

Unearthing the Environmental Impact of Human Activity:

A Global CO2 Emission Analysis

Team Members:

V. Shrilekha

M.Sridevi

L.Varshini

Overview

The project "Unearthing the Environmental Impact of Human Activity: A Global CO2 Emission Analysis using data analysis with Tableau" aims to investigate and analyze the environmental consequences of human activities, specifically focusing on global carbon dioxide (CO2) emissions. By utilizing data analysis techniques with Tableau, the project seeks to provide valuable insights into the extent of CO2 emissions nationwide, contributing to a better understanding of the environmental impact caused by human actions.

Problem Understanding

Business Problem:

The primary business problem addressed by this project is the need to gain a comprehensive understanding of the environmental impact of human activity, particularly regarding CO2 emissions. It is essential to assess and quantify these emissions to identify areas that require intervention and devise effective strategies for mitigating climate change. By analyzing and visualizing CO2 emission data, the project aims to provide stakeholders with actionable insights to tackle the problem of excessive greenhouse gas emissions.

Business Requirements:

- Data Collection and Integration: Gather and integrate relevant datasets on global CO2 emissions, ensuring accuracy, consistency, and compatibility for analysis in Tableau.
- Data Analysis and Visualization: Utilize Tableau's data analysis capabilities to perform comprehensive analysis and generate insightful visualizations of CO2 emissions. This includes identifying trends, patterns, and correlations within the data to provide meaningful insights.
- Interactive Dashboards: Develop interactive dashboards in Tableau that allow users to explore the data, filter information based on specific parameters, and gain a holistic understanding of the environmental impact of human activity.

Literature Survey:

Many experts have been looking into how human actions affect the amount of CO2 in the air. A really important study by Le Quéré and their team in 2018 showed that CO2 emissions are going up fast, making it crucial to understand these changes. Another research by Smith and others in 2020 highlighted that we need to know which specific activities create the most CO2 so we can fix them. Using tools like Tableau to show data in easy-to-understand pictures was talked about by Miller and colleagues in 2019. They said it's important for both experts and regular people to see the data this way. Our project fits into these ideas. By using Tableau to look at CO2 emissions worldwide, we want to help make decisions that protect the environment and promote a greener future.

Business Impact:

- 1. **Environmental Awareness:** By unearthing and visualizing the environmental impact of human activity, the project aims to raise awareness about the need for sustainable practices and the importance of reducing CO2 emissions to mitigate climate change.
- 2. **Policy and Decision-Making:** The insights derived from the analysis can inform policymakers, businesses, and organizations in developing effective strategies, policies, and initiatives to reduce CO2 emissions and promote sustainable development.
- 3. **Industry and Sector-Specific Interventions:** Identifying key contributors to CO2 emissions can help specific industries and sectors understand their environmental impact better. This knowledge can guide them in implementing targeted measures to reduce emissions and adopt greener practices.
- 4. **Collaboration and Partnerships:** The project's findings can facilitate collaborations between governments, businesses, and communities to work together towards mitigating climate change and achieving global environmental goals.
- 5. **Better pollution control:** Authorities involved in pollution control and common people will be given a good understanding about the emission and enable people to act accordingly.

Data Collection & Extraction From Database

Data collection is a crucial step in the data analytics process. It involves gathering relevant data from various sources to extract valuable insights and make informed decisions. The quality and completeness of the data collected directly impact the accuracy and reliability of the analysis and subsequent conclusions. Effective data collection is the foundation of successful data

analytics. It involves careful planning, consideration of data sources, adherence to ethical guidelines, and the use of appropriate tools and technologies to obtain high-quality data for analysis.

