CARBON FOOTPRINT CALCULATOR

Minor project-1 report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Artificial Intelligence & Machine Learning

By

Y.Abhinay	(22UEAM0069)	**(VTU 23450)**
M.Sai Teja Reddy	(22UEAM0035)	**(VTU 23445)**
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Under the guidance of
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE& MACHINE LEARNING
SCHOOL OF COMPUTING

VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY

(Deemed to be University Estd u/s 3 of UGC Act, 1956)
Accredited by NAAC with A++ Grade
CHENNAI 600 062, TAMILNADU, INDIA

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CERTIFICATE

It is certified that the work contained in the project report titled CARBON FOOTPRINT CALCULATOR by ”Y.ABHINAY (22UEAM0069), M.SAI TEJA REDDY (22UEAM0035), P.PRAHASH CHOWDARY (22UEAM0047)” has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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November, 2024

DECLARATION

We declare that this written submission represents my ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

(Signature)
(Y.ABHINAY)
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APPROVAL SHEET

This project report entitled (CARBON FOOTPRINT CALCULATOR) by (Y.ABHINAY (22UEAM0069), (M.SAI TEJA REDDY(22UEAM0035), (P. PRAHASH CHOWDARY (22UEAM0047) is approved for the degree of B.Tech in Artificial Intelligence & Machine Learning.

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ABSTRACT

In recent years, the growing awareness of environmental sustainability has emphasized the need to reduce carbon emissions to combat climate change. This project focuses on the development of a Carbon Footprint Calculator a tool designed to estimate the total greenhouse gas emissions produced by an individual or household's daily activities. The calculator uses inputs related to energy consumption, transportation, waste production, and dietary habits to compute the corresponding carbon footprint.

The primary objective of the project is to create a user-friendly interface that encourages users to input their lifestyle choices and provides immediate feedback on their environmental impact. The project employs algorithms to calculate carbon dioxide equivalent (COe) emissions, incorporating data from credible sources such as national environmental agencies and scientific studies.

By offering tailored suggestions for reducing emissions, the tool aims to raise awareness and motivate behavioral changes toward a more sustainable lifestyle. This project demonstrates how technology can play a crucial role in mitigating climate change by empowering individuals to make informed decisions about their carbon footprint.

Keywords:

1. Carbon Emissions
2. Sustainability
3. Greenhouse gases
4. Energy consumption
5. Environmental impact
6. Carbon reduction
7. Renewable energy
8. Market Analytics
9. Sustainability Focus
10. Community Support
11. Climate change
12. Eco-friendly

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LIST OF ACRONYMS AND ABBREVIATIONS

GHG	Green House Gas
C02	Carbon Dioxide
N20	Nitrious Oxide
IPCC	Intergovernmental Panel of Climate Change
SDG	Sustainable Development Goals

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Chapter 1

INTRODUCTION

1.1 Introduction

The increasing threat of climate change is one of the most pressing global challenges of the 21st century. Human activities, especially those related to energy consumption, transportation, and industrial production, have led to a significant rise in greenhouse gas emissions, contributing to global warming and environmental degradation. As awareness about the environmental impacts of carbon dioxide and other greenhouse gas emissions grows, there is an urgent need for individuals, communities, and businesses to actively reduce their carbon footprint.

A carbon footprint refers to the total amount of greenhouse gas emissions generated by an individual, organization, or product, usually measured in terms of carbon dioxide equivalents . Understanding the personal carbon footprint is a crucial step in identifying opportunities for emission reductions and promoting sustainable practices.

This project aims to develop a Carbon Footprint Calculator, an interactive tool that allows users to estimate their own carbon footprint based on various factors, including energy usage, transportation habits, waste generation, and diet. By providing a personalized evaluation of greenhouse gas emissions, the calculator serves as an educational resource, raising awareness about the impact of everyday activities on the environment.

The development of the carbon footprint calculator is rooted in a user-centered approach, designed to be intuitive, accessible, and engaging. It uses scientifically-backed emission factors to ensure accurate calculations, and provides users with actionable suggestions for reducing their carbon footprint. The ultimate goal is to empower individuals to make more informed choices that can lead to a more sustainable future.

1.2 Aim of the project

The aim of this project is to develop a Carbon Footprint Calculator that enables individuals to estimate their personal or household carbon emissions based on their daily activities, such as energy consumption, transportation, waste production, and dietary choices. The tool seeks to raise awareness about the environmental impact of these activities and provide users with personalized recommendations for reducing their carbon footprint. By offering a simple and interactive platform, the project aims to encourage more sustainable lifestyle choices and contribute to the broader effort of mitigating climate change.

1.3 Project Domain

The Carbon Footprint Calculatorproject lies at the intersection of two key domains: Environmental Sustainability and Software Development. In the domain of environmental sustainability, the project addresses the pressing need to combat climate change by helping individuals and households become aware of their greenhouse gas emissions.As global temperatures rise due to increasing levels of carbon dioxide and other greenhouse gas in the atmosphere, understanding and reducing one's carbon footprint is critical for environmental conservation efforts. This project contributes to this domain by educating users on how their daily choices impact the planet and encouraging sustainable behavior through data-driven insights.

In the domain of Software Development, the project involves designing and implementing a web or mobile-based application that provides an intuitive and user-friendly experience. The development process includes creating algorithms to accurately calculate emissions based on various input data, such as energy use, travel methods, and waste generation. Additionally, the project incorporates elements of user interface and user experience design to ensure the tool is accessible and engaging.By combining environmental science with software engineering, the project demonstrates how technology can be leveraged to address global challenges like climate change.

1.4 Scope of the Project

The scope of this project encompasses the development of a Carbon Footprint Calculator designed to assess and provide insights into the environmental impact of an individual's or household's activities. The calculator will cover key areas such as energy consumption, etransportation, waste management, and dietary choices. For energy usage, the tool will estimate emissions based on electricity, heating, and cooling, while transportation-related emissions will be calculated from factors like vehicle type, fuel consumption, and public transportation usage. Additionally, it will account for the user's waste generation and recycling habits, as well as the environmental impact of their food choices, particularly focusing on the carbon footprint of different diets (e.g., vegetarian, vegan, meat-heavy). By offering a comprehensive view of personal emissions, the tool will empower users to take actionable steps towards reducing their carbon footprint.

The project will also feature a user-friendly interface that ensures accessibility for non-technical users. It will be built as either a web or mobile application, depending on the target platform, with an emphasis on ease of use and engagement. The scope includes designing the core algorithm for carbon calculations based on up-to-date emission factors from reputable sources, such as government databases and scientific research. Furthermore, the tool will provide users with personalized recommendations for reducing their emissions, such as switching to renewable energy sources, adopting energy-efficient appliances, reducing waste, or opting for more sustainable transportation options. In the future, the scope can be expanded to incorporate features like tracking progress over time, community challenges, or integration with smart home devices to further enhance user engagement and sustainability outcomes.

Chapter 2

LITERATURE REVIEW

2.1 Literature Review

The concept of carbon footprinting has gained significant attention in the past two decades as a critical metric in assessing environmental sustainability.Smith (2022) further elaborates on the impact of carbon footprint calculators by examining their design and effectiveness. In GreenTech Journal, Smith discusses how calculators have evolved to provide detailed recommendations for emission reduction. These tools have demonstrated effectiveness in encouraging users to adopt environmentally friendly practices by offering targeted strategies based on individual activity patterns (Smith, 2022). For instance, calculators might recommend reducing car travel, opting for renewable energy, or minimizing food waste, all of which contribute to lower greenhouse gas emissions.

Peters (2020) discusses carbon footprint accounting as a fundamental tool in aligning individual behavior with climate policy. In Carbon Footprint Accounting and Climate Policy, Peters explains how accurate accounting methods can improve the transparency and accountability of emissions reporting, thereby supporting policy implementation at multiple levels. Such calculators integrate emission factors from national databases to provide precise estimations, helping users understand the environmental impact of activities like household energy consumption, vehicle usage, and dietary choices (Peters, 2020).

Brown (2019) analyzed various environmental metrics and measurement techniques, including carbon footprint calculators, to evaluate their effectiveness. In Environmental Metrics and Measurement Techniques: A Comprehensive Analysis of Methodologies and Data Collection, Brown examined the challenges and methodologies behind data collection, underscoring the importance of accurate metrics in environmental assessment. According to Brown (2019), reliable data collection processes and methodologies are fundamental for creating actionable and dependable footprint calculators, as these factors ensure precise estimations and meaningful guidance for users.

Johnson (2021) investigated sustainable practices in carbon management, highlighting strategies that go beyond measurement to actively reduce emissions. In Sustainable Practices in Carbon Management, Johnson emphasized that calculators integrated with sustainability insights can guide users toward more impactful changes, such as increasing energy efficiency or adopting low-emission practices. Johnson (2021) suggested that combining calculators with best practices in sustainability makes these tools more effective in driving long-term behavioral changes.

2.2 Gap Identification

One key gap in existing carbon footprint calculators is the lack of personalization. Most calculators use generalized data and assumptions that don't fully account for individual user behavior or localized conditions. For example, many tools estimate emissions based on broad averages for energy consumption, transportation habits, or food choices, without incorporating specific details like the energy source mix in a user's region, the fuel efficiency of their vehicle, or their precise dietary preferences. This lack of specificity can lead to less accurate results and reduce the relevance of the recommendations provided. As a result, users may find it difficult to relate the feedback to their actual lifestyle, limiting the calculator's effectiveness in encouraging meaningful behavior changes aimed at reducing carbon emissions. Addressing this gap by enhancing personalization features could significantly improve both the accuracy of the calculations and the engagement of users in sustainable practices.

