

Global CO₂ Emissions Policy Brief: Identifying Top Polluters by Sector and Country

Project Title: Global CO₂ Emissions Tracker by Sector

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Tools Used: Python, Excel, Tableau

Executive Summary

As the world faces mounting climate challenges, understanding the sources and distribution of CO₂ emissions is critical to developing effective mitigation strategies. This policy brief presents findings from an extensive data analysis project that tracked global CO₂ emissions across energy, transport, and industry sectors.

Using publicly available emissions data enriched with per capita and per GDP indicators, we created a comprehensive Tableau dashboard that visualizes emissions trends, sectoral impacts, and national disparities. The resulting analysis offers valuable insights into the behaviour of top emitters and the structural inefficiencies driving climate degradation.

Methodology Overview

1. Data Collection & Cleaning

- The primary dataset includes multi-year CO₂ emissions data segmented by country, sector, and year.
- Sectors include: **Power, Ground Transport, Industry, Domestic Aviation, International Aviation, and Residential.**
- Dates were standardized to extract the **year** for time-series analysis.
- Sector names were cleaned and categorized for consistency.

Link:

<https://colab.research.google.com/drive/1aKrdT2kk8bcbBVatMVUs9j6zOuOuYvOD?usp=sharing>

2. Data Enrichment

To allow for more meaningful comparisons:

- **Population** and **GDP** data (simulated for this project) were merged.
- Metrics calculated:
 - **Absolute Emissions** (Total CO₂ in Mt)
 - **Per Capita Emissions** (CO₂ per person)
 - **Per GDP Emissions** (CO₂ per USD of GDP)

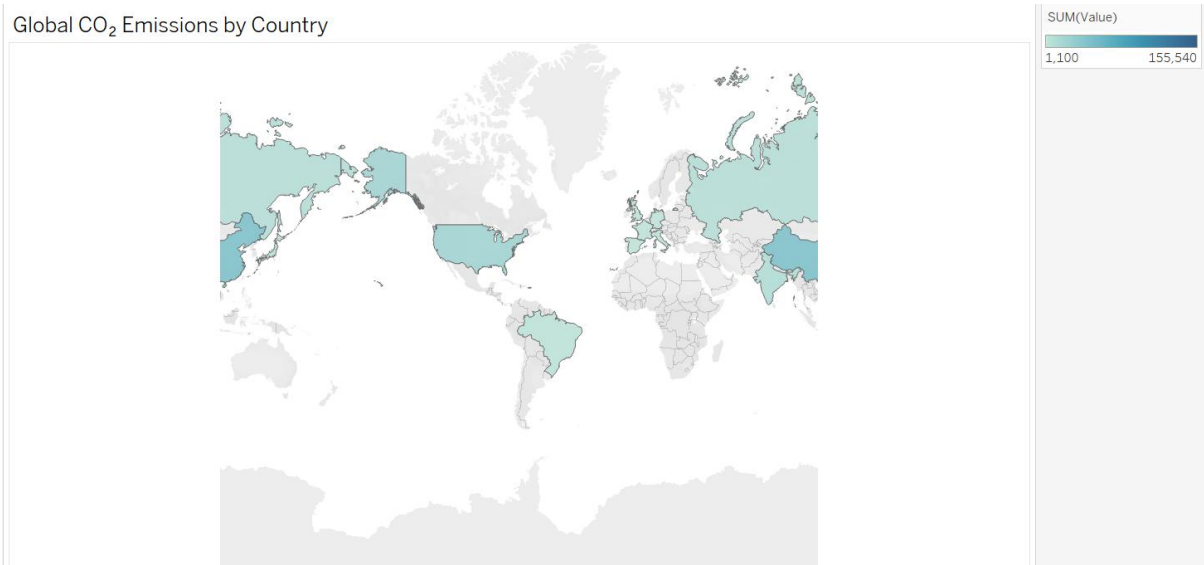
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3. Tools and Workflow

- **Python:** Used for data cleaning, merging, and metric computation
- **Excel:** Used for validating transformations and exporting enriched datasets
- **Tableau:** Used for creating dynamic dashboards and visual storytelling

