Final Project Report

Topic - Global Energy Trends: A Comprehensive Analysis of Key Regions and Generation Modes using Power BI

Date – 8th August 2025

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1. Introduction

1.1. Project Overview

Energy is the backbone of modern civilization, powering everything from transportation to industrial production and daily living. As the world transitions towards sustainability, the adoption of electric vehicles, heat pumps, and renewable energy has become imperative. While power generation remains a major contributor to global CO_2 emissions, it is also at the forefront of the movement toward net-zero targets. Leveraging **data analysis and smart technologies** can significantly accelerate this shift.

This project explores how **data analytics and renewable energy integration** are transforming energy systems across urban, industrial, and rural landscapes. Through three real-world inspired scenarios, the project highlights the pivotal role of technology in improving energy efficiency, reducing emissions, and enhancing accessibility.

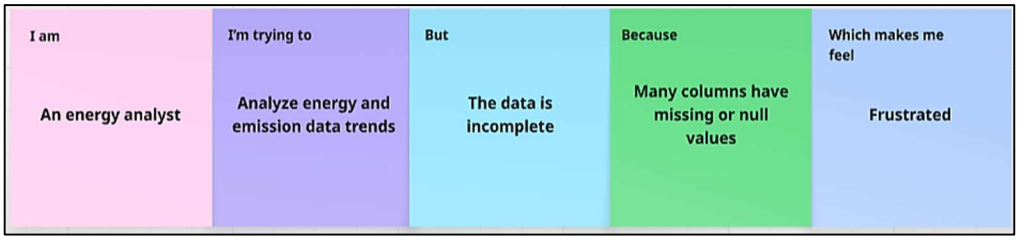
1.2. Objectives

- To understand the role of **data analytics** in optimizing energy use and reducing waste.
- To evaluate the impact of **smart grid systems**, **energy management tools**, and **microgrids** in diverse settings.
- To showcase how renewable energy integration supports **sustainable development goals (SDGs)**.
- To explore **real-time monitoring and predictive analytics** in improving energy efficiency and reducing carbon footprints.

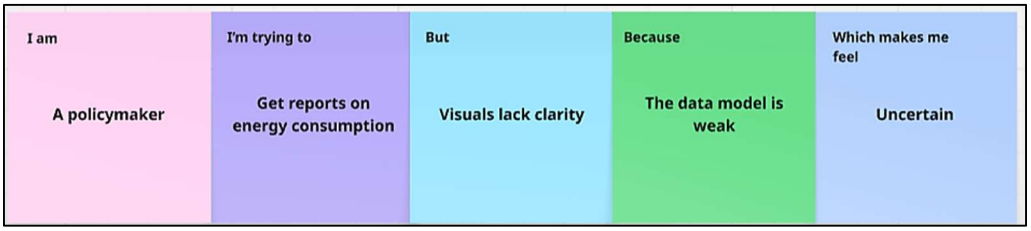
2. Project Initialization and Planning Phase

2.1. Define Problem Statement

PS_1: The dataset used for analyzing energy and emission trends contains a significant number of missing and null values, making it difficult to perform accurate and meaningful analysis. This data quality issue leads to incomplete insights and undermines the reliability of the visualizations.



PS_2: The Power BI dashboard lacks depth in analysis due to basic relationships and limited use of DAX measures. This restricts the user's ability to derive comprehensive insights from the energy and emissions data, resulting in less impactful decision-making.



Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	A sustainability analyst	Analyze global energy and emissions trends	The data is incomplete	It has many missing/null values across countries and years	Frustrated and stuck
PS-2	A policymaker looking to support clean energy goals	Get reliable reports on energy consumption	Visuals lack clarity	The data model is weak and relationships are not well established	Uncertain and confused

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	To analyze global energy trends using Power BI with a focus on regional variations and generation modes (renewables vs non-renewables), and to demonstrate how data visualization and analytics can support sustainable energy initiatives in urban, industrial, and rural contexts.
Scope	Includes data visualization and insights from smart grids in urban areas, industrial energy management, and rural electrification using renewables.
Problem Statement	
Description	Global energy systems face challenges in efficiency, sustainability, and equitable access—especially due to dependence on fossil fuels and uneven energy distribution.
Impact	Solving these problems enables reduced emissions, better energy planning, improved quality of life, and supports global sustainability goals.
Proposed Solution	
Approach	Use Power BI to analyze and visualize data from diverse energy scenarios to identify trends, inefficiencies, and opportunities for renewable integration.
Key Features	-Real-time analytics from smart meters and grids -Predictive insights for industrial energy use -Data-driven rural electrification models -Interactive Power BI dashboards for decision-making

Resource Requirements

Resource Type	Description	Specification/Allocation
Hardware		
Computing Resources	GPU specifications CPU specifications	Integrated Intel UHD Graphics Intel 11th Gen Core i3
Memory	RAM specifications	8 GB
Storage	Disk space for data, models, and logs	274GB
Software		
Frameworks	Power BI frameworks	Power Query, DAX, Data Model Framework
Libraries	Additional libraries	Power BI Visuals, Office 365 Integration
Development Environment	Tools used in Power BI	Power BI Desktop, Power BI Service, Power BI Report Builder, Git/GitHub
Data		
Data	Source, size, format	Source: https://www.kaggle.com/datasets/jamesvandenberg/renewable-power-generation Size: 15.22 Kb Format: CSV File

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	Trends-5 Trends-6	Data Gathering Loading Data	3 1	Moderate Simple	Anjali Vishwakarma	20/07/2025	21/07/2025
Sprint-1	Data Preparation	Trends-7 Trends-8	Handling Data Type Handling Missing Values	2 3	Easy Moderate	Anjali Vishwakarma	22/07/2025	23/07/2025
Sprint-2	Data Preparation	Trends-9	Creating New Fields	5	Very Difficult	Anjali Vishwakarma	24/07/2025	26/07/2025
Sprint-2	Data Visualization	Trends-11 Trends-12	Bar Chart Pie Chart	3 4	Moderate Difficult	Anjali Vishwakarma	26/07/2025	26/07/2025
Sprint-2	Dashboard	Trends-14 Trends-15 Trends-16	Global Energy Consumption Over Time Energy Production Power Generation : Top 20 Countries	3 4 3	Moderate Difficult Moderate	Anjali Vishwakarma	27/07/2025	30/07/2025

(1-Very Easy, 2-Easy, 3-Moderate, 4-Difficult, 5-Very Difficult)

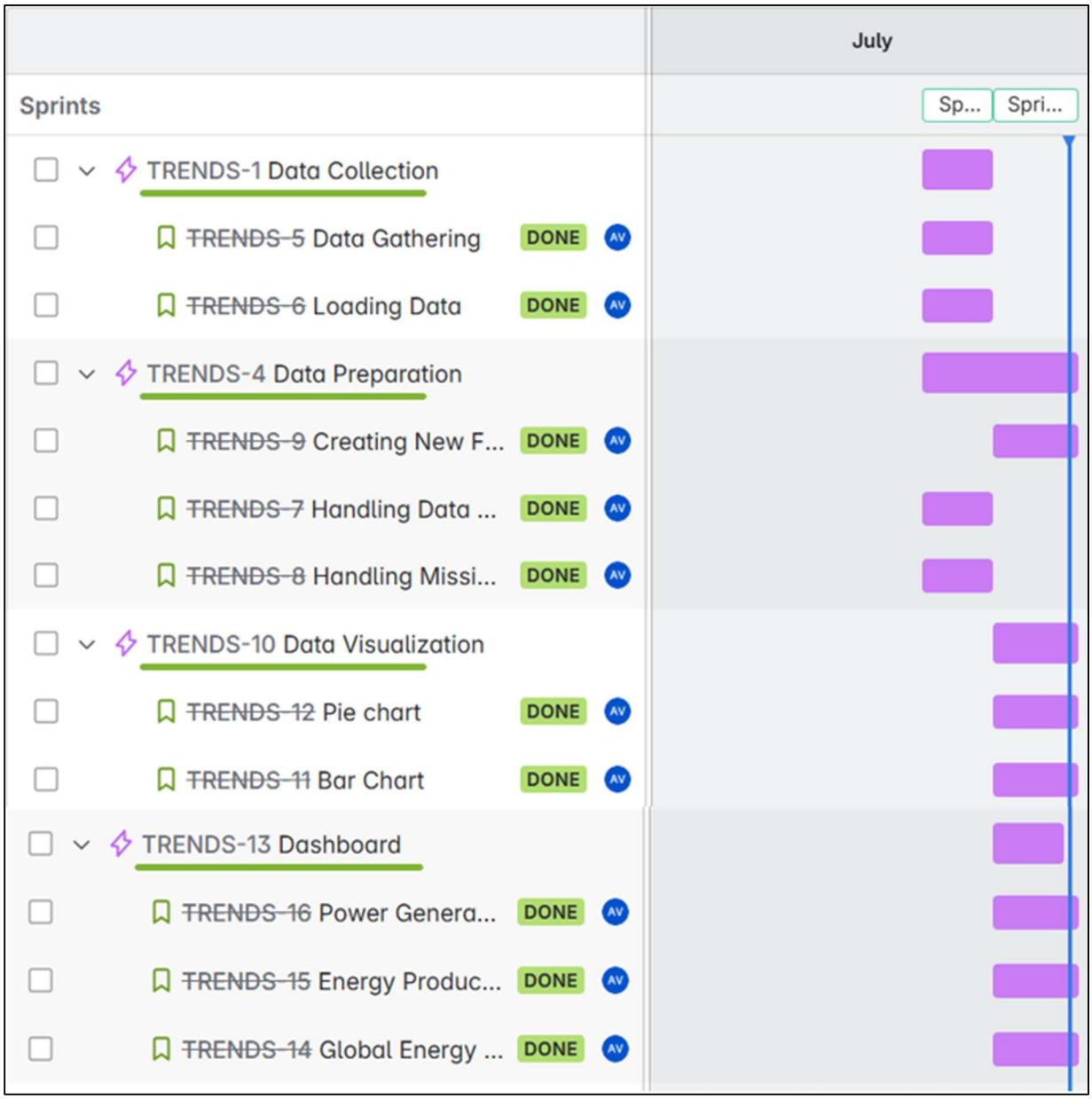
The Power BI project was strategically divided into two sprints, enabling a structured and efficient workflow from raw data collection to final dashboard creation.

