Final Report

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1 Introduction

Climate change has been a crucial issue for a long time. It is necessary to understand the factors affecting it. One must think that with the growth of climate adversities, we should switch to better options, like renewable energy. But is it so? With the rise of greenhouse gases, are we actually moving towards renewable energy? This report helps us analyze the same. This report aims to **analyze the relationship between greenhouse gas emissions and the share of energy from renewable sources across some European countries.** The need of the hour is to identify trends, correlations, and form insights that can eventually inform policy decisions and climate action plans.

2 Used Data

The data for this project was sourced from the Eurostat database, a comprehensive source of statistical information provided by the European Union. Two datasets were selected:

1. **Net Greenhouse Gas Emissions**: This dataset provides information on net greenhouse gas emissions of various countries, which is crucial for understanding the environmental impact of various sectors, from years 1990-2022.

2. **Share of Energy from Renewable Sources**: This dataset contains information on the percentage share of energy generated from renewable sources, from years 2013-2022.

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 both 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.
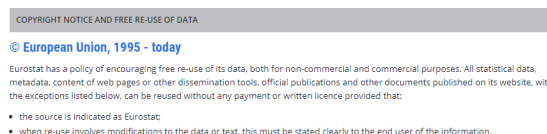

Figure 1: License Information

3 Analysis

The Project was made into life using the flow discussed in figure below. After successfully continuing the steps till Data Cleaning and Preparation, the data is ready to be analysed and bringing out insights.

Figure 2: Flowchart of Project

There are a few Analysis that was carried forward, This is described further in the form of figures, tables and texts.

3.1 Correlation Trends in Renewable Energy Share and Greenhouse gas emissions (2013-2021)
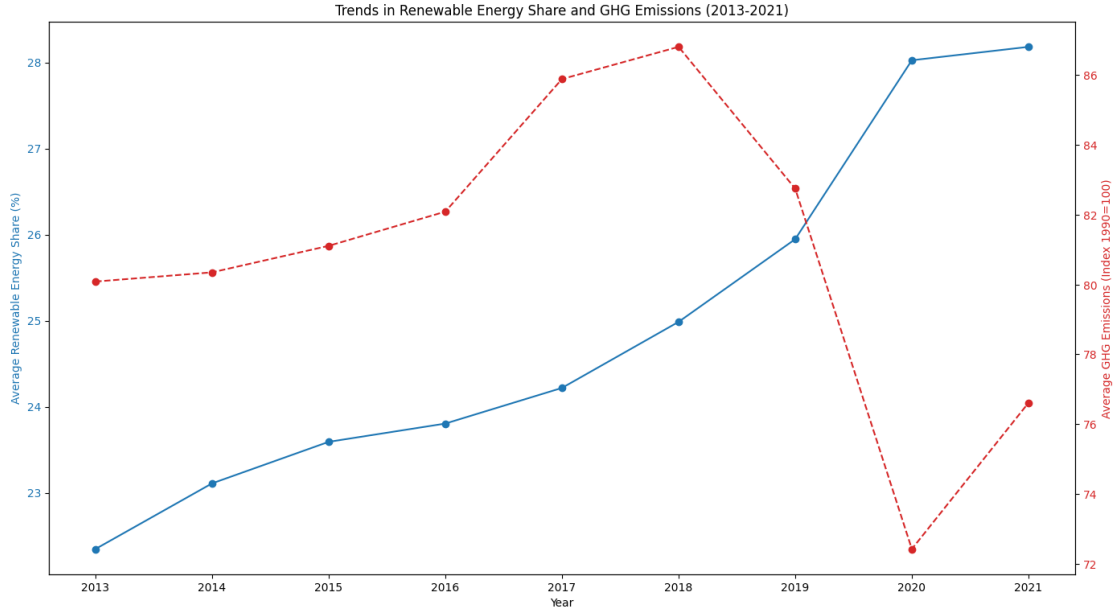

Figure 3: Correlation Trends

Trends in Renewable Energy Share

- **Steady Increase**: The average renewable energy share has shown a steady increase from 2013 (around 22%) to 2021 (around 28%).
- **Significant Growth Post-2018**: There is a noticeable acceleration in the growth rate of renewable energy share after 2018.