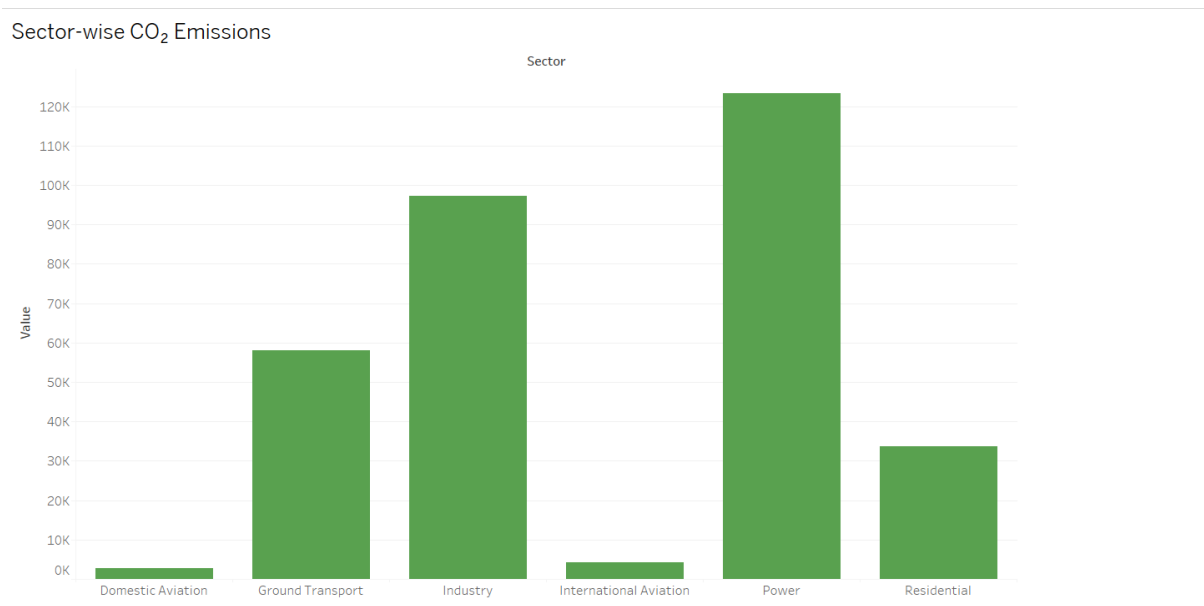
Key Visualizations & Insights

1. Global CO₂ Emissions by Country



Insight: The heatmap reveals that the highest absolute emissions originate from major industrial powers. China, the United States, and ROW (Rest of the World) display significant concentrations, highlighting the global scale of power-related CO₂ discharge.

