Renewable Energy Consumption & Efficiency Analysis

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Introduction

Solar Energy Sources

Solar panels harness sunlight to generate clean, renewable electricity for homes.

Wind Energy Sources

Wind turbines convert wind into electricity, reducing reliance on fossil fuels significantly.

Hydro Power Efficiency

Hydropower plants use flowing water to produce reliable, sustainable energy continuously.

PROBLEM STATEMENT

The efficiency and reliability of renewable energy sources solar, wind, and hydro are affected by seasonal variability, weather conditions, and inconsistent production rates, posing challenges for grid management, energy storage, and future demand prediction.

PROJECT PROCESS

Data Set

- We have use contains structured data. This dataset will include columns relevant to solar, wind, and hydro energy production, along with seasonal and weather impacts.

Data Cleaning and Preprocessing

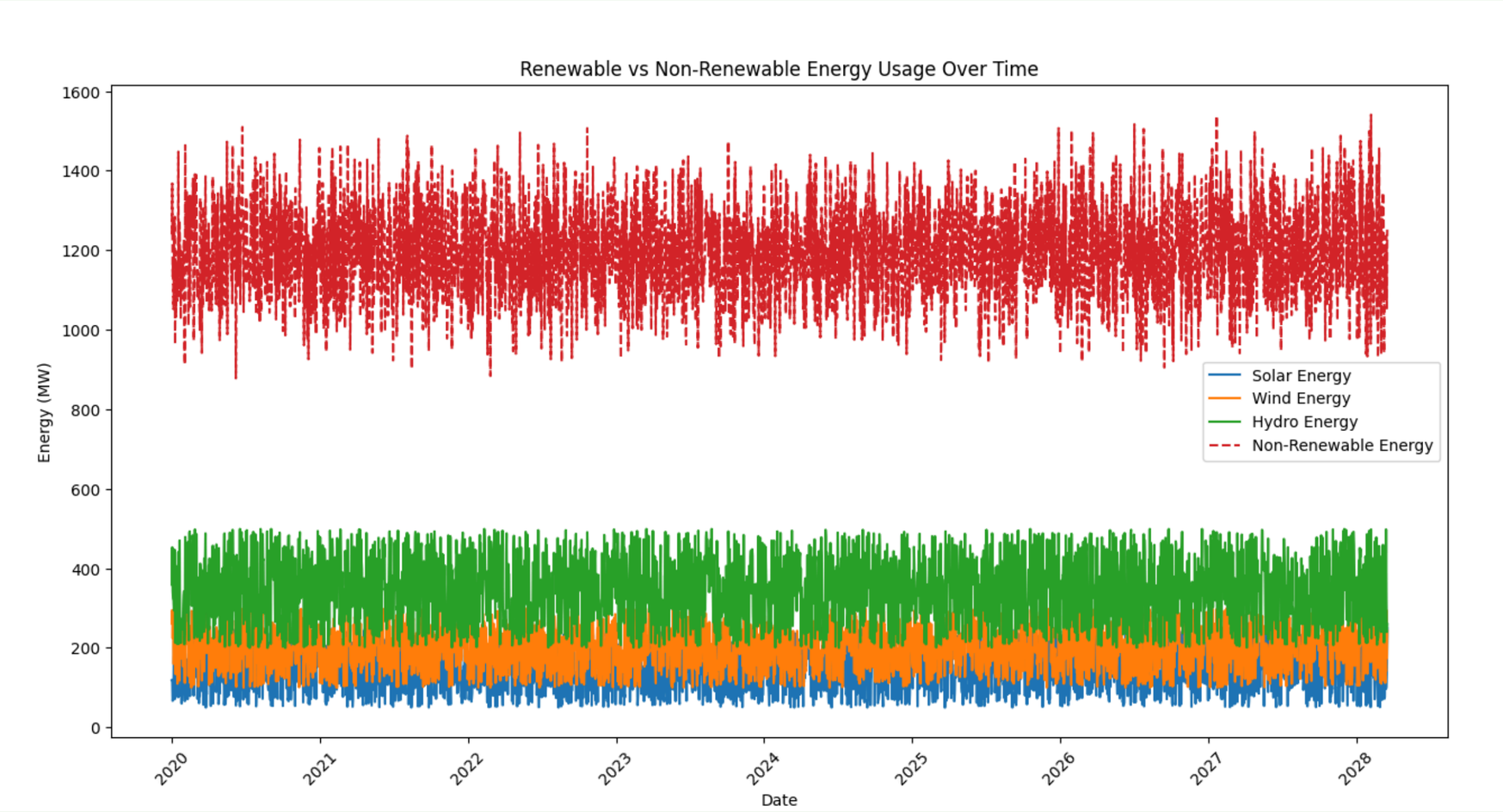
- WE HAVE USED EXCEL FOR DATA CLEANING, HANDLE MISSING VALUES,
- USED PYTHON FOR PREFORMING EXPLORATERY DATA ANALYSIS (EDA)

