GREEN AUDIT REPORT

SREE NARAYANA COLLEGE

CHATHANOOR

Executed by

OTTOTRACTIONS
Energy - Engineering - Environment

2023

OTTOTRACTIONS
Energy - Engineering - Environment

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Bureau of Energy Efficiency
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GREEN AUDIT REPORT

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CHATHANOOR

OTTOTRACTIONS
Energy-Engineering-Environment

Green Audit Report
Sree Narayana College, Chathanoor
Report No: EA 987/GA
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 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 Sree Narayana College, Chathanoor for their timely help extended to complete the audit and bringing 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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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 **Sree Narayana College, Chathanoor** 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.

SREE NARAYANA COLLEGE, CHATHANOOR

Sree Narayana College, Chathannur situates at Karamcode, near to the KSRTC Bus Station Chathannur in Kollam district in Kerala. The College is managed by the Sree Narayana Trusts, Kollam, one of the leading educational agencies in the state. It is affiliated to the University of Kerala, and has 12 B recognition from the UGC.

The first Principal of the college was the noted academician Prof. K. Udayakumar. Ever since its inception in 1981, Sree Narayana College, Chathannur has catered to the educational and intellectual needs of young men and women from the rural areas of south Kollam.

The college offers degree courses in Mathematics, Commerce, Chemistry & Industrial Chemistry and History. At the Post-Graduate level, the college offers M.Sc Mathematics and M.Com (Finance stream). Various clubs and study centers function to encourage and nurture the aesthetic and literary talents of its members.

Conscious of its inceptual obligation, it takes education to the doorsteps of the poor and marginalized sections of the society and endeavours to mould a humane, intellectually progressive, morally awakened and socially committed group of young men and women.

Occupancy Details	
Particulars	2022-23
Total Students	600
Staffs	30
Total Occupancy of the college	630

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	Sree Narayana College, Chathanoor									
2	Address (include telephone, fax & e-mail)	Karamcode P.O., Chathannoor, Kerala 691579									
3	Year of Establishment	1965									
4	Name of building and Total No. of Electrical Connections/building	SN College ,2 LT Connection									
5	Total Number of Students	Boys		Girls		Total	600				
6	Total Number of Staff	30									
7	Total Occupancy	630									
8	Total area of green cover (hectare)	8.75									
9	Type of Electrical Connection	HT		LT	2						
10	Total Connected Load (kW)	NA									
11	Average Maximum Demand (KVA)	-									
12	Total built up area of the building (M^2)	3250									
13	Number of Buildings	2									
14	Average system Power Factor	0.96									
15	Details of capacitors connected	NA									
16	Transformer Details (Nos., kVA, Voltage ratio)	TR 1									
		NA									
17	DG Set Details (kVA,)	DG1	DG2	DG3	DG4	DG5	Remarks				
18	Details of motors	Rating		Nos.		Remarks					
		5 to 10		1							
		10 to 50									
		Above 50									
19	Brief write-up about the firm and the energy/environmental conservation activities already undertaken.	Bhoomithrasena club, Water conservation activities, Energy conservation activities									
20	Contact Person & Telephone number	Principal									
		0474-2593312									

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 2319 occupants of this campuses will reach same number of households. This message will spread to at least 9276 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).

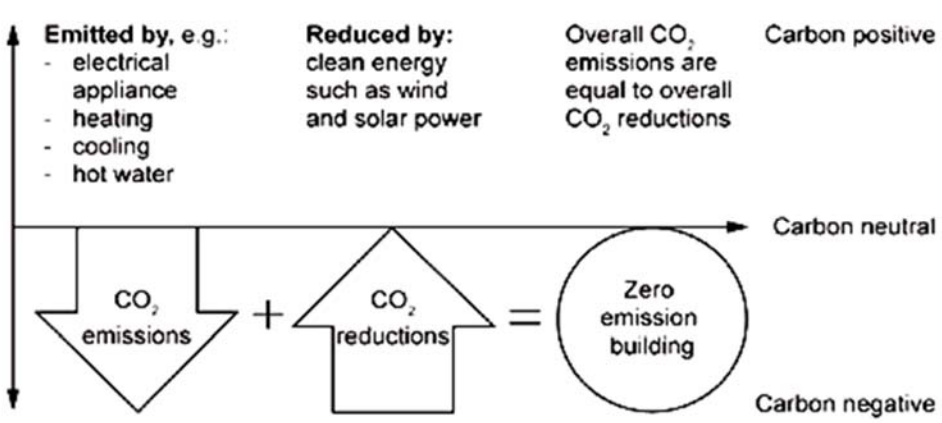
Global Warming Potentials (IPCC Second Assessment Report)					
Species	Chemical formula	Lifetime (years)	Global Warming		
			20 years	100 years	500 years
Carbon dioxide	CO2	variable §	1	1	1
Methane *	CH4	12±3	56	21	6.5
Nitrous oxide	N2O	120	280	310	170
HFC-23	CHF3	264	9100	11700	9800
HFC-32	CH2F2	5.6	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 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.