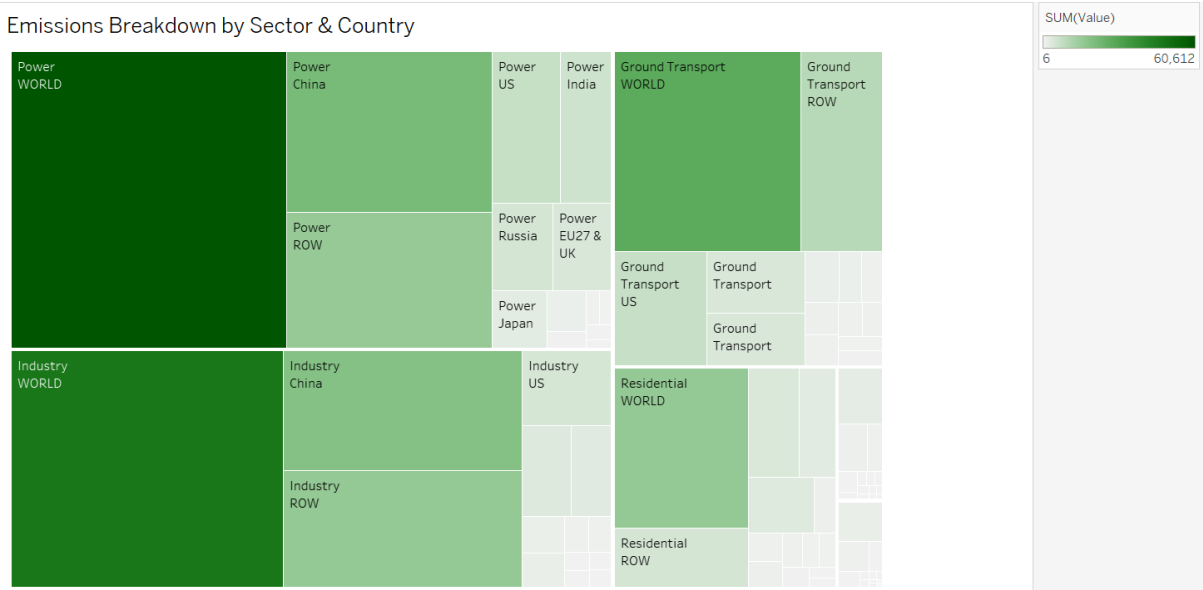
2. Sector-wise Emissions Comparison



Insight: The power sector accounts for the lion's share of emissions, followed by industry and

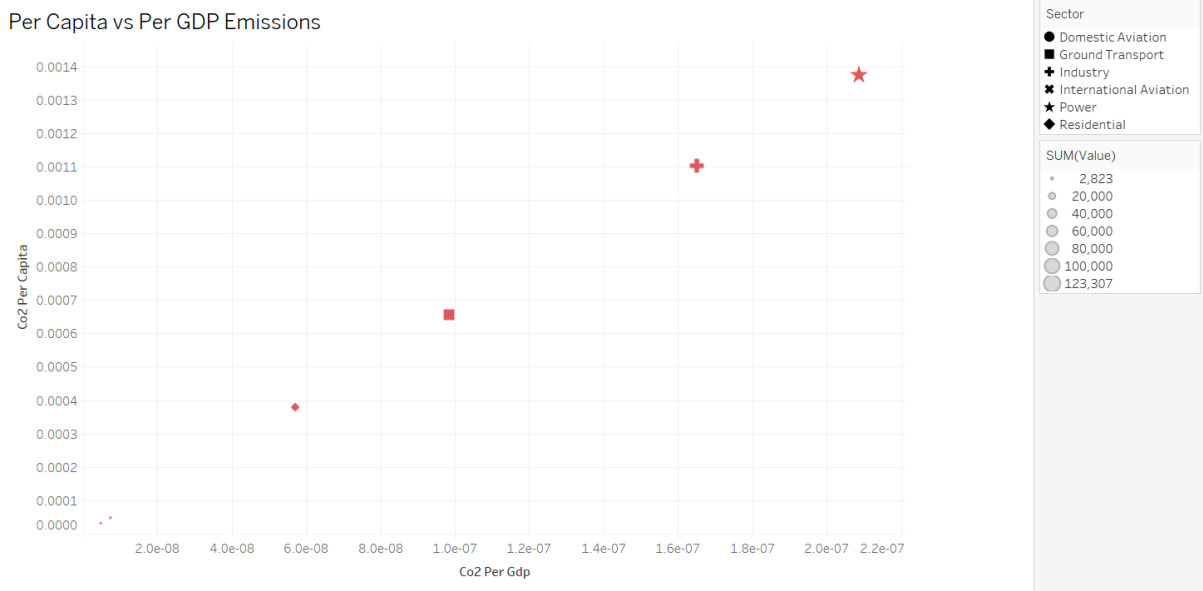
transport. Residential and aviation sectors contribute less but are critical due to urban growth and globalization.

