



Pave the Green Way



Green Audit Report – 2021-22

PES/2021-22/15

Submitted to

Presidency University, Bangalore



M/s. Paradigm Environmental Strategies Pvt. Ltd.

#150, 2nd Main, S.T. Bed Layout,

Koramangala 4th Block, Bangalore: 560034

Email ID: info@ecoparadigm.com Mobile: +91-9448077904



This documentation, (hereinafter referred to as the "Documentation") is for your informational purposes only and is subject to change or withdrawal by ECOPARADIGM at any time. This Documentation may not be copied, transferred, reproduced, disclosed, modified, or duplicated in whole or in part, without the prior written consent of ECOPARADIGM. This Documentation is confidential and proprietary information of ECOPARADIGM and may not be disclosed by you or used for any purpose other than as may be permitted in (i) a separate agreement between you and ECOPARADIGM; or (ii) a separate confidentiality agreement between you and ECOPARADIGM.

To the extent permitted by applicable law, Ecoparadigm provides this documentation "as is" without warranty of any kind, including without limitation, any implied warranties of merchantability, fitness for a particular purpose or noninfringement. In no event will Ecoparadigm be liable to you or any third party for any loss or damage, direct or indirect, from the use of this documentation, including without limitation, lost profits, lost investment, business interruption, goodwill, or lost data, even if Ecoparadigm is expressly advised in advance of the possibility of such loss or damage.

Copyright © 2013 ECOPARADIGM. All trademarks, trade names, service marks, and logos referenced herein belong to respective companies.

All rights reserved.



Project No: PES/2021-22/15/21/PUGA

Date of submission: 27 November 2021

Internal Document Control

Sl. No.	Document Number & Date	Prep	Chk	App	Remarks
1.	PES/2021-2022/15 /21/PUGA- 211127	RN	SS	PKP	

Cover page photographs:

Mobius strip – is a surface with only one side and only one edge. It has the mathematical property of being non-orientable. It can be embedded in three-dimensional Euclidean space.

The Mobius strip stands for Constancy of Change, Unconventional, Continuity and Sustainability. It represents something simple, yet profound -- something anyone could have discussed centuries prior to its discovery but didn't – *a Paradigm shift!*



Table of Content

List of Figure

List of Tables

Abbreviation

EXECUTIVE SUMMARY	10
1 INTRODUCTION	11
2 OVERVIEW OF INSTITUTE	11
3 OBJECTIVES AND SCOPE.....	12
4 METHODOLOGY ADOPTED.....	13
5 AUDIT STAGE.....	13
6 AUDIT FINDINGS.....	14
6.1 Land use and land cover.....	14
6.1.1 Observations	14
6.2 WATER AUDIT	15
6.2.1 Observations	19
6.2.2 Suggestions and Recommendations.....	19
6.2.3 Rain Water Harvesting.....	19
6.2.4 Liquid waste management	20
6.3 WASTE DISPOSAL AUDIT.....	20
6.3.1 Status of Solid Waste Generation in the campus	21
6.3.2 E-waste.....	22
6.3.3 Hazardous Waste	23
6.3.4 Observations	23
6.3.5 Suggestions and Recommendation	23
6.4 BIODIVERSITY AUDIT	23
6.4.1 Faunal diversity.....	24
6.4.2 Floral diversity	25
6.4.3 Tree diversity and Carbon Stock in Presidency University Campus.....	29
6.4.4 Observations	30

6.4.5	Suggestions and Recommendations.....	30
6.5	ENERGY AUDIT	30
6.5.1	Suggestions and Recommendations.....	32
6.6	Roof Top Solar Photovoltaic.....	33
7	CARBON FOOTPRINT CALCULATION	33
7.1	Scope	33
7.2	Methodology for estimation of Carbon Footprint	34
7.3	Emissions Analysis	34
7.4	Results and Analysis	37
7.5	Carbon Offsetting and Carbon credits.....	38
7.5.1	Forestry and conservation.....	38
7.5.2	Renewable energy	39
8	SUMMARY AND CONCLUSIONS	39

List of Figures

<i>Figure 1 : Presidency University</i>	12
<i>Figure 2: Map of Presidency University</i>	14
<i>Figure 3: Waste storage at PU</i>	22
<i>Figure 4: Land cover at PU</i>	29
<i>Figure 5: Lawn at PU</i>	29
<i>Figure 6: Energy consumption during the period 2020-2021</i>	31
<i>Figure 7: Energy expenditure during the period 2020-2021</i>	32
<i>Figure 8: Total CO2 emissions</i>	37
<i>Figure 12: Total CO2e emissions</i>	38

List of Tables

<i>Table 1: Students Strength during the Academic year 2020-21</i>	12
<i>Table 2: Borewell details</i>	15
<i>Table 3: Bore well details- water pumped</i>	15
<i>Table 4: Reported water usage and related data</i>	18
<i>Table 5: Waste data and composition</i>	21
<i>Table 6: Faunal diversity</i>	24
<i>Table 7: Tree diversity at PU</i>	25
<i>Table 8: Floral diversity</i>	27
<i>Table 9: Lawn cover area</i>	28
<i>Table 10: Energy audit questionnaire</i>	30
<i>Table 11: Details of Electricity Consumption</i>	32
<i>Table 12: Scope 1 emissions</i>	34
<i>Table 13: Scope 2 emissions</i>	35
<i>Table 14: Scope 3 emissions</i>	36
<i>Table 15: Total emissions from Presidency University</i>	36
<i>Table 13: Overall emission from PU</i>	37
<i>Table 14: Carbon offsetting by Solar energy</i>	39

Abbreviation

EMS	ENVIRONMENT MANAGEMENT SYSTEMS
UGC	UNIVERSITY GRANTS COMMISSION
UG	UNDERGRADUATE
PG	POSTGRADUATE
Ph. D	DOCTOR OF PHILOSOPHY
PU	PRESIDENCY UNIVERSITY
LULC	LAND USE AND LAND COVER
AC	AIR CONDITION
LPCD	LITERS PER CAPITA PER DAY
KL	KILO LITER
NBC	NATIONAL BROADCASTING COMPANY
STP	SEWAGE TRATMENT PLANT
BESCOM	BENGALORE ELECTRICITY SUPPLY COMPANY LIMITED
KVA	KILO VATT AMPERE
NPK	NITROGEN PHOSPHORUS AND POTASSIUM
GHG	GREEN HOUSE GASES
LPG	LIQID PETROLIUM GAS
CNG	COMPRESSED NATURAL GAS
DG	DIESEL GENERATOR
NSS	NATIONAL SERVICE SCHEME

Context

Presidency University Management have decided to conduct an independent Green Audit of the campus by a third party agency. Presidency University has entrusted the work to Ecoparadigm. Accordingly, a team of professionals carried out the audit between the period of 17th October to 10th November 2021.

Green Audit focuses on the Green Campus, Waste Management, Water Management, Air Pollution, Energy Management & Carbon Footprint etc. being implemented by the College Management. The concept, structure, objectives, methodology, tools of analysis, objectives of the audit are mentioned below.