Data Visualization

- USED POWER BI AND PYTHON TO BUILD VISUALIZATIONS AND DASHBOARD

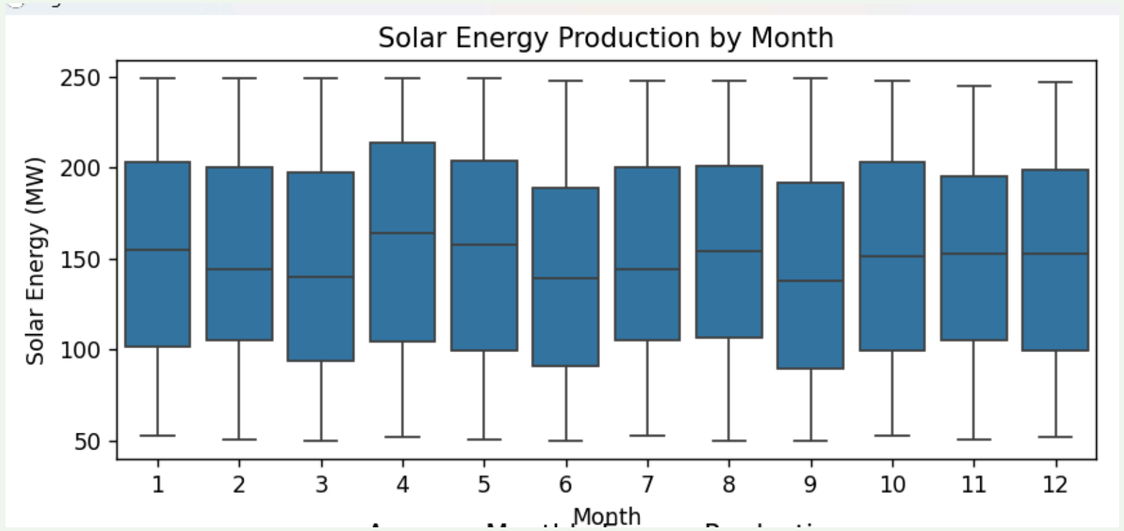
KEY INSIGHTS

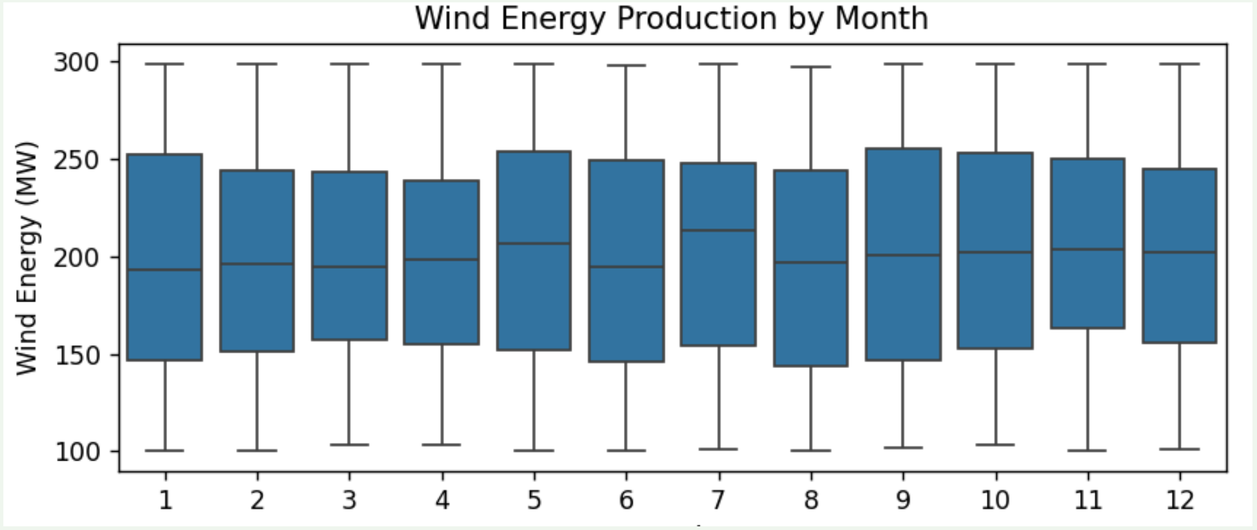
- Non-renewable energy remains the dominant source, while hydro leads among renewables. Solar and wind show lower yet fluctuating contributions, with a gradual rise in renewable adoption over time.



Comparison: Solar Energy vs. Wind Energy Production

- Stability: Solar energy production is relatively stable across months, while wind energy shows more fluctuations.
- Variability: Wind energy has a wider spread in box plots, indicating higher variability compared to solar energy.