Chapter 3

ACTIVITY LOG

3.1 Project Activity Log

Date	**BRIEF DESCRIPTION OF THE DAILY ACTIVITY**	**LEARNING-OUTCOME**
6-08-2024	Define project objectives, key features of the website, and audience needs.	Gained skills in project planning, defining objectives, and organizing data.
28-08-2024	Create wireframes for the website layout, including pages such as project overview, community engagement, survey results, and agricultural insights.	Strengthened HTML coding and website structure development.
12-09-2024	Use JavaScript libraries (e.g., Chart.js) to create visual charts or graphs showcasing survey data and agricultural insights.	Developed proficiency in JavaScript for interactivity.
02-10-2024	Test all interactive features, ensure forms are working correctly, and data is displayed accurately.	Enhanced troubleshooting and bug-fixing abilities.

Table 3.1: Activity log

The Table 3.1 Activity log during our Project.

Chapter 4

PROJECT DESCRIPTION

4.1 Existing System

Existing carbon footprint calculators exhibit several significant disadvantages that limit their effectiveness in promoting sustainable behavior among users. One major drawback is the lack of personalization in the assessment of individual carbon footprints. Many calculators employ generic assumptions and averages, failing to account for the unique lifestyles, energy sources, and consumption patterns of users. For example, a calculator may estimate emissions based solely on average energy consumption rates without considering local energy mixes, such as the proportion of renewable versus fossil fuel energy in a user's region. Similarly, transportation estimates often ignore the specific fuel efficiency of a user's vehicle or the frequency of their travel. This generalized approach can lead to inaccurate assessments, making users feel disconnected from the results and less likely to act on the recommendations provided. When users cannot see the relevance of the data to their own lives, they may be discouraged from making meaningful changes to reduce their carbon emissions.

Another critical disadvantage is the poor user engagement and interface design of many existing calculators. Many tools are overly complex, filled with technical jargon, and may present data in a way that is not intuitive for the average user. Furthermore, most calculators only provide a one-time assessment of an individual's carbon footprint, lacking features for ongoing tracking or feedback. Without the ability to monitor progress over time, users may struggle to understand the impact of their efforts or to stay motivated in their pursuit of sustainable practices. The absence of integration with smart home technologies or real-time data feeds also hinders these calculators, preventing users from receiving dynamic updates that could help them adjust their behaviors immediately. Overall, these disadvantages indicate a clear need for improvement in the design and functionality of carbon footprint calculators to enhance their relevance and usability.

4.2 Problem statement

The proposed Carbon Footprint Calculator addresses key limitations of existing tools by introducing personalization and accuracy in estimating individual carbon emissions. Unlike many current systems that rely on generic data, the proposed calculator will allow users to input specific details about their daily activities, energy usage, transportation methods, and dietary preferences. By incorporating regional energy mixes (e.g., renewable versus fossil fuel-based energy sources), vehicle fuel efficiency, and customized food consumption patterns, the tool will provide a more accurate and tailored carbon footprint assessment. This level of personalization will increase the relevance of the calculator's results, making it easier for users to understand their environmental impact and motivating them to adopt more sustainable behaviors. In addition, the system will offer personalized recommendations based on the user's lifestyle, such as suggesting alternative transportation options, dietary changes, or energy-saving tips, which will be more actionable and effective in reducing carbon emissions.

Another major advantage of the proposed system is its focus on user engagement and ongoing feedback. The calculator will feature an intuitive, user-friendly interface that simplifies the process of inputting data and understanding results, making it accessible to a broader audience, including those unfamiliar with environmental science. Unlike existing systems that often provide a one-time snapshot of carbon emissions, the proposed system will offer continuous tracking of users' carbon footprints over time. This feature will allow users to monitor their progress, set reduction goals, and receive regular updates on how changes in their behavior are impacting their overall emissions. The integration of real-time data through smart home devices and IoT technologies will also enable dynamic updates, allowing users to make immediate adjustments based on real-time information. These features will create a more engaging, long-term experience that encourages sustainable habits and drives lasting behavior change toward reducing carbon emissions.

4.3 System Specification

4.3.1 Hardware Specification

1. **Development Workstation**

- **Processor (CPU)**:
  - Minimum: Intel Core i5
  - Recommended: Intel Core i7 or higher
- **Memory (RAM)**:
  - Minimum: 8 GB
  - Recommended: 16 GB
- **Storage**:
  - Minimum: 256 GB SSD
  - Recommended: 512 GB SSD or higher
- **Graphics Card (GPU)**: Integrated graphics for basic tasks; dedicated GPU for graphic design work.

2. **Testing and Preview Devices**

- **Desktop/Laptop**: Secondary device for testing across different operating systems.
- **Mobile Devices**: Smartphones and tablets for testing responsive design.

3. **Peripherals**

- **Monitor**: Minimum: 24-inch Full HD display; dual monitors recommended.
- **Keyboard and Mouse**: Ergonomic options for comfort.
- **Graphics Tablet**: Optional, for graphic design tasks.

4. **Backup and Storage Solutions**

- **External Hard Drive or NAS**: For backups of project files.
- **Cloud Storage**: Services like Google Drive for easy access and sharing.

4.3.2 Software Specification

Frontend Tools

1. **HTML5:** HTML5 is used as the foundational markup language for creating structured and semantic web content, supporting multimedia elements, forms, and graphics.

2. **CSS3:** CSS3 is utilized for advanced styling, enabling rounded corners, gradient backgrounds, text shadows, and animations. It's essential for responsive web design.

3. **JavaScript:** JavaScript enhances user interactivity, providing dynamic behavior to the web interface.

Backend Tools

1. **Database Management System MySQL**: A widely used relational database management system (RDBMS) for storing and managing data.

2. **Local Development Environment XAMPP**: A free, open-source cross-platform web server solution stack package. XAMPP includes:

- **Apache**: A web server for hosting the website locally.
- **MySQL**: For database management, as mentioned above.
- **PHP**: A server-side scripting language for dynamic content generation.

4.3.3 Standards and Policies

Anaconda Prompt

Anaconda prompt is a type of command line interface which explicitly deals with the ML(MachineLearning) modules.And navigator is available in all the Windows,Linux and MacOS.The anaconda prompt has many number of IDE's which make the coding easier. The UI can also be implemented in python.

Standard Used: ISO/IEC 27001

Jupyter

It's like an open source web application that allows us to share and create the documents which contains the live code, equations, visualizations and narrative text. It can be used for data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning.

Standard Used: ISO/IEC 27001

Chapter 5

METHODOLOGY

5.1 Proposed System

The proposed system for a Carbon Footprint Calculator is a user-friendly web or mobile application that allows individuals to estimate their carbon emissions based on daily activities such as energy usage, transportation, and waste. Users will input data like electricity consumption, vehicle mileage, and flight details, and the system will calculate their total carbon footprint using standardized emission factors. The calculator will provide personalized tips on how to reduce emissions, track progress over time, and compare results with regional or global averages. It can also generate reports that users can share to raise awareness about environmental impact.

5.2 General Architecture

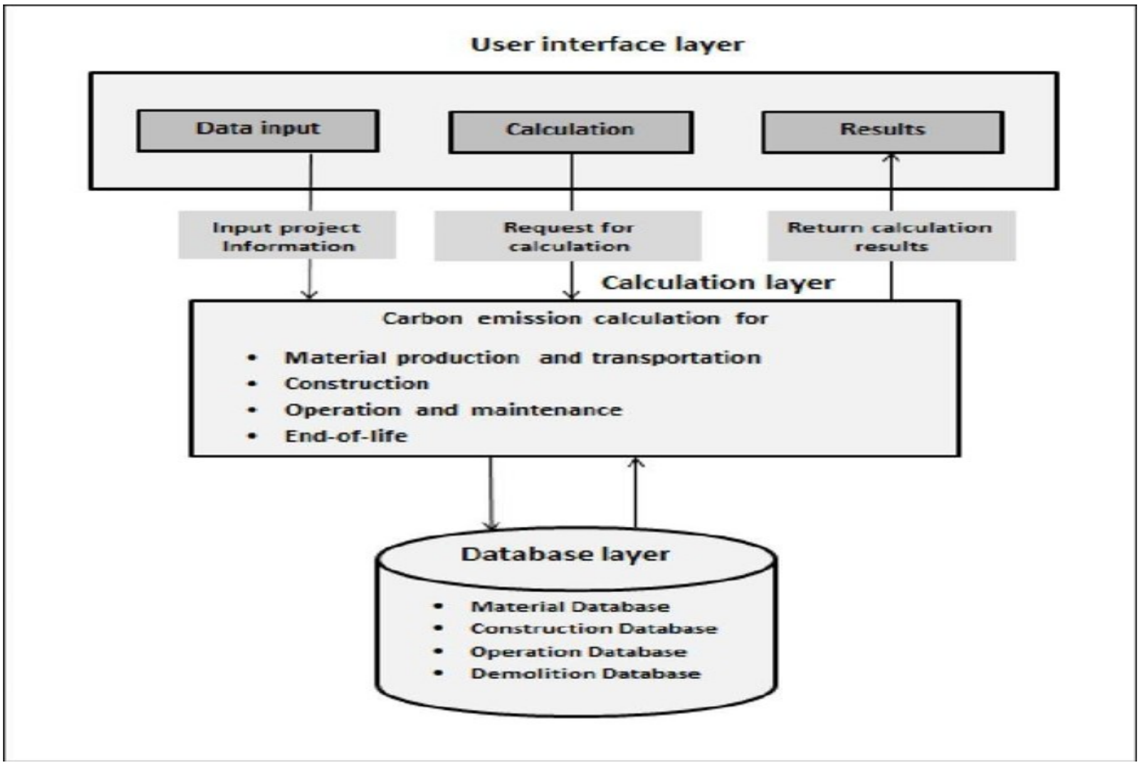

Figure 5.1: **Architecture Diagram**

The architecture diagram for a Carbon Footprint Calculator outlines the key components and their interactions within the system. At the user level, a User Interface (UI) layer provides input forms for data entry (e.g., energy usage, transportation). This UI connects to the Backend Server, which processes the user inputs through a Calculation Engine. The engine uses emission factors from a Carbon Emission Database to calculate the carbon footprint for each activity. The results are then stored in a Data Storage system, enabling historical tracking and reporting. The architecture ensures scalability, accuracy in emission calculations, and an intuitive user experience.

