

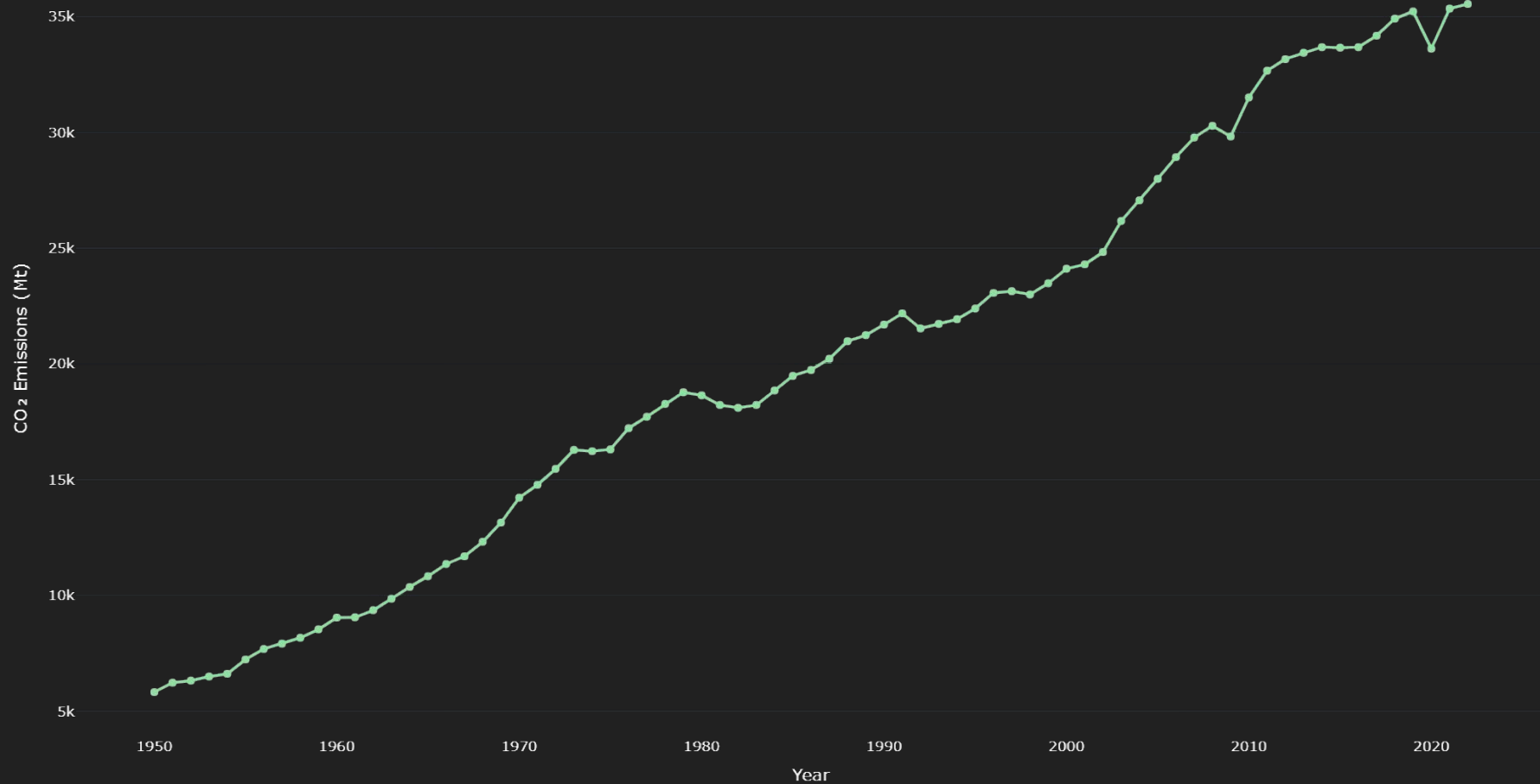
# Mapping Change: Carbon, Economy, and Climate's Future



