GHG Baseline Study Report

F.Y.
2024-25

A comprehensive analysis of the greenhouse gas emission generated by the internal operations of the Parul University. Annual data is prepared for the 12 months of F.Y. 2024-25.

Parul® University
NAAC GRADE A++

Greenify Integrators Pvt.ltd

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Executive Summary

Parul University, located in Vadodara, Gujarat, is a distinguished multidisciplinary institution committed to fostering excellence in higher education. This report provides a comprehensive analysis of the GHG emission generated by the internal operations of the Parul University campus. Annual data is prepared for the 12-months period of F.Y. 2024-25. It identifies the sources of greenhouse gases (GHG).

- The study identifies total of **2587.35 t CO2 eq Scope 1 GHG emissions** which is dominated by contribution of emissions due to fuel combustion (majorly Diesel and LPG).
- The organization is emitting around **18123.76 t CO2 eq Scope 2 emissions (Purchased electricity from MGVCL and purchased LPG gas cylinders).**
- However, Parul University is **avoiding 1344.67 t CO2 eq** scope 2 emissions by employing renewable energy (Solar Energy – Roof Top Solar).
- Total **Carbon sequestered by the Green Cover** is approximately **0.78 t CO2 eq.**
- *Thus, cutting down total emission of **20711.12 t CO2 eq** to **19365.67 t CO2 eq** Net GHG emission.*

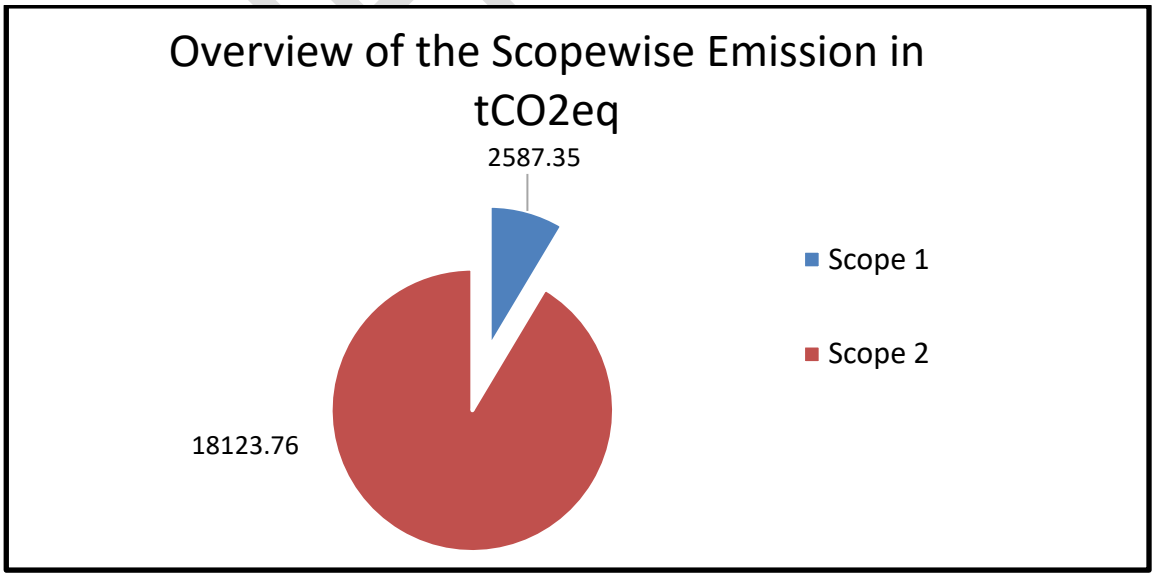

Table 1 Consolidated Summary of scope-wise emission of Parul University in F.Y.2024-25

Scope	Activities	Emission (t CO2 eq)	Total Emission (Scope-Wise)	Avoided Emission (t CO2 eq)
1	Fire Extinguisher	1.38	2587.35	1345.45
	Operation of AC/Refrigerators/ Chillers (Fugitive Emission), Insulating gas	460.92		
	Mobile Sources (University owned Vehicles)	262.44		
	SF_6 Gas	72.90		
	Wood Combustion (Water heating Boiler, Cooking activity in mess, canteen.)	904.70		
	Diesel combustion (DG set Inclusive)	4.06		
	Emissions from food waste handling	69.66		
	Emission from Biogas usage at canteen	0.57		
	Purchased LPG (Cylinder in Kg)	810.69		
	Emission from onsite Wastewater management system (STP)	0.03		
2	Purchased electricity from MGVCL	18123.76	**18123.76**	
Total Emission			**20711.12**	**t CO2 eq**
Net Total Emission (Total Emission – Avoided Emission)			**19365.67**	

Introduction

Reporting Organisation

Parul University, located in Vadodara, Gujarat, is a distinguished multidisciplinary institution committed to fostering excellence in higher education. It holds the distinction of being India's youngest private university to receive NAAC A++ accreditation in its first cycle. The University seamlessly integrates the nation's rich cultural heritage with modern innovations and academic advancements, offering a dynamic environment for student enrichment while contributing to both national and global development.

Comprising a diverse array of faculties and institutes, Parul University offers an extensive range of diploma, undergraduate, postgraduate, and doctoral programs across multiple disciplines. Its industry-aligned and field-oriented programs are designed to equip students with the necessary skills and knowledge to excel in their careers. The University has a proven track record of facilitating career success through start-up incubation initiatives and exceptional placement opportunities.

The 150+ acre eco-friendly campus is home to over 50,000 students from across India and more than 3,500 international students from 75+ countries, establishing it as a truly global academic destination. In addition to its NAAC A++ accreditation, the University holds prestigious global memberships, including the Association of Commonwealth Universities.