They were actively supported by Prof. Badrinath, Deputy Director, IQAC, Presidency University and his team.

EXECUTIVE SUMMARY

A Green audit is a snapshot in time, in which one assesses campus performance in complying with applicable Environmental laws and regulations. Though a helpful benchmark, the audit almost immediately becomes outdated unless there is some mechanism in place to continue the effort of monitoring Environmental compliance.

Audit criterion is Environmental cognizance, waste minimization and management, biodiversity conservation, water conservation, energy conservation and Environmental legislative compliance by the campus. A questionnaire is used during audit. This audit report contains observations and recommendations for improvement of Environmental consciousness.

The University consumes water at 22lpcd as against the 45lpcd suggested by NMC 2016. Similarly, the per capita solid waste generation is 6gpcd.

The university has a potential to harvest nearly 100MLD of water and recycle 36ML of water annually which can technical nullify the water footprint.

The green belt and landscape developed has an ability to offset about 50tCo₂ annually.

Installing solar photovoltaic on just 5% of the roof area can offset almost 35% of the carbon footprint while becoming “off grid” for all practical purpose.

The total annual carbon foot print of the Presidency University for the audit period is estimated to be 2699t CO₂ equivalent. This would translate to a per capita footprint of 238kg/student and 19.38kg/sqm of built up area.

1 INTRODUCTION

Educational institutions are becoming increasingly aware of the adverse environmental impacts that they cause in the pursuit of its activities. Therefore, they are also proactively engaging in implementing new concepts that make them eco-friendly. Institutions aim to achieve this by promoting energy saving initiatives, recycling of waste, water reduction schemes, rain water harvesting etc.

Green audit is defined as an official examination of the effects a college has on the Environment. Green audit can be a useful tool for a college to determine how and where they are using the most energy or water or resources; the college can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. It can also create health consciousness and promote Environmental awareness, values, and ethics. It provides staff and students better understanding of green impact on campus.

Green auditing promotes financial savings through reduction of resource conservation. It gives an opportunity for the development of ownership, personal and social responsibility for the students and teachers. Thus, it is imperative that the college evaluate its own contributions toward a sustainable future. Presidency University has embarked voluntarily to benchmark itself in its green compliance and use it continuously improve its green status. It has entrusted the audit to M/s Paradigm Environmental Strategies P Ltd, Bengaluru.

This report summarizes the Green audit carried out by Ecoparadigm during the period 17 October 2021 to 10 November 2021.

2 OVERVIEW OF INSTITUTE

Presidency University, Bangalore is a private university located in Itgalpur, Rajanakunte, Yelahanka, Bengaluru 560064 (10 kms from Yelahanka Town) 13.1682°N 77.5354°E. The University established in 2013 and commenced classes in 2015. The University is recognized by the University Grants Commission (UGC).



Figure 1 : Presidency University

The institute offers a total of 51 courses in various disciplines such as Engineering, Law, Management, Information Science, Commerce and Designing at the 38 undergraduate programs and 13 postgraduate programs.

Table 1: Students Strength during the Academic year 2020-21

Sl.no	Program	Male	%	Female	%	No. of students	%
1	UG	7257	72.54	2747	27.46	10004	85.48
2	PG	823	61.79	509	38.21	1332	11.38
3	PhD	192	52.17	176	47.83	368	3.14
	Total 1, 2, 3	8272	70.68	3432	29.32	11704	100

3 OBJECTIVES AND SCOPE

Main Objective of Green Audit is to assess the following with respect to Carbon footprint:

- Green cover of the campus
- Energy Consumptions
- Waste management measures
- Wastewater management

The Scope of work shall be as listed below:

- Site inspection by audit team and submission of data requirement (Checklist) to the Campus

- Assessing the data provided by the college on energy, water and other resources which has an impact on the carbon footprint of the campus.
- Calculating the carbon footprint of each significant attribute of the campus
- Preparing a Green Audit Report with recommendations for improvement

4 METHODOLOGY ADOPTED

The methodology adopted to conduct the Green Audit of Presidency University will have the following components:

- Onsite field visits were conducted by the Green Audit Team as and when necessary.
- Enquiries were conducted amongst faculty members and non-teaching staff to know about the various components in connection with water use, energy consumption and waste disposal, etc.
- Onsite waste segregation and waste disposal audit has been conducted with the help of a cloud based IoT enabled digital weighing solution - Sewac.
- Light levels have been measured at various location of the campus
- Listing the flora and fauna
- Assessment of data and reporting

5 AUDIT STAGE

Presidency University green audit focused on obtaining data on environmental parameters like green cover, land use and land cover (LULC), water availability and usage, waste generation and their management practices, recording of energy consumption and conservation strategies, etc. The members of the audit team recorded the different facilities at the Presidency University campus, determined different types of appliances and utilities (Water cooler, taps, toilets, lights, fan, ACs etc.) as well as measured the usage per item (Watts indicated on the appliance) and identified the relevant consumption patterns (such as how often an appliance is being used) and their impacts. The staffs, students and other stakeholders were interviewed through structured questionnaires to get details of usage, frequency, or general characteristics of different appliances. Data collection was done by onsite visit and also through questionnaires in different sectors such as water, energy, waste, biodiversity status. The data obtained were collated and analyzed to prepare this audit report of Presidency University.

6 AUDIT FINDINGS

6.1 Land use and land cover

The topography of Presidency University campus is undulating and interspersed with scattered trees at few places thus, making it a picturesque landscape suitable for a wide spectrum of flora and fauna.

The present study revealed that the PU campus has a total of 64 acres of land of which 38.4 acres has green cover. It is found that a total of about 25.6 acres (~40% of total) are under the built-up category, of which academic departments administrative units and canteen form a significant part.



Figure 2: Map of Presidency University

The buildings that have been built in the last few years are multistoried as a part of the initiative of the PU administration for vertical expansion.

6.1.1 Observations

- The vegetation areas are found to be reducing over the years owing to the construction of new buildings.

- Dweeding is being carried out annually to prevent the proliferation of weeds with in the campus following the rains

6.2 WATER AUDIT

Water audit is conducted to establish the water consumption pattern in individual sections, so as to realize the consumption levels with respect to exploring presence of potential leaks various pollution prevention and minimizing Unaccounted for Water (UFW) and identifying water reuse and recycle opportunities. Water is utilised by students, faculty, and other persons for meeting the domestic water requirements including drinking water. The water is supplied in the University by the ground water supply (bore wells). The water demand is fulfilled by 6 bore wells. The bore well details in the University is shown in Table. The borewells do not have individual water meter.