5.3 Design Phase

5.3.1 Data Flow Diagram

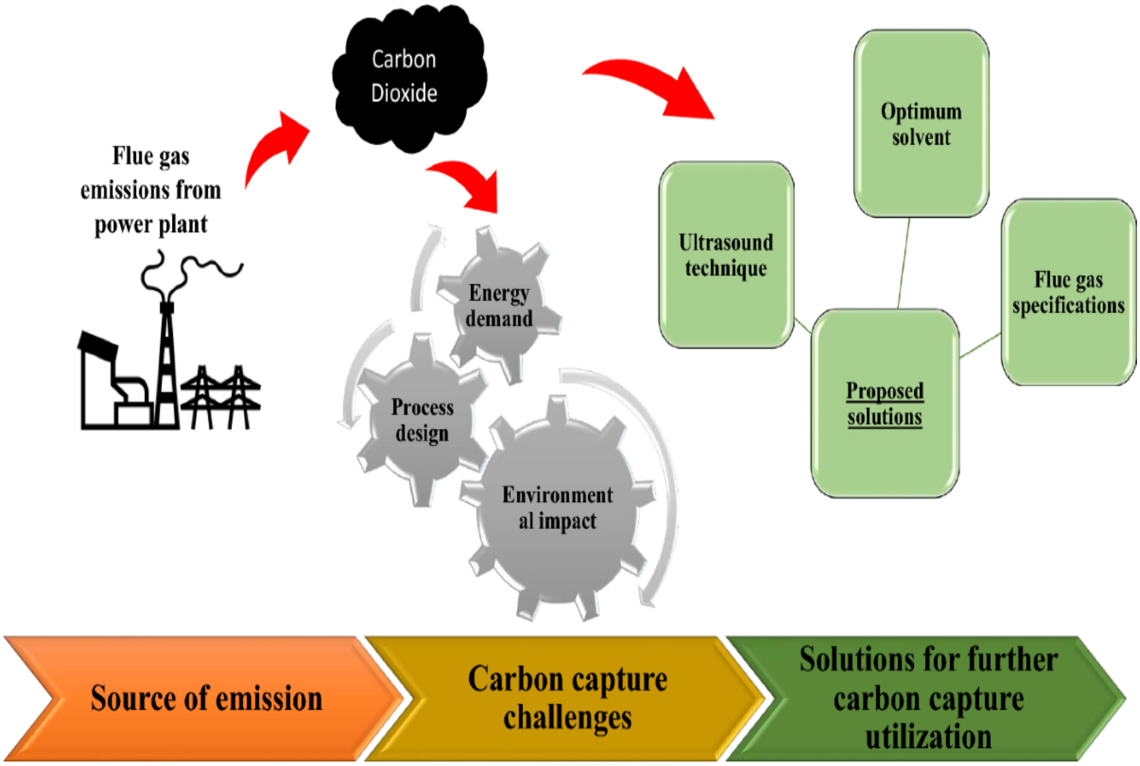

Figure 5.2: **Dataflow Diagram**

In the Data Flow Diagram (DFD) for a Carbon Footprint Calculator, the user enters information like energy usage, travel habits, and waste generation. This data is sent to a Calculation Process, where predefined emission factors are used to compute the carbon footprint. The calculated results are then directly shown to the user through the Output Display, like charts or summaries, without storing any data since there is no database in the project. The flow is simple: user input, calculation, and immediate output.

5.3.2 Use Case Diagram

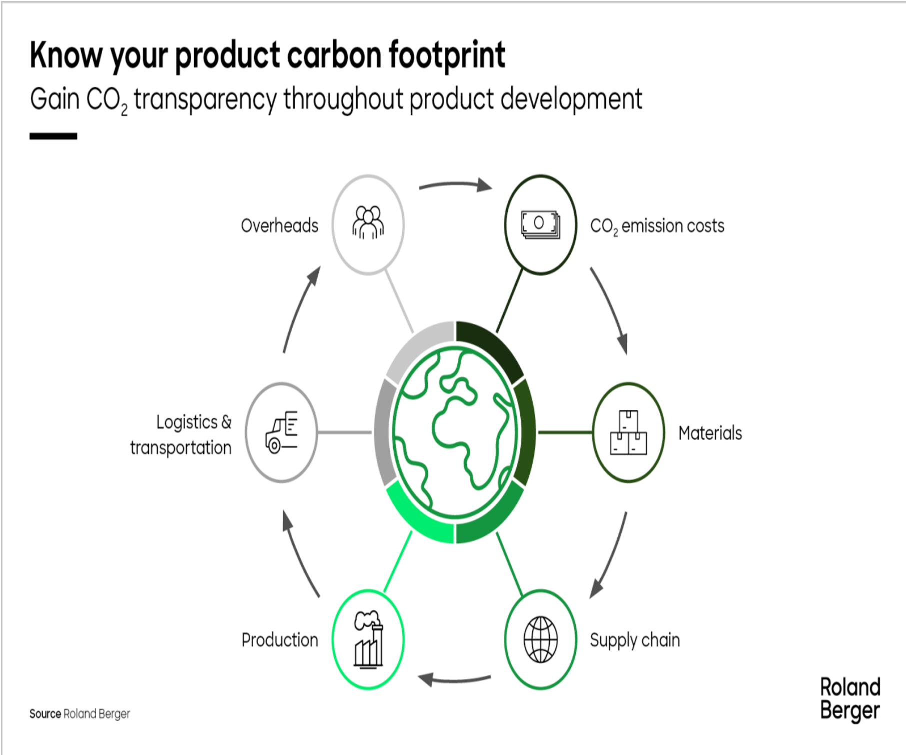

Figure 5.3: **Usecase Diagram**

The Use Case Diagram for a Carbon Footprint Calculator illustrates the interactions between users and the system. The primary actor is the User, who engages with the system to perform various tasks. Key use cases include Enter Data, where the user inputs information such as energy consumption and transportation habits; Calculate Footprint, which triggers the system to compute the carbon emissions based on the provided data; and View Results, allowing the user to see their carbon footprint in a visual format like charts or summaries. Additionally, there may be a use case for Receive Tips, where the system offers personalized suggestions for reducing carbon emissions. The diagram clearly defines the scope of the system and highlights the user's goals, providing a visual overview of how the user interacts with the Carbon Footprint Calculator.

5.3.3 Class Diagram

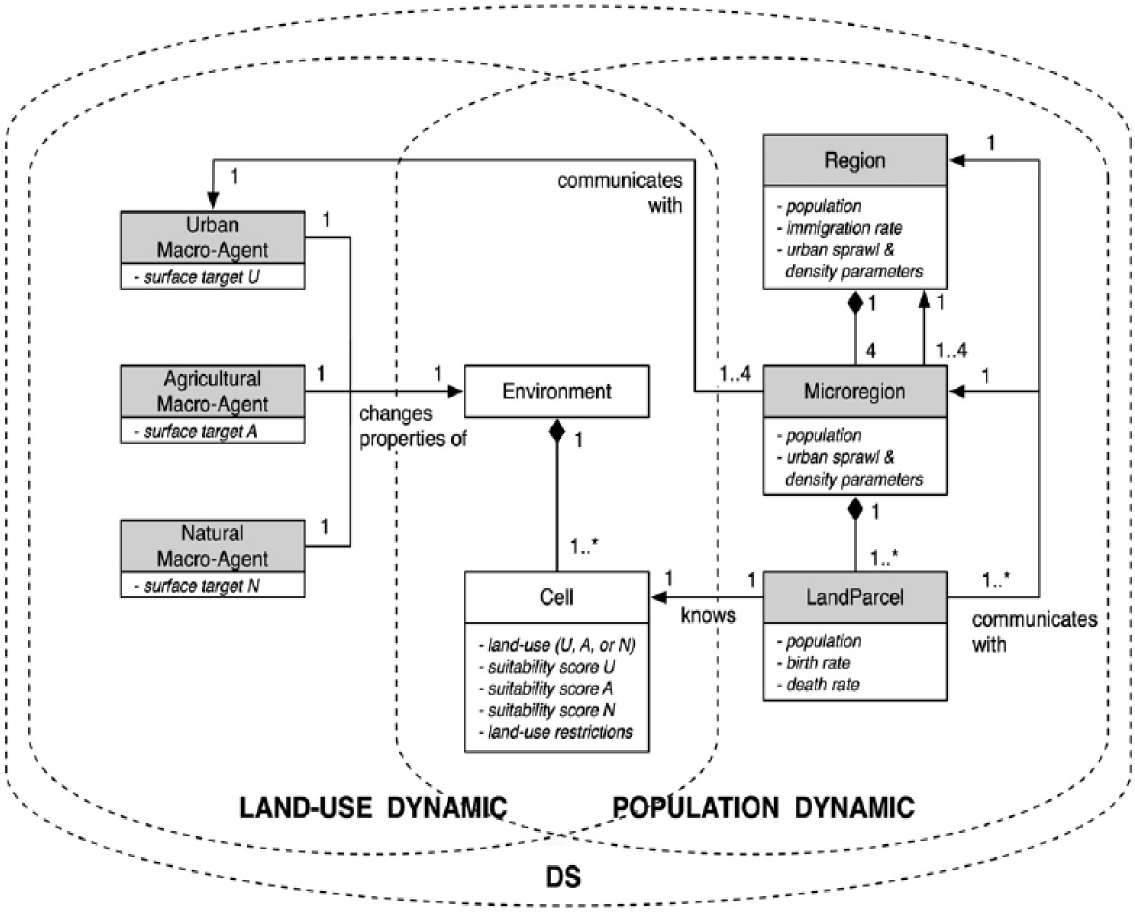

Figure 5.4: **Class Diagram**

The Class Diagram for a Carbon Footprint Calculator illustrates the main components of the system and their relationships. At the center is the User class, which holds attributes like name, location, and input data (energy usage, transportation methods, etc.). The Calculator class is responsible for processing the user input and calculating the carbon footprint using methods that apply emission factors to the data provided. The EmissionFactors class stores predefined values for various activities, such as electricity consumption and vehicle travel. Additionally, a Report class generates output in the form of visual representations or summaries based on the calculated data. Associations between these classes indicate how data flows between the user, calculation processes, and output generation, ensuring a clear structure for the application's functionality.