Greenhouse Gas Reporting Team

Reporting Organisation

1. Dr. Falguni Acharya (IQAC, Director)
2. Dr. Snehalkumar Patanwadia (Asst. Director, IQAC)
3. Mr. Ashu Singh Rajput (Chief Rector, University Hostel)
4. Mr. Deepak Parmar (Heat and Ventilation Air Condition Engineer)
5. Mr. Dharmeshbhai J. (Transport Manager)
6. Mr. Kamal Singh Shekhawat (Electrical Manager, Estate Department)
7. Mr. Kamaleshbhai Patel (STP & Water System)
8. Mr. Keval Raval (Transport Manager, (E-Vehicles))
9. Mr. Krunal Soni (Electrical Manager, Estate Department)
10. Mr. Priyanshu Nadda (Electrical Manager, Estate Department)
11. Mr. Priyesh Patel (HOD of Garden Dept)
12. Mr. Rahul Bharwad (Head of Water System)
13. Mr. Rushikesh Joshi (MTech Environment Partner, Atmiya Enterprise)
14. Mr. Shubham Sharma (Logistic Manager, University Hostel)
15. Mr. Utpal Patel (Fire & Safety Manager)
16. Ms. Rashmika Prajapati (Coordinator, Waste Management Site)

Third Party Assessment team

Organisation: Greenify Integrators Private Limited

Greenify Integrators Private Limited is a forward-thinking environmental solutions provider committed to integrating sustainability into the core of modern business practices. With a team of dedicated experts, Greenify delivers innovative and customized services aimed at helping organizations transition towards a net-zero future. From carbon credit consulting and ESG frameworks to renewable energy solutions and water management, Greenify offers a holistic approach to environmental responsibility. The company's mission is to empower clients to adopt eco-friendly strategies that not only minimize environmental impact but also drive long-term success. Guided by a clear vision

of harmonizing business growth with ecological well-being, Greenify is leading the charge in building a resilient and regenerative future.

Team:

A. Mr. Ujjwal Shah (Lead Assessor)
B. Ms. Dhruti Soni (Team Member)
C. Mr. Kunal Mehta (Team Member)
D. Mr. Chinmay Joshi (Team Member)
E. Mr. Meet Dhobi (Team Member)
F. Ms. Adhwaita Parikh (Team Member)
G. Ms. Prachi Gohi (Team Member)

Reporting Period and Frequency of Reporting

The GHG emissions covered by this inventory are based on calendar year April 1st, 2024 to March 31st, 2025 (F.Y. 2024-25). Parul University reports GHG emissions under the operational control approach criteria described in "GHG Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)", published by the World Resources Institute (WRI)/ World Business Council for Sustainable Development standard. The frequency of reporting is based annually.

Reporting Standards

The ISO 14064-1 standard (Second Edition – 2018-19), which provides organization-level- guidance for quantifying and reporting greenhouse gas emissions and removals, serves as the main basis for this report. The Intergovernmental Panel on Climate Change (IPCC) guideline publications and the India GHG program guidance documents are the sources of information used to estimate emissions for different categories. Aside from these citations, the document incorporates the GHG protocol for the identification, measurement, and classification of greenhouse gas emissions.

Assessment of GHG Inventory

Team conducted On-site field visit for identifying and quantifying GHG sources and sinks within the premise. Indirect and direct measurements of GHG emissions were evaluated and examined. Critical examination of data collection and measurement methodologies was conducted. Scrutiny of environmental policies and other relevant policies was carried out. Following listed aspects were explored and understood in order to categorise GHG emissions:

1. Electricity Bills of MGVCL
2. Wood Consumption for Boiler/ Conventional Water Heater
3. LPG & Diesel Consumption
4. Solar Power Generation Records
5. Owned Vehicle Records
6. AC/ Chillers/ Extinguishers inventory and refilling records

7. SF6 Inventory Data for Electrical System
8. Biogas Generation from Food Waste
9. Waste segregation and bailing process for Plastic Waste
10. Sewage Treatment Plant (STP) records of treatment
11. Inventory of various chemicals in different labs
12. Green cover details and records of species

Principles followed in Reporting

Applying principles is essential to ensuring that data on greenhouse gas emissions is accurate and impartial. The principles are the basis for, and will guide the application of, the requirements in this document.

A. Relevance

Choose the GHG sources, sinks, reservoirs, data, and procedures that best suit the intended user's needs.

B. Completeness

Includes all relevant GHG emissions and removals

C. Consistency

Allow relevant comparisons to be established between GHG-related data

D. Accuracy

As far as is practical, lessen bias and uncertainty.

E. Transparency

Deliver intended users with enough accurate and relevant GHG-related information, to enable them to make decisions with a fair level of confidence.

GHG Inventory Boundaries

Organisational Boundary

Parul University has established its prominence both nationally and internationally in the field of higher education. Nationally, it is recognized as one of Gujarat's leading private universities with a wide range of academic, research, and innovation initiatives. It comprises a state-of-the-art educational campus located in Vadodara, Gujarat, spread over 150+ acres, it hosts over 50,000 students, including 3,500+ international students from 75+ countries. It houses 20+ faculties and offers 200+ programs across diverse disciplines, including engineering, management, law, medicine, pharmacy, design, arts, and several others at undergraduate, postgraduate, and doctoral levels. Parul University maintains global partnerships with 75+ universities worldwide, enhancing academic exchange and international learning opportunities. The organizational boundary for the purpose of this exercise is considered as campus buildings and activities carried out in it.