- **Sprint-1** laid the foundation by completing essential tasks such as **data gathering, loading, and preparation**, ensuring data quality and consistency.
- **Sprint-2** focused on **advanced transformations, visualizations, and dashboard building**, covering critical business insights like global energy trends and production by country.

With **all 8 tasks completed within the planned timeline (20th–30th July 2025)** and a total of **30 story points** covered, the project demonstrated strong task planning and execution.

- **Outcome**: A fully functional and insightful Power BI dashboard that visualizes complex energy data in a user-friendly format.

- **Team Performance**: Single-member execution (Anjali Vishwakarma) with successful completion of tasks from **simple to very difficult**, showcasing good technical and project management skills.



3. Data Collection and Preprocessing Phase

3.1. Data Collection Plan and Raw Data Sources Identified

Elevate your data strategy with the Data Collection plan and the Raw Data Sources report, ensuring meticulous data curation and integrity for informed decision-making in every analysis and decision-making endeavor.

Data Collection Plan Template

Section	Description
Project Overview	This project explores Global Energy Trends and Sustainability by using Power BI to visualize, analyze, and interpret energy production and consumption data across different regions. The goal is to uncover key insights about renewable vs. non-renewable usage, CO_2 emissions, and global progress toward sustainable energy. By leveraging visual analytics, the project supports data-driven decisions for energy planning, policy formulation, and future infrastructure development. It also aims to highlight regional disparities and real-world applications such as smart grid systems, rural electrification, and industrial energy optimization.
Data Collection Plan	The data for this project is collected from reputable global energy databases and official open-data repositories. The focus is on ensuring the data covers a wide time frame and includes diverse metrics such as energy generation types (solar, wind, hydro, coal, gas), regional consumption, CO_2 emissions, and electricity access levels. The collection plan prioritizes sources that are updated

	annually or quarterly, ensuring accuracy and reliability. It also includes historical data to perform trend analysis and forecasts.
Raw Data Sources Identified	Global Energy Trends: A Comprehensive Analysis of Key Regions and Generation Modes using Power BI https://www.kaggle.com/datasets/jamesvandenberg/renewable-power-generation -Global Energy Consumption (1990-2020) & Renewable Energy Generation (1997-2017)

Raw Data Sources Template

Source Name	Description	Location/URL	Format	Size	Access Permissions
Dataset 1	Global Energy Consumption (1990-2020) & Renewable Energy Generation (1997-2017)	Global Energy Trends: A Comprehensive Analysis of Key Regions and Generation Modes using Power BI https://www.kaggle.com/datasets/jamesvandenberg/renewable-power-generation	.CSV	15.22 kB	Public

3.1. Data Collection Plan and Raw Data Sources Identified

Data collection was conducted during **Sprint-1** to support the development of a Power BI dashboard on global energy trends. The following tasks were completed:

- **TRENDS-5 Data Gathering**: Relevant datasets were collected from **Kaggle**, covering global energy production, power generation, and consumption statistics.

- **TRENDS-6 Loading Data**: The datasets were successfully loaded into the **Power BI** environment for further analysis.

These activities ensured that structured and meaningful data was available for preprocessing.

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
Dataset	Having Null Values and Missing Values	Moderate	Filter data and remove null values and Missing values row and column

3.2. Data Quality Report

To ensure data readiness, quality checks and cleaning operations were conducted during **Sprint-1**:

- **TRENDS-7 Handling Data Type**: Data types were corrected for consistency (e.g., numerical and date formats).
- **TRENDS-8 Handling Missing Values**: Null values present in the datasets were identified and appropriately handled.

These steps enhanced data integrity and prepared the datasets for accurate analysis.

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	The dataset captures global energy trends, including renewable usage, fossil fuel consumption, and CO_2 emissions across countries and years.
Data Cleaning	The primary issue was missing values (null) in key fields like energy access, renewable percentage, and emission data. These were handled by: – Filling missing values using regional averages – Removing rows with critical nulls where imputation wasn't possible
Data Transformation	Power Query was used to filter relevant years and regions, sort data chronologically, and create basic calculated columns (e.g., total energy).
Data Type Conversion	Ensured that all numeric fields (energy consumption, emissions) were properly formatted as numbers and dates as YYYY.
Column Splitting and Merging	Not applicable in this dataset since columns were already well-structured.
Data Modeling	Relationships were defined between country and year tables; basic DAX measures were created for aggregated energy and emission insights.
Save Processed Data	The cleaned dataset was saved within the .pbix file and exported as CSV for future reference.

In **Sprint-2**, the project moved into data transformation tasks:

- **TRENDS-9 Creating New Fields**: New calculated columns and measures were created to support detailed visualization and insights.

With the completion of these steps, the datasets were fully prepared for the data visualization and dashboard development phase.

4. Data Visualization

4.1. Framing Business Questions

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 continent consumes the most energy over time?

2. How does energy consumption differ across BRICS, OECD, and CIS regions?

3. What is the average energy consumption of countries and continents globally?

4. What is the contribution of each non-renewable energy source to global energy production?

5. How has renewable power generation evolved from 1997 to 2017?

6. What is the variance and standard deviation in energy contributions across all sources?

7. Which renewable energy source has the highest global share?

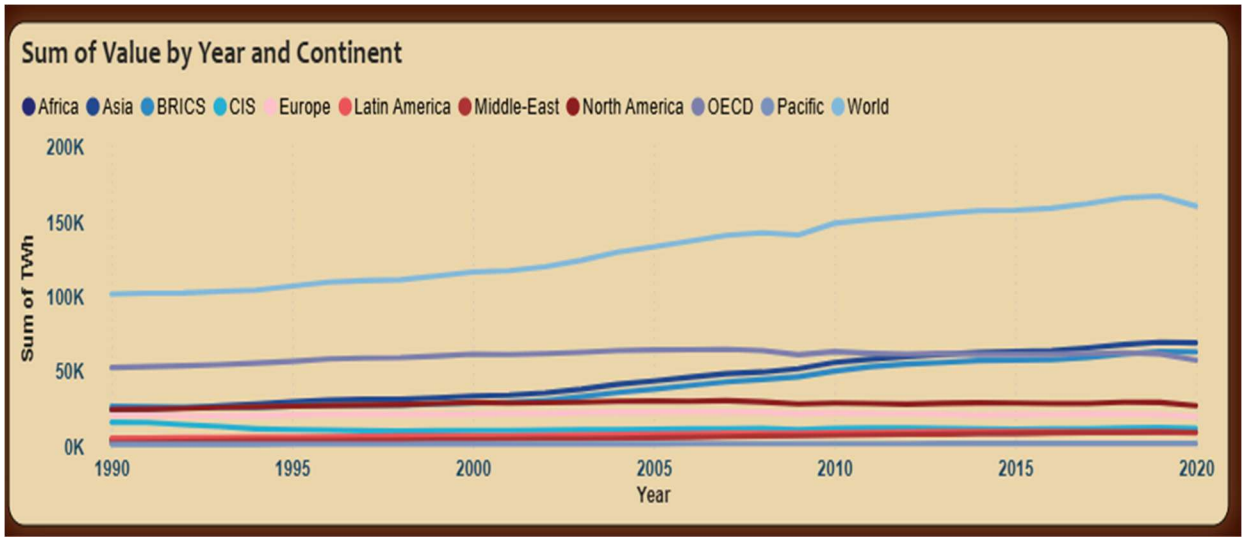
8. Which top 20 countries lead in geothermal, hydro, biofuel, and solar power generation?