- Peak Production: Solar energy has slight peaks in April and October, while wind energy has more consistent production across months.
- Outliers: Both energy sources show no significant outliers, indicating steady generation.
- Interquartile Range (IQR): Wind energy has a slightly larger IQR, meaning more variation in energy production than solar.

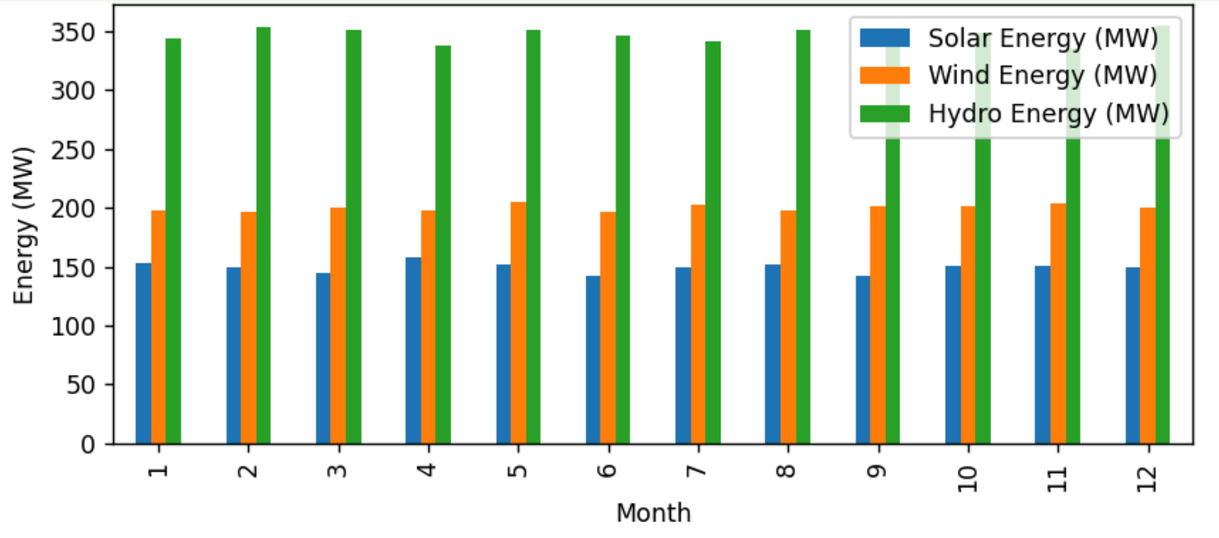




Average Monthly Energy Production:

- Hydro energy consistently has the highest production, staying above 300 MW each month.
- Wind energy production is higher than solar energy, maintaining around 200 MW, while solar remains near 150 MW.

