GREEN AUDIT REPORT

ST. ANTONY'S COLLEGE
PERUVANTHANAM

Executed by

OTTOTRACTIONS
Energy - Engineering - Environment

2023

OTTOTRACTIONS
Energy - Engineering - Environment

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Bureau of Energy Efficiency
Government of India.

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Report No: EA 1003A

2023

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, ISO 17020-2012 and ISO 14001-2015 Certified organization, which ensures the quality of its services.

Acknowledgment

We were privileged to work together with the administration and staff of St. Antony's College, Peruvanthanam 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
Government of India

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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1 Introduction

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.

The Green Audit of college 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.

ST. ANTONOY'S COLLEGE,PERUVANTHANAM

Capping Peruvanthanam hillock in majestic splendour and set in the entrance to the High ranges at Kodikuthy, St. Antony's Peruvanthanam is an index of the aspirations of the educationally deprived sections of the High-land society. This Eco-friendly institution with endemic diversity and evergreen scenery arrests our attention and capture the hearts by its serenity and purity. This ambience provides the setting for creative learning. Spread on 7 acres of lush verdant backdrop at Peruvanthanam in Idukki District. St. Antony's College affiliated to M.G. University and approved by Govt. of Kerala, provides the perfect setting for producing educated citizens by providing both infrastructure and instructional facilities in eight programmes in the fields of Commerce, Management, Literature and

Computer Applications. St. Antony's college aims to impart value-based education to produce intellectually well developed, morally upright, socially matched and spiritually enlightened citizens who could be pivots of various professions in the globalized village. The college has sufficient infrastructure and instructional facilities and amenities for academic, administrative and extracurricular activities that serve as lab and land for education. Besides, the college inculcates hard and soft skills in its budding managers and scholars to face the changes and challenges of tomorrow.

Occupancy Details			
Particulars	2020-21	2021-22	2022-23
Total Students	723	776	951
Staffs	48	53	66
Total Occupancy of the college	771	829	1017

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

Form-A											
BASELINE DATA SHEET FOR GREEN AUDIT											
1	Name of the Organisation	St. Antony's College Peruvanthanam									
2	Address (include telephone, fax & e-mail)	Peruvanthanam, KK Road, Idukki (Dist) 04869 281191,9562581191 principal@stantonyscollegepeerumade.ac.in									
2	Year of Establishment	2013									
3	Name of building and Total No. of Electrical Connections/building	HT (1)									
4	Total Number of Students	Boys		Girls		Total	951				
5	Total Number of Staff	66									
6	Total Occupancy	1017									
7	Total area of green cover	80%									
8	Type of Electrical Connection	HT	1	LT	0						
9	Total Connected Load (kW)	112.9									
10	Average Maximum Demand (KVA)	25									
11	Total built up area of the building (M^2)	5670									
12	Number of Buildings	1									
13	Average system Power Factor	0.96									
14	Details of capacitors connected (kVAr)	50									
15	Transformer Details (Nos., kVA, Voltage ratio)	TR 1									
		200									
15	DG Set Details (kVA,)	DG1	DG2	DG3	DG4	DG5	Remarks				
		30									
16	Details of motors	Rating		Nos.		Remarks					
		5 to 10		2							
		10 to 50									
		Above 50									
17	Brief write-up about the firm and the energy/environmental conservation activities already undertaken.	NSS, Energy Clubs etc.									
18	Contact Person & Telephone number	IQAC Cordinaor									
		9446121565									

2

METHODOLOGY

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 1914 occupants of this campuses will reach same number of households. This message will spread to at least 7992 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 CO_2 emitted per year, a number that can be supplemented by tons of CO_2-equivalent gases, including methane, nitrous oxide, and other greenhouse gases.

