Global Carbon Budget Visualization Project

This documentation is for the GCB Visualization Project on the GCB 2022 data, designed to explore, analyze, and visualize the Global Carbon Budget and National Fossil Carbon Emissions. The project uses Python's Pandas for data manipulation, along with Matplotlib, Seaborn, and Google Looker Studios for visualization, focusing on datasets related to global carbon emissions, sinks, and their implications over time.

Engineered Features

Throughout the analysis, several features were engineered to enhance the understanding of the datasets. Here's a breakdown of these features and their significance:

For Global Carbon Budget (DF1)

- `total_emissions`: Sum of fossil emissions (excluding carbonation), land-use change emissions, and cement carbonation sink. This metric provides a comprehensive view of total carbon emissions.
- `total_sinks`: Sum of the ocean sink, land sink, and cement carbonation sink. It represents the total capacity of natural and artificial sinks to absorb carbon from the atmosphere.
- `emissions_to_sinks_ratio`: Ratio of total emissions to total sinks, indicating the balance or imbalance between carbon emissions and the absorbing capacity of sinks.
- `coal_proportion`, `oil_proportion`, `gas_proportion`: These features represent the share of each fossil fuel type in the total fossil emissions, highlighting the reliance on different energy sources.
- `yearly_change_in_emissions`: Year-over-year change in total emissions, providing insights into the trends and pace of emissions growth or reduction.
- `atmospheric_growth_change`: The difference in atmospheric carbon growth from one year to the next, indicating acceleration or deceleration in atmospheric carbon accumulation.
- `fossil_fuel_diversity`: A measure of the diversity in fossil fuel usage, calculated as the inverse of the sum of squared proportions of coal, oil, and gas emissions. Higher values suggest a more balanced mix of fossil fuel sources.

- `carbon_intensity`: The amount of carbon emissions per unit of energy derived from fossil fuels, serving as an indicator of the carbon efficiency of energy production.

For National Fossil Carbon Emission (DF2)

- `total_global_emissions`: Aggregates fossil emissions excluding carbonation, land-use change emissions, and cement carbonation sink at a global level.
- `emissions_growth_rate`: The annual growth rate of total global emissions, highlighting trends in global carbon emission increases or decreases.
- `sink_efficiency`: Ratio of total sinks to total global emissions, indicating the efficiency of sinks in absorbing emitted carbon.
- `cumulative_emissions`: The cumulative sum of total global emissions over the years, providing a sense of the long-term impact of emissions.
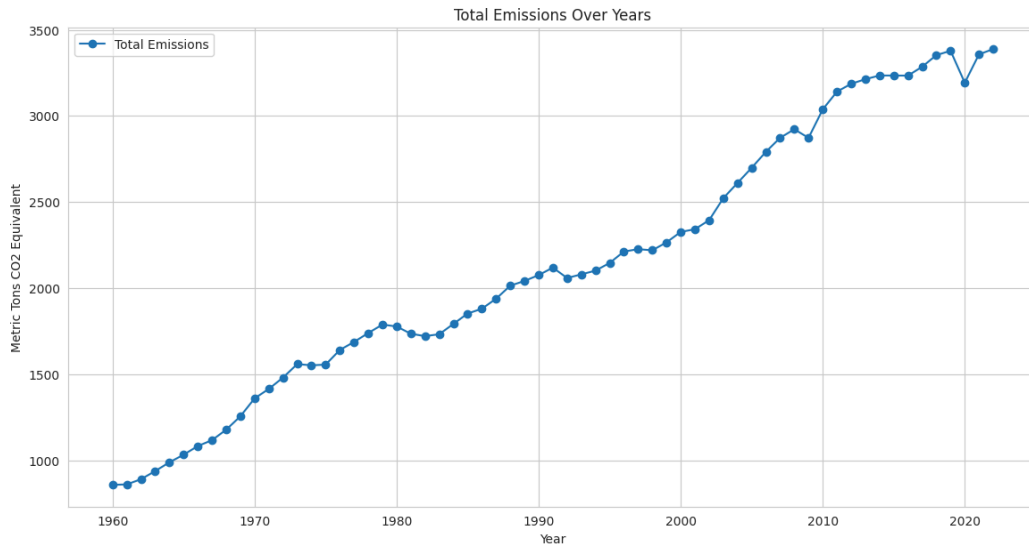
Data Visualization

Visualizations Detail

The Jupyter notebook along with the Google Looker Dashboard, contain several key visualizations crucial for understanding the dynamics of global carbon emissions and sinks. Below is a detailed explanation of each visualization, highlighting their significance and insights derived.

