

Project Report: Global Trends in Fossil CO2 Emissions and Air Travel Emission Intensities

1.0.1 Introduction

Climate change remains a critical global challenge, necessitating rigorous analysis of greenhouse gas emissions across regions and sectors. This report explores the trends in CO2 emissions per GDP and air travel emission intensity in Europe and globally. By comparing these datasets, we aim to uncover regional disparities, evaluate policy effectiveness, and identify potential avenues for sustainable development initiatives.

1.0.2 Used Data: The data used for this analysis comprises two primary datasets processed through an automated data pipeline.

1. CO2 Emissions per GDP Dataset (World Data)

- **Source:** Joint Research Centre's EDGAR database
- **Structure:** The dataset includes yearly records from 1970 to 2016, detailing CO2 emissions per unit of GDP for various countries globally. Columns include country identifiers, years, and emission values.
- **Meaning:** This dataset provides insights into the efficiency of economies in decoupling economic growth from carbon emissions.
- **License:** The data is sourced from the Joint Research Centre's EDGAR database, which typically employs open data licenses. Compliance involves proper attribution and ensuring the data is used for non-commercial research purposes.

2. Air Travel Emission Intensity Dataset (Europe Data)

- **Source:** Joint Research Centre's Urban Data Platform
- **Structure:** This dataset provides air travel emission intensity values for European regions, spanning the years 2019 to 2022. It includes region identifiers, years, and emission intensity values.
- **Meaning:** It offers insights into the environmental impact of air travel across different European regions over recent years.
- **License:** The dataset from the Urban Data Platform follows standard open-data licensing, requiring attribution and adherence to non-commercial use guidelines.

Both datasets underwent cleaning and transformation via an automated pipeline to ensure consistency and usability for subsequent analysis. Compliance with data licenses includes proper citation and adherence to usage restrictions to maintain ethical and legal standards in data utilization.

1.0.3 Analysis

The analysis focused on two key aspects of greenhouse gas emissions: CO2 emissions per GDP globally and air travel emission intensity in Europe. The data underwent preprocessing to handle missing values, outliers, and ensure consistency across years and regions. Visualizations were generated to compare trends over time and across regions.

Results

1. CO2 Emissions per GDP (World Data): The analysis revealed varying trends across countries

from 2013 to 2016. Some countries showed a decrease in CO2 emissions per unit of GDP, indicating improved efficiency in economic output relative to carbon emissions. However, others demonstrated an increase, highlighting challenges in decoupling economic growth from environmental impact.

2. Air Travel Emission Intensity (Europe Data): Examination of air travel emission intensity in European regions from 2019 to 2022 showed mixed results. While some regions exhibited a decline in emission intensity, others experienced an increase. This variation underscores the complexity of reducing emissions from the aviation sector and suggests regional differences in policy effectiveness and infrastructure development.

Interpretation

- **Policy Effectiveness:** The data analysis underscores the importance of effective environmental policies in mitigating greenhouse gas emissions. Countries and regions with stringent regulations and investments in sustainable technologies generally exhibited better emission intensity outcomes.
- **Regional Disparities:** Variations in emission trends highlight regional disparities in economic structure, energy consumption patterns, and policy priorities. Understanding these differences is crucial for targeted interventions and global climate action strategies.
- **Future Directions:** The findings advocate for continued monitoring and evaluation of emission trends, emphasizing the need for adaptive policies that consider regional contexts and evolving economic landscapes. This approach ensures sustainable development while addressing climate change challenges globally.

Table 1: Top 15 countries in Europe: Air Travel Emission Intensity in Europe (2019-2022)

Sr No	NAME_HTML	Year 2019	Year 2020	Year 2021	Year 2022
1	France	134.45	191.78	177.64	132.70
2	Iceland	135.09	187.00	189.50	130.95
3	Netherlands	127.36	239.68	219.09	130.40
4	Finland	112.98	172.26	193.55	124.44
5	Germany	117.36	172.81	159.15	120.86
6	Belgium	107.40	227.28	202.62	111.96
7	EU27	106.93	157.65	140.54	103.16
8	Switzerland	100.92	140.46	130.11	101.46
9	Luxembourg	119.63	226.59	225.85	98.36
10	Spain	93.26	129.71	112.19	89.32
11	Cyprus	87.52	132.71	103.54	86.84
12	Ireland	84.40	138.70	126.27	83.34
13	Denmark	86.78	119.33	118.62	80.87
14	Sweden	83.34	110.91	98.60	80.86
15	Portugal	93.89	121.25	112.69	80.59

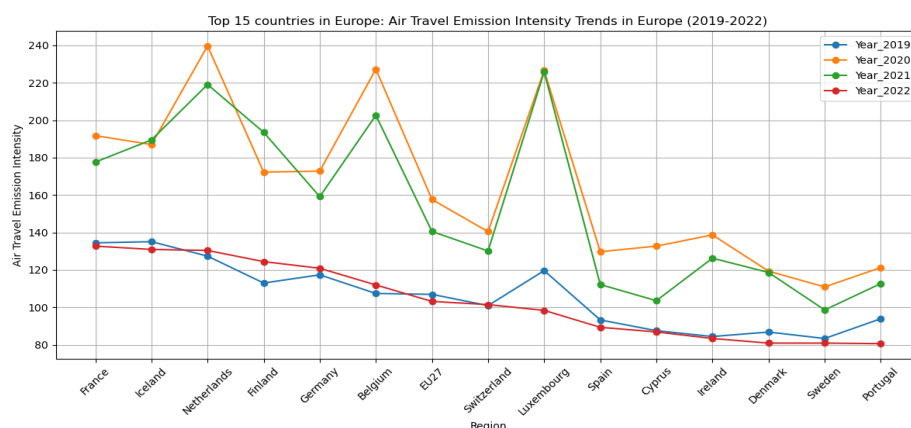


Figure 1: Air Travel Emission Intensity Trends in Europe (2019-2022)