5.3.4 Sequence Diagram

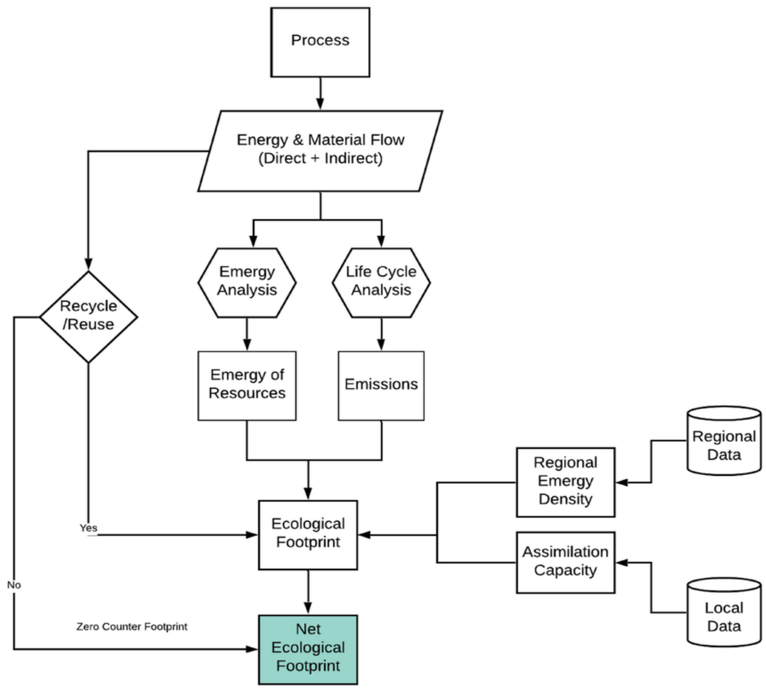

Figure 5.5: **Sequence Image**

In the Sequence Diagram for a Carbon Footprint Calculator, the interaction between the user and the system is illustrated step-by-step. It starts with the User initiating the process by entering their data, such as energy consumption and travel details, into the application. This input is then sent to the Calculation Engine. The engine processes the input by referencing predefined emission factors to calculate the total carbon footprint. Once the calculations are complete, the results are sent back to the User Interface, where the calculated carbon footprint is displayed to the user in an understandable format, such as charts or summaries. The diagram captures the sequence of events, highlighting the flow of information and the interactions between the user and the system components in a clear and structured manner.

5.3.5 Collaboration diagram

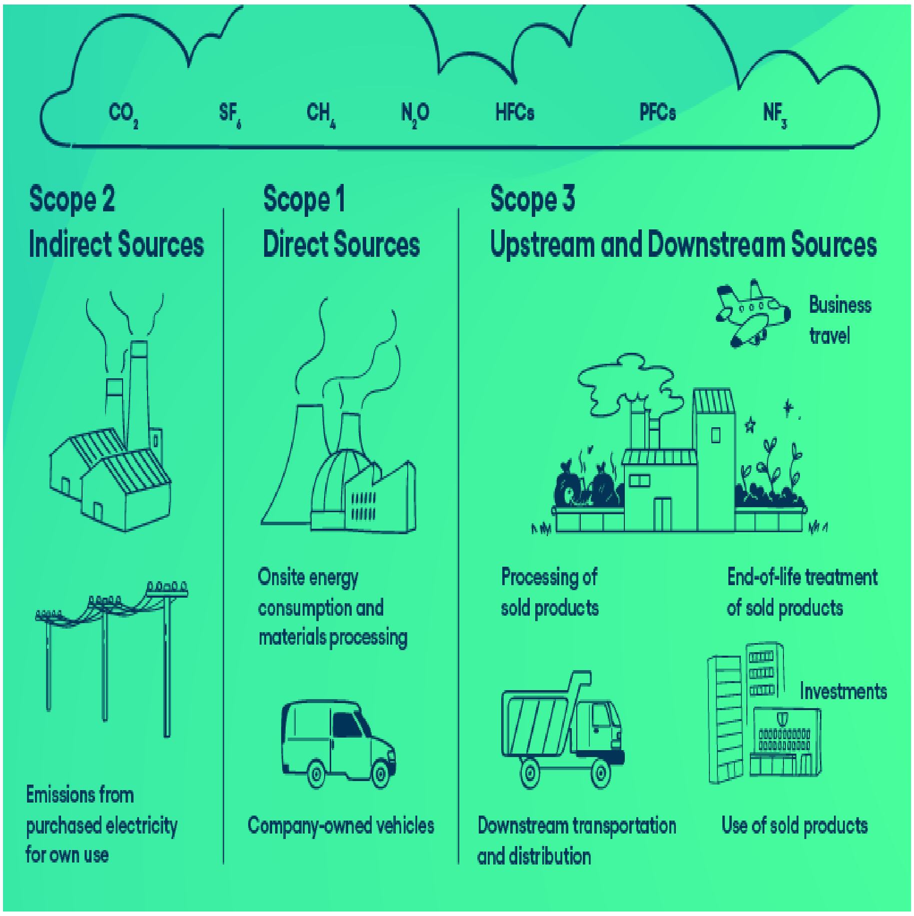

Figure 5.6: **Collabration Image**

In the Collaboration Diagram for a Carbon Footprint Calculator, the interactions between different components of the system are illustrated to show how they work together to fulfill user requests. The diagram highlights the User Interface, where users input their data on energy consumption, transportation, and waste. This data is then sent to the Calculation Engine, which processes the information using predefined emission factors. The results are communicated back to the User Interface for display, showing the calculated carbon footprint and suggestions for reduction. Additionally, the diagram may include elements like APIs for future integrations, indicating how the system could interact with external services. Overall, the collaboration diagram emphasizes the relationships and communication between the various components to provide a seamless user experience.

5.3.6 Activity Diagram

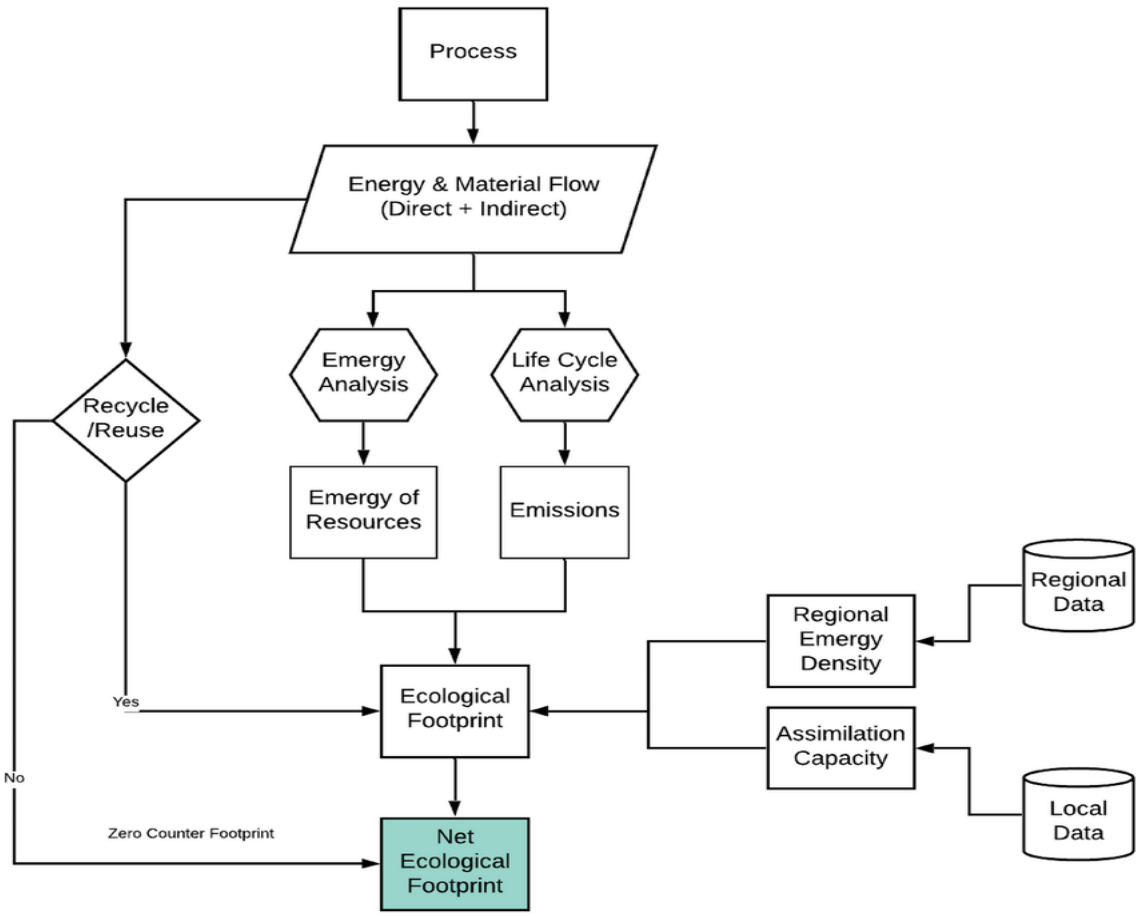

Figure 5.7: **Activity Diagram**

5.4 Algorithm & Pseudo Code

5.4.1 Algorithm

The following algorithm outlines the steps for calculating the carbon footprint based on user inputs regarding energy consumption, transportation habits, and waste generation.