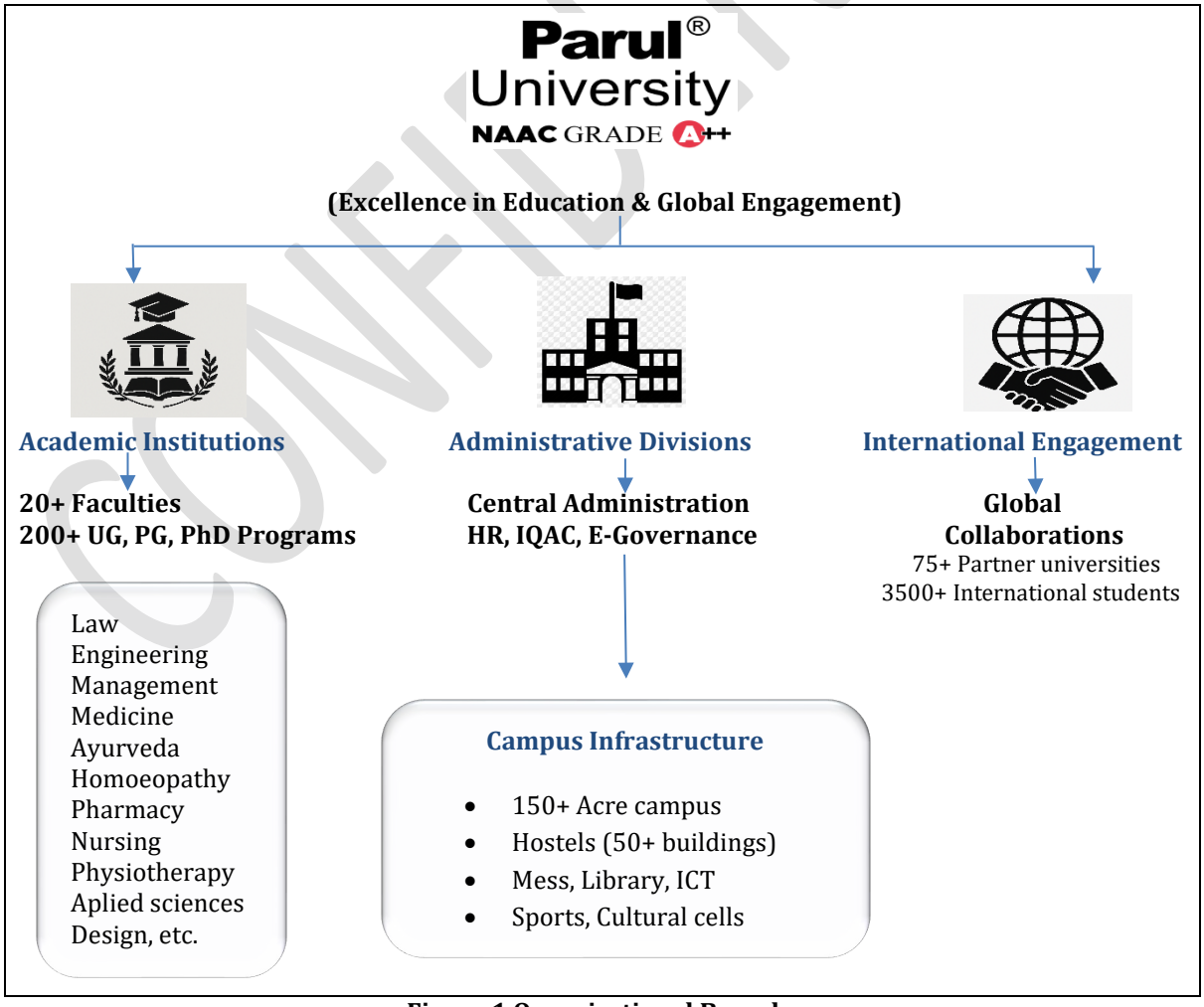

Figure 1 Organisational Boundary

Reporting Boundary

The present exercise of GHG Emission is reported for Parul University (India). Parul University's greenhouse gas (GHG) emissions reporting, in line with the GHG Protocol, encompasses both Scope 1 and Scope 2 emissions. Scope 1 includes Direct emissions and Fugitive emissions from sources owned or controlled by the Parul University. Scope 2 emissions arise from various indirect energy sources procured from any service provider.

Emission Categories and Classification

The **ISO 14064-1 standard** (Second Edition, 2018–19) lists the following emission categories:

1. **Category-1:** Direct GHG emissions and removal
2. **Category-2:** Indirect GHG emissions from imported energy
3. **Category-3:** Indirect GHG emission from transportation
4. **Category-4:** Indirect GHG emission from products used by an organisation
    a. Indirect emissions from goods purchased by an organisation
    b. Indirect emissions from services used by an organisation
5. **Category-5:** Indirect GHG emissions Associated with the use of products from the organisation
6. **Category-6:** Indirect GHG emissions from other sources.

On the other hand, **using GHG protocol (A Corporate Accounting and Reporting Standard guidance)** document the above-mentioned categories can be simplified into 2 major emission scopes:

A. **Scope 1 Emission: Direct GHG Emission**

Greenhouse gas emissions that are under the Parul University are considered as direct GHG emissions. Emissions from combustion through owned or controlled vehicles, Operation of AC / Refrigerators / Water Chillers, Solid waste handling system, onsite Wastewater management system (STP) and DG set, Fire extinguishers, SF6, LPG (Cylinder in Kg) etc.

B. Scope 2 Emissions: Indirect GHG emissions from purchased electricity
Includes emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment or operations.

Table 2 shows inclusion of **ISO 14064-1 standard** (Second Edition, 2018–19) emission categories into 2 major emission scopes of GHG protocol (A Corporate Accounting and Reporting Standard guidance) standard.

