CONTENTS

Project on:

Global Energy Trends: A Comprehensive Analysis of key regions and Generation modes using Power BI

1.Introduction

1.1.Project overviews:

The project aims to analyze global energy consumption patterns and the transition towards renewable energy using Power BI. As climate change accelerates and energy demands grow, understanding data-driven insights is vital for shaping sustainable strategies. By leveraging interactive dashboards, the project visualizes key metrics such as CO_2 emissions, energy source distribution, and regional consumption trends.

The analysis is designed to empower stakeholders with a clear picture of how different countries are progressing in renewable energy adoption, identify major contributors to emissions, and uncover opportunities for improvement based on real-world data.

1.2.Objectives

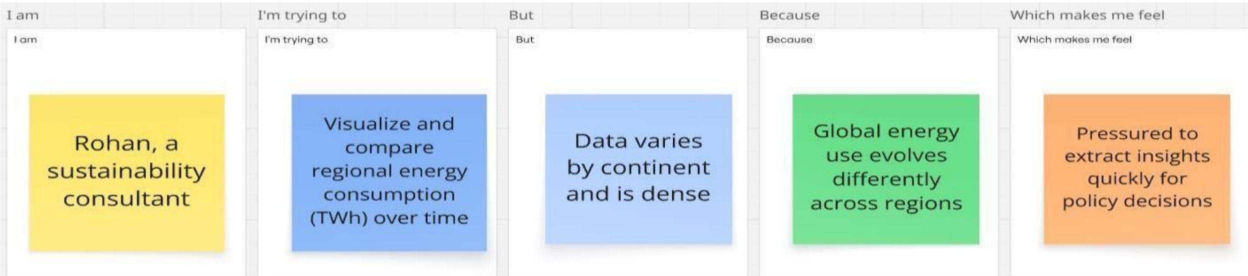
- To build an interactive Power BI dashboard that visualizes global energy trends and CO_2 emissions.
- To compare renewable and non-renewable energy usage across different countries and regions.
- To assess the impact of energy consumption patterns on environmental sustainability.
- To apply data cleaning and modeling techniques for accurate and meaningful insights.
- To explore correlations between policy changes and shifts in energy sources.
- To provide a user-friendly interface for stakeholders to interpret global energy data at a glance.

2. Project Initialization and Planning Phase

2.1 Define Problem Statement

Rohan, a sustainability consultant at an international energy think tank, is responsible for advising governments and large utility companies on global energy policies. His latest assignment is to present actionable insights on how different regions are transitioning from fossil fuels to renewables, considering geopolitical shifts, technological advancements, and environmental goals.

Example:



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Rohan, sustainability consultant	Visualize and compare regional energy consumptio n (TWh) over time	Data varies by contine nt and is dense	Global energy use evolves differently across regions	Pressured to extract insights quickly for policy decisions
PS-2	Fatima, an infrastructure analyst	Analyze energy consumptio n in emerging regions using Power BI	Data is limited and uneven ly distrib u ted	Energy access and reporting vary greatly across countries	Challenged but motivated to uncover actionable insights

2.2 Project Proposal (Proposed Solution)

This project proposal outlines a solution to address a specific problem. With a clear objective, defined scope, and a concise problem statement, the proposed solution details the approach, key features, and resource requirements, including hardware, software, and personnel.

Project Overview	
Objective	The objective of this project is to **analyze and visualize global energy consumption patterns** across key regions and energy generation modes using Power BI. It aims to provide decision-makers—like sustainability consultants or infrastructure analysts—with **interactive, data-driven insights** on regional disparities, renewable growth, and long-term trends, helping them **formulate effective energy transition strategies** and policy recommendations.
Scope	The scope of this project is to analyze **continental energy consumption trends from 1990 to 2020** using Power BI. It focuses on comparing consumption across regions like OECD, BRICS, Asia, Africa, and others, based on the uploaded dataset. The project highlights key patterns in global energy demand, aiding stakeholders in identifying regional shifts and opportunities for sustainable development.
Problem Statement	
Description	This project addresses the challenge of **fragmented and inconsistent global energy consumption data** across regions. It seeks to create an intuitive Power BI dashboard that consolidates long-term trends from 1990 to 2020, enabling analysts to compare regional energy patterns, monitor shifts toward renewables, and support data-driven energy planning worldwide.
Impact	Solving this problem will enable energy analysts and decision-makers to gain a **clear, data-driven understanding of regional energy consumption patterns**, helping them identify imbalances, forecast demand, and support sustainable planning. It empowers smarter investments in renewable infrastructure, fosters global collaboration on energy policy, and contributes to a more equitable and efficient transition toward clean energy across continents.
Proposed Solution	

Approach	• Import and clean the dataset (1990–2020, by region). • Load it into Power BI for modeling and time-series structure. • Create visuals (line charts, stacked bars, slicers) for trends and comparisons. • Generate insights from patterns like regional growth or renewable shifts.
Key Features	• **Longitudinal Analysis**: Covers 31 years (1990–2020) of global energy consumption, offering a rich historical perspective. • **Regional Comparison**: Allows side-by-side insights across OECD, BRICS, Asia, Africa, and more. • **Interactive Visuals**: Empowers users to filter by region or year, making exploration intuitive and dynamic. • **Focus on Sustainability**: Highlights renewable growth and regional transitions toward cleaner energy. • **Decision Support**: Delivers clear insights to guide policy recommendations and infrastructure planning.

Resource Requirements

Resource Type	Description	Specification/Allocation
Hardware		
Computing Resources	CPU/GPU specifications, number of cores	e.g.,intel core i3 processor
Memory	RAM specifications	e.g., 8 GB
Storage	Disk space for data, models, and logs	e.g., 516 GB SSD
Software		
Frameworks	NA	NA
Libraries	NA	NA
Development Environment	IDE, version control	e.g.Power BI desktop
Data		

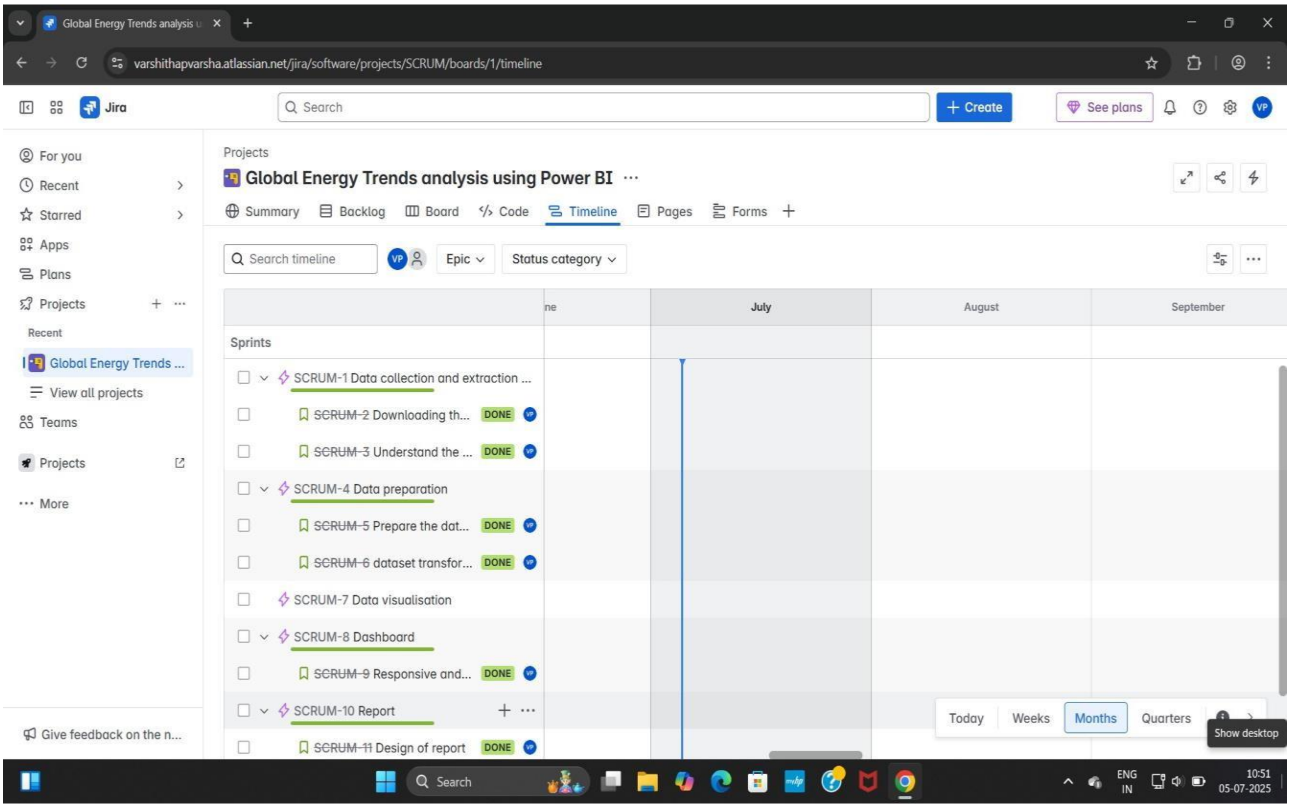
Data	Source, size, format	e.g., Kaggle dataset,31x11=341 datasets,csv

