World Energy Trends

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**Introduction**

**In** today’s world, Energy plays a crucial role in driving economic growth and development and in meeting the basic needs of individuals and communities. The demand is rapidly increasing due to population growth, rapid industrialization, and urbanization which is putting pressure on World's energy resources. Therefore, understanding energy trends and their implications is essential to make informed decisions.

This project aims to explore the latest trends in the energy sector over the last decade. Including the production and consumption of various energy resources, such as Fossil fuels, Biofuels, Renewable energy sources, and nuclear energy. In the context of global warming and climate change, I will also analyze the world's commitment to carbon neutrality. Energy conservation has become a crucial factor in the backdrop of soaring energy prices and inflation in the world economy. Energy efficiency is a critical aspect of energy conservation and promoting sustainable development. It is a measure of how effectively a country is using energy resources to generate economic output while minimizing emissions and wastage. Analyzing the energy efficiencies of countries can provide valuable insights into energy conservation practices and policymaking.

Additionally, this project aims to examine the relationship among population, Energy consumption, Economic status, and Emissions of countries. By analyzing these relationships. I wanted to identify key areas countries need to focus on to promote sustainable development and create a happier planet.

Research Questions

* Explore the trends of energy consumption of the world over the last decade.
* In context of Global Warming and rapid climate change. This project aims to examine the world’s commitment to carbon Neutrality.
* Global Inflation and Soaring Oil prices emphasized the importance of energy conservation. This project aims to explore World’s responsibility in conserving energy resources.
* Analyze and Establish relationships among population, Energy Consumption, Economic status of country and Emissions of a country to draw invaluable insights that contribute to promote suitability.

**Methodology**

For this project, the main data set is obtained from **“Our World in Data.”**. This data set contains a total of 21890 rows across 129 columns. It contains information about Population, GDP, Energy consumption and Production by source, Energy per capita, Green House emissions for electricity generation, and many other features for each country in the world by year.

The second dataset is obtained from **“U.S Energy Information Administration.”** While collecting the data set. I filtered for only Co2 emissions from fossil fuels production for each country in the world by year. The second sheet in this data set has country and geographical area details.

**Data Sources**

1. [**https://www.eia.gov/international/data/world**](https://www.eia.gov/international/data/world)
2. [**https://ourworldindata.org/energy**](https://ourworldindata.org/energy)

**Data Preparation**

For this Project, I undertook an extensive filtering process to analyze energy trends over the last decade. I carefully selected countries from every continent, ensuring a mix of developed and Emerging economies, highly populated nations, and oil-dependent countries. After thorough consideration, I included 30 countries and world in my dataset, excluding several columns to streamline my analysis.

Text

Description automatically generated

Graphical user interface, text, application

Description automatically generated

The final processed file has 302 rows and 36 columns.

**Model View**

**Graphical user interface, text, application

Description automatically generated**

I established relationships between the Processed Final and Emissions tables based on country and year. Emissions and Geographical area tables based on country.

**Analysis**

**Energy Consumption by Country**

Chart

Description automatically generated

The above visual shows the energy consumption of each country over the last decade. China, the US, and India occupy the first three positions followed by Russia and Japan. One key takeaway from this is Energy consumption of a country is much more dependent on economic activity than population.

**World Population and Fossil Fuel Consumption**

Graphical user interface, application

Description automatically generated

It is obvious that Fuel consumption increases with population growth but from the above visual during the years 2019 and 2020, there is a dip in consumption of Fossil fuels during the pandemic and grown steadily after that to reach the previous level.

**Energy Consumption by Source**

Chart, line chart

Description automatically generated

The above-stacked line graph shows the world's dependence on Fossil Fuels to meet its energy requirements. The key takeaway from this plot is there is a downward trend in coal consumption from 2014 to 2020. This is the period when crude oil prices fell from their all-time high. Many countries ramped up their oil consumption as coal efficiency is much more than oil and there is an upward trend after 2020.

**Energy Share in Percentage of Total Primary Energy Consumption by Source**

Chart, line chart

Description automatically generated

From the above-stacked line chart, it is evident that most of the countries derive their energy from fossil fuels. I included a parameter to choose between energy sources. Most Asian countries have their major share of energy from coal suggesting economic capabilities dictate the source of energy. Most OPEC countries, in North America, have their major share of energy from Oil and Gas. European countries lead the world in the consumption of clean energy forms. France derives almost 40% of its energy from Nuclear Energy.