Table 2 Inclusion of ISO 14064-1 categories of emissions into GHG protocol Emission Scopes

ISO 14064-1 standard (Second Edition, 2018–19)		**GHG Protocol Emission Scope (A Corporate Accounting and Reporting Standard guidance)**
Category	**Title**	
1	Direct GHG Emissions and removal	**Scope 1** (Direct GHG Emission)
2	Indirect GHG emissions from imported energy	**Scope 2** (Indirect GHG emissions from purchased energy)

Emission Sources (Inclusion and Exclusion)

The sources of GHG emissions are identified and classified according to the standards and listed in *Table 3.* All the relevant GHG sources within the premise according to boundary set by provided university layout has been considered.

At this stage, Scope 3 emissions have not been considered for this study.

Table 3 GHG Emission Sources included in carbon accounting calculation exercise

Scope	Activities	Remarks
1	**Fire Extinguisher Emission**	CO_2 emission during refilling
	Fugitive Emission	Emission due to AC/Refrigeration/ Water Chillers units due to refilling
	Emissions due to owned Vehicles	Vehicular GHG emission (Diesel/ Petrol)
	Emission from onsite Wastewater management system	Emissions due to the operation of the inhouse Sewage Treatment Plant (STP)
	Fuel consumption in DG Sets	Emissions due to combustion of fuel (Diesel)
	Purchased LPG	Emissions from cooking activity in messes and canteens
	Emission from onsite waste management system	Emissions from degradation of organic waste generated
2	**Purchased Electricity**	Emissions from generation of electricity procure from MGVCL

Quantified GHG Inventory of Emission

Consolidated Statement of GHG Emission

Table 4 discloses consolidated GHG emissions according to respective categories and scope emissions.

Table 4 Consolidated Statement of GHG Emissions

Scope	Activities	Emission (t CO2 eq)	Total Emission (Scope-Wise)
1	Fire Extinguishers	1.38	**2587.35**
	Operation of AC/Refrigerators/ Chillers (Fugitive Emission)	460.92	
	Mobile Sources (Owned Vehicles)	262.44	
	SF_6 Gas	72.90	
	Wood Combustion in boiler (Cooking and water heating activity)	904.70	
	Diesel combustion (DG set)	4.06	
	Emissions from food waste handling	69.66	
	CO2 emission from Biogas	0.57	
	Purchased LPG (Cylinder in Kg)	810.69	
	Emission from onsite Wastewater management system (STP)	0.034	
2	Purchased electricity from MGVCL	18123.76	**18123.76**

Methodologies of collection and quantification of data

The methodologies of quantification of data are part of FAS's (Facilities and Administration Services) personnel's everyday operations. The overview of emissions sources and their respective data sources is provided in *Table 5*. The best available data and computation methods are utilized when estimation is necessary.

Table 5 Overview of Emission Sources

Scope	Emission Sources	Data Source
1	Fire Extinguisher	Reports of inventory and refilling data
	Fugitive Emission	AC/ Refrigeration Servicing & Refilling reports
	Mobile Sources (Owned Vehicles)	Assumed data provided by Parul University's transport manager
	Fuel consumption	Annual Fuel Consumption Reports
	Emissions from food waste handling	Assumed data provided by Parul University's Coordinator of Waste Management Site
	Purchased LPG (Cylinder in Kg)	Purchased invoice of LPG gas cylinders
	Emission from onsite Wastewater management system	Monthly STP Reports
2	Purchased electricity from MGVCL	Electricity Bills

Calculation of GHG Emission

Scope 1 Emission Calculation: Direct Emissions

A. **Stationary emission:** IPCC 2006 Guidelines for National Greenhouse Gas Inventories has been employed for emission calculations from fuel consumption.

Equation 1 Emission from Fuel Consumption

Emission : Fuel Consumption X Emission Factor of fuel

Only Diesel and LPG were used as fuel for F.Y. 2024-25.

Following table indicates emission factors of fuel based on consumption.

Table 6 Emission Factor of fuel

	Kg GHG/litre		
Fuel Type	**CO_2 Emission Factor**	**CH_4 Emission Factor**	**N_2O Emission Factor**
Diesel	2.6764	0.00036	0.0000216
LPG	1.6117	0.000127	2.55×10^{-6}
		GWP = 27.9	**GWP = 273**

B. **Fugitive Emission:** Screening Method by India GHG Program was used for HFC and HCFC Emissions from Refrigeration/Water Chillers/AC Equipment (Emission Factor Based Approach)

Equation 2 Emission from AC/Water Chillers/Refrigeration (Operational Emission)

Emission during operation of AC/Refrigeration

= No. of units X (GWP) X Refrigerant Charge (kg) X Annual Leakage rate(%)

X Conversion Factor

Default annual leakage rate and GWP from IPCC guidelines have been assumed here.

C. **Mobile Emissions:** Here Vehicles owned by Parul University will account for scope1 mobile emission source. Parul University owns various vehicles such as, buses, cars, fire tender, ambulance, tankers, tractors, two wheelers whose fuel consumption will be accountable here. The source of methodology and emission factor is India GHG Program tool (Refer Table 7 and *Equation 1*)

Table 7 Emission factor of Fuel for mobile emission source

Fuel Type	Emission Factor (Kg CO_2/lit)
Petrol	2.27193
Diesel	2.6764

D. **Emissions from on-site Sewage Treatment Plant (STP):**

The general equation to estimate CH4 emissions from domestic wastewater is as follows:

Equation 3 total CH_4 emissions from domestic wastewater

TOTAL CH_4 EMISSIONS FROM DOMESTIC WASTEWATER

$$CH_4\ Emissions = \left[\sum_{i,j}\left(U_i \bullet T_{i.j} \bullet EF_j\right)\right](TOW - S) - R$$

Where,

CH_4 Emissions = CH_4 emissions in inventory year, kg CH_4/yr

TOW = total organics in wastewater in inventory year, kg BOD/yr

S = organic component removed as sludge in inventory year, kg BOD/yr

U_i = fraction of population in income group i in inventory year.

