

GLOBAL ENERGY TRENDS: A COMPREHENSIVE ANALYSIS OF KEY REGIONS OF GENERATION MODES USING POWER BI

INTRODUCTION:

Energy plays a crucial role in various aspects of modern life, and its demand is expected to rise significantly in the future. The increasing population and technological advancements have led to greater energy consumption across the globe. Understanding energy generation trends is essential to ensure sustainable development and meet future energy demands.

This project focuses on analyzing Global Energy Trends across key regions using Power BI. It highlights different energy generation modes such as renewable, non-renewable, and nuclear energy. By using Power BI, the data will be visualized in an interactive way to help identify patterns, trends, and regional contributions to energy production.

The insights from this analysis will help decision-makers in promoting the use of renewable energy sources and developing sustainable energy policies for the future.

Scenario 1:

Smart Grid Implementation in Urban Areas:

In a bustling urban city, the local government has embarked on a project to upgrade its energy infrastructure to meet the increasing

demands sustainably. They have implemented a smart grid system that integrates renewable energy sources like solar and wind power into the existing grid. This system allows for more efficient distribution of electricity, minimizing energy loss during transmission. Moreover, smart meters installed in households provide real-time data on energy consumption, enabling residents to monitor and adjust their usage patterns. As a result, the city experiences reduced reliance on fossil fuels, lower CO2 emissions, and increased resilience to power outages.

Scenario 2:

Industrial Energy Management in Manufacturing Plants: A large manufacturing plant recognizes the importance of optimizing energy usage to enhance its sustainability and cost-effectiveness. Leveraging data analysis techniques, the plant implements an advanced energy management system that monitors energy consumption across various processes in real-time. Through predictive analytics, the system identifies areas of inefficiency and suggests optimization strategies, such as scheduling production during off-peak hours or upgrading equipment to more energy-efficient models. Additionally, the plant integrates renewable energy sources like rooftop solar panels to offset its reliance on grid electricity further. This initiative not only reduces the plant's carbon footprint but also leads to substantial cost savings over time.

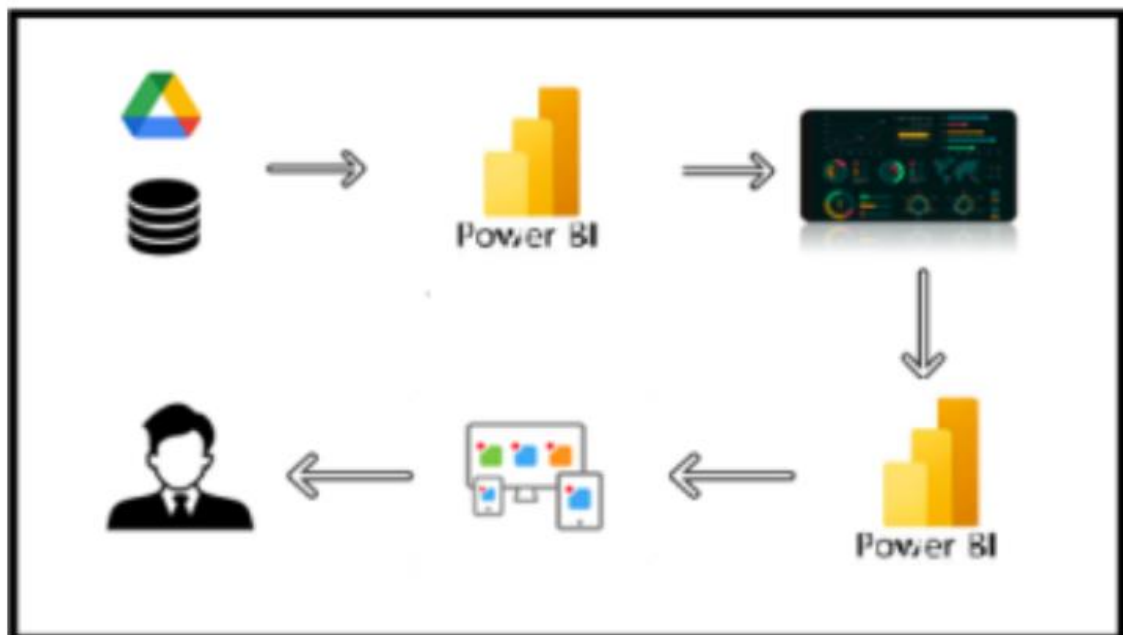
scenario 3:

Rural Electrification Project in Developing Countries

In a remote rural community in a developing country, access to reliable electricity has been a longstanding challenge. To address this issue sustainably, a non-profit organization initiated a rural electrification project focused on utilizing renewable energy sources. They install solar microgrids to power homes, schools, and community centers, providing access to clean and affordable electricity for the first time. Data analytics are employed to optimize the operation of these microgrids, ensuring efficient energy distribution and minimal wastage. As a result, the community

experiences significant improvements in living standards, with enhanced educational opportunities, better healthcare facilities, and economic empowerment through small-scale enterprises powered by electricity. This project serves as a model for sustainable development in similar rural areas worldwide, demonstrating the transformative potential of renewable energy and data-driven solutions.

