

# Unveiling Global Energy Pathways: Clustering Nations Based on Energy Sources and Future Prediction of Dependence on Coal Sources

**Abstract:** This poster presents a comprehensive clustering analysis of global electricity production, focusing on hydroelectric and coal sources. By employing K-Means clustering, countries are grouped based on their energy patterns. Additionally, the study explores the future trajectory of coal-dependent electricity in a selected country from each cluster. It also provide a shade on the error range throughout the fitted prediction curve. The study uses exponential growth function for fitting the curve.

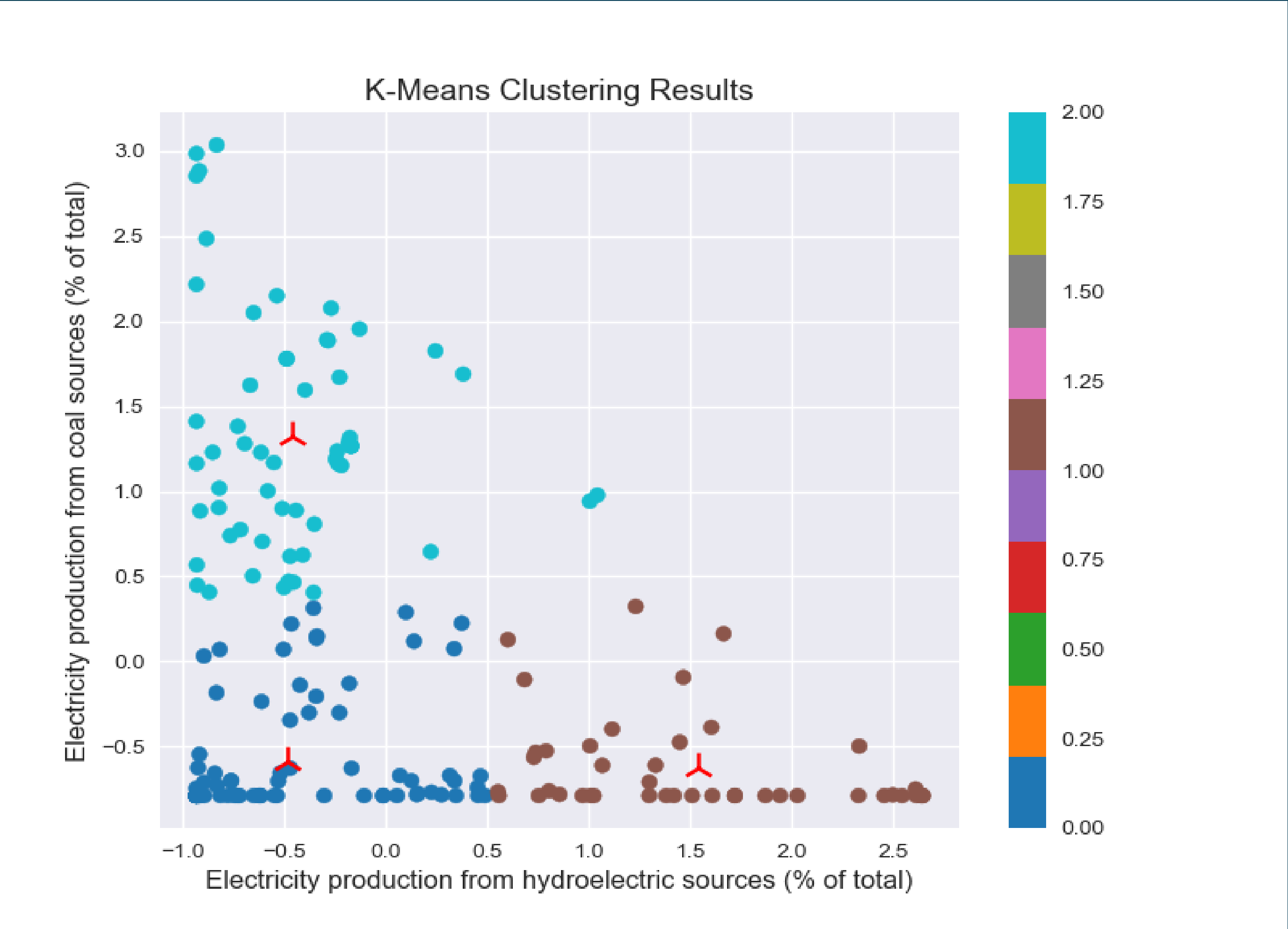
**Introduction:** Unraveling the dynamics of electricity production is pivotal for sustainable energy planning. This study employs exponential growth modeling to analyze key indicators, including hydroelectric and coal sources, across nations. By scrutinizing growth rates and projecting future trends, our exploration lays the foundation for informed decision-making in the realm of global energy sustainability. Through this analysis, we unveil distinctive global energy landscapes and provide insights into future trends in electricity production.

