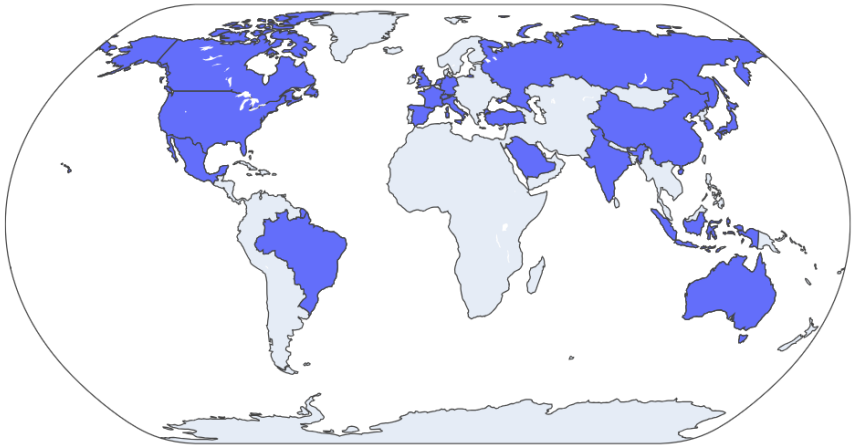
Data Visualization Pitch

Student Individual Assignment



the 20 largest economies

The Cost of Wealth: How Top 20 Economies' Growth Shapes Global CO_2 Emissions

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Research questions

To what extent does the economic growth (measured by GDP) of the world's wealthiest nations correlate with an increase in their carbon dioxide (CO_2) emissions over the last two decades?

- Is increasing CO_2 emissions an unavoidable consequence for these nations as they pursue further economic prosperity (GDP growth)?
- Are there specific wealthy nations that have successfully managed to increase their GDP while simultaneously reducing their CO_2 (a phenomenon known as decoupling, where emissions decrease as the economy grows) and if so, how significant is this reduction?

About Data

- *While searching for data, the main issue I encountered was finding a reliable and transparent source. I needed datasets officially reported by countries and published by institutions with clear methodologies.*

- *For GDP data, my first option was the World Bank, which is generally a trustworthy source. However, I realized that several recent years had not yet been updated in their database. Due to these gaps, I decided to adjust my scope and switch to a more complete and up-to-date source: the International Monetary Fund (IMF). I chose the IMF dataset, which is published under the IMF Open Data License. This license allows the use, modification, and sharing of the dataset, provided that the source is properly acknowledged.*
- *For CO_2 emissions data, I used Our World in Data (OWID), a platform supported by Oxford University, which shares its datasets under the Creative Commons BY 4.0 License. This license permits reuse for academic and analytical purposes as long as attribution is included.*

About Data

- *While examining the datasets, I noticed that some countries—especially low-income ones—did not report data consistently or had long gaps in past years. However, the recent data for most high-income and high-reporting countries appeared complete and reliable.*
- *To prepare the data for analysis, I removed all countries that were not relevant for my study. I also deleted very old records that were unnecessary for my timeframe. This cleaning process helped me obtain a more consistent and focused dataset.*

Data Sources

- *CO_2 Emissions Data: Our World in Data. Available at: https://ourworldindata.org/co2-emissions*

- *GDP Data: IMF, World Economic Outlook. Available at: https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEOWORLD*

Methodology

- For this project, I worked with two datasets: one containing GDP values and the other containing CO_2 emissions. Since they were provided by different sources, I manually downloaded the GDP dataset in CSV format and the CO_2 dataset in Excel format. I first processed the GDP data in KNIME, where I sorted all countries based on their 2023 GDP values, as this was the most recent year available. I then selected the top 20 countries and removed the remaining entries to narrow the scope of the analysis.
- The CO_2 dataset was processed in Python, where I loaded it into a DataFrame and used libraries such as pandas, matplotlib, seaborn, and re to clean and explore the data. After preparing both datasets separately, I merged them in Python to create a unified DataFrame that contained GDP and CO_2 emissions for the selected countries. During this stage, I also removed unnecessary columns, ensured consistent formatting, and aligned the datasets based on country codes.
- Due to limitations associated with using two different visualization tools, the charts were generated using Datawrapper and Python libraries.