Link to dataset:

https://drive.google.com/file/d/1nFMkhQV1TuDauhmffLAQAMjoyw8xWw1a/view?usp=drive_link

Dataset explanation video:

https://drive.google.com/file/d/1Lul1Qrt6lcIC9oQl8vQ7FRKEgl1zllTO/view?usp=drive_link https://drive.google.com/file/d/1k8V8VFLMsqDpr1Uc5EnstQfzXn_wLSn9/view?usp=drive_link

Database Connection with Tableau Video

https://drive.google.com/file/d/193jEptaMRIA0OlksHgc1Cb9pg UNgc97/view?usp=drive link

Data preparation

Data preparation involves cleaning, transforming, and organizing the raw data to make it suitable for analysis. The following steps are typically involved in our data preparation:

- ➤ <u>Importing the Data:</u> Begin by importing the "CO2.csv" file into the data analytics tool(e.g Tableau).
- ➤ <u>Data Exploration:</u> Perform an initial exploration of the data to understand its structure, check for missing values, and get an overview of the data types and variables present in the dataset.
- ➤ <u>Handling Missing Values:</u> Identify any missing or incomplete data points and decide how to handle them. Depending on the analysis requirements and the percentage of missing data, you can either remove rows with missing values, impute the missing values with appropriate methods, or leave them as is.
- ➤ <u>Data Cleaning:</u> Clean the data by checking for outliers or inconsistent values.
- ➤ <u>Aggregation and Grouping:</u> Depending on the level of granularity needed for the analysis, aggregate the data to a suitable level (e.g., yearly, monthly, or by region) or group the data into meaningful categories.

Data visualization

The visualizations used in our project are listed below:

• World Map:

World Map is a geographical visualization in Tableau for data analysis with latitude and longitude data representation. It plots data on interactive maps, supports zooming and panning, and aggregates data at various geographic levels. It aids in geographic analysis, location intelligence, and visualizing spatial data. Useful for understanding trends, demographics, and making location-based decisions, enhancing data storytelling. The World Map feature allows analysts and data professionals to explore data patterns, trends, and insights based on their geographical context.

Area chart:

An area chart is a data visualization that represents data as a series of data points connected by a continuous line and filled with color to create an area between the line and the horizontal axis. The area between the line and the axis is shaded, making it easier to visualize and compare changes in values over time or across different categories.

Pie Chart

The pie chart is a type of data visualization that represents data as slices of a circular pie. Each slice corresponds to a specific category or segment of the data being analyzed, and the size of each slice is proportional to the quantity it represents within the whole data set. The entire pie represents the total or 100% of the data.

Line Chart

A line chart is a type of data visualization that displays data points connected by straight lines. A Tableau line chart is a graphical representation that plots individual data points as dots and connects them with lines to show the progression or change in values over a specified dimension, often time. It is used to represent the trend or pattern of a continuous dataset over time or any other ordered variable. The x-axis typically represents time or the ordered variable, while the y-axis represents the values of the data points.

Bar Chart

A bar chart is a type of data visualization that represents categorical data using rectangular bars, where the length of each bar is proportional to the values they represent. Bar charts are one of the most commonly used and straightforward chart types in Tableau and data visualization in general. They are particularly useful for comparing the magnitude of different categories or groups within a dataset. It displays discrete data points on the horizontal axis (X-axis) and their corresponding numerical values on the vertical axis (Y-axis). Each category or group is represented by a separate bar, and the height or length of the bar corresponds to the value of the data point it represents.

Horizontal Bars

A horizontal bar chart in Tableau displays categorical data along the vertical axis (y-axis) and quantitative data along the horizontal axis (x-axis). The length of each bar is proportional to the value of the associated measure, which allows for easy visual comparison between different categories.

• Dual combination Chart

A dual combinations chart is a unique visualization that allows users to display two sets of data in a single view, combining two different chart types. It is particularly useful when comparing two related measures across multiple dimensions. This type of chart can provide valuable insights by showing relationships and trends that might not be immediately apparent in separate visualizations.

Doughnut Chart

The doughnut chart is created by mapping a dimension to the "Columns" or "Rows" shelf and a measure to the "Angle" shelf. The chart is divided into segments, each representing a category, and the size of each segment corresponds to the proportion of the data it represents. The inner circle of the doughnut chart is typically left empty to create the hole in the center.