Trend of Total Emissions and Sinks Over Years

- Visualization Type: Line plot
- Key Features: This plot displays the trend of total emissions over the years, using markers to denote individual data points for clarity.
- Insights: The visualization provides a clear picture of how total carbon emissions have evolved over time, highlighting any trends, such as increases or stabilizations, in global emissions.

Total Emissions Over Years

Comparison of Fossil Fuel Emissions (Coal, Oil, Gas) Over Years

- Visualization Type: Line plot
- Key Features: Separate lines for coal, oil, and gas emissions, each marked with distinct markers (circle for coal, cross for oil, and triangle for gas) for easy differentiation.
- Insights: This plot offers a comparative view of how emissions from different fossil fuels have changed over the years, revealing the relative contribution of each fuel type to the total emissions.
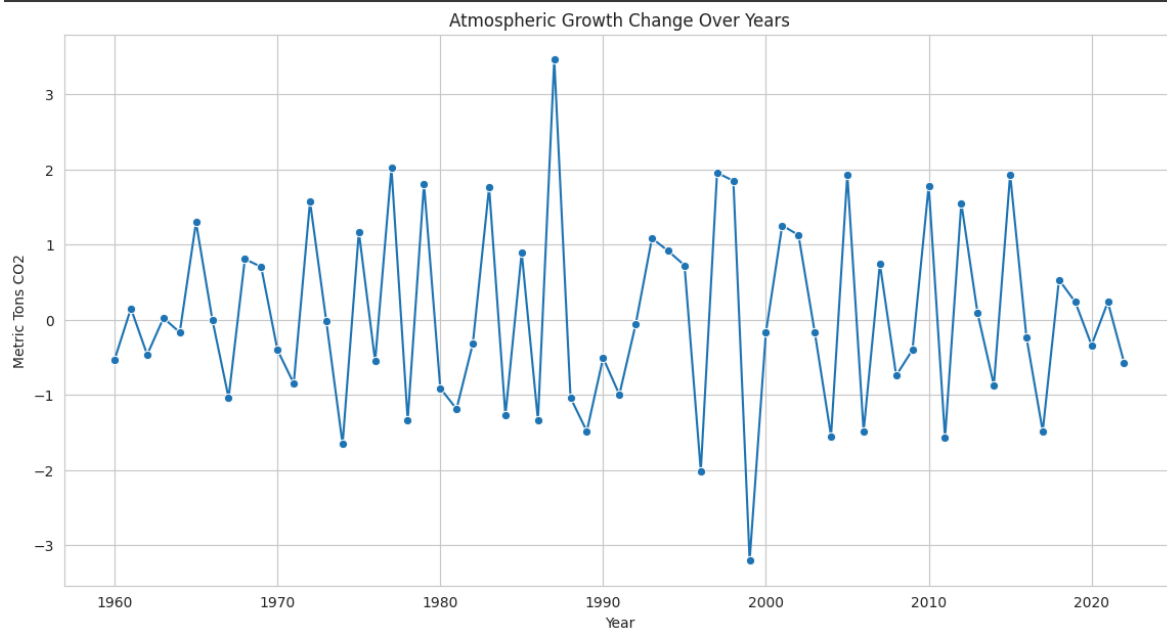