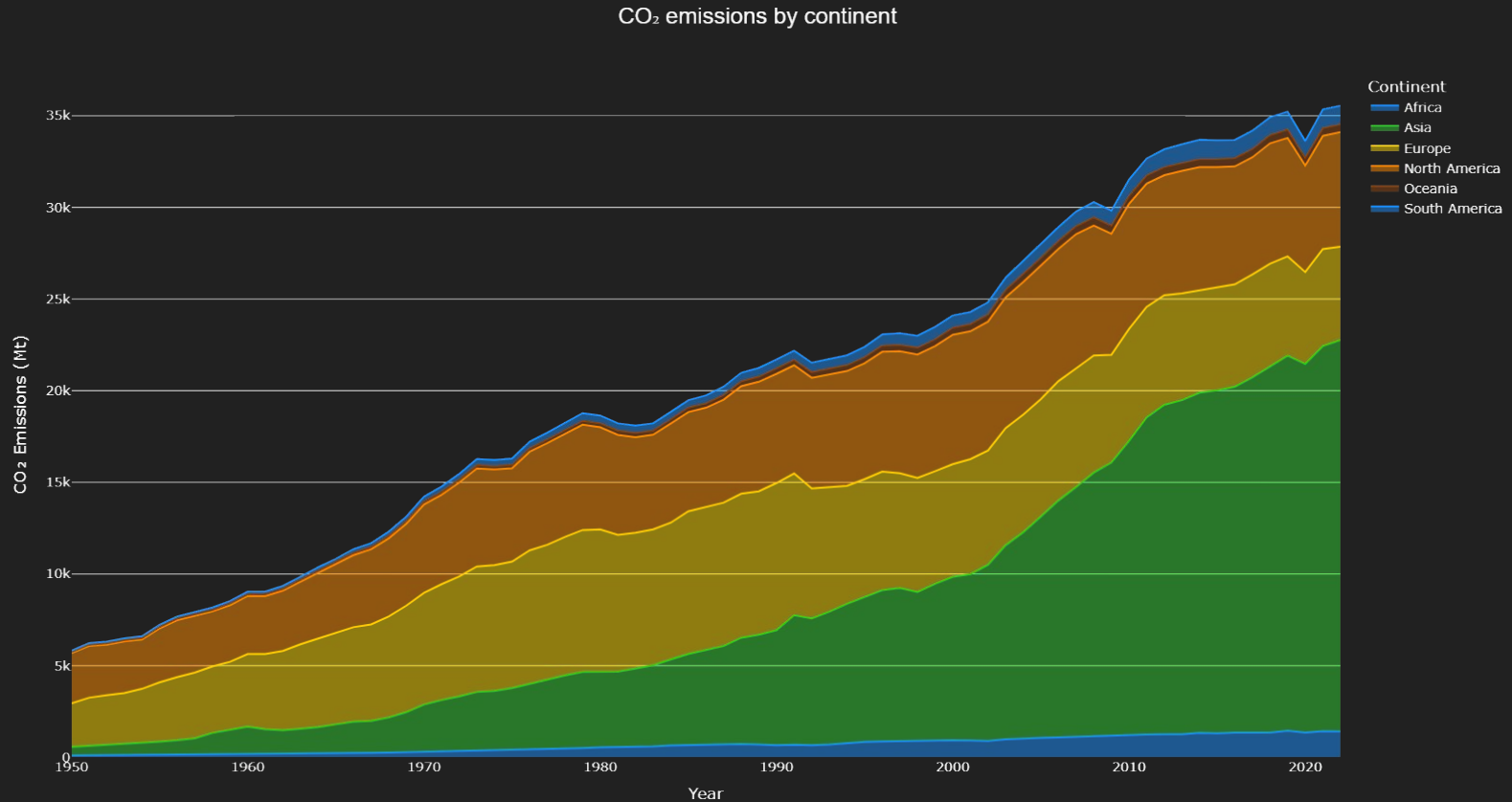
Belén Iturralde

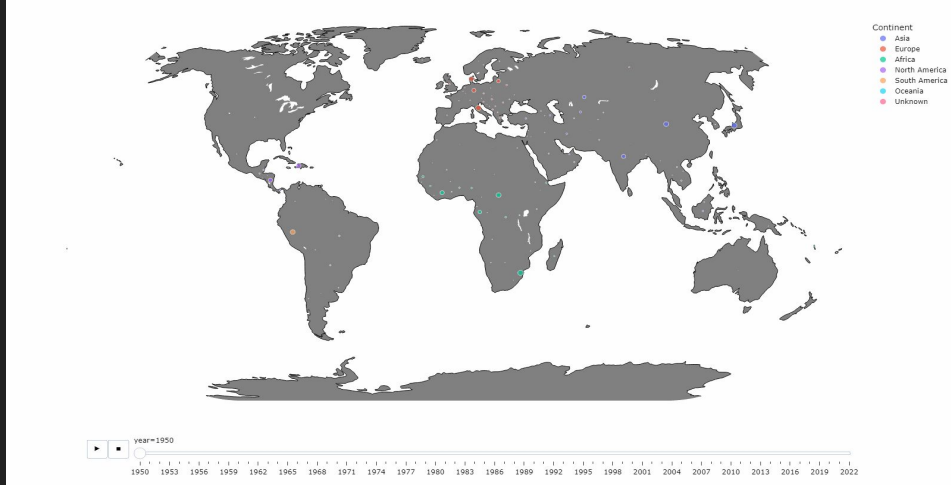
- Carbon dioxide ( $\text{CO}_2$ ) is one of the main greenhouse gases responsible for climate change. While it is a natural component of the atmosphere, its levels have risen alarmingly since the Industrial Revolution due to human activities such as fossil fuel combustion, deforestation, and land-use changes.
- $\text{CO}_2$  traps heat in the atmosphere, contributing to global warming. This phenomenon has triggered a series of global consequences: rising temperatures, glacier melting, sea level rise, and more frequent and intense extreme weather events.

Evolution of CO<sub>2</sub> Emissions over Time



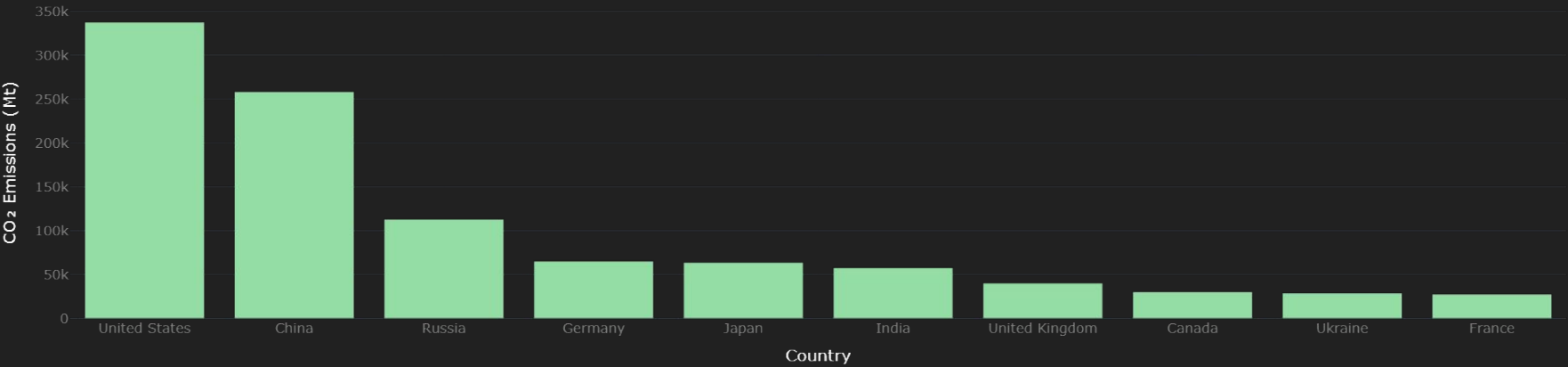
- CO<sub>2</sub> emissions vary widely across continents, shaped by differences in economic development, population size, and energy choices.