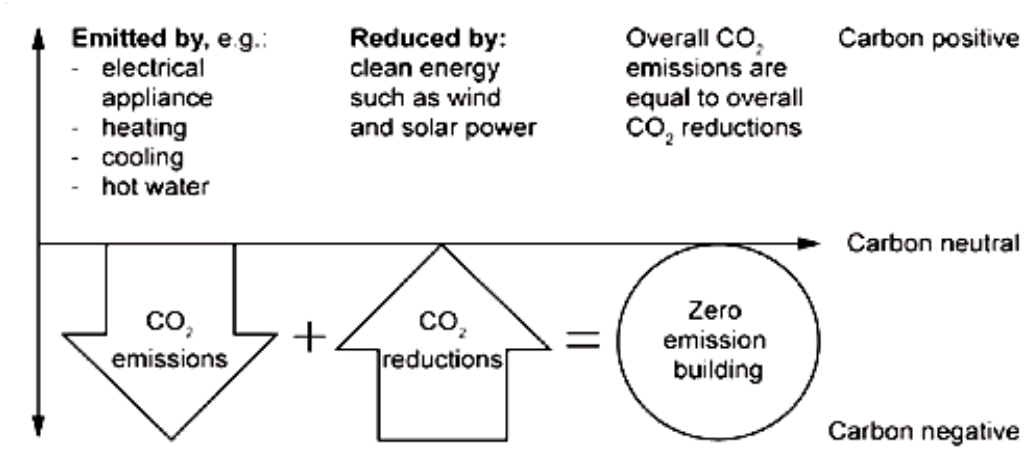
Global Warming Potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide. The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is 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 (CO_2).

Global Warming Potentials (IPCC Second Assessment Report)					
Species	Chemical formula	Lifetime (years)	Global Warming		
			20 years	100 years	500 years
Carbon dioxide	CO2	variable §	1	1	1
Methane *	CH4	12±3	56	21	6.5
Nitrous oxide	N2O	120	280	310	170
HFC-23	CHF3	264	9100	11700	9800
HFC-32	CH2F2	5.6	2100	650	200
HFC-41	CH3F	3.7	490	150	45
HFC-43-10mee	C5H2F10	17.1	3000	1300	400
HFC-125	C2HF5	32.6	4600	2800	920
HFC-134	C2H2F4	10.6	2900	1000	310
HFC-134a	CH2FCF3	14.6	3400	1300	420
HFC-152a	C2H4F2	1.5	460	140	42
HFC-143	C2H3F3	3.8	1000	300	94
HFC-143a	C2H3F3	48.3	5000	3800	1400
HFC-227ea	C3HF7	36.5	4300	2900	950
HFC-236fa	C3H2F6	209	5100	6300	4700
HFC-245ca	C3H3F5	6.6	1800	560	170
Sulphur hexafluoride	SF6	3200	16300	23900	34900
Perfluoromethane	CF4	50000	4400	6500	10000
Perfluoroethane	C2F6	10000	6200	9200	14000
Perfluoropropane	C3F8	2600	4800	7000	10100
Perfluorobutane	C4F10	2600	4800	7000	10100
Perfluorocyclobutane	c-C4F8	3200	6000	8700	12700
Perfluoropentane	C5F12	4100	5100	7500	11000
Perfluorohexane	C6F14	3200	5000	7400	10700

The methodology for carbon footprint calculations is 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.

a. Energy
b. Transportation
c. Waste minimisation
d. 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 sequestrated 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 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 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.

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)

Only vehicles operate from the campus will take in to the account of transportation. The private vehicles are not considered for accounting carbon foot print. As private vehicle footprint will be in the account for personal footprint.

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 sequestrated 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 CO_2 sequestrated in the tree
- Determining the weight of CO_2 sequestrated in the tree per year

Detailed calculations and results are given below.