Fossil Fuel Emissions Over Years
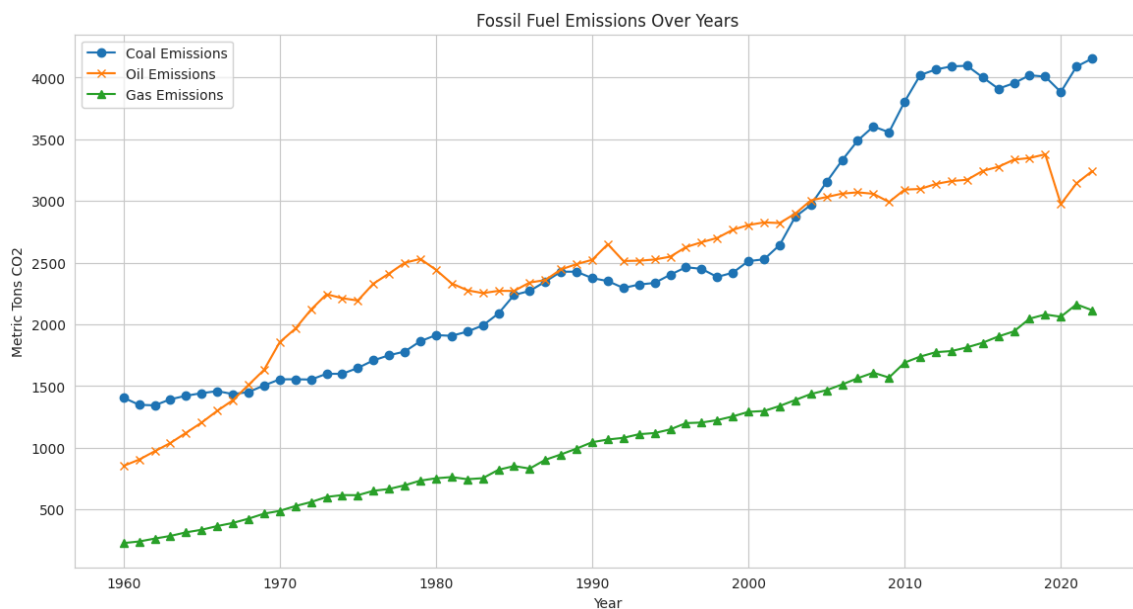
Emissions to Sinks Ratio Over Years

- Visualization Type: Line plot with Seaborn
- Key Features: A line plot showing the ratio of emissions to sinks over the years, marked with circles at each data point.
- Insights: It highlights the balance or imbalance between the emissions we produce and the carbon sinks' capacity to absorb these emissions, indicating the effectiveness of natural and artificial sinks in mitigating carbon accumulation.


Emissions to Sinks Ratio Over Years
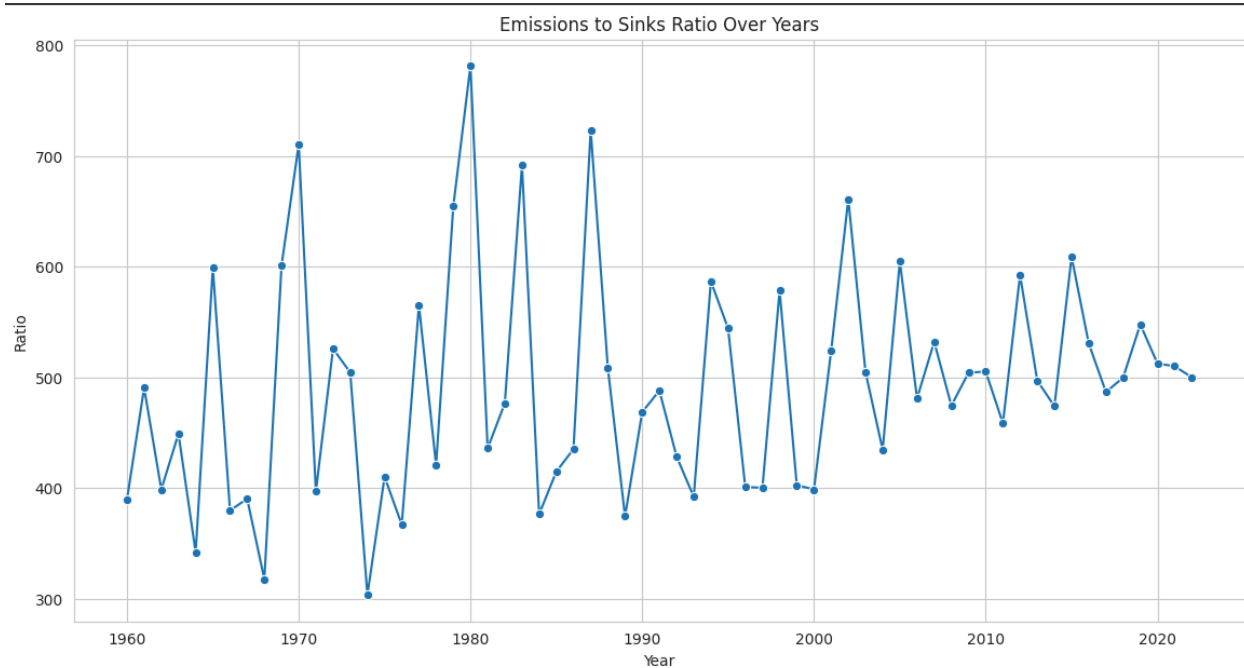
Atmospheric Growth Change Over Years

