)
4	Total Energy in Toe
5	Specific Energy Consumption kWh/m ²

2020-21
7400
78372189
91130
284
12.31

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The specific energy consumption in 2020-21 may be taken as benchmark

3.3. Waste Generation total

The major concern of waste management will be focused on the solid waste produced by the campus. Solid wastes produced in the campus are mainly of three types, food waste, paper waste, and plastic waste. Food wastes produced in the campus are mainly by two means. The vegetable wastes produced in the kitchen during the food preparation. The food waste produced by the students and staffs of the campus after the consumption of meals.



Degradable Waste

Degradable Waste Generation	
Saintgits College of Applied Sciences, Pathamuttom	
Particulars	2020-21
Total Occupancy	1071
Waste generated in kg /day	21.42
Waste generated in kg /Yr	4712.4

Non-Degradable waste

Solid non degradable Waste Generation	
Saintgits College of Applied Sciences, Pathamuttom	
Particulars	2020-21
Total Occupancy	1071
Waste paper generated in kg /day	0.2142
Waste plastic generated in kg /day	0.3213
Waste paper generated in kg /Yr	47.12
Waste plastic generated in kg /Yr	70.69

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3.4. Transportation

There are 6 numbers of buses and 3 cars for the public transportation available at the college.

Carbon Emission Profile (2021-22)

Carbon emissions in the campus due to the day-to-day activities are calculated and is discussed below. The emission factors considered for estimation and its units are given.

Emission Factors		
Item	Factor	Unit
Electricity	0.00082	tCO ₂ e/kWh
LPG	0.0015	tCO ₂ e/kg
Diesel	0.0032	tCO ₂ e/kg
Petrol	0.0031	tCO ₂ e/kg
Food Waste	0.00063	tCO ₂ e/kg
Paper Waste	0.00056	tCO ₂ e/kg
Plastic Waste	0.00034	tCO ₂ e/kg

Carbon Foot Print 2020-21

Carbon Foot Print			
Sl. No.	Particulars	2020-21	tCO ₂ e
1	Electricity (kWh)	41836	34.31
2	Diesel (L)	4037	12.92
3	LPG (kg)	0.00	0.00
4	Biogas (m3)	0.00	0.00
5	Degradable Waste in kg/yr.	47.12	2.97
6	Paper Waste in kg/yr	47.12	0.03
Total Carbon Foot Print tCO₂e/yr			50.22


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3.5. CARBON SEQUESTRATION

All the activities including energy consumption and waste management have their equivalent carbon emission and they positively contribute to the carbon footprint of the campus. Carbon sequestration is the reverse process, at which the emitted carbon dioxide will get sequestered according to the type of carbon sequestration employed. Even though there are many natural sequestration processes are involved in a campus, the major type of sequestration among them is the carbon sequestration by trees.

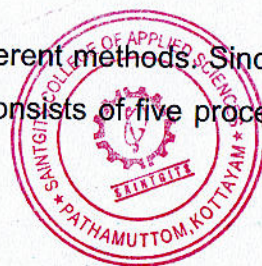
Carbon Sequestration	
Particulars	2020-21
Total No of Trees	198
Carbon sequestered by trees in the campus (tCO ₂ e)	6.34

Trees sequester carbon dioxide through the biochemical process of photosynthesis and it is stored as carbon in their trunk, branches, leaves and roots. The amount of carbon sequestered by a tree can be calculated by different methods. In this study, the volumetric approach was taken into account, thus the details including CBH (Circumference at Breast Height), height, average age, and total number of the trees, are required. Details of the trees in the campus compound are given in the Table. Detailed table is included in the technical supplement.

Carbon sequestered by a tree can be found out by using different methods. Since this study is employed the volumetric approach, the calculation consists of five processes.

- Determining the total weight of the tree
- Determining the dry weight of the tree
- Determining the weight of carbon in the tree
- Determining the weight of CO₂ sequestered in the tree
- Determining the weight of CO₂ sequestered in the campus compound per year

Carbon sequestered by each species of trees in the campus compound is given in the Table.3.19 Detailed calculation results are listed out in the tables provided in the technical supplements of 'Carbon sequestration'.