$T_{i,j}$ = degree of utilisation of treatment/discharge pathway or system, j, for each income group

i = income group: rural, urban high income and urban low income

j = each treatment/discharge pathway or system

EF_j = emission factor, kg CH_4 / kg BOD

R = amount of CH_4 recovered in inventory year, kg CH_4/yr

The emission factor for a wastewater treatment and discharge pathway and system (terminal blocks with bold frames in equation 3) is a function of the maximum CH_4 producing potential (B_o) and the methane correction factor (MCF) for the wastewater treatment and discharge system, as shown in equation 4 The B_o is the maximum amount of CH_4 that can be produced from a given quantity of organics (as expressed in BOD or COD) in the wastewater. The MCF indicates the extent to which the CH_4 producing capacity (B_o) is realised in each type of treatment and discharge pathway and system. Thus, it is an indication of the degree to which the system is anaerobic.

Equation 4 CH_4 emission factor for each domestic W.W treatment pathway or system

CH_4 EMISSION FACTOR FOR EACH DOMESTIC WASTEWATER TREATMENT/DISCHARGE PATHWAY OR SYSTEM
$EF_j = B_o \bullet MCF_j$

Where,

EF_j = emission factor, kg CH_4/kg BOD

J = each treatment/discharge pathway or system

B_0 = maximum CH_4 producing capacity, kg CH_4/kg BOD

MCF_j = methane correction factor (fraction), See Table 8.

Good practice is to use country-specific data for B_o, where available, expressed in terms of kg CH_4/kg BOD removed to be consistent with the activity data. If country-specific data are not available, a default value, 0.6 kg CH_4/kg BOD can be used. Table 8 includes default maximum CH_4 producing capacity (B_o) for domestic wastewater.

Table: 8 Default maximum CH_4 producing capacity for domestic wastewater

DEFAULT MAXIMUM CH_4 PRODUCING CAPACITY (B_0) FOR DOMESTIC WASTEWATER
0.6 kg CH_4/kg BOD

The activity data for this source category is the total amount of organically degradable material in the wastewater (TOW). This parameter is a function of human population and BOD generation per person. It is expressed in terms of biochemical oxygen demand (kg BOD/year). The equation for TOW is,

Equation 5 total orgamically degradable material in domestic wastewater

TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

E. **Emissions from Fire Extinguisher:** CO_2 gas refilling activity represents the amount of CO_2 gas released into atmosphere. Source of methodology is IPCC 2006 guidelines.

Equation 6 Emission from fire Extinguisher

Emission (t CO2e) = Quantity of CO2 gas refilled in 2021 (kg) /1000

F. **LPG cylinder:** Emission due to combustion of LPG for various cooking and heating purposes accounts in scope 1 emission.

Equation 7 Emission due to combustion of LPG

$$Emissions_{GHG,\,fuel} = Fuel\ \ Consumption_{fuel} \bullet Emission\ \ Factor_{GHG,\,fuel}$$

G. **Waste Management:** Parul University is controlling collection and disposal of solid waste generated from canteen and Hostels mess. Hence, considered in scope 1 emission. 'Biological Treatment of Solid Waste' emission guidelines by 2006 IPCC Guidelines for National Greenhouse Gas Inventories formulates basis for the calculation for composting methodology of waste treatment. Tier 1 approaches where IPCC default values are used for GHG emission calculation is employed.

Equation 8 CH_4 Emission from biological treatment

CH_4 EMISSIONS FROM BIOLOGICAL TREATMENT

$$CH_4\ Emissions = \sum_i (M_i \bullet EF_i) \bullet 10^{-3} - R$$

Where,

M = Mass of organic waste treated by biological treatment

EF = Emission factor for treatment (g CH_4/kg Waste)

R = Total amount of CH_4 recovered in inventory year

Equation 9 N_2O Emission from Biological Treatment

N_2O EMISSIONS FROM BIOLOGICAL TREATMENT

$$N_2O\ Emissions = \sum_i (M_i \bullet EF_i) \bullet 10^{-3}$$

Where,

M = Mass of organic waste treated by biological treatment

EF = Emission factor for treatment (g N_2O/kg Waste)

TABLE 4.1
DEFAULT EMISSION FACTORS FOR CH_4 AND N_2O EMISSIONS FROM BIOLOGICAL TREATMENT OF WASTE

Type of biological treatment	CH_4 Emission Factors (g CH_4/kg waste treated)		N_2O Emission Factors (g N_2O/kg waste treated)		Remarks
	on a dry weight basis	on a wet weight basis	on a dry weight basis	on a wet weight basis	
Composting	10 (0.08 - 20)	4 (0.03 - 8)	0.6 (0.2 - 1.6)	0.24 (0.06 - 0.6)	Assumptions on the waste treated: 25-50% DOC in dry matter, 2% N in dry matter, moisture content 60%. The emission factors for dry waste are estimated from those for wet waste assuming a moisture content of 60% in wet waste.
Anaerobic digestion at biogas facilities	2 (0 - 20)	0.8 (0 - 8)	Assumed negligible	Assumed negligible	

Sources: Arnold, M.(2005) Personal communication; Beck-Friis (2002); Detzel *et al.* (2003); Petersen *et al.* 1998; Hellebrand 1998; Hogg, D. (2002); Vesterinen (1996).
Note: Default emission factors for CH_4 for anaerobic digestion already account for CH_4 recovery.

Figure 2 Default emission factor for CH4 and N2O emission from biological treatment of waste

Scope 2 Emissions: Indirect Emissions from purchased Electricity

A. **Purchased Electricity:** Emissions due to generation of electricity procured from MGVCL grid accounts in scope 2 emission. Here, weighted average emission factor (Renewable energy inclusive) for Indian grid published by Central Electricity Authority (CO2 Baseline Database for the Indian Power Sector - User Guide Version 19, December 2023) is considered.