9. What are the energy consumption trends in African countries over time?

4.2. Developing Visualizations

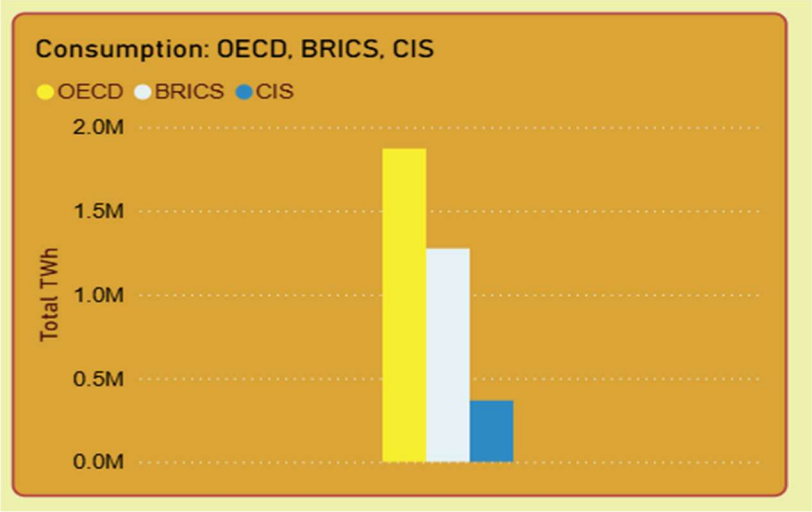
1. Which continent consumes the most energy over time?

- **Visualization**: Line Chart - Continent-wise energy consumption over the years



2. How does energy consumption differ across BRICS, OECD, and CIS regions?

- **Visualization**: Bar Chart - Consumption: OECD, BRICS and CIS Comparison"

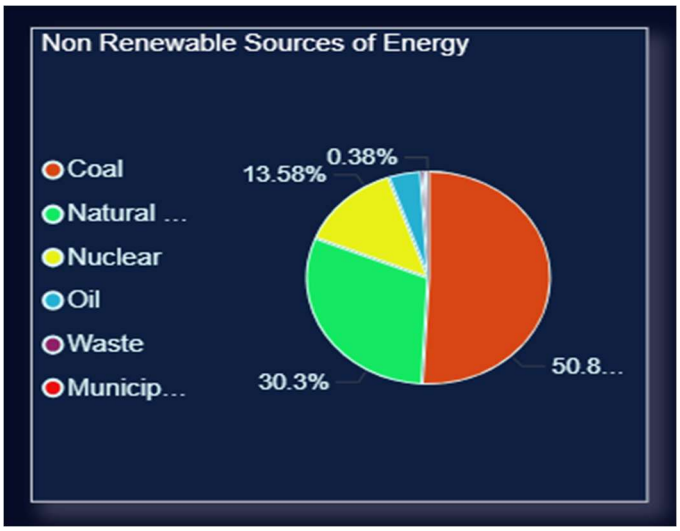


3. What is the average energy consumption of countries and continents globally?

- **Visualization**: KPI Cards - Country/Continent Average (TWh)

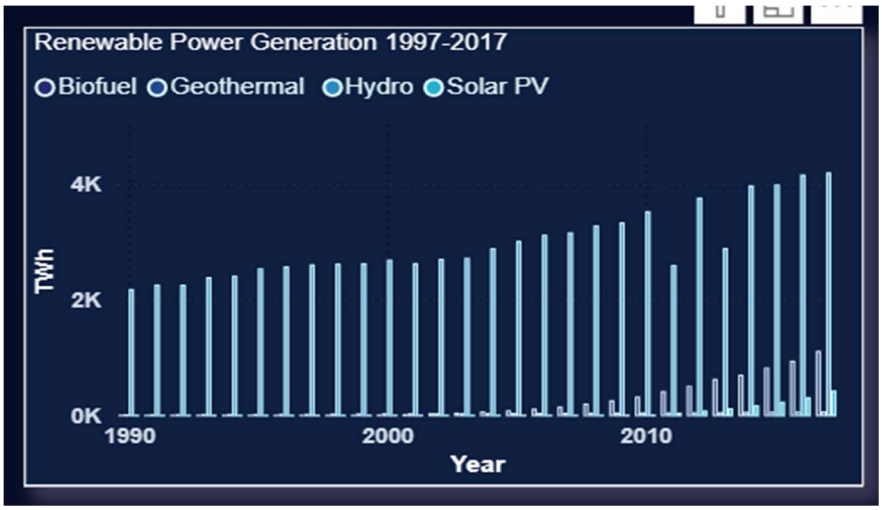
4. What is the contribution of each non-renewable energy source to global energy production?

- **Visualization**: Pie Chart - Non-Renewable Sources of Energy



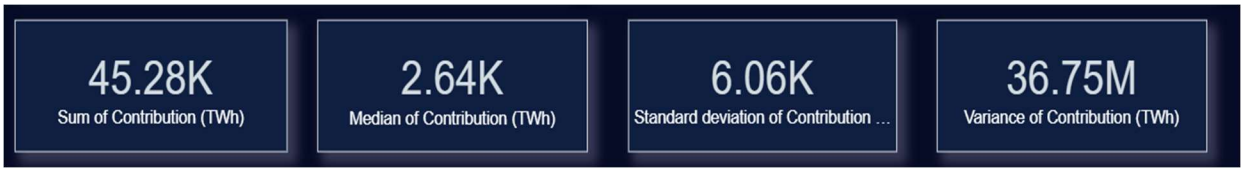
5. How has renewable power generation evolved from 1997 to 2017?

- **Visualization**: Vertical Bar Chart - Renewable Power Generation: 1997–2017



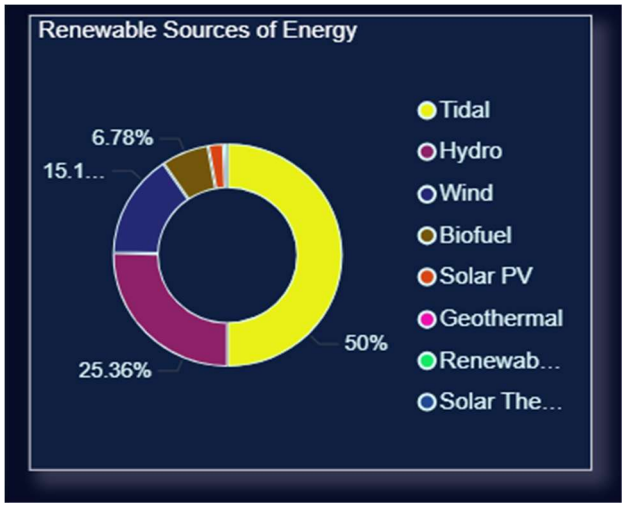
6. What is the variance and standard deviation in energy contributions across all sources?

- **Visualization**: KPI Cards - Cards – Variance, Std. Deviation, Median, Sum of Contribution