## CO<sub>2</sub> Emissions by Continent

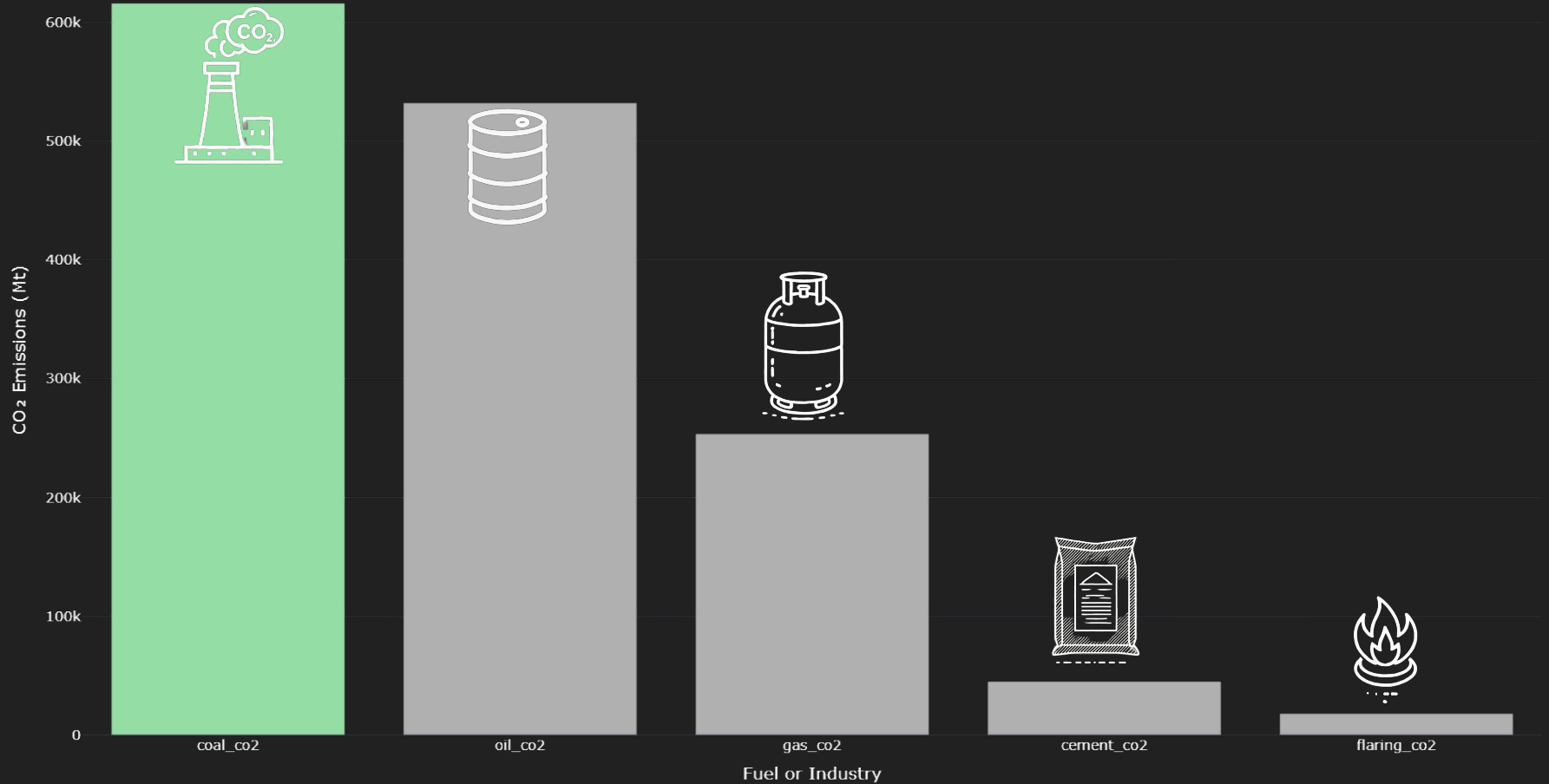
### Top 10 Countries that Emit the Most CO<sub>2</sub>