2.3 Initial Project Planning

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members	Sprint Start Date	Sprint End Date (Planned)
Sprint-1	Data collection and extraction from database	SCRUM-2 SCRUM-3	**As a** student intern working with limited time and resources, **I want to** identify reliable open-source energy datasets quickly, **so that I can** start analyzing without spending too much time just hunting for data.	2	High	Varshitha P	23-June-2025	23-June-2025
Sprint-2	Data preparation	SCRUM-5 SCRUM-6	**As a** beginner using Power BI in a real project for the first time, **I want to** clean and format the dataset using tools like Power Query, **so that I can** avoid errors during visualization and understand how professionals prep data.	2	High	Varshitha P	26-June-2025	26-June-2025
Sprint-3	Data visualisation	SCRUM-7	**As a** student still learning how to present data meaningfully, **I want to** create visualizations that are simple, clear, and focused, **so that I can** build a dashboard that makes sense even to someone seeing it for the first time.	3	Low	Varshitha P	27-June-2025	27-June-2025
Sprint-4	Dashboard	SCRUM-9	**As a** virtual intern aiming to showcase my skills, **I want to** design a dashboard that looks clean and is easy to interact with, **so that I can** highlight key trends and make a good impression on reviewers.	3	High	Varshitha P	29-June-2025	01-July-2025

Sprint-5	Report	SCRUM-11	**As a** student wrapping up this internship project, **I want to** write a clear report explaining what I did and what I found, **so that I can** submit something that reflects both my learning and effort.	5	High	Varshitha P	03-July-2025	03-July-2025

Screenshot:



3. Data Collection and Preprocessing Phase

3.1 Data Collection Plan and Raw data Sources

Section	Description
Project Overview	This project aims to examine electricity consumption and generation patterns across countries and continents from 1990 to 2020. It explores regional demand trends alongside the evolution of renewable and non-renewable energy sources. Using Power BI, the project visualizes mode-wise contributions and identifies top-performing countries and regions. It highlights imbalances between consumption and generation to support energy planning discussions. The ultimate goal is to generate actionable insights for sustainable and region-specific energy strategies.
Data Collection Plan	The dataset used in this project was sourced from **Kaggle**, a well-known platform for high-quality, user-contributed datasets.
Raw Data Sources Identified	We used six main datasets in this project to study how energy is consumed and generated around the world. Two of them came from **Enerdata**, a trusted website that publishes global energy statistics every year. These datasets gave us details about how much electricity different countries and continents have been using from **1990 to 2020**. The numbers were originally in a unit called mTOE, but we converted them into **TWh** (terawatt-hours) to match the rest of our data. The other four datasets came from a **Kaggle project shared by James Arthur**, which focuses on power generation trends. These
	datasets include both **renewable** and **non-renewable energy** sources. We got information about how much energy was produced by Solar, Wind, Hydro, Biofuel, and other sources each year. There's also a special file that shows how the **top 20 countries** perform in renewable energy production. To make all this data easier to work with, we cleaned and organized everything into simple CSV files. These were then imported into **Power BI** to create visuals, spot trends, and understand how energy use and production vary across time, regions, and energy types.

Raw Data Sources

Source Name	Description	Location/URL	Format	Size	Access Permissions
Continent_Consumption_TWH Country_Consumption_TWH nonRenewablesTotalPowerGeneration renewablePowerGeneration renewablesTotalPowerGeneration top20CountriesPowerGeneratio	72 columns Decimal 67 String 3 Integer 2	Global Energy Consumption & Renewable Generation	CSV	15.22 kB	Public
Renewable- -share – energy	22239x4=82956 Data Cells.	03_Renewable Power_Trends: 1965-2022	CSV	154 KB	Public
…	…	…	…	…	…

3.2 Data Quality Report

The Data Quality Report Template will summarize data quality issues from the selected source, including severity levels and resolution plans. It will aid in systematically identifying and rectifying data discrepancies.

Data Source	Data Quality Issue	Severity	Resolution Plan
Kaggle	1. Tidal Energy Mismatch: In the renewables dataset, the Tidal energy value (19,448.16 TWh) is unrealistically high and also matches the total value in the non-renewables file. This likely happened due to a copy-paste mistake or a misclassified value. 2. Missing or Expired File Content:A few datasets had to be reuploaded because their content had expired. This delayed analysis and shows the importance of maintaining organized file backups. 3. Inconsistent Totals: In the file showing total renewable generation, the total is shown as 6,384.25 TWh, but the sum of individual sources is much higher. This signals a possible calculation error or outdated total.	Moderate	**1. Tidal energy number is too high**: Replace it with a blank or zero, and double-check the original source. **2. Files lost their content after upload:** Re-uploaded them and kept a backup saved properly. **3. Totals didn't match the individual values:** Recalculated totals yourself instead of trusting the one already there. **4. Years and regions were written in different ways:** Cleaned and renamed columns so everything lines up. **5. Units didn’t match:** Converted all mTOE values into TWh to keep it the same.

	4. Format Variations:Some files used different formats — for example, year columns were not consistent across all datasets. This required extra cleaning to ensure timelines align correctly. 5. Units Conversion Needed: Consumption data from Enerdata was originally in mTOE (million tonnes of oil equivalent), and had to be converted to TWh to match the generation datasets. 6. No Metadata or Source Columns: Most files didn’t mention where the data was sourced from or what units were used. Without clear labels or descriptions, verifying and interpreting the data took more time. 7. Region vs. Country onfusion: Consumption was eparated by country in one file nd by continent or group (like RICS or OECD) in another. hile this adds richness, it also ade it tricky to match both rectly in one visual.		**6. Files didn’t say where the data came from:** Added a “source” column or made a note about where each file came from. **7. Mixing country and continent data:** Created groups or mapped countries into continents so they can be analyzed together.
Kaggle	1. Missing country codes for some regions	moderate	To address missing country codes, use a standard ISO lookup (via Python, Excel, or online mappers) to fill them in.

	2. Duplicate region entries (like “Asia” and “Asia Pacific”) 3. Inconsistent naming		For duplicate region names, decide on a consistent label and filter or merge using data cleaning tools like Power Query. Clean inconsistent names by applying text functions (like remove or replace) to standardize entities.

3.3 Data Exploration and Preprocessing

Identifies data sources, assesses quality issues like missing values and duplicates, and implements resolution plans to ensure accurate and reliable analysis.