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List of Trees in Campus

Saintgits College of Applied Sciences, Pathamuttom		
List of Trees on the College Campus		
Sl.No	Name of the trees	Number
1	Anjili	06
2	Almond	28
3	Ambazham (Ambade)	02
4	Adalodakam (Justicia Adhatoda)	01
5	Arecanut trees	11
6	Coconut trees	11
7	Elanji Flowering tree (Mimusops elengi)	01
8	Custard Apple Trees	03
9	Danthapala (Sweet Indrajao)	02
10	Fig Trees	04
11	Gua	02
12	Bilimbi Tree	02
13	Kayam (Asafoetida)	01
14	Kumizh tree	01
15	Mango trees	11
16	Pathimugam (Sappan Wood)	01
17	Pathiri	01
18	Paeral (Baniayan tree)	01
19	Red Palm Trees	12
20	Rubber	07
21	Teak	02
22	Thazha (Screw Pine)	80
23	Ungu	01
24	Vatta (Thodukanni)	12
25	Analivegam	01
26	Sarpa Gandhi	01
	Total Trees	205



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CARBON FOOTPRINT OF THE CAMPUS (2021-22)

Various carbon emitting activities such as consumption of energy, transportation and waste generation leads to the total emission of **50.22 tCO₂e** per year by the campus. The total carbon sequestration by trees in the campus compound is **6.34tCO₂e**. Thus, the current carbon footprint of the campus will be the difference of total carbon emission and total carbon sequestration/mitigation. The following table shows the carbon footprint level

Specific CO₂ Footprint

Amount of Carbon to be mitigated for Low Carbon Campus		
Sl No	Particulars	2020-21
1	Total carbon emission tCO ₂ e	50.22
2	Total carbon sequestration tCO ₂ e	6.34
3	Amount of carbon mitigated through renewable energy tCO ₂ e	5.24
4	To be mitigated tCO ₂ e	38.64
5	Total No of Students	1017
6	Specific Carbon Footprint kg CO ₂ e/Student/Yr	38.00

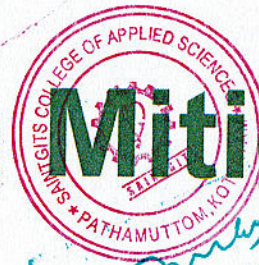
The total specific carbon emission is estimated as **38** kg of CO₂e per student for the year 2020-21.



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Carbon Mitigation Plans



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The total emission of the carbon dioxide per student is **49.38** kg per year (2020-2021). Emission reduction plans were prepared to bring the existing per capita carbon footprint to zero or below so as to bring the campus a carbon neutral or carbon negative campus.

This can be achieved in many ways but, every alternate plan must be in such a way that, it must fulfill the actual purpose of each activity that is considered.

Here, three major methods are taken in to account as the plans for reducing the carbon emission of the campus.

- Resource optimisation
- Energy efficiency
- Renewable energy


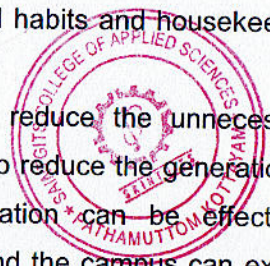
RESOURCE OPTIMISATION

The effective use of resources can limit its unnecessary wastage. Optimal usage of the resources (such as fuels) can save the fuel and can also reduce the carbon emission due to its consumption. This technique can be effectively implemented in the 'transportation' and 'waste' sectors of the campus.

WASTE MINIMISATION

Optimal utilisation of paper and plastic stationaries can reduce the frequency of purchase of items. This can reduce the unnecessary wastage of money as well as the excess production of waste. In the case of food, proper food habits and housekeeping practices can optimise its usage.

Currently, the campus is taking an appreciable effort to reduce the unnecessary production of wastes. But the campus still has opportunities to reduce the generation of waste and can improve much more. Resource optimisation can be effectively implemented in all type of waste generated in the campus and the campus can expect about 50% reduction the total waste produced.



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ENERGY EFFICIENCY

Energy efficiency is the practice of reducing the energy requirements while achieving the required energy output. Energy efficiency can be effectively implemented in all the sectors of the campus.

FUELS FOR COOKING

The campus uses commercial LPG cylinders for its cooking purpose. The campus can install a biogas plant to treat food waste and the biogas thus generated can be used in kitchen. Installation of a solar water heater to rise the water temperature to a much higher level, then it has to consume only very less amount of thermal energy for preparing the same amount of food is another method. This can make a positive benefit to the campus by saving money, energy and can reduce the carbon emission of the campus due to thermal energy consumed for cooking.

