# GREEN AUDIT REPORT

SREE NARAYANA TRAINING COLLEGE
NEDUNGANDA, VARKALA

**Sree Narayana Training College Nedunganda,**
**Varkala, Thiruvananthapuram - 695307**

VYDYUTHI™
ENERGY SERVICES

**Indira Babu Energy Ventures Pvt Ltd**
**Thiruvathira, CP III 520**
**Nalanchira P.O, Thiruvananthapuram- 695015**
**Kerala, India**

VES_0471_EE_21_REP02

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# List of Acronyms

| Acronym | Description |
|---|---|
| BEE | Bureau of Energy Efficiency |
| CO2 | Carbon Dioxide |
| dB | Decibel |
| HCHO | Formaldehyde |
| ICC | International Chambers of Commerce |
| NAAC | National Assessment and Accreditation Council |
| SN College | Sree Narayana College |
| OC | Organic Carbon |
| pH | Potential of Hydrogen |
| PM | Particulate Matter |
| SDG | Sustainable Development Goals |
| TVOC | Total volatile organic compounds |
| UN | United Nations |
| VES | Vydyuthi Energy Services |
| WHO | World Health Organization |

# 1. ACKNOWLEDGEMENT

The world stands on the brink of an environmental crisis, the magnitude of which is unfathomable. We are living in that part of the history where entire human race has to come together and put in maximum efforts to rejuvenate the nature and safeguard our mother earth. Green auditing is one of the first steps for the same analyzing the current practices and bring in suitable improvements to perform in most sustainable way. We acknowledge and appreciate the responsibility taken and social commitment by Sree Narayana Training College Nedunganda, Varkala to initiate this green audit for the campus.

We, hereby express sincere thanks and gratitude to Smt. Dr. Sheeba P, Principal, Sree Narayan Training College Nedunganda, Varkala, Smt. Dr. Sangeetha. N.R. Coordinator,IQAC, and Smt. Dr. Viji. V, Assistant Professor for the initiative taken to conduct this audit and entrust Vydyuthi Energy Services for the said purpose. We thankfully acknowledge the whole hearted support extended for the entire audit process. Also, sincere thanks to and Smt. Dr. Dhanya B Chandran, Assistant Professor for their co-operation and the needful assistance, extended to us, during the conduct of the audit.

The Audit, data collection, data analysis and reporting were carried out by the following qualified and experienced energy auditors/professionals of Vydyuthi Energy Services.

1. Er. Akhil Dev D J, Energy & Market Analyst
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## 2. DISCLAIMER

Vydyuthi Energy Services audit team has developed this report for Sree Narayana Training College, Nedunganda, Thiruvananthapuram based on the input data provided by the representatives of the institute with the best and careful judgement capacity of our expert team. The conclusions arrived are following the best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by the Audit team in this report or for any direct or consequential loss arising from any use of the information, statements, or forecasts in this report.

If you wish to distribute the copies of this report to any external organisations, then all pages must be included.

Vydyuthi Energy Services, its staff and agents shall keep all information as confidential with pertaining to the institute and shall not disclose any such information to any third party, except that in public domain or required by law or relevant accreditation bodies.

Data storage or the validity of the collected data on our digital archives from the institute maybe maintained for a period of 6 months and shall be deleted thereafter.

Report verified and approved by:

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Independent Energy and Carbon Consultant
Advisory Board Member - CINEA - European Climate, Infrastructure and Environment Executive Agency

# 3. EXECUTIVE SUMMARY

Through green audit, a systematic analysis, quantification and reporting of environmental parameters of an establishment is carried out by qualified professionals. As we are globally facing environmental crisis created due to urbanization and industrialization, it is necessary that every organization and individual understands the need for sustainable and eco-friendly living. In this context, green auditing and environmental audit has become a necessary criteria for academic institutions as per the grading system of National Assessment and Accreditation Council, New Delhi (NAAC). Moreover educational organisations have the moral responsibility of promoting and practicing sustainable development measures and help in reducing environmental impact and its consequences.

Even though there are no set standards for educational institutions to carry out green audit, experts from Vydyuthi Energy Services (VES) would help the institute in improvising the existing environmental and resource management criteria which are education for sustainability, climate action and biodiversity through building a process framework for establishing short, medium and long-term targets to be achieved in a long run. . This environmental audit is carried out for Sree Narayana Training College, Nedunganda, Thiruvananthapuram campus during December 2021. The entire college campus has been audited to evaluate the environmental conditions and practices. The audit is carried out by qualified professionals and consultants with the support of Sree Narayana Training College, Nedunganda management and technical staffs. The audit process, analysis and reporting has been prepared based on the criteria mentioned above with important sections of various national and international standards, general guidelines, best practices and requirements for NAAC accreditation.

# 4. ABOUT VYDYUTHI ENERGY SERVICES

Vydyuthi Energy Services (VES) under Indira Babu Energy Ventures Pvt. Ltd, located in Kerala, India with services focused on energy sector. VES helps businesses and organizations across sectors to identify energy efficiency drivers and enable them to adopt viable action plans.

VES works with the vision of supporting the economy in achieving the Sustainable Development Goals (SDG) target by 2030. The important focus of the activities are to Enhance awareness, acceptability and applicability of energy efficiency and renewable energy technologies and provide energy services to build a sustainable future for generations to come. Other than energy auditing, VES offers consulting, training, project management services and R&D in the below areas for businesses in India and abroad

- Energy Efficiency
- Renewable Energy
- Power Quality assessment
- E-Mobility
- Carbon Accounting
- Climate action

Vydyuthi Energy Services is:

- Empanelled as Energy Auditing Firm under Energy Management Centre Government of Kerala
- Recognised as signatory under UN Women empowerment Program
- Partner of confederation of Indian Industries for training and consultancy in sustainability projects
- Recognised as startup under Ministry of commerce and industries, Govt of India

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# 5. CONTEXT

Green audit aims at analysing the environmental and resource management policies and practices within the organisation and the campus which has significant impact on eco-friendly functioning. Green audit is a process of systematic identification, quantification, recording, analysing and reporting of various environmental parameters. As education institutions it is the responsibility of the organisation to promote green campus thereby help in sustainable development climate action environmental protection and impart awareness to the upcoming generation.

Green audit provides and insight how the organisation is utilising managing and wasting various resources and understand the methods of improvement. The conservation of resources ultimately helps is reduction of carbon emission and help in bringing about a carbon neutral ecosystem and fighting climate change

The term ‘Environmental audit’ or ‘Green audit’ means differently to different people. Terms like ‘assessment’, ‘survey’ and ‘review’ are also used to describe similar activities. Furthermore, some organizations/Institutions believe that an ‘environmental audit’ addresses only environmental matters, whereas others use the term to mean an audit of health, safety and environment-related matters. Although there is no universal definition of Green Audit, many leading companies/institutions follow the basic philosophy and approach summarized by the broad definition adopted by the International Chambers of Commerce (ICC) in its publication of Environmental Auditing (1989).

The major aspects covered in this green audit are:

- Overall features of the campus
- Present practices with respect to resource usage and conservation supporting green campus
- Over view of carbon emission sources and carbon sequestration
- Pros and cons of present situations and suitable recommendation

# 6. INSTITUTION CAMPUS

## 6.1. Overview

Sree Narayana Training College, Nedunganda is a pioneer educational institution in the field of Teacher Education. The college was established six decades ago in 1958 by Sri. R. Sankar in the name of the Great Visionary Spirit Sree Narayana Guru. The College is located at Nedunganda, a beautiful place near Varkala. The location is known for its serenity and calmness. The locality is hallmarked by the frequent presence of Sree Narayana Guru and Mahakavi Kumaranasan physically once and spiritually forever. The College is a well-established Teacher Education Institution contributing to the Society and Nation. It is affiliated to the University of Kerala and accredited by NAAC.