- Visualization Type: Line plot with Seaborn
- Key Features: Visualization of the year-over-year change in atmospheric carbon growth, with markers for each year.
- Insights: This plot sheds light on the acceleration or deceleration of atmospheric CO2 concentration growth, providing insights into the effectiveness of global efforts to curb emissions.

Atmospheric Growth Change Over Years

Yearly Change in Emissions

- Visualization Type: Line plot
- Key Features: A line plot showing the annual change in emissions, with markers denoting each year's change.
- Insights: It provides an understanding of how emissions growth rates fluctuate annually, revealing years of significant increase or decrease in emissions.
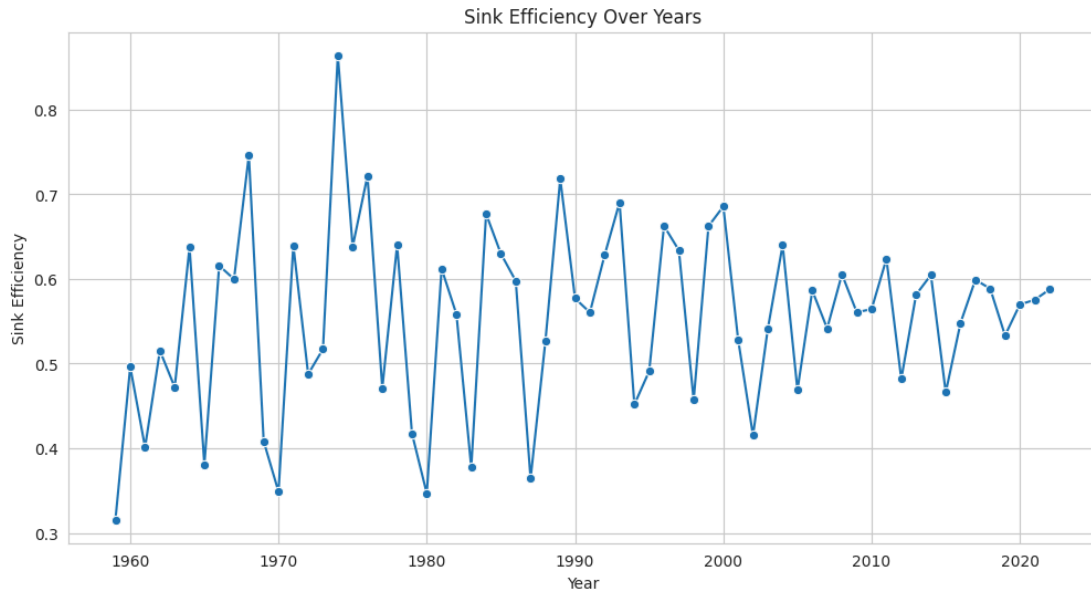