Technical Architecture:



Project Flow

The activities listed below must be completed:

1. Data Collection

- Collect the dataset
- Connect Data to Tableau

2. Data Preparation

- Prepare the Data for Visualization

3. Data Visualizations

- Number of Unique Visualizations

4. Dashboard

- Response and Design of Dashboard

5. Report

- Report Creation

6. Performance Testing

- Utilization of Data Filters
- Number of Calculated Columns/Measures
- Number of Visualizations/Graphs

7. Project Demonstration & Documentation

- Record explanation Video for project end-to-end solution
 - Project Documentation - Step by step project development procedure
- Investigate the contribution of various types of sources to the total energy produced.

Milestone 1: Data Collection & Extraction from Database

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, evaluate outcomes and generate insights from the data.

Activity 1.1: Downloading The Dataset

Data contains all the meta information regarding the columns described in the CSV files

Data set link

<https://www.kaggle.com/datasets/jamesvandenbergh/renewable-power-generation>

Activity 1.2: Understand the data

Data contains all the meta information regarding the columns described in the Excel files.

Description of the Dataset:

There are six data files that collectively form our dataset. The list of files is as follows:

1. Continent Consumption TWH
 1. Year
 2. World
 3. OECD
 4. BRICS
 5. Europe
 6. North America
 7. Latin America
 8. Asia
 9. Pacific
 10. Africa
 11. Middle East
 12. CIS
2. Country Consumption TWH
Columns in the dataset:
 1. Year
 2. China
 3. United States
 4. Brazil
 5. Belgium
 6. Czechia
 7. France
 8. Germany
 9. Italy
 10. Netherlands
 11. Poland
 12. Portugal
 13. Romania
 14. Spain
 15. Sweden
 16. United Kingdom
 17. Norway

18. Turkey
19. Kazakhstan
20. Russia
21. Ukraine
22. Uzbekistan
23. Argentina
24. Canada
25. Chile
26. Colombia
27. Mexico
28. Venezuela
29. Indonesia
30. Japan
31. Malaysia
32. South Korea
33. Taiwan
34. Thailand
35. India
36. Australia
37. New Zealand
38. Algeria
39. Egypt
40. Nigeria
41. South Africa
42. Iran
43. Kuwait
44. Saudi Arabia
45. United Arab Emirates
3. Non-Renewable – Total Power Generation
Columns in the dataset:
 1. Mode of Generation
 2. Contribution (TWH)
4. Renewable – Total Power Generation
Columns in the dataset:
 4. Mode of Generation
 5. Contribution (TWH)
 - 6.

5. Renewable Power Generation 1997-2017

Columns in the dataset:

1. Year
2. Solar (TWH)
3. Biofuel (TWH)
4. Hydro (TWH)
5. Geothermal (TWH)

6. Top 20 Countries Power Generation

Columns in the dataset:

1. Country
2. Solar PV (TWH)
3. Biofuel (TWH)
4. Hydro (TWH)
5. Geothermal (TWH)
6. Total (TWH)

Milestone 2: Data Preparation

Preparing the data for visualization involves cleaning the data to remove irrelevant or

missing data, transforming the data into a format that can be easily visualized, exploring the data to identify patterns and trends, filtering the data to focus on specific subsets of data, preparing the data for visualization software, and ensuring that the data is accurate and complete.

Activity-1: Preparation the data for visualizations:

Preparing the data for visualization involves cleaning the data to remove irrelevant or missing data, transforming the data into a format that can be easily visualized, exploring the data to identify patterns and trends, filtering the data to focus on specific subsets of data, preparing the data for visualization software, and ensuring the data is accurate and complete. This process helps to make the data easily understandable and ready for creating visualizations to gain insights into the performance and efficiency. Since the data is already cleaned, we can move to visualization.

Data Loading: <https://drive.google.com/file/d/156ffF275TKDeNW-k3jEdQQmn4OJ0APMf/view?usp=sharing>

Data Cleaning: https://drive.google.com/file/d/177bYqaildeZk-P9phsVJui3_37127Xv/view?usp=drive_link

To prepare data for visualization in Power BI , specifically for Global energy trends

A comprehensive analysis of key regions of generation modes ,using powerBI.

