

Analysis Report

1.1 Introduction

This report is aimed at determining whether introduction of renewable energy affects carbon dioxide emissions at national level. This project is driven by the objective to evaluate the effects of utilizing clean power sources on total carbon dioxide emission in different nations. Understanding these dynamics can frame ways that are effective when it comes to decreasing carbon footprints through increased use of renewable energy.

1.2 Used Data

Carbon Emission and Renewable Energy Consumption Data

The carbon emission data was sourced from Global Carbon Project, which provides carbon emission data for countries over the years. Data is structured annually and includes total CO2 emissions, fossil fuel combustion, cement production, and gas flaring, emissions per capita.

Furthermore, the renewable energy consumption data was sourced from the World Bank Portal. The dataset concludes the information of access to electricity, renewable energy generation, renewable energy consumption in TJ, and etc.

Country	Year	Renewable energy consumption	
Filter	Filter	Filter	
Afghanistan	1996		9304.887
Afghanistan	1997		9861.213
Afghanistan	1998		10254.29
Afghanistan	1999		10765.99
Afghanistan	2000		11301.39
Afghanistan	2001		11510.28
Afghanistan	2002		11997.1
Afghanistan	2003		12635.1
Afghanistan	2004		12869.72
Afghanistan	2005		13245.71
Afghanistan	2006		14324.37
Afghanistan	2007		15270.5
Afghanistan	2008		15312.85
Afghanistan	2009		16854.19
Afghanistan	2010		19578.7
Afghanistan	2011		20435.21
Afghanistan	2012		22561.36

Country	Year	Total	Coal	Oil	Gas	Cement	Flaring	Other	Per Capita
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
Afghanistan	1996	1.370104	0.007328	0.985616	0.307776	0.0474	0.021994	0.0	0.060092
Afghanistan	1997	1.304152	0.003664	0.948976	0.282128	0.0474	0.021984	0.0	0.073313
Afghanistan	1998	1.278504	0.003664	0.941648	0.263808	0.0474	0.021984	0.0	0.069134
Afghanistan	1999	1.09164	0.003664	0.776768	0.241824	0.0474	0.021984	0.0	0.056671
Afghanistan	2000	1.047128	0.003664	0.78776	0.223504	0.010216	0.021984	0.0	0.053581
Afghanistan	2001	1.060098	0.069616	0.762112	0.208848	0.006538	0.021984	0.0	0.0543
Afghanistan	2002	1.340995	0.055109	0.727438	0.547416	0.011033	0.0	0.0	0.063856
Afghanistan	2003	1.559602	0.091813	0.991575	0.466408	0.009807	0.0	0.0	0.068871
Afghanistan	2004	1.237247	0.0916	0.908672	0.227168	0.009807	0.0	0.0	0.052529
Afghanistan	2005	1.889307	0.106236	1.44728	0.32976	0.006211	0.0	0.0	0.077403
Afghanistan	2006	2.159318	0.160944	1.656993	0.329204	0.012177	0.0	0.0	0.084869
Afghanistan	2007	2.799909	0.747436	1.733072	0.307776	0.011605	0.0	0.0	0.108091
Afghanistan	2008	4.254477	1.078145	2.864051	0.297704	0.015242	0.0	0.0	0.160989
Afghanistan	2009	6.391888	1.3141	4.593624	0.271291	0.012872	0.0	0.0	0.233406
Afghanistan	2010	8.364803	2.246032	5.833088	0.271136	0.014547	0.0	0.0	0.296733
Afghanistan	2011	11.838316	4.180624	7.335328	0.307776	0.014588	0.0	0.0	0.40474
Afghanistan	2012	10.035314	3.125392	6.573216	0.307776	0.02893	0.0	0.0	0.329389

Figure 1: Pipeline output for renewable and carbon emission table

Data Compliance

Both datasets are used in compliance with their respective licenses. The license allows for any use of the data for non-commercial purposes provided that the citation is given and is used under the license CC BY 4.0.

1.3 Analysis

The analytical process goes through several steps

Data Cleaning and Preprocessing: An initial examination and cleaning of the data should be done so that any missing values or inconsistencies can be addressed. We need to align the datasets based on the columns 'Year' and 'Country' to make sure that we carry out correct comparisons and analyses. Invalid data is removed from the dataset. Columns have been checked for correct data type and invalid data inputs. Missing data has been dropped or imputation technique has been used to fill them up.

Data Integration: Yearly carbon emission data was merged with yearly renewable energy consumption data based on the years.

Visualization and Analysis: Multiple plots were created to visualize the trends in carbon emission and renewable energy consumption to find a correlation between them. This will help understand whether increases in renewable energy usage coincide with the amount of carbon emission released in a year.