Yearly Changes in Emissions
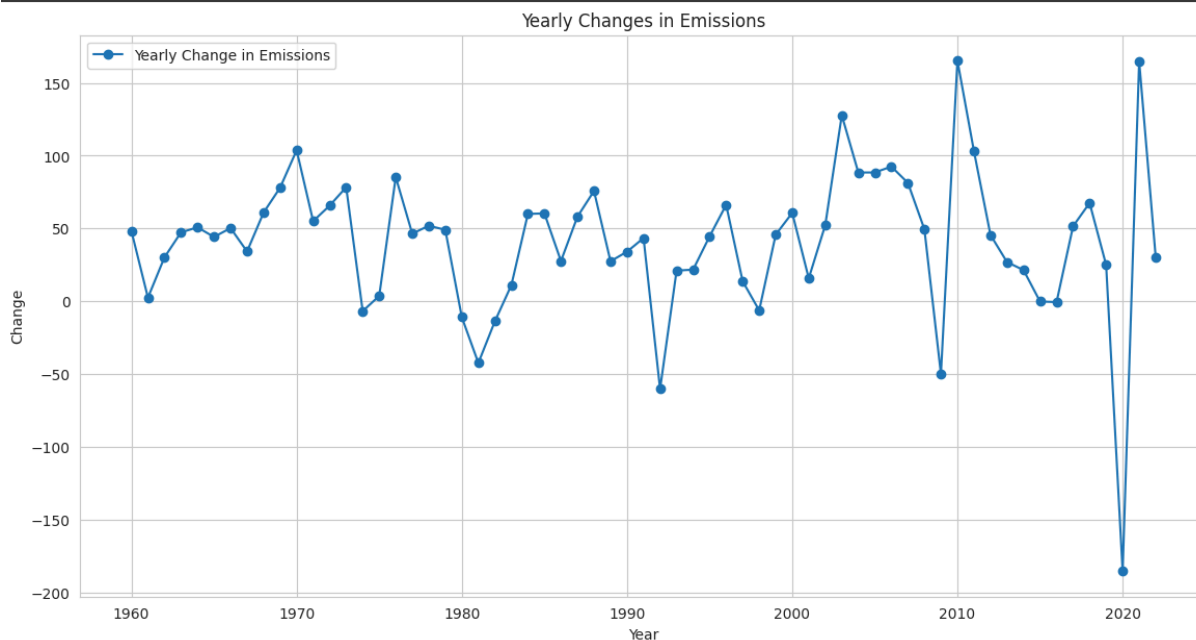
Emissions Growth Rate Over Years