Sree Narayana Training College, Nedunganda campus is functioning in Thiruvananthapuram district of Kerala and is in a well-connected and accessible location.

*Image 1: Sree Narayana Training College, Nedunganda, Thiruvananthapuram*

## 6.2. Location

The Sree Narayana Training College campus is located at Nedunganda in Thiruvananthapuram, capital city of Kerala as shown in the below image. The elevation is 75 m (246.06 ft) and is located close to Arabian Sea at approximately 3 km. Hence the weather and topographical features are influenced by the same.

*Table 1: Basic Details of the campus*

| | |
|---|---|
| Location | Sree Narayana Training College, Thiruvananthapuram – 695587, Kerala, South India |
| Co-ordinates | 8.697 E, 76.738 N |
| Total area | 1.46 Acres |
| Access | Easy road access |
| Nearest major Railway station | Varkala Sivagiri |
| Nearest Airport | Trivandrum International Airport |

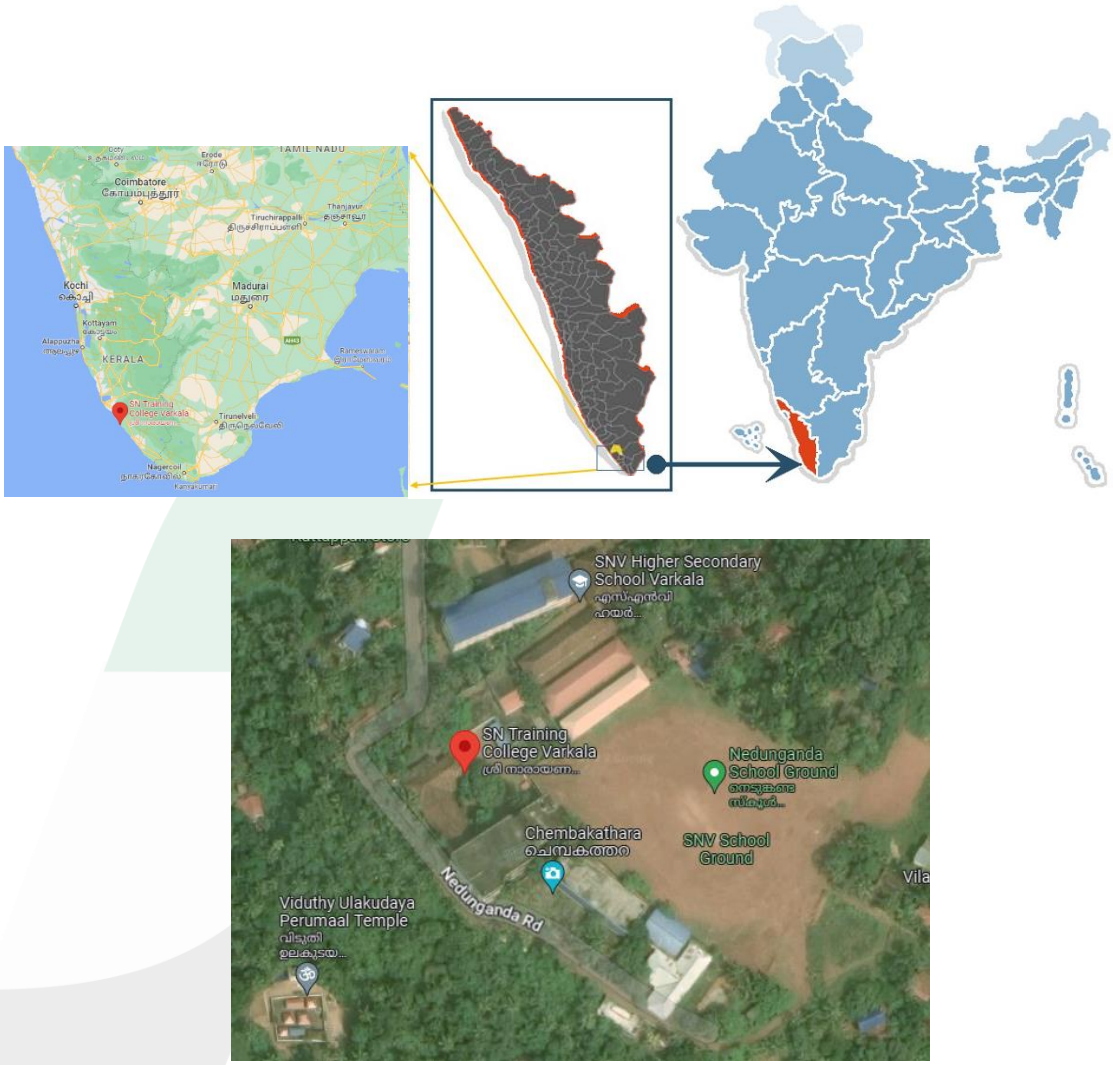



*Image 2: Satellite view of Sree Narayana Training College, Nedunganda main campus block*

## 6.3. Buildings and departments

Sree Narayana Training College, Nedunganda campus is designed for easy accessibility and movement of students, faculty members and other staffs from one department to another. Out of the 1.46 acres of total campus area, a built-in area is of 2589.51 Square meter which mainly consists of the following buildings:

- Main Block
- Office Block
- Golden Jubilee Block(UGC)

The campus has tarred roads and ways for vehicle and people access. The remaining area consists of natural flora and fauna along with preserved plants and lawns.

*Image 3: Various buildings in Sree Narayana Training College, Nedunganda*

The campus has below mentioned major departments with well-equipped facilities to carry out quality education according to the department specialties

| | | |
|---|---|---|
| Malayalam | Physics | Sociology |
| English | Chemistry | Mathematics |
| Hindi | Botany | Statistics |
| History | Zoology | Psychology |
| Political Science | Geology | Physical Education |
| Economics | Commerce | |

PROGRAMMES OFFERED BY THE COLLEGE AND NUMBER OF STUDENTS

| No. | Programme | 1st year | 2nd year |
|---|---|---|---|
| 1 | B .Ed. English | 22 | 24 |
| 2 | B .Ed. Malayalam | 13 | 12 |
| 3 | B .Ed. Mathematics | 13 | 11 |
| 4 | B .Ed. Physical Science | 15 | 17 |
| 5 | B .Ed. Social Science | 19 | 16 |
| 6 | B .Ed. Natural Science | 18 | 17 |
| | GRAND TOTAL | 100 | 97 |

## 6.4. College building

The college building is located near the admin block with proper tarred road access. It is a multi-storage building with G +2 floors. The ground floor has reception, labs, and officer's room for principal and vice principal. There is one fish tank located in front of the office block. The first and second floors have classrooms, labs, staff rooms and seminar halls. Proper ventilation and natural lighting is available.

*Image 4: College Building*

## 6.5. Human Resource

College has experienced team of highly qualified, motivated and dedicated staff supported by infrastructural facilities is imparting meaningful and disciplined education to students. The faculties support and promote excellence by focusing on student experience, quality teaching.