Section	Description
Data Overview	This project uses six datasets that cover global electricity consumption and power generation patterns from 1990 to 2020. Two datasets provide information on how much electricity is consumed by countries and continents, while the other four focus on electricity generation from both renewable and non-renewable sources. The data includes regional and country-level details, mode-wise generation breakdowns (like Hydro, Solar, Wind, and Fossil Fuels), and contributions from top energy-producing nations. Together, these datasets allow for a comprehensive comparison of energy usage versus production, making it possible to explore sustainability trends and regional shifts in energy dependency.

Data Cleaning	During data cleaning in Power BI and Excel, the following steps were taken to improve data quality:
	
	1. Handling Missing Values
	Tidal energy value: in the renewable dataset was unrealistically high and likely incorrect. It was replaced with \`null\` or zero to avoid distortion in totals.
	- Blank rows and incomplete entries (if any) were removed using Power Query filtering and cleaning tools.
	2. Removing Duplicates
	- Duplicate entries (especially in country and continent consumption files) were removed using:
	  - Power BI's Remove Duplicates option in Power Query.
	  - Excel's Remove Duplicates feature for early cleaning before import.
	- Final datasets ensure each record is unique by year, country/region, and energy type.
	
	3. Fixing Incorrect Values
	Unit mismatches were corrected: mTOE values from Enerdata were converted to **TWh** using a standard factor (1 mTOE = 11.63 TWh).
	- The Tidal energy value (19,448.16 TWh), which matched a non-renewables total, was flagged as an error and corrected.
	- Totals that didn't match their mode-wise sums were recalculated** manually or through DAX in Power BI.

	4. Standardizing Format - Column names like "year" and "region" were made consistent across all files. - Data was reshaped into long format (one row per year-country/mode) to improve filtering and visuals in Power BI. - Unnecessary rows, decimal noise, and extra totals were removed for a neat dataset.
Data Transformation	To prepare the datasets for analysis and visualization in Power BI, I used Power Query Editor for the following transformations: **1. Filtering Data** - Removed unnecessary rows (like extra headers or totals at the bottom of raw files). - Filtered out blank or irrelevant years and entries (e.g., empty TWh rows). **2. Sorting and Arranging** - Sorted data by year and region/country for proper time-series tracking. - Sorted generation modes (Hydro, Solar, etc.) to maintain consistency across visuals. **3. Calculated Columns** - Created new columns using simple DAX or Power Query logic such as: - Total TWh by Year or Region - Share of Each Energy Source -YoY Growth Rate (Difference between current and previous year) **4. Merging Queries** - Combined country and continent data from separate files to enable region-wise comparisons. - Merged renewable and non-renewable sources for a full energy generation picture. **5. Column Renaming and Formatting** - Standardized column names like "TWh", "Year", "Country" to match across all tables. - Changed data types (e.g., Year to Whole Number, TWh to Decimal Number) for consistent calculations.

	6. Pivoting and Unpivoting - Used “Unpivot Columns” to convert wide-format data (columns for each year) into long-format tables . - Pivoted source columns where needed to calculate totals or percentage splits.
Data Type Conversion	**1. Converted “Year” Columns** • Original data had years sometimes stored as **text** or **decimal**. • Changed them to **Whole Number** type to enable time-series analysis and sorting. **2. Cleaned “Region” and “Country” Columns** • Ensured these were set to **Text** data type for clear filtering and label visuals. • Removed extra spaces and formatting inconsistencies. **3. Standardized “TWh” Columns** • All electricity generation and consumption values were made **Decimal Number** type. • This allowed accurate totals, averages, and percentage calculations in Power BI. **4. Replaced Errors or Nulls** • Power BI showed type errors (e.g., “Error” in place of numbers) in a few places. • Replaced these with null or fixed the format so the correct data type could be applied. **5. Applied Consistent Types Across Queries** • Made sure similar columns across different tables (like TWh, Year, and Country) had matching data types. • Helped when **merging queries** or creating relationships in the Power BI model.

Column Splitting and Merging	**Column Splitting**
	• In some original datasets, the data was packed into **wide formats** (with one year per column).
	• I used **Power Query → Unpivot Columns** to split these into:
	  ○ One column for Year
	  ○ One column for TWh (value)
	• This step was used in:
	  ○ continent table
	  ○ country table
	• It helped simplify filtering and build proper **time-series visuals** in Power BI.
	Column Merging or Combination
	• I created **Total columns** (e.g., Total TWh) by merging different source columns like Hydro, Solar, Biofuel, etc., using:
	  ○ Power Query's **"Add Column → Custom Column"**
	  ○ Or Excel's **SUM formula** across multiple columns
	• In the **Top 20 Countries** file, individual energy sources were combined to compute a final Total column.
	• In some datasets, I merged **metadata fields** (like Region + Year) into a single column to improve traceability or chart labeling.
	Why This Was Important
	• Splitting helped standardize **long format** for visuals and calculations.
	• Merging made it easier to calculate totals, percentages, and create summary visuals.
	• Both made relationships between tables stronger and visuals more flexible.

Data Modeling	In the original six datasets, there were no relationships between tables — each file stood on its own, with wide-format structures and inconsistent field names. There were no keys like Country, Continent, or Year that could be directly used to connect files. Because of this, it was not possible to filter or analyze data across different tables in a unified way. After cleaning and transforming the data into eight structured files, I created a proper data model in Power BI. I converted all

	datasets into long format, where each row represents a single year, country/region, and its corresponding energy value. This allowed me to define clear relationships: for example, I linked the country consumption table to the top 20 countries generation file using the Country field. Similarly, the continent consumption table was connected to generation totals by Continent. The Year column was unified across all datasets, enabling dynamic filtering using slicers and trend lines. These relationships allowed me to build a star-schema-style model, where central fact tables like generation and consumption were linked through shared dimension fields like Year and Country. On top of this model, I created DAX measures to calculate total generation (in TWh), percentage contributions by source or region, and year-on-year growth. These measures added flexibility, enabling dynamic insights that update instantly when filters are applied in the dashboard. This approach turned the project into a connected, interactive experience rather than just standalone files.
Save Processed Data	Each cleaned dataset was exported from Power BI or restructured in Excel and saved as **.xlsx** files.

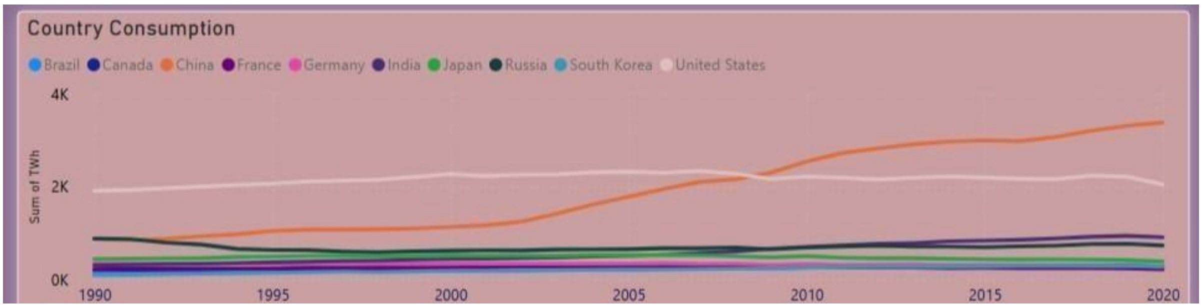
4. Data Visualization:

Visualization development refers to the process of creating graphical representations of data to facilitate understanding, analysis, and decision-making. The goal is to transform complex datasets into visual formats that are easy to interpret, enabling users to gain insights and make informed decisions. Visualization development involves selecting appropriate visual elements, designing layouts, and using interactive features to enhance the user experience. This process is commonly associated with data visualization tools and platforms, and it plays a crucial role in business intelligence, analytics, and reporting