Methodology

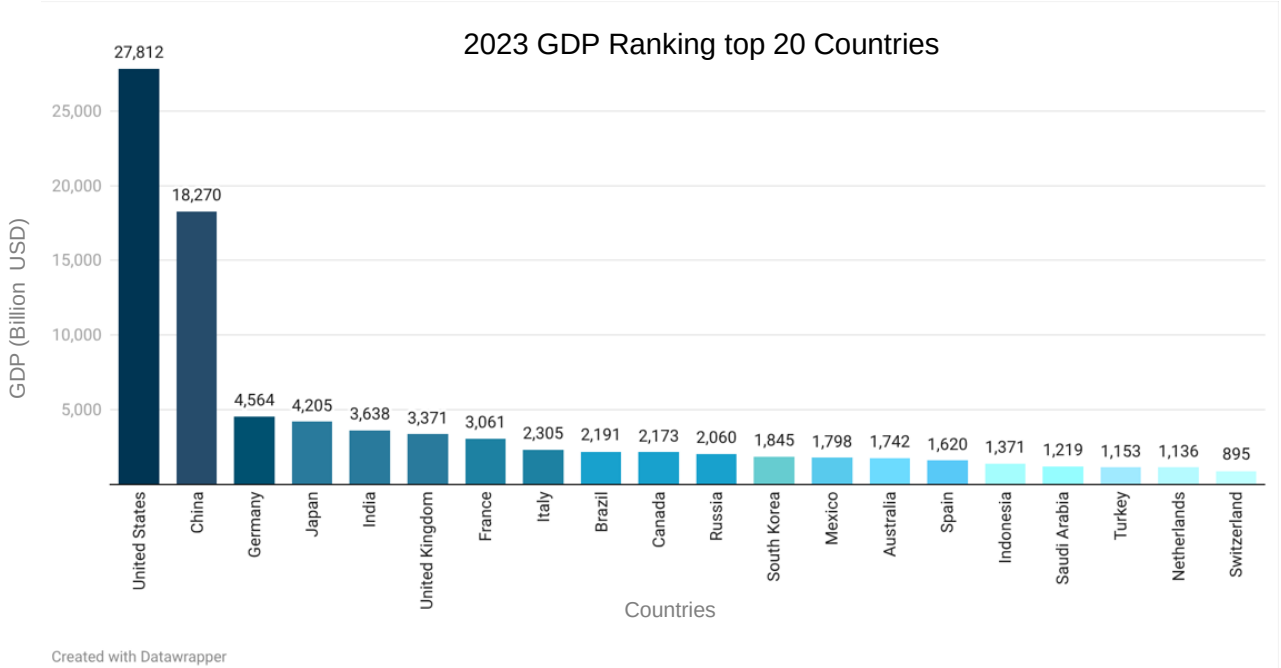
- While writing the code, I used AI tools such as ChatGPT and Gemini, but only for purposes like syntax correction and minor code suggestions. I did not use AI for the analytical or interpretative aspects of the project. After generating the visualizations, I noticed that the difference between the highest and lowest CO_2 emitters was extremely large, making a single combined plot difficult to interpret. For this reason, I decided to create two separate charts to provide clearer insights.
- Finally, all Python scripts will be published on GitHub to ensure reproducibility. Although the KNIME workflow can also be reproduced, it may require some additional configuration before running due to tool-specific settings.