1. **Start**
2. **Input Data**

   The input data consists of energy source percentages for various countries, including coal, gas, oil, hydro, renewable, and nuclear energy, as well as custom values for additional energy sources.
3. **Define Emission Factors**

- Set emissionFactorEnergy to 0.5 (kg CO2 per kWh)
- Set emissionFactorTransportation to 0.404 (kg CO2 per mile)
- Set emissionFactorWaste to 0.3 (kg CO2 per pound)

4. **Calculate Carbon Footprint**
   - Calculate carbonFootprintEnergy as energyUsage × emissionFactorEnergy
   - Calculate carbonFootprintTransportation as `transportation` × emissionFactorTransportation
   - Calculate carbonFootprintWaste as `waste` × emissionFactorWaste

5. **Display Results**
   - Display "Your total carbon footprint is: " + `totalCarbonFootprint` + " kg CO2"
   - Provide suggestions for reducing carbon footprint

6. **End**

5.4.2 Pseudo Code

```
FUNCTION CalculateCarbonFootprint()
    // Initialize variables
    totalEmissions = 0
    power = GetPowerConsumption() // Retrieve power consumption input
    energySources = ["coal", "gas", "oil", "hydro", "renewable", "nuclear"]
    emissionFactors = {
        "coal": coalEmissionFactor,
        "gas": gasEmissionFactor,
        "oil": oilEmissionFactor,
        "hydro": hydroEmissionFactor,
        "renewable": renewableEmissionFactor,
        "nuclear": nuclearEmissionFactor
    }
    FOR each source IN energySources DO
        percentage = GetPercentage(source) // Retrieve percentage for each energy source
        emissions = (power * (percentage / 100)) * emissionFactors[source] // Calculate emissions
            for each source
        totalEmissions = totalEmissions + emissions // Accumulate total emissions
    END FOR

    // Output total carbon footprint
    DisplayTotalEmissions(totalEmissions)
END FUNCTION
```

5.4.3 Data Set

The Carbon Footprint Calculator dataset consists of user inputs that estimate individual carbon emissions based on daily activities. It includes three key attributes: Energy Usage (measured in kilowatt-hours, kWh), representing the amount of electricity consumed; Transportation (measured in miles traveled), indicating the total distance traveled by personal or public transportation; and Waste Generation (measured in pounds), reflecting the weight of waste produced. Each input is used to calculate CO2 emissions through predefined emission factors, such as 0.5 kg CO2 per kWh for electricity, 0.404 kg CO2 per mile for transportation, and 0.3 kg CO2 per pound for waste. This dataset allows users to understand and quantify their carbon footprint effectively.

5.5 Module Description

5.5.1 Module 1-Data Collection

Data Collection This dataset represents the energy mix of various countries, showing the percentage of different energy sources used to generate power.- The energy sources include Coal, Gas, Oil, Hydro, Renewable, and Nuclear.- Each country's energy mix is unique, with some relying heavily on fossil fuels like Coal and Gas, while others prioritize Renewable energy sources like Hydro and Solar.- The data can be used to identify trends and patterns in global energy production and consumption.- It can also help inform policy decisions and investments in the energy sector.

5.5.2 Module 2-Country Based Collection

Country Based Collection The image you provided displays a list of countries in the form of HTML ¡option¿ elements. These elements are typically used within a ¡select¿ dropdown menu in a web form, allowing users to choose a country from a predefined list. Each '¡option¿' tag contains the country means as both its display text and value attribute. The data includes a wide variety of countries, from all over the world, listed in alphabetical order. The structure and format of the list suggest it's intended for a user interface element where a user needs to select their country of origin or residence

5.5.3 Module 3-Percentage Based CO2 EmissioN

Percentage Based CO2 Emission Calculation he Percentage-Based CO2 Emission Calculation is a method used to analyze the relative contributions of various activities to an individual's overall carbon footprint. The calculation involves determining CO2 emissions from three primary activities: energy consumption, transportation, and waste generation, using predefined emission factors. Once the individual emissions are calculated and summed to obtain the total carbon footprint, the percentage contribution of each activity is determined using the formula: Percentage Contribution = (Emissions from Activity Total Emissions) × 100 Percentage Contribution=(Total Emissions Emissions from Activity)×100. For instance, if energy usage results in 200 kg CO2, transportation contributes 100 kg CO2, and waste generation adds 50 kg CO2, the total emissions would be 350 kg CO2, with energy usage accounting for approximately 57.14

Chapter 6

TESTING

6.1 Testing

- **Unit Testing**: Verifies individual functions and components to ensure they work as expected in isolation, helping to catch bugs early in development.
- **Integration Testing**: Tests the interactions between different modules to ensure they function together correctly, preventing issues caused by miscommunication between components.
- **Functional Testing**: Validates that user flows and the application's interface perform according to requirements, ensuring that all features work as intended from the user's perspective.
- **Performance Testing**: Assesses the system's speed, load-handling capacity, and resource usage under various conditions, ensuring the application remains responsive and efficient even under stress.
- **Security Testing**: Identifies potential vulnerabilities and security risks within the application, helping to protect against threats such as unauthorized access or data breaches.
- **User Acceptance Testing (UAT)**: Collects feedback from actual users to ensure the system meets their needs and expectations, often being the final step before the product is released.
- **Regression Testing**: Ensures that existing features continue to work properly after updates or changes, preventing new code from breaking previously functioning components.
- This structured testing approach will help ensure your online portfolio project is robust, user-friendly, and secure. Tailor the testing strategies to fit the specific needs of your project, and document the results for future reference.

6.1.1 Test Result

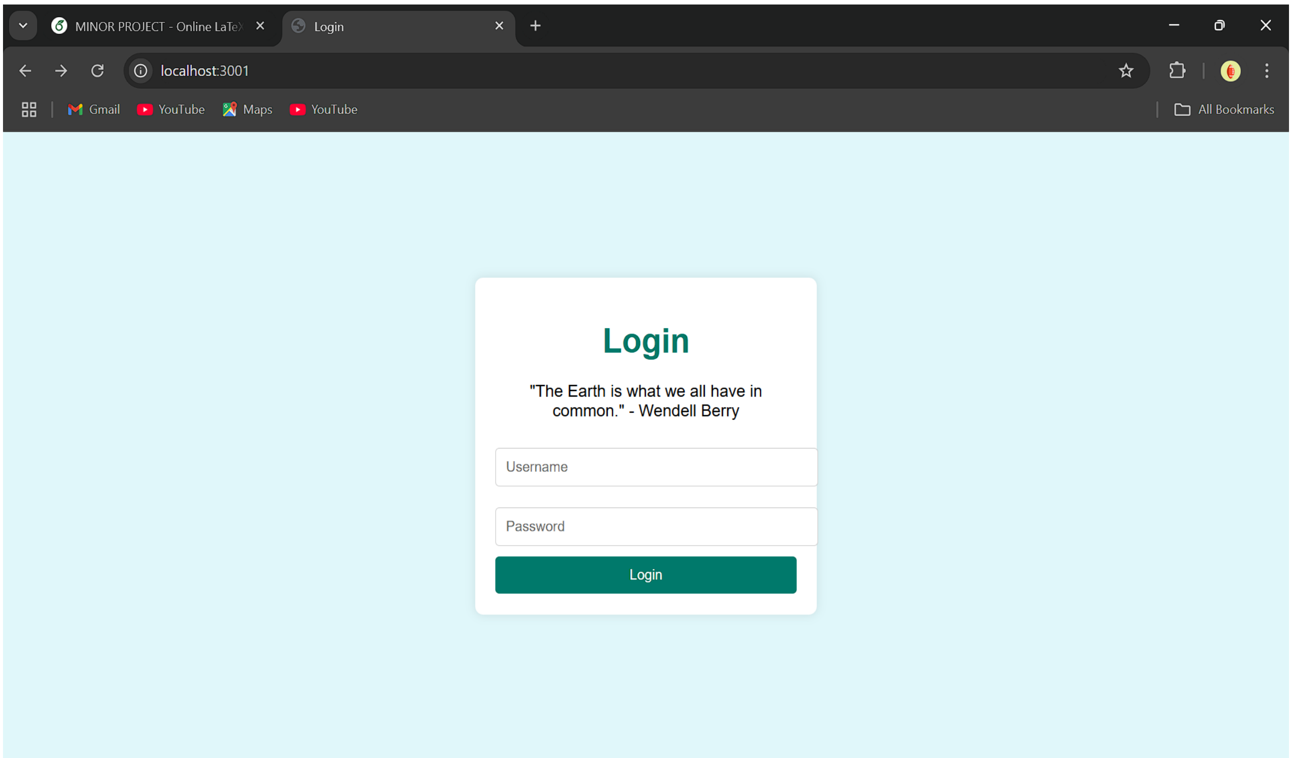

Figure 6.1: **Admin Test**

6.1.2 Test Bugs

• Based on the provided test cases, some of the potential bugs that are found during testing are: Blank spaces are allowed in the username or password fields. Numbers are allowed in the username field.