## Cluster Analysis:

K-Means clustering identifies patterns in normalized data. Similarities and differences in electricity production trends among all countries are revealed. The analysis takes into account electricity production percentage from a non-renewable source i.e., coal and from a renewable source i.e., hydroelectric sources and cluster the countries according to the year 2014. The study gives 3 clusters. Each cluster has countries with same properties in energy production using the given indicators. A country from each cluster is taken for further fitting and prediction. This allows for a nuanced understanding of how countries group based on their electricity production profiles.

## Exponential Growth Modeling:

Utilizing exponential growth models, we explore the historical trends in electricity production from coal sources for one country from each cluster. By fitting growth parameters to the data, we gain insights into the underlying patterns and predict future values. In the context of energy consumption and environmental sustainability, this modeling technique helps to assist decision-making by allowing the identification of prospective growth rates. The selected countries are Morocco, Japan and Norway.



## Future Predictions:

Utilizing the data spanning from 1980 to 2014, exponential growth curve fitting is applied to project future energy production trends until 2025. By selecting one country from each identified cluster through K-Means clustering, we gain insights into distinct growth patterns and potential trajectories for electricity production. These predictions offer valuable perspectives for strategic planning and policy formulation in the context of sustainable energy development.

The error band provides information about the uncertainties associated with these parameter estimates. The predicted percentage of energy production from coal in 2025 is projected to be 91.01%, indicating a substantial increase and suggesting potential implications for the country's energy landscape and environmental policies.