1. import data into Power BI

File:imported global energy trends data from CSV or database file into power BI.

- Go to Home and Get data chose file format (eg.CSV)
- Load the into Power BI

2. Clean the Data (Remove Nulls, Duplicate Data)

- Go to Transform Data (Power Query Editor) to clean the data.
-
- Remove Nulls: Select columns with inflation rates and filter out null values.
- - In Power Query, select the column > Click on the Filter icon > Uncheck null to remove them.
 -
- Remove Duplicates: If there are duplicate rows, remove them by:
 - Go to Transform > Remove Duplicates.

-
- Rename Columns: Ensure column names are consistent and clear
- Change Data Types:
 - - Ensure that columns like Year are formatted as Whole Numbers and Inflation_rate is formatted as a Decimal.
 -
 - Done this in Power Query or directly in Power BI by selecting the column in the Data View and changed the data type.

Milestone 3: Data Visualization

Data visualization is the process of creating graphical representations of data to help people understand information. The goal of data visualization is to make complex data sets more accessible, intuitive, and easier to interpret. By using visual elements such as charts, graphs, and maps, data visualization can help people identify patterns, trends, and outliers quickly in the data.

Activity 1: Number of unique visualizations

The number of unique visualizations that can be created with a given dataset. Some common types of visualizations that can be used to analyze include bar charts, line charts, heat maps, scatter plots, pie charts, maps, etc. These visualizations can be used to compare, and track changes over time, show distribution, relationships between variables, breakdown of one category, and much more.

Activity 1.1: Country wise consumption

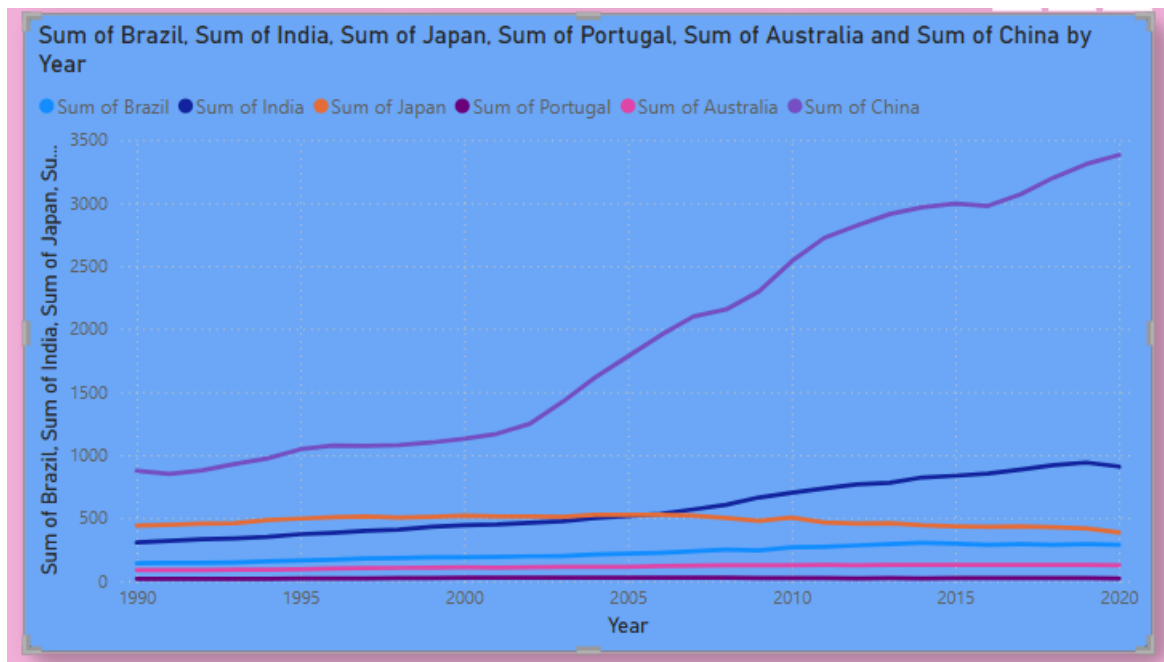
Line chart: country wise consumption

X-AXIS: Year

Y-AXIS: Sum of countries, Brazil, India, Australia, China

Purpose : This line chart provide sum of countries by the year (Brazil, India, Australia, China)