Equation 10 Indirect Emissions due to generation of purchased electricity

Emission (t CO2 eq) = Electrical Consumption (Mwh) X Emission Factor

Weighted average emission factor for Indian grid is 0.716 t CO2 eq/MWh. Which is average emission of all stations in the grid, weighted by net power generation.

GWP Calculation and sources

According to the requirement of ISO 14064-1:2018, seven GHGs include CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3. Here quantities of GHG emissions are given in tones of CO2eq using the GWP from the IPCC Sixth Assessment Report (AR6). **The scope of time is 100 years.**

Table 9 Global Warming Potential (IPCC Sixth Assessment Report)

Species	Lifetime (Years)	GWP-20	GWP-100	GWP-500
CO2	Multiple	1	1	1
CH4 fossil	11.8	82.5	29.8	10
CH4 non-fossil	11.8	79.7	27	7.2
N20	109	273	273	130
HFC-32	5.4	2693	771	220
HFC-134a	14	4144	1526	436
CFC-11	52	8321	6226	2093
PFC-14	50000	5301	7380	10587

Review, Internal audit and Improvement

As the first thorough representation of the emissions from the Parul University, this study looks at the facts and information that are currently accessible. Primary data gathering has been attempted for all significant emission sources. Conservative estimating techniques have been used in cases when data is lacking or incomparable, which encourages ongoing improvements in the ratio of source data to estimation techniques. The Parul University intends to use this part going forward to emphasize improvements

to its approach and structure for gathering and analysing emissions data and removing uncertainty.

Removals or Reduction Emission

Parul University is also active in emission reduction and removal voluntary activities. Parul University is developing good amount of green cover within its institutional boundary. Moreover, it has employed solar power generation to decrease scope 2 emissions. Furthermore, the institution promotes sustainable transportation through the use of electric vehicles and deployment of bicycles under MYBYK scheme. It also supports a comprehensive waste management system to ensure responsible disposal and recycling practices. Parul University sets a strong example of institutional leadership in sustainability.

Carbon Sequestration Approach

Parul University has developed green cover within its premises including 20 species of trees with 4636 individuals. This cover gives Parul University about 0.78 t CO2 eq Sequestration annually. Detailed Species-specific sequestration data is provided in *Annexure II.*

Methodology: Data collection and requirement demonstrated in Table 10.

Table 10 Data collection and Requirement for Carbon Sequestration by trees

Sr.no.	Data	Remarks
1	**Species Specification**	Species Specific sequestration capacity
2	**Diameter of Trunk**	For calculation of AGB (Above Ground Biomass) and BGB (Below Ground Biomass)
3	**Height of tree**	
4	**Age of Tree Species**	For Annual carbon sequestration Rate

Calculation Basis:

A. Calculating 'Above Ground Biomass' (AGB) using diameter and height of tree using. Green weight is estimated to be 120% of AGB.

B. Calculating Total Biomass (TB) which is summation of AGB and BGB (Below Ground Biomass) that is root system. Since 20% of AGB is BGB

Equation 11 Total Biomass Calculation

$$\text{Total Biomass (TB)} = 1.2 \times \text{AGB}$$

C. Identifying 'Total Dry Weight' (TDW) using 'Total Biomass' data (*Equation* 12). Where Carbon occupies 50% of TB (TC = TDW X 0.5)

Equation 12 Total Dry Weight Calculation

$$\text{Total Dry Weight (TDW)} = \text{TB} \times 0.725$$

D. Calculating Total CO2 sequestered by tree in its entire lifetime using *Equation 13*

Equation 13 Calculating Total CO2 Sequestered by tree

$$\text{Total CO2 Sequestered} = \text{TC} \times 3.67$$

Renewable Energy and Clean Energy Approach

A. Solar Power Generation Unit: Parul University has employed on-grid solar power generation unit of total capacity 36 KW and 1 MW with 60-70% of generation. Total power consumption by solar power generation unit is consolidated into *Table 11.* Approximately 7.4% of scope 2 emission is avoided by the solar power generation unit.

Table 11 Solar Energy power consumption and Avoided Emission

Production	1344.66	MWh
Emission Factor	0.716	t CO2/ MWh
Total Emission Avoided	**1344.66**	**t CO2 eq**

Recommendations and Mitigation Actions

Data Collection and GHG Inventorisation

A. Organisation may define formats and logbooks specific to departments for systematic data collection and management (Refer Table 12 recommended format and departments responsible).

Table 12 Recommended departments and data collection formats

Department	Data Collection formats
Transport	**1.1** Logbook maintenance of Vehicle transit data (Fuel type, Vehicle model, distance travelled, etc.)
Maintenance	**1.2** Logbook use for maintaining data of LPG cylinders, AC, refrigerator and coolants installations, refiling.
Gardening	**1.3** Logbook maintenance of Trees data (Number of different species, total green cover area, and carbon sequestration data)
Admin	**1.4** Generation of Waste record (Type of waste, quantity, etc.) **1.5** Record of waste disposal (Disposal method, Quantity disposed, Amount of GHG emitted, etc.)

	1.6 GHG emitted from STP record book (Total organic carbon of Sludge and Effluent, Sludge generation quantity, CH_4 emission, N_2O Emission, etc.)
Electrical	**1.7** Logbook maintenance of electricity and solar data (This logbook helps keep track of consumption, maintenance, inspection, and performance of both conventional electricity systems and solar systems.)

B. Allocating proper roles and responsibilities for the data collection and inventorisation will improve data management and data insights to set ambitious targets aligned to Parul University's climate action policy.