TRANSPORTATION

Energy efficiency of the transportation sector is mainly depended on the fuel efficiency of the vehicles used. Here mileage of the vehicle (kmpl - Kilometres per Litre) is calculated to assess the fuel efficiency of the vehicle.

Percentage of closeness is the ratio of actual mileage of the vehicle to its expected mileage. If the percentage of closeness of mileages of each vehicle is greater than that of its average, then the efficiency status of the vehicle is considered as 'Above average' and else, it is considered as 'Below average'.



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Carbon Mitigation Proposals

After analyzing the historical and measured data the following projects are proposed to make the campus carbon neutral. The projects are from energy efficiency and renewable energy. The further additions in the green cover increase will also give positive impact in the carbon mitigation.

OTTOTRACTIONS- ENERGY AUDIT						
Saintgits College of Applied Sciences, Pathamuttom						
Greenhouse Gas Mitigation through Major Energy Efficiency Projects						
SI No	Projects	Energy saved (Yearly)		Sustainability (Years)	First year ton of CO ₂ mitigated	Expected Tons of CO ₂ mitigated through out life cycle
		(kWh)	MWh			
1	Energy Saving in Lighting by replacing existing 257 No's T12 (55W) Lamps to 18W LED Tube	6819	6.82	10	4.98	49.78
2	Energy Saving by replacing existing 260 No's in-efficient ceiling fans with Energy Efficient Five star fans	9784	9.78	10	7.14	71.43
Total		16603	17	10	12.12	121.20

Saintgits College of Applied Sciences, Pathamuttom						
Greenhouse Gas Mitigation through Renewable Energy Projects						
SI No	Projects	Energy saved (Yearly)		Sustainability (Years)	First year ton of CO ₂ mitigated	Expected Tons of CO ₂ mitigated through out life cycle
		(kWh)	MWh			
1	Installation of 30kWp Solar Power Plant	38325	38.33	25	27.98	699.43
Total		38325	38	25	27.98	699

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OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal 1	
Energy Saving in Lighting by replacing existing 257 No's T12 (55W) Lamps to 18W LED Tube	
Existing Scenario	
257 numbers of T12(55 W) lamps were identified during the energy audit field survey in the facility. During discussion with officers it is observed that the average utility of these fittings are of 30%.	
Proposed System	
The existing T12 may be replaced to LED Tube of 18W in phased manner and the savings will be of 67% (inclusive of improved light output and reduced energy consumption)	
Financial Analysis	
Annual working hours (hr)	2400
No of fittings	257
Total load (kW)	14.14
Annual Energy Consumption (kWh)	10177
Expected Annual Energy saving for replacing all fittings (kWh)	6819
Cost of Power	13.39
Annual saving in Lakhs Rs (1st year)	0.91
Investment required for complete replacements [@Rs 300 per fittings](Lakhs Rs)	0.77
Simple Pay Back (in Months)	10.13



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OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal 2	
Energy Saving by replacing existing 260 No's in-efficient ceiling fans with Energy Efficient Five star fans	
Existing Scenario	
There are 260 numbers of ceiling fans installed in the facility with minimum 8 hrs a day operation. All are conventional type and most of them are very old.	
Proposed System	
There is an energy saving opportunity in replace the existing fans with new five star labelled fans. The five star labelled fans give a savings up to 30% with higher service value (air delivery/watt).	
Financial Analysis	
Annual working hours (hrs)	2400
Total numbers of ordinary fans	260
Total load (kW)	18.20
Annual Energy Consumption (kWh)	34944
Expected Annual Energy saving, for total replacement(kWh)	9784
Cost of Power (Rs)	13.39
Annual saving in Lakhs Rs (1st year)	1.31
Investment required for a total replacement (Lakhs Rs)[@3000 Rs per Fan with 50W at full speed]	7.80
Simple Pay Back (in Months)	71.44



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Energy Saving Proposal	
Installation of 30kWp Solar Power Plant	
Existing Scenario	
There is a good potential of solar power electricity generation. The availability of sunlight is very high. There are some canopies available in the proposed site, but by having proper trimming of trees this may be avoided. If the SPVs are placed in the roof top it will help improving RTTV (Roof Thermal Transmittance Value) of the building.	
Proposed System	
It is proposed to have a Solar Power Plant of 30kW at the beginning stage. The state and central government is pushing and giving good assistance to the installation. It can be installed as an internal grid connected system which is much cheaper than off grid system. Now days the technology provides trouble free grid interactive and connected system. The installation will provide 25yrs trouble free generation with only 20% efficiency loss at the 25th year.	
Financial Analysis	
Proposed Solar installed Capacity (kW)	30
Total average kWh per day expected (3.5kWh/day average)	105.00
Total annual Generating Capacity (kWh)	38325
Cost of energy generated annually Lakhs Rs	5.10
Investment required (INR lakh)(Approx)	16.50
Simple Pay Back (in Months)	38.84
Life cycle in Yrs	25
Total Saving in Life Cycle (Approx) RS lakh	127.43