Table 2: Borewell details

Location	Bore well length in feet	pipe	Motor capacity HP	Remarks
Main Gate	1040		20	working but, yielding less
Near G Block	1080		20	working condition
Near MBA Block canteen	1000		7.5	working condition
Jungle borewell	1000		17.5	No yielding of water
Near Cicon labour Shed	1100		15	No yielding of water
Ramesh Galappa	NA		NA	Working condition

Table 3: Bore well details- water pumped

Sl. No	Name of the Equipment	Location	Quantity	Capacity HP	Water supplied (KL)	Pumping to	OHT no's	OHT capacity (KL)	Water used in KL
--------	-----------------------	----------	----------	-------------	---------------------	------------	----------	-------------------	------------------

1	Borewell	Main Gate	1	20	Main gate water fountain			
					Main gate 1 security washroom	0.75	0.75	
					sprinklers (3 main lawn area and 1 near atm)		0	
					Hostel 1 canteen	10	10	
2	Borewell	Near G Block	1	20	150 KL irrigation sump		0	
					Gardening		0	
					Central admin	2	5	10
					F Block	3	5	15
3	Borewell	Near MBA Block canteen	1	7.5		1	2	2
					D block	1	3	3
					E Block	2	5	10
					E Block faculty washroom	1	5	5
3	Borewell	Near MBA Block canteen	1	7.5	Admin G	1	5	5
					Domestic water sump 150 KL			150

					MF Classroom	3	5	15
					MF Classroom (RO)	1	10	10
					Library	2	10	20
					Old admin	1	5	5
					COE office	1	5	5
4	Borewell	Jungle borewell	1	17.5	Irrigation tank 150 KL			0
5	Borewell	Near Cicon labour Shed	1	15				0
					Phase 3 Q Block	1	10	10
					cicon labour shed	1	5	5
					cicon labour shed	1	2	2
6					Phase workshop	3	2	10
	Borewell	Ramesh Galappa	1	NA	Irrigation tank 150 KL	1		150
Total						27	97.75	442.75

Presidency university with a student and staff population of 12040 persons is estimated to consume 542 KLD or 164million liters annually (as per NBC guidelines- 45lpcd). As per the data provided by the Presidency university, total water consumption in a campus is 168 KLD for academic and 97.68KLD for irrigation. It is reported that the water tanks are filled once a day. From the water audit it is noted that there is a difference of 373.8 KLD which is 69%

lesser than the calculated water data. The water usage translates to about 22lpcd for the Presidency University. No water is recycled at the moment.

The apparent water use frugality is questionable unless it is backed by actual water meter data. Hence it is recommended to install water meters at the inlet of storage tanks and borewell for monitoring the actual water consumption details.

Table 4: Reported water usage and related data

Source of Water		
Sl no	Parameters	Information
1	No. of Bore wells	6 no's. 4 in working condition
2	No of motors used	4 no's
Quantity of water used in different sections of the campus	Sections	Water used per day
	G/F and 1st floor	5,000
	B/G To 2nd floor	15,000
	B/G To 1st floor	5,000
	G/F and 2nd floor and canteen	25,000
	Connect to Ro raw water	10,000
	B/G To 2nd floor	7,000
	For Hostel	10,000
	G/F and 2nd floor	10,000
	G/F and 2nd floor	10,000
	3rd floor washroom	5,000
	connect labs	2,000
	G/F and 2nd floor	10,000
	G/F and 2nd floor	5,000
	G/F and 2nd floor	5,000
	L Block G/f to 2nd floor	7,000
	B/F to 2nd floor	30,000
	washroom and labs	5,000
	Washroom	2,000
	Total water consumption (L)	1,68,000
	Water use for irrigation (L/d) (Phase 1 and Phase 2)	97,681
	Total Water used	2,65,681
	No of water taps	270
	No of Wash basins	270
	No of Urinals	323

No of Water closet	429
Hot and cold water dispenser	33
Drinking water filters	25
Water meters at every inlet of sintex/tanks	No
Any water wastage/why?	Yes, leakage from wash basin in several washrooms
Wastewater sources	Overflowing of tanks, Canteen, Toilets, laboratories.
Use of wastewater	No
Any wastewater treatment for lab water	No
Rainwater harvesting	No
Whether any green chemistry method practiced in Labs	No

6.2.1 Observations

- Water consumption is not properly monitored within the campus as there are no systems to record it.
- Seepage through roof slabs and beam junctions are observed
- PU has innovated by fixing a cable tie to each of the push to on tap. This has helped in reducing the idle water flow.

6.2.2 Suggestions and Recommendations

- Automated level controller/ sensors can be installed to prevent the overflow from water tanks.
- A water conservation drives should be initiated by involving all the stake holders.
- Water meters can be provided at the outlet of the Overhead Tank or at the Inlet to quantify the flow.

6.2.3 Rain Water Harvesting

Bengaluru experiences an average of 850mm of rainfall annually and spread over 45 days during the monsoon. This water could be harvested and stored for gainful use. The Presidency University with its 64 acres campus has a potential to harvest almost 100ML of rain water with in the campus annually. The potential is about 60% of the water drawn by the University.

Currently, there are no RWH structures within the campus and it is recommended to implement the same. This will ensure that the University's water foot print is minimised. A minimum of 150 harvesting structure/ recharge pits need to be installed.

6.2.4 Liquid waste management

Liquid waste is generated from science laboratories, Academic blocks, and canteen. Liquid wastes generated by the University are of two types:

1. Sewage waste
2. Laboratory and canteen effluent.

The University would require an Sewage treatment plant capacity of ~450KLD to cater to 12000 pax, if water consumption is as per NBC 2016 norms. However, Presidency University has already implementing a Sewage treatment plant of Sequential batch reactor technology with a capacity to handle 300KLD wastewater. This plant is yet to be commissioned. As an interim measure, the wastewater generated is being drained out into the public sewers.

In the absence of actual consumption data, it is difficult to comment on the sizing of the STP. Once the STP is commissioned and functional and if needed, another STP may be installed to take care of shortfall if any. It is recommended to reuse the treated wastewater for gardening and flushing to reduce the freshwater consumption. This is expected to reduce 100KLD by way of landscaping water and almost 100KLD in toilet flushing water.

6.3 WASTE DISPOSAL AUDIT

Solid waste can be categorized into three types: biodegradable, non-biodegradable, and hazardous waste. Bio-degradable wastes include food wastes, canteen waste, wastes from toilets etc. Non-biodegradable wastes include plastic, tins and glass bottles etc. Hazardous waste is waste that is likely to be a threat to health or the environment like laboratory chemicals, waste oils and rags from workshop, cleaning chemicals, acids, and petroleum products. Unscientific management of these wastes such as dumping in pits or burning them may cause the harmful discharge of contaminants into soil and water supplies and produce greenhouse gases contributing to global climate change respectively. Special attention should be given to the handling and management of hazardous waste generated in the campus. Bio-degradable waste can be effectively utilized for energy generation purposes through anaerobic digestion or can be converted to fertilizer by composting technology. Non-biodegradable waste can be

utilized through recycling and reuse. Thus, the minimization of solid waste is essential to a sustainable University.

6.3.1 Status of Solid Waste Generation in the campus

Every department of Presidency University as well as administrative offices create waste in some form which is deposited locally in small waste bin provided by the administration. This is collected daily by the housekeeping who transfer it to larger bins that are carried to the designated waste holding area. A service provider (Annapurna old paper mart, Rajankunte) is engaged to clear the waste on a regular basis.

During the period of the audit, a IoT enable digital weighing machine SEWAC (Segregated Waste ACcountant), was deployed to obtain data regarding the waste generation from various areas.