7. Which renewable energy source has the highest global share?

- **Visualization**: Donut Chart - Renewable Sources of Energy

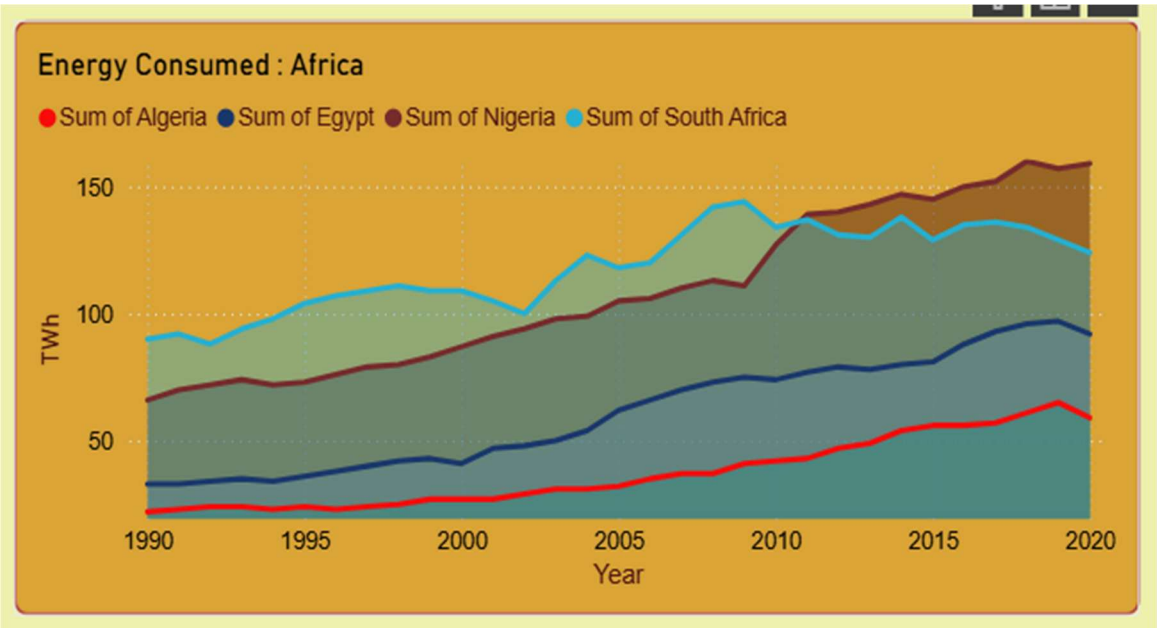


8. Which top 20 countries lead in geothermal, hydro, biofuel, and solar power generation?

- **Visualization**: Cards + Geographic Map - Power Generation: Top 20 Countries

9. What are the energy consumption trends in African countries over time?

- **Visualization**: Area Chart - Energy Consumed: Africa



5. Dashboard

5.1. Dashboard Design File

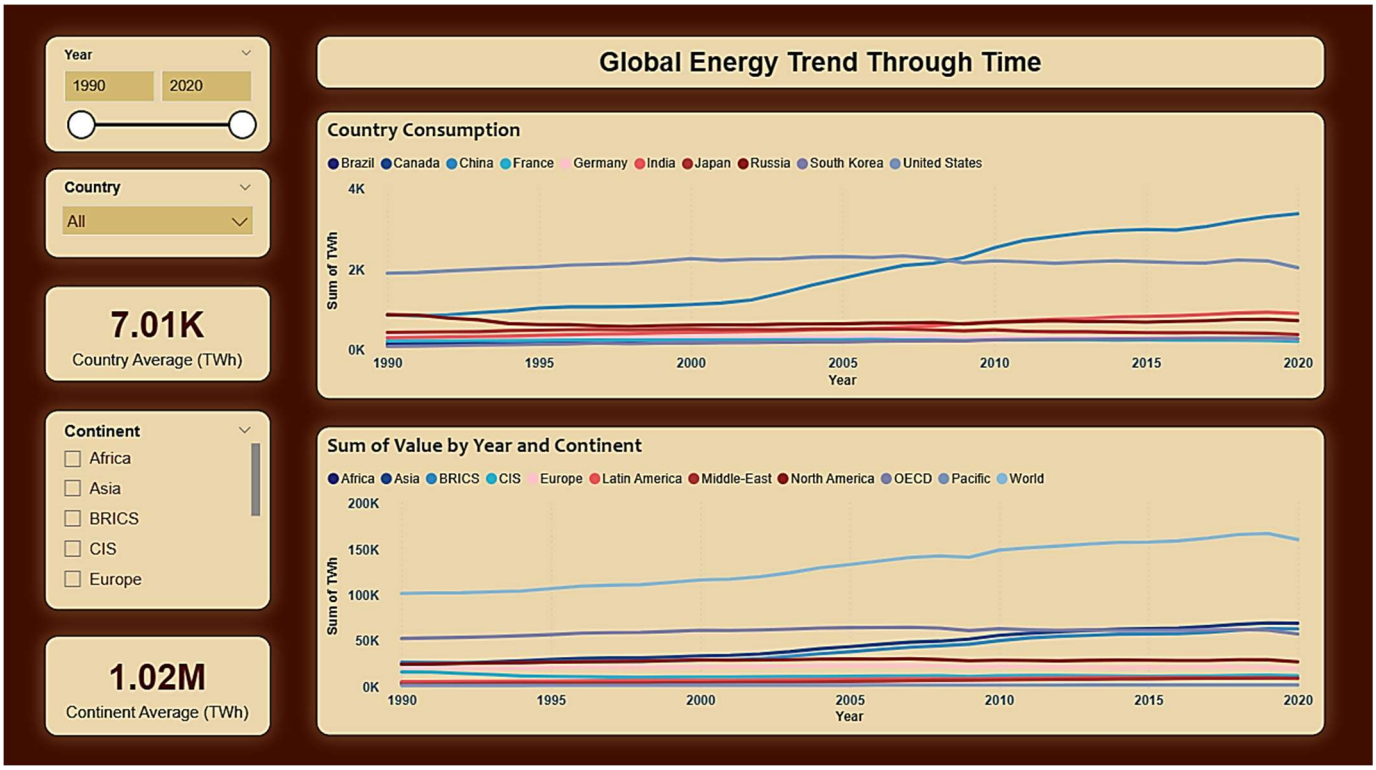
Creating an effective dashboard involves thoughtful design to ensure that the presented information is clear, relevant, and easily understandable for the intended audience. Here are some key principles and best practices for dashboard design.

Activity 1: Interactive and visually appealing dashboards

Creating interactive and visually appealing dashboards involves a combination of thoughtful design, effective use of visual elements, and the incorporation of interactive features. Here are some tips to help you design dashboards that are both visually appealing and engaging for users so take care of below points:

- Clear and Intuitive Layout
- Use Appropriate Visualizations
- Colour and Theming
- Interactive Filters and Slicers
- Drill-Down Capabilities
- Responsive Design
- Custom Visuals and Icons
- Use of Infographics

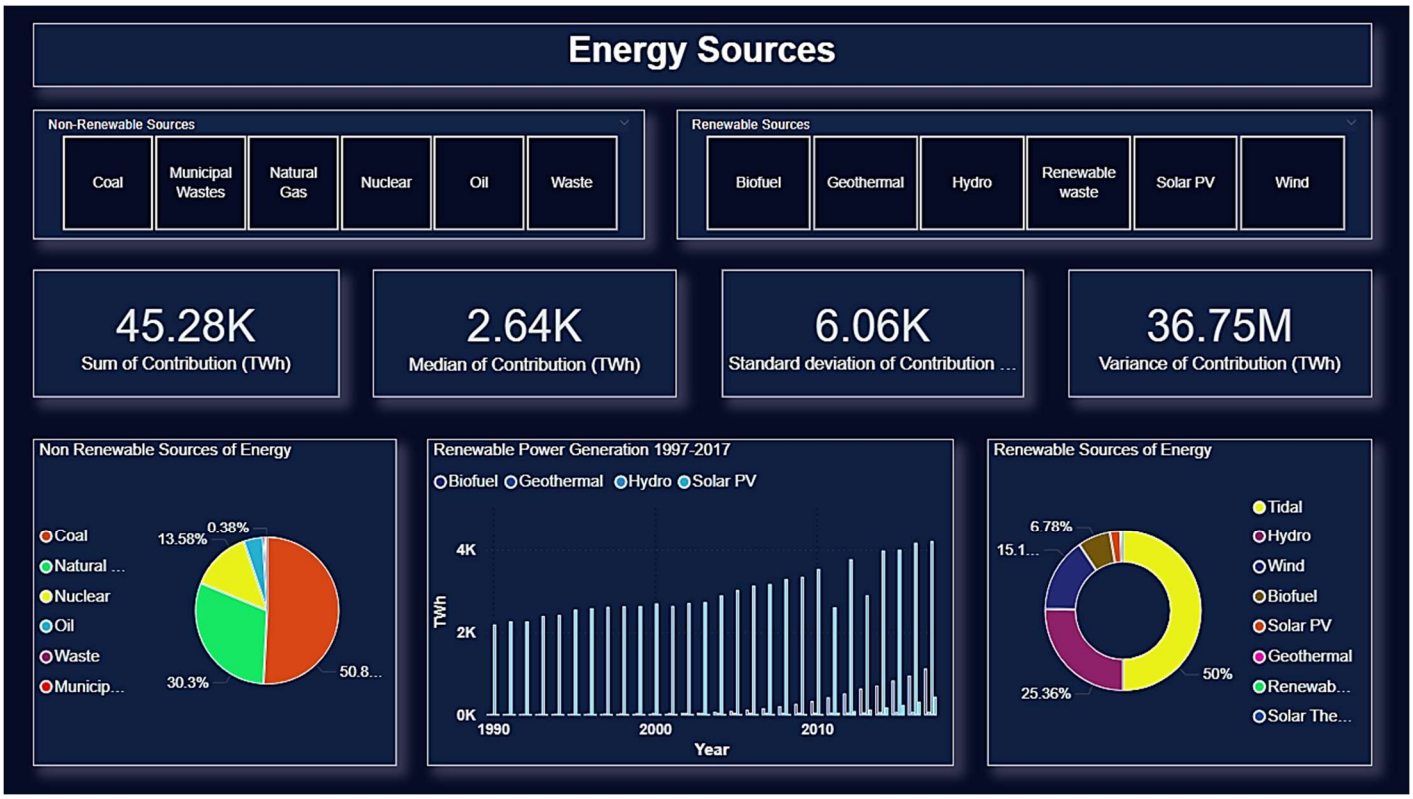
Dashboard 1: Global Energy Trend Through Time



Outcomes:

1. **Asia leads in overall energy consumption**, driven by rapid industrialization and population growth.
2. **North America and Europe show steady consumption**, indicating energy-efficient practices or economic maturity.
3. **Country-wise**, the **United States remains the highest energy consumer** consistently.
4. **India and China show strong upward trends**, signaling growing industrial and urban energy needs.
5. **Africa's consumption is low but gradually increasing**, reflecting developmental energy access initiatives.