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, 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.

Transportation

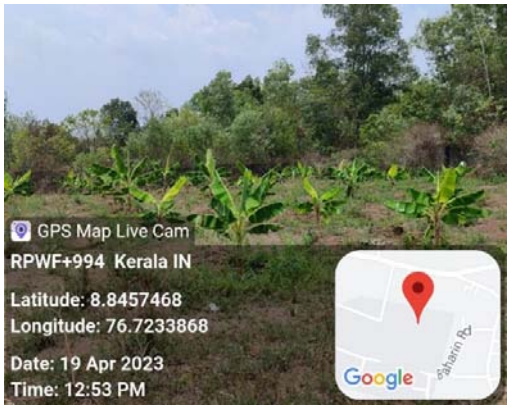
Carbon emission from transportation to be calculated by using the following formula:

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 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%.

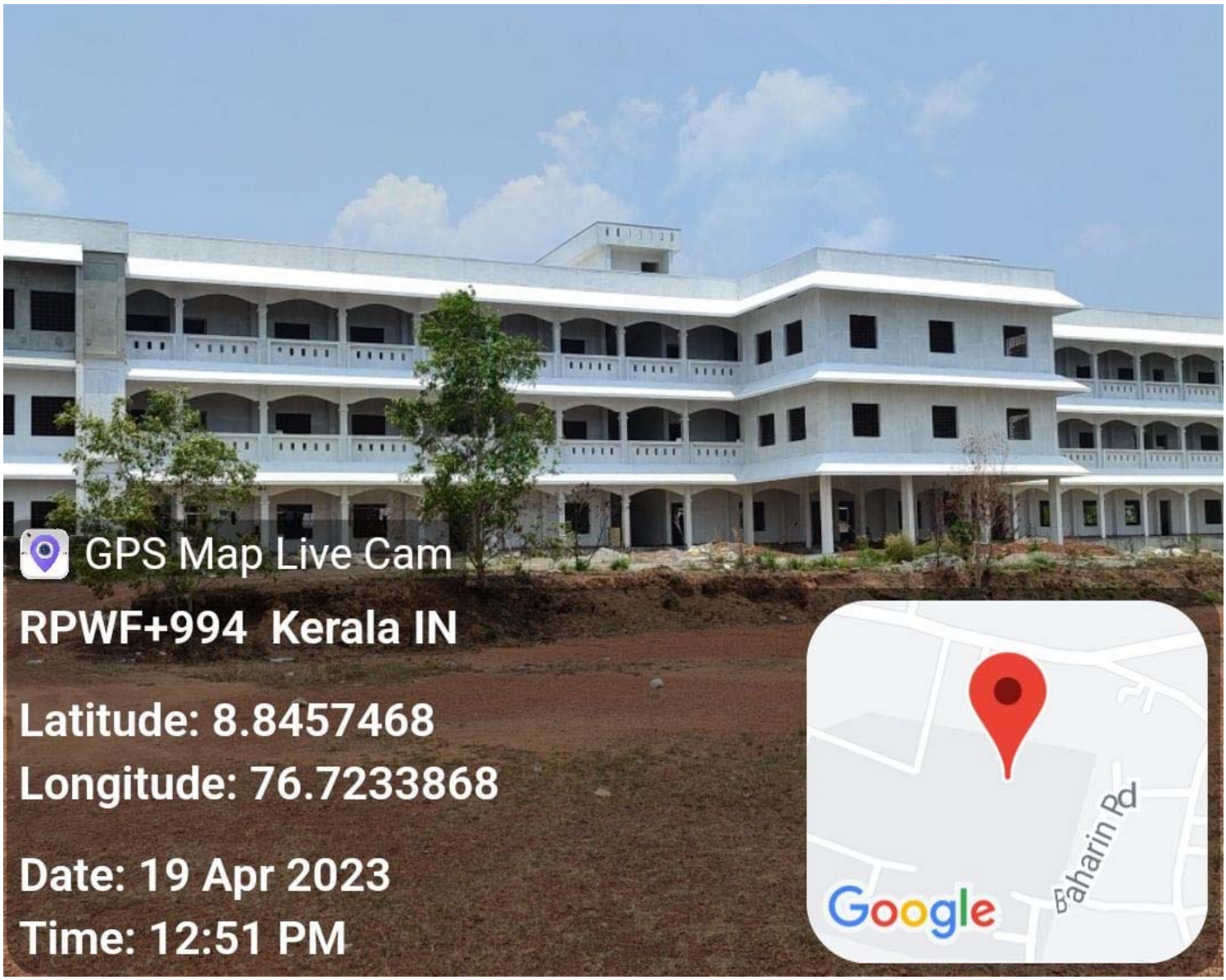
$W_{\text{carbon}} = 0.5 * W_{\text{dry weight}}$