Reproducibility

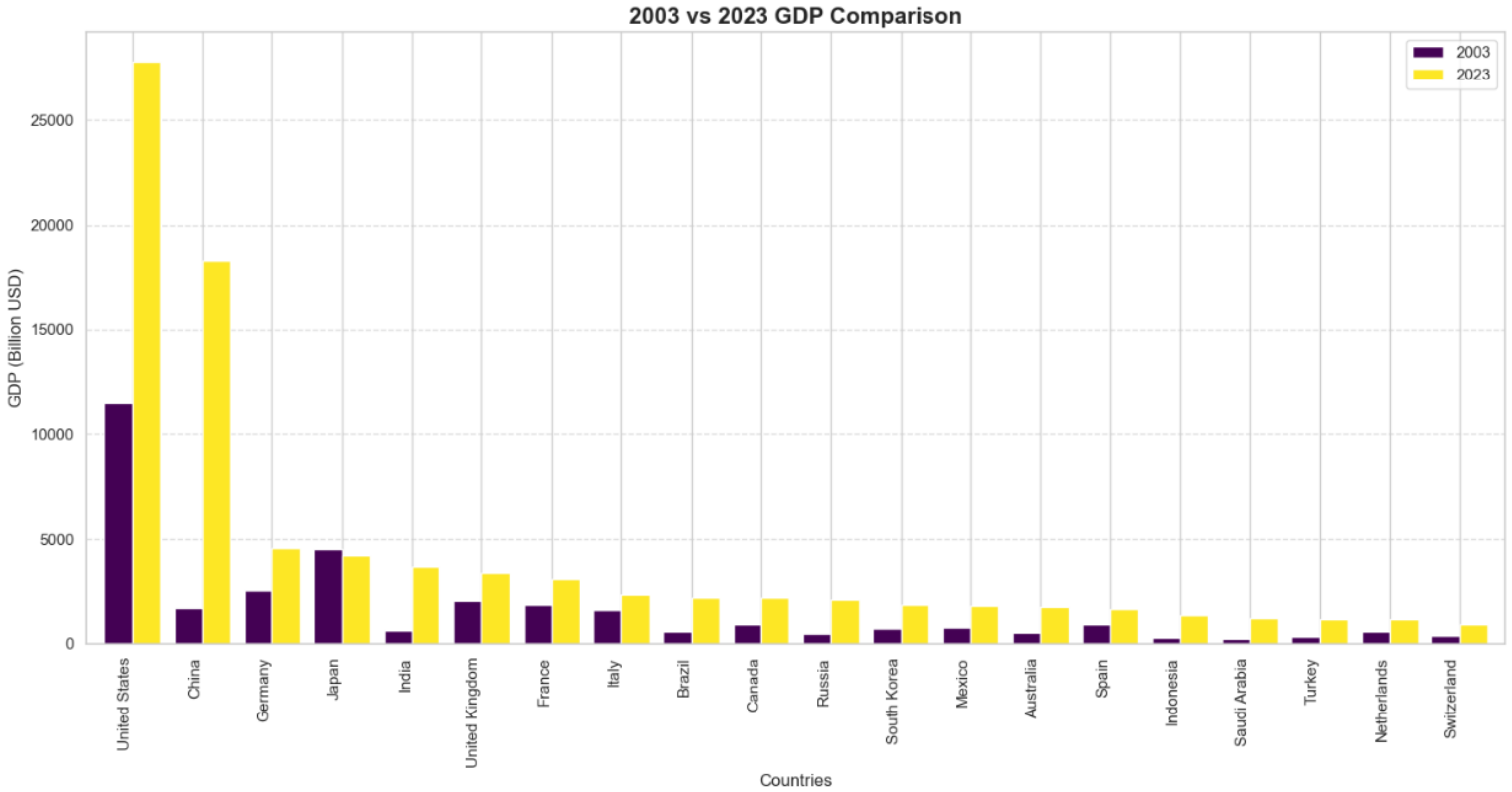
All Python scripts and data processing steps used in this analysis are available on GitHub: https://github.com/SelimAkpunar/GDP-CO2-Analysis-of-20-richest-countries