4.1 Framing Business Questions and Visualisation

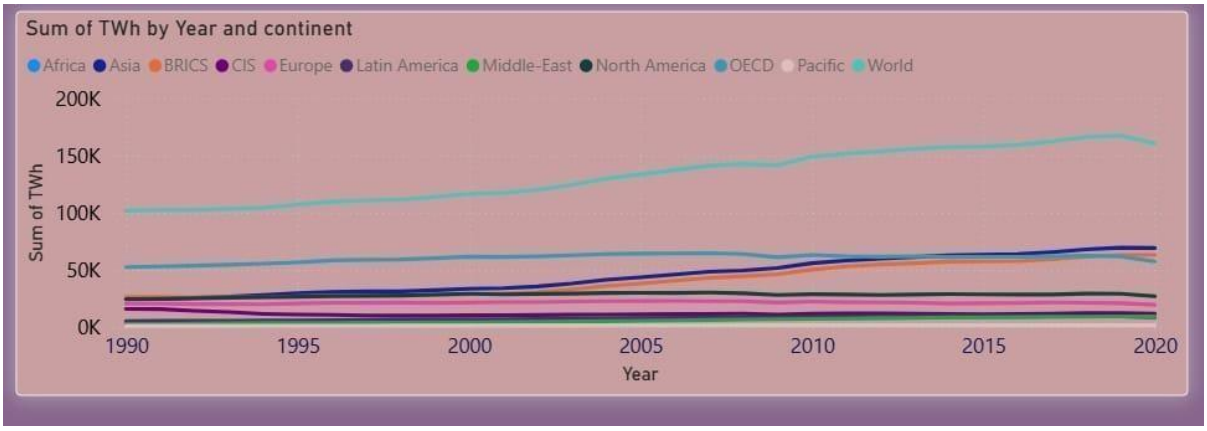
The process involves defining specific business questions to guide the creation of meaningful and actionable visualizations in Power BI. Well-framed questions help in identifying key metrics, selecting relevant data, and building visualisation that provide insights.

1. **Which countries have had the highest electricity consumption from 1990 to 2020, and how do they compare?**
   - *Visualization*: Line chart showing Country consumption.
   - *Screenshot of visualisation*



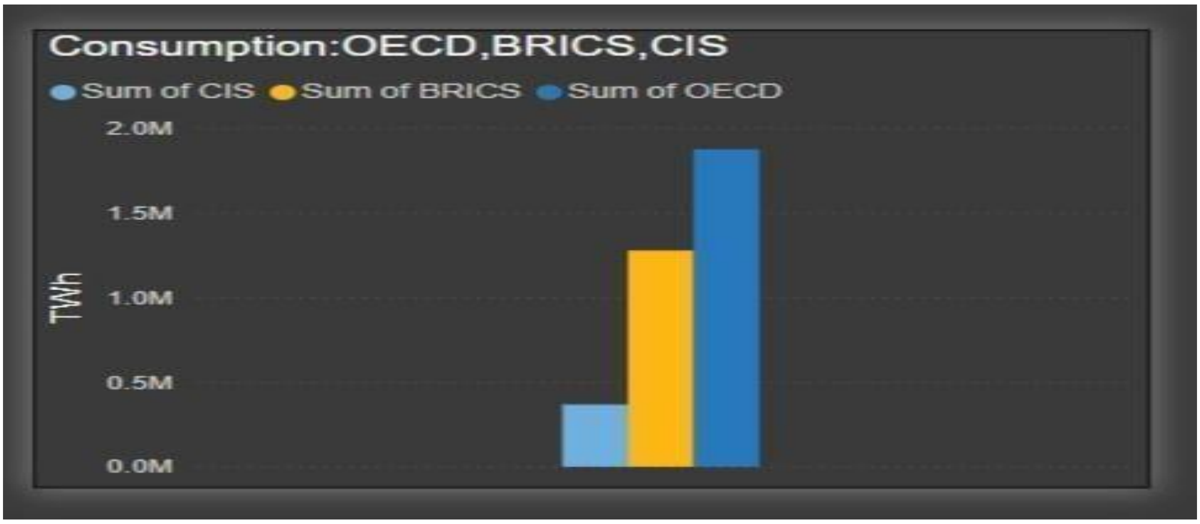
2. **How has electricity consumption evolved across different continents between 1990 and 2020?**
   - *Visualization*: Line chart showing sum of TWh by year and continent.

- *Screenshot of visualisation*



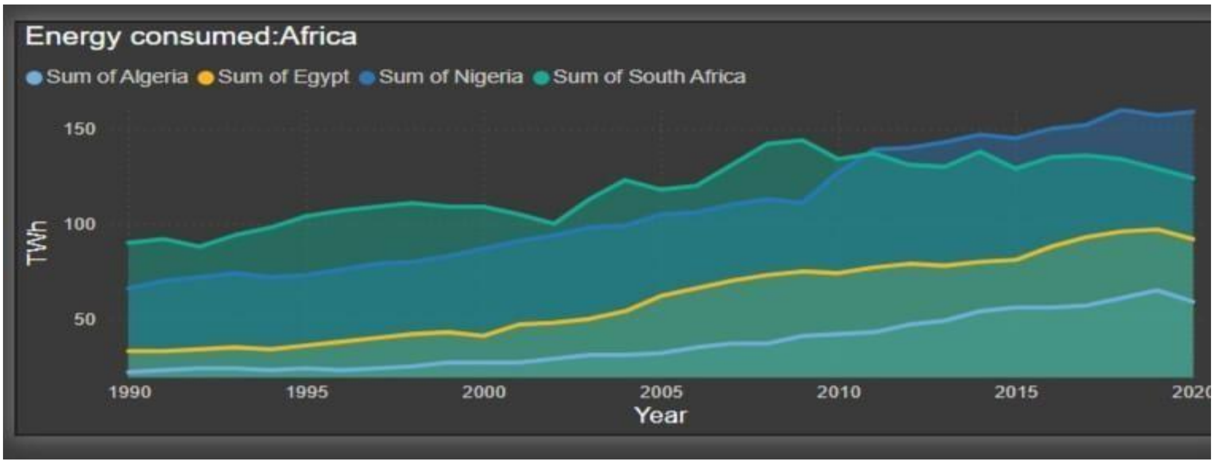
3. How do electricity consumption trends differ among OECD, BRICS, and CIS regions over time?

- *Visualization*: Clustered column chart showing consumption of OECD,BRICS and CIS.
- *Screenshot of visualisation*



4. Among Algeria, Egypt, Nigeria, and South Africa, which country has shown the most consistent growth in electricity consumption from 2000 to 2020?