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. $W_{\text{carbon-dioxide}} = 3.67 * W_{\text{carbon}}$

3

RESULTS AND DISCUSSIONS



3.1 CARBON FOOTPRINT ESTIMATION

3.1.1 ENERGY

a. Electricity

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

Electricity Connection Details		
Sree Narayana College, Chathanoor		
1	Name of the Consumer	Sree Narayana College, Chathanoor Chathanoor
2	Tariff	LT-6A General
3	Consumer Number	1145751027868, 1145754004277
4	Connected Load Total (kW)	NA
5	Annual Electricity Consumption (kWh)	17516

Diesel

Diesel Consumption Details		
	Total	cost
	in L	Rs
21-22	300	28800

LPG

LPG Consumption Details	
Particulars	2022-23
No Cylinders	12
Canteen LPG Consumption in kg	228
Total in kg	228

Base Line Energy Data		
Sree Narayana College, Chathanoor		
		2022-23
1	Electricity KSEB (kWh)	17516
2	Electricity Solar Consumption (kWh)	2555
3	Electricity (KSEB + Solar) kWh	20071
4	Electricity Solar Export (kWh)	0
5	Diesel (L)	300.00
6	LPG (kg)	228
7	Biogas (m^3)	0.00

Renewable Energy

Solar Power Plant	
Particulars	Remarks
Capacity kWp	2
Annual Generation	2555

A 2kWp solar power plant is installed in the college.

Specific Energy Consumption

OTTOTRACTIONS- ENERGY AUDIT		
Sree Narayana College, Chathanoor		
Energy Performance Index (EPI)		
Sl No	Particulars	2022-23
1	Total building area (m^2)	3250
2	Annual Energy Consumption (kCal)	23146937
3	Annual Energy Consumption (kWh)	26915.04
4	Total Energy in Toe	2.31
5	Specific Energy Consumption kWh/m^2	8.28

The specific energy consumption in 2022-23 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	
Sree Narayana College, Chathanoor	
Year	2022-23
Total Occupancy	630
Waste generated in kg /day	12.6
Waste generated in kg /Yr	1512

Non-Degradable waste

Solid non degradable Waste Generation	
Sree Narayana College, Chathanoor	
Year	2021-22
Total Occupancy	630
Waste paper generated in kg /day	0.126
Waste plastic generated in kg /day	0.189
Waste paper generated in kg /Yr	15.12
Waste plastic generated in kg /Yr	22.68

3.4. Transportation

There are no vehicles operates from the campus so it is not considered to calculate the carbon footprint.

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_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 2021-22

Carbon Foot Print			
Sl. No.	Particulars	2021-22	tCO2e
1	Electricity (kWh)	20071	16.46
2	Diesel (L)	300	0.96
3	LPG (kg)	228	0.34
4	Biogas (M3)	0	0.00
5	Degradable Waste in kg/yr.	1512	0.95
6	Paper Waste in kg/yr	15	0.01
7	Plastic Waste in kg/yr	23	0.01
Total Carbon Foot Print tCO2e/yr			18.73

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	
Particular's	2021-22
Carbon sequestrated by trees in the campus (tCO2e)	1.02

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. 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 Table.