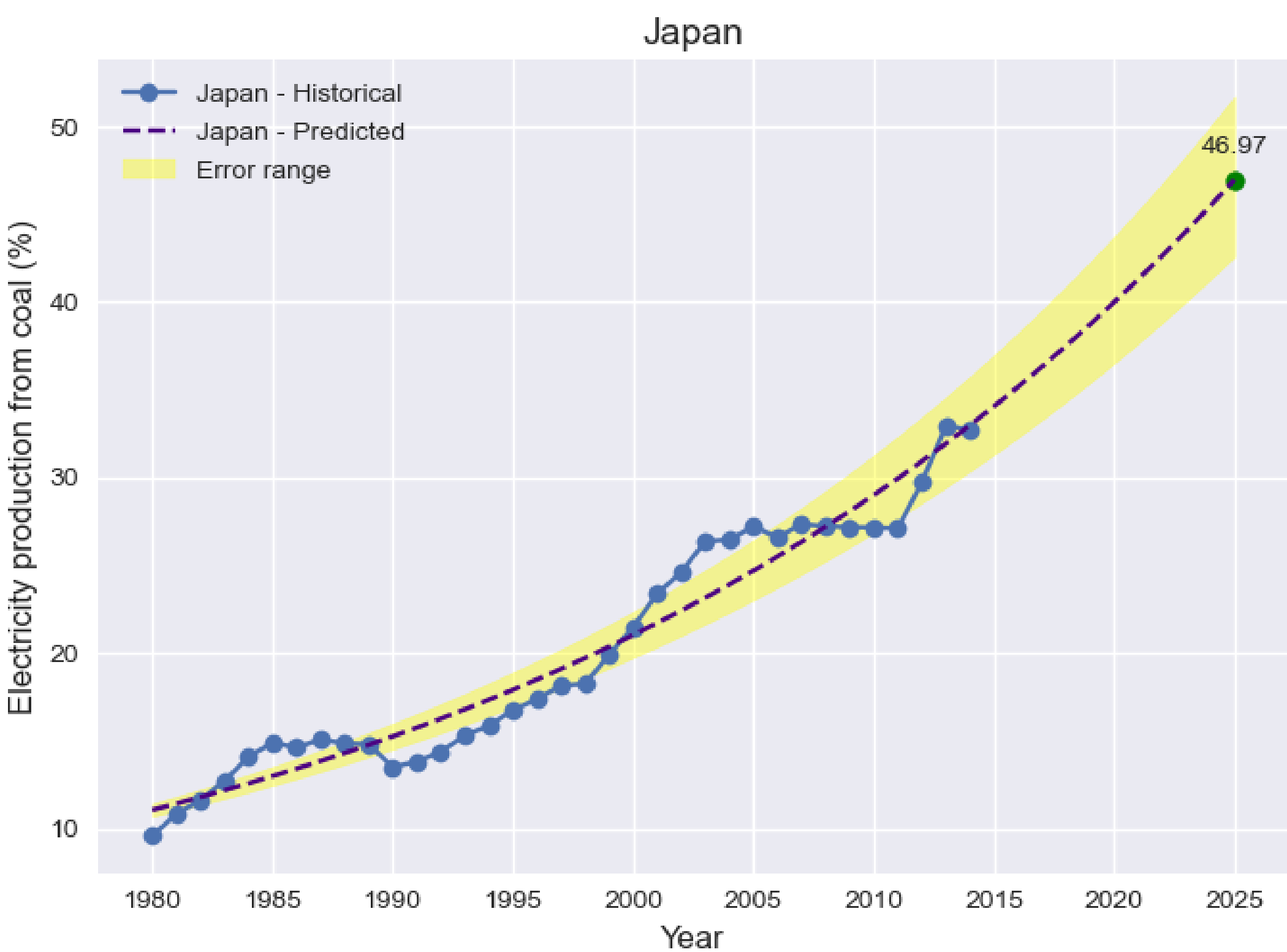
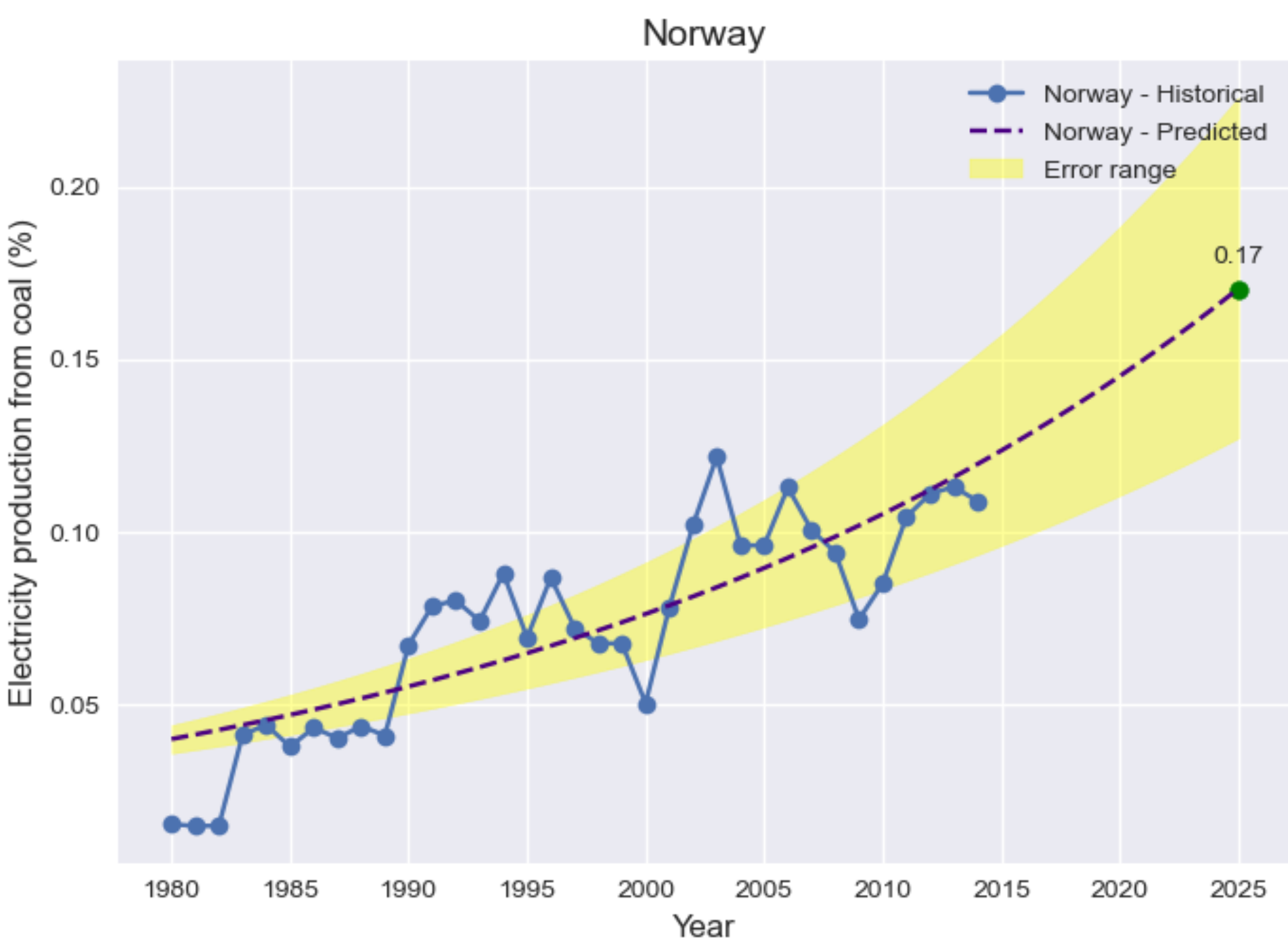
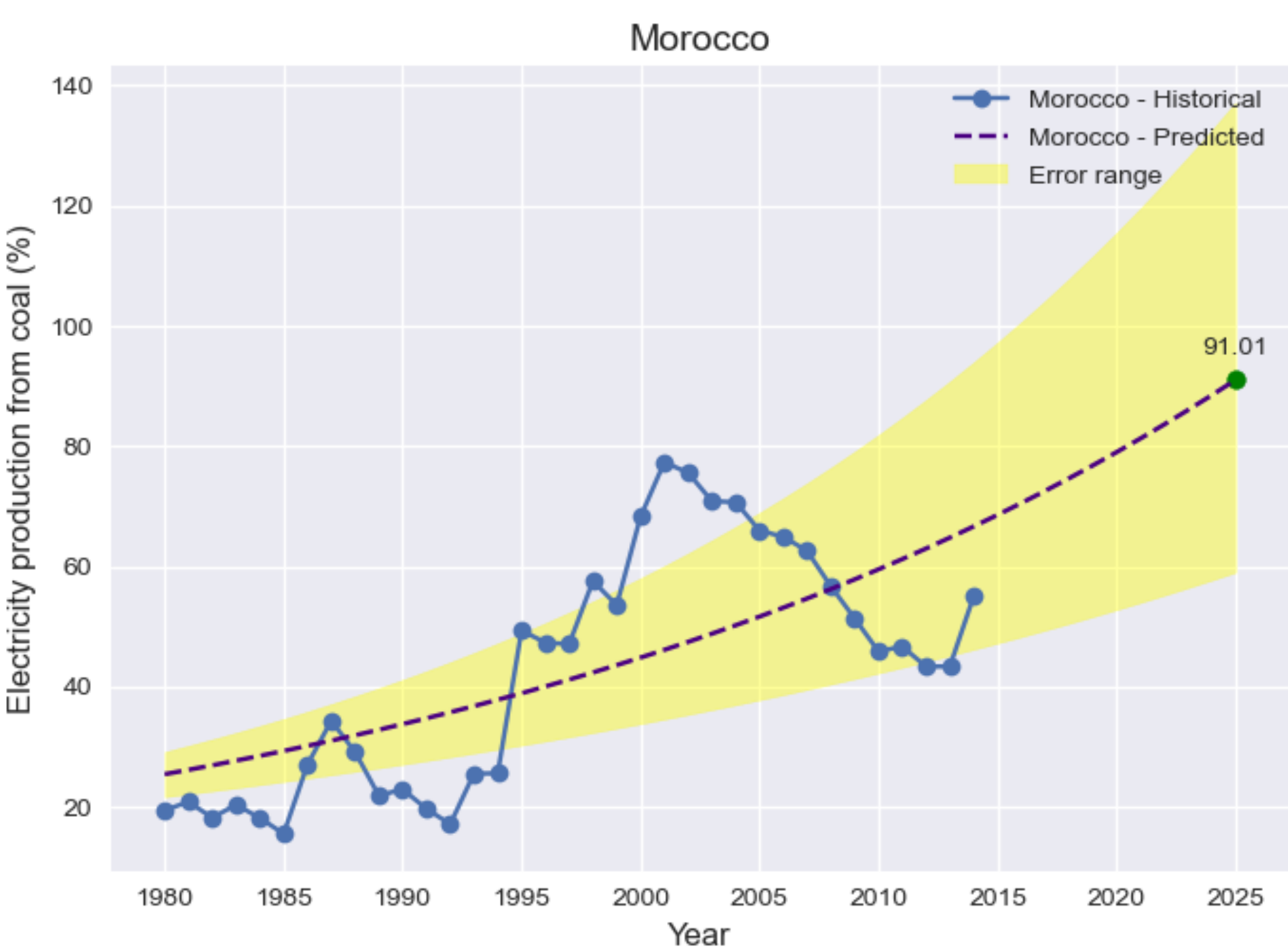
MOROCCO

NORWAY

JAPAN

The predicted percentage of energy production from coal in 2025 (0.17) reflects a considerable increase from the initial value, signaling a notable upward trend in Norway's reliance on coal for electricity generation.

The predicted percentage of energy production from coal in Japan is estimated to reach 46.97% by 2025, providing valuable insights into the country's future energy composition. The uncertainty also is relatively small when looking at the error band.



## Conclusion:

The cluster analysis was effective in identifying unique patterns in the way that coal and hydroelectric power are produced in different countries. We were able to get important insights into the future predicted values of each cluster by comparing one nation from each, which revealed possible changes in the patterns of energy production. In the process of moving toward sustainable energy sources, this study adds to a thorough understanding of global energy dynamics and offers a foundation for strategic decision-making.

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GitHub Link:  
[https://github.com/sandra-binu3/Clustering\\_and\\_Fitting](https://github.com/sandra-binu3/Clustering_and_Fitting)