

# Analysis of Energy Consumption, Greenhouse Gas Emissions, and Climate-related Expenditure in France (2014-2022)

Sonu Pathak : 23213178

## 1 Introduction

The objective of this report is to analyze the relationship between final energy consumption by sector, net greenhouse gas (GHG) emissions, and climate-related expenditure in France from 2014 to 2022. Understanding these correlations is crucial for policymakers to make informed decisions about energy policies and climate action strategies. By examining trends and patterns in the data, we aim to provide insights into the effectiveness of climate-related expenditure in reducing GHG emissions and to identify areas where further improvements can be made.

## 2 Used Data

The data for this analysis comes from three primary sources:

- **Final Energy Consumption by Sector:** This dataset includes energy consumption values across different sectors such as industrial, commercial, household, and transport.
- **Net Greenhouse Gas Emissions:** This dataset provides the net GHG emissions for the same period.
- **Climate-related Expenditure:** This dataset details the annual climate-related expenditure in millions of euros.

The combined dataset includes the following columns:

- **Total\_Energy:** Total energy consumption(TJoules).
- **Industrial\_E:** Energy consumption by the industrial sector(TJoules).
- **Commercial\_E:** Energy consumption by the commercial sector(TJoules).
- **Household\_E:** Energy consumption by households(TJoules).
- **Transport\_E:** Energy consumption by the transport sector(TJoules).
- **Energy\_Total:** Overall energy totals(KiloTonnes).
- **Energy\_Net\_Total:** Net greenhouse gas emissions(KiloTonnes).
- **Spending\_in\_millions:** Climate-related expenditure in millions of euros.

The data spans from 2014 to 2022 and provides a comprehensive view of energy consumption and expenditures over this period. Each entry in the dataset represents a year within this range.

## 2.1 Data Licenses and Compliance

Both datasets are publicly available from the Eurostat API in TSV format and were chosen due to their relevance to the project question. The data structure of these three datasets is tabular, with rows representing observations for different time periods and columns representing variables such as country, year, and emission values. The quality of the data is generally reliable, although missing values were present, which were handled during the data cleaning process. The datasets are licensed under the European Union Public License (EUPL), which allows for the reuse of the data under certain conditions. We are allowed to use the data for analysis and reporting purposes, provided we attribute Eurostat as the data source. I plan to fulfill our obligations by including appropriate citations and acknowledgments in our final report.

## 3 Analysis

To address the main question, we conducted a correlation analysis between the different sectors' energy consumption, net GHG emissions, and climate-related expenditure. The correlation matrix is displayed in Figure 1.