List of Trees in Campus

List of Trees in the Campus		
Sl No	Name	Number
1	Teak	5
2	Mahagoni	8
3	Jack fruit	5
Total		18

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 **18.73tCO$_2$e** per year by the campus. The total carbon sequestration by trees in the campus compound is **1.02tCO2e**. 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

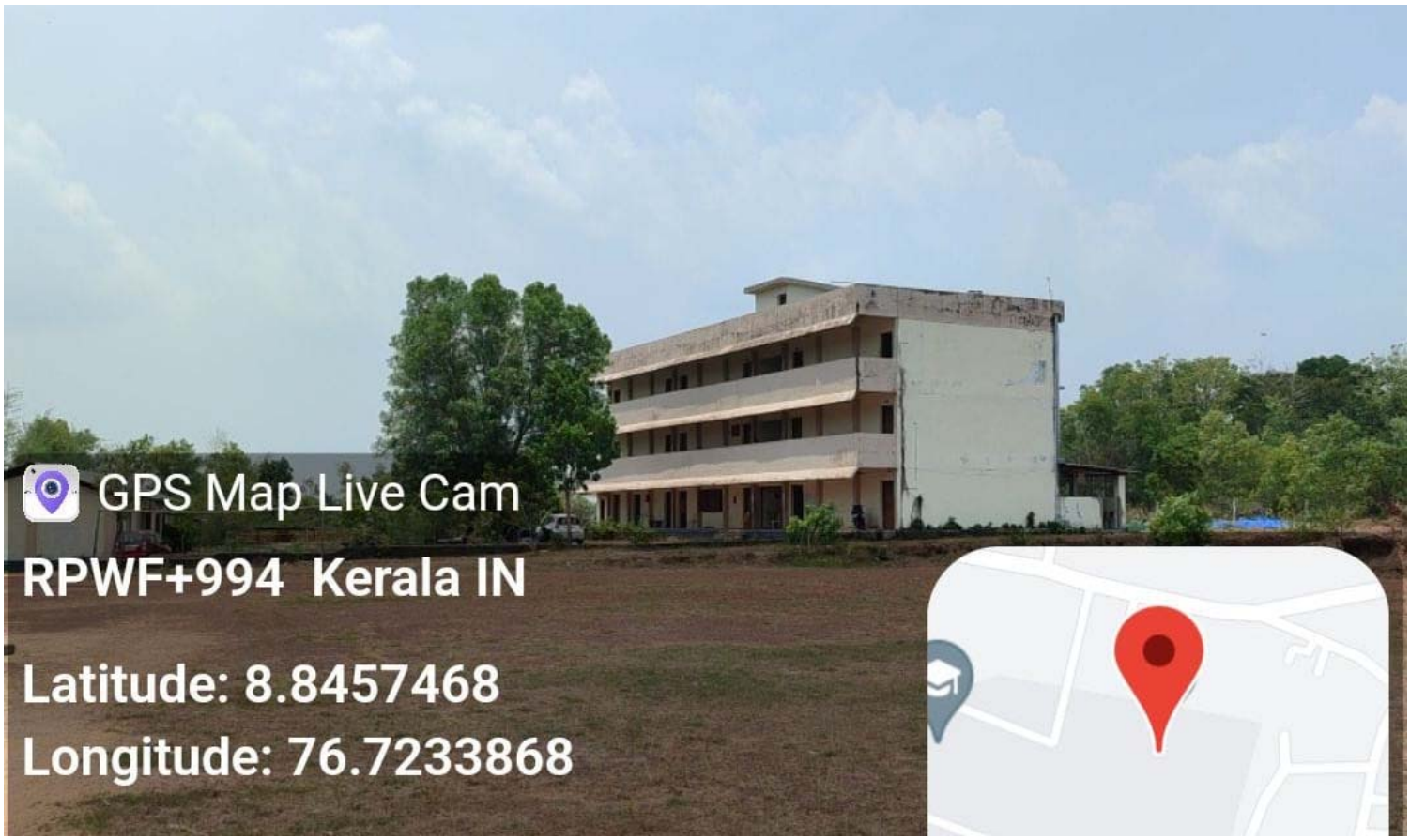
Specific CO2 Footprint

Amount of Carbon to be mitigated for Low Carbon Campus		
Sl No	Particulars	2021-22
1	Total carbon emission tCO$_2$e	18.73
2	Total carbon sequestration tCO$_2$e	1.02
3	Amount of carbon mitigated through renewable energy tCO$_2$e	2.10
4	To be mitigated tCO$_2$e	15.62
5	Total No of Students	600
6	Specific Carbon Footprint kg CO$_2$e/Student/Yr	26.03

The total specific carbon footprint is estimated as **26.03** kg of CO$_2$e per student for the year 2022-23.