Country wise consumption



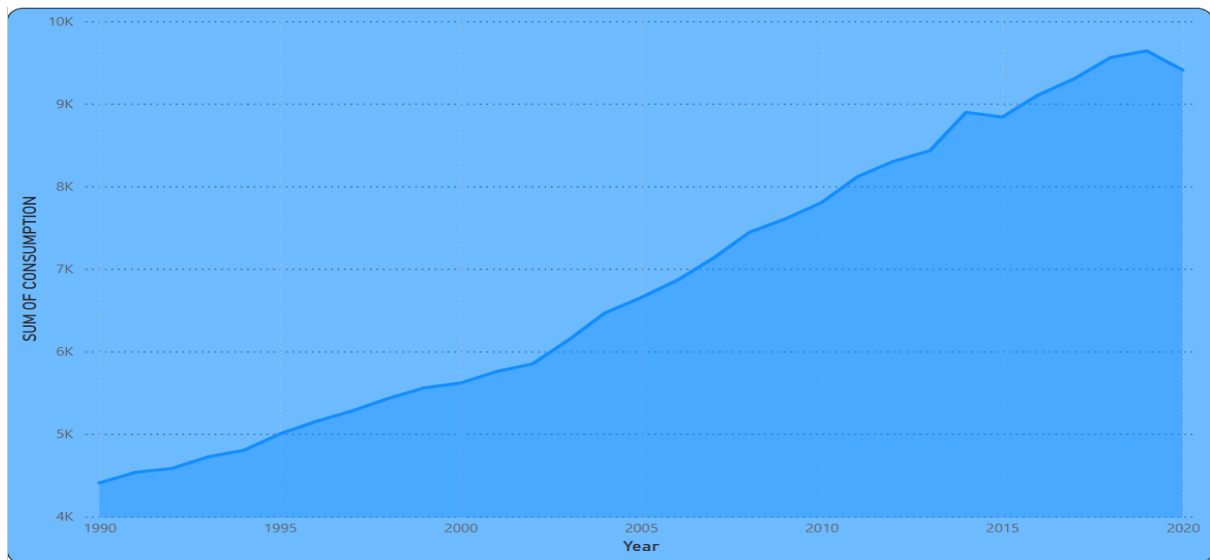
Activity 1.2: Continent Consumption

Area chart: Continent Consumption

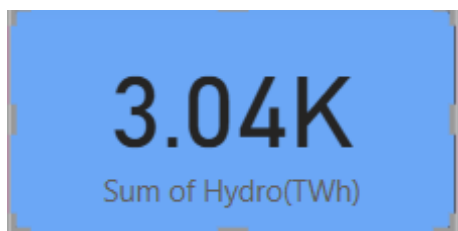
X-AXIS: Year

Y-AXIS: Sum of consumption

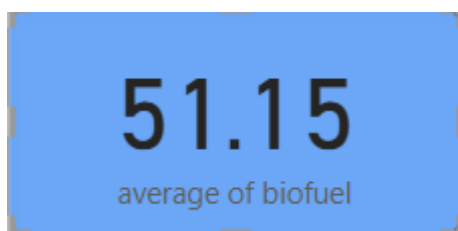
Purpose: this area chart represent the sum of consumption over years



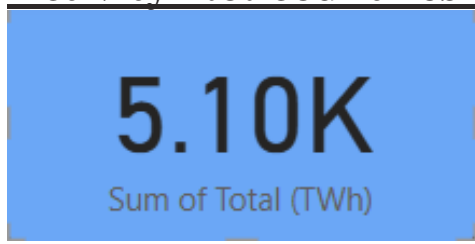
Activity 1.3: Sum of Hydro



Activity 1.4: Average of Biofuel



Activity 1.6: countries Power Generation Total



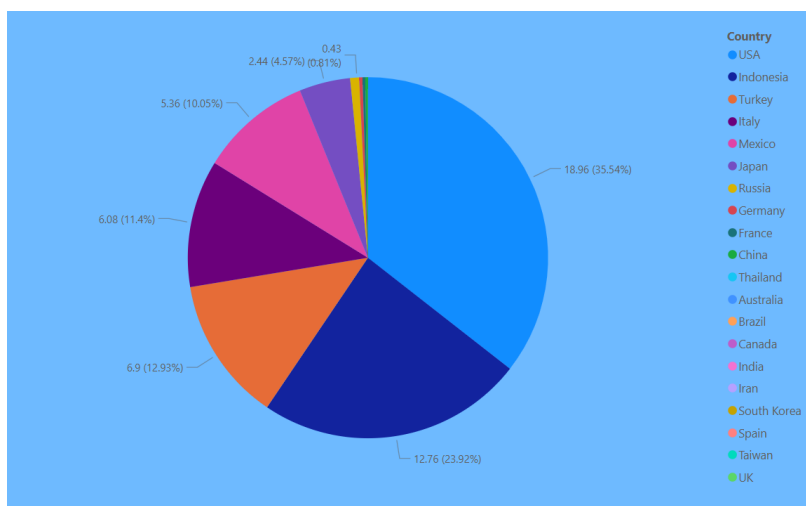
Activity 1.6: Geothermal by country

Piechart: Geothermal by country

Legend: Country

Values: Geothermal

Purpose: This piechart shows Geothermal by the country in Global energy trends.