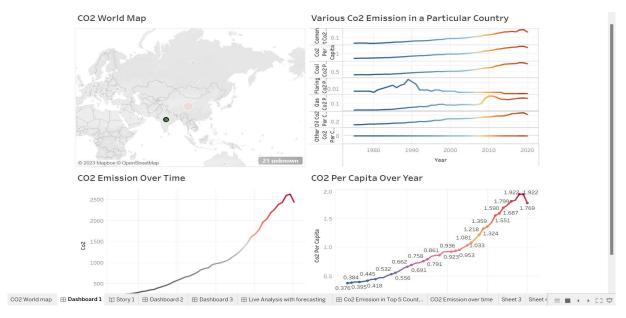
Forecasting

Tableau forecasting refers to the capability of Tableau, a popular data visualization and business intelligence software, to predict future values based on historical data trends. It allows users to apply various forecasting models to their data and visualize the projected values using charts and graphs. Tableau's forecasting feature is particularly useful for businesses and analysts to gain insights into potential future outcomes, make data-driven decisions, and plan for the future. Tableau's forecasting capability empowers users to leverage historical data and gain insights into future trends, enabling better planning, efficient resource management, and data-driven decision-making across various business domains.

Dashboard and Forecasting

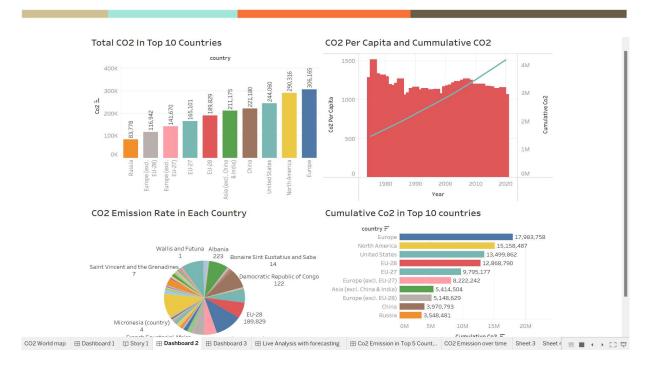
Dashboard 1:

https://public.tableau.com/app/profile/shrilekha.v2669/viz/co2emission_16911666458910/Dashboard1



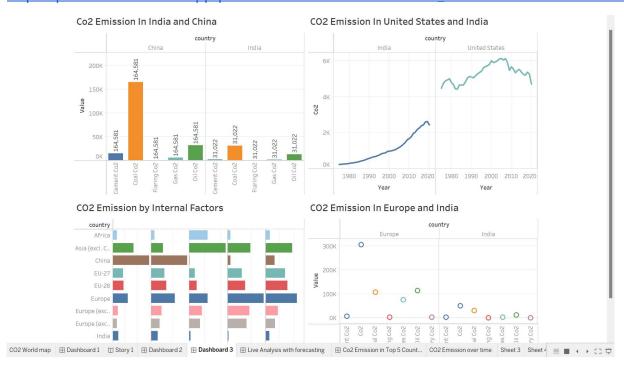
Dashboard 2:

https://public.tableau.com/app/profile/sridevi.m6321/viz/C02dashboard_16906537842470/Dashboard2



Dashboard 3:

https://public.tableau.com/app/profile/varshini.l/viz/co2emission_16896975404460/Dashboard3



Dashboard 4:

https://public.tableau.com/app/profile/sridevi.m6321/viz/donutcharts_16907135959170/Co2EmissioninTop5Countries



The forecasting visualizations for this project will be made available through the following link: https://public.tableau.com/app/profile/sridevi.m6321/viz/C02dashboard3/LiveAnalysiswithforecasting

Dashboard video link:

https://drive.google.com/file/d/11t283xWJ-vqx-R369zUsye3qIhguEECg/view?usp=drive_link

Forecasting video link:

https://drive.google.com/file/d/1lw6um9aTPjZDwyeUCHdddCiOywO9cHig/view?usp=drive_link

Story

In a world grappling with environmental challenges, understanding the impact of human activity on our planet's climate is of paramount importance. This data analytics project aims to unearth vital insights into the extent of human influence on the Earth's atmosphere. This study seeks to shed light on the key contributors, regional patterns, and potential implications, providing valuable knowledge to inform sustainable practices and combat climate change.