• The application does not properly validate input data, allowing non-numeric characters in fields such as energy usage, transportation miles, and waste generation. This could lead to incorrect calculations or application errors.

• In cases where the input values are zero or negative, the calculator does not handle these scenarios appropriately. Instead of displaying a relevant error message, it may return misleading results or crash.

• The application fails to provide immediate feedback when users input their data. For instance, there are no loading indicators while calculations are being performed, leaving users uncertain about whether their input has been processed.

• The website takes an excessive amount of time to process a login request, causing slow performance for the user.

Chapter 7

RESULTS AND DISCUSSIONS

7.1 Efficiency of the Proposed System

The proposed Carbon Footprint Calculator is designed to maximize efficiency in terms of accuracy, user engagement, and system performance. By incorporating personalized inputs based on specific lifestyle factors (e.g., energy consumption, transportation habits, diet), the calculator delivers more accurate carbon footprint estimates compared to generic systems. This high level of personalization ensures that users receive relevant recommendations for reducing their carbon emissions, thus improving the system's effectiveness in driving sustainable behavior changes.

In terms of performance, the system will be optimized for low-power devices and efficient resource utilization. Using lightweight frameworks like ReactJS for web and Flutter for mobile ensures the application runs smoothly across platforms while minimizing CPU and memory usage. The integration of cloud-based processing also reduces the local hardware load, allowing the system to function efficiently even on devices with lower specifications. Additionally, the use of real-time data integration with IoT devices allows dynamic updates without significant delays, enhancing the system's responsiveness and overall user experience.

7.2 Comparison of Existing and Proposed System

Existing system:(Decision Trees)

In the existing system, carbon footprint calculations are often done manually or using basic calculators that rely on predefined values for specific activities, such as average energy consumption or transportation emissions. These calculators do not account for personalized user data and fail to give a detailed breakdown of emissions. Additionally, the manual approach is prone to errors and lacks accuracy due to oversimplified models that do not consider variations in energy usage, transportation, and waste generation. Moreover, existing systems generally lack features like real-time suggestions to help users reduce their carbon footprint. This makes them less user-friendly and less effective in helping users make informed decisions about reducing their environmental impact.

Proposed system:(Random Forest Algorithm)

In the proposed system, we have developed an enhanced carbon footprint calculator using a more refined and user-specific approach. By allowing users to input personalized data, such as exact energy consumption, transportation miles traveled, and waste generated, the proposed system provides a more accurate calculation of carbon emissions. The system uses predefined emission factors for each category (energy, transportation, waste) and calculates total CO2 emissions. The proposed system also includes a breakdown of percentage-based CO2 emissions for each activity, giving users a clearer understanding of which activities contribute most to their carbon footprint. Additionally, the system provides real-time suggestions for reducing emissions, making it more interactive and user-centric than the existing systems. The improved accuracy and detailed insights of the proposed system offer a significant advantage over traditional calculators by providing actionable insights and fostering greater awareness of personal environmental impact.

Output

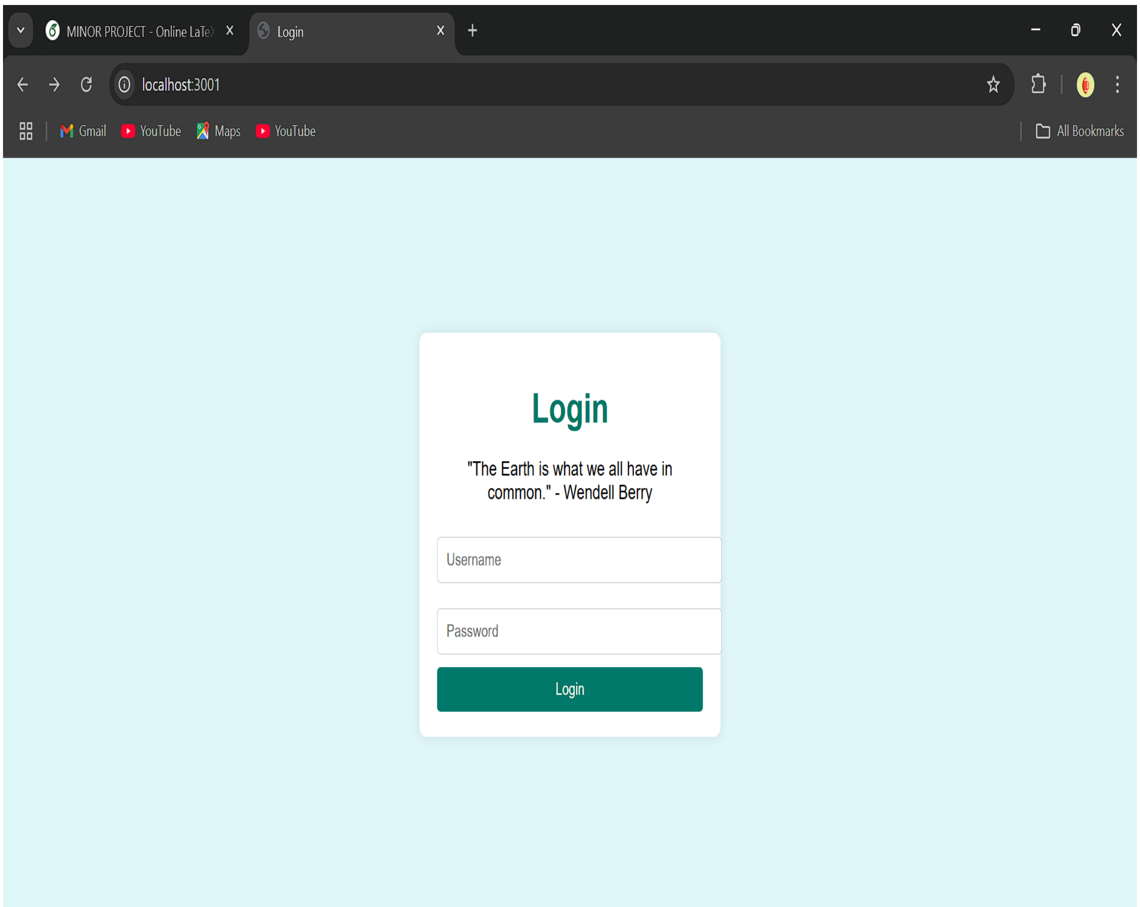

Figure 7.1: **Login Page**

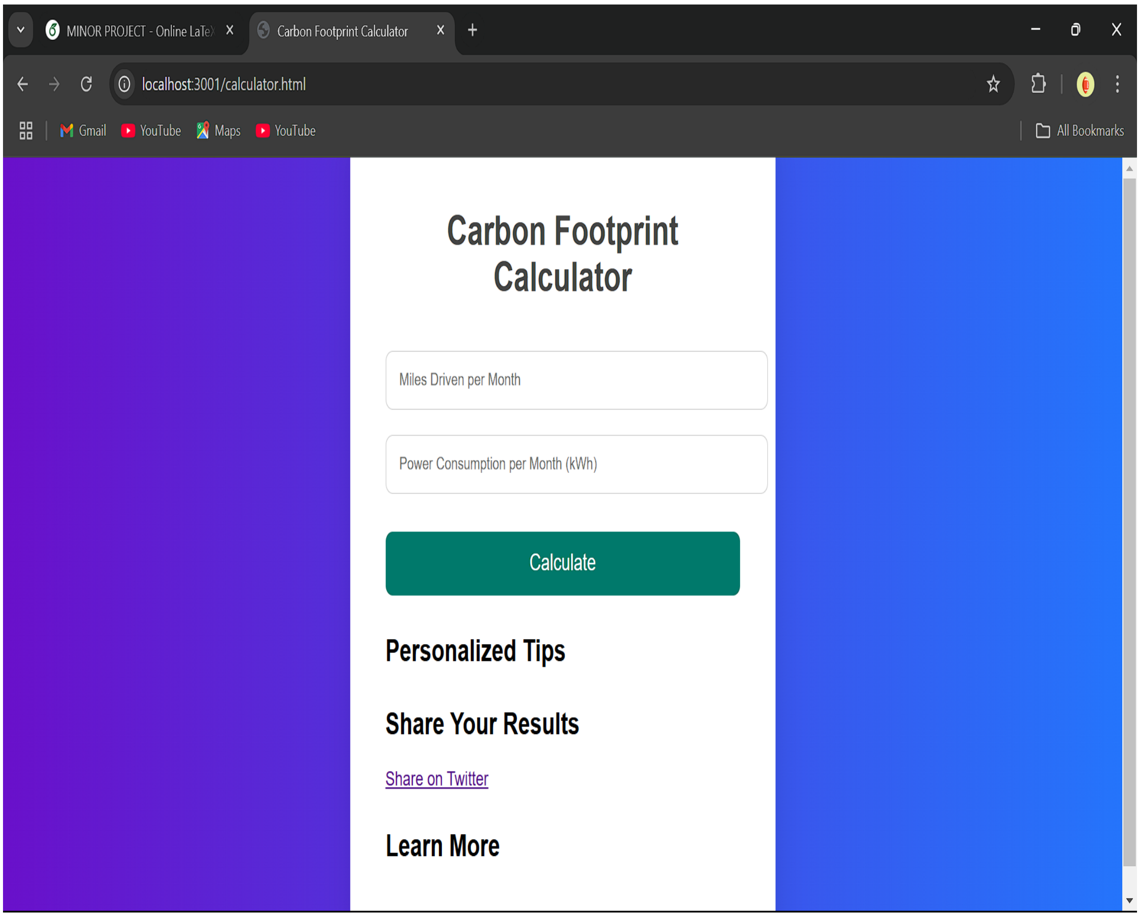

Figure 7.2: **Carbon Emission Calculator**

Chapter 8

CONCLUSION AND FUTURE ENHANCEMENTS

8.1 Conclusion

In conclusion, the proposed Carbon Footprint Calculator offers a modern solution to a growing environmental challenge by providing a personalized, accurate, and user-friendly tool for assessing and reducing carbon emissions. Unlike existing systems that rely on generalized assumptions, this calculator incorporates detailed user-specific data related to energy usage, transportation, waste management, and dietary choices. By offering tailored carbon reduction recommendations and integrating real-time data from IoT devices and smart technologies, the system empowers individuals to make informed decisions that can significantly reduce their environmental impact. The system's ability to track progress over time also helps users stay engaged and motivated in their sustainability efforts, encouraging long-term behavioral changes.

