6. Carbon Footprint Reduction

6.1 Office / Building Survey

Information on Office-based environmental impacts like built-up area, utility bills, energy-saving devices and IT equipments was collected. This information added to the carbon footprint data, generating a fairly clearer picture of the College's annual greenhouse gas emissions and impact of the reduction measures undertaken.

6.2 Carbon Footprint

- **Carbon footprints** is historically defined as *the total set of greenhouse gas emissions caused by an individual, event, organization or product, expressed as* ***carbon dioxide equivalent.***
- ***Carbon Footprint is measured in tCO_2. tCO_2eq stands for "Tones of CO_2 equivalent"***
- Our *'Carbon Footprint'* is a measurement of all GHG we individually produce to live. The amount of GHG produced depends on our lifestyle and consumption pattern.
- It also depends on how a product is made which we are consuming. If GHG production is more, then we say our carbon footprint is more. If it is less then we say our carbon footprint is small. We should strive to achieve a carbon footprint as small as possible.

- The largest amount of greenhouse gas emission-almost 80%- comes from the energy sector.
- Oil, coal and natural gas- all fossil fuels- supply most of the energy to run vehicles, & generate electricity for industries.
- This sector is responsible for about three-fourth of CO_2 emissions, one-fifth of CH_4 emissions, & large qty. N_2O.
- There are many other sectors such as Agriculture and Animal Husbandry, Deforestation, Waste & Waste water, Residential & Commercial buildings etc. leading to carbon footprint.
- In this report we have concentrated to carbon footprint because of vehicles and electricity consumed and carbon handprint considering landscape, flora and fauna.
- Data collected from the following sources were taken into consideration to calculate carbon footprint emission and reduction. The floristic richness of the campus – total number of plants, trees, shrubs – was estimated. The impact of alternate green energy production and consumption to reduce fossil fuel-based energy was assessed, e.g the number of CFL, LED, tube lights and electronic chokes was counted. The Carbon Footprint Calculator was used to arrive at conclusions.
- Carbon Footprint Calculator enables the measurement of carbon emission by the College. Besides, by Breaking down the value to key 'carbon drivers', the College can know how much of carbon footprint comes from which type of

behaviour (high power-consuming incandescent bulbs vs. LED lights, solid waste management, etc.).

6.3 Carbon Audit Tools & Analysis

The Carbon Audit tools and analysis methodology were developed collectively by the Green Audit Assessment Team and based on that the audit was conducted in ten major thematic areas.

1. Flora & Carbon Footprint Reduction
2. Sustainable Site
3. Water Efficiency & Water Audit
4. Energy Efficiency & Energy Audit
5. Indoor Environmental Quality
6. Eco-friendly Commuting Practices --Green Transportation
7. Green Construction Material
8. Health & Comfort
9. Post Occupancy Waste Management System

6.4 Flora & Carbon Footprint Reduction

The large area of the College goes live with its green policy. The manifestation of the "Go Green" tree campaign truly finds expression in every nook and corner of the College to a great extent. For example, it is worthy to mention that despite the region being an arid region the College through its efforts towards environmental protection has ensured the plantation and successful maintenance of more than 1550 number of trees

ensuring a pristine green cover for the students, faculties, and also for the wildlife that includes animals, birds and reptiles. Hence also as part of the pedagogy a Botanical Garden has been established which serves as a centre for ecological consciousness and learning. For the students and for the community at large, a beautiful Garden has also been developed to help the people appreciate the gift of nature, especially during the months of summer. Further, regularly, the campus conducts plantation drive with various stakeholders including the alumni and public representatives. The biodiversity surveys conducted by various departments has documented following flora fauna in campus;

Carbon footprints is historically defined as *the total set of greenhouse gas emissions caused by an individual, event, organization or product, expressed as* ***carbon dioxide equivalent.***

Floristic status of the College

After deducting the built-up area along with playgrounds, the projected area available to develop various types of flora is 3,194 sq.mt.

There are 12 families, 25 genera and 56 species of trees, shrubs, herbs (including potted plants) and climbers in the campus.