- *Visualization*: Area chart showing energy consumed:Africa.
- *Screenshot of visualisation*

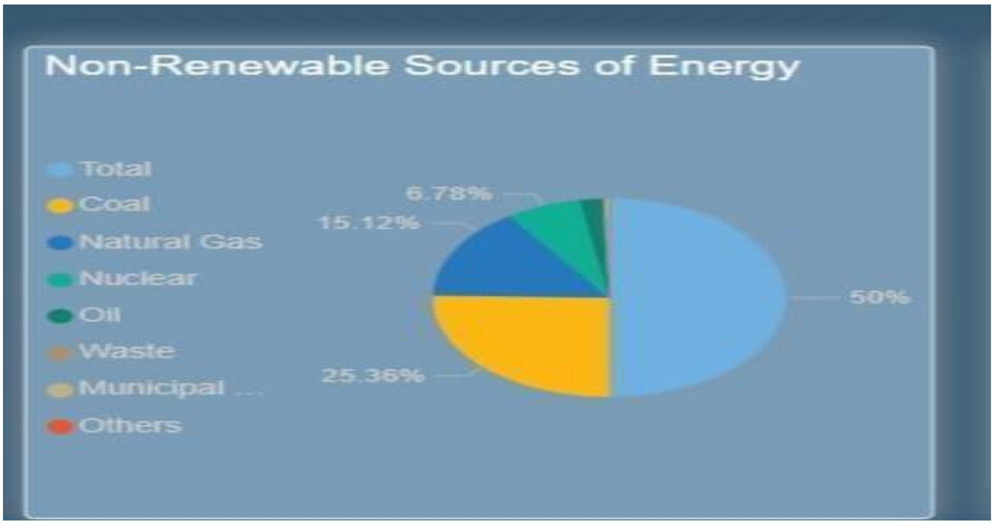


5. What is the total contribution of non-renewable energy sources to global power generation?

- *Visualization*: Card showing sum of contribution(TWh).
- *Screenshot of visualisation*

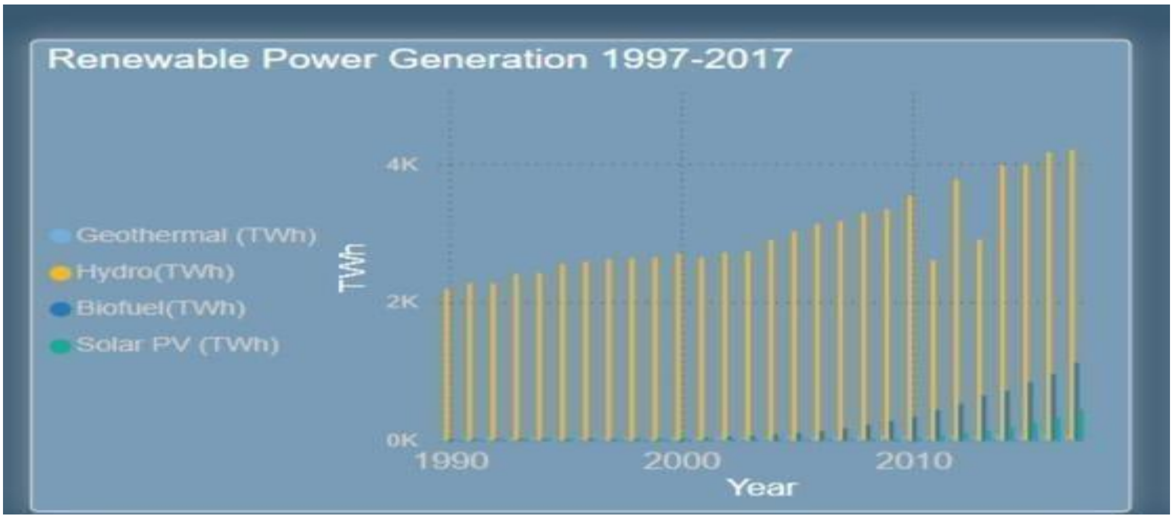
6. Which non-renewable source contributes the most to global electricity generation?

- *Visualization*: Pie chart showing Non Renewable sources of energy.
- *Screenshot of visualisation*



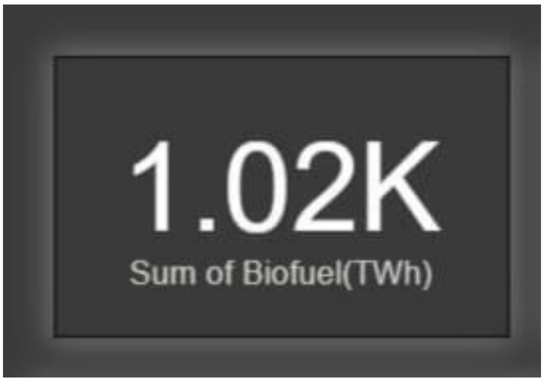
7. How has renewable power generation evolved globally between 1997 and 2017?

- *Visualization*: Clustered column chart showing renewable power Generation 1997 to 2017.
- *Screenshot of visualisation*



8. Which countries contribute the most to global biofuel-based power generation, and how significant is their share compared to others in the top 20 list?

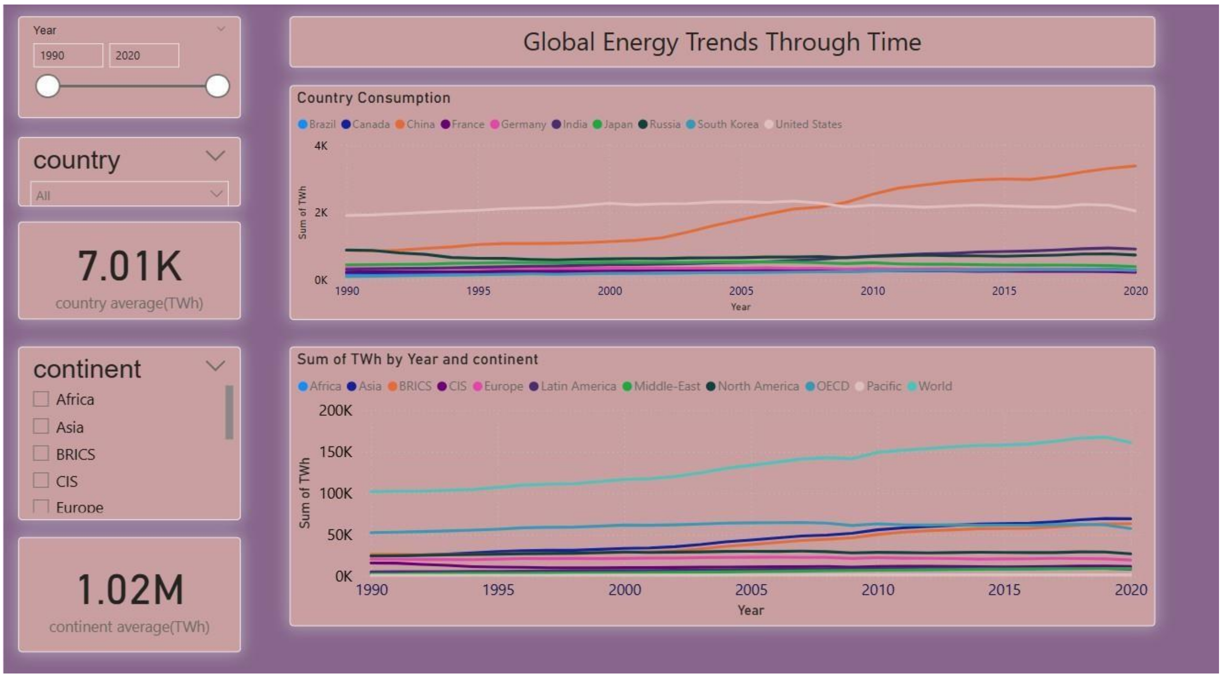
- *Visualization*: Card showing some of biofuel(TWh).
- *Screenshot of visualisation*