3. Emissions Breakdown by Sector & Country



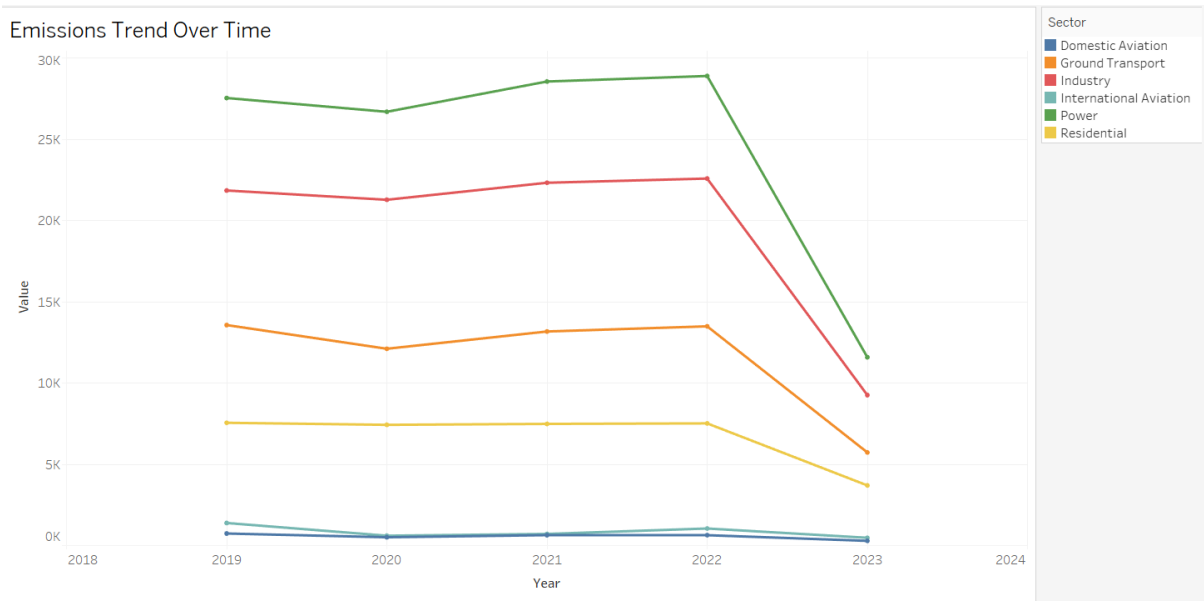
Insight: This visualization provides a proportional view of each country’s contribution to different sectors, offering clarity on national sectoral priorities. China's dominance in power and ROW's in industry are visually pronounced.

4. Per Capita vs. Per GDP Emissions Scatter Plot



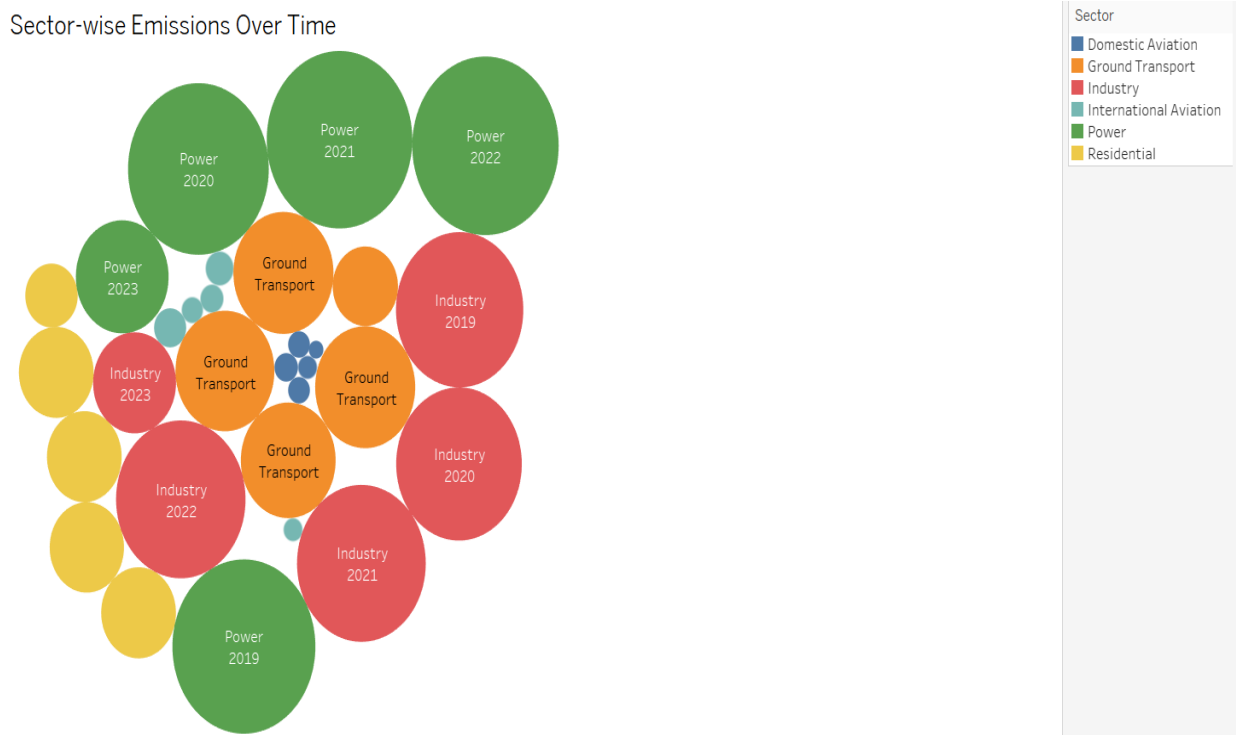
Insight: Countries with high per capita emissions but low GDP highlight inefficiencies or over-reliance on carbon-intensive processes. Conversely, some developed countries show better efficiency, indicating progress in clean technologies.

