ENERGY ACCESS AND ELECTRIFICATION PLANNING IN KENYA

Meet Group 8 Team

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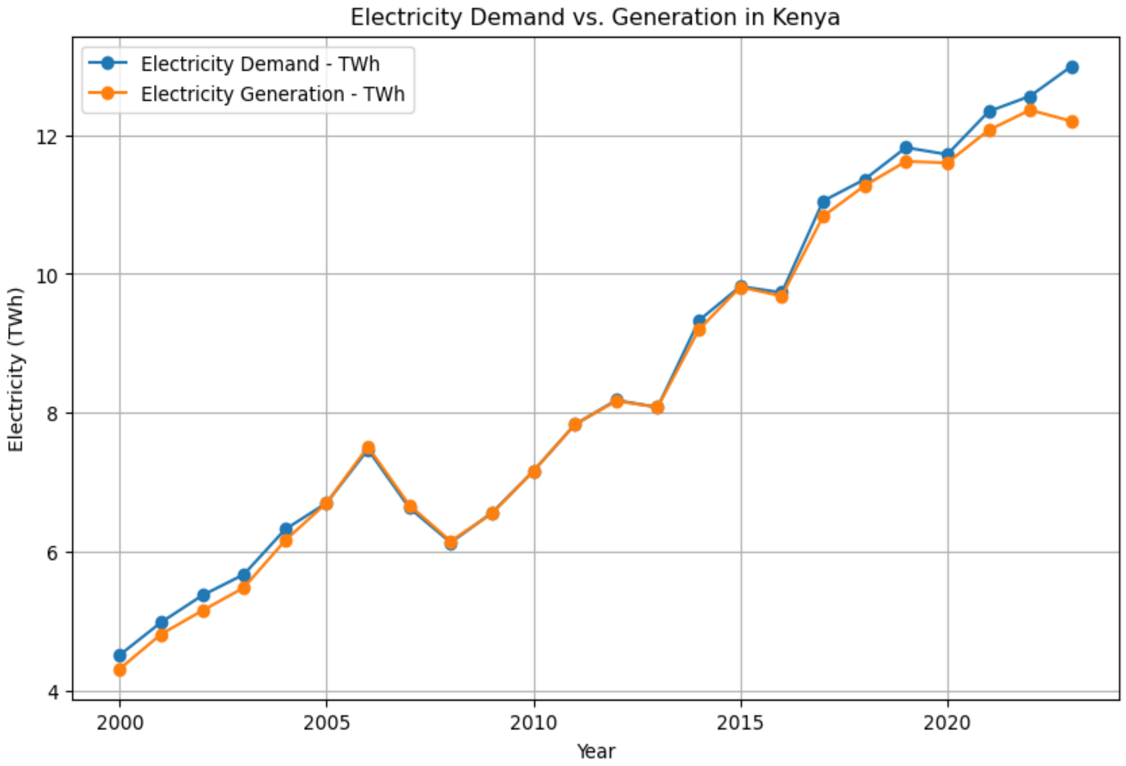
Overview