Table 2: Top 15 Countries from the world: CO2 Emissions per GDP by Country (2013-2016)

Sr No	ISO_NAME	2013	2014	2015	2016
1	Cayman Islands (the)	0.136	1.414	1.471	1.493
2	Libya	0.434	0.543	0.621	1.148
3	Turkmenistan	0.990	0.911	0.945	0.895
4	Trinidad and Tobago	0.891	0.891	0.892	0.866
5	Turks and Caicos Islands (the)	0.230	0.770	0.801	0.813
6	Ukraine	0.805	0.758	0.677	0.713
7	Bosnia and Herzegovina	0.661	0.659	0.666	0.653
8	Estonia	0.681	0.611	0.628	0.614
9	Guyana	0.592	0.579	0.591	0.580
10	South Africa	0.603	0.607	0.576	0.570
11	Uzbekistan	0.694	0.646	0.608	0.570
12	Kazakhstan	0.648	0.571	0.534	0.556
13	Mongolia	0.494	0.448	0.464	0.542
14	Bahamas (the)	0.483	0.486	0.499	0.524
15	China	0.650	0.613	0.569	0.524

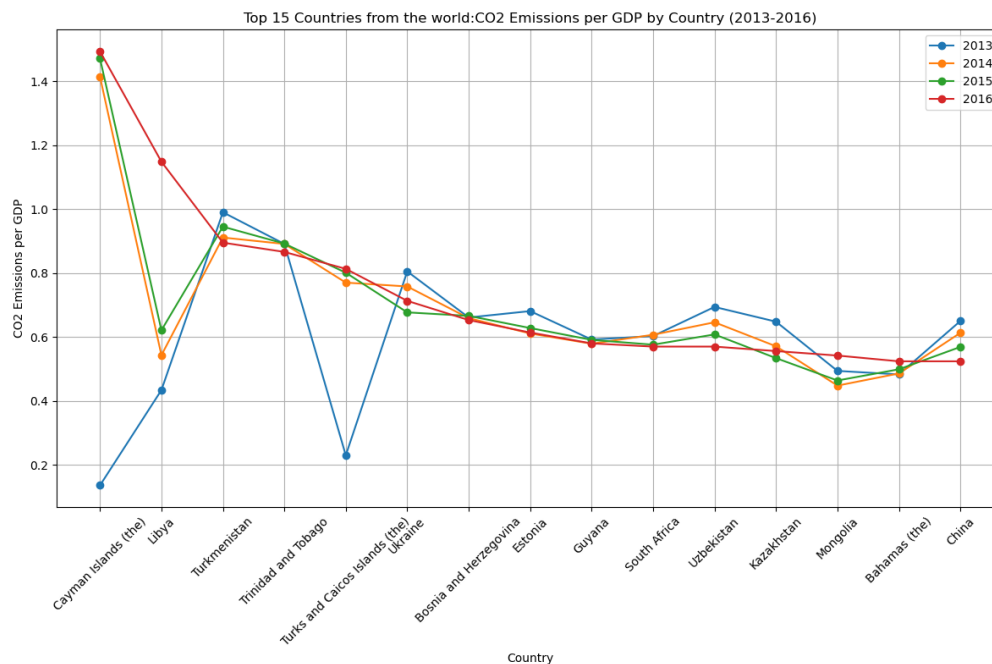


Figure 2: CO2 Emissions per GDP by Country (2013-2016)

1.0.4 Conclusions

- The primary question addressed in this analysis was to examine trends in CO2 emissions per GDP globally and air travel emission intensity in Europe, evaluating the effectiveness of environmental policies and identifying regional disparities.
- CO2 Emissions per GDP (World Data The analysis revealed significant variations in CO2 emissions per unit of GDP across countries from 2013 to 2016. Countries with robust environmental policies demonstrated a decline in emission intensity, indicating progress

towards decoupling economic growth from carbon emissions. However, persistent challenges remain in high-emission regions, reflecting the need for enhanced policy measures and international cooperation to achieve global climate targets.

- **Air Travel Emission Intensity (Europe Data Analysis)** Analysis of air travel emission intensity in European regions from 2019 to 2022 highlighted mixed results. While some regions showed a decrease in emission intensity, others experienced an upward trend. This variation underscores the complexity of reducing emissions from the aviation sector and underscores the need for targeted policies and technological innovations to mitigate environmental impact.
- **Critical Reflection** The analysis successfully addressed the primary question by providing insights into emission trends and policy effectiveness. However, several uncertainties and limitations should be noted: - **Data Quality:** The quality of emission data can vary across regions, affecting the accuracy of comparisons and trend analysis.
- **Temporal Scope:** The analysis focused on specific years (2013-2016 for CO₂ emissions per GDP and 2019-2022 for air travel emission intensity), limiting the ability to capture long-term trends and cyclical patterns.
- **Policy Implications:** While the analysis identified regions with effective policies, the impact of socio-economic factors and technological advancements on emission trends requires further exploration.