World Map: Unveiling Global CO2 Emissions

A dynamic world map presents a visual narrative of CO2 emissions across different countries. By plotting emissions using longitude and latitude as coordinates, we can discern the hotspots and trends of carbon dioxide output. The map allows us to see which regions contribute most significantly to global CO2 levels and identify countries that require focused attention for emissions reduction efforts.

https://drive.google.com/file/d/1mMsr3hNCWZ|xSiVLbHgl85-mTpNuM9ea/view?usp=drive_link

Line Chart: Evolution of CO2 Emissions Over Time

A line chart showcasing CO2 emissions over the years takes us on a historical journey. The graph's x-axis denotes each year, while the y-axis represents the cumulative CO2 emissions. This visual portrayal enables us to observe the changing emission trends, understand the impact of various global events, and identify periods when emissions surged or plateaued.

https://drive.google.com/file/d/1lw6um9aTPjZDwyeUCHdddCiOywO9cHjg/view?usp=drive_link

Pie Chart: Exploring CO2 Emission Rates by Country

Through an insightful pie chart, we examine the distribution of CO2 emission rates in different countries. The chart represents each country's contribution to the total global emissions in a given year. By analyzing this data, we gain an understanding of how much each nation is responsible for, shaping international perspectives on climate responsibility and collective action.

https://drive.google.com/file/d/1BHZ62BNZ3s87-w3SkY6MAhCM_sD0Eeow/view?usp=drive_link

Horizontal Bars: Ranking Cumulative CO2 Emissions in Top 10 Countries

A horizontal bar graph illustrates the cumulative CO2 emissions in the top 10 emitting countries. These countries, such as China, the United States, and the European Union, significantly impact the global carbon footprint. This visual representation serves to underscore the importance of collaboration and concerted efforts in mitigating climate change on a global scale.

https://drive.google.com/file/d/10vmDgNAJGKxHp1y0tB0-HRJLFQ6Hi9JF/view?usp=drive_link

Line Chart: Analyzing CO2 Emissions by Internal Factors

A line chart dissects CO2 emissions within countries based on various internal factors. By filtering for Trade CO2 share, we can examine the contributions of cement, coal, flaring, gas, and oil industries. Understanding which sectors drive emissions is crucial for crafting targeted policies and interventions.

https://drive.google.com/file/d/1aGcUGugcSSMjZjvCeBskQAeZeSjipebe/view?usp=drive_link

Bar chart: Total CO2 in Top 10 Countries: Peering into Major Emitters

This visual representation delves further into the CO2 emissions of the top 10 countries, specifically focusing on their cumulative contributions from different sectors. With Trade CO2 sharing as a filter, we gain insights into the primary sources of emissions in these influential nations, providing a foundation for international cooperation to address climate challenges.

https://drive.google.com/file/d/1YKk VIsc0inKI-FODeD2Z5VX2wLwzlGv/view?usp=drive link

Bar Chart: CO2 Per Capita vs. Cumulative CO2

A bar chart compares CO2 emissions per capita with cumulative CO2 emissions over the years. This graph allows us to understand the relationship between population growth, industrialization, and carbon footprints. Identifying countries with high per-capita emissions can help devise strategies for more equitable and sustainable development.

https://drive.google.com/file/d/1DmKKDrgBWzf4_mk0yiSdT4fz47bWws7z/view?usp=drive_link

