Power Dynamics: Analyzing Global Electricity Trends and Dependencies

1. Introduction

This report provides insights into electricity production, imports, and exports across various countries. Using data from the International Energy Agency (IEA), the report analyzes key metrics such as net energy balance and import dependence, offering a detailed examination of energy dynamics across different nations.

2. Data Preprocessing

The data underwent several preprocessing steps to ensure accuracy:

- **Data Cleaning:**
  - Removed any rows with missing values.
  - Ensured that the energy values were numeric and the time data was in a consistent datetime format.
- **Data Filtering:**
  - Focused on three key areas: net electricity production, electricity imports, and electricity exports.

3. Data Transformation

The data was transformed to facilitate meaningful analysis:

- **Pivoting:**
  - Data was reorganized to show electricity production, imports, and exports over time for each country.
- **Merging:**
  - Combined the production, imports, and exports data to calculate two critical metrics:
    - **Net Energy Balance:** The difference between electricity production, imports, and exports.
    - **Import Dependence:** The proportion of electricity imports relative to total electricity available (production + imports).

4. Exploratory Data Analysis (EDA)

The analysis uncovered several insights through various visualizations and statistical summaries:

4.1 Summary Statistics

The data was summarized to provide a general overview of electricity production and related metrics across all countries.
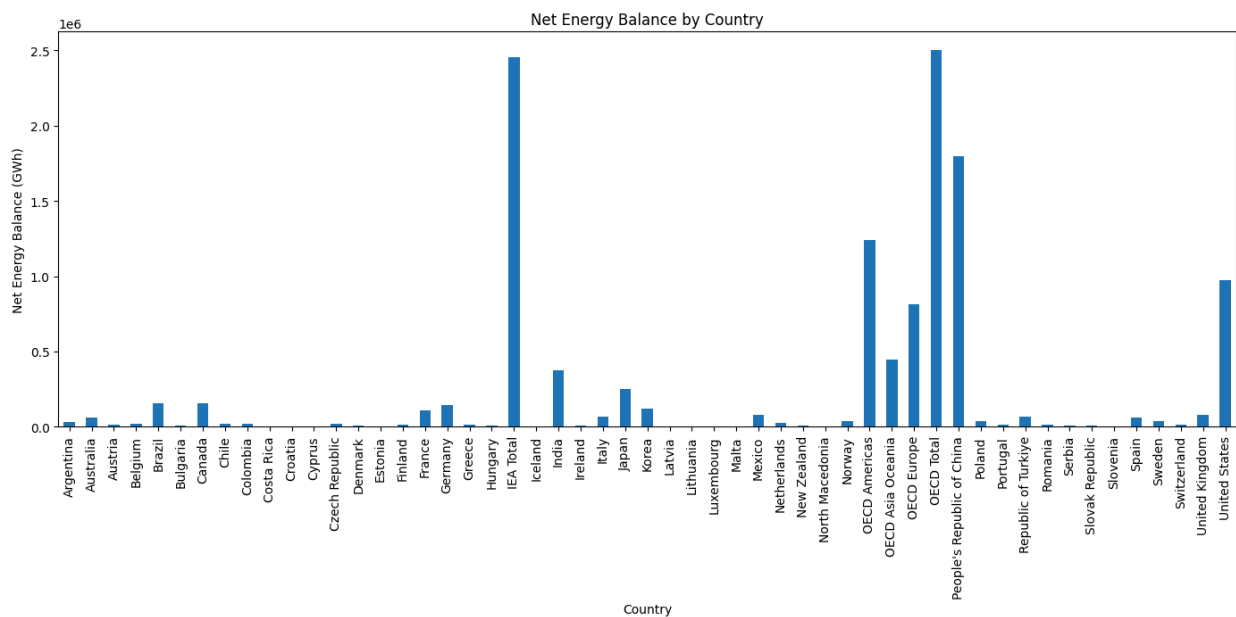
4.2 Time Series Analysis