As tabulated below, on an average, S block accounts for the highest amount of solid waste generated on the campus. On average, various stakeholders generate 72.77 kg of different types of solid waste per day.

Table 5: Waste data and composition

Location	Wet waste (Kg/d)	Mix waste (Kg/d)	Dry waste (Kg/d)	Paper waste (Kg/d)	Plastic waste (Kg/d)	total waste (Kg/d)
S Block	8.00	8.20	0.00	5.83	2.63	24.65
F & B Counters	9.33	4.95	0.00	7.78	1.67	23.72
Cafeteria (Canteen)	11.90	4.58	0.00	4.70	3.23	24.40
Total waste	29.23	17.73	0.00	18.30	7.52	72.77
Percentage	40%	25%		25%	10%	100%

It may be observed that the University produces nearly 73 kgs of waste every day, of which nearly 56kg is received in a segregated fashion. (30kg is wet, and 26 kg is dry recyclables). It may be noted that almost 25% is still unsegregated, which offers a potential to create awareness

and bring higher compliance. The waste data indicates that the university produces waste at the rate of 6g per capita day.

However, management at the common storage or holding site requires lot of attention. The waste are being dumped in a common storage place without segregation. The paper and cardboard waste was exposed to rains, thereby reducing its recyclability potential. It is recommended to have a covered and secure area to house the segregated waste, The dry recyclables should be stored separately and disposed regularly to the recycler.



Figure 3: Waste storage at PU

6.3.2 E-waste

Presidency University has very efficient mechanism to dispose E wastes generated from various sources. E-wastes are generated the computer laboratories, electronic labs, Physics Labs, Chemistry Lab, Biotech Labs, Academic and Administrative Offices.

E-waste includes out of order equipments or obsolete items like lab instruments, circuits, desktops, laptops and accessories, printer, charging and network cables, Wi-fi devices, cartridges, sound systems, display units, UPS, Biometric Machine, scientific instruments etc. All these wastes are put to optimal use. All such equipment's which cannot be reused or recycled is being disposed off through authorized vendors (E-parisara). Instead of a new procurement Buy-Back option is preferred for technology upgradation.

6.3.3 Hazardous Waste

Presidency University, like other entities that generate hazardous wastes. The following features create hazardous waste management problems unique to the University:

Most departments do not generate large quantities of hazardous waste and can be classified as conditionally exempt small quantity generators (generators of less than 100 grams of hazardous waste per month)

Stakeholders are not adequately aware of the regulations that may apply to them, or they may have chosen to ignore the regulations, believing they do not have to comply.

During the audit it was noticed that a majority of the respondents were uncertain of disposal of hazardous waste. It is evident that hazardous wastes which though is generated in very small quantity requires transportation off the university property, to an approved treatment facility. It is evident that there is no collection and management of waste across the campus, but improvements in the overall liquid waste is required to manage the handling and transportation of the generated waste to a treatment facility off the campus.

6.3.4 Observations

- Disposal of Hazardous waste from the PU Academic buildings and laboratories are not streamlined.
- The liquid hazardous waste generated in the laboratories required transportation to off campus disposal facility.
- No source segregation is observed
- Organic waste composting facility is in progress
- No proper waste disposal facility, all type of waste is being dumped on a common place

6.3.5 Suggestions and Recommendation

- The practice of using biodegradable materials should be encouraged as alternatives.
- Awareness on segregation of waste should be initiated by involving all stakeholders
- Proper data management system for waste disposal techniques should be maintained

6.4 BIODIVERSITY AUDIT

Biodiversity audit of Presidency University is a continuous process and efforts of the faculty members, researchers, and the students to assess the living biota and its conservation have been going on for many years. Regularly many conservation practices are taken up by the University so that anthropogenic impact on the biodiversity components and ecosystems are minimized. The scientific information and existing database are based on various studies as well as research

work done by Horticulture department of Presidency University. Despite various limitations, data have been compiled to prepare authentic documentation that provides an insight into the status of the biodiversity and natural ecosystem in the campus. Different conservation practices also have been applied for a better and sustainable campus ecosystem.

The main objective of biodiversity audit is to provide documentation of biodiversity components within the institutional area, to observe ecosystem structures and functions along with regular biodiversity monitoring of the different components of biodiversity.

Spread over approximately 64 acres of land, the Presidency University campus is home to different varieties of fauna as well as flora.

6.4.1 Faunal diversity

The faunal diversity under different species groups is listed in Table 7

Table 6: Faunal diversity

Sl no	Particular
Birds	
1	Acridotherestrictis
2	Corvussplendens
3	Spilopeliachinensis
4	Athenebrama
5	Psittaculakrameri
6	Pycnonotusjocosus
7	Halcyon smyrnensis
8	Dendrocittavagabunda
9	Pycnonotuscafer
10	Columba livia
11	Dicrurusmacrocerus
12	Orioluskundoo
13	Eudynamysscolopaceus
14	Milvusmigrans
15	Passer domesticus
16	Ariadne merione
Butterflies	
17	Tirumalalimniace
18	Euthaliaaconthea
19	Mycalesisperseus
20	Melanitisleda

21	Euremahecade
22	Papiliopolytes
23	Elymniashypermnestra
24	Delias eucharis
25	Euchrysopschejus
26	Danauschrysippus
Ants and wasps	
27	Camponotuswasmani
28	Crematogastersp.
29	Meranoplus bicolor
30	Solenopsisgeminata
31	Plagiolepislongipes
32	Oecophyllasmaragdina
33	Ropalidiaartifex
34	Odynerusfistulosus
35	Scoliaobscura

6.4.2 Floral diversity

The floral diversity under different species groups is listed in Table. The list is based on the studies carried out by Horticulture department of Presidency university

Table 7: Tree diversity at PU

Sl.no	Specifications	Number
1	Agathis robusta plant	10
2	Alstonia scholaris	29
3	Artocarpus integrifolia	3
4	Areca catechu	11
5	Bauhinia blakeana	4
6	Butea Monosperma,	2
7	Brassia actinophylla	8
8	Callistemon Citrinus,	11
9	Cassia marginata	
10	Clusia rosea	8
11	Cordia Sebestena	16
12	Couroubita guiensis	

13	Conocarpus erectus	9
14	Colovelia racemosa	
15	Delonix regio (Gulmohar)	19
16	Erythrina Varigata,	5
17	Ficus Carica(Fig tree),	1
18	Ficus religiosa	1
19	Ficus Lyrata	6
20	Filicium Decipiens	60
21	Golden Melaleuca,	61
22	Jacaranda mimosifolia	6
23	Kegelia pinnata	5
24	Manikara soapota	10
25	Michello champoka	30
26	Mimusops Elengi,	21
27	Milingtonia hortensis	20
28	Phoenix Sylvestris	6
29	Peltophorum Pterocarpum,	12
30	Pisonia Alba	
31	Plumeria Obtusa	107
32	Plumeria Alba Americon dwarf	57
33	Plumeria pudica	77
34	Spethodea Companulata	20
35	Swietenia Mahagani,	48
36	Syzygium cumini	
37	Saraca asoca	6
38	Tabebuea rosea	103
39	Tabebuea impetiginosa	
40	Terminalia Mantaly	110
41	Ptychosperma Macarthurli	90
42	Ticoma	29
43	Caesalpenia pulcherima	81
44	Coconut	80
45	Neem	
46	Ongamare	14
47	Silverok	622
48	Tamarind	
49	Mango	2

