

Exercise 3 Report: CO2 Emissions by State Analysis

Motivation

We are entering the times where climate change is becoming obvious not only to the scientific community, but also it affects our day-to-day life. The strong agreement between global warming and greenhouse emissions makes it unavoidable to perform the analysis of their source. The given dataset allows the exploration of the CO2 emissions **trends** by sectors for each state and the comparison of different states. Since each state's population is different, it is important to show not only the absolute value of emissions (Million Metric Tons CO2 - MMTCO2) but also the normalized value (MMTCO2/population) for a given year.

Problems/Tasks

1. What states do mostly contribute to emissions in absolute values? Do average state CO2 emissions roughly correlate with the average population number?
2. For each state, what are the most contributing sources of CO2 emissions in absolute values and relative to the population. Is there any difference between states?
3. Do some states behave differently than others over time? Example: transportation emissions increase in California, but they decrease in Hawaii.

Data augmentation (if any)

1. Join of two tables: **CO2_Emissions** and **Populations** on **CO2_Emissions.Year=Populations.Year**
2. Added column with calculated value: **Ratio = CO2_Emissions / Population**

Solution

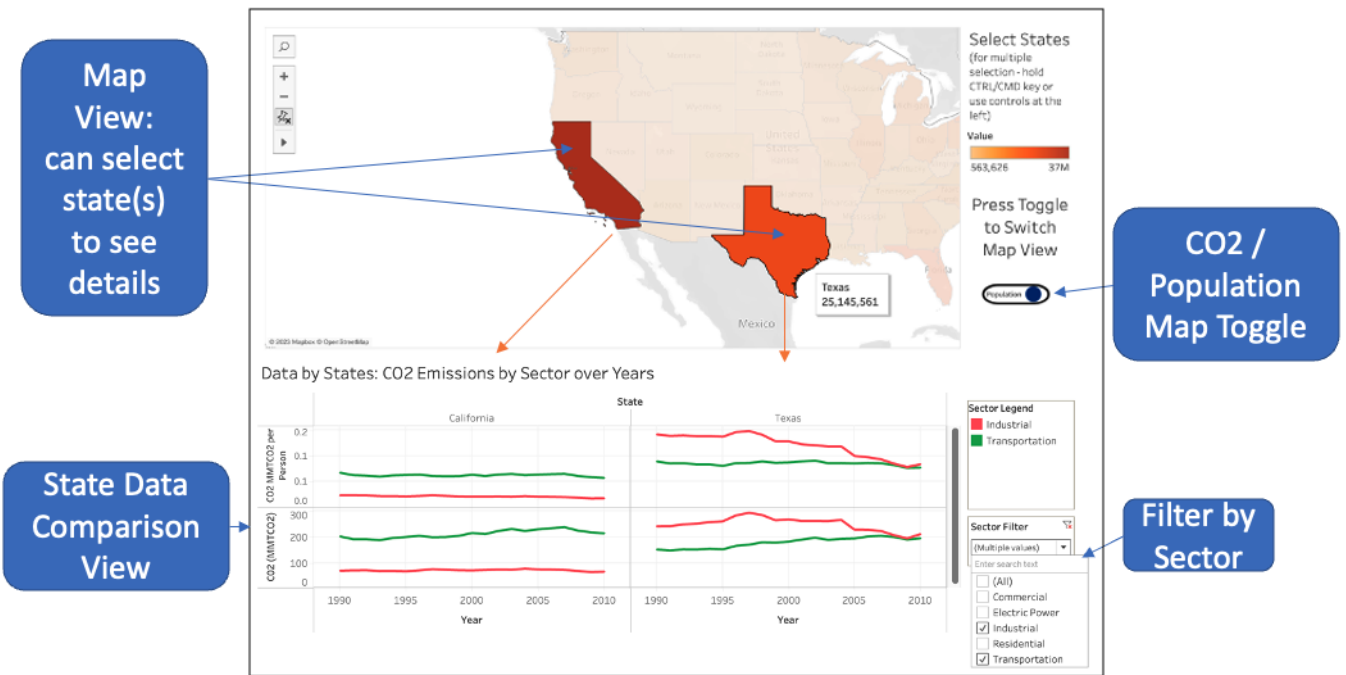


Figure 1: User Interface of the proposed visualization

1. Expressiveness

- a. **Map View.** The dataset attribute 'State' is categorical, but it also can be thought of as a geographic geometry type. The natural choice is to represent this attribute on a Choropleth map of the United States.
- b. **State Data Comparison View.** The data is quantitative (CO2 emissions) and ordered (by years). The task is to see the trends over time, that's why the line chart is chosen. For saving screen space and convenient comparison, both CO2 trend and CO2 per Person trend charts will share X-axis (the timeline).

2. Effectiveness

- a. **Map View.** Space: geometric shapes (polygons) which represent the states areas (channel #1). Channel #2 is the sequential colormap, which represents the intensity of (1) average population over time or (2) average CO2 emissions over time. The most populated states and the states with largest average CO2 emissions will have the darkest color luminance.
- b. **State Data Comparison View.** The CO2 magnitude is visible by the vertical position of point marks (connected with lines). The ordering by Year attribute is done by horizontal positions. Several categories of CO2 emissions can be plotted in one chart and will be separated by color channel.

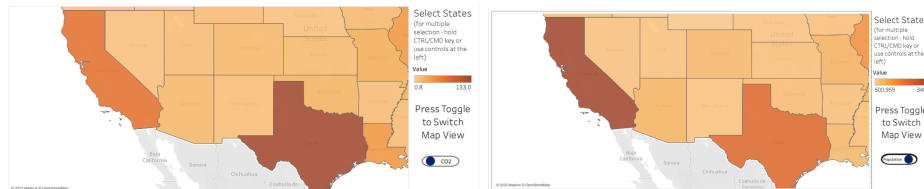
3. Interaction

- a. Hovering the mouse on the state shows the details of average population or average CO2 emissions.
- b. Special toggle button allows switching between average population and average CO2 emissions map views.
- c. Selecting states with CTRL/CMD button or Shape/Lasso control button adds selected states to the comparison view.
- d. State comparison view allows filtering of categories (sectors).

Conclusions

The following insights can be made if selecting the two most populated states: California and Texas:

- 1. Although California dominates by population, Texas pollutes with CO2 more than California.



- 2. California's emissions are mostly from the transportation sector, followed by industrial. However, in Texas, electric power and industrial sectors pollute more than transportation
- 3. Over time, in California the sectors' emissions don't change their order. However, in Texas, the industrial sector dominated in the past, but in recent years it has shared equally with transportation and electric power.