**Energy Per-capita Vs Green House Emissions from Electricity Generation**

Chart

Description automatically generated with medium confidence

Energy-Per capita is the amount of energy consumed by a person in a country. Higher Energy-per capita indicates high energy consumption in turn indicating higher greenhouse emissions. From the above China tops the emissions followed by the United States. The countries on the right bottom of the chart are high Energy consuming countries yet still, they produce little emissions during electricity indicating most of the electricity generated is using alternative clean sources of energy and better systems are in place to curb the emissions. China, the USA, and India are heavily dependent on fossil fuels to derive electricity.

**Clean Energy Utilization**

**Chart, line chart

Description automatically generated**

From the above visual, there is a significant rise in the consumption of Renewable energy over the last decade, but the overall share of renewable energy consumption is not yet significant. On the other hand, the consumption of nuclear energy is pretty much stagnant. Given that world had witnessed 2 nuclear disasters in the form of Chornobyl and Fukushima, Countries may be cautious about using it but with evolving technology and safety measures in place, Countries shouldn't fear any disaster, and Western sanctions on countries using radioactive materials may be one the reason countries with rich nuclear deposits restricting them to use as a source of energy.

**Fossil Fuel Energy Consumption by Source.**

Chart

Description automatically generated

In the above area graph, I have included a filter by continent. The graph clearly shows that Asia is heavily dependent on coal as its major source of energy. In contrast, Africa has almost equal shares among the three sources of energy - coal, oil, and gas. Europe is driven by gas, and North America and South America are driven by oil. It is evident that the economic status of countries largely dictates their source of energy consumption.

**Animated race chart for Energy Consumption per Unit GDP and Country**

Chart

Description automatically generated with medium confidence

The above animated race chart displays the ranking of countries in their respective continents based on their Energy Consumption per Unit GDP, which is a measure of the amount of energy required to produce a unit of economic output. This is also known as Energy Intensity, and it is an indicator of energy efficiency. The higher the Energy Intensity, the more energy is consumed to generate a unit of economic output, implying that countries with higher rankings are less efficient in utilizing their energy resources.

Careful observation of the chart shows that countries with high Energy Intensity are mostly dependent on Fossil fuels. Venezuela, Canada, Russia, and Iran are oil and gas-dependent nations, while New Zealand and South Africa are coal-dependent nations.

**An animated Bubble chart for GDP, Energy Per-Capita and Fossil emissions.**

Chart, scatter chart, bubble chart

Description automatically generated

The bubble chart above serves as an indicator of a country's energy and environmental sustainability. Countries with higher energy consumption per capita and higher GDP are likely to have higher economic activity, which in turn can lead to higher emissions. China tops the list in terms of emissions, followed closely by the US. It is evident from all the above visualizations that China is a high coal-consuming nation, while the US is a high oil-producing and consuming nation. In contrast, countries like Saudi Arabia and Norway, among the largest oil-producing nations globally, have been able to significantly reduce their emissions. This is a clear indication of their state-of-the-art systems and innovative energy policies aimed at sustainable development.

**Dash Boards**

My idea of conceiving this project is to observe and analyze World energy trends as a whole and Fossil Energy trends. Accordingly, I created 2 dashboards illustrating these ideas.

**Energy Dashboard**

Graphical user interface

Description automatically generated with medium confidence

**Fossil Energy Dashboard**

Chart, bubble chart

Description automatically generated

In the above two dashboards, I Included Energy statistics over the top and gave dashboard filters by country and continent to observe the trends interactively.

**Conclusion**

In conclusion, my analysis shows that the world is still heavily dependent on fossil fuels to meet its energy needs. While there is an upward trend in the consumption of renewable energy sources, the shift towards renewable energy is far from complete. This shift can be achieved at a faster pace with strong policy support. Many countries have pledged to achieve carbon neutrality, and some are making policy changes, but the rise in emissions suggests that tangible actions are needed to achieve the target. From an energy efficiency standpoint, many fossil fuel-dependent nations and emerging economies need to accelerate their transition to cleaner sources of energy.

**Future Course**

1. I would like to expand this project over a span of 100 years, covering all countries and analyze the trends, and identify any aberrations. I am particularly interested in analyzing the behavior of nations during significant events such as the Great Depression and the financial crisis of 2008.
2. I plan to expand this project by incorporating climate change and agricultural data to investigate the implications of climate change on food security.