Moreover, the proposed system's cross-platform compatibility, efficient resource usage, and cloud-based storage ensure broad accessibility, even on devices with minimal hardware specifications. By integrating advanced technologies like cloud computing and smart sensors, the tool enhances both accuracy and efficiency, delivering real-time updates that make it a valuable resource in today's connected world. This combination of user engagement, technological integration, and practical impact makes the proposed Carbon Footprint Calculator a meaningful contribution to individual and collective efforts to combat climate change. With ongoing enhancements and wider adoption, the system could help raise environmental awareness and promote more sustainable living at both personal and societal levels.

8.2 Future Enhancements

The Carbon Footprint Calculator has the potential for several future enhancements that can further improve its accuracy, functionality, and user engagement. One key enhancement would be the integration of machine learning algorithms to provide more intelligent, data-driven recommendations for users. Machine learning can analyze patterns in user behavior over time and offer increasingly personalized suggestions based on individual habits, local environmental conditions, and broader trends in energy consumption. Additionally, the calculator could be improved by incorporating real-time carbon pricing data to help users see the financial benefits of reducing their emissions. For instance, users could receive alerts on how much they could save by switching to renewable energy sources or reducing their travel emissions, linking sustainability with economic incentives.

Another area of enhancement involves greater connectivity with smart technologies. As IoT devices and smart homes become more common, integrating deeper with energy monitors, smart thermostats, and electric vehicle chargers could provide users with instant updates on their carbon emissions. Future versions of the system could allow users to automatically adjust their home energy use based on real-time data, optimizing both energy efficiency and cost savings. Additionally, expanding the calculator to include community-based features could create a social aspect where users compare their carbon footprints with friends or local groups, participate in challenges, and collectively work towards emission reduction goals. This would enhance user motivation and engagement, turning the calculator into a tool for not only personal progress but also collective environmental action.

Chapter 9

PLAGIARISM REPORT

Check Plagiarism

PLAGIARISM SCAN REPORT

Date	October 29, 2024
Exclude URL:	NO

Unique Content	**100**	Word Count	165
Plagiarized Content	**0**	Records Found	0

CONTENT CHECKED FOR PLAGIARISM:

Aim of the project:
The aim of this project is to develop a Carbon Footprint Calculator that enables individuals to estimate their personal or household carbon emissions based on their daily activities, such as energy consumption, transportation, waste production, and dietary choices
Scope Of Project:
The scope of this project encompasses the development of a Carbon Footprint Calculator designed to assess and provide insights into the environmental impact of an individual’s or household’s activities. The calculator will cover key areas such as energy consumption, etransportation, waste management, and dietary choices. For energy usage, the tool will estimate emissions based on electricity, heating, and cooling, while transportation-related emissions will be calculated from factors like vehicle type, fuel consumption, and public transportation usage.
It is certified that the work contained in the project report titled CARBON FOOTPRINT CALCULATOR by ”Y.ABHINAY (22UEAM0069), M.SAI TEJA REDDY (22UEAM0035), P.PRAHASH CHOWDARY (22UEAM0047)” has been carried out under my supervision and that this work has not been submitted elsewhere for a degre

MATCHED SOURCES:

Report Generated on **October 29, 2024** by https://www.check-plagiarism.com/ (https://www.check-plagiarism.com/)

