

GreenChain: A Supply Chain Emissions and Performance Tracker

Project Summary

GreenChain Insights is a web application that enables users to explore greenhouse gas emissions data across different industry sectors, with a focus on NAICS code classifications. Through an interactive dashboard interface, users can analyze emissions data and simulate the impact of their own purchases, providing both broad industry-level insights and personalized carbon footprint calculations. The platform serves as a comprehensive tool for understanding emissions patterns and their relationship to individual consumer choices.

The system's strength lies in its ability to combine historical industry data with personal impact simulations, creating a bridge between macro-level emissions data and individual decision-making. Users can explore detailed breakdowns of emissions by sector, conduct advanced searches based on various parameters, and generate personalized scenarios to understand the environmental impact of their purchasing decisions.

Application Description

We aim to build a database-driven application that consolidates key information from two sources:

1. **GHG Emission Factors by Industry:** Each NAICS code has a CO₂-equivalent emission factor (e.g., kg CO₂e per USD spent). This dataset reveals the upstream or embedded carbon footprint for products in that industry sector. ([Link](#))
2. **Supply Chain Operational Data:** Detailed shipping and order records, including shipping days, scheduled vs. real timelines, late-delivery risk indicators, category information, and more. ([Link](#))

By combining these datasets, we can create an estimated emission intensity of each shipment or order, estimate the environmental impact of various factors, and potentially identify the most “carbon-heavy” product segments. The primary problem it addresses is the lack of accessible, granular information on the environmental impact of business activities, which can hinder effective sustainability strategies. In addition to offering interactive visualizations and detailed category dashboards, the platform features a scenario planner that allows users to simulate how changes in purchasing behaviors or operational decisions could affect emissions, thereby empowering consumers and businesses to make more informed, eco-friendly decisions.

Complementing the industry-level analysis is the Personal Carbon Footprint Module, branded as "Explore Carbon Footprint." This interactive simulation tool enables users to model the environmental impact of their purchases through detailed input capabilities for purchase amounts, product categories, and frequency. The system provides real-time calculations of estimated CO₂e impact and offers comparative analysis against historical baselines. To ensure data persistence and user privacy, the module includes SSO authorization, allowing users to save and manage their scenarios over time.

Creative Component

The interactive dashboard serves as the cornerstone of our user engagement strategy, employing dynamic data visualizations that bring emissions data to life through intuitive and responsive interfaces. Users begin their journey on a main landing page featuring an intuitive search functionality that guides them to detailed category-specific dashboards. The platform's visualization capabilities extend beyond simple data presentation, offering interactive filters and drill-down features that allow users to explore emissions data at various levels of granularity.

To enhance user engagement and provide practical value, we've implemented a comprehensive scenario planner that enables hypothetical impact modeling. This feature is supported by a robust user authentication system that allows individuals to save and revisit their personalized scenarios. The combination of dynamic visualizations, interactive filtering, and personalized scenario planning creates a rich, engaging experience that makes complex emissions data accessible and actionable for all users.

Usefulness

GreenChain Insights addresses a critical gap in environmental impact understanding by providing a comprehensive platform for analyzing greenhouse gas emissions at both macro and micro levels. The application's unique value proposition lies in its ability to combine historical 2017 industry data with personal impact simulation capabilities, creating a powerful tool for informed decision-making. This dual approach enables users to not only understand broad industry-wide emissions patterns but also see how their individual choices contribute to the larger picture.

The platform's practical applications extend across multiple user groups, from individual consumers seeking to understand their carbon footprint to businesses looking to make data-driven sustainability decisions. By providing detailed sector-specific analyses alongside personal impact modeling tools, GreenChain Insights enables users to make more informed choices about their purchasing decisions and understand the broader implications of those choices within the context of industry-wide emissions patterns. The inclusion of advanced search and filtering capabilities, combined with interactive visualization tools, makes complex emissions data accessible and actionable for users at all levels of technical expertise.