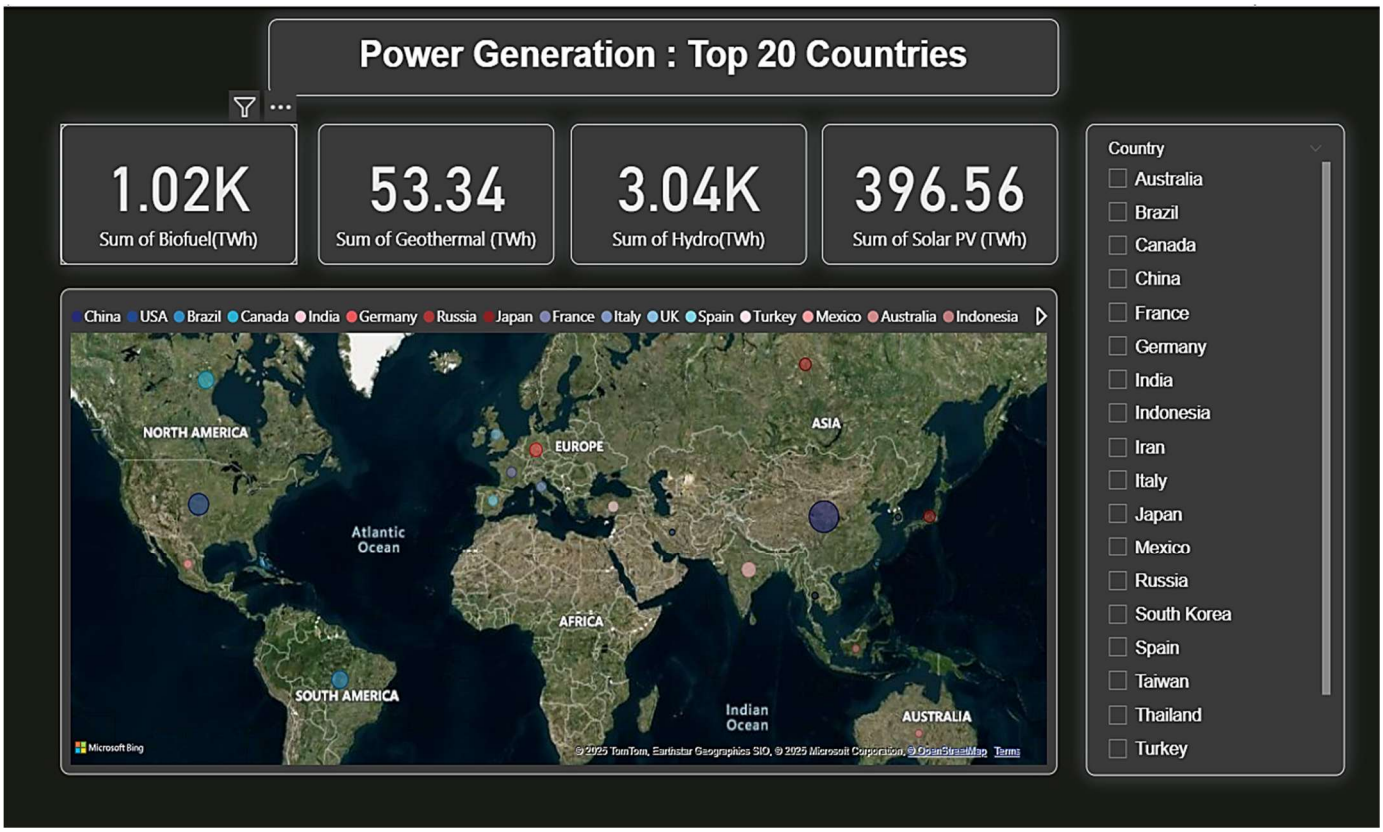
Dashboard 2: Energy Sources



Outcomes:

1. **Coal dominates non-renewable energy**, contributing over 50% of total non-renewable production.
2. **Hydro and Solar PV are the most significant renewable sources**, showing rapid growth post-2000.
3. **Standard deviation and variance values indicate a wide disparity** in energy production across sources, requiring balancing policies.
4. **Solar PV and Biofuel are scaling up**, hinting at diversification in renewable strategy.
5. **Natural Gas and Oil remain key transitional fuels**, though renewable shares are closing the gap.

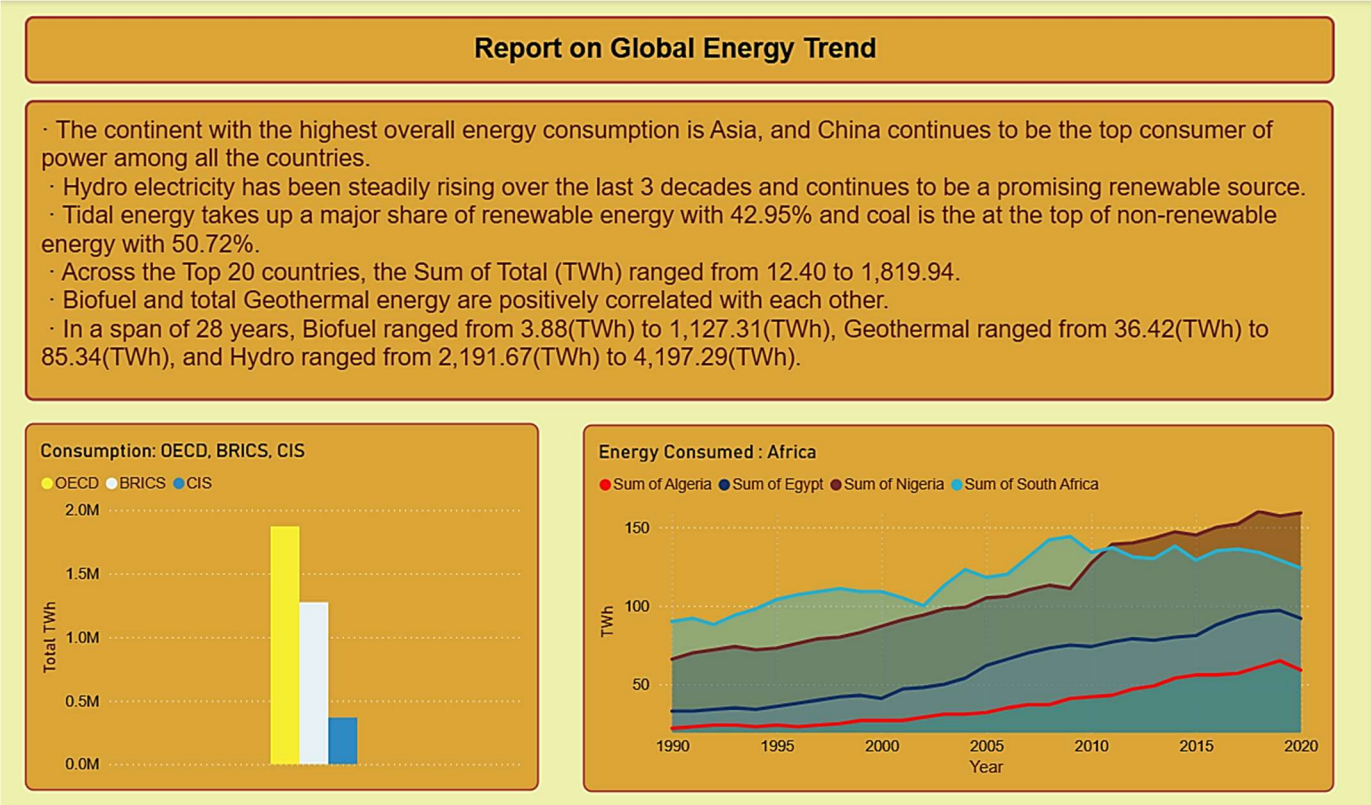
Dashboard 3: Power Generation - Top 20 Countries



Outcomes:

1. **China and the USA dominate solar, hydro, and geothermal energy production**, indicating strong infrastructure and investment.
2. **Germany and Japan are notable contributors to solar energy**, aligning with their national sustainability goals.
3. **Emerging economies like Brazil and India are catching up** in renewable generation, mainly hydro.
4. **Geographic clustering shows renewable energy is concentrated** in technologically advanced and high-resource countries.
5. **Geothermal energy is limited**, suggesting potential for exploration in underutilized regions.