4

Carbon Mitigation Plans



The total emission of the carbon dioxide per student is **26.03** 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 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’.

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						
Sree Narayana College, Chathanoor						
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 by replacing existing 95No's in-efficient ceiling fans with Energy Efficient Five star fans/BLDC Fans	3344	3.34	10	2.74	27.42
Total		**3344**	**3**	**30**	**2.74**	**27**

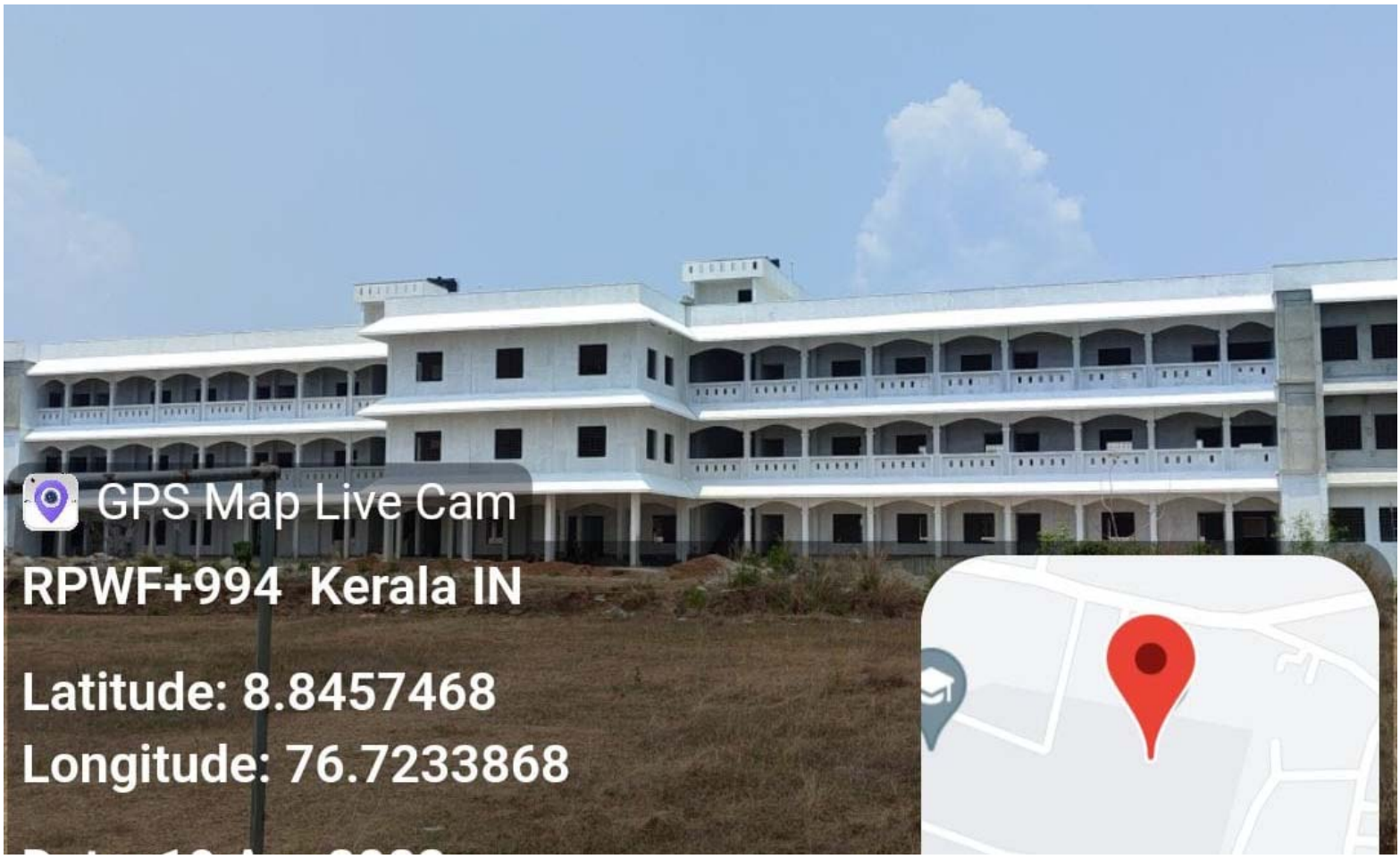
OTTOTRACTIONS- ENERGY AUDIT						
Sree Narayana College, Chathanoor						
Greenhouse Gas Mitigation through Renewable Energy Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Installation of 15 kWp Solar Power Plant	19163	19.16	25	15.71	392.83
	Total	19163	19	25	16	393