Step 1: Determine the total green weight of the tree

The green weight is the weight of the tree when it is alive. First, you have to calculate the green weight of the above-ground weight as follows:
W above-ground= 0.25 D2 H (for trees with D<11)
W above-ground= 0.15 D2 H (for trees with D>11)

W above-ground= Above-ground weight in pounds

D = Diameter of the trunk in inches

H = Height of the tree in feet

The root system weight is about 20% of the above-ground weight. Therefore, to determine the total green weight of the tree, multiply the above-ground weight by 1.2:

$W_{\text{total green weight}} = 1.2 * W_{\text{above-ground}}$

Step 2: Determine the dry weight of the tree

The average tree is 72.5% dry matter and 27.5% moisture. Therefore, to determine the dry weight of the tree, multiply the total green weight of the tree by 72.5%.

$W_{\text{dry weight}} = 0.725 * W_{\text{total green weight}}$

Step 3: Determine the weight of carbon in the tree

The average carbon content is generally 50% of the tree's dry weight total volume. Therefore, in determining the weight of carbon in the tree, multiply the dry weight of the tree by 50%.

$W_{\text{carbon}} = 0.5 * W_{\text{dry weight}}$

Step 4: Determine the weight of carbon dioxide sequestered in the tree

CO_2 has one molecule of Carbon and 2 molecules of Oxygen. The atomic weight of Carbon is 12 (u) and the atomic weight of Oxygen is 16 (u). The weight of CO_2 in trees is determined by the ratio of CO_2 to C is 44/12 = 3.67. Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.67. $W_{\text{carbon-dioxide}} = 3.67 * W_{\text{carbon}}$

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RESULTS AND DISCUSSIONS

3.1 CARBON FOOTPRINT ESTIMATION

3.1.1 ENERGY

a. Electricity

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

Base line Data (Electricity Bill)	
Code	EA
Facility	St. Antony's College Peruvanthanam
Provider	KSEB
Contract Demand (kVA)	70
Connected Load (KW)	113
Tariff	HT II (B) GENERAL
Consumer Number	1357200060681
Energy Charge Rs/ kWh Z1	6.8
Energy Charge Rs/ kWh Z2	10.2
Energy Charge Rs/ kWh Z3	5.1
Demand Charge Rs/ kVA	500
Excess Demand Rs/kVA	250
Energy Bill Analysis interval	2022-23

Electricity Bill Analysis

Electricity Bill Details (2022-23)												
Month	Name of the Consumer				St. Antony's College Peruvanthanam							
	Contract		70		Consumer number & Section			1357200060681				
	Tariff		HT II (B)					Peruvanthanam				
	kWh				kVA			PF	PF Incentive	PF Penalty	Rs (Total)	Rs/kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3					
Apr	1589	659	406	2654	21.66	5.58	5.1	0.96	91	0	43319	**16.32**
May	1864	96	396	2356	22.9	14.7	12.2	0.72	0	2930	42028	**17.84**
Jun	998	1	263	1262	17.49	3.84	4.56	0.58	0	2560	43689	**34.62**
Jul	1652	5	306	1963	25	14	15	0.64	0	2627	39527	**20.14**
Aug	942	82	318	1342	16.75	8.96	5.13	0.67	0	2260	42229	**31.47**
Sep	1278	191	373	1842	19.9	9.6	4.6	0.77	0	1944	42284	**22.96**
Oct	1703	260	506	2469	21.9	17	17	0.78	0	2438	48551	**19.66**
Nov	1532	225	452	2209	22.6	4.2	4.4	0.81	0	1727	46560	**21.08**
Dec	1812	206	405	2423	24.2	4.3	5	0.83	0	1566	46500	**19.19**
Jan	1430	268	509	2207	19.66	5.41	4.24	0.97	0	0	43114	**19.54**
Feb	1643	186	369	2198	19	3	3	0.99	0	0	43837	**19.94**
Mar	1991	196	343	2530	21	11	2	0.99	0	0	45680	**18.06**