Dashboard 4: Report on Global Energy Trends



Outcomes:

1. **Asia is confirmed as the highest energy-consuming continent**, with China being the top consumer globally.
2. **Coal and Hydro are the dominant energy types**, reflecting both legacy systems and renewable focus.
3. **Geothermal and Biofuel show positive correlation**, which may inform future integrated renewable projects.
4. **Tidal energy accounts for 42.95% of renewable generation share**, highlighting its untapped potential.
5. **Africa's consumption remains low but is steadily increasing**, offering investment opportunities in rural electrification.

5.2. Design Features and Best Practices Used

The Power BI dashboard was developed by following effective design principles and industry-recommended best practices to ensure clarity, usability, and impactful storytelling.

◆ **Design Features:**

- **Consistent Color Scheme:**
  - Green tones represent renewable energy sources (e.g., solar, wind, hydro).
  - Red/Orange highlight fossil fuels and CO_2 emissions.
  - Blue is used for metrics related to access, innovation, and development.
- **Clean Typography and Labels:**
  - Fonts were chosen for legibility.
  - All charts include clear **axis titles, data labels, and headings** to avoid confusion.
- **Interactive Slicers:**
  - Year, country, region, and energy type slicers enable **dynamic filtering** of visuals.
- **Responsive Layout:**
  - Visuals are aligned using **Power BI's built-in grid system**, ensuring logical flow and visual balance across screen sizes.
- **Visual Hierarchy:**
  - **Important KPIs and high-level insights** are placed at the top.
  - Detailed breakdowns follow in a left-to-right or top-to-bottom reading order.
- **Tooltips and Drill-Throughs:**
  - Hovering over visuals shows tooltips for added context.
  - Drill-through pages were created for deeper country-wise or year-wise analysis.
- **Optimized Visual Selection:**
  - Used the **most appropriate charts** (e.g., bar charts for comparison, pie charts for distribution) to match data types.
- **Backgrounds:**
  - Backgrounds were kept clean with subtle contrasts to keep the focus on visuals.

6. Report

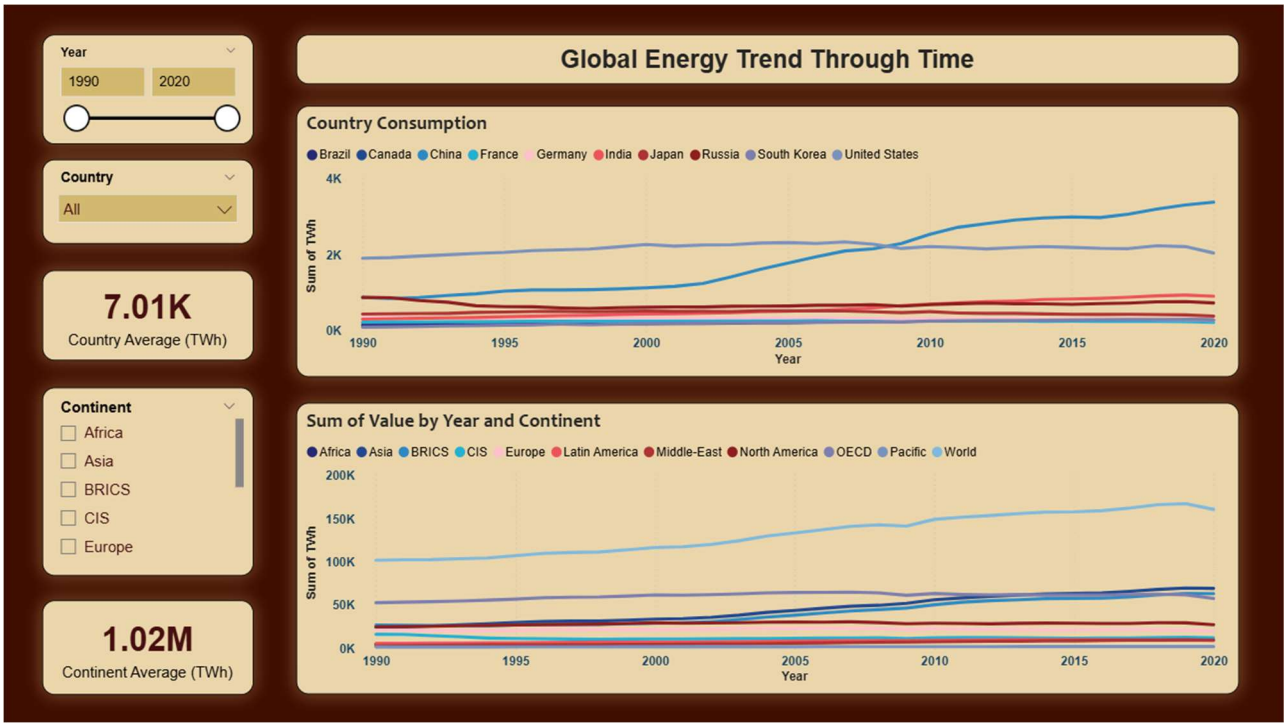
6.1. Story Design File

The **Story Design File** serves as the **narrative blueprint** that transforms raw insights from the dashboard into a compelling, **data-driven story** for stakeholders. It walks decision-makers through a logical sequence—from understanding the problem to arriving at meaningful conclusions and calls to action.

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.

Dashboard **1: Global Energy Trend Through Time**



Valuable Insights:

1. Asia Dominates Global Energy Use

Asia's energy consumption is the highest among all continents, primarily driven by industrialization, rapid urbanization, and population growth in countries like China and India. This highlights the continent's central role in global energy demand.

2. North America Shows High but Stable Usage

North America (especially the United States) maintains consistently high energy consumption levels, though growth is minimal. This may reflect mature economies with optimized usage patterns and better energy efficiency measures.

3. Europe Demonstrates Declining or Flat Consumption

European countries are either stable or slightly declining in energy use, indicating successful implementation of conservation policies, technological efficiency, and transitions toward renewables.

4. Africa's Energy Use is Low but Rising

Africa has the lowest consumption but shows a gradual upward trend. This suggests growing access to electricity and economic development, especially through rural electrification initiatives and microgrids.

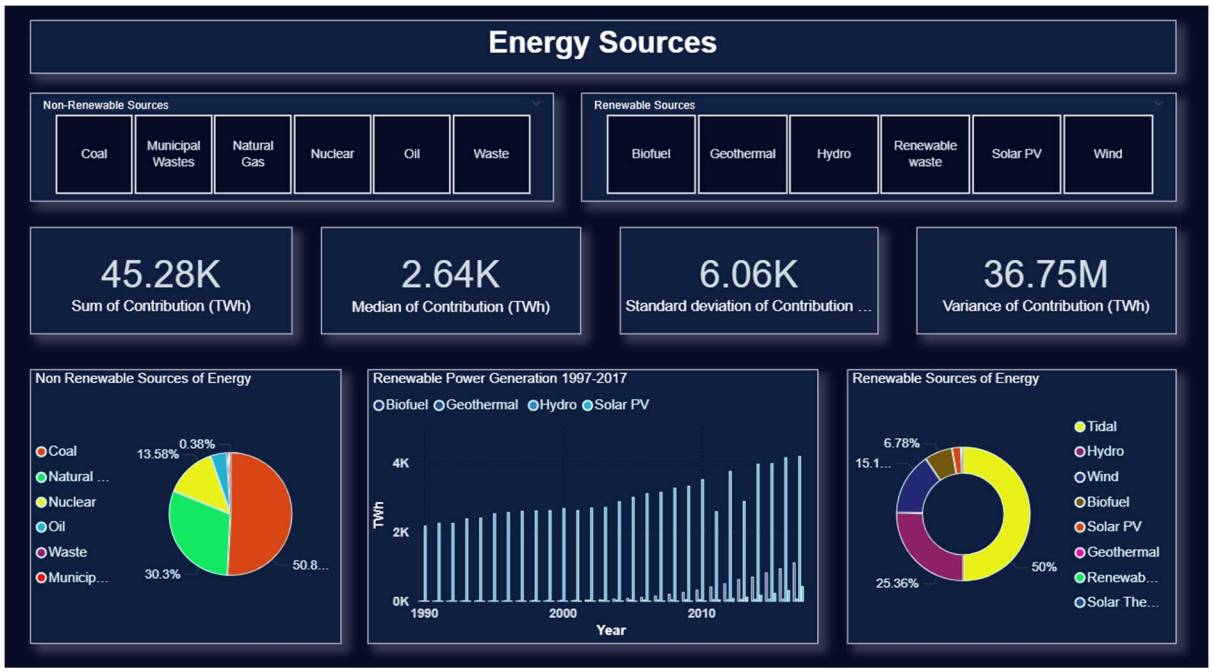
5. Country-Specific Leadership and Trends

The United States is a long-standing top energy consumer. China's energy usage has surged rapidly post-2000, now surpassing the U.S. India is steadily increasing its consumption, pointing to rising industrial output and infrastructure expansion.