C. There should be proper communication in terms of SOPs about collection methods to enhance and encourage awareness data insights.

D. Both qualitative and quantitative approach should be considered in data collection process. Organisation may follow IPCC guideline document for data inventorisation.

Operations

A. Parul University can significantly advance its sustainability agenda by optimizing its primary activities and infrastructure to reduce fuel consumption and overall energy demand. A strategic shift towards electric mobility by replacing diesel and petrol based institutional vehicles with electric alternatives will not only lower Scope 1 emissions but also reduce fuel dependency and long-term operational costs. Expanding the electric vehicle fleet and enhancing on-campus EV charging infrastructure will further support this transition. Institute can significantly reduce their energy demand by adopting green building norms set by IGBC

B. Scaling up the existing biogas plant will allow for more efficient processing of organic waste from hostel mess and canteens, generating clean energy for cooking and thereby reducing reliance on LPG cylinders.

C. On the electricity front, increasing the capacity of solar PV installations across academic blocks, administrative offices, and hostels will reduce dependence on grid electricity, contributing to a reduction in Scope 2 emissions. Institute can also

plan to go for PPA for additional capacity of cleaner energy (e.g. solar and wind or hybrid)

D. The university operates a sewage treatment plant (STP) that can be upscaled to treat and recycle wastewater for non-potable purposes such as toilet flushing, campus cleaning, and landscape irrigation, thereby conserving freshwater resources

Monitoring

As per the GHG Protocol clause 9, The organization shall establish and maintain GHG information management procedures that –

- Ensure conformance with the principles, ensure consistency with the intended use of the GHG inventory,
- Provide routine and consistent checks to ensure accuracy and completeness of the GHG inventory,
- Identify and address errors and emissions, and document and archive relevant GHG inventory records, including information management activities.

During developing GHG inventory, a Core Team should be formed. Training on the GHG protocol specification including introduction of climate change, impacts of GHG emission on environment, role of organization in GHG emission reduction should be conducted for the core team members where other locations participated through intranet video and where GHG activity data collection and archiving procedures should be discussed with core team.

Strategic Mitigation

Parul University can implement a comprehensive and formal strategic Climate Action Plan addressing key environmental concerns:

1. Optimization of electrical (EV) vehicle system

    - Enhance the existing EV network by expanding EV fleet coverage across the campus. Installing smart EV charging stations powered by solar energy to ensure zero-emission transport. Implementing a centralized EV scheduling and monitoring system for efficiency.

2. Maximization of Solar Energy Utilization

    - Scale up solar panel installations on rooftops and parking structures. Introduce real-time solar performance tracking and integration with the campus power grid to increase solar share in total energy consumption. Use solar energy to power EV stations and campus lighting systems.

3. Strengthening the Biogas Plant Operations

    - Expand feedstock input by systematically collecting biodegradable food and garden waste. Increase capacity of biogas for cooking in canteens or convert it into electricity for use in hostels or laboratories. Integrate biogas slurry for organic fertilizer production to support campus landscaping.

4. Advanced Waste Management
    - Scale up waste segregation system by expanding the number of color-coded bins across hostels, academic blocks, and public areas. Regular training sessions for housekeeping staff and awareness programs for students are essential to promote proper waste disposal practices and to ensure the system functions effectively at all levels.

5. Greening and Carbon Sequestration Projects

    - Expand the green cover and implement Miyawaki forest model on underutilized land and monitor its carbon sequestration potential annually. Maintain a digital inventory of green cover and calculate annual CO_2 offset. Involve students and staff in tree plantation drives with a focus on native and climate-resilient species.

Awareness

A. Parul University should set ambitious scientific targets to reduce GHG emissions and communicate with faculty, staff, and students. This will encourage target-based active participation and innovative solutions to achieve.

B. Responsible waste handling, awareness posters and digital bulletins on proper waste segregation should be strategically placed in mess and canteen areas, supported by student-led initiatives in composting and recycling.

C. Regular training programs and seminars on GHG Inventorisation and mitigation will further build awareness and technical knowledge, empowering individuals to contribute meaningfully to the university's environmental goals. This comprehensive awareness approach will help embed a culture of sustainability across all levels of the institution.

Way Forward to Net Zero Emissions

Parul University has a strong potential to transition towards a **Net Zero Campus** through strategic planning, innovation, and sustainable practices.

- To further mitigate Scope 1 emission arising from institutional fuel usage, diesel generators, wood combustion, and on-site waste treatment plant, etc;
- The university should fully electrifying its campus fleet, integrate additional EV charging stations, and expand its biogas plant capacity to replace LPG in hostel mess and canteens. Promoting non-motorized and electric intra-campus mobility will further reduce direct emissions.
- In addressing Scope2 emissions, primarily from purchased electricity, the university must scale up rooftop and ground-mounted solar PV installations, coupled with battery storage solutions to enhance renewable energy utilization and reduce grid dependency.
- Aligning with ISO 14064 and ISO 50001 standards, setting science-based targets, and establishing a robust ESG monitoring framework will ensure transparent and measurable progress.
- Integrating nature-based solutions like Miyawaki afforestation and wastewater reuse will complement technological interventions.
- Through strategic investments, institutional innovation, and stakeholder engagement, Parul University can position itself as a model of sustainability in higher education and achieve its long-term vision of becoming a carbon-neutral campus.
- Institute need to register and follow the guidelines of SBTi (Science Based Target Initiative) and need to plan for Scope 3 emission baseline study along with action plan.