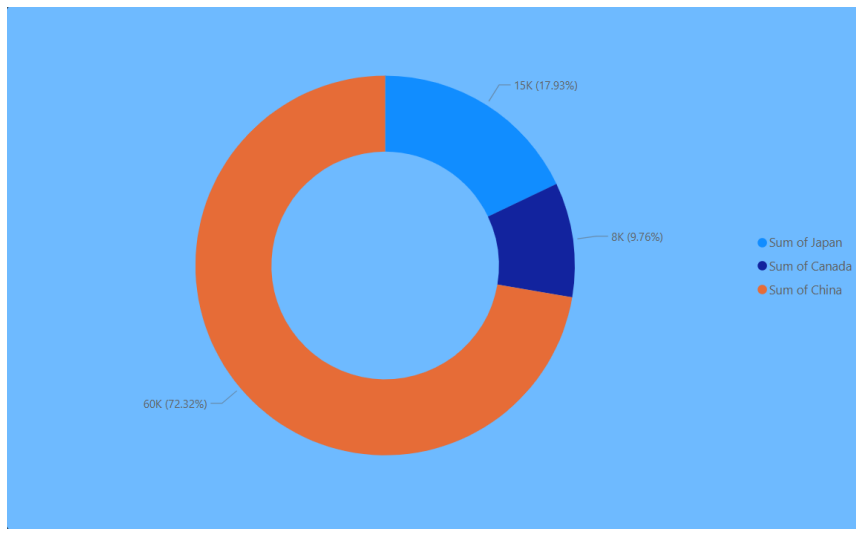


Activity 1.7: consumption countries

Donut chart: consumption countries

Values: sum of japan, Canada, china

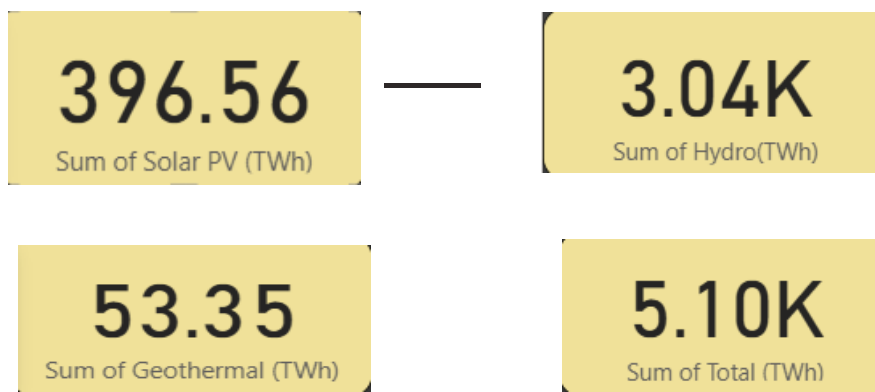
Purpose: This Donut chart shows sum of japan, Canada, china in the Consumption countries



Activity 1.8: cards –Geothermal, Hydro, Solar tv

Cards: Geothermal, Hydro, Solar tv

Purpose: This cards are visualize Sumo of solartv, Sum of Hydro and Geithermal, total.



Activity 1.9: Power Generation Top20 Countries

Map: Power Generation Top20 Countries

Location: country

Legend: Solartv

Bubble Size: Sum of total

Purpose: This Map visualize the Solartv in world, we can take different

Countries like Australia, Brazil, india, china, etc.. it can be used find out the solartv's or count of solartv's across the world.



Activity 1.10 Top20 countries

Slicer: Top20 countries

Field : country

Purpose: This slicer shows the Top20 power Generation Countries

In the world , it can be used to find the top and lowest country's in the power generation.