6. Global Growth in Energy Demand

All continents, especially in developing regions, show a general increase in energy demand. This signals the need for global energy infrastructure upgrades and sustainable solutions to meet future requirements.

Dashboard 2: Energy Sources



Valuable Insights:

1. Coal is Still the Leading Energy Source

Coal accounts for over 50% of non-renewable energy production, making it the most dominant source globally. This underscores the challenge of transitioning away from fossil fuels in emission reduction efforts.

2. Natural Gas and Oil are Still Crucial

Despite the push for renewables, natural gas and oil remain critical components of the energy mix, often serving as backup or transitional sources due to their flexibility and availability.

3. Hydro Leads Among Renewable Sources

Hydropower is the most widely used renewable energy source, offering consistent and reliable output. Countries with abundant water resources have heavily invested in hydro plants.

4. Solar PV and Biofuel Show Rapid Growth

Solar PV has experienced exponential growth, especially since 2010, owing to decreasing installation costs and government subsidies. Biofuel production is also rising, indicating its role in transportation and rural energy systems.

5. Geothermal and Tidal are Underutilized

Although geothermal and tidal energy have potential, their global production levels are low. This may be due to geographic limitations or lack of investment, representing untapped areas for innovation.

6. Disparity in Source Contributions

The high variance and standard deviation in energy contributions reveal significant imbalance. A few sources dominate while many others lag behind, which poses risks for long-term energy resilience.

Dashboard 3: Power Generation – Top 20 Countries

Valuable Insights:

1. USA and China Lead in Renewable Production

These two nations dominate the production of solar, hydro, and geothermal energy, showing their leadership in energy infrastructure, R&D, and clean energy policies.

2. Brazil is a Hydro Power Giant

Brazil's energy production is largely hydro-based, taking advantage of its vast river systems and topography. It serves as a case study for leveraging natural resources sustainably.

3. Germany and Japan are Solar Leaders

These countries have invested heavily in solar PV technologies, supported by strong government policies, subsidies, and a public push for carbon neutrality.

4. Emerging Countries Are Gaining Ground

India, South Korea, and Canada show moderate but rising renewable generation. Their energy policies reflect increasing emphasis on diversification and self-reliance.

5. Biofuel and Geothermal Adoption is Limited

Production in these sources is much smaller. However, their growth potential is strong, especially in volcanic or agricultural regions.

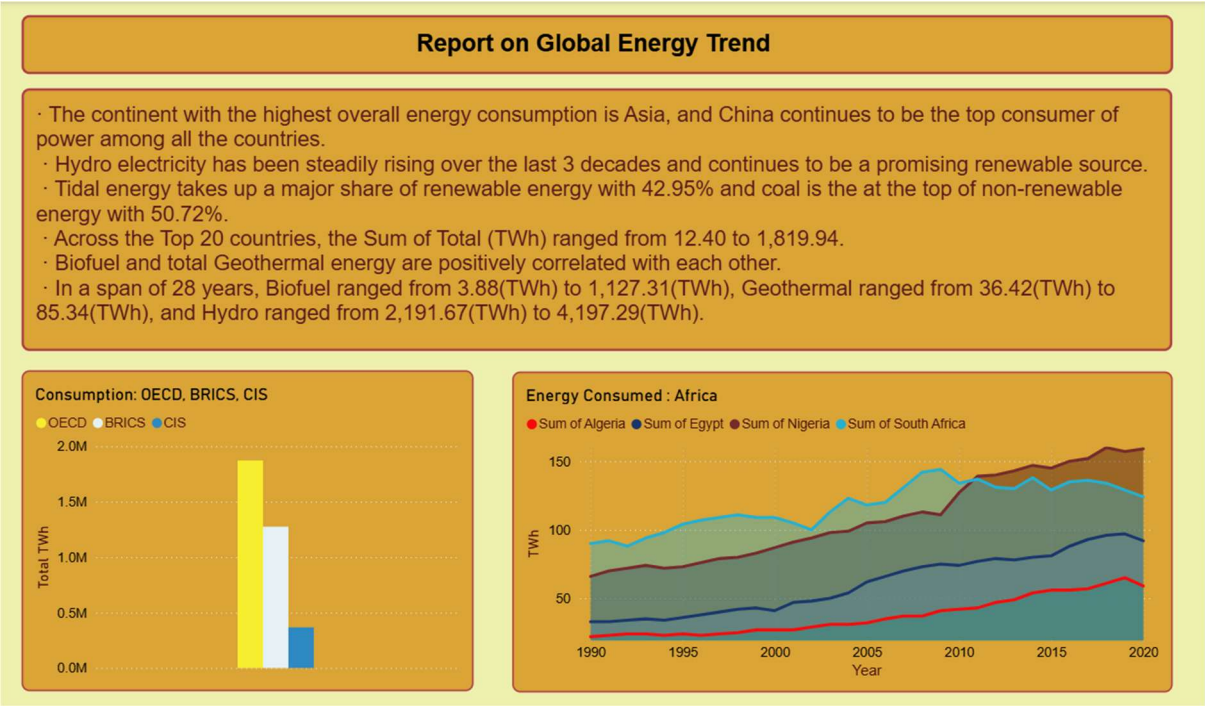
6. Spatial Distribution Shows Energy Gaps

Mapping the data reveals that energy generation is concentrated in developed countries. This underscores the global divide in energy infrastructure and access.

7. Investment Opportunities in Underserved Regions

Countries not in the top 20 have limited generation capacities, highlighting opportunities for foreign direct investment, energy partnerships, and technology transfer.

Dashboard 4: Report on Global Energy Trends



Valuable Insights:

1. Asia is the Most Energy-Intensive Region

Asia has the highest total energy consumption, driven primarily by China and India. It reflects both their economic growth and energy security needs.

2. Tidal Energy Has a Large Share Among Renewables

Tidal energy accounts for 42.95% of the renewable generation share in this dataset, an unexpected insight that reveals its growing (but still localized) role in the energy mix.

3. Coal's Dominance in Non-Renewables

Coal continues to hold the largest share (50.72%) among non-renewables. Its phasedown is crucial for global decarbonization, but it remains entrenched due to low costs and established supply chains.

4. Renewable Sources are Rising But Unevenly

Hydro and solar are the most widely adopted renewables. Others, like geothermal and biofuel, show potential but are limited by infrastructure and geography.

5. Strong Correlation Between Biofuel and Geothermal

There is a notable positive correlation between these two sources, implying they are often implemented together in regional or localized renewable strategies.

6. Production Growth Over 28 Years

Biofuel grew from 3.88 TWh to 1,127.31 TWh, and geothermal from 36.42 TWh to 85.34 TWh. Hydro nearly doubled, indicating stable and increasing reliance.

7. Large Gap in Country Contributions

Top 20 countries show a huge disparity (from 12.40 TWh to 1,819.94 TWh). This reflects inequality in energy production capacity and global access, with room for improvement via international cooperation.

8. Africa's Gradual Energy Rise

Africa's energy consumption remains the lowest but is increasing steadily. Countries like Nigeria and South Africa are leading the region, showing the impact of targeted electrification programs.

9. CIS Consumption is Lower Than OECD and BRICS

Commonwealth of Independent States countries lag behind, suggesting lesser development in energy infrastructure and demand. Targeted investments could improve their global energy standing.

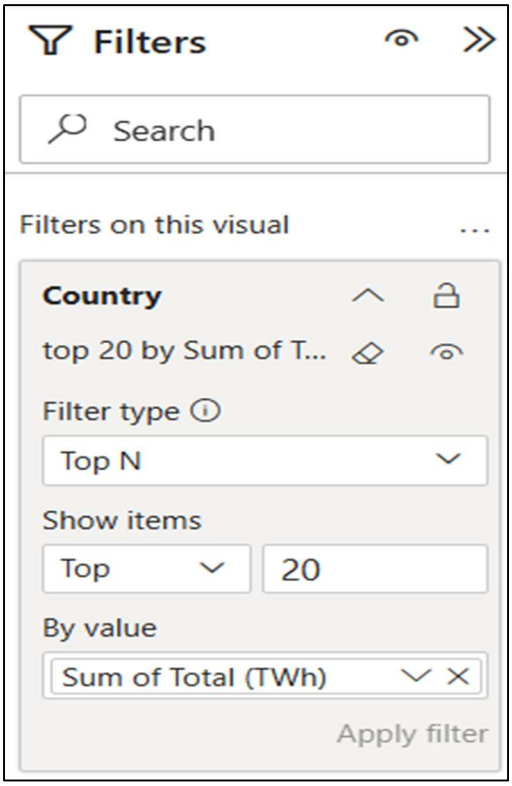
6. Performance Testing

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.