5. Emissions Trend Over Time



Insight: There is a visible dip in 2020 emissions due to the COVID-19 pandemic, with a sharp rebound by 2022. Long-term trends still point to rising emissions despite temporary declines.

6. Sector-Wise Emissions Over Time



Insight: Bubble sizes represent magnitude and temporal changes. Power and industry show steady dominance, with some volatility in transport and aviation sectors.

7. KPI Cards Summary

KPI Cards

Total Global CO₂ Emissions :

319,487

Top CO₂ per

Capita: 0.003592

Top CO₂ per GDP :

0.0000005413

- **Total Global Emissions:** 319,487 MtCO₂
 - **Top Emitting Sector:** Power
 - **Highest Per Capita Emissions:** 0.003592 tonnes/person
 - **Highest Per GDP Emissions:** 0.0000005413 tonnes/USD
-

Top Polluters Identified

By Absolute Emissions:

- **China** (particularly in the **Power** sector)
- **ROW (Rest of the World)** across **Industry** and **Transport**
- **USA**, driven by high emissions from **Transport** and **Power**

By Per Capita Emissions:

- Countries with smaller populations and significant resource extraction (e.g., Middle Eastern oil economies)
- Emissions from aviation per capita also elevate figures in tourism-driven economies

By Emissions per GDP:

- Developing nations with inefficient industrialization
- Economies lacking green infrastructure or reliant on fossil fuel exports

These findings suggest that both absolute and relative measures are needed to develop fair and targeted emission reduction strategies.

Policy Recommendations

1. **Prioritize Decarbonizing Power Sector Globally:**
Power emissions dominate, especially in China and ROW. Renewable energy subsidies, phasing out coal plants, and carbon pricing mechanisms are urgently required.
2. **Modernize and Electrify Public Transport:**
Urban congestion and rising vehicle ownership are major concerns. Investments in electric

buses, metro systems, and carbon-efficient rail can significantly reduce ground transport emissions.

3. **Promote Emission Efficiency in Industry:**

Tax credits for green tech adoption, emissions benchmarking, and technology transfer for energy-intensive sectors like cement, steel, and chemicals.

4. **Implement Equity-Based Climate Goals:**

Countries with lower GDP but higher emissions per capita may need different policy frameworks. Global agreements should reflect responsibility and capability.

5. **Strengthen Emissions Data Monitoring:**

Support real-time emissions tracking and data transparency to empower climate governance and public accountability.

Conclusion

This project offers an evidence-based, multi-dimensional view of the global emissions landscape. By using Tableau for interactive storytelling and Python/Excel for data processing, we have delivered a policy toolkit that is both accessible and insightful.

The next steps include:

- Integrating real GDP and population data sources
- Publishing the dashboard for public access
- Sharing findings with environmental policy bodies and sustainability councils

Well-informed climate action must begin with **data-driven insights**. Our dashboard and this report aim to catalyse that transformation.