- Visualization Type: Line plot with Seaborn
- Key Features: Annual emissions growth rate, with markers for visualization clarity.
- Insights: By showing the percentage growth rate year over year, this plot highlights periods of rapid increase or decrease in emissions, indicating shifts in global emissions patterns.
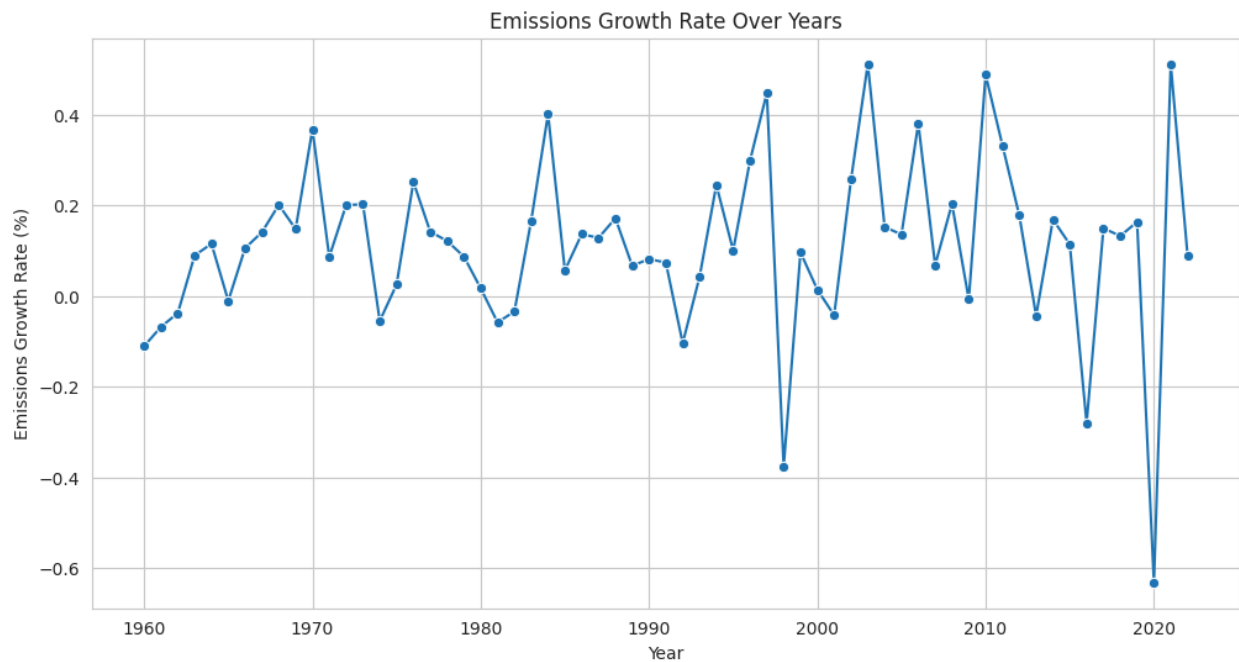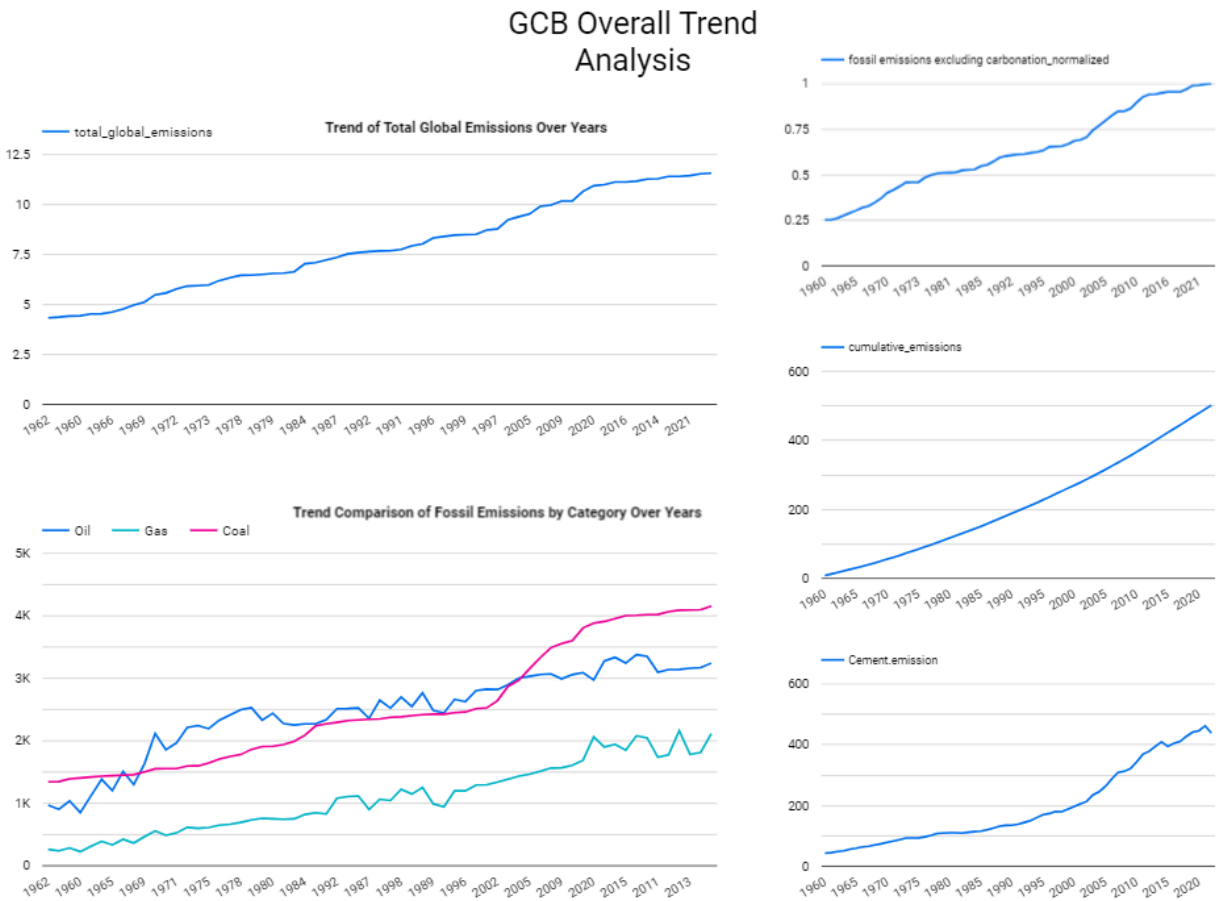