Country
☐ Australia
☐ Brazil
☐ Canada
☐ China
☐ France
☐ Germany
☐ India
☐ Indonesia
☐ Iran
☐ Italy
☐ Japan
☐ Mexico
☐ Russia
☐ South Korea
☐ Spain
☐ Taiwan
☐ Thailand
☐ Turkey
☐ UK
☐ USA

Activity 1.11: Report Narrative

Narrative: Report Narrative

Purpose : This Narrative view provide information about the charts (according to charts in dashboard)

At 65, 2019 had the highest Sum of Algeria and was 195.45% higher than 1990, which had the lowest Sum of Algeria at 22.

Sum of Algeria and total Sum of Egypt are positively correlated with each other.

2019 accounted for 5.63% of Sum of Algeria.

Across all 31 Year, Sum of Algeria ranged from 22 to 65, Sum of Egypt ranged from 33 to 97, and Sum of Nigeria ranged from 66 to 160.

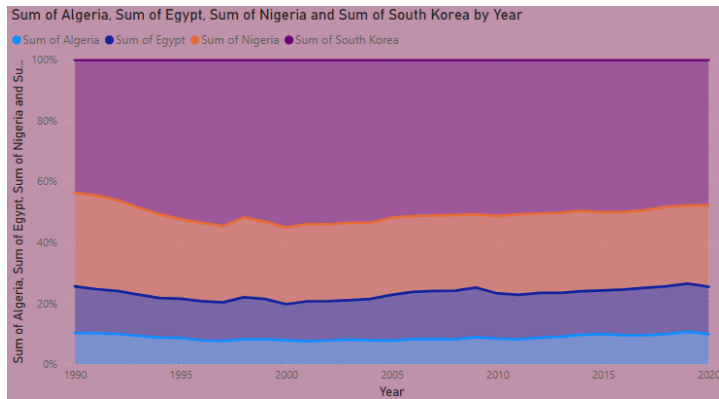
Activity 1.12:Energy consumption in south Africa

Stacked Area chart:

X-AXIS: Year

Y-AXIS: Algeria, Egypt, Nigeria, korea

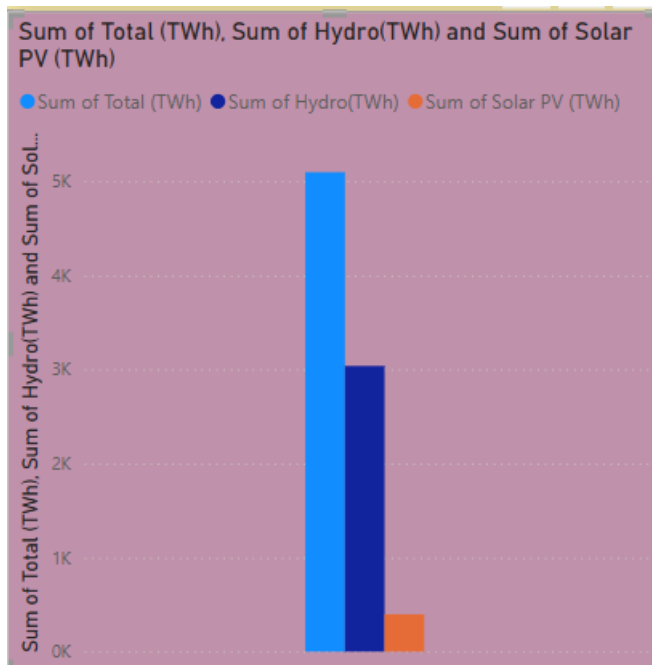
Purpose: This stacked Area chart shows the sum of countries are Algeria, Egypt, Nigeria, korea by the Year it can be used for simply understand the data with visualization.



Activity 1.13: Power Generation

Clustered bar chart: Power Generation

Purpose: This Clustered bar chart shows the power Generation with visualiztion



Milestone 3: Dashboard

A dashboard is a graphical user interface (GUI) that displays information and data in an organized and easy-to-read format. Dashboards are often used to provide real-time monitoring and analysis of data. They are typically designed for a specific purpose or use case. Dashboards can be used in a variety of settings, such as business, finance, manufacturing, healthcare, and many other industries. They can be used to track key performance indicators (KPIs), monitor performance metrics, and display data in the form of charts, graphs, and tables.