Annual Electricity Consumption (kWh)				
Consumer No	**2020-21**	**2021-22**	**2022-23**	Connected Load (kW)
1357200060681	19091	21860	25455	113
Total	**19091**	**21860**	**25455**	**113**

b. Diesel

Diesel Consumption Details				
	Transportation	Generator	Total	cost
	in L	in L	in L	in Rs
20-21	1423	323	1747	165956
21-22	6456	1085	7541	716437
22-23	12782	1347	14129	1342260

c. LPG

LPG Consumption Details			
	2020-21	**2021-22**	**2022-23**
No Cylinders	12	20	24
Canteen/Lab LPG Consumption in kg	228	380	456
Total in kg	228	380	456

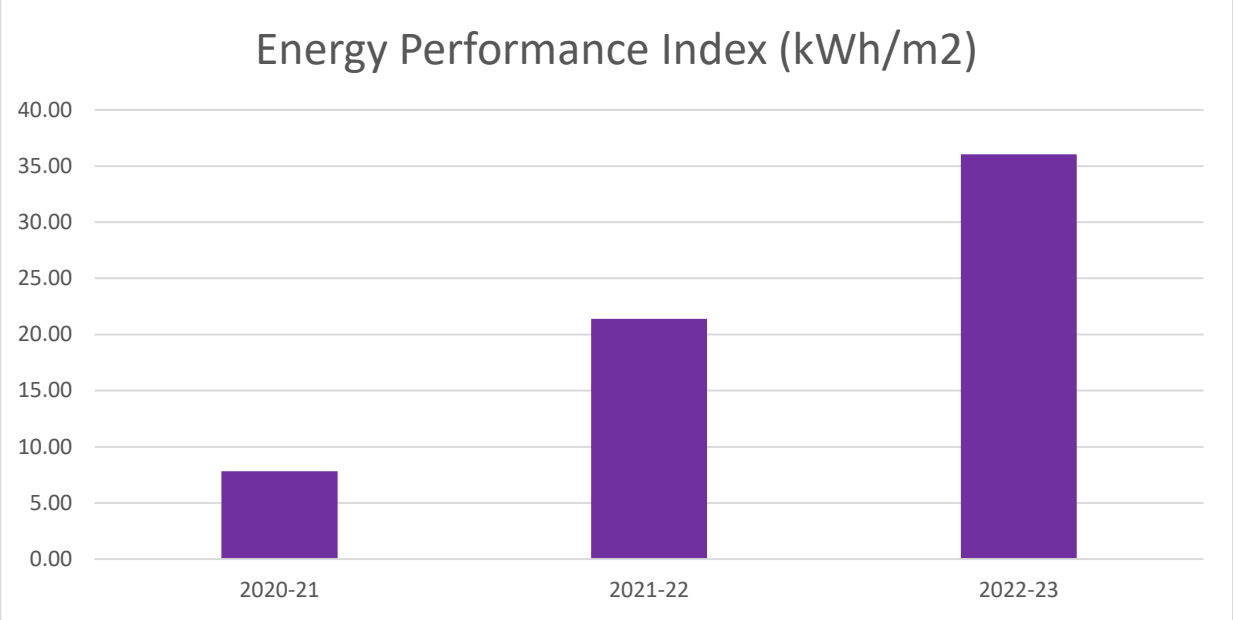
Base Line Energy Data				
St. Antony's College Peruvanthanam				
	Year	**2020-21**	**2021-22**	**2022-23**
1	Electricity KSEB (kWh)	19091	21860	25455
2	Electricity Solar - Off grid (kWh)	0.00	0.00	0.00
3	Electricity (KSEB + Off grid) kWh	19091	21860	25455
4	Electricity Grid Tied (kWh)	0	0	0
5	Diesel (L)	1747	7541	14129
6	LPG (kg)	228	380	456
7	Biogas (m3)	0.00	0.00	0.00

Energy Consumption Profile				
Sl No	Fuel	**2020-21**	**2021-22**	**2022-23**
		(kCal)		
1	Electricity	16418475	18799170	21891300
2	Diesel	18342505	79185142	148355053
3	LPG	2736000	4560000	5472000
4	Biogas	0	0	0
Total		37496980	102544312	175718353