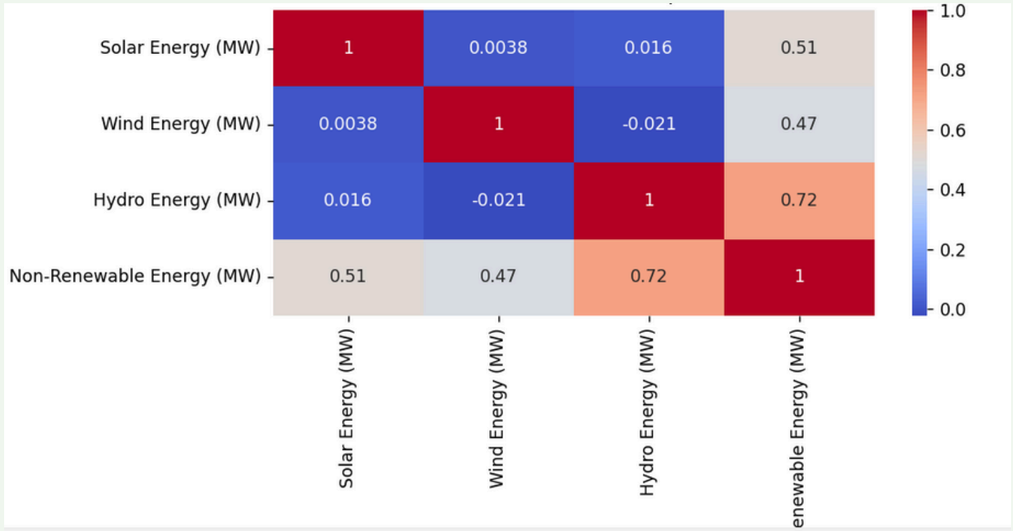
Average Monthly Energy Production

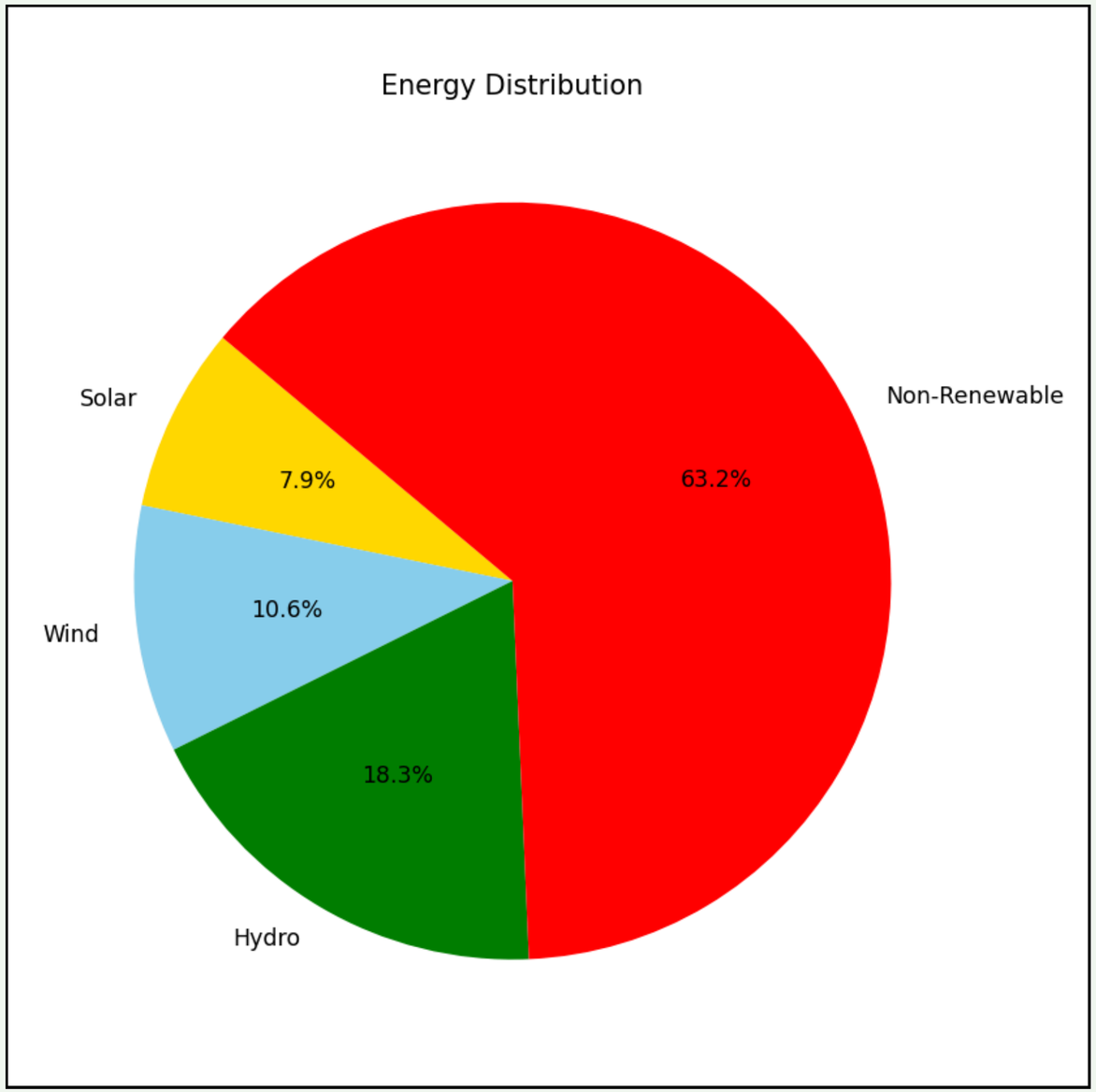


Correlation Heatmapt:

- Solar and Wind Energy have almost no correlation (0.0038), meaning their production is independent of each other.
- Hydro Energy has a strong correlation (0.72) with Non-Renewable Energy, suggesting a possible connection in their production trends.