Interactive time series plots were created for each country, revealing trends in electricity production, imports, and exports over time.
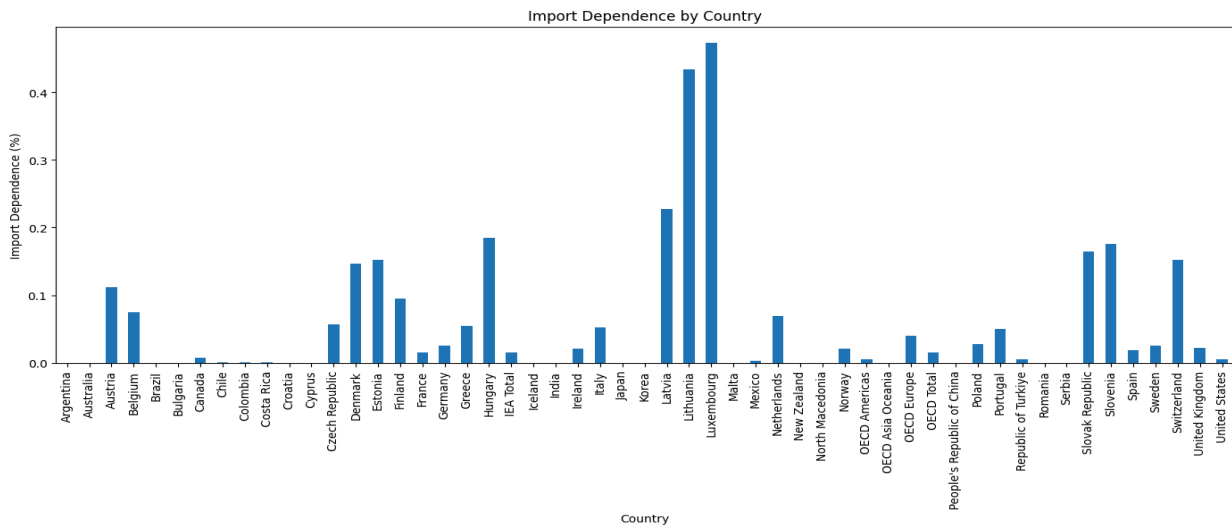
4.3 Country-Level Insights

Bar charts were used to visualize:

- **Net Energy Balance:** Highlighting which countries have a surplus or deficit of electricity.
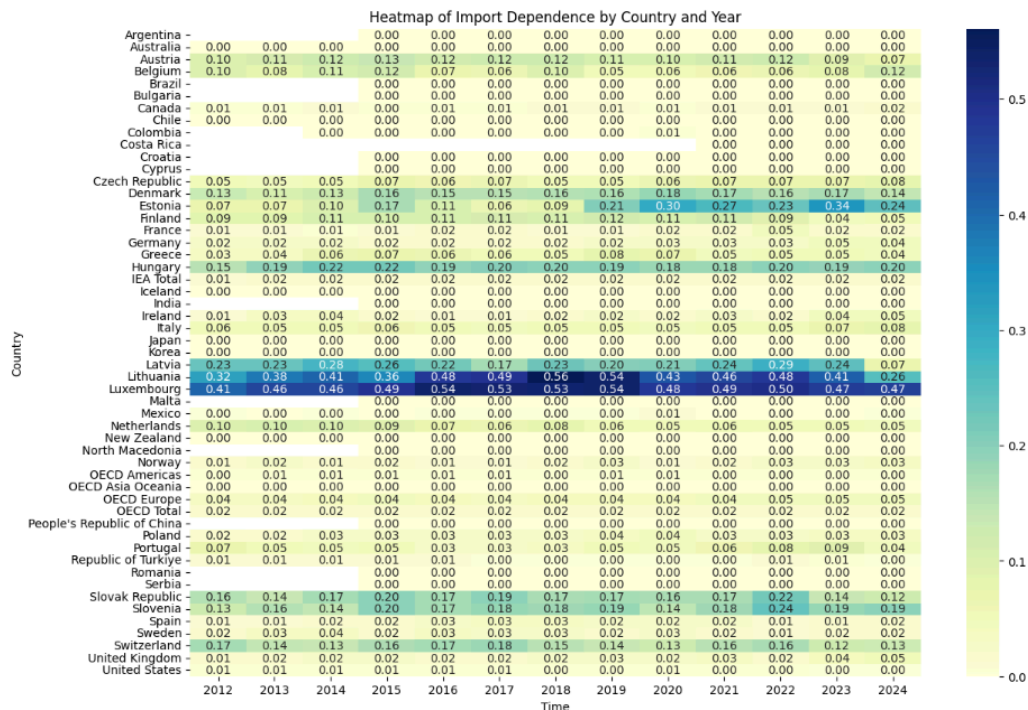
- **Import Dependence:** Showing the extent to which each country relies on electricity imports.


4.4 Heatmap of Import Dependence

A heatmap was generated to show how import dependence varied by country and year, offering a clear visual representation of changes over time.