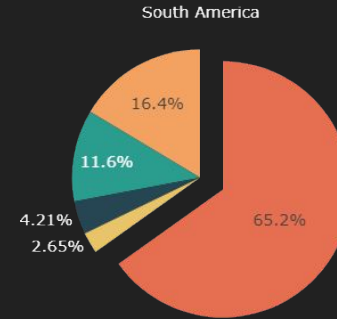
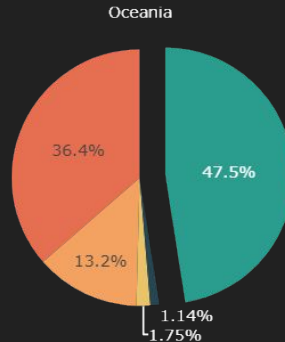
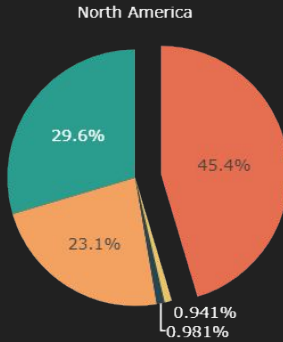
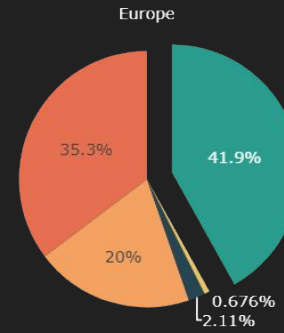
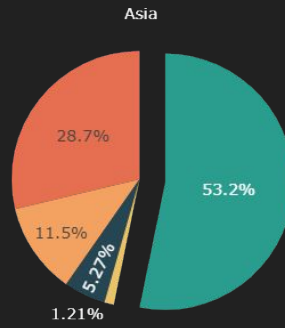
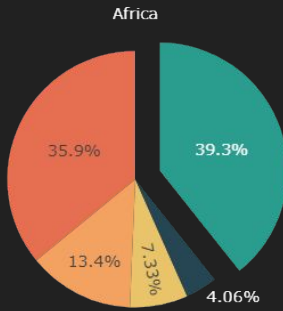
CO<sub>2</sub> emissions come from various human activities closely tied to industrial development, energy use, and agriculture. The main sources include:

- Coal: Primarily used for electricity generation and heavy industry, coal is the largest source of CO<sub>2</sub> emissions due to its high carbon content.
- Oil: A major contributor to emissions, especially in transportation (cars, planes, and ships) and the petrochemical industry.
- Natural Gas: While cleaner than coal and oil, burning natural gas still produces significant CO<sub>2</sub> emissions, particularly in power generation and heating.
- Cement: Cement production is one of the largest industrial emission sources, as it releases CO<sub>2</sub> during the chemical process of calcination.
- Gas Flaring: The burning of natural gas during extraction or processing (flaring) also contributes to emissions

# What Are the Main Sources of CO<sub>2</sub> Emissions?"



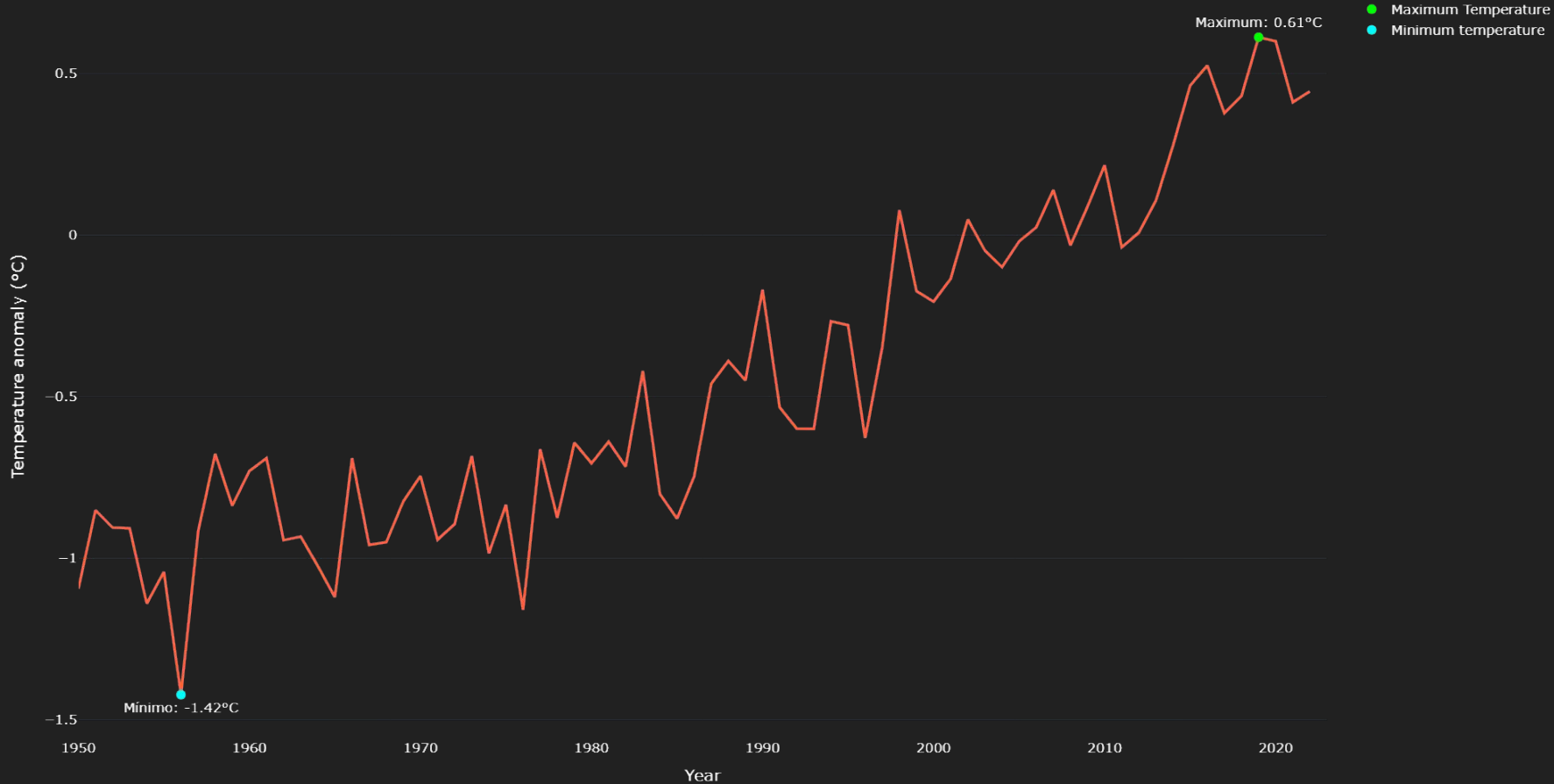
## Distribution of CO<sub>2</sub> Emissions by Sector and Continent