50	Ashoka	2
51	Teak	285
Total trees		2107

Table 8: Floral diversity

Sl.no	Specifications	Number
1	Bambusa Ventricosa	10
2	Black bamboo	29
3	Golden Bamboo	3
4	Chamaedorea Elegans,	11
5	Licuala Grandis,	4
6	Phyllostachys aurea	2
7	Raphis Excelsa	8
8	Yucca	11
9	Ficus Benjamina Prestigious Gold	9
	Total specimen shrubs	87
1	Allamonda nerifolia	197
2	Ficus panda	
3	Furcrarea/Agave angustifiliya	10
4	Hymenocallis speciosa	1044
5	Nerium oleander dwarf	
6	Pennisetum setaceum	102
7	Pennisetum moebeleni	
	Total small shrubs	1353
1	Alpinia zerumbet	
2	Aglaonema nitidum	844
3	Calathea lutea	
4	Cyperus papyrus	
5	Dracena marginata	32
6	Heliconia caribaeae dwarf	336
7	Heliconia psittacorum	110
8	Plumbago auriculata	
	Medium small shrubs	1322
1	Asparagus myyeri	
2	Asystasia gangetica var.	1270
3	Cuphea hyssopifolia	3154
4	Equisetum hyemale	788.4

5	Geranium	
6	Irisine herpsti	
7	Ixora dwarf plant	1740
8	Ophiopogon var.	
9	Peperomia variegated	
10	Pentas lanceolata mix colors	422
11	Philodendron cylon gold	
12	Phyllodendron selloum	
13	Jatropha dwarf red	2758
14	Rhoeo spathacea	
15	Russelia juncea	
16	Spathiphyllum	
17	Syngonium butterfly var.	
18	Yellow daisies	
19	Zephyanthus candida	
20	Altemanthera betzickion (green)	2460
21	Altemanthera betzickion (Red)	2712
22	AB green varicated	2872
23	Ipomea botatas gold	586
24	Ipomea botatas black	
26	Lantana sellowiana pink	1458
27	Pachy sandra terminallis green	
28	Tabernemontana coronaria var	
29	Wadelia trilobata	982
30	Verbeenas	
31	Aptenia cordifolia	424
32	Pandanus variegated	2161
33	Hydrangea	300
32	Pandanus variegated	4656
Total ground cover		28743.4

Table 9: Lawn cover area

Sl.no	Specifications	Area in Sqm
1	Mexican Grass	17117
2	Burmuda Grass	3996

Total Lawn cover

21113



Figure 4: Land cover at PU

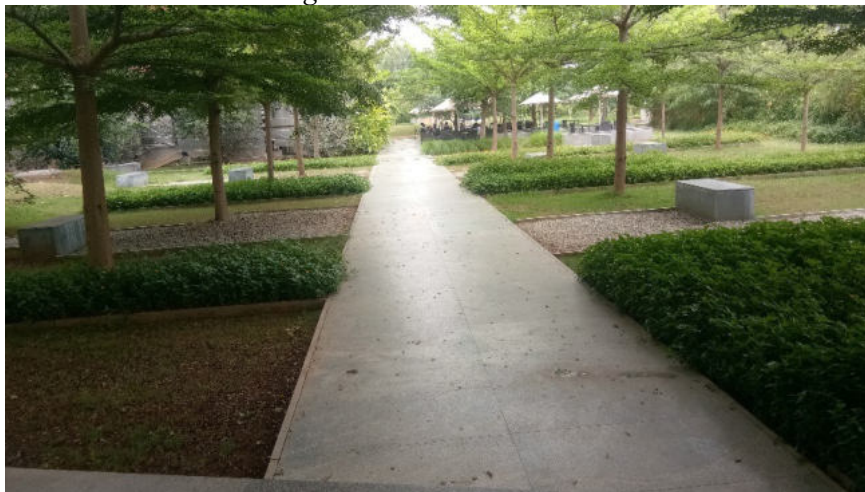


Figure 5: Lawn at PU

6.4.3 Tree diversity and Carbon Stock in Presidency University Campus

Trees are the prevalent component of a terrestrial ecosystem. They provide benefiting function by accumulating atmospheric carbon. A total of 51 tree species with 2107 individuals were identified from Presidency University campus. The dominant family was silver oak (n=622) followed by Teak (n=285) and Terminalia mantaly (n=110). The total carbon sequestered in the entire area is 63.21 T as 6 T ha⁻¹. Silver oak is emerged as the highest biomass contributor due to its higher number of individuals. The study shows that the tree species found in the campus make an important contribution in conserving diversity and helps to maintain the carbon stock in the University Campus.

The study concluded that tree species richness of the campus is important as it is playing vital role in carbon management. Trees like *Anacardium occidentale*, *Artocarpus heterophyllus*, *Cassia siamea*, *Mangifera indica* and *Sapindus mukorossi* possess interesting qualities like

large size, high sequestration potential and better aesthetical values, making them good candidates for landscape designing. Overall, tree planting has helped to transform the area into a verdant green campus. The campus is enriched with various plants of different habitat. The largest collection of trees in the campus may help to reduce the ambient temperature and keep the environment clean.

Fertilizers and organic sprays used for maintenance of lawn and garden per year is approximately 660 kg and 52.5 l per year, as per the data provided by PU for the year 2020-2021. It is recommended to use Organic compost instead of NPK, Micronutrients, UREA etc as fertilizers.

6.4.4 Observations

- Fascinating characteristic of the Presidency University Campus is its lush green environment with rich floral and faunal diversity.
- Exotic species were observed
- Planted courtyards were observed along the campus

6.4.5 Suggestions and Recommendations

- The ecosystem of the campus should be managed properly for a better environment.
- Proper landscape and long-term plan of the vegetational distribution/area is required for sustainable management of the trees and other vegetation in PU campus

6.5 ENERGY AUDIT

According to Energy Conservation Act, 2001, Energy Audit is the verification, monitoring, and analysis of the use of energy including submission of a technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption. Energy audit of PU has been conducted by analysis of power consumption patterns over the year, total connected load, and utilization of power.

Table 10: Energy audit questionnaire

1	Name of Consumer:	Presidency University- Bangalore
2	Name of the contact person	Dr. Bahri H S - Deputy Director
3	Address of the consumer	AH Memorial Education Trust No 21/1, Dibur Village, Hessaraghatta Hobli Bangalore North Taluk, Karnataka -560084
4	Transformer capacity	1300 kVA
5	Capacity of back generators	1500 kVA
6	Contract Demand	400 kVA

7	Demand Charges	₹210/KVA for 85% Of contract demand
8	Roof top solar power plant	NA
10	Annual Energy consumption	Jan-20 to Jan-21, 582460 Units
11	Annual Amount paid to BESCOM	₹1,02,73,351/-
12	Type of connection	1HT2C2
13	Period of Audit	Jan 2020 - Jan 2021

The annual energy consumption pattern of the year 2021 has been compared with previous year to understand consumption patterns, yearly load variation patterns. We were provided with the BESCOM data from the university authorities for the year Jan 2020 – July 2021. It should be noted that the years under study were affected due to the pandemic and does not represent the actual consumption.