Insights from the Data

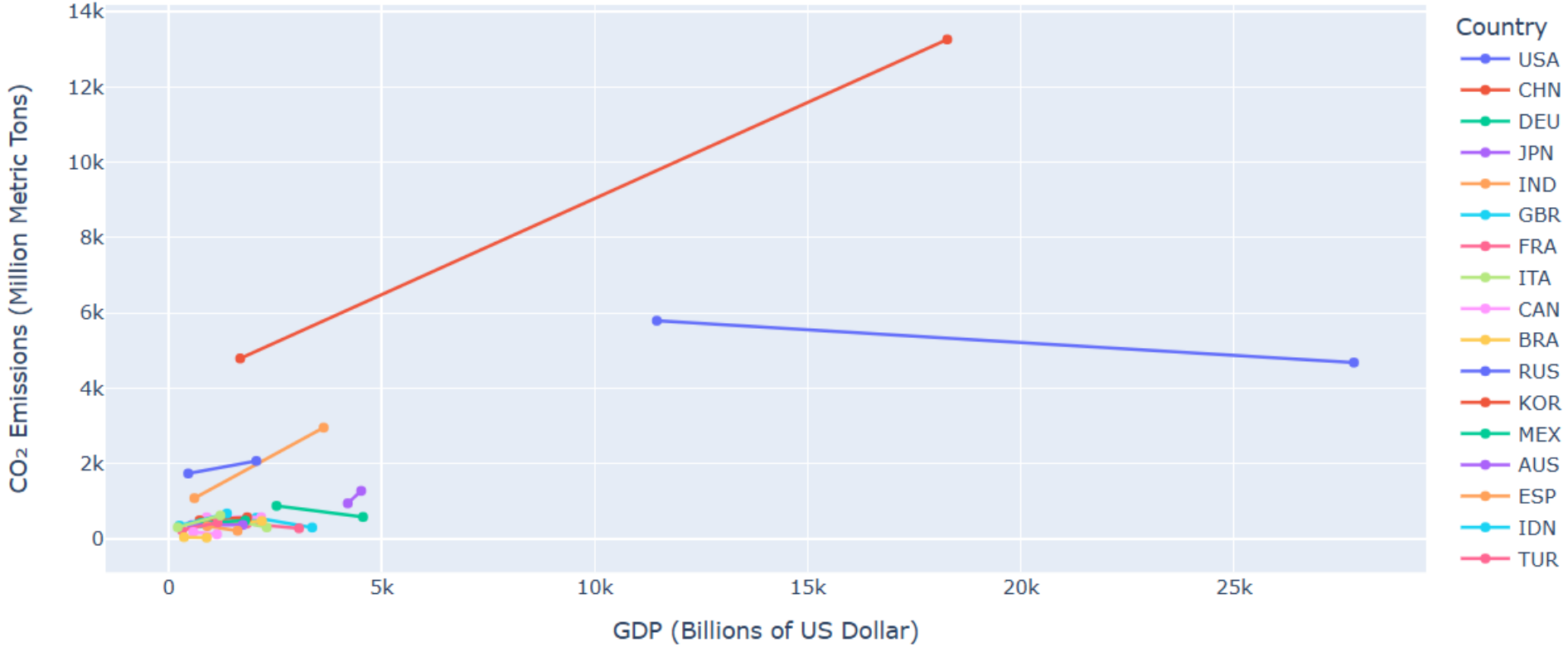
- *The GDP and CO_2 emissions of the United States and China are significantly higher than those of the other 18 countries in the dataset.*
- *While the United States has managed to reduce its CO_2 emissions despite its rising GDP, China has not achieved the same trend, and its emissions remain far above those of all other countries. This evidence suggests that economic growth may have been prioritized at the expense of environmental sustainability and emission mitigation.*
- *Several developed European countries, such as the United Kingdom and Germany, have managed to reduce their emissions—though not drastically—indicating progress toward cleaner economic activity. This success suggests that the 'net-zero' policies shaped under the European Green Deal are yielding tangible results on the ground. Particularly, this transformation in the industrial and energy sectors proves that economic growth can be decoupled from environmental pollution, providing an inspiring model for other nations.*
- *In Asia, CO_2 emissions show a generally increasing trend. India stands out with a sharp rise in emissions, while Japan and Indonesia also exhibit moderate increases. Similarly, Russia has continued to record high emission levels with limited evidence of sustained reduction. This pattern may suggest the lack of a strong and coordinated emissions-regulation framework in the region, especially when compared to Europe.*