Page 1 of 1

Figure 9.1: **Plagiarism Report**

Chapter 10

SOURCE CODE

```
<!DOCTYPE html>
<html lang="en">

<head>
    <link rel="stylesheet" href="style.css">
</head>

<body>
    <form>
        <label for="countries">Preload the electricity generation stats by the country:</label>
        <select id="countries" onchange="CountrySelected()" autofocus>
            <option value="Albania">Albania</option>
            <option value="Algeria">Algeria</option>
            <option value="Angola">Angola</option>
            <option value="Argentina">Argentina</option>
            <option value="Armenia">Armenia</option>
            <option value="Australia">Australia</option>
            <option value="Austria">Austria</option>
            <option value="Azerbaijan">Azerbaijan</option>
            <option value="Bahrain">Bahrain</option>
            <option value="Bangladesh">Bangladesh</option>
            <option value="Belarus">Belarus</option>
            <option value="Belgium">Belgium</option>
            <option value="Benin">Benin</option>
            <option value="Bolivia">Bolivia</option>
            <option value="Bosnia and Herzegovina">Bosnia and Herzegovina</option>
            <option value="Botswana">Botswana</option>
            <option value="Brazil">Brazil</option>
            <option value="Brunei Darussalam">Brunei Darussalam</option>
            <option value="Bulgaria">Bulgaria</option>
            <option value="Cambodia">Cambodia</option>
            <option value="Cameroon">Cameroon</option>
            <option value="Canada">Canada</option>
            <option value="Chile">Chile</option>
            <option value="China">China</option>
            <option value="Hong Kong SAR, China">Hong Kong SAR, China</option>
            <option value="Colombia">Colombia</option>
            <option value="Congo, Dem. Rep.">Congo, Dem. Rep.</option>
            <option value="Congo, Rep.">Congo, Rep.</option>
            <option value="Costa Rica">Costa Rica</option>
            <option value="Cote d'Ivoire">Cote d'Ivoire</option>
```

```
        <option value=”Croatia”>Croatia</option>
        <option value=”Cuba”>Cuba</option>
        <option value=”Curacao”>Curacao</option>
        <option value=”Cyprus”>Cyprus</option>
        <option value=”Czech Republic”>Czech Republic</option>
        <option value=”Denmark”>Denmark</option>
        <option value=”Dominican Republic”>Dominican Republic</option>
        <option value=”Ecuador”>Ecuador</option>
        <option value=”Egypt, Arab Rep.”>Egypt, Arab Rep.</option>
        <option value=”El Salvador”>El Salvador</option>
        <option value=”Eritrea”>Eritrea</option>
        <option value=”Estonia”>Estonia</option>
        <option value=”Ethiopia”>Ethiopia</option>
        <option value=”Finland”>Finland</option>
        <option value=”France”>France</option>
        <option value=”Gabon”>Gabon</option>
        <option value=”Georgia”>Georgia</option>
        <option value=”Germany”>Germany</option>
        <option value=”Ghana”>Ghana</option>
        <option value=”Greece”>Greece</option>
        <option value=”Guatemala”>Guatemala</option>
        <option value=”Haiti”>Haiti</option>
        <option value=”Honduras”>Honduras</option>
        <option value=”Hungary”>Hungary</option>
        <option value=”Iceland”>Iceland</option>
        <option value=”India”>India</option>
        <option value=”Indonesia”>Indonesia</option>
        <option value=”Iran, Islamic Rep.”>Iran, Islamic Rep.</option>
        <option value=”Iraq”>Iraq</option>
        <option value=”Ireland”>Ireland</option>
        <option value=”Israel”>Israel</option>
        <option value=”Italy”>Italy</option>
        <option value=”Jamaica”>Jamaica</option>
        <option value=”Japan”>Japan</option>
        <option value=”Jordan”>Jordan</option>
        <option value=”Kazakhstan”>Kazakhstan</option>
        <option value=”Kenya”>Kenya</option>
        <option value=”Korea, Dem. Peoples Rep.”>Korea, Dem. Peoples Rep.</option>
        <option value=”Korea, Rep.”>Korea, Rep.</option>
        <option value=”Kosovo”>Kosovo</option>
        <option value=”Kuwait”>Kuwait</option>
        <option value=”Kyrgyz Republic”>Kyrgyz Republic</option>
        <option value=”Latvia”>Latvia</option>
        <option value=”Lebanon”>Lebanon</option>
        <option value=”Libya”>Libya</option>
        <option value=”Lithuania”>Lithuania</option>
        <option value=”Luxembourg”>Luxembourg</option>
        <option value=”Macedonia, FYR”>Macedonia, FYR</option>
        <option value=”Malaysia”>Malaysia</option>
        <option value=”Malta”>Malta</option>
```

```
            <option value="Mauritius">Mauritius</option>
            <option value="Mexico">Mexico</option>
            <option value="Moldova">Moldova</option>
            <option value="Mongolia">Mongolia</option>
            <option value="Montenegro">Montenegro</option>
            <option value="Morocco">Morocco</option>
            <option value="Mozambique">Mozambique</option>
            <option value="Myanmar">Myanmar</option>
            <option value="Namibia">Namibia</option>
            <option value="Nepal">Nepal</option>
            <option value="Netherlands">Netherlands</option>
            <option value="New Zealand">New Zealand</option>
            <option value="Nicaragua">Nicaragua</option>
            <option value="Niger">Niger</option>
            <option value="Nigeria">Nigeria</option>
            <option value="Norway">Norway</option>
            <option value="Oman">Oman</option>
            <option value="Pakistan">Pakistan</option>
            <option value="Panama">Panama</option>
            <option value="Paraguay">Paraguay</option>
            <option value="Peru">Peru</option>
            <option value="Philippines">Philippines</option>
            <option value="Poland">Poland</option>
            <option value="Portugal">Portugal</option>
            <option value="Qatar">Qatar</option>
            <option value="Romania">Romania</option>
            <option value="Russian Federation">Russian Federation</option>
            <option value="Saudi Arabia">Saudi Arabia</option>
            <option value="Senegal">Senegal</option>
            <option value="Serbia">Serbia</option>
            <option value="Singapore">Singapore</option>
            <option value="Slovak Republic">Slovak Republic</option>
            <option value="Slovenia">Slovenia</option>
            <option value="South Africa">South Africa</option>
            <option value="South Sudan">South Sudan</option>
            <option value="Spain">Spain</option>
            <option value="Sri Lanka">Sri Lanka</option>
            <option value="Sudan">Sudan</option>
            <option value="Suriname">Suriname</option>
            <option value="Sweden">Sweden</option>
            <option value="Switzerland">Switzerland</option>
            <option value="Syrian Arab Republic">Syrian Arab Republic</option>
            <option value="Tajikistan">Tajikistan</option>
            <option value="Tanzania">Tanzania</option>
            <option value="Thailand">Thailand</option>
            <option value="Togo">Togo</option>
            <option value="Trinidad and Tobago">Trinidad and Tobago</option>
            <option value="Tunisia">Tunisia</option>
            <option value="Turkey">Turkey</option>
            <option value="Turkmenistan">Turkmenistan</option>
```

```
                <option value="Ukraine">Ukraine</option>
                <option value="United Arab">United Arab</option>
                <option value="United Kingdom" selected>United Kingdom</option>
                <option value="United States">United States</option>
                <option value="Uruguay">Uruguay</option>
                <option value="Uzbekistan">Uzbekistan</option>
                <option value="Venezuela, RB">Venezuela, RB</option>
                <option value="Vietnam">Vietnam</option>
                <option value="Yemen, Rep.">Yemen, Rep.</option>
                <option value="Zambia">Zambia</option>
                <option value="Zimbabwe">Zimbabwe</option>
            </select>
            <br><br>

            <table id="inputTable" class="inputTable">
             <td><label for="coal"¿Coal¡/label¿¡/td¿¡td¿¡input type="text" id="coal¡td¿¡input type="text" id="coalCO" class="num"
                 value="820" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>
            <tr>
                <td><label for="gas"¿Natural gas¡/label¿¡/td¿¡td¿¡input type="text" id="gas¡td¿¡input type="text" id="gasCO"
                    class="num" value="490" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>
            <tr>
                <td><label for="oil"¿Oil¡/label¿¡/td¿¡td¿¡input type="text" id="oil¡td¿¡input type="text" id="oilCO" class="num"
                    value="778" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>
            <tr>
                <td><label for="hydro"¿Hydropower*¡/label¿¡/td¿¡td¿¡input type="text" id="hydro¡td¿¡input type="text" id="hydroCO"
                    class="num" value="24" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>
            <tr>
                <td><label for="renew"¿Renewable**¡/label¿¡/td¿¡td¿¡input type="text" id="renew¡td¿¡input type="text" id="renewCO"
                    class="num" value="41" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>
            <tr>
                <td><label for="nuclear"¿Nuclear¡/label¿¡/td¿¡td¿¡input type="text" id="nuclear¡td¿¡input type="text" id="nuclearCO"
                    class="num" value="12" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>
            <tr>
                <td><label for="custom"¿Custom¡/label¿¡/td¿¡td¿¡input type="text" id="custom¡td¿¡input type="text" id="customCO"
                    class="num" value="0" onkeyup="Calculate("> gCO<sub>2</sub>/kWh</td>
            </tr>

        </table>
        <br>

        Total percentage: <span id="total"¿¡/span¿¡br¿¡label for="power"¿How much power do you use (continuously?</label>
        <input type="text" id="power" value="1000" class="power" onkeyup="Calculate()">
        <select id="powerUnit" onchange="Calculate()">
            <option value="1000" id="W" selected>W</option>
            <option value="1" id="kW">kW</option>
            <option value="0.001" id="MW">MW</option>
            <option value="0.000001" id="GW">GW</option>
```

```
            <option value="0.000000001" id="TW">TW</option>
        </select>
        <br>


        <!--RESULTS-->
        You produce <b><span id="kgCO2result"></span></b> kg of CO<sub>2</sub> emissions per year.
        <br>
        You would need to plant <b><span id="treesRequired"></span></b> trees to eliminate your carbon footprint on our
        planet.
        <br>
        You can donate <b><span id="priceRequired"></span>$</b> to <a href="https://trees.org">trees.org</a> to eliminate
        your carbon footprint.

        <br>
        <input type="reset">

</form>

*gCO<sub>2</sub> can vary widely, read Wiki page in Sources
<br>
**using gCO2 values for Solar PV rooftop, read Wiki page in Sources for other values

<br>
<button title="Click to show/hide content" type="button"
        onclick="if(document.getElementById('spoiler').style.display==='none') {document.getElementById('spoiler').style.display=''}else{document.getElementById('spoiler').style.display='none'}">
    Sources and notes
</button>
<div id="spoiler" style="display:none">
    <fieldset class="fieldSet">
        Electricity sources: <a href="http://wdi.worldbank.org/table/3.7">The World Bank statistics</a> (Data from 2015)
        <br>
        CO<sub>2</sub>/kWh values: Using median values from IPCC: Global warming potential of selected electricity
        sources (2014)
        <br>
        CO<sub>2</sub>/kWh values may differ a lot, especially when power plants use newest (better values), or older
        (worse values) technologies.
        Check the <a href="https://en.wikipedia.org/wiki/Life-cycle_greenhouse-gas_emissions_of_energy_sources">Wikipedia
        page</a> for Min/Max values.
        <br>
        This calculations assume that you use electricity proportionally from all power plants of your country.
```

```
        <br>
        If you know better where your electricity comes from (for example, you use your own solar power), edit the
        settings accordingly.
        <br>
        One tree can eliminate 15.7 kg of CO<sub>2</sub> per year. Source: <a href="https://www.tfaforms.com/4666774">https://www.tfaforms.com/4666774</a>
        <br>
    </fieldset>
</div>
<br>



    <script src="script.js"></script>
</body>

</html>
```

CSS CODE

```
html
{
font-family: Source Sans Pro, sans serif;
background-color:#AAAAAA;
}

.num
{
  width: 5ch;
}

.power
{
  width: 7ch;
  text-align: right;
}

.fieldSet
{
  display:inline-block;
}

table
{
  border: 2px solid black;
}

th, td
```

```
{
  border-bottom: 1px solid #DDD;
}

tr:hover
{
  background-color: #B58F8F !important;
}

tr:nth-child(even)
{
  background-color: #F2F2F2;
}

select
{
    width: 20ch;
    padding: 4px 10px;
    border: none;
    border-radius: 4px;
    background-color: #f1f1f1;
}

input
{
    border: 1px solid black;
    border-radius: 4px;
  padding: 3px;
}
```

JS CODE

```
const byId = (id) => document.getElementById(id);
const csvData = CSVParse();

CountrySelected();
Calculate();

function CountrySelected() {
    const country = byId("countries").value;
    const energySources = ['Coal', 'Gas', 'Oil', 'Hydro', 'Renewable', 'Nuclear'];

    energySources.forEach(source => {
        byId(`${source.toLowerCase()}`.value = csvData[country][source];
    });

    Calculate();
}

```

```
function Calculate() {
    const e = byId("powerUnit");
    const power = byId("power").value / e.options[e.selectedIndex].value;

    const totalPercentage = energySources.reduce((total, source) => {
        return total + Number(byId(`${source.toLowerCase()}`.value);
    }, 0) + Number(byId("custom".value);

    byId("total".textContent = `${Math.round(totalPercentage * 10) / 10}`;updateResults(kgCO2result,
        treesRequired;
}

function calculateCO2(power) {
    return (
        ((energySources.reduce((total, source) => {
            return total + (Number(byId(`${source.toLowerCase()}`.value) * Number(byId(`${source.
                toLowerCase()}CO`).value));
        }, 0) + Number(byId("custom".value) * Number(byId("customCO").value) / 100000) * 24 *
            365.2422 * power)
    );
}

function updateResults(kgCO2result, treesRequired) {
    byId("kgCO2result").textContent = Math.ceil(kgCO2result).toLocaleString('en').replace(/,/g, " ")
        ;
    byId("treesRequired").textContent = Math.ceil(treesRequired).toLocaleString('en').replace(/,/g,
        " ");
    byId("priceRequired").textContent = Math.round(treesRequired / 10).toLocaleString('en').replace
        (/,/g, " ");
}

function CSVParse() {
    // CSV->JSON from /Sources/data.csv
    const rawData = `{
        "Albania": {"Coal": 0, "Gas": 0, "Oil": 0, "Hydro": 100, "Renewable": 0, "Nuclear": 0},
        "Algeria": {"Coal": 0, "Gas": 97.8, "Oil": 1.8, "Hydro": 0.4, "Renewable": 0, "Nuclear": 0},
        // ... (other country data)
        "France": {"Coal": 2.2, "Gas": 2.3, "Oil": 0.3, "Hydro": 11.3, "Renewable": 0, "Nuclear":
            50.6}
    }`;
    return JSON.parse(rawData);
}
```

Appendix A

REFERENCES

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