Annexure - I

Assumptions Sheet

Assumptions considered into GHG Inventorization and Calculations

Scope	Category	Assumption	Remark / Methodology
1	**Fuel Consumption**	**1.1** Total operating days to be considered as 200	**1.1**Communication with Parul University Managerial personnel
	STP	**1.2** Methane Correction Factor (MCF) assume to be 0 and BO (Maximum methane producing potential) is considered 0.25 kg CH4/kg COD according to IPCC default value	**1.2** 2006 IPCC Guidelines for National Greenhouse Gas Inventories
	University owned transportation	**1.3** 100% carbon present in fuel is oxidized during or immediately following the combustion process (for all fuel types in all vehicles) irrespective of whether the CO2 has emitted other gases such as CO, CH4 or NMVOC.	**1.3** 2006 IPCC Guidelines for National Greenhouse Gas Inventories
	Waste Management	**1.4** Quantity of solid waste is assumed quantity of Solid waste generated by canteen and hostel mess. **1.5** 25-50% DOC in dry matter, 2% N in dry matter, moisture content 60% **1.6** Emission factor for CH4=8 and N2O = 0.6	**1.4** Communication with Parul University Managerial personnel **1.5** 'Biological Treatment of Solid Waste' emission guidelines by 2006 IPCC Guidelines for National Greenhouse Gas Inventories

2	**Purchased Electricity**	**2.1** Weighted average emission factor (including RES & Captive power injection into grid) = 0.716 t CO2/MWh **2.2** Calculation is based on location-based approach methodology	**2.1** CO2 Baseline Database for the Indian Power Sector (Version 19.0 December 2023) published by GOI (Ministry of Power, CEA)

Annexure II

Detailed Species-Specific Carbon Dioxide Sequestration

Sr. no.	Tree species	No. of Units	Total Carbon (TC)	Total CO_2weight (lbs.)	Average Age	Annual CO2 Sequestration (lbs.)
1	Neem *(Azadirachta indica)*	395	501.12	1839.11	13	141.47
2	Royal palm *(Roystonea regia)*	1032	563.76	2068.99	11	188.09
3	Coconut *(Cocos nucifera)*	204	101.79	373.56	9	41.50
4	Foxtail Palm *(Wodyetia bifurcate)*	232	117.45	431.04	10	43.10
5	Bismarckia Palm *(Bismarckia nobilis)*	32	313.2	1149.44	12	95.78
6	Gulmahor *(Delnix ewgia)*	1119	438.48	1609.22	12	134.10
7	Tecoma *(Tecoma stans)*	80	101.79	373.56	10	37.35
8	Spathodea *(Spathodea campanulata)*	120	54.81	201.15	6	33.52
9	Terminalia *(Terminalia arjuna)*	53	46.98	172.41	12	14.36
10	Banyan *(Ficus benghalensis)*	15	1057.05	3879.37	15	258.62
11	Peepal *(Ficus religiosa)*	8	1409.4	5172.49	17	304.26
12	*(Accacia plantaform)*	137	86.13	316.09	12	26.34
13	Ashoka *(Polyalthia longifolia)*	260	70.47	258.62	9	28.73
14	Champa *(Michelia champaca)*	250	62.64	229.88	7	32.84
15	Cordia *(Cordia sebestena)*	25	9.78	35.92	9	3.99

16	Mango *(Mangifera indica)*	150	375.84	1379.33	13	106.10
17	Jamun *(Syzygium cumini)*	149	469.8	1724.16	12	143.68
18	Kadam (*Neolamarckia cadamba)*	25	62.64	229.88	11	20.89
19	Borsalli *(Mimusops elengi)*	25	54.81	201.15	10	20.11
20	Conocarpus (*Conocarpus erectus*)	325	78.3	287.36	6	47.89

Annexure III

List of Abbreviations

1. AC : Air Conditioner
2. AGB : Above Ground Biomass
3. BGB : Below Ground Biomass
4. BOD : Biological Oxygen Demand
5. CCUS : Carbon Capture utilisation and Storage
6. CH_4 : Methane
7. DG : Diesel Generator
8. EHSF : Environment, Health, Safety and Fire
9. EnMS: Energy Management System
10. EV : Electrical Vehicle
11. FAS : Facilities and Administration Services
12. GHG : Greenhouse Gases
13. GSEB: Gujarat State Electricity Board
14. GWP : Global Warming Potential
15. HCFC: Hydrocholoroflurocarbon
16. HFC : Hydrofluorocarbon
17. IPCC : Intergovernmental Panel on Climate Change
18. LPG : Liquefied Petroleum Gas
19. MGVCL : Madhya Gujarat Vij Company Limited
20. N_2O : Nitrous Oxide
21. NMVOC : Non-Methane Volatile Organic Compounds
22. PFC : Perfluorocarbon
23. SF_6 : Sulphur Hexafluoride
24. SOPs : Standard Operating Procedures
25. STP : Sewage Treatment Plant
26. T CO_2 eq : Tonnes CO_2 Equivalent
27. TB : Total Biomass
28. TC : Total Carbon
29. TDW : Total Dry Weight
30. WRI : World Resources Institute

Annexure IV

References

1. IPCC 2006 Guidelines for National Greenhouse Gas Inventories
2. India GHG Program: Calculating HFC and PFC Emissions from the Manufacturing, Installation, Operation and Disposal of Refrigeration & Air-conditioning Equipment (Version 1.0). (n.d.).
3. A Corporate Accounting and Reporting Standard by 'The Greenhouse Gas Protocol'
4. CO2 Baseline Database for the Indian Power Sector, User Guide (Version 19.0, December 2023), Government of India Ministry of Power Central Electricity Authority.
5. ISO 14064-1:2018(E): Greenhouse Gases Part 1- Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

Disclaimer

This report is to be viewed as an internal assessment and to be considered for internal reference only (unverified). The report shall be accessible for internal key managerial personnel and key stakeholders only. The report is purely based on present site record and on-site assessment.