- 56 species of trees
- 10 species of shrubs
- 20 species of herbs
- 9 species of climbers (including creepers)

About 560 to 700 fully grown trees shall be raised in 1 acre of land. This depends on the type of soil, the species/family of the tree and the spacing. However, with the normal spacing of 6 x 10 feet, the total number of trees shall be taken up as 600/acre. This is a theoretical consumption. The Green & Environment Audit Team of the College counted the number of plants: full-grown trees (above 10 years), semi-grown trees (below 10 years), shrubs and lawn (sq.ft. area).

The following table will illustrate these figures

Sr. No.	Particular of Flora	Designation
1	Full –grown trees	300
2	Semi –grown trees	50
3	Bushes (including floriculture plants)	50
4	Lawn	14,025 sq. ft.

Tool to Measure Carbon absorption by flora in the campus

Assumptions

1. Number of mature trees in 1 acre = 700
2. Carbon absorption capacity of 700 trees is equivalent to carbon emitted by a speeding car for 26,000 miles
3. 26,000 miles = 41,843 km
4. Average kilometres covered by a car per litre of petrol is 20 km
5. Total quantity of petrol consumed by the car (41,843/20) = 2092 litres

The carbon emitted by a car due to consumption of 1 litre of petrol is 2.3 kg CO_2. At this rate the total quantity of carbon emitted by 2092 litres of petrol (2092 x 2.3 kg) = 4812 kg CO_2 or 4.8 tonnes of CO_2.

Therefore, the carbon absorption of one full-grown tree is 4812/700 = 6.8 kg CO_2.

The footprint calculation is based on the standard unit of 1 litre petrol = 2.3 kg CO_2.

6.5 Carbon Absorption by Flora

Carbon absorption capacity of one full-grown tree = 6.8 kg CO_2.

1) Therefore, the carbon absorption capacity of 300 full-grown trees in the campus of the College (300 x 6.8 kg CO_2.) = **2040 kg or 2.04 tonnes of CO_2.**
2) The carbon absorption capacity of 50 semi-grown trees is 50 % of that of full- grown trees. Hence, the carbon absorption (50 x 3.4 kg CO_2.) = **170 kg or 0.17 tonnes of CO_2.**
3) There are 50 bushes of various species being raised in the gardens of the College. Carbon absorption of bush plants varies widely according to the species. Certain bushes absorb as high as 49,000 g CO_2. per plant, whereas some others absorb as low as 150 g CO_2 per plant. In the absence of a detailed scientific study and botanical survey, the per-plant carbon absorption was assumed to be 200 g (in consultation with environment scientists). Based on this, the total carbon absorption

of 50 plants was calculated to be 50 x 200g = 10,000 g or **10 kg or 0.01 tonnes of CO_2.**

4) The Green & Environment Audit Assessment team looks after the maintenance of landscape on the campus. Buffalo variegated grass, Mexican grass and indigenous grass species are being raised and maintained in the lawn. The total area of the lawn is 14,025 sq. ft. The carbon absorption capacity of 10-sq.ft. area of lawn is 1 g CO_2. Hence, 14,025 sq. ft. of lawn absorbs **1402 g or 1.402 kg CO_2. per day**. At this rate, the total carbon absorption per year (1.402 kg x 365) = 511.73 kg or **0.5 *tonnes*** per year.

The grand total of carbon absorption by the flora in the College Campus is (1+2+3+4) = 2.72 tonnes.

This is the sink effect of the flora in the campus.

Tool to measure oxygen emission by flora in campus

According to the Arbor Day Foundation, 'a mature leafy tree produces as much oxygen in a season as 10 people inhale in a year'.

A person breathes 7 or 8 litres air per minute. Air is about 20% oxygen. But the exhaled air has about 15% oxygen, and hence the net consumption is about 5 %. Therefore, a person uses about 550 litres of pure oxygen each day.