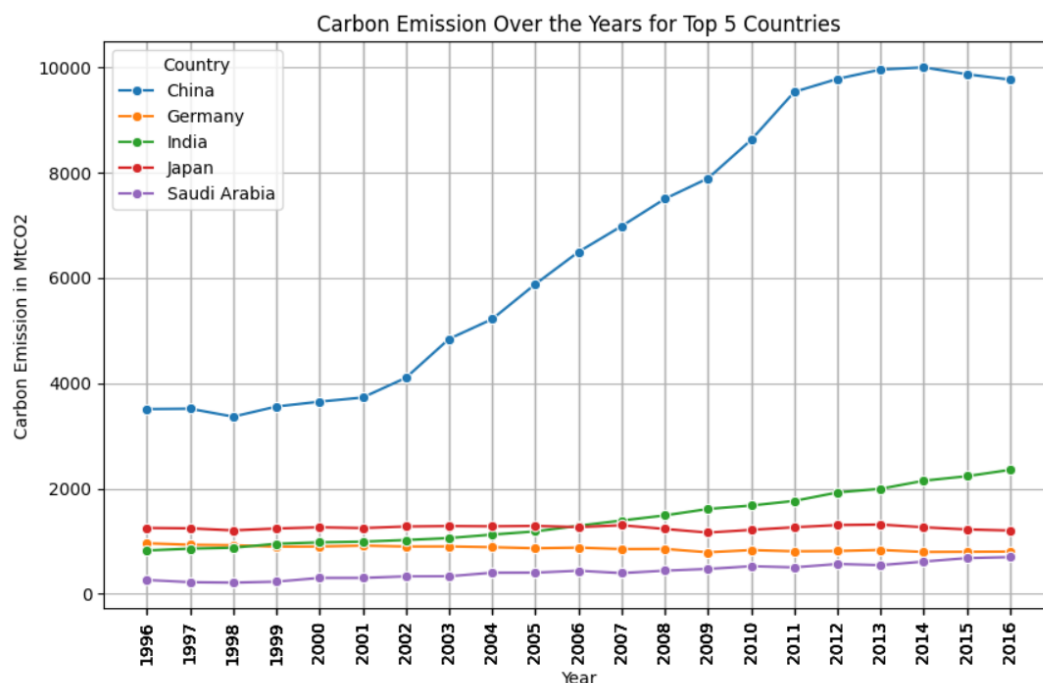


Figure 2 Carbon emission of the top 5 countries

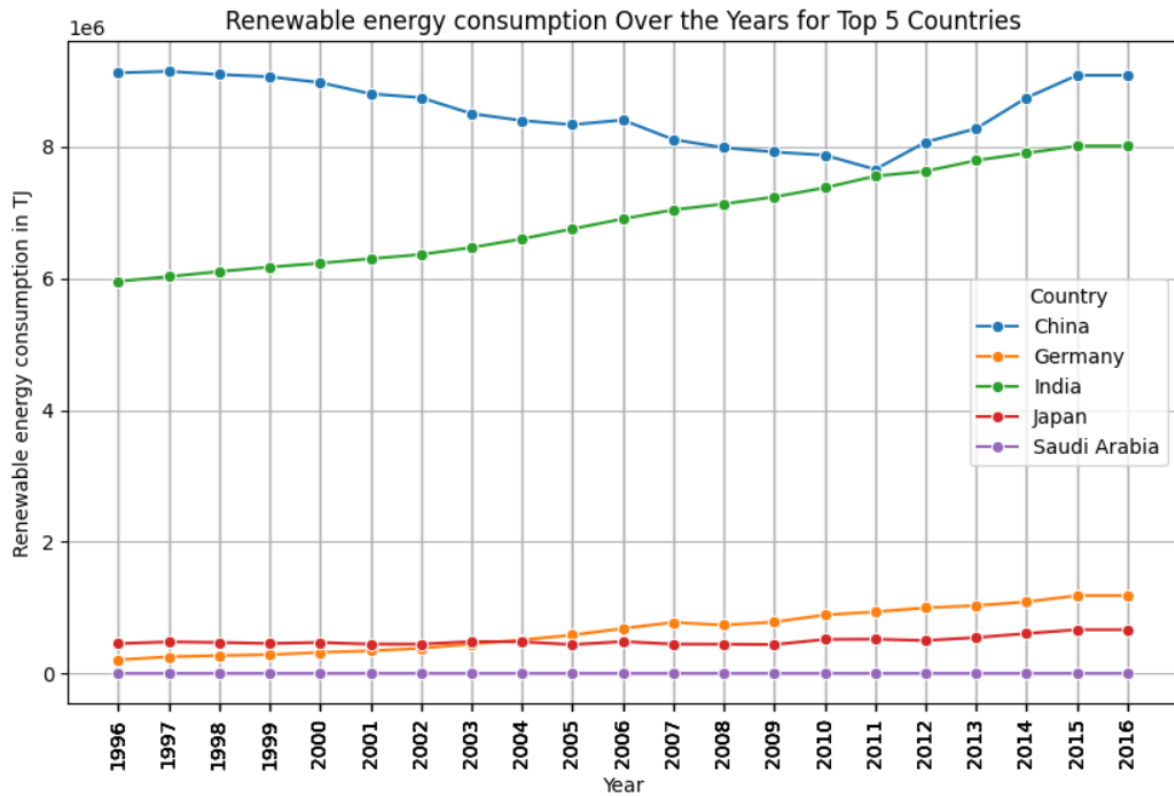


Figure 3: Renewable energy consumption for top 5 countries

The global trend shows that carbon emissions have increased over the years and as well as the use of renewable energy. To get a clear picture we will look at the data of Germany and analyze the situation.

Detailed insight in Germany:

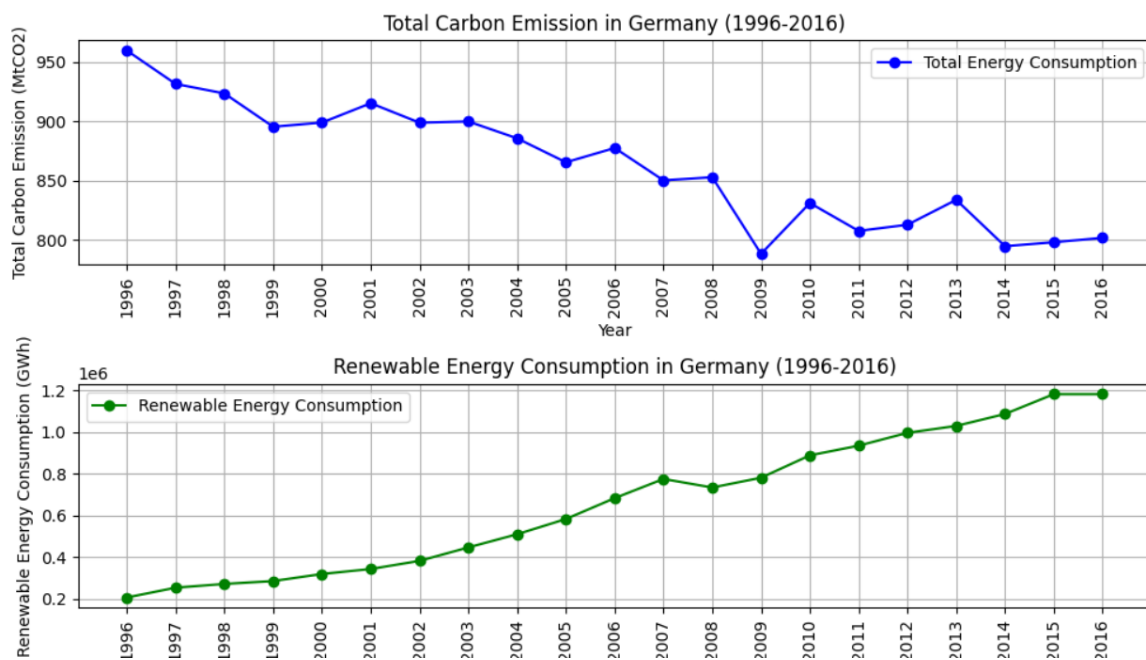


Figure 4: Carbon emission and renewable energy consumption in Germany

Correlation coefficient:

The Pearson correlation coefficient for the data is -0.933 which indicates a very strong negative relation between carbon emission and usage of renewable energy. This strong negative correlation implies that as the usage of renewable energy increases carbon emission decreased over the time.

1.4 Conclusions

The analysis reveals several key insights into the relationship between carbon emission and renewable energy consumption over the years. The global correlation coefficient is 0.68 which suggests a positive linear relationship. Although it is positive the amount of carbon emission is getting reduced as more natural ways to get energy are introduced. Such insights can be found when trends for individual countries.

Reflections and Limitations

- **Completeness:** While the analysis provides valuable insights, the data is limited to past years until 2016.
- **Uncertainties:** Some of the data was missing and imputation technique has been used to fill them up. This might not give an accurate result.

This analysis emphasizes how the countries are shifting to renewable energy usage and reducing carbon emissions. Most countries show a growing trend in the adoption of renewable energy, reflecting global shifts towards more sustainable energy sources. It is important that stakeholders, environmental planners, and politicians review and strengthen the programs designed to support renewable energy.