Horizontal Bars: Analyzing CO2 Emissions by Internal Factors

Building on the previous analysis, this horizontal bar graph highlights the contributions of cement, coal, flaring, gas, and oil industries in specific countries. The filter, Trade CO2 share, refines the focus on emissions originating within national boundaries, empowering policymakers to target specific sectors for emission reduction.

https://drive.google.com/file/d/1gz9dvRclKke1E9jOMonugou4pvXAaPgp/view?usp=drive_link

Doughnut Graph: CO2 Analysis by Type in Select Countries

A series of doughnut charts presents a comprehensive analysis of CO2 emissions in various countries. These charts dissect emissions into categories, such as Cement CO2, Coal CO2, Flaring CO2, Gas CO2, Oil CO2, and Other Industry CO2. By studying these visuals for Asia, China, Europe, EU-28, EU-27, and other regions, we can discern emission trends and disparities.

https://drive.google.com/file/d/170pbmGOma9Zz1Bxrnk3irgVZKt4yNaB7/view?usp=drive_link

Line Graph: CO2 Emission Comparison - United States vs. India

A line graph provides a direct comparison of CO2 emissions between the United States and India. Through this visual, we can grasp the differing emission trajectories of these two nations and draw valuable insights on potential areas of collaboration in the fight against climate change.

https://drive.google.com/file/d/1FOVAy5u7G iPEk8ssVg1HH3ffLX3wj4B/view?usp=drive link

Bubble Chart: CO2 Emission Comparison - Europe vs. India

A vibrant bubble chart further compares CO2 emissions, including specific categories like Cement CO2, Coal CO2, Flaring CO2, Gas CO2, Oil CO2, and Other Industry CO2. This comparison between Europe and India helps us comprehend regional disparities and potentially identify areas for technology transfer and sustainable development partnerships.

https://drive.google.com/file/d/19pz5D22m4MB_FKdCBRbVmvjMejm_OOVN/view?usp=drive_link

Bar Chart: CO2 Emission Comparison - China vs. India

A bar chart provides a side-by-side comparison of CO2 emissions in China and India. With separate bars for Cement CO2, Coal CO2, Flaring CO2, Gas CO2, and Oil CO2, this visualization highlights the relative contributions of these two populous nations to global emissions.

https://drive.google.com/file/d/1S1gBMVvnlhPT6ccMYFdlUxjn_pghM1ya/view?usp=drive_link

Area Chart: Examining Other Industry CO2 and Trade CO2 Over Time

An area chart plots the trends of Other Industry CO2 and Trade CO2 share over the years. Understanding the evolution of emissions from industrial processes and trade can inform strategies to promote sustainable practices and enhance climate resilience.

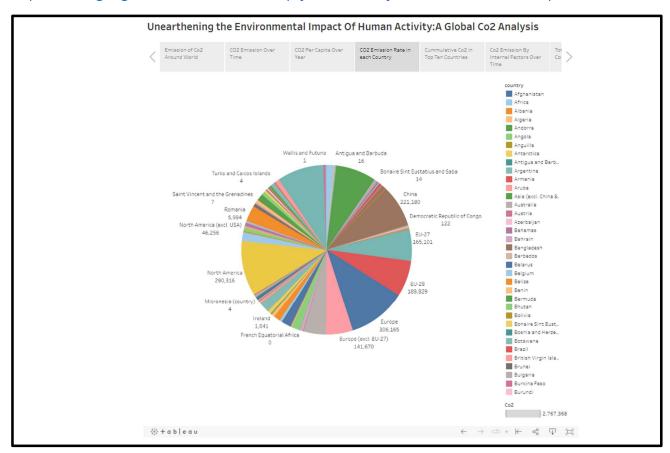
https://drive.google.com/file/d/1nbO43lumbVsM6dsGWJwc89PsJKS7Nk0K/view?usp=drive_link

Tableau link for storyboard:

https://public.tableau.com/views/C02story 16906578925290/Story1?:language=en-US&publish=yes&:display count=n&:origin=viz share link