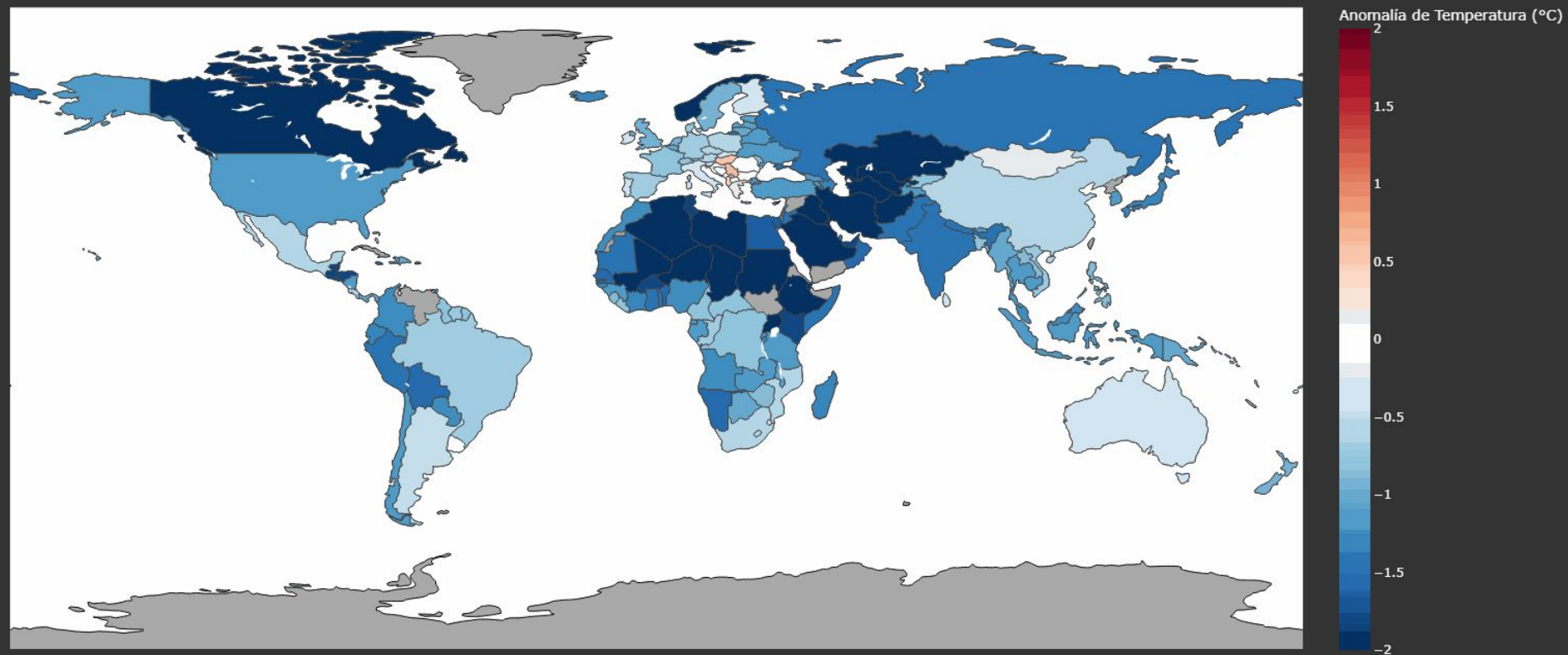
coal\_co2  
oil\_co2  
gas\_co2  
flaring\_co2  
cement\_co2