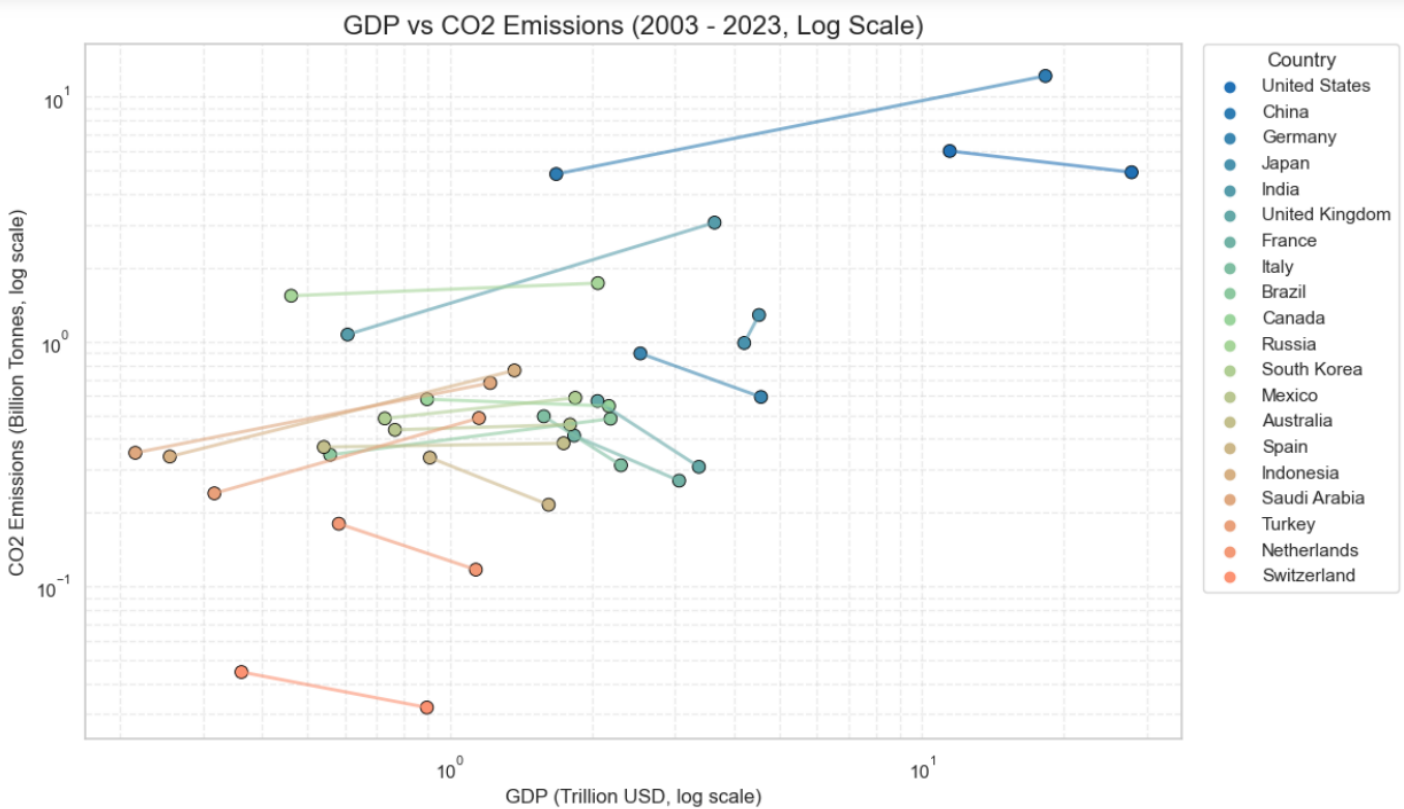
This chart shows the top 20 economies in 2023 and highlights a massive gap between the top two and the rest. The USA and China are far ahead of all other nations. While the USA leads with over $27 trillion, the GDP levels of the remaining 18 countries are much closer to each other, showing a more gradual decline after the two leaders.