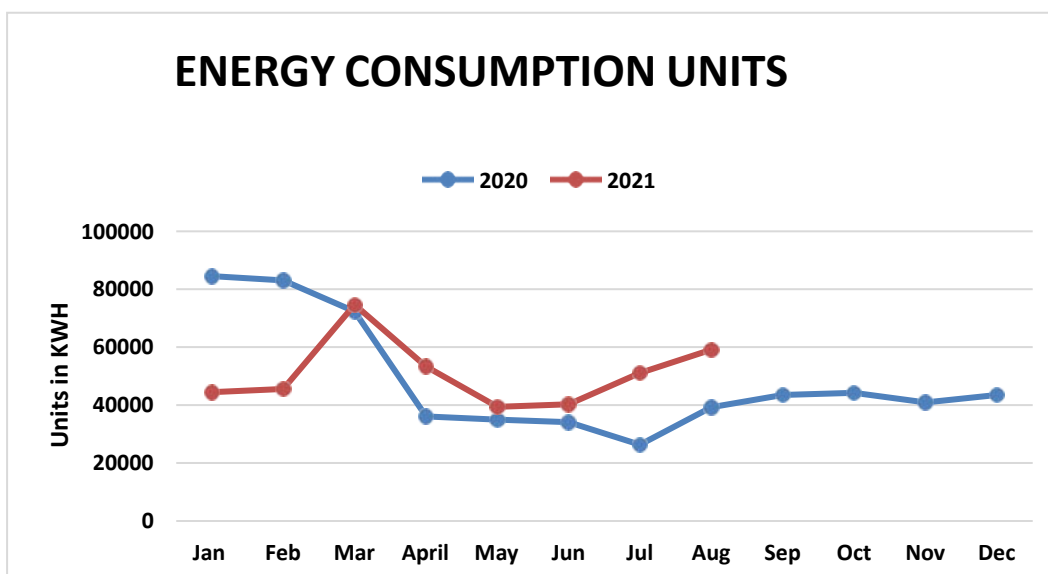


Figure 6: Energy consumption during the period 2020-2021

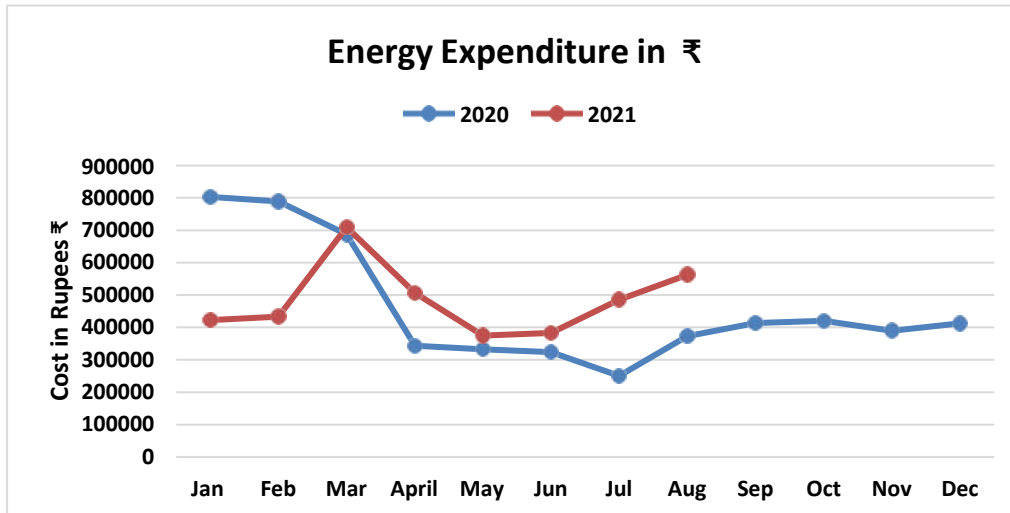


Figure 7: Energy expenditure during the period 2020-2021

An analysis of power consumption pattern over the year, total connected load, and utilization of power. The loads were segregated based on the end use as listed below. Total connected load is 425kW and load distribution is given below.

Table 11: Details of Electricity Consumption

Sl.No.	Particulars	Load (kW)
1	AC	702
2	Fans	177
3	Lights	211
4	Lifts	4
5	Projector	25
6	Pumps	68
7	Refrigerators	1
Total Load kW		1,185

It can be observed that lighting account for the maximum energy, followed by AC, fans and pumps. The key variable loads that may be directly linked to full functioning of the university contribute to about 54000 kWh/ month. This would imply that leakages/ system losses of about 20000 kWh - 25000 kWh exists and need detailed investigation

6.5.1 Suggestions and Recommendations

- There should be facility to record energy consumption in every building.

- Regular Campaigns should be done to switch off of lights and other electric appliances after use.
- Automatic sensor/ motion detector based lighting system can be installed for effective power saving

6.6 Roof Top Solar Photovoltaic

Currently there no Roof Top Solar provisions at the college campus. The Presidency University has ~138053 Sqm of roof area. Assuming even 5% of the roof is dedicated to SPV, there is a potential to install nearly 700 kWp of roof top grid connected SPV. This has a potential to generate about 2700 units every day or nearly 78000 kWh monthly. This can almost bring Presidency University to a net zero consumer.

7 CARBON FOOTPRINT CALCULATION

Carbon Footprint refers to the potential climatic impact (Global Warming) of the Greenhouse Gases (GHG) emitted directly or indirectly due to an organization's activities. A Carbon Footprint Disclosure of any educational institution is very important to understand such that its key emission sources can be identified, and necessary mitigation measures can be adopted for carbon reduction.

An organizational carbon footprint measures the GHG emissions from all the activities across the organization, including energy used in buildings, industrial processes, fugitive emissions and organization's vehicles. Besides quantifying organization's total GHG impact, a CF analysis will provide the organization with a comprehensive GHG inventory, allowing it to identify and target reductions from its major emissions sources.