# • The Consequences: Temperature anomaly



## Evolución de las Anomalías de Temperatura Global



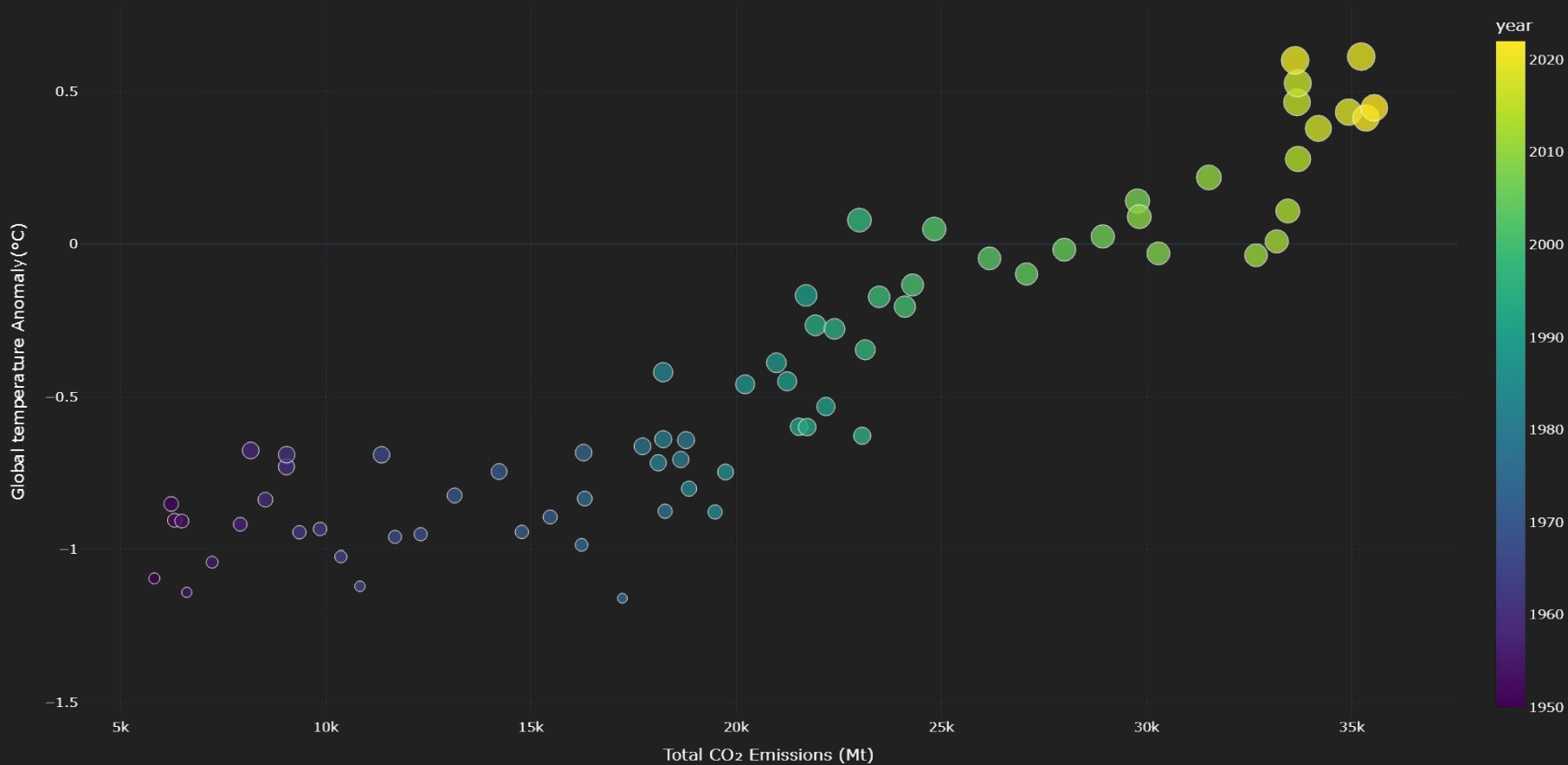
year=1950

1950 1953 1956 1959 1962 1965 1968 1971 1974 1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007 2010 2013 2016 2019 2022

## The Consequences

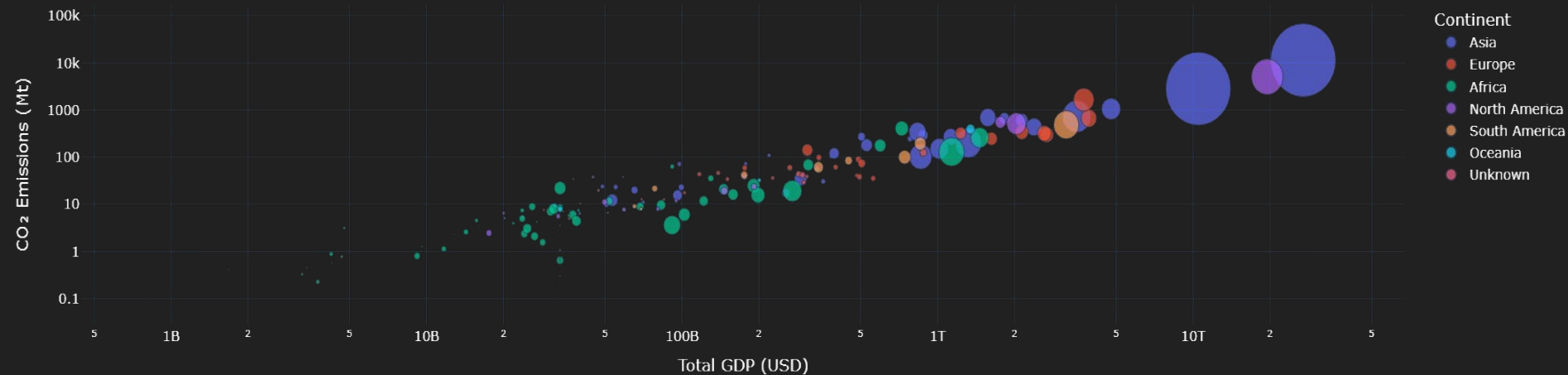
- On average, global temperatures have risen by approximately 1.1°C since the late 19th century. The direct link between CO<sub>2</sub> emissions and temperature anomalies is clear. If emissions are not drastically reduced, global temperatures could rise by 2°C to 3°C by the end of the 21st century, leading to irreversible consequences—rising sea levels, more intense heatwaves, and an increase in extreme weather events.
- The correlation between CO<sub>2</sub> emissions and global temperature anomalies is one of the clearest and most alarming findings in climate research. Since the Industrial Revolution, the rise in CO<sub>2</sub> emissions from human activities has significantly intensified the greenhouse effect, trapping more heat in the atmosphere and driving a steady increase in global temperatures.