Trends in Greenhouse gas emissions

- **Overall Decrease**: The average Greenhouse Gas Emissions emissions index shows a fluctuating but overall decreasing trend from 2013 (around 80%) to 2021 (around 77%).
- **Volatility**:
    - *Increase till 2018*: There is a sharp increase in Greenhouse gas emissions from 2016 to 2018.
    - *Sharp Decrease in 2019-2020*: Greenhouse gas emissions significantly dropped from 2018 to 2020, reaching a low point in 2020.
    - *Rebound in 2021*: A noticeable rebound in Greenhouse gas emissions in 2021.

3.2 Insights from Correlation Table

To get a more deeper insight, a correlation table has been plotted between Renewable Energy Share and Greenhouse Gas Emissions.

Based on the correlations shown in Table, we can derive the following insights:

Table 1: Correlations between Renewable Energy Share and Greenhouse gas Emissions (2013-2021)

Year	Correlation
2013	-0.14
2014	-0.09
2015	-0.04
2016	0.00
2017	0.02
2018	0.18
2019	0.11
2020	0.06
2021	0.04

- There is a weak negative correlation between Renewable Energy Share and Greenhouse gas Emissions in 2013 (-0.14), indicating that countries with higher renewable energy shares tended to have slightly lower Greenhouse gas emissions.

- The correlations become closer to zero in subsequent years (2014 to 2016), suggesting a weaker relationship between renewable energy adoption and Greenhouse gas emissions during these years.

- From 2017 onwards, the correlations start to become positive but remain relatively weak, indicating that in recent years, there has been a trend towards increasing renewable energy adoption without a significant increase in Greenhouse gas emissions.

- The highest positive correlation is observed in 2018 (0.18), suggesting a slight tendency for countries with higher renewable energy shares to also have higher Greenhouse gas emissions during that year.

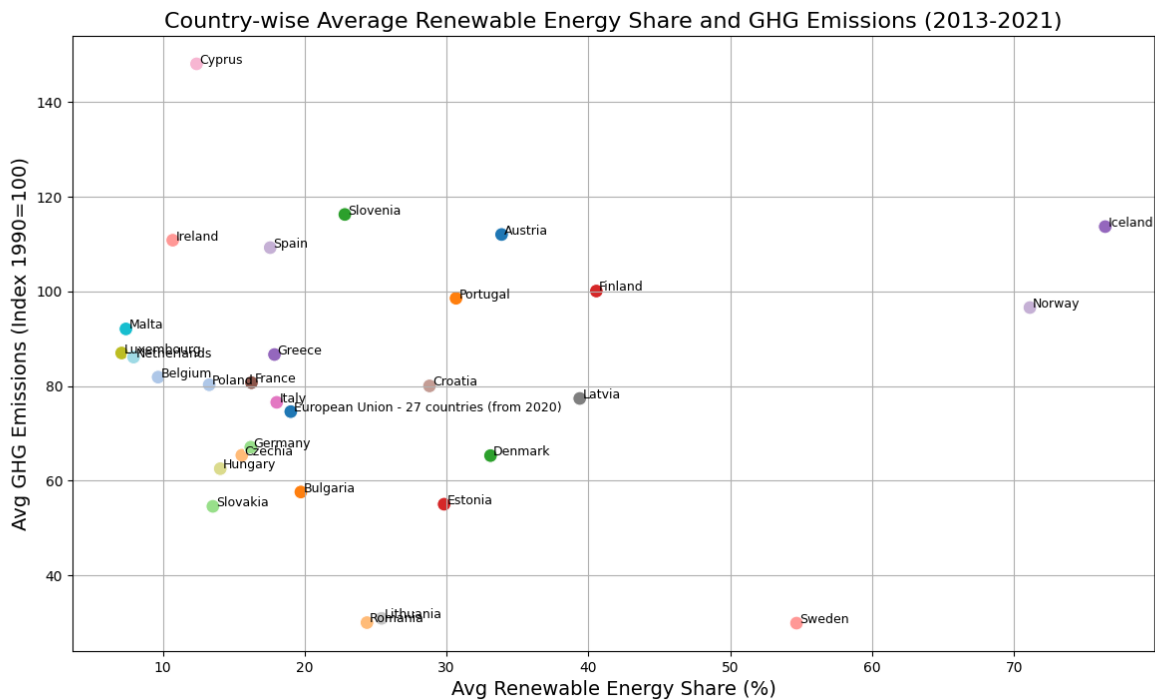## 3.3 Country Wise Average Renewable Energy Share and Greenhouse gas Emissions (2013-2021)