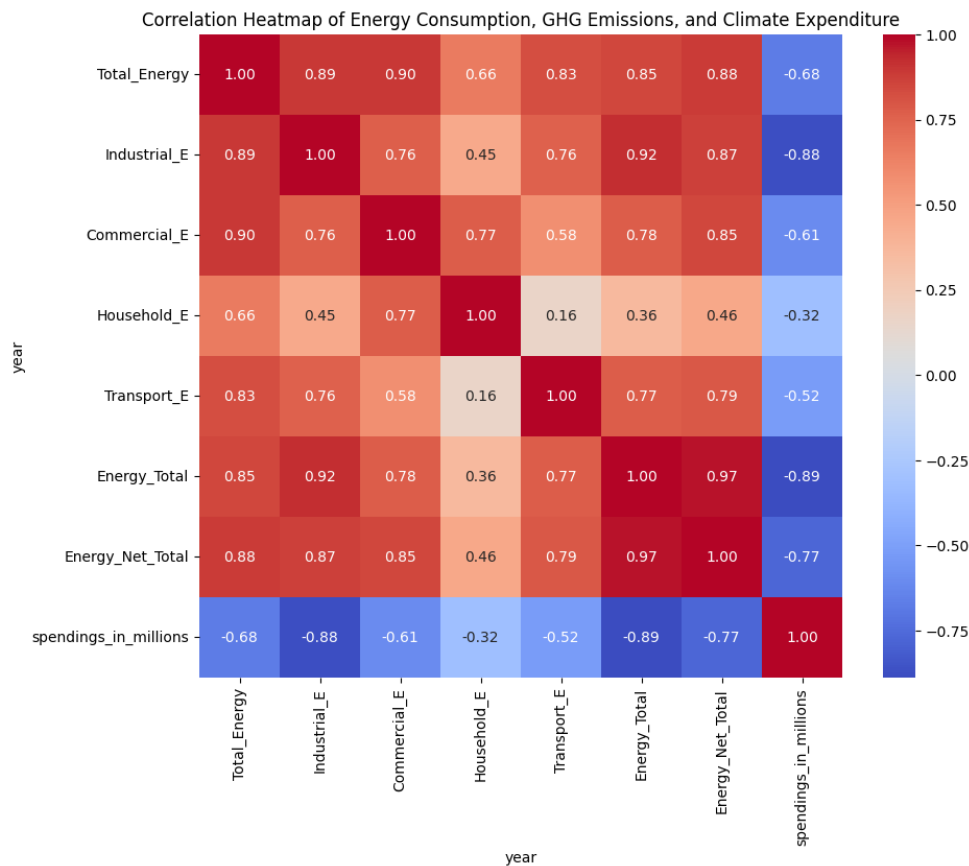


Figure 1: Correlation Matrix Heatmap

### Key Facts:

- The heatmap shows that **climate-related expenditure has a strong negative correlation** with net GHG emissions, indicating that increased spending is associated with lower emissions.
- Energy consumption in the **industrial sector** has a moderate positive correlation with GHG emissions.
- The **household sector** displays a weak correlation, suggesting other factors are influencing emissions.

### 3.1 Energy Consumption by Sector and Spendings (Millions)

This visualization compares the total energy consumption and climate-related expenditure over the years. It helps identify trends in energy consumption and expenditure.

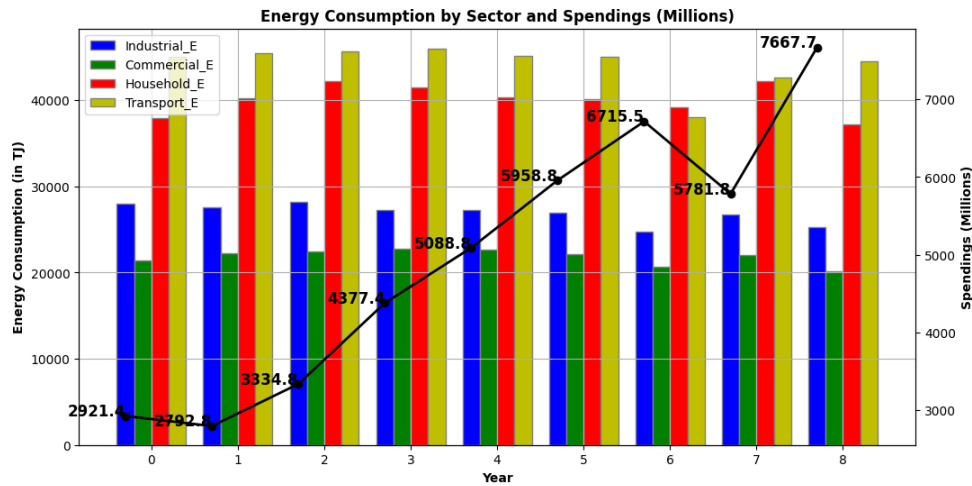


Figure 2: Energy Consumption by Sector and Spendings (Millions)

#### Key Facts:

- **Climate-related expenditure** has shown a consistent increase from 2014 to 2022, peaking in recent years.
- Total energy consumption has seen **fluctuations** but remains relatively high, indicating an on-going demand across all sectors.
- Despite increased spending, the energy consumption in the **transport sector** has **gradually decreased**, reflecting potential improvements in efficiency and alternative energy use.