The staff details of college are as below:

*Table 2: Staff details*

| | No. of Teachers | No. Non-teaching staff |
|---|---|---|
| Gents | 5 | 4 |
| Ladies | 11 | 1 |
| Total | 16 | 5 |

# 7. SCOPE OF GREEN AUDIT

Green Audit is carried out to upgrade the resource management practices and environment condition in and around the institutes, colleges, companies and other organizations. It is carried out with the aid of performing tasks like waste management, energy saving and thereby to turn into a better environmental friendly institute. The details of scopes covered under the audit are as shown below

| | |
|---|---|
| Institute Policy on Environment | •Mapping institute policy on the environment and governance mechanism |
| Carbon Footprint | •Measuring initiatives implemented for reducing power requirements, promoting cycling, no vehicle days, public transport in premises |
| Water Management | •Measures adopted for water conservation, recycling and harvesting |
| Waste Management | •Measures and methodologies adopted for E waste, plastic, hazardous, food and garden wate management in premises |
| Biodiversity Conservation | •Area covered under plantation, biodiversity gardens, floral and faunal diversity, estimation of carbon sequestration by trees |
| Awareness on Environment | •Awareness and engagement on environment management in premises with students and staff |

After detailed survey and analysis it is found that the organisation qualifies satisfactorily for the aspects covered under green audit. The carbon emission by various sources and possibilities of carbon sequestration are studied in detail. The campus attempts to reduce the carbon footprint as much as possible through resource conservation measures, preservation of vegetation and use of clean energy solutions. However, recommendations for improvement and long-term action plan for maintaining green campus based on the audit results are provided further details of the environmental parameters can be found in environmental audit report in support of this green audit report

# 8. INTRODUCTION TO GREEN AUDIT

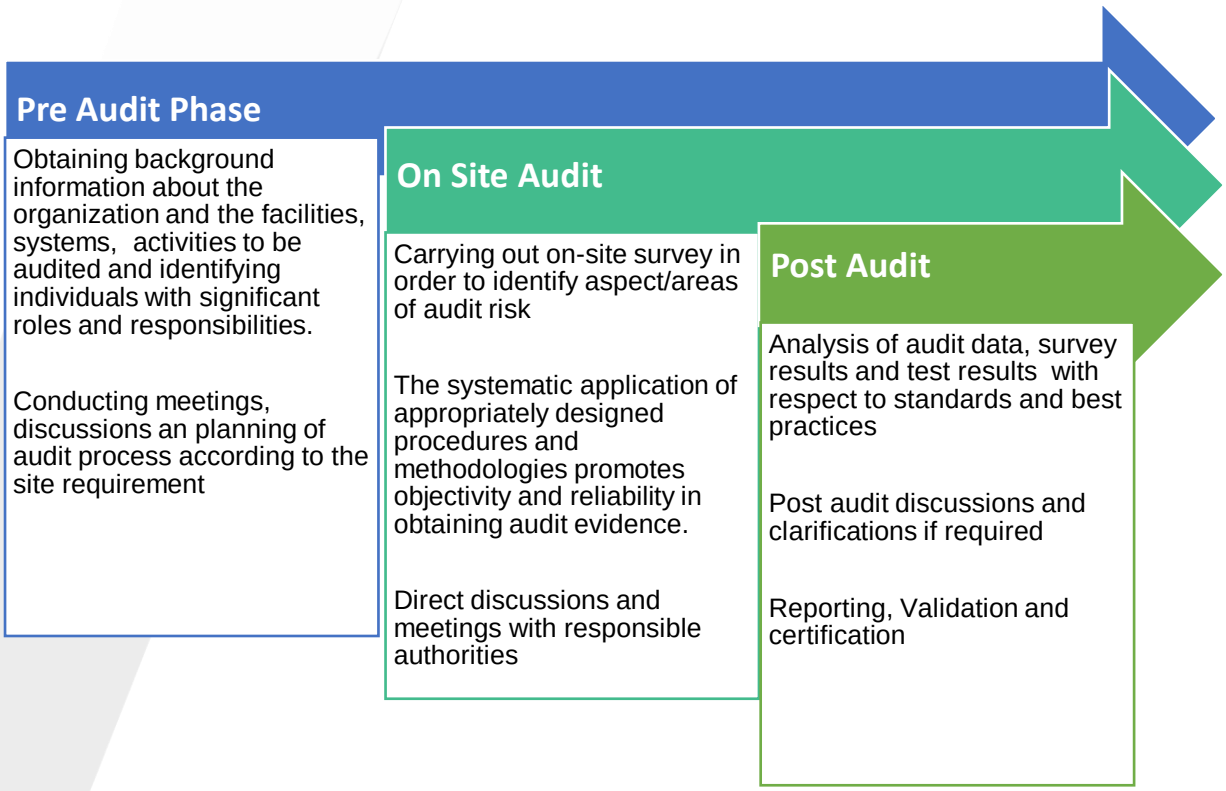
## 8.1. Benefits of Green Audit for an Educational Institution

The objective of carrying out Green Audit is securing the environment and cut down the threats posed to human health. To make sure that rules and regulations are taken care of , to avoid the interruptions in environment that are more difficult to handle and their correction requires high cost and to suggest the best protocols for adding to sustainable development.

The major benefits of green audit are:

- Recognize the initiative taken by organization towards environment and resources
- Secure the environment and minimize threats human health
- Provide baseline information to enable organization to evaluate and manage environmental change, threat and risk
- Assess environmental performance and the effectiveness of the measures to achieve the defined objectives and targets
- Ensure that the natural resources are utilized properly as per national policy of environment
- Establish the parameters for maintaining health and welfare of the community of the organization

## 8.2. Methodology



# 9. ENVIRONMENTAL PARAMETERS

All the major environmental parameters of the campus and buildings under audit are covered in detail in environmental audit report VES_0471_EE_21_REP02. Below are the highlights of the environmental audit in support of this green audit.

Topography and climate

The campus is located at 246.06 feet from sea level and experiences tropical climate in general. The campus facilities and buildings are constructed so as to suit the climatic conditions.

Flora and Fauna

The campus has a wide variety of plants and trees comprising of both naturally grown and preserved gardens. A detailed study of the type of plants, their dimensions and carbon sequestration are conducted and reported.

Air quality

Air quality of both indoor and outdoor location in the campus are analysed using air quality analyser for HCHO, TVOC and PM2.5/10 components. It is found that the air is fresh with minimal amount of pollutants and appropriate for health and wellbeing of the occupants

Soil Analysis

Soil analysis provides an overview of natural habitat environmental practices waste management health effects and need for improvement. The lab test conducted for soil from the campus shows satisfactory results for PH salinity organic carbon, phosphorus and potassium content

Sound level

The sound level at various locations are studied using sound level meter as sound pollution has direct effect on mental health physical discomfort loss of productivity and hearing problems the results are found to be in safe limits

Overall performance and environmental policies

The recommendations for improvement of environmental parameters and eco-friendly operation is provided in the environmental audit report and the organization is taking necessary steps to comply with the same. This will help the organization to perform in alignment with environmental standards and practices on a long term basis.

# 10. WATER MANAGEMENT

The scope of this section is to identify the types of water sources, the current practices in water usage and measures taken for conservation of water. The audit investigates the relevant method that can be adopted and implemented to balance the demand and supply of water.

## 10.1. Water sources and supply

The campus has sufficient fresh water supply to meet the needs of the occupants, employees and students. The details of sources, water pumping and storage mechanism are as shown in the below table. This is common water supply mechanism for all the buildings in the campus. As the water source and supply mechanism is in-house and managed by organisation staff, the campus and buildings does not experience water shortage issues. However the details of usage pattern are surveyed to identify the possibilities of saving and reuse.