Correlation between CO<sub>2</sub> Emissions and Global Temperature Anomaly

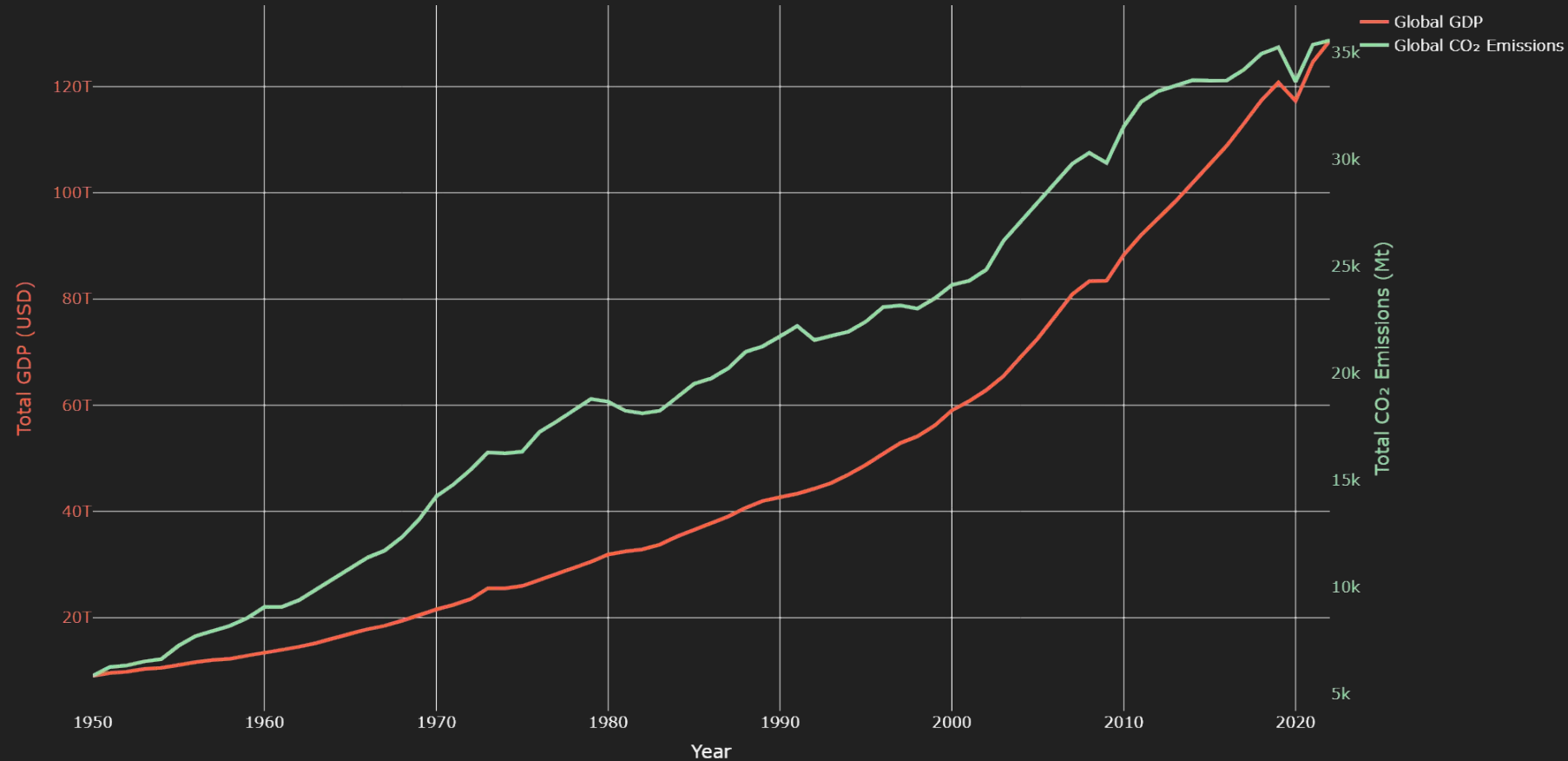


- The Relationship Between GDP and CO<sub>2</sub> Emissions
- 
- Gross Domestic Product (GDP) and carbon dioxide (CO<sub>2</sub>) emissions are closely linked due to the historical reliance of economic activities on fossil fuel-based energy sources. As countries expand their infrastructure, increase industrial production, and enhance services, energy demand rises—often leading to higher CO<sub>2</sub> emissions.

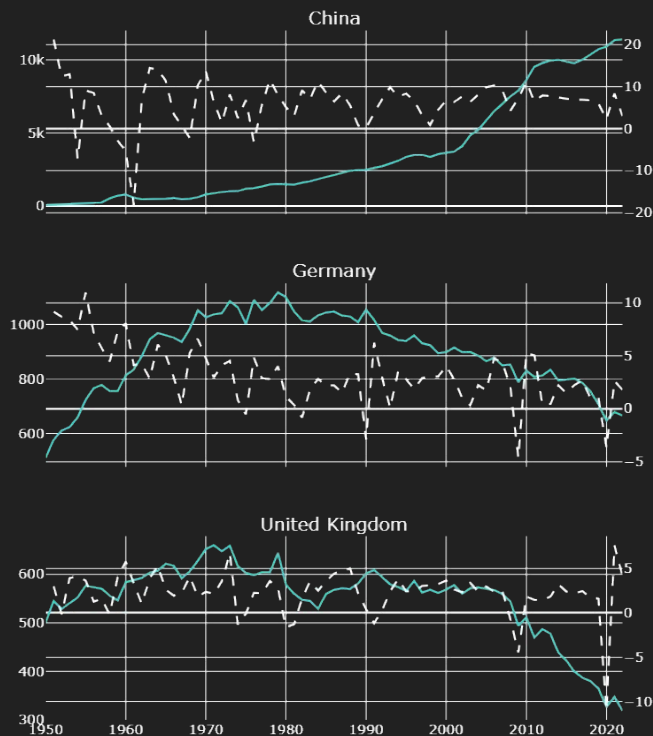
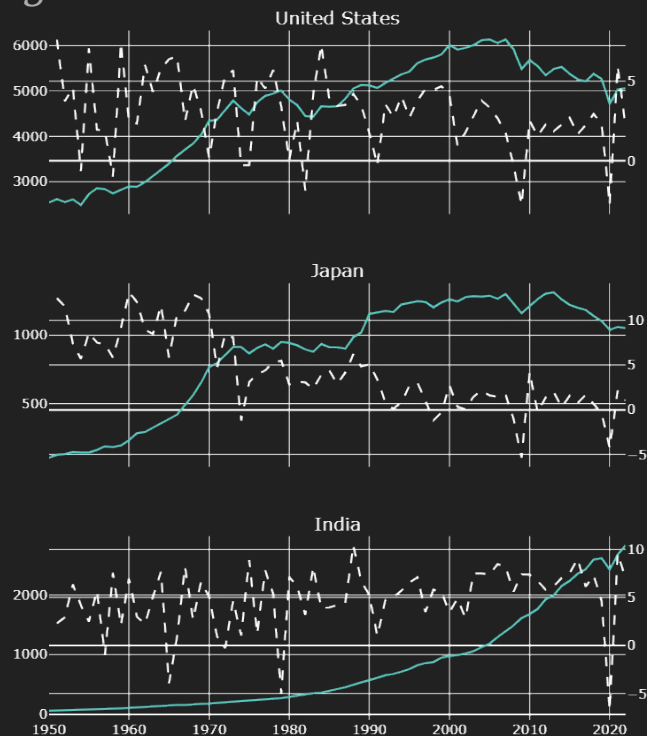
Correlation between GDP and CO<sub>2</sub> Emissions