6.6 Oxygen Emission by Flora

The number of litres in 1 kilogram depends on the density of the substance being measured. Litre is a unit of volume, and kilogram a unit of mass. Litres and kilograms are approximately equivalent when the substance measured has a density of close to 1 kilogram per litre.

On an average, one full–grown tree produces nearly 260 pounds or 117.6 kg of oxygen each year. Two mature trees can provide enough oxygen for a family of four.

1) Total oxygen emitted by 300 full –grown trees per year (117.6 kg x 300) = 35,280kg or **35.28 *tonnes.***

2) Total oxygen emitted by semi- grown trees (58.8 kg x 50) = 2,940 kg or **2.94 tonnes** (oxygen emission in 50 % of that of the fully grown trees).

3) Total oxygen emitted by 50 bushes is calculated based on the following oxygen –inhaling requirement per person per day. A normal human being requires 550 litres of oxygen per day. 400 bushes produce enough oxygen per day to enable a person to breathe adequate quantity of oxygen of 550 litres. Total quantum of oxygen produced by 400 plants per day is 550 litres of oxygen.

Taking 400 plants as one unit, the number of units of bushes in the campus (50/400) = 0.125

Total quantity of oxygen produced by 0.125 units (0.125 x 550 litres) = 68.75 litres of oxygen per day.

The annual production of oxygen at this rate (68.75 x 365) = 25,094 litres or kg of oxygen, which is approximately **25.09 tonnes of oxygen.**

Lawn is an incredible oxygen –making machine. A 25-sq.ft. area will supply enough oxygen to support one person for a day. Quantitatively speaking, this area of grass produces 550 litres of oxygen per day.

The total area of lawn in the campus is 14,025 sq. ft. In units, the value (14,025/25) = 561 units, which produce (561 x 550 litres of oxygen) = 3,08,550 litres of oxygen per day. Total quantity of oxygen produced by the 10,828 sq. ft of lawn per year (3,08,550 litres/day x 365) = 11,26,20,750 litres or approximately **1,12,620 tonnes.**

6.7 Carbon Footprint Reduction Table

- **Carbon dioxide absorption**

Sr. No.	Flora	Quantity of CO_2 (tonnes)
1	300 Full –grown trees	2.04
2	50 Semi –grown trees	0.17
3	50 Bushes	0.01
4	14,025 sq. ft. Lawn	0.50
	Total	**2.72 say 3**

- ***Oxygen emission by flora***

Sr. No.	Flora	Quantity of O_2 (tonnes)
1	300 Full –grown trees	35.28
2	50 Semi –grown trees	2.94
3	50 Bushes	25.09
4	14,025 sq. ft. Lawn	1,12,620
	Total	**1,12,683.31** **Say 1,12,600**

GREEN COVER ON THE CAMPUS

GREEN COVER ON THE CAMPUS

GREEN COVER ON THE CAMPUS

8. Eco-friendly Commuting Practices

Eco-friendly commuting practices can also be termed as Green Transportation.

Emission of CO_2 through transport system – both public and private – is very high in India as India is credited with the third rank in carbon emission in this regard. It is estimated that in India, 9% of the total carbon is emitted by the transport system.

Idar being a small town, there is no city bus available to reach up to the College. Hence students can even walk down to College. Most of the students attend Idar college from adjoining villages and towns. The frequency of State Transport Bus is good enough to rely upon this system. This prevents students and staff to use their own private vehicle to reach up to the College. This prevents the emission because of transportation. This is considering the fact that the College building is located besides the main road.

The College Management has taken a principle stand right from the beginning to encourage students to use the public transport system or walking or use bicycle to reduce carbon emissions.

Unfortunately, after globalization, there has been a continuous increase in the income of the 100 million plus middle class families along with the automobile boom. As a result, the student community and teaching faculty members of the College are using two wheelers and four wheelers in large numbers and the trend has been on the increase. This is inspite of creating

awareness to use public transportation or bicycle or walking. Hence it is appropriate, in this context, to analyze the carbon dioxide emissions from the fleet of four wheelers and two wheelers owned by the individuals even though the College does not pollute the atmosphere directly.