Correlation Heatmapt

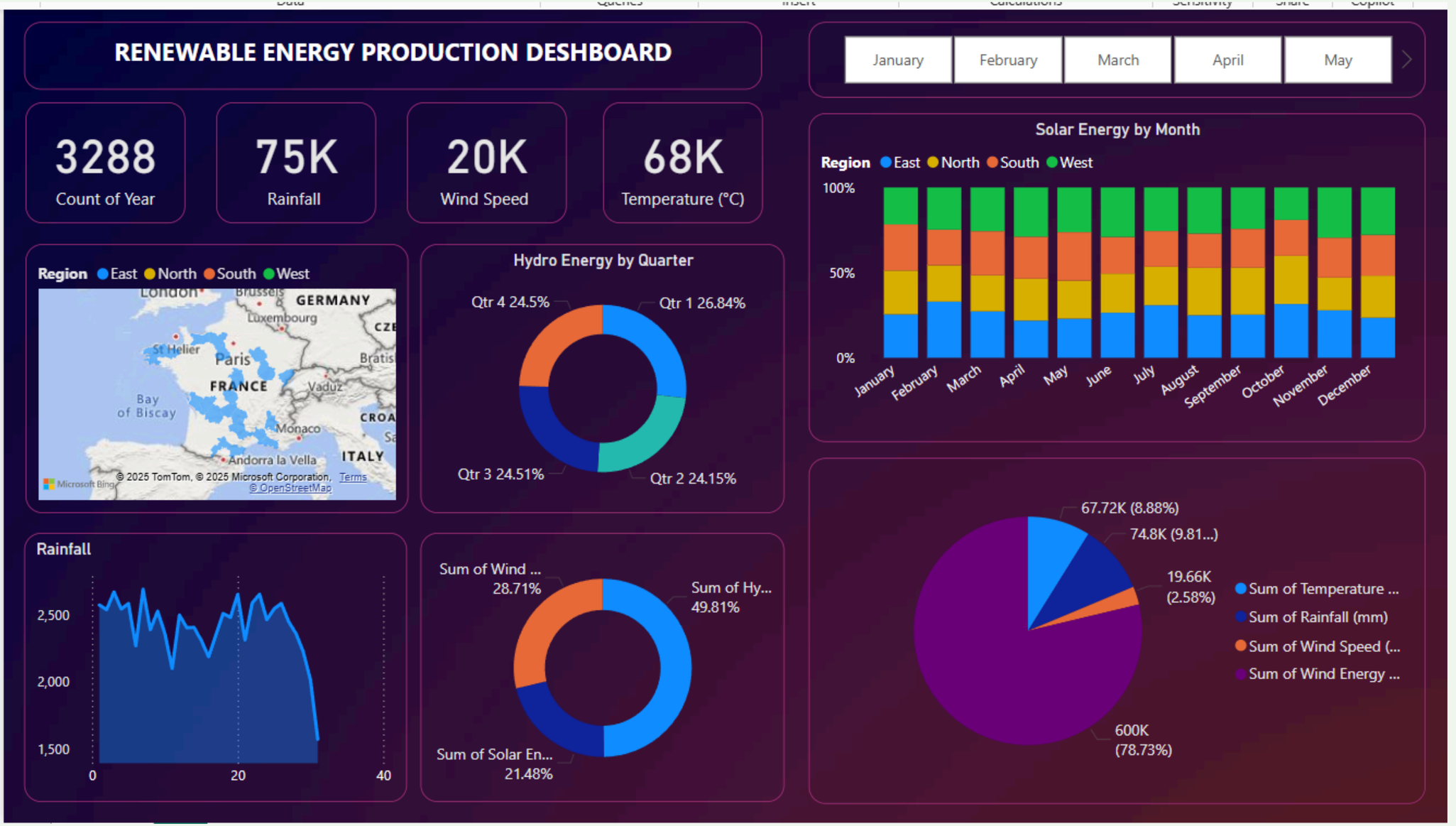




Energy Distribution

- Non-Renewable Energy is the largest contributor (63.2%), indicating a heavy reliance on non-renewable sources.
- Hydro Energy is the most significant renewable source (18.3%), contributing more than Wind and Solar.
- Wind Energy accounts for 10.6%, making it the second-largest renewable energy source.
- Solar Energy has the smallest share (7.9%), showing lower production compared to other sources.
- The combined renewable energy share (36.8%) is still much lower than non-renewable energy, highlighting the need for more sustainable energy transitions.

Data Visualization & Dashboard (Power BI)



1️⃣ Hydro Energy is the Leading Contributor

- Hydroenergy contributes 49.81%, making it the largest source of renewable energy.
- The production is evenly distributed across all four quarters, showing consistent availability.

2️⃣ Wind Energy is the Second Highest Source

- Wind energy accounts for 28.71% of total production.
- Wind speed data (20K) suggests its strong impact on overall energy generation.

3️⃣ Solar Energy is the Smallest Renewable Source

- Solar energy contributes 21.48%, making it the least significant of the three renewable sources.
- The monthly breakdown shows steady production across all regions.

4️⃣ Non-Renewable Energy Still Plays a Major Role

- The earlier pie chart on energy distribution indicated that non-renewable energy still has a large share (from the previous analysis).
- A shift towards renewable sources may still be in progress.

5️⃣ Environmental Factors Impact Energy Production

- Rainfall (75K) might be supporting hydro energy.
- Wind speed (20K) directly affects wind energy production.
- Temperature (68K) could impact overall energy demand and solar efficiency.

RECOMMENDATIONS:

1 Optimize Energy Storage Solutions

- Implement battery storage systems to store excess solar and wind energy.
- Use pumped hydro storage to balance energy supply during low production periods.

2 Improve Seasonal Energy Efficiency

- Adjust solar panel angles seasonally to maximize energy absorption.
- Install hybrid wind-solar systems to balance variations in seasonal energy production.

