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Assessing and Reducing the Carbon Footprint of SSCET: Strategies for a Sustainable Campus

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ABSTRACT

This project investigates the carbon footprint initiatives at Shri Sai College of Engineering and Technology, focusing on student behavior to foster a sustainable university environment. A carbon footprint measures the total carbon dioxide emissions attributed to an individual or organization. The study reveals that during in-person learning, the average annual carbon footprint of a college student is 2.55 t-CO₂e, which drops to 1.35 t-CO₂e during online learning. Specifically, students at Shri Sai College of Engineering and Technology emit an average of 2.16 tons of CO₂ equivalent (tCO₂e) per year. Key contributors to these emissions include the usage of electrical appliances, food consumption, and transportation. The research highlights a lack of awareness among students about their digital carbon footprint, which encompasses the emissions generated from activities such as scrolling, browsing, and sending emails. These activities are categorized into three broad areas: daily life, academics, and transportation, with daily life encompassing dining, showering, and general dormitory electricity use. To mitigate their carbon footprint, students can adopt several strategies, such as using public transportation or biking instead of driving, reducing waste by avoiding disposables and recycling, conserving energy by turning off lights and unplugging appliances, eating more plant-based foods, and conserving water. The Greenhouse Gas Protocol (GHG Protocol) and various carbon footprint calculators, like those from The Nature Conservancy and the Environmental Protection Agency (EPA), can help in calculating the emissions from different equipment and activities, thereby promoting more sustainable practices in college settings.

Keywords: Greenhouse Gases, Carbon Footprint, Process Analysis, Input-Output Model

1. Introduction

1.1 General

Overview:

The study of carbon footprints involves analyzing the total greenhouse gas (GHG) emissions caused directly or indirectly by human activities. This analysis helps understand the impact of various activities on climate change and guides efforts to reduce emissions. A carbon footprint refers to the total amount of greenhouse gases (GHGs), primarily carbon dioxide (CO₂), emitted into the atmosphere as a result of human activities. It is often measured in units of carbon dioxide equivalent (CO₂e), which accounts for the impact of all GHGs, including methane (CH₄) and nitrous oxide (N₂O), based on their global warming potential.

1.2 Aim and objectives:

The aim of a carbon footprint project is to measure, analyze, and reduce the total greenhouse gas emissions caused by human activities, such as energy consumption, transportation, and production processes. The goal is to identify ways to minimize environmental impact and promote sustainability through informed decision-making and the adoption of eco-friendly practices.

Objectives:

1. To Save Energy
2. To Protect Natural Resources
3. To Reuse and Recycle
4. To Use Eco-Friendly Options

5. To Adopt Clean Energy

1.3 Need of Project

Creating a project focused on reducing carbon footprints can address critical environmental issues and contribute to sustainable development. Here are some key reasons highlighting the need for such a project:

Climate Change Mitigation: Reducing carbon footprints helps in mitigating climate change by lowering the amount of greenhouse gases released into the atmosphere. This is essential for slowing down global warming and its associated impacts like extreme weather events, rising sea levels, and loss of biodiversity.

Sustainability: Projects aimed at reducing carbon footprints promote sustainable practices. This includes energy efficiency, use of renewable energy sources, waste reduction, and sustainable transportation, all of which contribute to long-term environmental health.

Health Benefits: Lowering carbon emissions can improve air quality, which has direct health benefits. Reduced pollution levels can lead to fewer respiratory and cardiovascular diseases, improving overall public health.

Economic Benefits: Reducing carbon footprints can lead to significant cost savings. Energy efficiency measures, for example, can reduce utility bills, and waste reduction can lower disposal costs. Additionally, companies that demonstrate environmental responsibility can attract environmentally conscious consumers and investors.

Educational Opportunities: Such projects can provide valuable learning experiences. They can educate employees, students, and the community about the importance of sustainability and the practical steps they can take to reduce their carbon footprints.