Activity 1.1: Responsive and Design of Dashboard

ENERGY PRODUCTION : SOURCES

5.10K

Sum of Total (TWh)

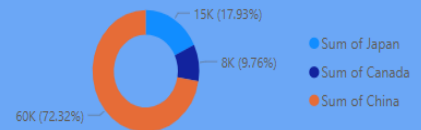
3.04K

Sum of Hydro(TWh)

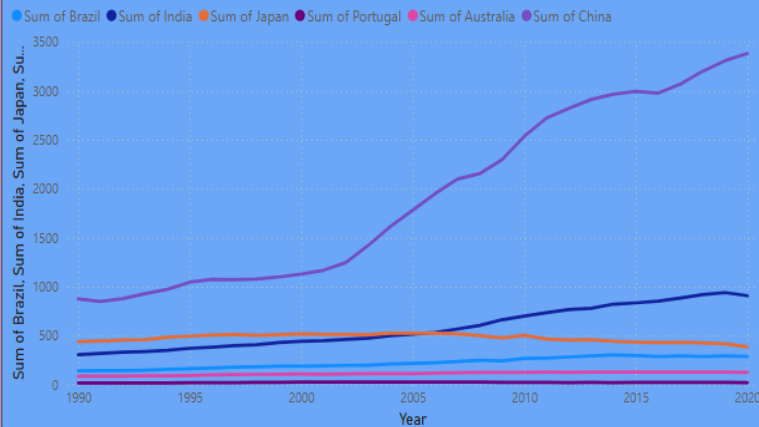
51.15

average of biofuel

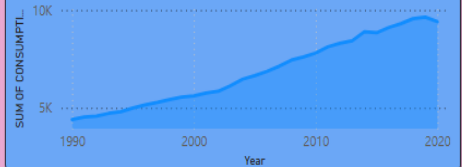
Sum of Japan, Sum of Canada and Sum of China



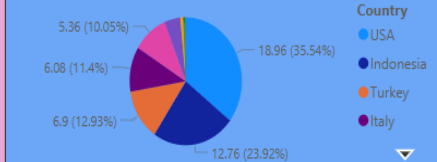
Sum of Brazil, Sum of India, Sum of Japan, Sum of Portugal, Sum of Australia and Sum of China by Year



SUM OF CONSUMPTION by Year



Sum of Geothermal (TWh) by Country



Explanation Video :

Link: https://drive.google.com/file/d/177bYqailideZk-P9phsVJui3_37127Xv/view?usp=drive_link

POWER GENERATION : TOP 20 COUNTRIES

3.04K

Sum of Hydro(TWh)

53.35

Sum of Geothermal (TWh)

396.56

Sum of Solar PV (TWh)

5.10K

Sum of Total (TWh)

Sum of Total (TWh) by Country and Solar PV (TWh)



- Country
- ☐ Australia
 - ☐ Brazil
 - ☐ Canada
 - ☐ China
 - ☐ France
 - ☐ Germany
 - ☐ India
 - ☐ Indonesia
 - ☐ Iran
 - ☐ Italy
 - ☐ Japan
 - ☐ Mexico
 - ☐ Russia
 - ☐ South Korea
 - ☐ Spain
 - ☐ Taiwan
 - ☐ Thailand
 - ☐ Turkey
 - ☐ UK
 - ☐ USA

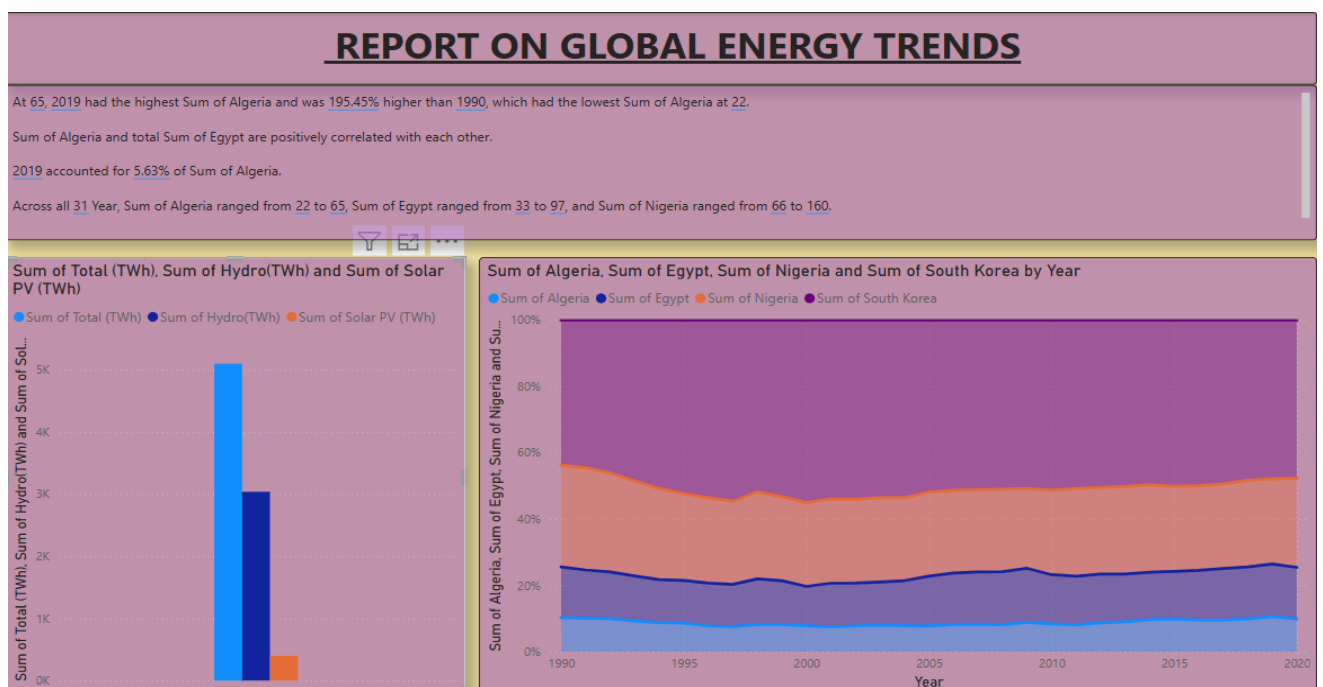
Explanation Video :