Thermal Fuel Consumption			
St. Antony's College Peruvanthanam			
	2020-21	2021-22	2022-23
Annual LPG consumption in kg	228	380	456
Annual Diesel consumption in L	1747	7541	14129
Annual petrol consumption in L	0	0	0
Annual Biogas consumption in m3	0	0	0

Specific Energy Consumption

OTTOTRACTIONS- ENERGY AUDIT				
St. Antony's College Peruvanthanam				
Energy Performance Index (EPI)				
Sl No	Particulars	2020-21	2021-22	2022-23
1	Total building area (m²)	5570	5570	5670
2	Annual Energy Consumption (kCal)	37496980	102544312	175718353
3	Annual Energy Consumption (kWh)	43601	119238	204324
4	Total Energy in Toe	3.75	10.25	17.57
5	Specific Energy Consumption kWh/m²	7.83	21.41	36.04



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			
St. Antony's College Peruvanthanam			
Particulars	2020-21	2021-22	2022-23
Total Occupancy	771	829	1017
Waste generated in kg /day	15.42	16.58	20.34
Waste generated in kg /Yr	3392.4	3647.6	4474.8

Non-Degradable waste

Solid non degradable Waste Generation			
St. Antony's College Peruvanthanam			
Particulars	2020-21	2021-22	2022-23
Total Occupancy	771	829	1017
Waste paper generated in kg /day	0.1542	0.1658	0.2034
Waste plastic generated in kg /day	0.2313	0.2487	0.3051
Waste paper generated in kg /Yr	33.92	36.48	44.75
Waste plastic generated in kg /Yr	50.89	54.71	67.12

3.4. Transportation

Buses are used for the transportation from the college.

Carbon Emission Profile (2022-23)

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_2e/kWh
LPG	0.0015	tCo_2e/kg
Diesel	0.0032	tCo_2e/kg
Petrol	0.0031	tCo_2e/kg
Food Waste	0.00063	tCo_2e/kg
Paper Waste	0.00056	tCo_2e/kg
Plastic Waste	0.00034	tCo_2e/kg

Carbon Foot Print 2020-23

Carbon Foot Print							
Sl. No.	Particulars	2020-21	tCO_2e	2021-22	tCO_2e	2022-23	tCO_2e
1	Electricity (kWh)	19091	15.655	21860	17.92	25455	20.87
2	Diesel (kg)	1443	4.6191	6533	20.91	11675	37.36
3	LPG (kg)	228	0.342	380	0.57	456.00	0.68
4	Biogas (m3)	0.00	0.00	0.00	0.00	0.00	0.00
5	Degradable Waste in kg/yr.	3392.4	2.1372	3647.6	2.3	4474.8	2.82
6	Paper Waste in kg/yr	33.92	0.019	36.48	0.02	44.75	0.03
Total Carbon Foot Print tCO2e/yr			**22.77**		**41.72**		**61.76**

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 sequestrated 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	2021-22	2022-23
Total No of Trees	151	151	151
Carbon sequestrated by trees in the campus (tCO2e)	0.87	0.92	0.97

Trees sequestrate 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 sequestrated 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 3.18. Detailed table is included in the technical supplement.

Carbon sequestrated 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 CO_2 sequestrated in the tree
- Determining the weight of CO_2 sequestrated in the tree per year

Carbon sequestrated by each species of trees in the campus compound is given in the technical supplement.

CARBON FOOTPRINT OF THE CAMPUS (2020-23)

Various carbon emitting activities such as consumption of energy, transportation and waste generation leads to the total emission of **63.92 tCO_2e** per year by the campus. The total carbon sequestration by trees in the campus compound is **0.97 tCO_2e**.

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 of 2022-23.