5.Dashboard

4.2 Dashboard design file:

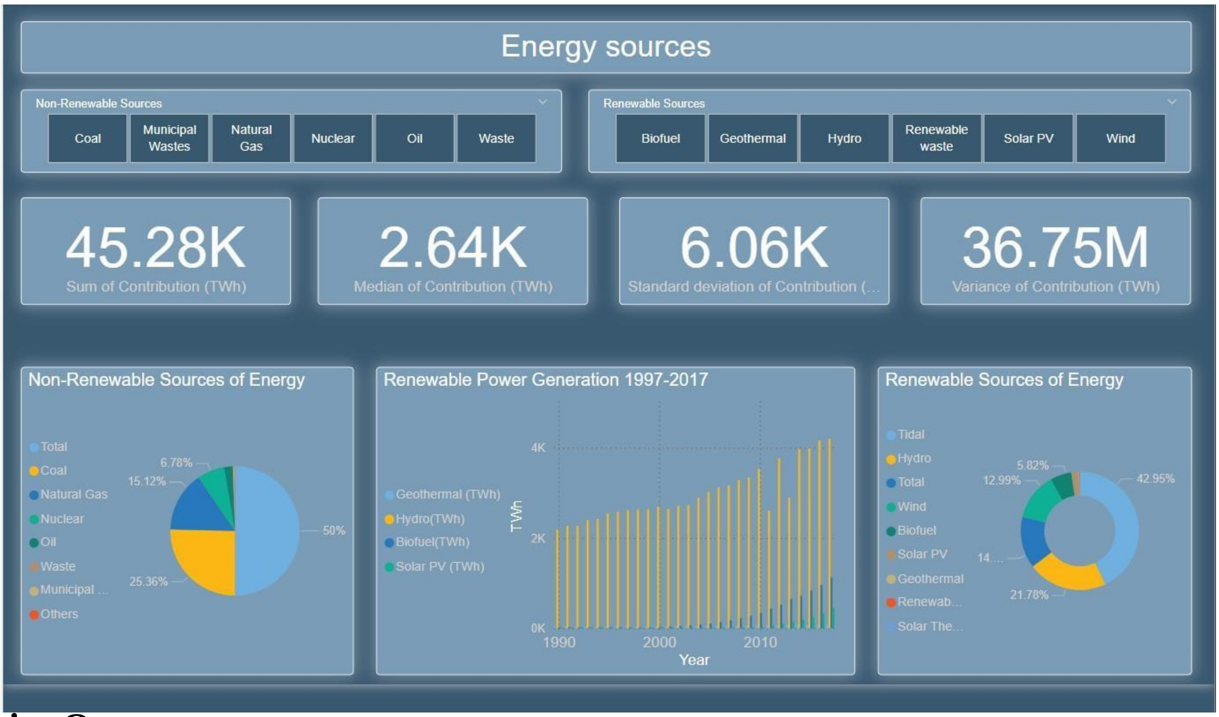
Dashboard 1:



Major Outcomes:

- China has shown the steepest increase in electricity consumption from 1990 to 2020, leading all other countries.
- North America and Asia are the top consuming continents, consistently driving global energy demand.
- Electricity consumption has increased steadily across all continents over the 30-year period.
- The average electricity consumption per country is 7.01 TWh, while the continent-level average is significantly higher at 1.02 million TWh.
- OECD and BRICS region account for a major share of global energy usage highlighting the influence of developed and developing economies.

Dashboard 2:



Major Outcomes:

- Non-renewable sources like nuclear and oil are the dominant contributors, with nuclear alone accounting for 50% of non-renewable energy generation.
- The total contribution of all energy sources combined is 45.28K TWh, with a median of 2.64K TWh, indicating a skewed distribution likely driven by a few high-volume contributors.
- Among renewable sources, geothermal (21.78%), wind (14.44%), and hydro (12.99%) represent the most significant shares in the renewable energy mix.
- Renewable power generation has steadily increased from 1997 to 2017, with notable growth across solar PV, hydro, and biofuel, based on the bar chart trends.
- The standard deviation (6.06K TWh) and variance (36.75M) in total contributions reflect high variability in generation capacity across sources, both renewable and non-renewable.

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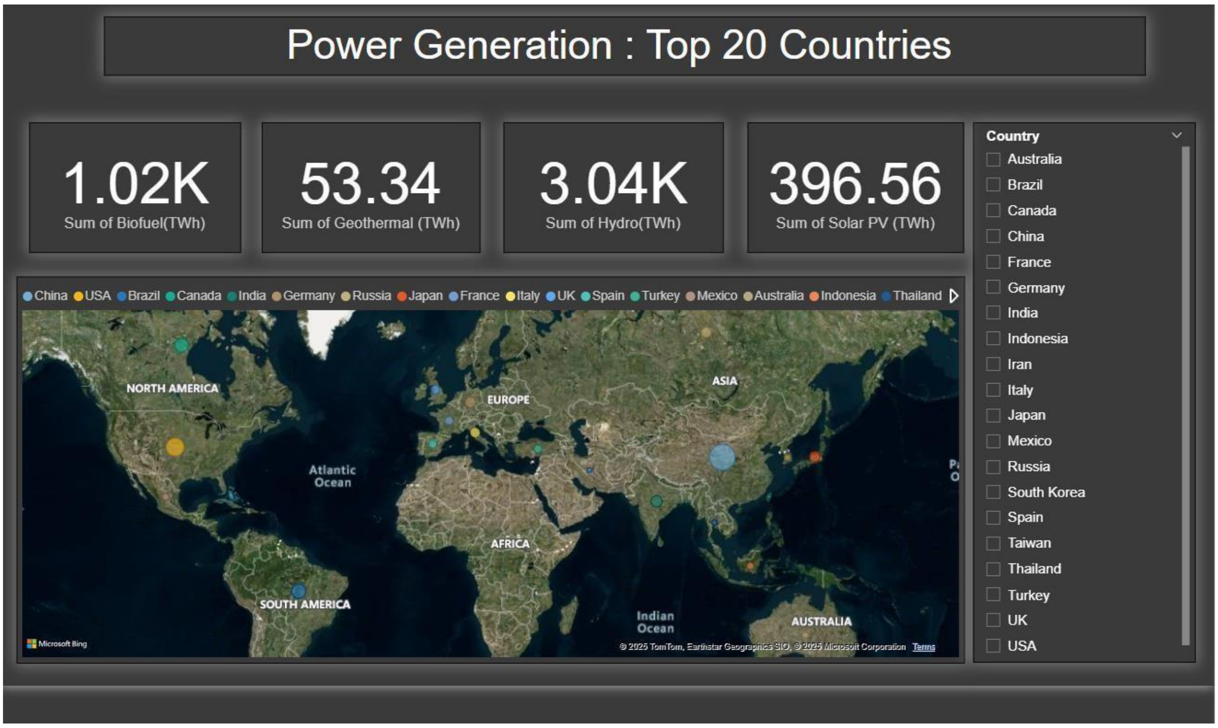
Dashboard 3:



Major Outcomes:

- China leads all countries in renewable power generation, with the highest cumulative output across Hydro, Biofuel, and Solar PV.
- Hydropower contributes the largest share among the top 20 countries, totaling 3.04K TWh, indicating its global dominance in renewable generation.
- Biofuel generation stands at 1.02K TWh across the selected countries, showing its growing role in the energy mix.
- Solar PV generation has reached 396.56 TWh, with visible contributions from technologically advanced nations like Germany, USA, and India.
- Geothermal energy generation remains limited among these countries, totaling just 53.34 TWh, suggesting geographic or infrastructural limitations in deployment.