7.1 Scope

Physical boundary:

Location of the building: Presidency University

Operational boundary –

Scope 1 Direct GHG emissions from process:

- Combustion of fuels in stationary sources-diesel used in electricity generators
- Combustion of fuels in stationary sources – LPG consumption in canteen and Chemistry laboratories
- Combustion of fuels in mobile sources- CNG used in owned vehicle (College Bus)

- Fugitive emissions from Refrigeration/air-conditioning equipment
- Scope 2 Indirect emissions from:
 - Purchased electricity
- Scope 3 Other Indirect GHG emissions from:
 - GHG emissions due to daily commuting of Teaching Staff, Non-Teaching Staff and Students to and from college
 - GHG emissions due to paper consumption
 - GHG emissions from garden waste generation across the campus

7.2 Methodology for estimation of Carbon Footprint

- i. Set the organizational boundaries
- ii. Set the Operational Boundaries: Operational buildings/departments were decided for which the Footprint was calculated
- iii. Data Collection Template was designed to track emissions
- iv. Validation and quantification of data.
- v. Scope 1, Scope 2 and Scope 3 sources were identified and listed through site visits
- vi. On the basis of data collected, Emission factors were obtained for the calculation of Carbon Footprint.
- vii. Analysis of the collected data to calculate the Carbon dioxide equivalent for all the three scopes.
- viii. Best practices listed for the College to reduce the emissions

7.3 Emissions Analysis

The following tables show the computation for the Scope 1, 2 and 3 emissions

Table 12: Scope 1 emissions

Sl No	Particulars	Operating hours/month	Fuel consumed/ hour	Emission factor	T CO2e /year
			lit		
1	On campus stationary sources(Combustion)	0			0.0
2	Diesel used in electricity generation	0			0.0
	DG1 1 x 250 kVA	8	15.27601	2.61	3.8
	DG2 250 kVA	8	15.27601	2.61	3.8
	DG3 500 kVA	8	92.95615	2.61	23.3
	DG4 500 kVA	8	92.95615	2.61	23.3
					54.2

3	LPG for canteen and laboratories @ one 14kg cylinder /day	308	2.983	0.9
4	Direct transportation	Fuel used in L		0.0
	TRACTOR	314	2.653	10.0
	SML	729	2.653	23.2
	SML	665	2.653	21.2
	SML	554	2.653	17.6
	TT 1	85	2.653	2.7
	TT2	426	2.653	13.6
	MAHINDRA JEETO AUTO	7.63	2.653	0.2
	HONDA CITY	88	2.653	2.8
	MARUTI VAN	40	2.653	1.3
	HONDA CITY	86	2.653	2.7
	TT(AMBULENCE)	55	2.653	1.8
	HONDA ACTIVA	30.12	2.653	1.0
	INNOVA CRYSTA	117.94	2.653	3.8
	SML	259	2.653	8.2
	Total			110.0
5	Fugitive emission (AC and refrigerants) 415TR @0.9 kg/ton and 5% leakage	373.5	3.922	0.88
	Total			166.08

Table 13: Scope 2 emissions

Sl no	Particulars	Energy consumption kWh	Emission factor	TCO2e/year
	Purchased electricity			
1	AC	92600.64	0.209	19.35353
2	Fans	141401	0.209	29.55282
3	Lights	293926.2	0.209	61.43059
4	Lifts	972	0.209	0.203148
5	Projector	18110.4	0.209	3.785074
6	Pumps	104040	0.209	21.74436
7	Refrigerators	2540.16	0.209	0.530893

			136.6004

Table 14: Scope 3 emissions

Sl no	Particulars	No's	mileage	Distance	Emission factor	TCO2e /year
				km		
1	Staff commuting					
	4 wheelers	110	12	15	2.63	144.65
	2 wheelers	250	35	15	2.38	102
	Bus	4	6	25	2.63	17.53333
						264.1833
2	Student commuting					
	4 wheelers	50	12	15	2.63	65.75
	2 wheelers	5000	35	15	2.38	2040
						2105.75
3	Solid waste					
	Organic	25			0.4	2
	Inorganic (recycling)	35			0.4	2.8
						4.8
4	Wastewater	168000			0.3	4.032
5	Paper	19551.75			0.9	17.59658
						2396.362

Table 15: Total emissions from Presidency University

Scope	Emission category	Total emission kg CO2e	Total emission %
Scope 1	On campus stationary sources	0.0	0.0
	Diesel used in DG sets	54237.3	2.0
	LPG for canteen and laboratories	918.8	0.0
	Direct transportation	110047.2	4.1
	Fugitive emission (AC and refrigerants) 415TR	878.9	0.0
Scope 2	Purchased electricity	136600.4	5.1
Scope 3	Staff commuting	246650.0	9.1
	Student commuting	2123283.3	78.7
	Solid waste	4800.0	0.2

	Wastewater	4032.0	0.1
	Paper	17596.6	0.7
Total emission kg CO2e		2699044.5	
Total emission tonnes CO2e		2699.0	

7.4 Results and Analysis

It may be observed that Presidency University contributes to about 2699 Ton equivalent of CO₂. The figure shows Scope 3 emissions account for the maximum impact.

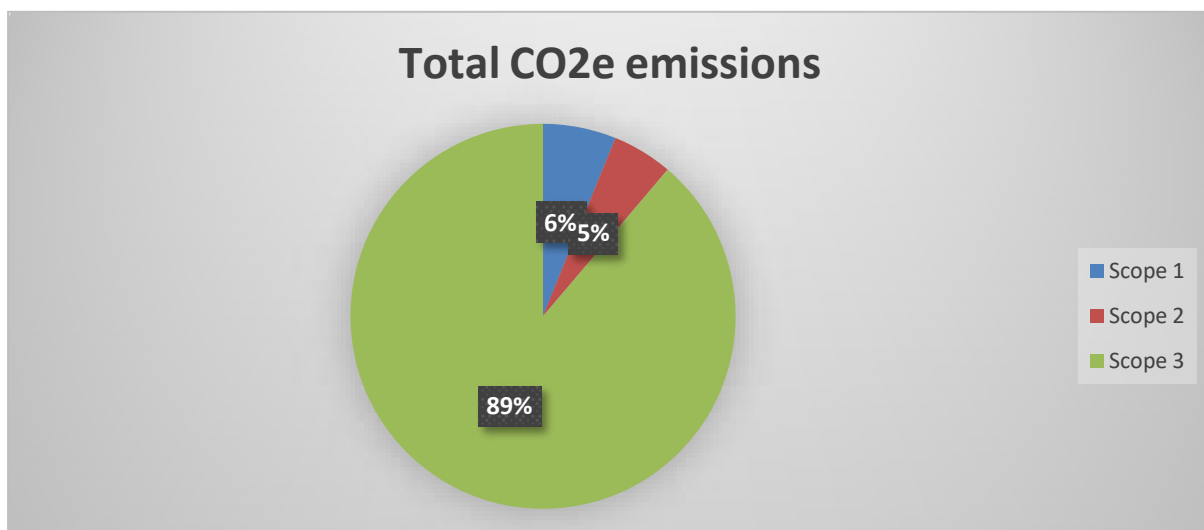


Figure 8: Total CO₂ emissions

Carbon Footprint of Presidency University for the year 2020-21 was computed to be **2699 T** of CO₂ equivalent. The major source of emissions came from Scope 3 emissions i.e., **2396 tCO₂e** followed by Scope 1 which is **166 tCO₂e**. The minimum contribution is by Scope 2 which was computed to be **137tCO₂e**.