Video Link:

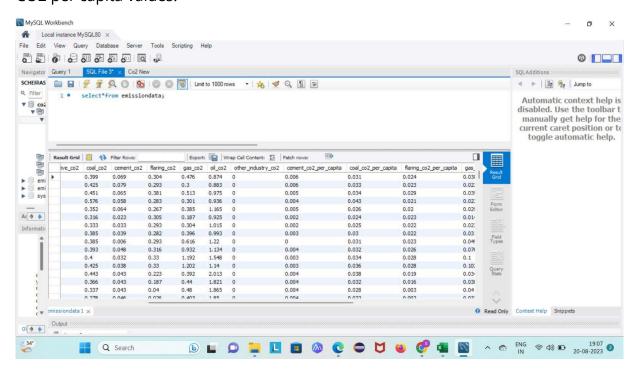
https://drive.google.com/file/d/1QSMWNqwjREKHTr9nzBjYA8fizXUReb6v/view?usp=drive_link



Performance testing

Amount Of Data Rendered To DB

The table appears to show CO2 emission values associated with different sources. Each row represents a source type, and the columns provide CO2 values for various categories. The data includes measurements for coal, cement, flaring, gas, oil, and other industries, along with CO2 per capita values.



Utilization Of Data Filters

The analysis of global CO2 emissions comprises a diverse array of visualization techniques, each revealing distinct insights into this critical issue. The world map graph (Graph 1) leverages the geographical coordinates of longitude and latitude to map emissions across countries. Moving chronologically, the line chart (Graph 2) charts CO2 emissions over time, with 'Year' and 'SUM(CO2)' as dimensions, capturing annual emission trends. Transitioning to a pie chart (Graph 3), emissions are broken down by country and year, providing a snapshot of CO2 emission rates within individual nations.

Shifting focus to cumulative emissions, the horizontal bars graph (Graph 4) showcases cumulative CO2 in the top 10 countries, with 'Sum(Cumulative CO2)' and 'Country' as dimensions. Internal factors driving emissions are highlighted in the line chart (Graph 5) by examining the 'Sum(Cement CO2)', 'Sum(Coal CO2)', 'Sum(Flaring CO2)', 'Sum(Gas CO2)', and 'Sum(Oil CO2)' for various countries, with 'Country' as the dimension and 'Trade CO2 share' applied as a filter.

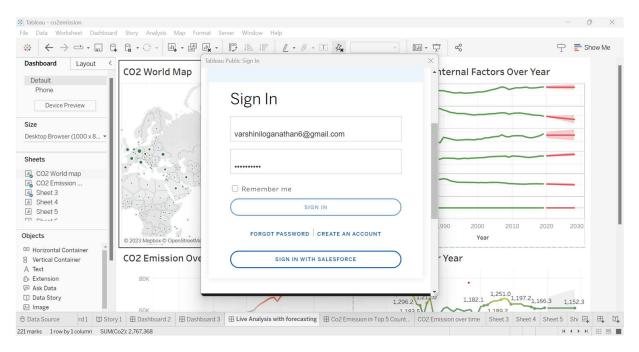
Expanding on this, the total CO2 in the top 10 countries (Graph 6) employs similar dimensions and filters, divulging the collective emission impact of internal factors across influential nations. CO2 per capita and cumulative CO2 are contrasted in the bar chart (Graph 7) using 'Year' as the dimension and 'Measure Names' encompassing 'CO2 per capita' and 'Cumulative CO2'. This theme continues in the horizontal bars graph (Graph 8), which dissects internal factors' contributions across different countries using the 'Sum(Cement CO2)', 'Sum(Coal CO2)', 'Sum(Flaring CO2)', 'Sum(Gas CO2)', and 'Sum(Oil CO2)' dimensions and the 'Trade CO2 share' filter.