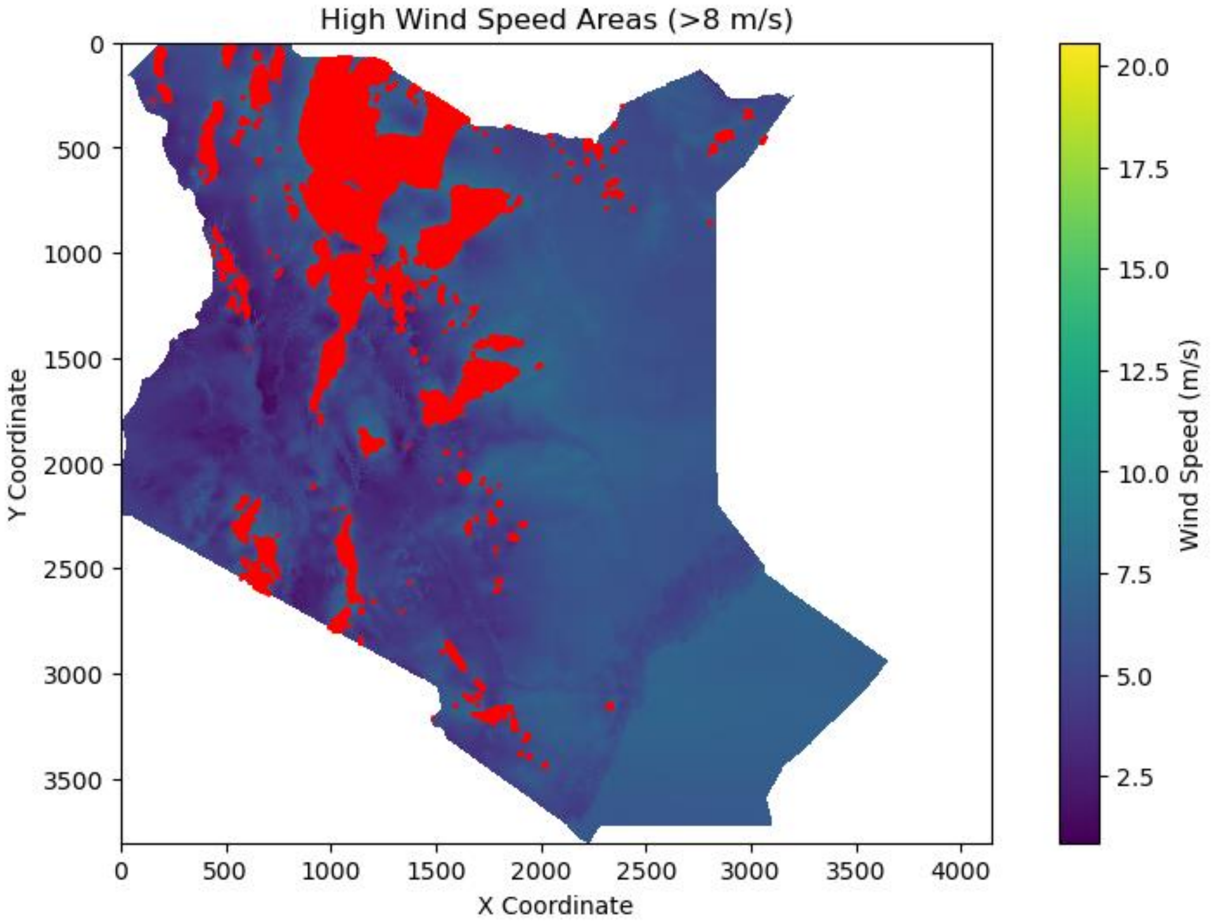
Since the conclusion of the Rural Electrification Program in Kenya in 2022, the country has faced challenges in sustaining electricity access, driven by rising demand and declining generation capacity. As a result, approximately 25% of Kenya's population currently lacks access to reliable electricity.

In line with the World Bank's Mission 300, this project focuses on electrification planning in Kenya, contributing to the goal of connecting 300 million people in Sub-Saharan Africa to electricity by 2030.



BUSINESS UNDERSTANDING

The project supports the transition to sustainable & impactful energy solutions in Kenya .
The map provides a clear visual aid for identifying regions where wind energy can address gaps in electricity access.



Objectives

01

To use **classification algorithms** to classify areas based on their suitability for microgrid installation and map regions with high wind speeds to optimize the placement of wind farms and mini-grids in off-grid locations.

02

To use **clustering algorithms** to identify regions with sparse grid infrastructure and high population density where wind farms and microgrids could be feasible.

Data Understanding

Sources of Data

- Global Wind Atlas
- WorldPop Hub
- Global Electrification Platform (GEP)
- Global Subnational Poverty Atlas (GSAP).

Datasets were merged on latitudes and longitudes using an outer merge and the emerged null values were filled using machine learning's k-nearest neighbors.

Columns used in our analysis:

01 Latitudes & Longitudes

02 Population Density 2000 - 2020

03 Grid Infrastructure

04 Wind Renewable Energy Potential

05 Income Distribution

Models

Clustering Algorithms

- HDBSCAN
- K-Means Clustering

Classification Algorithms

- Multi-Layer Perceptron (MLP): Deep learning model.
- Random Forest
- XGBoost

Findings

The clustering algorithms demonstrated better performance in generating meaningful and distinct clusters.

K-Means achieved a **Davies-Bouldin Index** of **0.7332** and a **Calinski-Harabasz Score** of **995,263.16**.

HDBSCAN attained a **Davies-Bouldin Index** of **0.4270** and a **Calinski-Harabasz Score** of **253,060.86**.

All the classification algorithms achieved a cross-validation score of **0.99**, an accuracy score of **1.00** in the classification report, and a standard deviation of **0.0041** for cross-validation accuracy.