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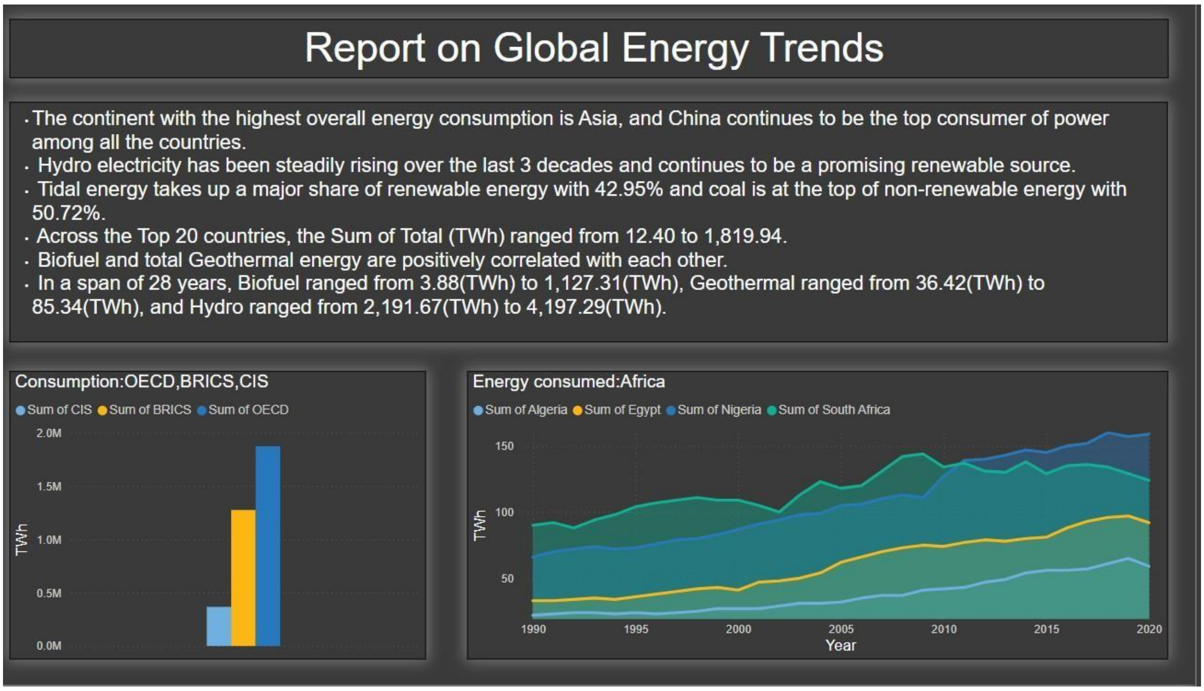
Dashboard 4:



Major Outcomes:

- Asia leads global electricity consumption, with China consistently ranking as the top energy-consuming nation.
- Hydroelectric power has shown steady growth over three decades and remains a strong pillar among renewable sources.
- Tidal energy accounts for the largest share of renewable generation at 42.95%, while coal dominates non-renewables with 50.72%.
- Among the top 20 countries, total renewable generation ranges widely — from as low as 12.40 TWh to as high as 1,819.94 TWh.
- There's a positive correlation between biofuel and geothermal generation, both showing growth trends over the last 28 years.

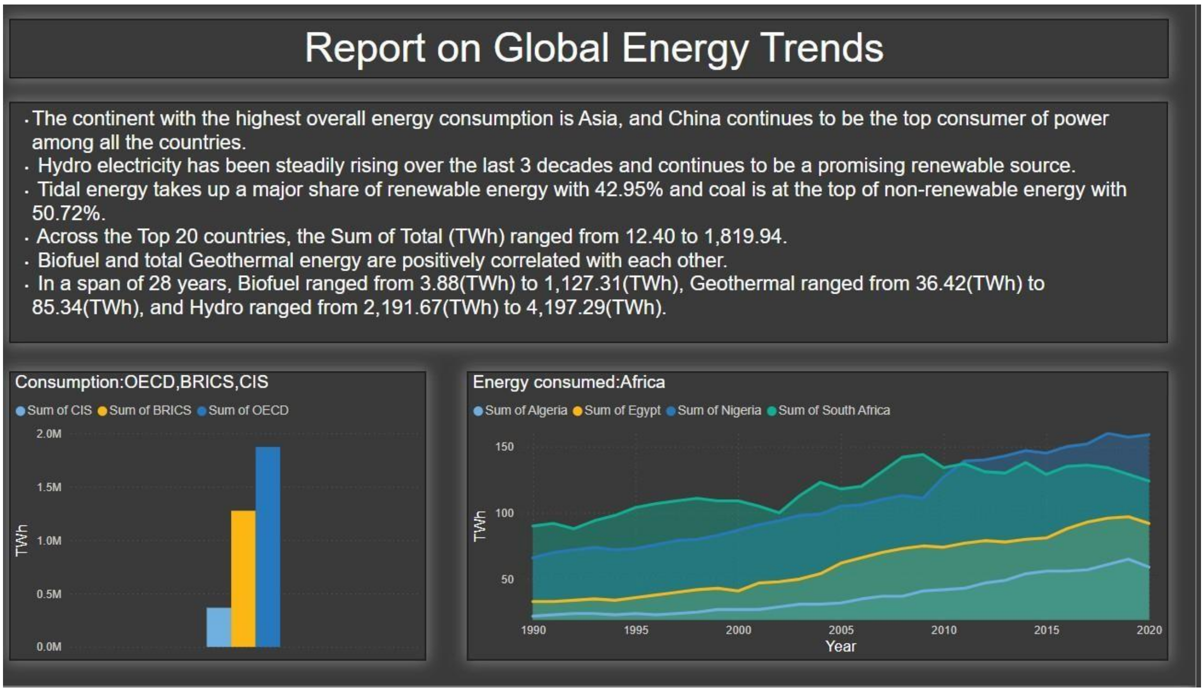
6.Report

6.1Story Design File:

Overview

A report is a comprehensive document that provides a detailed and structured account of data analysis, findings, and insights. It is typically used for in-depth analysis, documentation, and communication of results. Reports are suitable for a diverse audience, including decision-makers, analysts, and stakeholders who need a comprehensive understanding of the data.

Designing a report in Power BI involves connecting to data sources, creating visualizations like charts and graphs, customizing their appearance and interactivity, organizing them logically on the canvas, formatting elements for consistency and clarity, and optionally creating dashboards for a summarized view. Throughout the process, it's essential to consider the audience's needs and ensure the report effectively communicates insights from the data. Finally, iterate based on feedback to continually improve the report's design and usefulness.



Observations drawn from report:

1. Continental Energy Consumption

- Asia records the **highest total electricity consumption**, led by China, which consistently ranks as the top consumer globally.
- This trend underscores Asia's accelerating industrial development and energy demand compared to other continents.

2. Renewable vs. Non-Renewable Share

- **Tidal energy accounts for 42.95%** of the total renewable energy mix, suggesting a major reliance on this resource—potentially an outlier due to cumulative data reporting.
- **Coal remains the dominant non-renewable source** with a 50.72% share, emphasizing ongoing reliance despite global decarbonization goals.

3. Long-Term Source-Wise Trends

- **Hydropower generation has doubled** from 2,191.67 TWh in 1990 to 4,197.29 TWh in 2017, showing it remains a stable and expanding renewable base.
- Biofuel grew significantly from 3.88 TWh to 1,127.31 TWh over 28 years, and geothermal increased from 36.42 TWh to 85.34 TWh, reflecting steady interest in diverse renewable sources.

4. Regional Energy Group Comparisons

- Among regional blocs, the **OECD contributes the highest cumulative energy consumption (~2.0M TWh)**, followed by BRICS (~1.5M TWh), and CIS (~0.5M TWh), indicating varying energy intensities and economic maturity.

5. Country-Level Consumption Range

- Across the top 20 countries, total renewable power generation spans from **12.40 TWh to 1,819.94 TWh**, showcasing stark contrasts in capacity and infrastructure.

6. Correlation Analysis

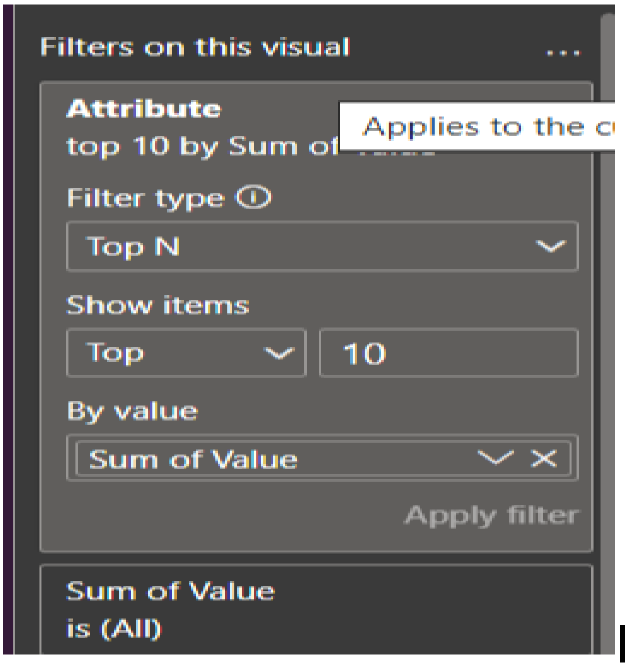
- A **positive correlation exists between biofuel and geothermal energy usage**, suggesting aligned growth strategies or technological overlap in countries investing in diversified renewable energy.