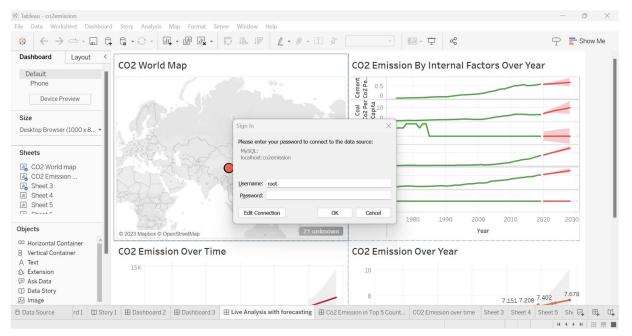
Transitioning to specific countries, a line chart (Graph 9) introduces 'SUM(CO2 per capita)' and 'Year' as dimensions to delineate CO2 per capita for the chosen country over time. Furthermore, doughnut charts (Graph 10 to 14) spotlight CO2 analysis concerning specific types—Cement, Coal, Flaring, Gas, Oil—across various regions. Graphs 15 to 17 culminate in comparative analyses, as a line graph (Graph 15) measures CO2 emissions between the United States and India, a bubble chart (Graph 16) juxtaposes emissions in Europe and India, and a bar chart (Graph 17) presents CO2 emissions in China and India. Each of these graphs presents unique perspectives on the complex web of CO2 emissions, facilitated by distinct measures, dimensions, and filters.

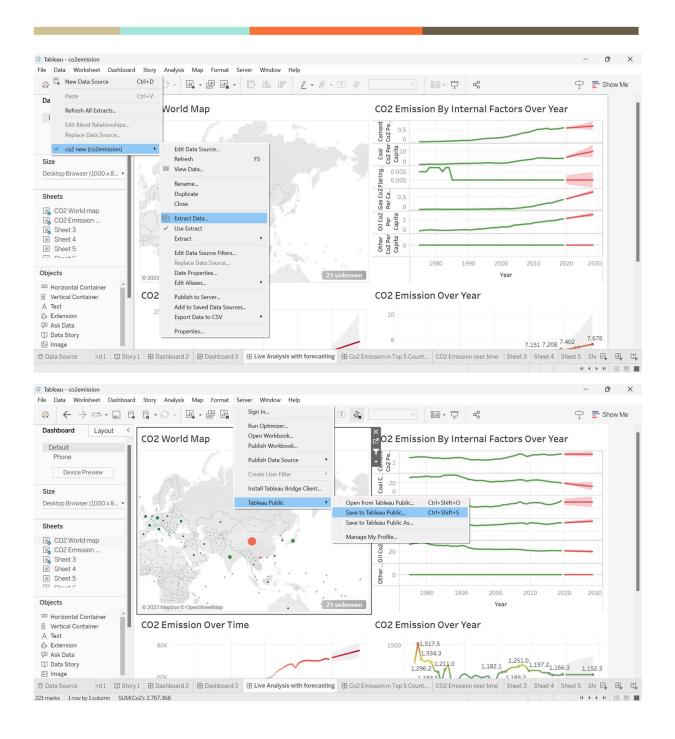
No Of Visualizations

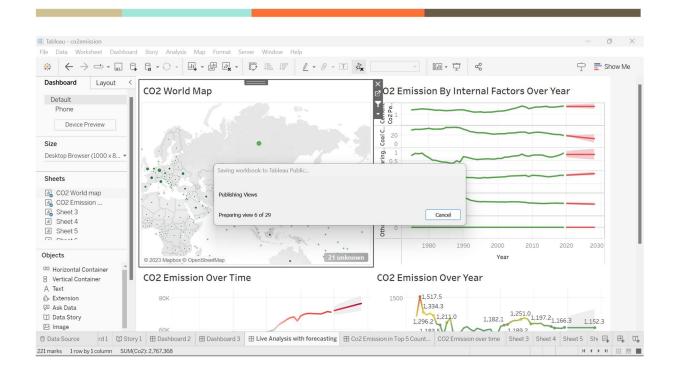
The number of visualizations used in our project is 13 sheets and 4 dashboards and all were composed in 1 storyboard.