3 Enhance Grid Integration for Renewables

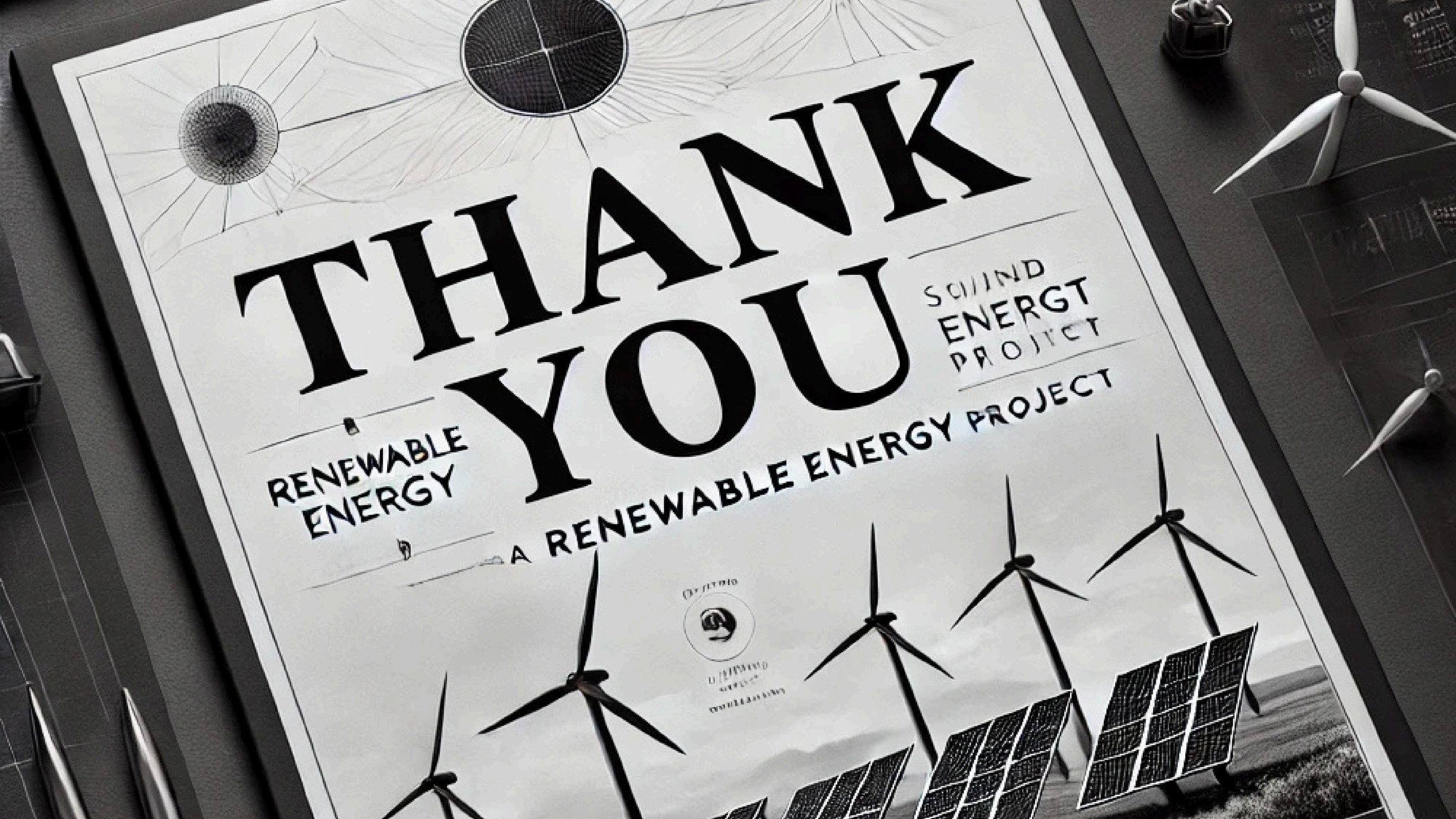
- Develop a smart grid to integrate renewable sources efficiently.
- Use real-time data monitoring to predict demand and avoid energy wastage.

4 Leverage Predictive Analytics for Energy Demand

- Use machine learning models to forecast peak demand periods.
- Implement automated grid balancing to prevent shortages or excess energy loss.

5 Encourage Policy & Investments in Renewable Energy

- Advocate for government subsidies to improve renewable infrastructure.
- Promote public-private partnerships for large-scale renewable projects.


THANK YOU
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A RENEWABLE ENERGY PROJECT