1.4 Scope of Project

1. Energy Use
2. Transportation
3. Waste Management
4. Water Use

The figure shows the Carbon Footprint Banners posted in Campus



(a)



(b)

Fig. 1 (a) & (b) – Carbon Footprint

2. Literature Review

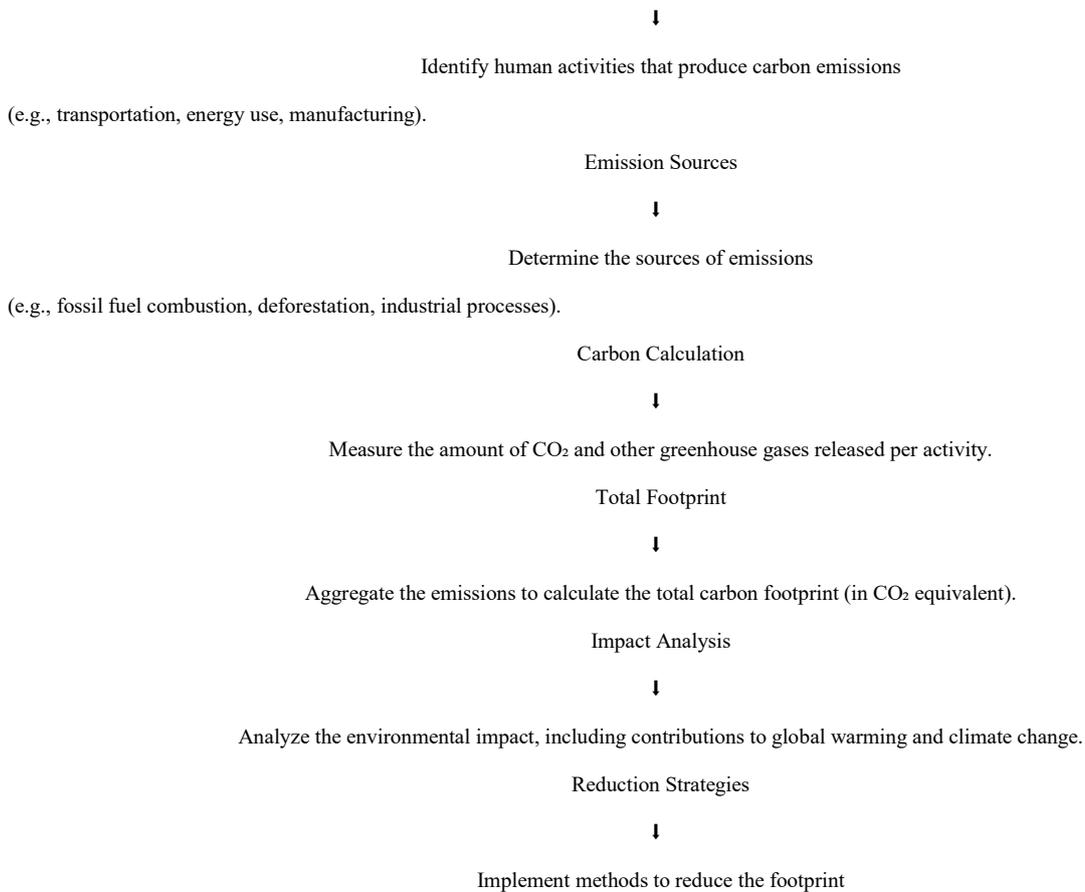
1. The study by Mishra, Gupta, and Kumar (2018) investigates the indirect carbon emissions that arise from activities within India's supply chains and their contribution to the country's overall carbon footprint. The study examines various sectors, including manufacturing, transportation, logistics, and the sourcing of raw materials, and explores how emissions in these areas, often overlooked in traditional carbon footprint assessments, significantly affect the national total. The authors' work contributes significantly to the field of environmental impact assessment by offering a more nuanced view of carbon footprints in developing countries. It underscores the importance of a holistic approach to carbon accounting that includes both direct and indirect emissions, particularly in the context of global supply chains. The study

provides valuable insights into the indirect carbon emissions associated with India's supply chains. Highlights the often-overlooked emissions that result from supply chain activities such as transportation, logistics, and sourcing of raw materials. The study's findings call for better integration of supply chain emissions into national carbon reduction strategies.