Web integration





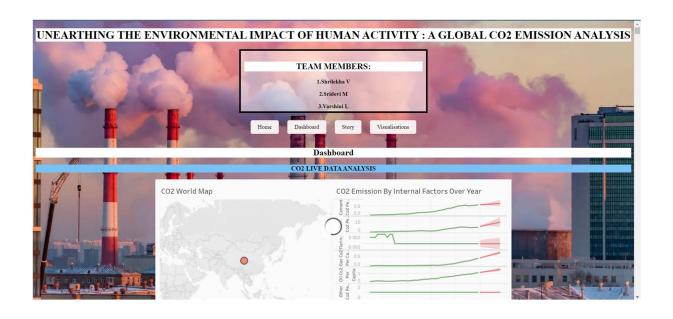




Dashboard And Story Embed With UI

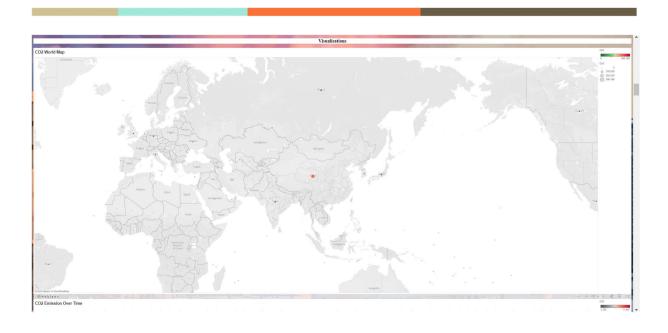
The web interface for this project will be made available through the following link:

https://drive.google.com/drive/folders/1nU252b RJt0hu5W58dxAe2gtsC6WrKL ?usp=drive link









Web Interfacing Video link:

https://drive.google.com/file/d/1Fnj7eZKvV7G43BrwiMaadktNwpilrCR3/view?usp=drive_link

Project demonstration and documentation

This project serves as an in-depth exploration into the ecological destruction of human behaviors, with a particular emphasis on the worldwide emission of carbon dioxide (CO2). Employing tools including HTML, CSS, JavaScript, and Flask, this endeavor aims to reveal the intricate relationship between human actions and environmental changes. By drawing upon a meticulously curated dataset encompassing diverse dimensions of CO2 emissions across countries and emission types, the project endeavors to showcase the true extent of our global carbon footprint. Tableau, a potent visualization platform, comes into play as a transformative tool, crafting intricate visual narratives with the help of measures, dimensions, and parameters. From these, comprehensive dashboards and a compelling storyline are created, clearly capturing the essence of the data's revelations. The integration of web technologies enables the seamless fusion of HTML and Tableau dashboards within the Flask framework. Through the innovative use of Flask's url_for() function, the connection between HTML templates and the Tableau visualizations is established, fostering a cohesive and dynamic user experience. Ultimately, the project illuminate the path toward sustainable practices that can mitigate our collective impact on the planet.

Video Links for end to end solution:

Database Connection with Tableau Video

https://drive.google.com/file/d/193jEptaMRIA0OlksHgc1Cb9pq_UNqc97/view?usp=drive_link

Story Video

https://drive.google.com/file/d/1QSMWNqwjREKHTr9nzBjYA8fizXUReb6v/view?usp=drive_link

User Interface Front-End

https://drive.google.com/file/d/1Fnj7eZKvV7G43BrwiMaadktNwpilrCR3/view?usp=drive_link

Conclusion

This data analytics project uncovers the multifaceted story of global CO2 emissions. From dissecting emissions by region and industry to comparing countries' contributions, the visualizations provide a roadmap for informed decision-making towards a greener, more sustainable future. Armed with these insights, we can collectively address the climate crisis and foster a world that cherishes its environment for generations to come.