*Table 3: Fresh water sources and supply in campus*

| | |
|---|---|
| Sources of fresh water in campus | Conventional well, Borewell, Rainwater harvesting and public water supply system |
| No. of wells in campus | 1 |
| Water pumping system | Well - 1 nos., Borewell- 1 nos |
| Capacity of water pumping motors | 5 HP: College borewell, |
| Approximate depth of well | College borewell : 20 ft |
| No. of water tanks in the campus | 1 water tanks of 5000 ltr capacity; 2 of 1000 ltr capacity; 1 of 1000 ltr capacity and 1 of 500ltr |
| Capacity of water tank (in Litres) | 9,500 |
| Quantity of water stored in your overhead water tank (in litres) | 8,500 |
| Quantity of water pumped every day (in litres) | 1000 |

*Image 5: Open well*

## 10.2. Water Usage pattern

The details of water usage in the building under audit is surveyed and analysed as below. In order to analyse the water usage of the entire campus a detailed survey is required as the water usage within campus is highly dependent on the departmental activities type of students, faculty members, lab activities.

The SN Training college, Nedunganda building has 197 occupants including students teachers and non-teaching staff out of which 184 are ladies and 13 are gents. The total number of toilets, urinals, water taps and wash basins in the building are as shown in the table below. An average water usage of approximately 3 to 4 litres per person is assumed during office hours including drinking water and other requirements. This accounts to almost 1000 litres of water usage per day for college building

*Table 4: Details of water usage in college building*

| College | |
|---|---|
| Total Number of toilets (college, staffroom) | 8 |
| Total Number of toilet flush's | 25 |
| Total Number bathroom faucet | 8 |
| Total Number of waterless urinals | - |
| Total Number of water taps | 58 |
| Total Number of wash basins | 10 |
| Amount of water used per day (in litres) | 1,000 litres |

There are no leaking taps in college buildings however awareness of the staffs and students with respect to water conservation is the most important factor to be taken care in case of college.

## 10.3. Recycling and Reuse

Recycling of used water is the most effective way to conserve water and help in sustainable development. The reused water can be used for Irrigation of garden and agriculture, Indoor uses such as toilet flushing, dust control or surface cleaning of roads, construction sites, and other trafficked areas, concrete mixing and other construction processes and Environmental restoration.

The waste is also used for gardening purpose. The garden is watered once per day. Approximate 100 litres of water usage is assumed per day for gardening. However for better conservation drip irrigation system is recommended. Rain water is harvested in to rain water harvesting RCC (reinforced cement concrete) tank of capacity 50,000Ltrs.

*Image 6: Rainwater harvesting tank*

## 10.4. Effective measures for water conservation

As a result of survey, it is found that the organization is taking care to conserve water and reduce water wastage, even though the requirement for water is high due to the nature of the organization

- It is found that there are no leaking taps in the buildings under study
- It is found that there is leakage in concrete water tank in front of main building
- There are no fountains in the campus
- Rainwater is harvested into the tank within the campus
- Awareness signboards about water conservation are not displayed

However, In addition to the current practices, below are the major recommendations to promote water conservation and support in maintaining green campus and sustainable development

- Periodic inspection and maintenance of toilets, other taps and water supply for leaks
- Protection of Water from Pollution
- Redistribution of Water
- Renovation of Traditional Water Sources
- Use of drip irrigation system and other modern Irrigation Methods
- Warning and reminder signs to save water and use effectively
- Watering the garden according to requirement as per temperature and rain pattern
- Deep-soak lawns to avoid frequent watering
- Optimised planning for washing of clothes and vessels in hostels
- Install water-saving shower heads or flow restrictors
- Plant more drought-resistant trees and plants
- Provide a layer of mulch around trees and plants.
- Reused water can be used for gardening purpose.
- Awareness session to students and other occupants regarding water conservation:
    - Dumping wastes/ plastic bottle in your toilet tank
    - Take shorter showers
    - Turn off taps when not in use
    - Educate canteen staff about optimised method of washing vegetables and cleaning vessels

## 11. WASTE MANAGEMENT

With the growing population of the world the amount of waste is also increasing exponentially, and the problem of waste management is posing serious threat to the ecosystem. Dumping of wastes especially non-bio-degradable ways into natural water sources and ocean are putting the life of not only human beings but also all the animal species on land and in water. Consumption of goods creating minimum damage to the environment is the most important factor to be considered in achieving sustainable development. In this section, the type of waste generated in various buildings and waste clearance measures associated to hazardous wastes and recycling are reviewed. This is a very important step of the audit which has direct impact on the environmental protection, carbon footprint.

## 11.1. Sources and types of wastes

As the campus constitutes of college buildings, hostel buildings and office buildings large amount of various varieties of wastes are generated. Compared to the whole campus, the wastes generated by building under audit are comparatively less, however the general types of wastes include the below major types. The toxic, non-toxic, bio-degradable and non-bio degradable wastes are segregated at the wastes sources

- Food wastes from students and staffs
- Paper and other bio- degradable material wastes from offices
- Non- bio- degradable material wastes from offices
- Random wastes generated by public/students/staffs and other occupants

## 11.2. Waste disposal methods

The wastes from the campus are segregated and handled separately as below, which also includes the wastes from the building under audit

1. Food waste and other biodegradable wastes are segregated.
2. Reusable wastewater with no toxic substances are used for watering garden areas in the campus
3. Other solid non-toxic wastes are sold to scrap dealers like Harita Karma Sena, local scrap collectors etc.

*Image 7: Waste bin*

## 11.3. Methods for better waste management

Even though the waste from the campus is taken away by responsible authorities, it is the responsibility of the organization to reduce the generation of waste as much as possible which will help the organization to excel both in economic and environmental aspects. Below are some of the recommendations for better ways management with in the campus

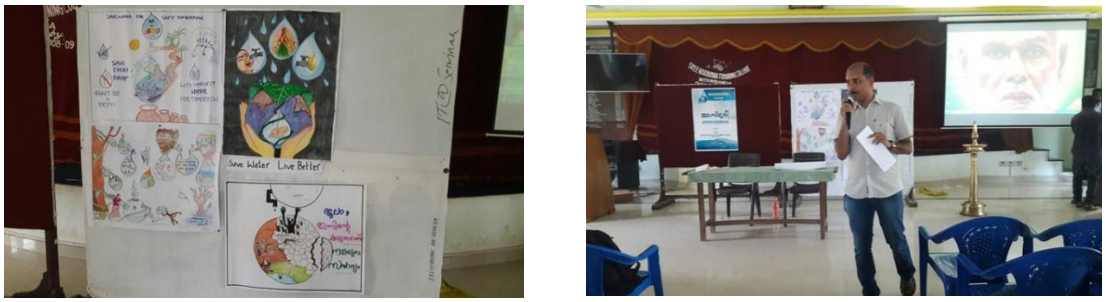
| | |
|---|---|
| **Recycle and Reuse** | • Practice use of recycleable and sustainable materials and creative ways to reuse various goods |
| **Biological Reprocessing** | • Applicable for bio degradable wastes, where Biological reprocessing helps to speed up the decomposition of organic matter. The methane that comes as a gaseous waste can be used for producing heat and electricity. |
| **Composting** | • Natural process that breaks down organic waste and turns it into rich manure that can be used to improve the quality of the soil in garden and agricultural areas |
| **Bioremediation** | • Conversion of hazardous wastes to non-toxic products using natural degradation process. It is an ecofriendly and cost effective way even thoughit is a time taking process |
| **Sanitary Landfill** | • Scientific methods for utilising wastes for landfilling generally with layers of different levelling, with the bottom having the smallest volume which gets bigger as you move towards the top |
| **Thermal treatment** | • Coversion of waste materials in to gas, ash and heat, where the mass of waste can be reduced up to 95%. Appropriate measure to be taken to manage exhaust without affecting the environment |
| **Waste to Energy Process** | • Method of generating heat or electricity from waste materials. This is the most ecofriendly method which helps to reduce use of fossil fuels |