Performance testing ensures that the Power BI dashboard is **efficient, responsive, and scalable**. This step is essential to verify that users can interact with the dashboard smoothly, even when applying filters, calculations, or loading visuals across large datasets.

7.1 Utilization 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.



Purpose:
To test how data filters behave under different user interactions and data segments.

Filters Used:

- **Region/Continent** (Asia, Europe, Africa, etc.)
- **Country** (e.g., India, USA, Germany, etc.)
- **Year Range** (2000 to 2022)
- **Energy Type** (Renewables, Fossil Fuels, Hydro, etc.)
- **CO_2 Emission Levels** (Low, Moderate, High)
- **Access to Electricity** (Yes/No or % Ranges)

Test Scenarios:

- Filter combinations (e.g., Asia + Renewables + 2015–2020).
- Dynamic cascading filters tested for dependency (e.g., Country changes after Region).
- Speed checked after applying 3–4 filters simultaneously.

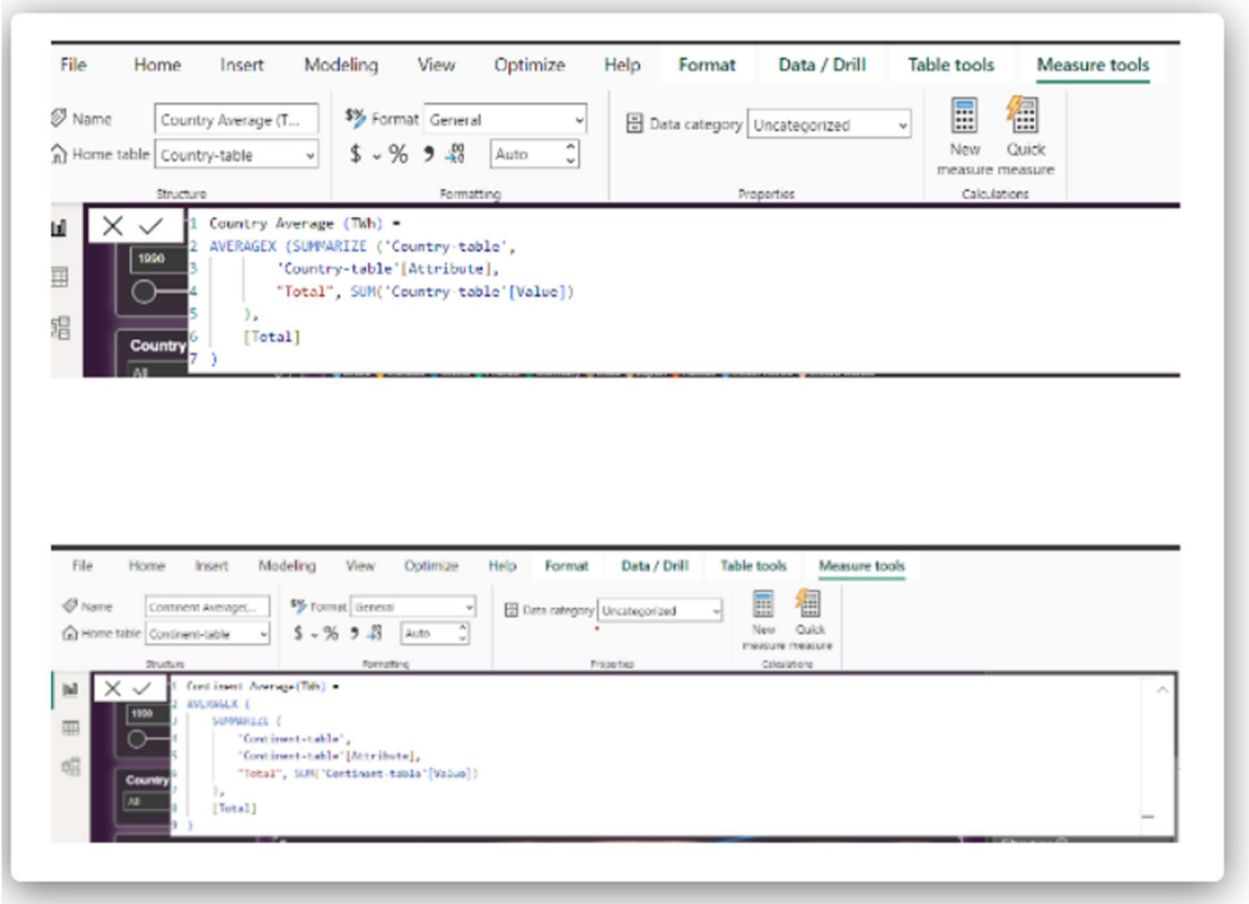
Findings:

- All slicers operate with minimal lag.
- Data refreshes in real-time under normal load.
- Performance slightly dips when too many filters (6+) are active.

7.2 Number of Calculation Fields

Power BI allows the creation of reusable filter objects like Measures, and Calculated Columns which can simplify the process of applying consistent filters across multiple visualizations and dashboards.

Purpose:
To track the number and complexity of calculated fields (measures and columns) used, which impact load time and responsiveness.



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

8. Conclusion / Observation

The Power BI project on Global Energy Trends and Sustainability effectively illustrates how data visualization can simplify and present complex global energy data in a meaningful way, enabling clearer insights and strategic decisions. By analyzing trends across regions and time periods, and mapping the impact of energy consumption on CO_2 emissions, the project brings several crucial findings to light. It reveals that despite the rising interest in renewable energy, the global economy remains heavily reliant on fossil fuels. The analysis underscores the uneven access to clean energy across nations, with developed countries progressing faster toward sustainable alternatives, while developing regions continue to face significant challenges. A clear link between industrial growth and increased carbon emissions was observed, emphasizing the environmental costs of rapid development. Countries like Germany, Denmark, and Norway demonstrate notable progress in renewable energy adoption, whereas regions in Asia and parts of Africa still show heavy dependence on coal and oil. Furthermore, the project highlights ongoing energy inequality, particularly in Sub-Saharan Africa, where access to electricity remains limited. Overall, the findings validate the power of visual analytics in supporting evidence-based policymaking and global sustainability planning.

Additionally, the project draws attention to innovative real-world applications, such as the integration of smart grids, industrial energy optimization, and the potential of renewable energy to power remote rural communities. These use cases demonstrate how data-backed decisions can lead to smarter, greener infrastructure development.

In conclusion, the project not only provides a lens to evaluate present energy realities but also acts as a blueprint for future energy planning. It emphasizes the need for global cooperation, localized solutions, and continuous investment in data analytics to address the twin goals of energy security and environmental sustainability.

9. Future Scope

The project has the potential to grow and adapt in various impactful ways:

◆ **Integration of Real-Time Data**

- Connect with **live data APIs** from energy and environmental agencies (like IEA, UN, or World Bank).
- Enable **real-time monitoring dashboards** for national and corporate energy tracking.

◆ **Advanced Forecasting & Predictive Models**

- Use **Python/R scripts in Power BI** to integrate machine learning for:
  - CO_2 emissions forecasting.
  - Renewable energy adoption trends.
  - Impact analysis of energy policies.

◆ **Drill-down to State/City Level**

- Expand the dataset to sub-national levels for better micro-level planning (e.g., states in India or the US).

◆ **Industry-Specific Dashboards**

- Build versions tailored for:
  - Manufacturing (energy usage per unit output).
  - Smart grids and utility providers.
  - Rural electrification NGOs.

10. Appendix

10.1. Source Code

While Power BI does not use conventional source code, the following components were created using DAX (Data Analysis Expressions):

Sample DAX Measures:

1. Average_TWh_By_Country_Year = AVERAGEX(
VALUES(Country_Table[Year]),
CALCULATE(SUM(Country_Table[TWh]))
)

Data Transformation: Create average of country in country table.

2. Continent Average (TWh) =
AVERAGEX (
SUMMARIZE (
'Continent_Table',
'Continent_table'[Continent],
"Total", SUM('Continent_table'[Value])
),
[Total]
)

Data Transformation: Used to calculate the average energy consumption per continent.

10.2. GitHub & Project Demo Link

- 🔗 **GitHub Repository:**
  Anjali0910-IT/Global-Energy-Trends
- 📽️ **Project Demo Video (Drive):**
  https://drive.google.com/file/d/1zpxWLdBrQX0BqWL2nkbYbaAOllTUXa29/view?usp=sharing