Link: https://drive.google.com/file/d/13VKpVGkDQqK_ZBGYhIBv-jTDCcpuMX9r/view?usp=drive_link

Milestone 4: Report

A report is a way of presenting data and analysis in a narrative format, with the goal of making information more engaging and easier to understand. It typically includes a clear introduction that sets the stage and explains the context for the data, a body that presents the data and analysis in a logical and systematic way, and a conclusion that summarizes the key findings and highlights their implications. Data stories can be told using a variety of media, such as reports, presentations, interactive visualizations, and videos.

Activity 1.1: Design of Report



Explanation Video :

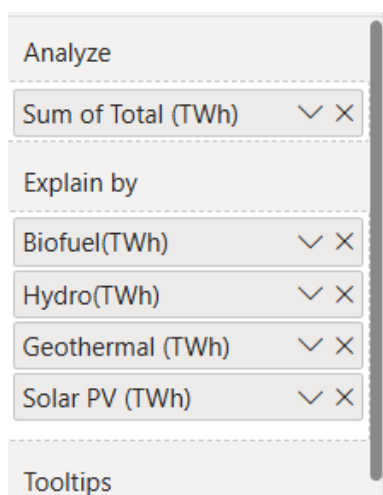
Link: https://drive.google.com/file/d/1ICvooAcaK_TYm4av7HgaIuq5As_oE_kX/view?usp=drive_link

Milestone 5: Performance Testing

For the aforementioned energy project focusing on incorporating renewable energy sources and optimizing energy usage, performance testing plays a critical role in ensuring the effectiveness and reliability of the implemented systems. Performance testing involves assessing various aspects, including the efficiency of energy generation from renewable sources, the effectiveness of energy distribution through smart grids or microgrids, and the accuracy of data analytics algorithms in identifying optimization opportunities.

Activity 1.1: Application of Data Filters

Selections within the data allow users to filter data based on individual fields or dimensions. Users can choose specific values within a field to include or exclude from analysis. Complex filters based on predefined conditions and logic can also be created.



The image shows a vertical sidebar of a data analysis tool. At the top is a section labeled 'Analyze' with a dashed border. Below it is a filter for 'Sum of Total (TWh)' with a dropdown arrow and an 'X' icon. The next section is labeled 'Explain by' and contains four filters: 'Biofuel(TWh)', 'Hydro(TWh)', 'Geothermal (TWh)', and 'Solar PV (TWh)', each with a dropdown arrow and an 'X' icon. At the bottom is a section labeled 'Tooltips'.

Activity 1.2: Use of Measures/Calculated Columns

1 continent consumption = SUM(Continent_Consumption_TWH[Latin America])

☐ Line chart- Country wise energy consumption

□ Area chart- Continent Energy Consumption

□ Pie chart-Geotheramal by country

□ Card-Average of Biofuel ,Hydro,Total

□ Map-Top20 countries power Generation

□ Slicer Top20 countries

□ Cards – Sum of Geothermal, Sum of Hydro, Sum of slolarty

□ Stacked Area chart-Country consumption

- ☐ Clustered Column Chart-Power generation countries
- ☐ Report Narrative

Milestone 6: Project Demonstration & Documentation

Below mentioned deliverables are to be submitted along with other deliverables.

Activity 1: Record explanation video for the project's end-to-end solution

Activity 2: Project Documentation-step by step project development procedure
Create the document as per the template provided.