*World Environment Day - Haritholsavam- 2018*


*World Environment Day Haritholsavam 2018- Valedictory*


*World Environment Day 2019*


*Awareness against Plastic Pollution*




*JALASMRITHI 2019*

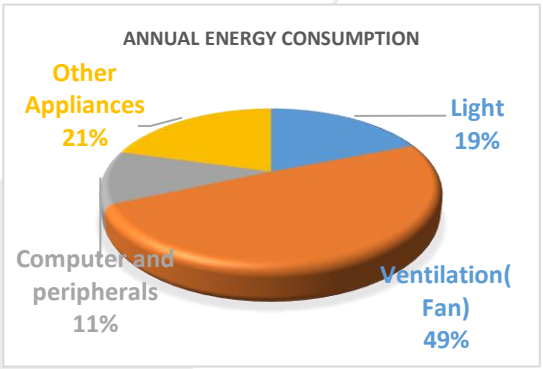
*Image 8: Activities*

# 12. ENERGY MANAGEMENT

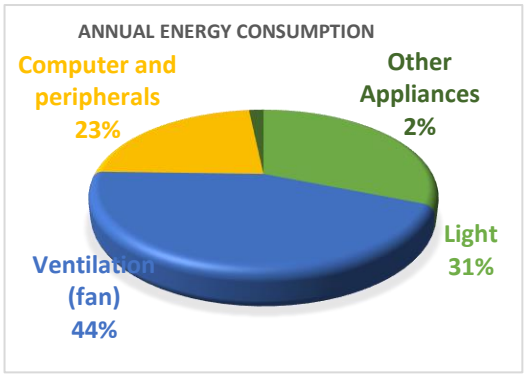
Out of the operation expense of any organization, one of the major factor is energy usage in various forms. Every unit of electricity consumed by the organization is associated quit monetary value and also environmental impact. Electrical energy consumption is one of the major source of carbon emission in our ecosystem which basically represents the emission caused during the generation of electricity at the power plants. Hence energy management is an important criterion in determining the eco-friendly functioning of the organization. Energy Audit is carried out under separate scope and presented in the report. The highlights of the reports are given in the below sub sections

## 12.1. Energy Usage

The details of energy usage by various category of loads are shown in table 6. The list of Image 8 shows the consumption break up




*Estimated Annual Energy Consumption: 3832kWh (Consumer No.: 1145254014593)*




*Estimated Annual Energy Consumption: 3692kWh (Consumer No.: 1145258017079)*

*Image 9: Energy Usage Chart*

*Table 15: Estimated Annual energy consumption-Equipment wise (Consumer No.: 1145254014593)*

| Load Description | Annual Energy Consumption in kWh | Percentage of Annual Energy Consumption |
|---|---|---|
| Light | 727 | 19% |
| Ventilation (fan) | 1892 | 49% |
| Computer and peripherals | 422 | 11% |
| Other Appliances | 791 | 21% |
| Total | 3832 | 100% |

*Table 16: Estimated Annual energy consumption-Equipment wise (Consumer No.: 1145258017079)*

| Load Description | Annual Energy Consumption in kWh | Percentage of Annual Energy Consumption |
|---|---|---|
| Light | 1149 | 31% |
| Ventilation (fan) | 1637 | 44% |
| Computer and peripherals | 845 | 23% |
| Other Appliances | 61 | 2% |
| Total | 3692 | 100% |

## 12.2. Clean Energy solution in use

A solar plant of capacity 5kWp is installed at the roof tops of college main block. On sunny days the existing solar PV system generates approximately 20 units of electricity and on cloudy days approximately 12 units. An annual generation of approximately 1460 units is expected by the plant in the present climatic conditions of the location.

*Image 10: Solar roof top at the college premises*

## 12.3. Energy Audit summary and recommendations

An energy audit is conducted in the campus by certified energy auditor and energy managers based on the standards defined by Bureau of energy efficiency and guidelines from Energy Management Centre, Department of Power Government of Kerala. The details of the analysis are presented in energy audit report which includes the present pattern of energy usage and opportunities of improvement.

For more details, refer Energy Audit Report

In addition to recommendations for retrofitting, immediate energy savings, can be achieved from the effective usage of lights and Fans. The following activities, having no/low investment, can be adopted in these areas.

- Replace the existing Fluorescent Tube lights with LED lights.
- Replace old/ inefficient fan with BEE 5 star rated ceiling fan (BLDC)
- Switch OFF appliances, when not in use.
- Utilize BEE star labeled appliances, as far as possible.
- Avoid very old and obsolete appliances and replace with energy efficient and environment friendly appliances.
- The existing air conditioners can be replaced with inverter Air conditioners, to get better energy efficiency.
- Avoid the exposure of Air conditioner's outdoor units, to sunlight.
- Avoid air leakage in Air conditioned rooms.
- Keep the computers in sleep/shut down mode, when not in use. (i.e., during lunch time)
- Regular cleaning of glass panes of Windows, light fixtures, and appliances, to get maximum output.
- Utilize the natural lights and wind, as far as possible, to reduce energy consumption.
- Create awareness among the employees about the importance and practice of energy conservation.

# 13. CARBON FOOTPRINT

Climate change is disrupting the economies and lives of people in every country in every continent. In recent years, Kerala has seen the worst changing weather patterns, rising sea levels and greenhouse gas emissions are now at the highest levels in history. Wildfires, floods and temperature rises have become a threat to the state of Kerala. Collective action is imperative to maintain the maximum temperature less than 35°C and the minimum temperature to range between 23°C and 24°C in Kerala, according to the recent data from the Indian Meteorological Department (IMD).As per secretary General of United nations, Global institutions continues to show that going beyond a 1.5 °C increase in average surface temperature will lead us to catastrophic disaster and extreme weather events. The United Nations warned that unless global greenhouse gas emissions fall by 7.6 per cent each year between 2020 and 2030, the world will not put itself on track towards the sustainable development.

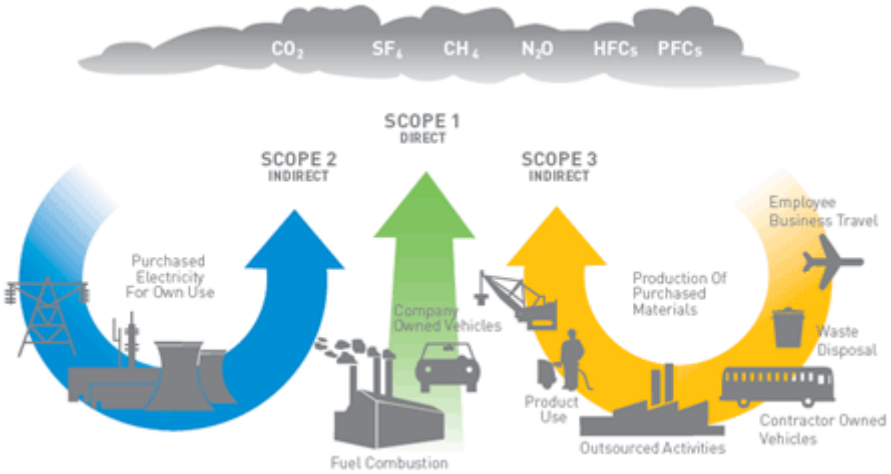
Greenhouse gases dominated by Carbon di-oxide emission is the major reason for global warming and consequent climate change and carbon accounting provides a quantification of greenhouse gas emitted by the organization. This is one of the most important step of green audit determining the green index of the organization and finding ways to achieve carbon neutrality. Carbon neutrality is achieved by calculating a carbon footprint and reducing it to zero through a combination of efficiency measures in-house and supporting external emission reduction projects. The total possible emission is identified and compared with the carbon sequestration to evaluate the green index of campus and further measures for reducing carbon emission and achieving carbon neutrality are recommended.