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code 3	
Energy Saving by replacing existing 95No's in-efficient ceiling fans with Energy Efficient Five star fans/BLDC Fans	
Existing Scenario	
There are 95 numbers of ceiling fans installed in the facilty 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 55% with higher service value (air delivery/watt). The operating factor is taken as 50%	
Financial Analysis	
Annual working hours (hrs)	1760
Total numbers of ordinary fans	95
Total load (kW)	7.60
Annual Energy Consumption (kWh)	5350
Expected Annual Energy saving, for total replacement(kWh)	3344
Cost of Power (Rs)	8.30
Annual saving in Lakhs Rs (1st year)	0.28
Investment required for a total replacement (Lakhs Rs)[@2500 Rs per Fan with 30W at full speed]	2.38
Simple Pay Back (in Months)	102.68

Energy Saving Proposal Code 4	
Installation of 15 kWp 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 place in the roof top it will help improving RTTV (Roof Thermal Transmit Value) of the building.	
Proposed System	
It is proposed to install a 20kWp Solar Power Plant in addition to the existing one. 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)	15
Total average kWh per day expected (3.5kWh/day average)	52.50
Annual generation kWh	19163
Cost of energy generated annually Lakhs Rs	1.59
Investment required (INR lakh)(Approx)	8.25
Simple Pay Back (in Months)	62.25
Life cycle in Yrs	25
Total Saving in Life Cycle (Approx) RS lakh	39.76

Executive Summary					
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects					
Sree Narayana College, Chathanoor					
Sl No	Projects	Investment	Cost saving	SPB	Energy saved
		(Lakhs Rs)	(Lakhs Rs)/Yr	Months	kWh/Yr
1	Energy Saving by replacing existing 95No's in-efficent ceiling fans with Energy Efficient Five star fans/BLDC Fans	2.38	0.278	102.68	3344
	Total	**2.38**	**0.28**	**102.68**	**3344**
(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.)					

5
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	18.73
2	Carbon Sequestrated tCO2e/yr	1.02
3	Carbon mitigated by Renewable Energy tCO2e/yr (Installed)	2.10
3	Carbon mitigated by Renewable Energy tCO2e/yr (Proposed)	15.71
4	Carbon mitigated by Energy Efficiency (Proposed) tCO2e/yr	2.74
5	Effective Carbon footprint tCO2e/yr	-2.84
6	Total No of Students	600
7	Specific Carbon Footprint kg CO2e/Student/Yr	-4.73

From this study it was found that carbon footprint of the campus to be **-4.73** kgCO_2e/ Student/ Year in place of current footprint i.e., 26.03 kgCO_2e/ student/ Year. This will be achieved after implementing energy efficiency projects. To achieve this an investment of **10.63Lakhs Rs** is required through energy efficiency and renewable energy projects proposed. It will be around **1771 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	2.38
2	Cost of implementation in Renewable Energy Lakhs Rs	8.25
3	Total Lakhs Rs	10.63
4	Total number of students	600
5	Cost per student to make the campus carbon negative Rs/ Student	1771

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6

TECHNICAL SUPPLEMENT

Sree Narayana College, Chathanoor

SI.No	Location	Lights			Fans		IT			Others	
		T12	LEDT	LEDB	CF	WF	Printer	Projector	PC	Mixer	Fridge
1	Staffroom		2		2				1		
2	PG Maths		2		2	1	1		1		
3	Class 1		2		4						
4	BSc Maths		2		4						
5	Class 2		2		4						
6	Physics Lab		2		8						
7	Department of Chemistry		9		2	1					
8	Chemistry Lab		4		2						
9	Outdoor		2		1						
10	Chemistry Lab 2		4		2						
11	NCC office		1		1						
12	Office		2		2				1		
13	Passage		5								
14	10 Rooms		10		20						
15	Study Hall		6		8						
16	Store	1			2						
17	Kitchen		2		1					1	1
18	Dining room		6		6						
19	Office		4		5		2		2		
20	Principal		4		3		2		2		
21	Library		6		3						
22	PG		2		2	1	1		1		
23	Classroom		2	1	1						
24	Mcom		2		2						
25	MSc		1		1						

26	Mcom 2				1						
27	Computer Lab		4					1	20		
28	Room No 8		2		2						
29	Room No 9		2		2						
30	Room No 7		2		2						
TOTAL		1	94	1	95	3	6	1	28	1	1