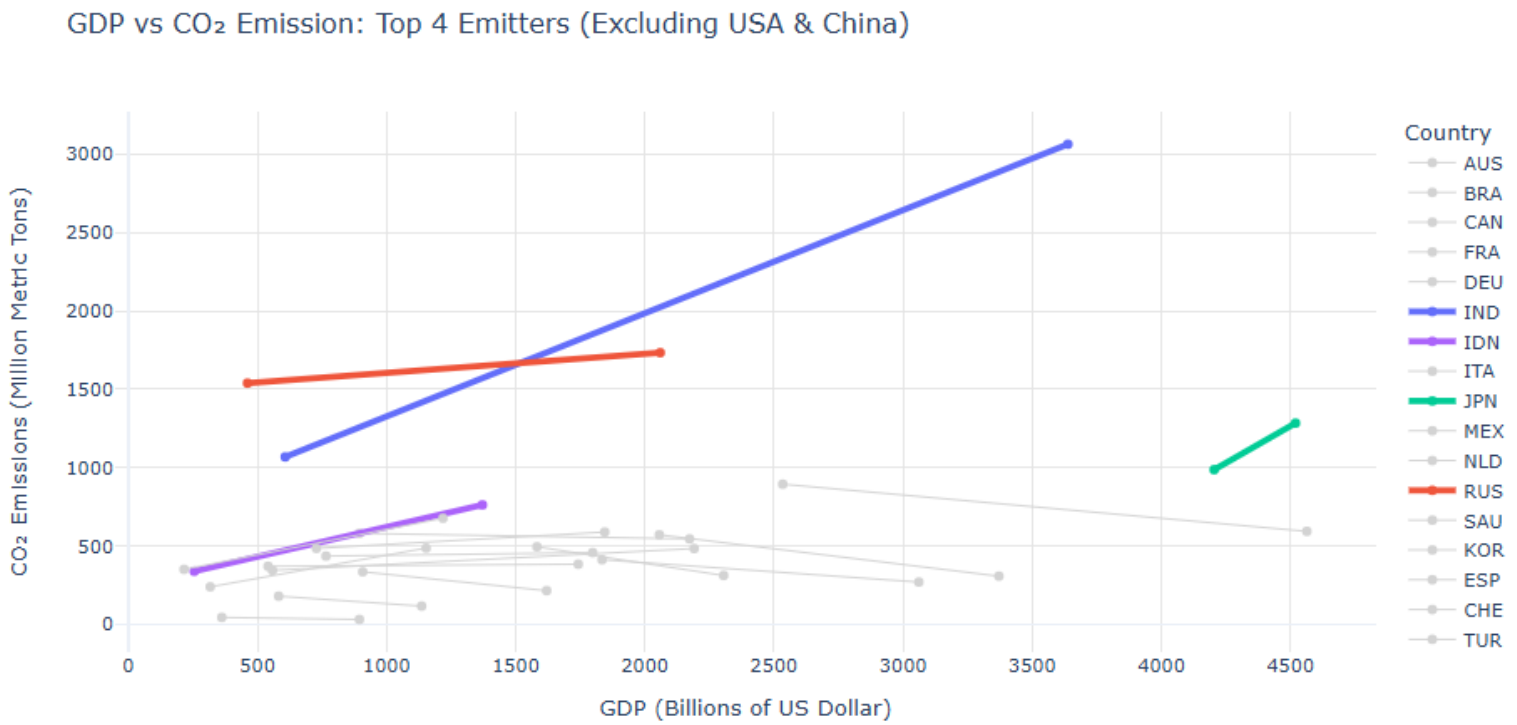
This chart compares the GDP growth of top economies between 2003 and 2023. The USA and China show a massive and sudden increase in economic power, significantly outperforming all other nations. Outside of these two leaders, India's growth is also very noticeable. In contrast, Japan stands out as the only major economy in this group that saw its GDP decrease over the last 20 years.