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Executive Summary					
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects					
Saintgits College of Applied Sciences, Pathamuttom					
Sl No	Projects	Investment	Cost saving	SPB	Energy saved
		(Lakhs Rs)	(Rs)/Yr	Months	kWh/Yr
1	Energy Saving in Lighting by replacing existing 257 No's T12 (55W) Lamps to 18W LED Tube	0.77	0.913	10.13	6819
2	Energy Saving by replacing existing 260 No's in-efficient ceiling fans with Energy Efficient Five star fans	7.80	1.310	71.44	9784
3	Installation of 30kWp Solar Power Plant	16.50	5.10	38.84	38325
	Total	8.57	2.22	81.58	16603.04
(The saving are projected as per the assumed operation time observed based in the discussions with the plant officials. The data of saving percentages are taken from BEE guide books and field measurements.)					



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CONCLUSION

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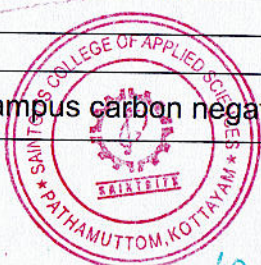


The carbon emission from different sectors namely, Energy, Transportation and wastes were calculated using standard procedures. Carbon sequestration by the trees present in the campus was also estimated. From these the total carbon footprint of the campus was arrived at.

Net Carbon Emission after implementing Energy Efficiency projects and Renewable Energy Projects Proposed		
1	Total Carbon Foot Print tCO ₂ e/yr	50.22
2	Carbon Sequestered tCO ₂ e/yr	6.34
3	Carbon mitigated by Renewable Energy tCO ₂ e/yr (Installed)	5.24
4	Carbon mitigated by Renewable Energy tCO ₂ e/yr (Proposed)	27.98
5	Carbon mitigated by Energy Efficiency (Proposed) tCO ₂ e/yr	12.12
6	Effective Carbon footprint tCO ₂ e/yr	-1.46
7	Total No of Students	1017
8	Specific Carbon Footprint kg CO ₂ e/Student/Yr	-1.43

From this study it was found that carbon footprint of the campus to be **-1.43 kgCO₂e/ Student/ Year** in place of current footprint i.e., **50.22 kgCO₂e/ student/ Year**. This will be achieved after implementing energy efficiency projects and implementation of 530kWp solar power plant. To achieve this an investment of **25.07 lakhs Rs** is required through energy efficiency and renewable energy projects proposed. It will be around **2645 Rs per student** to make the campus the carbon negative.

Cost to make the campus Carbon Negative		
1	Cost of implementation in Energy Efficiency Lakhs Rs	8.57
2	Cost of implementation in Renewable Energy Lakhs Rs	16.50
3	Total Lakhs Rs	25.07
4	Total number of students	1017
5	Cost per student to make the campus carbon negative Rs/ Student	2465



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TECHNICAL SUPPLEMENT

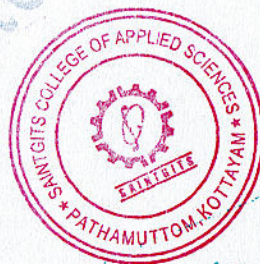


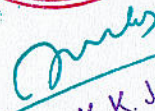
Saintgits College of Applied Sciences, Pathamuttom															
Sl No		Light							FAN			AC			
		T12	T8	T5	CFL	ICL	LEDT	LEDB	LED (40w)	CF	EF	WF	2TR	1.5TR	1TR
1	Old building	198					77			157			9		
2	Deceinial block	59					127			103				3	1
	Total	257	0	0	0	0	204	0	0	260	0	0	9	3	1
	Wattage	55	40	28	30	100	18	30	40	80	60	55	2000	500	4000
	Power	14.14	0	0	0	0	3.67	0	0	21	0	0	18	1.5	4



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