Specific CO2 Footprint

Amount of Carbon to be mitigated for Low Carbon Campus				
Sl No	Particulars	2020-21	2021-22	2022-23
1	Total carbon emission tCO2e	22.77	41.72	61.76
2	Total carbon sequestration tCO2e	0.87	0.92	0.97
3	Amount of carbon mitigated through renewable energy tCO2e	0.00	0.00	0.00
4	To be mitigated tCO2e	21.90	40.80	60.79
5	Total No of Students	723	776	951
6	Specific Carbon Footprint kg CO2e/Student/Yr	30.29	52.58	63.92

The total specific carbon emission is estimated as **64.94** kg of CO_2e per student for the year 2022-23.

4

Carbon Mitigation Plans

The total emission of the carbon dioxide per student is **63.92** kg per year (2022-2023). 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.

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 and biogas for its cooking purpose. The 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’

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.

St. Antony's College Peruvanthanam						
Greenhouse Gas Mitigation through Major Energy Efficiency Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Energy Saving in Lighting by replacing existing 61 No's T8 (40W) Lamps to 18W LED Tube	966	0.97	10	0.71	7.05
2	Energy Saving by replacing existing 135 No's in-efficient ceiling fans with Energy Efficient Five star fans	7672	7.67	10	5.60	56.01
Total		**8639**	**9**	**10**	**6.31**	**63.06**

OTTOTRACTIONS- ENERGY AUDIT						
St. Antony's College Peruvanthanam						
Greenhouse Gas Mitigation through Renewable Energy Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Installation of 60kWp Solar Power Plant	76650	76.65	25	55.95	1398.86
	Total	76650	77	25	55.95	1399

Executive Summary					
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects					
St. Antony's College Peruvanthanam					
Sl No	Projects	Investment	Cost saving	SPB	Energy saved
		(Lakhs Rs)	(Rs)/Yr	Months	kWh/Yr
1	Energy Saving in Lighting by replacing existing 61 No's T8 (40W) Lamps to 18W LED Tube	0.18	0.08	27.38	966
2	Energy Saving by replacing existing 135 No's in-efficent ceiling fans with Energy Efficient Five star fans	4.05	1.03	47.31	7672
3	Installation of 60kWp Solar Power Plant	33.00	10.19	38.84	76650
	Total	**37.23**	**11.30**	**37.84**	**85289**
(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

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 tCO2e/yr	61.76
2	Carbon Sequestrated tCO2e/yr	0.97
3	Carbon mitigated by Renewable Energy tCO2e/yr (Installed)	0.00
4	Carbon mitigated by Renewable Energy tCO2e/yr (Proposed)	55.95
5	Carbon mitigated by Energy Efficiency (Proposed) tCO2e/yr	6.31
6	Effective Carbon footprint tCO2e/yr	-1.47
7	Total No of Students	951
8	Specific Carbon Footprint kg CO2e/Student/Yr	-1.54

From this study it was found that carbon footprint of the campus to be **–1.54** kgCO_2e/ Student/ Year in place of current footprint i.e., **64.94** kgCO_2e/ student/ Year. This will be achieved after implementing energy efficiency projects and implementation of 60kWp solar power plant. To achieve this an investment of **70.23 lakhs Rs** is required through energy efficiency and renewable energy projects proposed. It will be around **7385 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	37.23
2	Cost of implementation in Renewable Energy Lakhs Rs	33.00
3	Total Lakhs Rs	70.23
4	Total number of students	951
5	Cost per student to make the campus carbon negative Rs/ Student	7385

REFERENCES

Reports and Books

- Towards campus climate neutrality: Simon Fraser University's carbon footprint (2007), Simon Fraser University, Bokowski, G., White, D., Pacifico, A., Talbot, S., DuBelko, A., Phipps, A.
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OTTOTRACTIONS
Energy-Engineering-Environment