7. Performance Testing

7.1. Utilization of Data Filters

Top N Filter Implementation

As part of optimizing performance and enhancing readability, a Top N filter was applied to specific visualizations. This filter was configured to display the Top 10 categories based on the Sum of Value metric. By focusing only on the most significant data points, this approach reduced unnecessary visual clutter and improved the interpretability of charts.



Implementation Highlights:
- The Top N setting was used to rank categories dynamically.
- The filter condition was based on the Sum of Value, ensuring only the most relevant entries are visualized.
- This strategy ensured visuals remain both insightful and lightweight, boosting load times and user engagement.

Impact on Performance:
- Helped reduce rendering time by limiting the volume of data displayed.
- Simplified visuals for end-users, enhancing decision-making focus.
- Prevented overloading Power BI visuals with low-impact data.

7.2. Number of Calculation Fields

To enable meaningful insights and dynamic interactivity, multiple DAX (Data Analysis Expressions) calculation fields were created. These measures were designed to compute averages and summaries across different dimensions like country and continent, aiding comparison and pattern discovery.

Measures Implemented:

- **Country Average (Twh):**

```
Country Average (TWh) =
AVERAGEX (
   SUMMARIZE (
      'Country-table',
      'Country-table'[Attribute],
      "Total", SUM('Country-table'[Value])
   ),
   [Total]
)
```

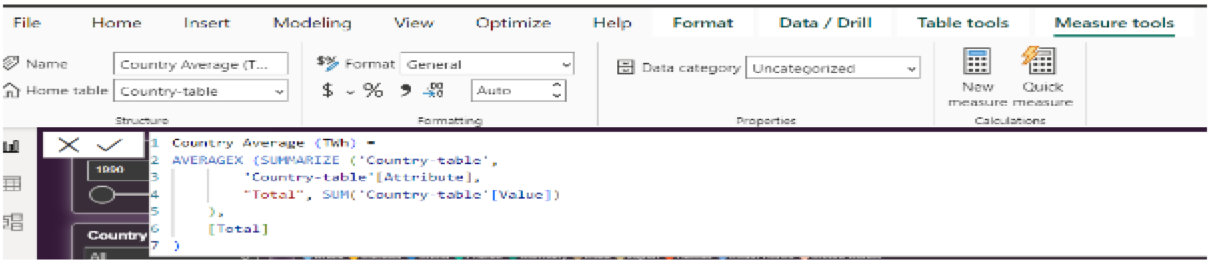
- **Continent Average (TWh):**

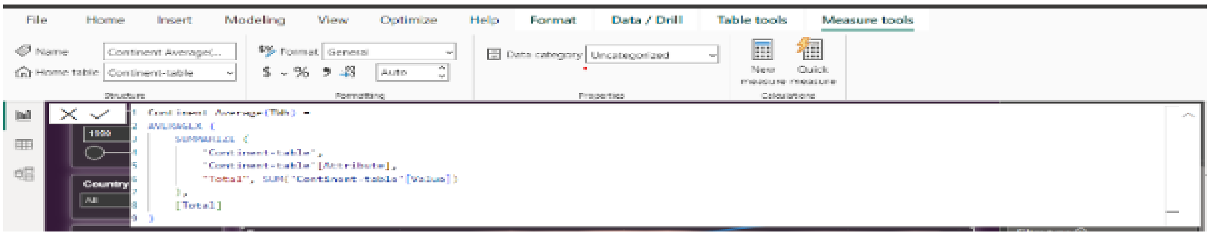
```
Continent Average (TWh) =
AVERAGEX (
   SUMMARIZE (
      'Continent-table',
      'Continent-table'[Attribute],
```

```
            "Total", SUM('Continent-table'[Value])
        ),
        [Total]
    )
```

Purpose and Impact:

- These measures enabled aggregated comparisons between countries and continents on key metrics like energy usage or CO_2 emissions.
- Simplified visuals while maintaining analytical depth.
- Helped streamline performance by calculating summaries dynamically without the need for manual aggregations.





7.3. Number of Visualizations

1. Country-wise energy consumption
2. Continent Energy Consumption
3. Continent Average (TWh)
4. Country Average (TWh)
5. Non-renewable sources of Energy
6. Renewable Generation 1997–2017 (TWh)
7. Cards – Sum, Median, Standard Deviation and Variance of Contribution (TWh)
8. Renewable Sources of Energy
9. Cards – Geothermal, Biofuel, Hydro and Solar PV
10. BRICS, OECD, and CIS Comparison
11. Report Narrative
12. Energy Consumption in African countries

The Power BI dashboard designed for this project integrates twelve purpose-driven visualizations that together narrate the global energy consumption story with clarity and depth. These visuals range from country-wise and continent-wise energy consumption comparisons to detailed averages in terawatt-hours, offering both micro and macro insights. Dedicated charts dissect renewable and non-renewable energy sources, including trend analysis over two decades and category-specific highlights for technologies like geothermal, biofuel, hydro, and solar PV. Cards displaying statistical metrics such as sum, median, standard deviation, and variance provide foundational context for interpreting energy contributions. Further, comparative visuals for geopolitical groups like BRICS, OECD, and CIS emphasize regional patterns, while a focused analysis on African nations spotlights emerging consumption trends. The inclusion of a narrative-driven report visualization enhances user understanding, making the dashboard not just informative but also engaging and accessible for decision-makers and stakeholders.

8. Conclusion / Observation

The project titled *"Global Energy Trends: A Comprehensive Analysis of Key Regions and Generation Modes Using Power BI"* delivers an insightful exploration of worldwide energy consumption patterns, highlighting the evolving balance between renewable and non-renewable energy sources. Through structured visualizations, custom DAX calculations, and interactive filters, the dashboard transforms raw global datasets into meaningful, actionable insights.
The analysis revealed region-specific trends in energy generation and usage, emphasized the rapid yet uneven adoption of renewable technologies, and uncovered disparities between developed and developing regions. With group-wise comparisons (like BRICS, OECD, and CIS) and country-specific metrics, the dashboard encourages a nuanced understanding of policy effectiveness, sustainability efforts, and long-term environmental impact.

9. Future Scope

- Integration of real-time energy data using APIs to enable live updates and up-to-date trend analysis.
- Implementation of machine learning models for predictive analytics to forecast future energy demands and renewable growth.
- Inclusion of policy-related metrics such as carbon pricing, climate commitments, and regulatory changes to assess their impact on energy trends.
- Development of interactive scenario modeling tools that allow users to simulate the effect of changes in energy mix, population, or emissions targets.
- Expansion to granular data levels such as state-wise or city-specific datasets for more localized insights.
- Creation of mobile-friendly dashboard versions and multilingual support to increase accessibility across different regions.
- Automation of data refresh pipelines to maintain dashboard accuracy with minimal manual intervention.
- Deployment of the dashboard in institutional platforms or public portals to support collaborative research, policymaking, and awareness.

10. Appendix

10.1. GitHub & Project Demo Link

GitHub: Your Repositories

Project Demo Link:
https://drive.google.com/file/d/1TkBpqjqiA6xgKhzh_INRjwwiIrdAEOmM/view?usp=sharing