4.5 Correlation Analysis

A correlation heatmap was created to explore the relationships between different energy metrics, identifying how changes in one metric might influence another.

Correlation Heatmap of Energy Metrics
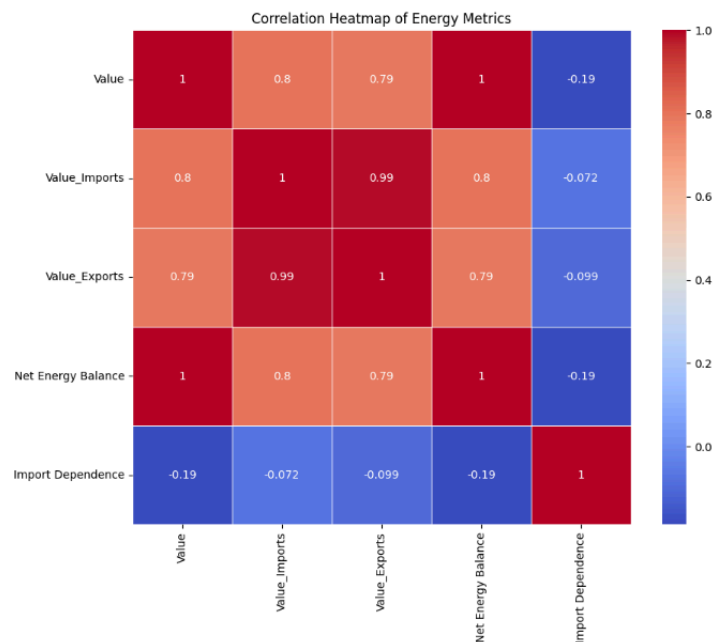
4.6 Top 10 Countries by Import Dependence

The analysis identified the top 10 countries with the highest average import dependence, which were visualized in a bar chart. These countries have significant reliance on imported electricity, posing potential risks to energy security.

Top 10 Countries with Highest Import Dependence
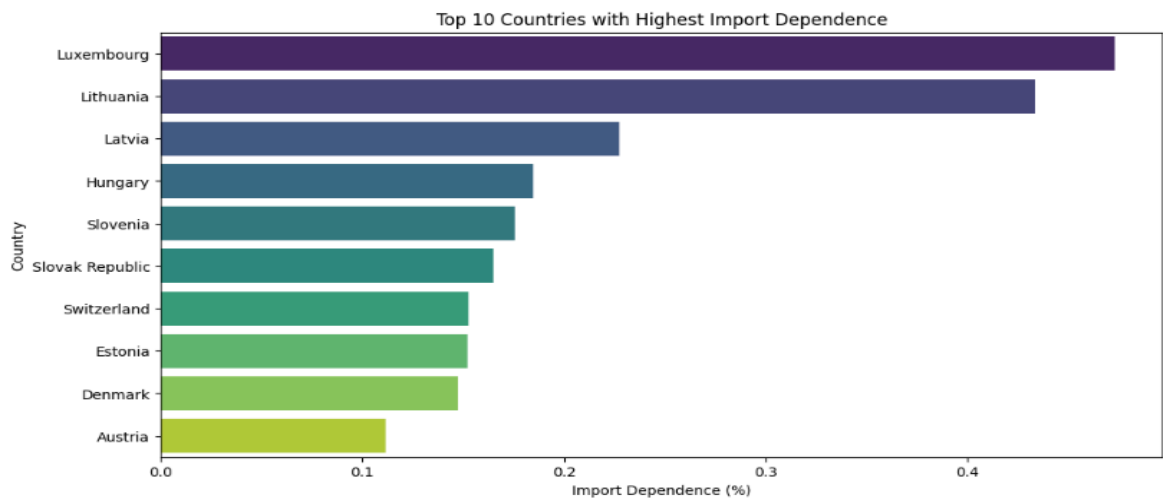
5. Conclusion

This data analytics report highlights the energy dynamics across different countries, with a particular focus on import dependence. These insights are critical for informing energy policy and strategic decisions aimed at enhancing energy security and reducing reliance on electricity imports.

6. Data Licensing and Usage

The data for this analysis is sourced from the International Energy Agency (IEA) under a non-exclusive, worldwide license. Users are required to attribute the IEA and adhere to specific guidelines to maintain the integrity and value of the data. The IEA's licensing terms ensure that the data is used responsibly, promoting transparency while protecting intellectual property rights.