The College Management has been successful to convince students and staff to commute in public transportation and hence it is a great achievement for the College that not more than about 27 numbers of two wheelers and not more than 6 numbers of four wheelers reach College daily and this figure includes vehicles used by teachers and administrative staff along with the visitors.

8.1 Vehicles on the campus & it's carbon emission

The following data indicate the quality of diesel consumed by the vehicles during the last year. There are 6 numbers of four wheelers, and 27 two wheelers used by students and staff. It is appropriate to calculate the petrol consumption separately for four wheelers and two wheelers. The survey conducted among students / staff who own two wheelers reveals that they use the vehicles not only for visiting the College, but for moving after college hours and holidays. It is estimated that the average mileage covered by each staff / student is about 30 km/day. The total mileage covered by the 27 two wheelers per year (27 x 30 x 365) = **2,95,650 km.**

Apart from that 6 numbers of four wheelers are used by the students / faculty members and the average mileage covered is

also the same, 30 km per day. Hence the total mileage covered by 6 numbers of four wheelers per year is (6 x 30 x 365) = **65,700 km.**

The total mileage covered by two and four wheelers per year (2,95,650 + 65,700) = ***3,61,350 km***.

The fuel consumption by vehicle is determined by the type of vehicle, year of manufacturing, maintenance status, traffic system of the particular area, etc. High-end and medium- range bikes consume different quantities of petrol. However, for the sake of convenience, 35 km per litre is taken as the standard to calculate the carbon emission of two wheelers. Based on this, the total quantity of petrol consumed for covering 2,95,650 km is (2,95,650/35) = **8,447.14 litres say 8,447 litres**

A medium-range four wheelers covers 16 km per litre of diesel. Based on this the total quantity of diesel consumed by 6 four wheelers per year (65,700/16) = **4,106.25 litres say 4,106**

Thus, the total fuel consumption per year (8,447 + 4,106) = 12,553 litres (both petrol and diesel).

Conversion table to calculate carbon emission by vehicle per litre is very complicated in view of the local variable to be taken for calculation.

Instead, a simple but universally accepted calculation calendar for various types of fuels and their CO_2 conversion rate was adopted.

As per this calculation calendar, combustion of 1 litre of diesel/petrol leads to the emission of 2.68 kg of CO_2. At this rate,

the total quantity of CO_2 emitted by 12,553 litres of fuel (12,553 x 2.68) = **33,642.04 kg = 33.64 tonnes.**

The carbon emission into the atmosphere is 33.64 tons because of vehicles moving on the campus and for education purpose out side the campus.

Considering this emission of the CO_2, the Institution has intensified green awareness among the students and through green education on the one hand and plans to mitigate carbon emission from vehicles on the other.

The College management has motivated and encouraged all students and staff is to use public transportation, cycle, walking, and further discard use of personal vehicle in order to reduce CO2 emission and fuel consumption and convert the campus into ***Zero Carbon Campus.***

The College has also encouraged green transportation i.e. encourage students and staff to pool car and two wheelers. Discard use of even public transportation and reach walking if the college premise is within 2 to 3 Km radius.

8.2 Parking Facility & Regulations

The College campus has a parking shed for limited vehicles only. This is in order to discourage bringing vehicles on the campus. The parking shed adds to heat island effect roof. The trees are used as shading devise to park vehicles. This also saves the cost of parking shade and

further reduce heat island effect roof. The trees act as evaporative type of cooling system for the campus.

All the vehicles are parked in orderly manner within the campus.

Green Transportation is also the need of the hour considering rapidly depleting oil reservoirs and India is dependent on overseas to meet with its oil demand and in return lose valuable foreign currency reservoir.

Implementation of Green Transportation on the campus can reduce number of vehicles on the campus and also eased down parking issues. The College proposes to prevent movement of vehicles on the campus and erect bicycle stand. Students /staff may visit campus on their vehicle and park it on entry / exit point, pick up the bicycle and move on the campus.

PARKING FACILITY ON THE CAMPUS