Sink Efficiency Over Years

- Visualization Type: Line plot with Seaborn
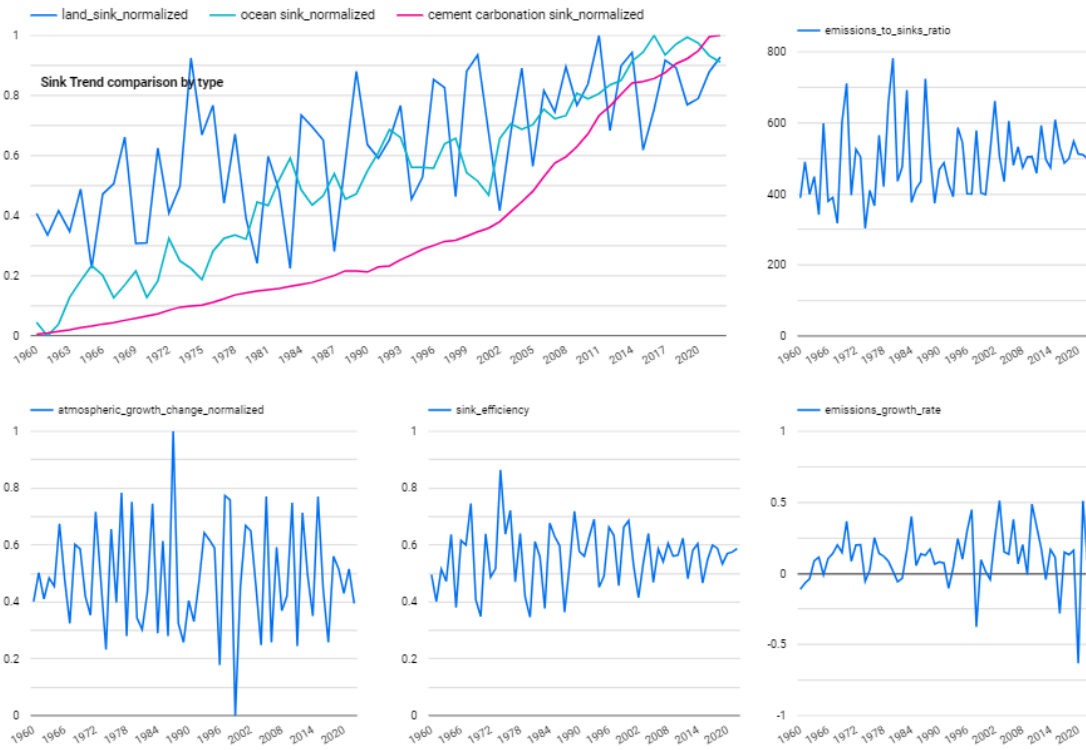- Key Features: Visualization of sink efficiency over time, with data points clearly marked.
- Insights: This plot evaluates how efficiently carbon sinks are absorbing emissions, a critical factor in understanding the potential for natural and artificial sinks to mitigate climate change impacts.

Sink Efficiency Over Years

Google Looker Dashboard

GCB Overall Trend Analysis

Sink vs Emission Analysis

Sink Trend comparison by type

land_sink_normalized — ocean sink_normalized — cement carbonation sink_normalized

emissions_to_sinks_ratio

atmospheric_growth_change_normalized

sink_efficiency

emissions_growth_rate

Region and Country Vise Analysis

Total_Emissions
0 — 84,784.68

Region
North America · OECD · Europe · Non-OECD · EU27 · Oceania · Asia · Non KP Annex B · Africa · Central America

USA · Russia · Germany · France · Poland · Canada · Ukraine · Spain · Kazakhstan · Australia

Total_Emissions