6

TECHNICAL SUPPLEMENT

St. Antony's College Peruvanthanam																
Sl No		Light				FAN		IT				AC		Others		
		T 8	LED T	LED B	LED SQ	CF	W F	T V	P C	PRINTER	Projector	1	3	Tailoring Machine	Fridge	PA System
1	Conf Hall				20		8				1		2			1
2	Principal											1				
3	Chairman		2		5							1				
4	Media room				3		1					1				
5	Guest room				4							1				
6	Secretary				5							1				
7	Corridor				20			1								
8	Admission Cell					5		1	1			1				
9	Classroom	1				4										
10	D4	2				4										
11	D3	1	1			4										
12	D2	2				2										
13	D1	2				2										
14	Office		3			2			5						1	
15	Staff room	4				4										
16	Auditorium	6	1			25										
17	Art Lab	2				2										

18	Construction Lab	2				2								10		
19	BFT 1	2				2										
20	BFT 2	2				2										
21	BBA		2			2										
22	BCA 1	2				3										
23	BCA 2	2				3										
24	C3	2				3										
25	Computer Lab				20				46	1			2			
26	BSc Cyber 1		8			7										
27	BBA 1	2				4										
28	BBA 2	2				4										
29	Management Department	2				3			1							
30	Library	6				6			1							
31	First Floor corridor				20											
32	Commerce Department	2				4			1							
33	B Com F & T 1	1	1			4										
34	B Com F & T 2	3				4										
35	Mcom F & T	1				2										
36	B2		2			1										
37	B1	2				4										
38	B O	2				4										
39	A1	1	1			2										

40	A2	1	1			2										
41	A3	1	1			2										
42	A4	1	1			2										
43	A5	1	1			2										
44	A6	1	1			2										
45	Toilets		12													
46	Canteen			2		5				1						
	Total	**61**	**38**	**2**	**97**	**135**	**9**	**2**	**55**	**2**	**1**	**6**	**4**	**10**	**1**	**1**

GREEN AUDIT

Particulars	2022-23	2021-22	2020-21	2019-2020	2018-19
Number of students	951	776	723	708	741
Number of staff	66	53	48	48	43
Total Building area (m^2)	5670 sqm	5570sqm	5570sqm	5570sqm	5570sqm
Total Land Area(acre)	5.5Acre	5.5 Acre	5.5 Acre	5.5 Acre	5.5 Acre
Total Green cover	80%	90%	90%	90%	90 %
Total Number of trees	156	130	100	95	90

List Of Trees:

1. Jack fruit -7
2. Wild Jack Tree- 5
3. Mango tree -4
4. Coconut palm-10
5. Guava-10
6. Fruit trees-40
7. Bamboo-65
8. Clove – 2
9. Casuarina (kattadi) -1
10. Teak 1
11. Pine -1
12. Gooseberry -2
13. Pomegranate -1
14. Spanish cherry – 1
15. Mahogany Tree – 1

KERALA STATE ELECTRICITY BOARD LIMITED

Office of the Special Officer(Revenue), Pattom,Thiruvananthapuram

DEMAND NOTICE FOR JANUARY 2022

(As per CHAPTER VII OF KERALA ELETRICITY SUPPLY CODE -2014)

Con. Code	1357200060681	Bill Date	04-Jan-2022	Due Date	11-Jan-2022	Bill.No	2102811940070 Ver : 0
Tariff	HT II (B) GENERAL			DC Date	27-Jan-2022	CD(cash)	136000 BG 0

St. Antonys College
St Antonys College,I-396 B,
Peruvanthanam,
Idukki,,685532
Mobile no–9562581191

LCN :11/8772

SBI Virtual A/c No(IFS Code:SBIN0070493)-KSEBHT11C8772

KSEBL WISHES all its consumers A VERY HAPPY NEW YEAR
Consumer GSTIN_ID- /KSEB (L)GST ID=32AAECK2277NBZ1

Arrears as on 30-Nov-2021			
Disputed	0	Undisputed	225119

Contract Demand(kVA)	75% of CD (KVA)	130% of CD (KVA)	Connected Load (KW)
70.0	52.5	91.0	112.9