Realness

Our data sources are cited and elaborated upon below:

Dataset 1: [*SupplyChainGHGEmissionFactors_v1.2_NAICS_CO2e_USD2021.csv*](#)

- **Format:** CSV (123 kB, 8 columns)
- **Information Captured:** Emission factors per dollar spent by NAICS code, including margins vs. no margins. Provides the 2017 NAICS code/title, GHG type, and references to the USEEIO model.
- **Data Size:** 1016 entries

Dataset 2: [DataCoSupplyChainDataset.csv](#)

- **Format:** CSV (~95.91 MB, 53 columns)
- **Information Captured:** Shipping details (real vs scheduled days), benefit per order, sales per customer, late-delivery risk, category info, city, etc.
- **Data Size:** 181K entries

Dataset 3: [EC1700BASIC - ALL SECTORS: SUMMARY STATISTICS](#)

- **Format:** CSV (8KB, 15 columns)
- **Information Captured:** Summary statistics by NAICS code, including total revenue, annual payroll, and number of firms, establishments, and employees. Provides 2017 NAICS code/descriptions.
- **Data Size:** 30 entries

The first dataset of Supply Chain emissions provides a robust foundation for emissions calculations. The division of Dataset Two into specialized tables serves multiple purposes: it improves query performance by allowing more targeted data access, enables more efficient data updates and maintenance, and provides clearer organization of related information. Each specialized table will maintain connections to our emissions factors data through the NAICS codes provided by Dataset Three, creating a cohesive system that can support both broad industry analysis and detailed operational insights. This data split ensures that our platform can deliver both high-level emissions insights and granular operational details while maintaining optimal performance and data integrity.

Although our third dataset is only 30 rows, we only plan on using it as a connector between the other two datasets as it houses the NAISC codes that relate the other two tables together. We plan to split Dataset Two into multiple tables each with at least 1,000 entries and connect it to Dataset 1 (by using Dataset 3) to accomplish our goals and meet the project requirements for tables.

Detailed Functionality

The GreenChain Insights dashboard is a comprehensive platform that displays 2017 supply chain greenhouse gas emissions by various categories, with a major focus on industries classified by NAICS codes. On the home page, users are greeted with key performance indicators (such as total CO₂e emissions and industry breakdowns) presented through dynamic visualizations like bar charts, pie charts, and line graphs. Interactive filters allow users to select specific industries or product categories and delve into detailed emissions data, while advanced search functionalities enable filtering and sorting by parameters such as total emissions, average emissions per dollar spent, or shipment frequency.

In addition to exploring historical data, the dashboard offers a dedicated “Explore Carbon Footprint” module that empowers users to simulate the impact of their purchases on overall emissions. Users can input hypothetical purchase amounts, select product categories, and specify purchase frequency, after which the system automatically calculates an estimated CO₂e impact and displays the results both numerically and graphically for easy comparison with the historical baseline.

CRUD Operations:

1. **Create:** Users can add new records to simulate the impact of their own purchases on greenhouse gas emissions. This operation allows users to input details such as purchase amount, product category, and frequency via a web form. The new data is stored as simulated purchase entries, which are then used to calculate an estimated CO₂e impact based on the historical emission factors. The user would have to be authorized by logging in with SSO authorization
2. **Read:** Users can view and explore both the historical 2017 emissions data and their own simulated entries. This includes interactive dashboards with charts and tables, detailed views of individual shipment or purchase records, and advanced search and filtering capabilities to quickly locate specific industry or category data.
3. **Update:** Users can modify existing simulated purchase entries. For instance, if a user wants to adjust a purchase amount or change the frequency of their transactions, they can update the relevant record through an editing interface. Once updated, the system automatically recalculates the associated emissions, ensuring that the displayed data remains current and accurate.
4. **Delete:** This operation allows users to remove simulated purchase records that are no longer relevant or were entered in error. Deletions can be implemented as soft deletes (such as by marking records as inactive while maintaining an audit trail) or as permanent removals, ensuring the data remains clean and reflective of the user's current simulation scenarios.

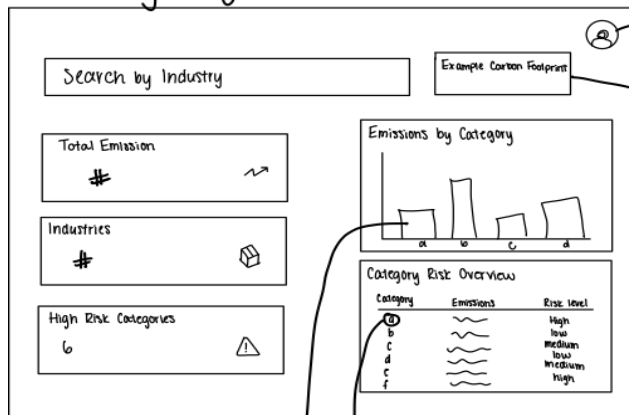
Search & Filter:

1. By Industry
2. By Product

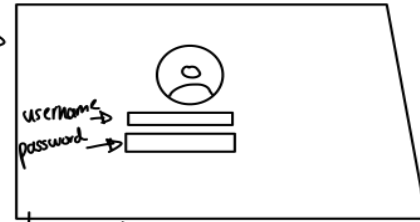
User Interactions:

1. **Dashboard:** Displays key metrics such as total CO₂e from shipments in the past month, or top 5 categories with the highest emission intensity.
2. **Scenario Planner:** Allows “what-if” comparisons between different product categories or shipping modes (if the latter data is found or approximated).

Landing Page



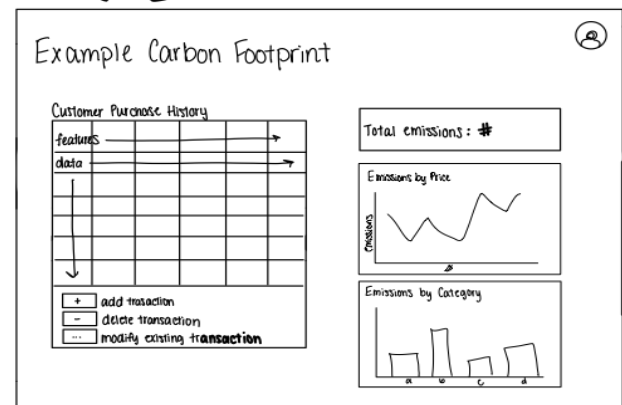
User Login



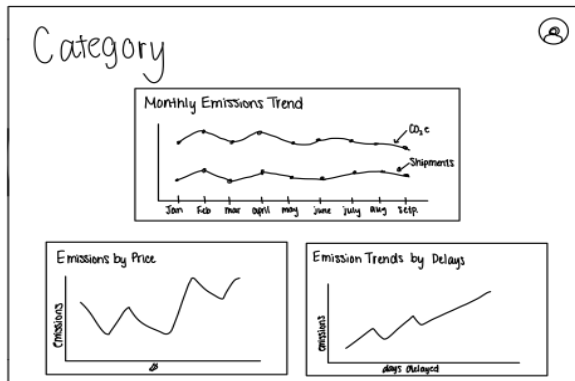
on click

on button clicks

Scenario Planner



When you click a certain bar in the category



Category Dashboard

We plan on having a main landing page with a search bar where you can input a specific industry. If you're unsure of what to search for, you could click on one of the bars/companies from the data visualization. From there you would go to a category dashboard which has some different data visualizations. You also have the option to go to a scenario planner where you can view and change an example of consumer data to see how it would affect the emissions data in a hypothetical scenario. Just in case, we also added a user login page to keep the changes the user made to their scenario planner.

Project Work Distribution

The project responsibilities will be distributed across team members based on their technical expertise and experience, with clear ownership of specific components while maintaining collaborative overlap for integration.

Frontend Development

Ismail M. will serve as the primary front-end architect, leveraging his extensive experience with d3.js, Tableau, and React. Primarily, he will lead the designing and implementing of the data visualizations using d3.js and related technologies. Additionally, he will create responsive and interactive dashboard components and Develop the user interface using React and modern CSS frameworks. He will also help Ashley with the UI/UX design process using Figma for mockups and prototypes

Ashley W. will focus on leading the design aspect of the project (UI/UX) while helping with integrating the front-end and back-end. Specifically, she plans on implementing (in association with Ananth) API integration layers between frontend and backend services and creating React components for data input. Finally, she'll collaborate with Ismail on ensuring the UI/UX is implemented correctly on the front-end side.

Backend Development

Shashank B. has experience with data processing and backend development so he will lead those aspects of the project. His main responsibilities are to design and implement the core backend API structure, develop data processing pipelines for supply chain emissions calculations, and implement backend validation and security measures. Others will help Shashank with the database but Shashank will take charge of these tasks.

Ananth H. will serve as the full-stack bridge, focusing on system integration while supporting both front-end and back-end teams. He will work on managing the data and backend systems while working to integrate these features into the front-end. He will use his experience in full-stack development and data modeling to assist all other team members with their portions of the project.

These requirements are subject to change as the team seems fit. Although these are our strengths and preferred working areas, our goal with this project is to learn other technologies and how to work with databases.