## 13.1. Sources of carbon emission

In carbon accounting the major reasons of carbon emission within the organisation are identified and quantification of the weight of carbon dioxide emitted is done based on scientific calculations and standard assumptions. Below table shows the list of major carbon emission sources in the campus description.

*Table 11: Details various scopes of emission*

| Type of emission | Inclusions |
|---|---|
| SCOPE 1 | |
| Fuel Consumption | Petrol consumption in Petrol Generator set in the campus |
| Vehicles | Fuel consumed by vehicles within the campus |
| SCOPE 2 | |
| Electrical energy consumption | No. of units of electricity consumed by the campus |
| SCOPE 3 | |
| Employee travel | Fuel consumed by vehicles during travel |
| Waste disposal | Carbon equivalent of the waste materials |
| Purchased materials | Carbon equivalent of various products used |
| Outsourced activities | Electricity consumed due other activities for the campus but carried out outside the campus |




## 13.2. Analysis of emission sources in the campus

Exact calculation of the amount of carbon dioxide requires a comprehensive carbon auditing process. However, as a part of the green audit, based on available information an overall approximate analysis of carbon emission within the campus is carried out as below on annual basis.

### 13.2.1. Emission due to Diesel Generator and in-campus vehicles

This includes the direct CO2 emissions from the consumption of petrol used for running generators in the campus. The $CO_2$ emission in tons is calculated is based on the following equation

*$CO_2$ emissions due to fuel [t] = Fuel $CO_2$ emission factor [t/l] x Consumed fuel [l]*

- Fuel $CO_2$Emission factor: 74.1 t$CO_2$ / TJ of fuel energy (Ref.[1])
- Consumption data: Approximately 10 litres of Petrol/ year(2020-21)
- Approximate total $CO_2$Emission from petrol generator = 23kg of $CO_2$/year

### 13.2.2. Emission due to Energy Usage

Every unit of electricity consumption is associated with carbon emission according to the methods of power generation in the utility grid of the region. According to Indian grid standards, 0.79 kg$CO_2$ is emitted per kWh of electricity generated. The $CO_2$ emission by the energy consumed by the campus is calculated as below

*$CO_2$ emissions due to electricity consumption [t]*

*= Grid emission factor [tCO2/MWh] X Electricity imported [MWh]*

- Grid emission factor: The emission factor value for electricity consumption from grid is 0.79 kg$CO_2$/kWh according to Central Electricity Authority database.
- Consumption of the campus: Annual value according to utility bill= 5917 kWh/Year
- $CO_2$ emission by electricity consumption by the campus= 4674.43kg$CO_2$/Year

### 13.2.3. Emission by other Scope 3 sources

The analysis of emission from scope 3 sources requires a detailed survey and carbon accounting which is outside the scope of this report. However, the general analysis of types of emissions covered under this section are as below

a. Emission due to vehicle and employee travel

The emission from petrol and diesel vehicles used by staff and students are to be covered under this. The carbon emission is calculated using below formula and the emission factor is determined depending on the type of vehicle as shown in the table

*CO2 emissions due to travel [t]=Travel emission Factor [tCO2e/km] X Distance travelled [km]*

*Table 12: Emission factors for road vehicles*

| | | | |
|---|---|---|---|
| Two wheelers | 0.0000266 | tons/km | Data from India's transport sector: Statewide synthesis |
| Cars and jeeps | 0.0002236 | tons/km | |
| Taxi | 0.0002083 | tons/km | |
| Bus | 0.0005152 | tons/km | |

b. Materials goods and wastes

This section covers the carbon footprint caused by various materials used in the building as per the below formula. The emission factor for each material depends on the emission during production process

*CO2 emissions = Product emission factor [(kgCO2/kg of item) /1000] X Weight of item [kg)*

c. Food preparation

This covers the emission caused during cooking process of the food consumed and distributed in the building under study. The carbon emission is calculated using the below formula by surveying the exact quantity of food emission factor with respect to the fuels used for cooking are sourced from IPCC fuel emission data

*$CO_2$ emissions due to food [t] = Food emission factor [tCO2/kg of item] X Weight of item [kg)*

## 13.3. Carbon Sequestration

The process of removing carbon oxide from the atmosphere is known as carbon sequestration. In order to achieve net zero emissions, all worldwide greenhouse gas emissions will have to be counterbalanced by carbon sequestration. Carbon neutrality means having a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks. The naturally available carbon sinks are plants and trees. However the amount of carbon offsetted by renewable energy source in the is also studied under this section as it effectively reduces the overall emission

### 13.3.1. By plants and trees

Carbon sink is any system that absorbs more carbon than it emits. The main natural carbon sinks are soil, forests and oceans. According to estimates, natural sinks remove between 9.5 and 11 Gt of CO2 per year. The amount of carbon dioxide absorbed by the plants and trees in campus are calculated based on standard assumptions and scientific formulae as shown in the table below. A total sequestration of 162.23 kg/year.