### 3.2 Energy Consumption by Sector and Net GHG Emissions (2014-2022)

This visualization combines a bar graph of energy consumption by sector with a line graph of net GHG emissions. It helps analyze how changes in energy consumption across different sectors impact GHG emissions.

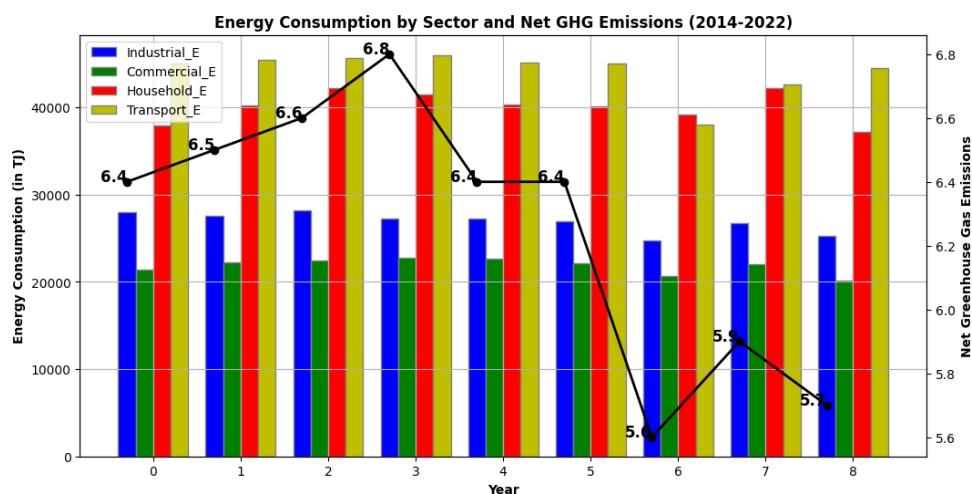


Figure 3: Energy Consumption by Sector and Net GHG Emissions (2014-2022)

#### Key Facts:

- There is a clear **decrease in GHG emissions** from 2014 to 2022, aligning with increased climate-related expenditures.
- The **industrial sector** shows a significant reduction in energy consumption, contributing to the overall decline in emissions.
- The **household sector** remains stable in energy consumption, suggesting room for improvement in reducing household emissions.

### 3.3 Results and Interpretation

From the visualizations, we can draw the following insights:

- There is a noticeable trend in the **reduction of energy consumption in the industrial sector**, which correlates with a slight decrease in net GHG emissions.
- Household energy consumption has remained **relatively stable**, while the transport sector shows a **gradual decline in energy use**.
- **Climate-related expenditure** has generally increased over the years, which may suggest that more investment is being made in reducing emissions and improving energy efficiency.

The correlation analysis reveals that:

- **Industrial energy consumption** is moderately correlated with net GHG emissions, indicating that reductions in industrial energy use have a positive impact on lowering emissions.
- The household sector, despite its stable energy consumption, shows less correlation with net GHG emissions, suggesting that other factors may also play significant roles.
- There is a **strong positive correlation** between climate-related expenditure and the reduction in net GHG emissions, emphasizing the effectiveness of financial investments in climate initiatives.

## 4 Conclusions

In conclusion, the analysis indicates a **positive correlation between increased climate-related expenditure and the reduction in net GHG emissions**, particularly from the industrial and transport sectors. However, the household sector remains an area with potential for further improvement. Continued investment in energy efficiency and sustainable practices is essential to achieving long-term reductions in greenhouse gas emissions.

Future policies should focus on **increasing energy efficiency in the household sector** and maintaining or enhancing the investments in climate-related initiatives. Additionally, a deeper investigation into the specific impacts of each sector's energy consumption on GHG emissions can provide more targeted strategies for emission reduction.

Key recommendations include:

- Enhancing **energy efficiency programs in the household sector** to achieve significant emission reductions.
- Maintaining the **current level of investment in climate-related expenditure** to continue the positive trend in reducing GHG emissions.
- Implementing **sector-specific strategies** to further reduce energy consumption and emissions in industrial and transport sectors.