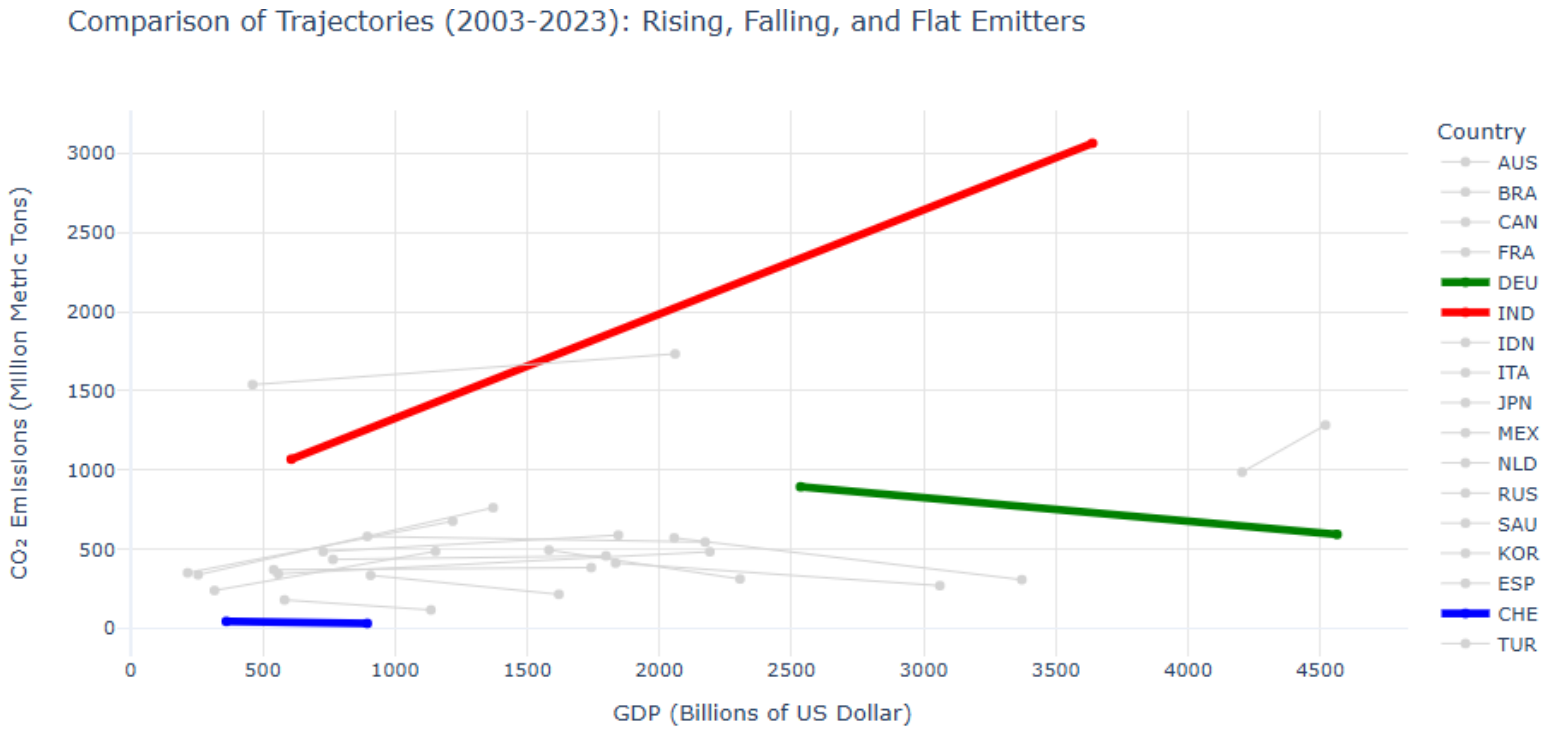
This chart compares GDP and CO_2 trends over the last 20 years. The USA increased its GDP while lowering emissions, whereas China saw massive growth in both. Note that due to their huge scale, other countries appear clustered and harder to see.



Since the GDP and CO_2 values vary greatly across these 20 countries, plotting them on a standard scale makes the graph difficult to read. To solve this, I applied a logarithmic transformation (this scales down large differences, allowing very high and very low numbers to be compared easily on the same chart). This chart makes the trends for all countries clearly visible.



Excluding the USA and China highlights India's massive CO_2 surge over the last 20 years. The top 4 emitters of 2023 are highlighted to emphasize the most significant trends, while others are greyed out to enhance readability. While India's trajectory climbs sharply, European nations maintain flatter lines, showing a successful decoupling of economic growth from emissions.



Excluding the USA and China reveals three distinct developmental paths between 2003 and 2023. While India (red) shows a sharp CO2 surge alongside economic growth, Germany (green) illustrates a successful "decoupling" by reducing emissions as its GDP rises. Switzerland (blue) represents a stable, low-emission trajectory, while other nations are greyed out to maintain visual clarity and focus on these key trends.

LICENCE

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Mehmet Selim Akpunar
MSc Data Science student at the University of Milano-Bicocca.

I am currently studying Data Science and building a solid foundation in data analysis and data visualization. Through my coursework and projects, I focus on understanding data, cleaning it properly, and presenting results in a clear and meaningful way.

I am motivated to continue developing my skills in this field and to grow professionally as a data analyst or data scientist, with a particular interest in sustainability and the economic impact of data-driven decisions.

Technical Skills
Python for data analysis, Data Visualization, Exploratory Data Analysis, Data Cleaning, Analytical Thinking, Reproducible Analysis, Version Control (GitHub)

Career Goal
To continue improving my technical skills during my studies and pursue a career in data-related roles in the future.