*Table 13: Analysis of carbon sequestration*

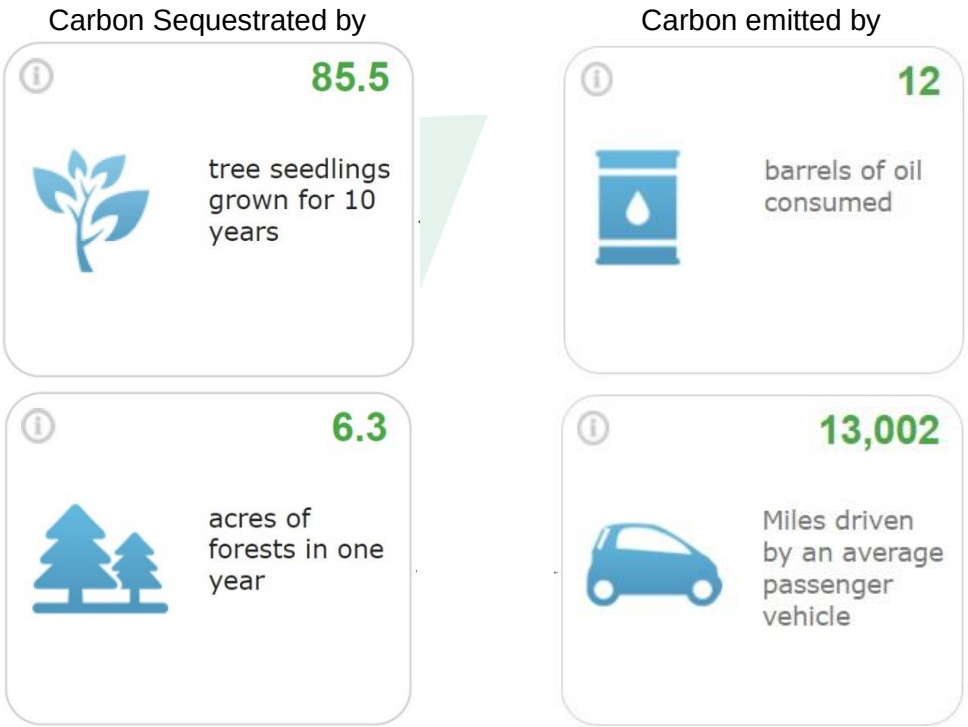
| Sl No. | Height in feet | Diameter in inches | Green weight above ground (kg) | Total Green Weight (kg) | Total Dry weight (kg) | Weight of Carbon (kg) | Weight of CO2 in kg | CO2 in kg/year |
|---|---|---|---|---|---|---|---|---|
| 1 | 16.4 | 5.02 | 61.88 | 74.25 | 53.83 | 26.92 | 44.75 | 0.90 |
| 2 | 16.4 | 5.02 | 61.88 | 74.25 | 53.83 | 26.92 | 44.75 | 0.90 |
| 3 | 29.52 | 10.03 | 445.51 | 534.62 | 387.60 | 193.80 | 322.23 | 6.44 |
| 4 | 29.52 | 10.03 | 445.51 | 534.62 | 387.60 | 193.80 | 322.23 | 6.44 |
| 5 | 26.24 | 7.52 | 222.76 | 267.31 | 193.80 | 96.90 | 161.12 | 3.22 |
| 6 | 22.96 | 7.52 | 194.91 | 233.89 | 169.57 | 84.79 | 140.98 | 2.82 |
| 7 | 22.96 | 12.54 | 541.42 | 649.71 | 471.04 | 235.52 | 391.60 | 7.83 |
| 8 | 22.96 | 11.91 | 488.63 | 586.36 | 425.11 | 212.56 | 353.42 | 7.07 |
| 9 | 22.96 | 8.78 | 265.30 | 318.36 | 230.81 | 115.40 | 191.89 | 3.84 |
| 10 | 22.96 | 9.40 | 304.55 | 365.46 | 264.96 | 132.48 | 220.28 | 4.41 |
| 11 | 16.4 | 10.03 | 247.51 | 297.01 | 215.33 | 107.67 | 179.02 | 3.58 |
| 12 | 26.24 | 20.06 | 1584.05 | 1900.86 | 1378.12 | 689.06 | 1145.72 | 22.91 |
| 13 | 29.52 | 11.91 | 628.24 | 753.89 | 546.57 | 273.29 | 454.40 | 9.09 |
| 14 | 22.96 | 9.40 | 304.55 | 365.46 | 264.96 | 132.48 | 220.28 | 4.41 |
| 15 | 26.24 | 15.05 | 891.03 | 1069.23 | 775.19 | 387.60 | 644.47 | 12.89 |
| 16 | 16.4 | 7.52 | 139.22 | 167.07 | 121.12 | 60.56 | 100.70 | 2.01 |
| 17 | 26.24 | 16.30 | 1045.72 | 1254.86 | 909.78 | 454.89 | 756.35 | 15.13 |
| 18 | 16.4 | 6.27 | 96.68 | 116.02 | 84.11 | 42.06 | 69.93 | 1.40 |
| 19 | 9.84 | 8.78 | 113.70 | 136.44 | 98.92 | 49.46 | 82.24 | 1.64 |
| 20 | 13.12 | 5.64 | 62.65 | 75.18 | 54.51 | 27.25 | 45.31 | 0.91 |
| 21 | 22.96 | 9.40 | 304.55 | 365.46 | 264.96 | 132.48 | 220.28 | 4.41 |
| 22 | 19.68 | 8.78 | 227.40 | 272.88 | 197.84 | 98.92 | 164.47 | 3.29 |
| 23 | 13.12 | 9.65 | 183.43 | 220.12 | 159.59 | 79.79 | 132.67 | 2.65 |
| 24 | 9.84 | 7.90 | 92.10 | 110.52 | 80.12 | 40.06 | 66.61 | 1.33 |
| 25 | 19.68 | 8.90 | 233.94 | 280.73 | 203.53 | 101.76 | 169.21 | 3.38 |
| 26 | 13.12 | 3.76 | 27.84 | 33.41 | 24.22 | 12.11 | 20.14 | 0.40 |
| 27 | 26.24 | 6.27 | 154.69 | 185.63 | 134.58 | 67.29 | 111.89 | 2.24 |
| 28 | 22.96 | 12.54 | 541.42 | 649.71 | 471.04 | 235.52 | 391.60 | 7.83 |
| 29 | 22.96 | 18.18 | 1138.34 | 1366.01 | 990.36 | 495.18 | 823.34 | 16.47 |
| 30 | 13.12 | 5.02 | 49.50 | 59.40 | 43.07 | 21.53 | 35.80 | 0.72 |
| 31 | 19.68 | 6.27 | 116.02 | 139.22 | 100.94 | 50.47 | 83.91 | 1.68 |
| Total | | | | | | | | 162.23 |

### 13.3.2. By Solar Power plant

As described in section 9.4, use of renewable energy sources helps in reducing the emission caused by generation energy consumed from the grid. The campus has installed solar power plant of 5 kW capacity.

On sunny days the system generates approximately 20 units of electricity and on cloudy days approximately 12 units. An annual generation of approximately 7300 units is expected to be generated by the plant in the present climatic conditions of the location. This amount of electricity if consumed from grid was supposed to generate 6.866 tonnes of Co2/Year. Using a Solar PV plant it is reduced to approximately 0.6205 tonnes of Co2/Year

This reduction is equivalent to the carbon emission by below sources as comparison




## 13.4. Recommendations for emission reduction

Optimize electrical energy usage through Energy Management Solutions

Every unit of electricity saved is a unit of electricity created. As energy sector contributes to more than 70% of world CO2 emission, energy conservation is the most effective way to reduce net emission and promote a sustainable ecosystem. Along with the recommendations in energy audit report, use of modern technology and solutions for energy efficiency improvement and optimum energy management for the overall building and energy intensive equipment's can create significant impact in emission reduction.

More utilization of green energy solutions

Use of renewable energy sources is the most effective way to reduce carbon emission and thereby help in sustainable development. As mentioned in the previous section the amount of carbon emission per unit of electricity used from the grade can be reduced by generating the same unit of electricity by renewable energy sources. The campus is already utilising 5 kilowatt of solar power system however more opportunities for renewable energy utilisation are to be explored below table shows the comparison of tons of carbon dioxide emitted in the electricity generation process using various fuels. Exploring more opportunities of renewable energy utilisation in the campus including micro wind turbines and bio gas plants will help in further emission reduction.