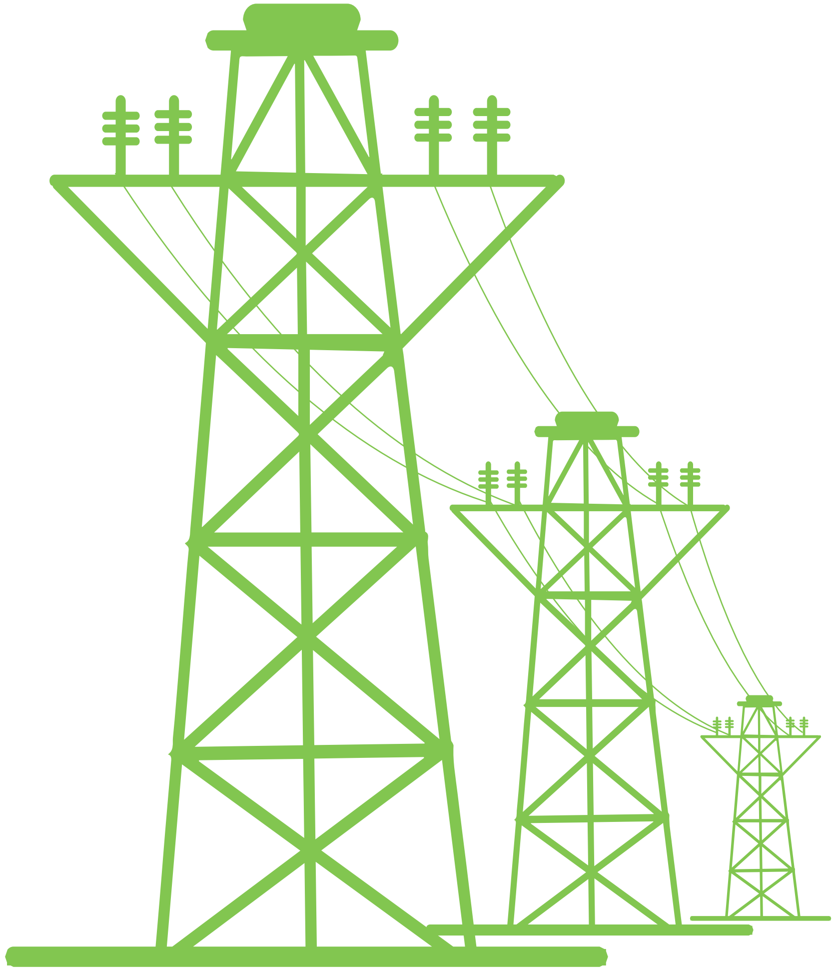
A hybrid model was deployed, combining **K-Means clusters**, **HDBSCAN's PCA**, and a **Multi-Layer Perceptron (MLP) deep learning classification model**.

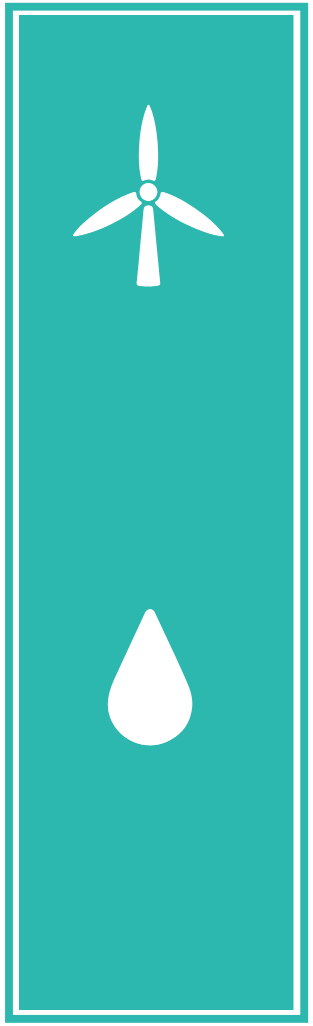
Conclusion

The machine learning analysis identified regions suitable for wind microgrids and wind farm installations as being **relatively densely populated**, with **stronger wind conditions** and significantly **limited grid infrastructure**.

Additionally, about **50% of the population lives below the $2.15 poverty line**, underscoring the urgent need for economic empowerment through electrification initiatives in these regions.

Recommendations





The **government of Kenya** in Collaboration with the **private sector** should adopt this deployment model as a **strategic framework** for the placement of **wind farms and microgrids** in Kenya.

This approach will improve energy and electricity access for rural populations, thereby promoting sustainable development and enhancing the economic resilience of rural communities.

Deployment

	Pop_Density_2010	Pop_Density_2011	Pop_Density_2012	Pop_Density_2013	Pop_Density_2014
705,017	14.7392	15.2442	17.8877	19.621	20.8623
705,146	17.621	19.4745	22.2419	25.2996	24.8632
705,285	17.621	19.4745	22.2419	25.2996	24.8632
705,292	14.7392	15.2442	17.8877	19.621	20.8623
705,436	17.621	19.4745	22.2419	25.2996	24.8632
705,437	17.621	19.4745	22.2419	25.2996	24.8632
705,587	17.621	19.4745	22.2419	25.2997	24.8632
705,588	17.621	19.4745	22.2419	25.2996	24.8632
705,729	17.621	19.4745	22.2419	25.2997	24.8632
705,730	17.621	19.4745	22.2419	25.2996	24.8632
705,734	14.7392	15.2442	17.8877	19.621	20.8623

https://model-deployment-cvnqlemdbbcfdby4berxa2.streamlit.app/

QUESTIONS

Thank You

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