Report: Visualization of Global CO₂ Emissions

i. The Domain, the Why, and the Who of the Visualization

The domain of this visualization lies in **environmental science**, specifically focused on global carbon dioxide (CO_2) emissions and their implications for climate change. The primary objective (the "why") of this visualization is to provide a comprehensive overview of CO_2 emissions over time, by sector, and by geographic distribution. It also explores the relationship between CO_2 emissions and global temperatures to highlight the urgency of addressing climate change. This visualization serves as a tool for understanding emission patterns, emphasizing the importance of effective climate policies to curb emissions.

The target audience (the "who") includes **policymakers**, **environmental researchers**, **climate activists**, and the **general public**. Policymakers can use the insights derived from the visualization to design more effective climate action strategies tailored to specific sectors and regions. Environmental researchers can leverage this data to further analyze emission trends and their effects on global warming, while climate activists can use the visuals to communicate the urgency of emission reductions to a broader audience. The general public, often unfamiliar with complex datasets, can gain a clearer understanding of how CO_2 emissions have changed and continue to impact the environment.

ii. What: The Data

The data used for this visualization comes from several reliable and comprehensive sources, each providing essential information for understanding global CO_2 emissions trends. The primary datasets include:

1. **Emissions by Country**:
   - **Source**: [Kaggle - Global Fossil CO₂ Emissions by Country (2002-2022)](#)
   - **File**: `GCB2022v27_MtCO2_flat.csv`
   - This dataset provides country-level CO_2 emissions data from 2002 to 2022, covering fossil fuel and industry-based emissions. It is the key source for the choropleth map, which compares CO_2 emissions per capita by country for the year 2021.
2. **Annual CO₂ Emissions**:
   - **Source**: [Our World in Data - Annual CO₂ Emissions](#)
   - **File**: `annual-co2-emissions-per-country.csv`
   - This dataset offers a global and country-level overview of annual CO_2 emissions. It is used to create the line graph, which illustrates the global emission trend from 1750 to 2022.
3. **CO₂ Emissions by Sector (World)**:
   - **Source**: [Our World in Data - CO₂ Emissions by Sector](#)
   - **File**: `co-emissions-by-sector.csv`
   - This dataset breaks down global CO_2 emissions by sectors such as electricity, transportation, and industry. It forms the basis for the stacked area graph, showing sector-specific emissions from 1990 to 2020.
4. **Global Annual Mean Temperature**:
   - **Source**: [Kaggle - Global Annual Mean Temperature](#)
   - **File**: `global-annual-mean-temperature.csv`

- o This dataset tracks global temperature changes over time. It is used to plot the scatter graph, which correlates CO_2 emissions with global mean temperature increases.
5. **Countries by Continent**:
   - o **Source**: Kaggle - Countries by Continent
   - o **File**: `Countries by continents.csv`
   - o This dataset categorizes countries by continent and is used to create the pie chart that shows the distribution of CO_2 emissions among continents for the year 2022.

iii. How: Visual Design and Idioms

The **idioms** chosen for this visualization include a mix of a **choropleth map**, **line charts**, **stacked area graphs**, **pie charts**, and **scatter plots**, each suited for different data representation purposes.

- The **choropleth map** (used for "Global CO_2 Emission (2021)") effectively shows per capita emissions across different countries, leveraging color intensity to communicate differences between regions. This is useful for **geographic comparisons** and for users to quickly understand which areas contribute the most to global emissions.
- The **line chart** for "CO_2 Emissions Trends Over Time" depicts the global emission growth over the last two centuries. The **linear trend** allows users to observe historical patterns, highlighting critical periods such as the industrial revolution and modern global emissions spikes.
- The **stacked area graph** (used for CO_2 emissions by sector) is ideal for **multi-dimensional data**, where users need to see contributions from different sectors like electricity, transport, and manufacturing. This idiom provides a **comprehensive view** of how emissions have shifted among sectors, offering insight into policy-making decisions that target high-emission industries.
- The **pie chart** is used to show the distribution of CO_2 emissions among continents in 2022, offering a **proportional comparison**. It helps users quickly see which regions are contributing the most and least, supporting geographically targeted climate policies.
- Lastly, the **scatter plot** visualizes the relationship between global CO_2 emissions and temperature change, showcasing a **correlation** that underlines the need for reducing emissions to limit further global temperature rise.