*Table 14: Emission details of various fuels used for energy generation*

| Fuel | Coal | Oil | Natural Gas | Solar PV | Biomass | Wind |
|---|---|---|---|---|---|---|
| Mean $CO_2$ Emission Tonnes $CO_2$/GWh | 888 | 733 | 499 | 85 | 45 | 26 |

Promotion of e-mobility an electric vehicle infrastructure

Switching to E-mobility is the need of the hour due to the rising pollution level, fuel scarcity and also fuel price. The comparison of Carbon emission caused by fossil fuel vehicles and electric vehicles shown in the below image is self-explanatory to understand the emission reduction by use of electric vehicles. Initiatives are to be taken by the organization management to promote e mobility in the campus and within the employees through suitable allowances and providing proper charging infrastructure

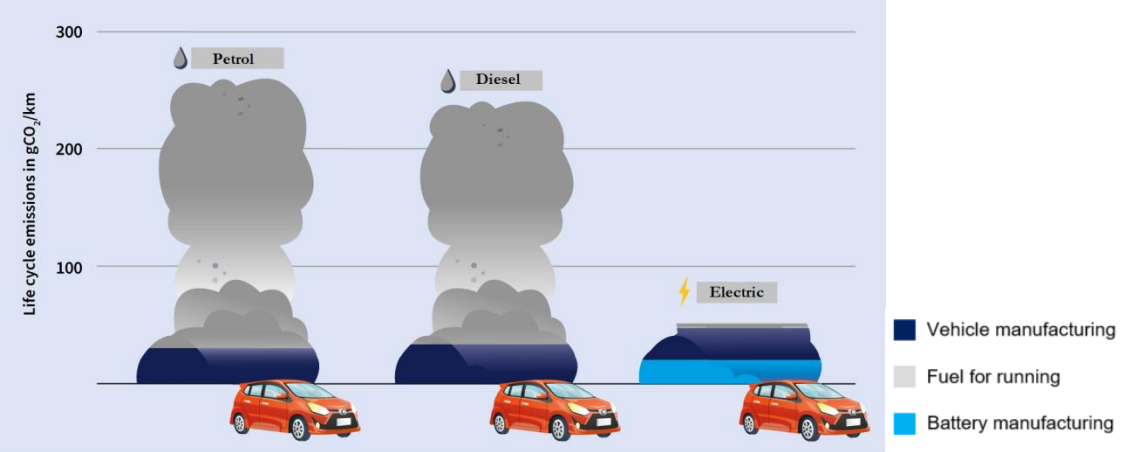



*Image 6: Emission reduction by e mobility solutions*

Assign management teams for sustainable activities

- Reduce wastage of water, paper and other resources
- Promote use of sustainable materials and reduce plastic usage
- Promote recycling and reuse of products
- Practice car-pooling/mass transportation within the employees

Educate and create awareness

The below activities will help to impart interest and awareness among the employees staff and other occupants about ways to reduce emission

- Sign boards and write ups in public locations
- Awareness sessions for staff and students
- Creative events to promote sustainable practices
- Encouraging rewards for departments or individuals for practicing efficient resource management

Carbon Offsetting

Carbon offsetting is reduction in emissions of carbon dioxide or other greenhouse gases made in order to compensate for emissions made elsewhere. Offsets are measured in tonnes of carbon dioxide-equivalent ($CO_2e$) generated by the organisation and equivalent offsets are purchased from international carbon credits system. It is a way of paying for others to reduce emissions or absorb CO2 to compensate for your own emissions where it funds solutions to reducing carbon emissions. Frequently carbon offsetting reduces emissions much faster than you can as an individual/single company. Carbon offsetting projects help to combat global climate change as well as caring for local communities. In many instances providing much needed employment, health improvement, biodiversity, reforestation and broad social benefits to impoverished communities. To carry out carbon offsetting detailed carbon accounting, reporting and credit purchasing is to be done with the help of suitable carbon consultants. This increases the value of the organization in terms of its commitment towards environmental protection.

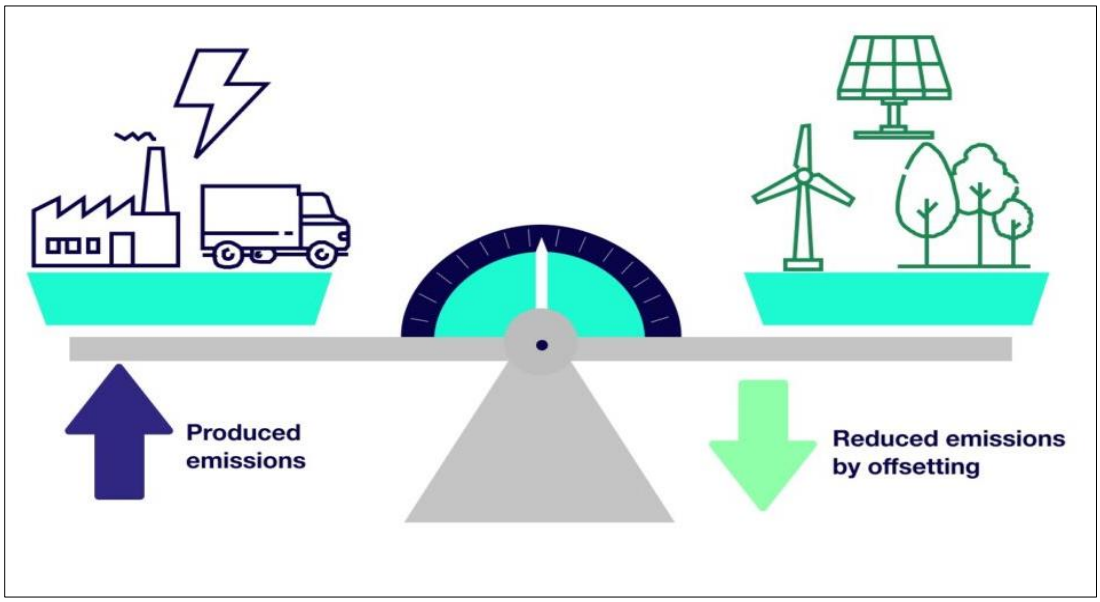



*Image 7: Concept of carbon offsetting*

## 14.COMMITMENT OF INSTITUTION TOWARDS GREEN CAMPUS

| Sl.no. | Project | Status |
|---|---|---|
| 1 | Renewable Energy | Solar power plant of 5kWp capacity has been installed on the college rooftop.<br><br>Further opportunities to be investigated. |
| 2 | Environmental protection and awareness<br><br>(Biodiversity Conservation<br>Tree plantation drives<br>Air quality<br>Sound level) | Refer points 2,3,4 and 5 in section 12 of Environmental audit report |
| 3 | Water Management | Overall water supply and management strategy is meeting the water requirement of the campus and scarcity is not experienced.<br><br>Forecast of future requirements and more scientific rainwater harvesting are areas of improvement |
| 4 | Waste Management | It is recommended to for management team to impart reduction in waste generation. For more effective strategies and in house management of wastes, methods under section 6.3 are recommended to be adapted |

| | | |
|---|---|---|
| 5 | Energy Management | Energy Audit is conducted at the campus and the analysis is presented in energy report. There is an annual energy saving potential of 3,737kWh if the recommendations are implemented. |
| 6 | Carbon Neutrality | The campus has considerable levels of carbon sequestration by implementation of renewable energy solutions and trees and plants within the campus.<br><br>Measures as described under section 9.4 will help the campus in becoming a carbon neutral campus and there by excel in overall sustainable development |
| 7 | CSR activities | The management conducts various CSR activities related to promotion of green campus like awareness on resource management strategies<br><br>No evidence has been found and recommended for inclusion in the long-term plans for improving, maintaining and monitoring the green campus parameters. |

## 15. CONCLUSIONS

This green audit involved extensive collaboration and consultation with campus team, government entities such as agriculture department, third party consulting agencies etc. to explore the wide range of issues related environmental parameters and maintaining a green campus. Sree Narayana Training College, Nedunganda and its management has been proactively involved in various environmental friendly and resource conservation solutions and its implementations. However, a defined environmental policy, continuous monitoring of various environmental parameters and achieving carbon neutrality could place the institution as a role model for others and would help the management to incubate similar policies for achieving desired results from the evaluating bodies.

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SUSTAINABLE DEVELOPMENT GOALS