Global GDP and CO<sub>2</sub> Emissions Over Time

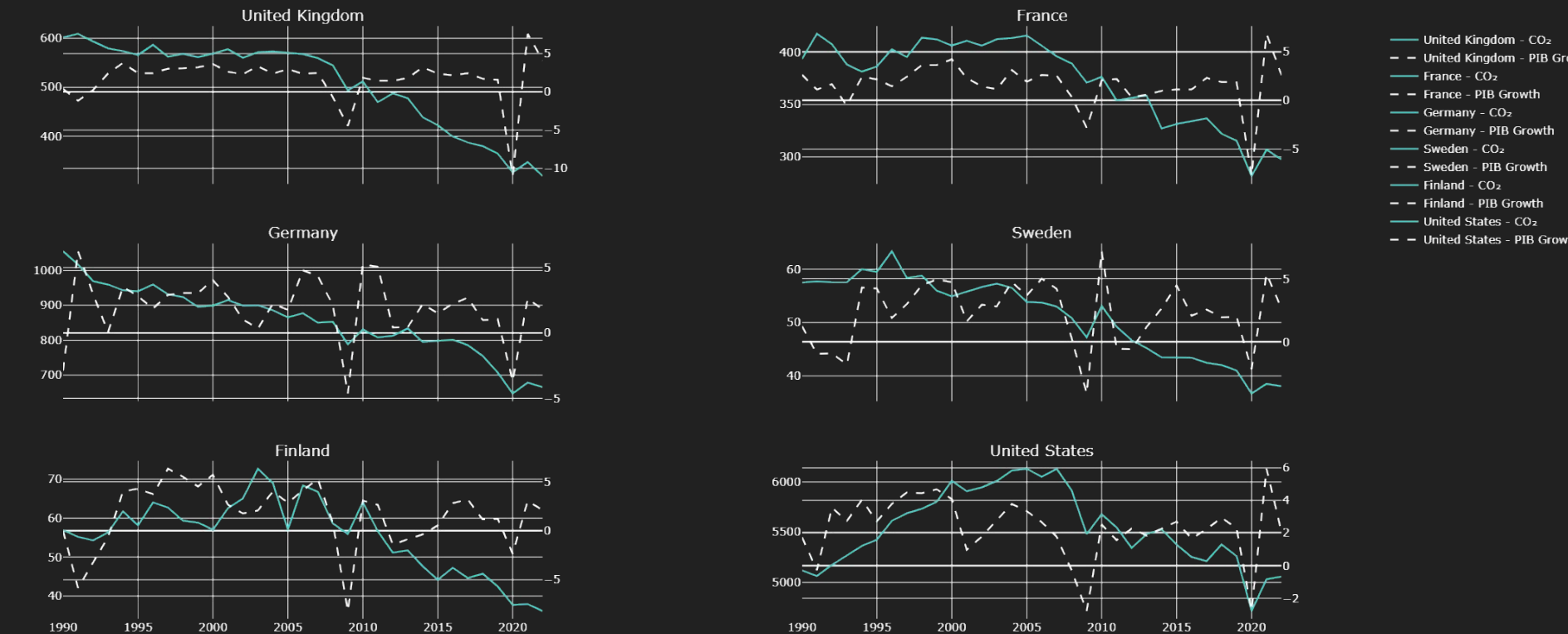


The global trend shows a strong correlation between GDP and carbon emissions. However, some economies in the Global North have managed to achieve absolute or relative decoupling, reducing emissions while maintaining economic growth.



- United States - CO<sub>2</sub>
- - United States - PIB Growth
- China - CO<sub>2</sub>
- - China - PIB Growth
- Japan - CO<sub>2</sub>
- - Japan - PIB Growth
- Germany - CO<sub>2</sub>
- - Germany - PIB Growth
- India - CO<sub>2</sub>
- - India - PIB Growth
- United Kingdom - CO<sub>2</sub>
- - United Kingdom - PIB Growth

Some of the world's strongest economies have achieved **absolute decoupling** of GDP and CO<sub>2</sub> emissions. However, the United States remains an exception, with only **relative decoupling** due to its continued reliance on fossil fuels.





## Conclusions

Today, CO<sub>2</sub> emissions remain closely tied to economic development, as highly industrialized nations tend to emit more. However, the shift toward clean energy and the adoption of sustainable policies offer a path to decoupling economic growth from environmental impact.

In today's context, understanding CO<sub>2</sub> emission trends and patterns is essential for designing effective solutions that balance economic development with environmental protection.

Change is possible. Through sustainable policies and innovation, we can reduce emissions without compromising economic progress.