2. The study by Bansal, Sharma, and Yadav (2014) titled "Carbon Footprint and Sustainability in India: A Sectoral Review" was published in the *Environmental Science & Technology Journal*. The paper provides a comprehensive analysis of the carbon footprint across various sectors in India and assesses the potential impacts of these sectors on the country's sustainability goals. The study uses a sectoral approach to examine carbon emissions from industries such as agriculture, transportation, energy, manufacturing, and waste management. The authors concluded that India's carbon footprint is growing due to rapid industrialization, urbanization, and increased energy demand. There are substantial opportunities to mitigate these impacts. India can reduce its carbon emissions without compromising its developmental goals.
3. The study by Tiwari and Mishra (2015) examines the significant contribution of urban transportation systems to India's overall carbon emissions. As urbanization rapidly increases in India, transportation has emerged as a major source of greenhouse gas emissions, particularly in large cities where car ownership is on the rise. The study investigates the factors contributing to these emissions and proposes potential solutions to mitigate them. The paper assesses the efficiency of existing urban transport systems, including public transit and private vehicles. It notes that the current transport infrastructure in many Indian cities is often inadequate or inefficient, contributing to long commute times, air pollution, and higher emissions. The study concludes that urban transportation is a significant contributor to India's carbon emissions and that addressing this issue is crucial for the country's efforts to reduce its overall carbon footprint. The authors emphasize that effective solutions to this problem must involve a combination of infrastructure development, policy interventions, and technological advancements. India can significantly reduce its transportation-related carbon emissions and play a more active role in global climate change mitigation.
4. The study by Kumar and Jain (2011) titled "Life Cycle Assessment of Agricultural Products in India: A Case Study on Rice Production" was published in the *Journal of Cleaner Production*. The primary aim of the study was to assess the environmental impact of rice production in India by using a Life Cycle Assessment (LCA) approach. This methodology evaluates the environmental footprint of a product through its entire life cycle, from raw material extraction, production, processing, distribution, use, and disposal. The authors concluded that rice production in India has significant environmental impacts, particularly in terms of water usage and methane emissions. They emphasized that rice cultivation is a vital part of India's agriculture and food security. The environmental footprint of rice production could be significantly reduced.
5. The study by Ravindranath and Sudha (2013) titled "Afforestation and Reforestation as a Strategy to Reduce Carbon Footprints in India" was published in *Forest Ecology and Management*. This paper focuses on the role of afforestation (planting trees on land that was not previously forested) and reforestation (replanting trees in areas where forests have been depleted) in reducing India's carbon footprint. The authors examine how these land-use practices can contribute to the mitigation of greenhouse gas emissions by enhancing carbon sequestration in forest ecosystems. The main objective of the study was to assess the potential of afforestation and reforestation as strategies to reduce carbon emissions and mitigate climate change in India. The authors concluded that afforestation and reforestation hold significant potential as strategies for mitigating India's carbon footprint. They emphasized that increasing forest cover could make a major contribution to reducing CO₂ emissions. Particularly in the context of India's growing carbon emissions from energy and industrial sectors.
6. The study by Sarkar and Ghosh (2016) titled "Energy Consumption and Its Impact on Carbon Footprint in India" was published in the *Renewable and Sustainable Energy Reviews*. The paper investigates the relationship between energy consumption, particularly coal-based power generation, and India's carbon footprint. The authors analyze the role of energy consumption in the country's greenhouse gas emissions, with a focus on the major sources of energy, and emphasize the need for transitioning towards cleaner energy sources to mitigate environmental impacts. The authors concluded that while energy consumption is high, especially from coal-based power generation, there is significant potential for reducing emissions by transitioning to cleaner energy sources. Improving energy efficiency across sectors.
7. The study by Reddy and Shukla (2015) titled "Renewable Energy and Carbon Footprint in India: A Path Forward" was published in *Energy Policy*. This paper explores India's renewable energy potential and outlines strategies for reducing the carbon footprint of the country's energy sector. The authors examine the current energy landscape in India, assess the role of renewable energy sources, and provide policy recommendations to transition to a low-carbon energy system. Renewable Energy Potential: India possesses enormous renewable energy potential, especially in solar and wind power. The country is blessed with abundant sunlight, and many regions have favorable conditions for wind energy. The study emphasized that India's geographical location makes it one of the most promising countries for renewable energy generation. Additionally, other renewable resources like biomass and small-scale hydro can play a role in reducing carbon emissions from the energy sector. The authors concluded that renewable energy plays a critical role in reducing the carbon footprint of India's energy sector. The study highlighted that India faces significant challenges in transitioning from fossil fuels to renewables. The country's renewable energy potential is vast, and the transition is essential for achieving sustainable development and addressing climate change.