Date of Previous Reading	30-Nov-2021	Email:			
Date of Present Reading	31-Dec-2021	Supply Voltage	11 kV	HT	

Average			Billing Type	DPS
MD (kVA)	Consumption (kWh)	PF	Section	Peruvanthanam
21.80	2420	0.93	Circle	Thodupuzha

Reading Details of meter 17125387 a-Working (KVA,KWh,KVAh & KVArh) for 12-2021

1. Energy Consumption(KWh)

Zone	FR	IR	MF	Units
1	29677.00	28069.00	1.000	1608
2	4812.00	4507.00	1.000	305
3	10159.00	9603.00	1.000	556
			Total	2469

2. Energy Consumption(KVAh)

Zone	FR	IR	MF	Units
1	34814.00	32934.00	1.000	1880
2	6322.00	5957.00	1.000	365
3	15544.00	14798.00	1.000	746
			Total	2991
Ave.PF=KWh/KVAh			0.83	

3. Energy Consumption(KVArh) Lag and kVARh (Lead)

Zone	FR	IR	MF	Units	FR	IR	Units
1	13133.00	12273.00	1.000	860	7701.00	7692.00	9
2	3368.00	3172.00	1.000	196	2723.00	2723.00	0
3	9940.00	9451.00	1.000	489	3755.00	3755.00	0
			Total kVArh(Lag)	1545	kVArh(Lead)		9

4. Demand (KVA)	Readings	MF	Units
1	21.69	1.000	21.69
2	13.07	1.000	13.07
3	5.841	1.000	5.84
5.Factory Lighting			0.0
6.Colony Lighting			0.0
7.Generator			0

INVOICE

	Unit	Rate (Rs)	Amount (Rs)
1.Total Demand Charge			
a. Demand Charge - Normal	53.0	440.000	23320.00
b. Demand Charge - Peak	0.0	440.000	0.00
c. Demand Charge - Off peak	0.0	440.000	0.00
d. Excess Demand Charge (Normal)	0.0	220.000	0.00
e. Excess Demand Charge(Peak)	0.0	220.000	0.00
f. Excess Demand Charge (Off peak)	0.0	220.000	0.00
Sub Total (a+b+c+d+e+f)			**23320.00**
2.Total Energy Charges			
a. Energy charges - Normal	1608	6.20000	9969.60
b. Energy charges - Peak	305.0	9.30000	2836.50
c. Energy charges - Off peak	556.0	4.65000	2585.40
Sub Total(a+b+c)			**15391.50**
3.PF Incentive / Disincentive			1462.19
Total Energy Charge			**16853.69**
4.Energy Charges on Lighting load			
a.Factory Lighting	0	0.2	
b.Colony Lighting	0	0.2	0.00
Sub Total(a+b)			
5.Electricity Duty	15392	0.100	1539.15
6.Ele. Surcharge	2469	0.025	61.73
7.Duty on self generated energy	0	0.012	0.00
8.Penalty for non-segn. of light load			

	Amount
9.Other Charges	
Reconnection Fee	0.00
10.Total(add 1 to 9)	**41774.57**
Plus/Minus (Round off)	0.43
UnDisputed Arr Amount	225119.00
Less 1. Advance / Credit	
2. CD Interest	0.00
3. CD Refund	0.00
Net Payable	**266894.00**

(Rupees Two Lakh Sixty Six Thousand Eight Hundred Ninety Four Only)

E & O.E

Balance Advance at Credit, if any

As per Regulation 130 of Kerala Electricity Supply Code 2014 any complaint regarding accuracy of a bill shall be first taken up wih the officer designated to issue the bill (Special Officer(Revenue)). Please follow our official Facebook page fb.com/ksebl for information &announcements.(Please see the instructions overleaf)

SPECIAL OFFICER (REVENUE)

Please Detach and enclose with the DD

1357200060681 | 2102811940070 | Rs.266894.00 | January 2022

St. Antonys College

DD/Payment Instruction | Name of the Bank | Date | Signature