Figure 4: Correlation Trends

- **Highest Renewable Energy Share:** Iceland (76.43%) and Norway (71.12%) have the highest average renewable energy shares.

- **Lowest Renewable Energy Share:** Luxembourg (7.10%), Malta (7.40%), and the Netherlands (7.94%) have the lowest average renewable energy shares.

- **Lowest Greenhouse gas Emissions:** Lithuania (30.89), Romania (29.99), and Sweden (29.88) show the lowest average Greenhouse gas emissions index.

- **Highest Greenhouse gas Emissions:** Cyprus (148.12), Austria (112.04), and Iceland (113.71) have the highest average Greenhouse gas emissions index.

- **Balanced Performance:** Countries like Sweden and Finland exhibit high renewable energy shares with relatively low Greenhouse gas emissions, indicating effective policies in place.

- **Discrepancies:** Despite high renewable energy shares, Iceland and Norway still have high Greenhouse gas emissions indexes, possibly due to industrial activities or other factors.

- **European Union Average:** The EU-27 average shows a renewable energy share of 19.02% with a Greenhouse gas emissions index of 74.60, reflecting moderate progress toward sustainability goals.

3.4 Overall Results

- **Renewable Energy Trends**: The average share of renewable energy increased steadily from 22% in 2013 to 28% in 2021, with significant growth post-2018.

- **Greenhouse gas Emissions Trends**: The average Greenhouse gas emissions index decreased from 80% in 2013 to 77% in 2021, with notable fluctuations including an increase until 2018, a sharp drop from 2018 to 2020, and a rebound in 2021.

- **Correlation Insights**: Correlation between renewable energy share and Greenhouse gas emissions is weak and varies year by year, indicating a complex relationship that requires further analysis.

- **Country-Wise Insights**: Iceland and Norway have the highest renewable energy shares, while Lithuania and Romania have the lowest Greenhouse gas emissions. Discrepancies exist, such as Iceland's high renewable energy share paired with high Greenhouse gas emissions, likely due to industrial factors.

4 Conclusion

Are there any trends in net greenhouse gas emissions with the use of energy from renewable sources?

- Renewable Energy Adoption: There is a clear trend of increasing renewable energy adoption across European countries from 2013 to 2021.

- Greenhouse gas Emissions Trend: Overall, greenhouse gas emissions have shown a fluctuating but decreasing trend during the same period.

- Correlation Insights: There exists a weak negative correlation between renewable energy share and Greenhouse gas emissions, indicating that higher renewable energy adoption tends to associate with slightly lower emissions.

- Top Performers: Iceland and Norway lead in renewable energy adoption, but they still face challenges with high Greenhouse gas emissions indexes.

- Challenges: Countries like Luxembourg, Malta, and the Netherlands lag behind in renewable energy adoption, while Cyprus and Austria struggle with high Greenhouse gas emissions.

- Policy Implications: Effective policies are critical to balancing high renewable energy adoption with reduced Greenhouse gas emissions, as seen in countries like Sweden and Finland.