3. Methodology

Activity Identification



4. Study of Energy Consumption

A campus study about carbon footprint involves assessing and analyzing the greenhouse gas emissions associated with various activities on a university or college campus. Such a study can provide valuable insights into the environmental impact of the institution and help develop strategies for reducing emissions. A carbon footprint project for a college campus aims to evaluate and reduce the environmental impact of various campus activities. The study would focus on several key areas:

Energy Use: Assessing energy consumption in classrooms, dormitories, libraries, and other campus buildings. This includes electricity, heating, and cooling systems, to increase energy efficiency and transition to renewable energy sources.

Transportation: Evaluating the emissions from campus transportation, such as buses, cars, and student commuting. The study would explore ways to promote walking, cycling, carpooling, or the use of electric vehicles.

Waste Management: Analyzing waste generation on campus, including food waste, paper, plastic, and other materials. The project would focus on increasing recycling, composting, and reducing single-use plastics.

Water Use: Studying water consumption patterns across the campus, including in dormitories, kitchens, and landscaping. Strategies could include water-saving technologies, better irrigation practices, and awareness campaigns.

5. Data Collection

Table No. 1 shows the No. of Energy Equipment in the College Campus

Sr. No.	Name Of Equipment	No. of Equipment
1.	Two-wheeler Bike	300
2.	Two-wheeler Moped	130
3.	Car	10
4.	Bus	07

5.	Light	350
6.	Fans	250
7.	Air Conditioner	05
8.	Projector	04
9.	Computer	200
10.	Printer	20

6. Assessment and Reduction

Assessing the carbon footprint of a “No Vehicles Day” on campus involves several steps to quantify the impact of reduced vehicle usage.

Steps for Assessment

1. Baseline Data Collection:

- Vehicle Count: Record the number of vehicles entering the campus on a regular day.
- Vehicle Types: Categorize the vehicles (e.g., cars, motorcycles, buses).
- Fuel Types: Note the types of fuel used (e.g., petrol, diesel, electric).
- Average Distance: Estimate the average distance traveled by each vehicle to the campus.
- Emission Factors: Determine the emission factors for each type of vehicle and fuel.

2. No Vehicles Day Implementation:

- Ensure compliance with the “No Vehicles Day” policy.
- Promote alternative modes of transportation (e.g., walking, cycling, and public transportation).

3. Alternative Transportation Assessment:

- Record the number of individuals using alternative transportation methods.
- Calculate the emissions associated with these alternatives, if any (e.g., emissions from public transportation).

4. Compare Emissions:

- Calculate the total emissions on the “No Vehicles Day” from alternative transportation methods.
- Compare these emissions to the baseline emissions.

The figure shows “No Vehicle Day” in the College Campus



Fig. 2 (a) & (b) - No Vehicle Day in College Campus

Steps for Electric Boards Assessment

1. Identify All Electric Boards:

- Conduct a thorough survey of the campus to locate all electric boards.
- Create a map or diagram to mark the locations of each board.

2. Document Board Details:

- Record the details of each board including:
- Location (building, floor, room number).
- Type of board (main distribution board, sub-distribution board, etc.).
- Number of circuits and their ratings.
- Manufacturer and model.

3. Labelling and Naming:

- Implement a clear and consistent naming convention for each board.
- Ensure each board is labeled with its name, purpose, and relevant safety information.
- Use durable and legible labels.