Table 16: Overall emission from PU

	Kg CO ₂ e/ year	Tonnes CO ₂ e/year	CO ₂ Per student	CO ₂ Per Sqm
Scope 1	166082	166	14.65086152	1.207901046

Scope 2	136600	137	12.0501422	0.99348283
Scope 3	2396362	2396	211.393958	17.42853024
Total	2699044	2699	238.0949618	19.62991412

The total emission per student is 238kg/ student and 19.62kg/ sqm of built up area

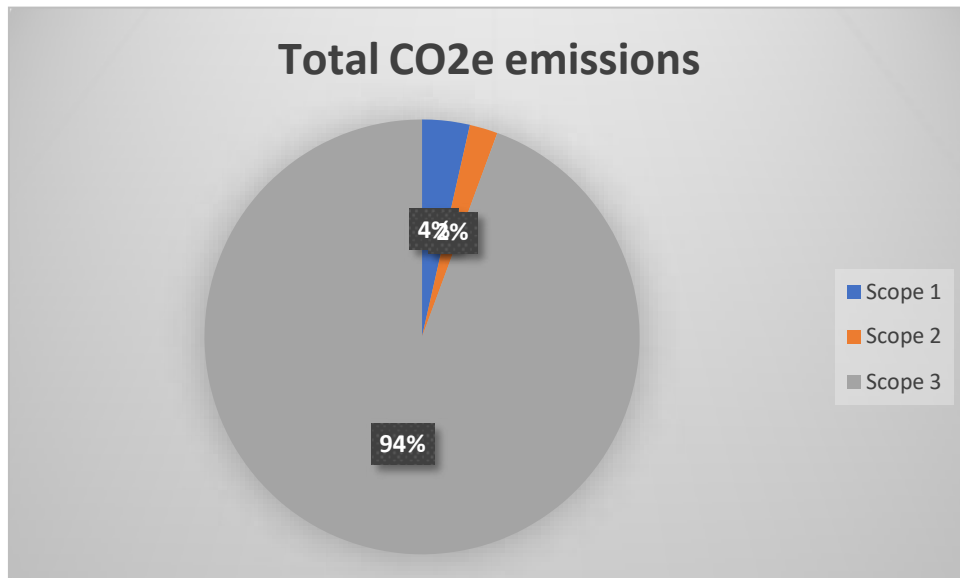


Figure 9: Total CO₂e emissions

7.5 Carbon Offsetting and Carbon credits

In simple terms, offsetting one tonne of carbon means there will be one less tonne of carbon dioxide in the atmosphere than there would otherwise have been. Completely eliminating carbon emissions through mitigation methods is not always possible. That's where carbon offsetting comes in. It is important to take steps to reduce your carbon footprint as much as possible before considering carbon offsets. Carbon credits should certainly not be used to buy an organization a clean conscience or create a mirage of sustainability for consumers. Carbon offsetting is a valuable tool, and when used to supplement a company's mitigation efforts, creates a genuinely sustainable and resilient foundation.

7.5.1 Forestry and conservation

Reforestation and conservation have become very popular offsetting schemes. Credits are created based on either the carbon captured by new trees, or the carbon not released through protecting old trees. There are total of 2107 number of trees in PU campus and sequestered about **50.57 tonnes of carbon/ year. Offsetting with plantation would mean having a wood lot of about 50 times the current landscape.**

7.5.2 Renewable energy

Energy efficiency, clean energy usage, and sustainable strategies can be very effective in reducing an organisation's emissions. Presidency University must implement sustainable strategies by using Renewable energy for electricity by using solar / wind energy. Typical SPV generate about 4.5kWh to 7kWh per day in Bengaluru.

Following table represents the area of solar panels required for 100%, 50% and 25% of carbon offsetting.

Table 17: Carbon offsetting by Solar energy

Total emission (TCO ₂ e/yr.)	Offsetting (%)	Solar energy generated per year (KWh/year)	Emission savings per Sqm (TCO ₂ e/yr.)	Potential installed capacity KWp	Area of Solar panels required (m ²)
2400	100	1460	1.31984	2045	21472
	50	1460	1.31984	1023	10736
	35	1460	1.31984	700	7500

- SPV 1Sqm =1500KWh/year

It can be seen that while installation of about 700KWp of SPV can result in completely offsetting the Scope1 and Scope 2 emissions, it would also offset the purchase of BESCOM power and result in a true off grid campus. The cost of such installation would be about ₹ 5 crores.

8 SUMMARY AND CONCLUSIONS

The green audit was conducted during a period where operation were just getting to normalcy after an extended period of restrictions caused due to the pandemic. Hence the data is not absolute and can only indicate the trend. However, it highlights certain potential opportunities to better the green index of the university.

The current water reported consumption of 22 lpcd is based on estimates. It is recommended to install block wise IoT enabled water meter to gather real time water consumption data and thereby reduce consumption in future years.

The sewage treatment plants needs to be made operation and treated water to be utilised for flushing. Dual plumbing needs to be made operational. Recycling of treated water also can reduce 36ML per annum. Rain water harvesting presents an opportunity to save nearly 100ML of water annually,

The campus generates less than 100kgs/ of waste at a per capita of 6g/ person. Segregation levels are 75% and constant awareness needs to be provided to the stakeholders. A covered waste storage yard needs to be implemented in order to assure 100% recyclability of waste.

It is observed that all the buildings of the University are designed and constructed in such a way that during daytime natural day light and ventilation facilities are available for every building. All artificial lightings are with LED, thereby minimizing electricity consumption. Blockwise energy meters are not present to identify saving opportunities. It is recommended to install IoT enabled smart meters, that will reduce energy bills in the future.

Presidency University has to take initiative to utilize renewable energy by installing roof top solar panels to offset the electrical energy used in normal operation.

Biodiversity audit of Presidency University is a continuous process and efforts of the faculty members, researchers, and the students to assess the living biota and its conservation have been going on for many years. Spread over approximately 64 acres of land, the Presidency University campus is home to different varieties of fauna as well as flora. Although best effort was made to record the fauna of the campus, but the list has not been exhaustive. A total of 51 tree species with 2107 individuals were identified from Presidency University campus. The dominant family was silver oak (n=622) followed by Teak (n=285) and Terminalia mantaly (n=110). The total carbon sequestered in the entire area is 63.21 T as 6 T ha⁻¹. Silver oak is emerged as the highest biomass contributor due to its higher number of individuals. It would be good to prefer endemic species as a landscape element. Lawns consume a lot of water and should be least preferred.

The present study estimates the carbon footprint of the Presidency University for the Reporting Year 2020-2021 as about 2699 tCo₂/ year.

The current plantation and landscape has an ability to offset about 50tCO₂ annually, it would need to be expanded by 50 times to completely be carbon neutral.

Presidency University must implement solar photovoltaic as an alternate energy source as it has an ability to sink the emission while also reducing the power bill. Installation of 700kWp is recommended. The cost of such intervention is about 5 crores, while the annual energy bill savings would be about ₹1 crore, resulting in a payback of under 5 years.

The total emission for the year 2020-21 is 238kg/ student and 19.62kg/ sqm of built up area. This can be used to bench mark the performance in later years

Finally, it can be concluded that the Green Audit Report-2020-21 will help in assisting the process of an ecofriendly approach to the sustainable development of the Presidency University Campus.



REGISTRAR
PRESIDENCY UNIVERSITY
BANGALORE