(a)



(b)

Fig. 3 (a) & (b) - Naming on Electric Board

Table No. 2 shows the Calculation/Assessment of Carbon Footprint

Sr. No.	Name of equipment	No. of equipment	Carbon emission per year (per eqp.) (in metric tons)	Total (in metric ton)
		(A)	(B)	(AXB)
1.	Two-wheeler Bike	300	0.0003	0.09
2.	Two-wheeler Moped	130	0.00013	0.0169
3.	Car	10	0.00011	0.0011
4.	Bus	07	0.000515	0.003605
5.	Lights	350	1.752	6.132
6.	Fans	250	0.0014	0.35
7.	Air Conditioner	05	0.002326	0.01163
8.	Projector	04	0.000212	0.001908
9.	Computer	200	8.76	1.752
10.	Printer	20	2.9	5.8

Method of Reduction of Carbon Footprint

Reducing the carbon footprint on a campus can be achieved through various practical steps:

1. Energy Efficiency:

- Install energy-efficient lighting, such as LED bulbs, and ensure lights are turned off when not in use.
- Use energy-efficient appliances and HVAC systems.
- Implement energy-saving policies, like setting computers to sleep mode after a period of inactivity.

2. Renewable Energy:

- Install solar panels or wind turbines to generate renewable energy for the campus.
- Purchase green energy from utility providers.

3. Sustainable Transportation:

- Promote walking, biking, and the use of public transportation among students and staff.
- Provide bike racks and safe bike paths.
- Encourage carpooling and offer incentives for using electric vehicles.

4. Waste Reduction:

- Implement comprehensive recycling programs for paper, plastic, metal, and electronic waste.
- Reduce single-use plastics by encouraging the use of reusable bottles, cups, and containers.
- Organize campus-wide clean-up events and waste reduction campaigns.

7. Result

These objectives are crucial for reducing our carbon footprint, and their impacts can be observed in the results of carbon footprint assessments. Here's how each objective contributes:

1. Reducing energy consumption lowers the demand for fossil fuels, which in turn reduces greenhouse gas emissions.
2. Sustainable use of natural resources prevents overexploitation, helping maintain ecosystems and biodiversity, which are vital for carbon sequestration.
3. Reusing and recycling materials reduces the need for new raw materials, which decreases the energy and emissions associated with extraction, production, and disposal.
4. Opting for products and practices that have a lower environmental impact helps reduce pollution and conserve resources.
5. Utilizing renewable energy sources like solar, wind, and hydroelectric power significantly reduces carbon emissions compared to fossil fuels.

8. Conclusion

In conclusion, a carbon footprint project addresses key areas such as energy use, transportation, waste management, and water consumption. By analyzing energy usage, optimizing transportation methods, reducing waste production, and improving water efficiency, the project identifies opportunities for emission reductions. Implementing sustainable practices in these areas helps lower the overall carbon footprint, contributing to environmental protection, cost savings, and the fight against climate change.

1. Assessing energy consumption from electricity, heating, and cooling, and shifting to renewable sources to reduce emissions.
2. Analyzing emissions from vehicles, public transport, and logistics, and promoting fuel-efficient, electric, or shared transportation options.
3. Reducing waste generation, enhancing recycling and reuse, and minimizing landfill disposal to cut methane emissions.
4. Optimizing water consumption and improving water management to reduce energy demand for water heating and treatment.

9. Future Scope

The future of carbon footprint management is about finding better ways to reduce the amount of carbon dioxide and other greenhouse gases we release into the atmosphere. Here are some key points in simple terms:

1. **Renewable Energy:** More energy will come from sources like wind, solar, and hydropower instead of fossil fuels like coal and oil. This helps reduce the carbon footprint.

2. **Energy Efficiency:** Homes, buildings, and vehicles will use energy more efficiently, wasting less and saving more. For example, using LED bulbs, electric cars, and better insulation.
3. **Sustainable Practices:** Industries and businesses will adopt practices that are better for the environment, like recycling, reducing waste, and using eco-friendly materials.
4. **Technological Innovation:** New technologies will emerge to capture and store carbon emissions, preventing them from reaching the atmosphere.
5. **Public Awareness:** People will become more aware of their carbon footprint and take steps to reduce it, such as using public transport, reducing meat consumption, and conserving energy.

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