Group ID: 25GK26

Renewable Energy Production Prediction using Hybrid Machine Learning Models

Abstract

We propose a data-driven framework for renewable energy prediction that integrates meteorological and environmental variables with advanced forecasting techniques. The system leverages historical time-series data such as solar irradiance, wind speed, temperature, humidity, and seasonal effects, alongside corresponding photovoltaic and wind energy outputs. To ensure data consistency, preprocessing steps include managing missing values, normalization, and extracting temporal patterns through feature engineering methods like lagged inputs, rolling statistics, and seasonality decomposition.

The predictive framework combines both traditional statistical approaches and modern deep learning architectures, ensuring the ability to capture nonlinear patterns as well as long-term temporal dependencies. Instead of relying on a single model, a hybrid ensemble mechanism is adopted to integrate the strengths of multiple learning paradigms, enhancing robustness and predictive accuracy.

Evaluation is conducted using error metrics such as mean absolute error, root mean square error, and coefficient of determination, with walk-forward validation applied to preserve temporal consistency. Beyond accuracy, interpretability is incorporated through sensitivity analysis to identify which weather and environmental factors contribute most significantly to renewable energy production.

Keywords: Renewable Energy Forecasting; Data-Driven Models; Hybrid Framework; Time-Series Prediction; Ensemble Learning; Sustainability.

Gantt Chart

Task	Aug 13-20	Aug 21-31	Sep 1-10	Sep 11-20	Sep 21-30	Oct 1-10	Oct 11-20	Oct 21-31	Nov 1-5
Proposal	X								
Literature Survey		X							
Data Collection			X						
Feature Engineering				X					
Classical ML					X				
Deep Learning						X			
Hybrid Development							X		
Model Evaluation								X	
Report Writing									X

Roles and Responsibilities

Team Member	Responsibilities
Juhi Sahni (2301CS88)	Define overall roadmap; ensure integration of Data + Models + Results; oversee version control; validate end-to-end system; prepare executive summary & final integration report.
Saniya Prakash (2301CS49)	Collect solar/wind/weather datasets; clean and normalize data; handle missing/outlier values; engineer time-based features (lags, rolling means, seasonal indicators); document preprocessing pipeline.
Mihika (2301CS31)	Build predictive models; tune hyperparameters; compare classical ML vs deep learning; evaluate using RMSE, MAE, R^2; explore hybrid CNN-LSTM approaches; select best model.
Shefali Bishnoi (2301CS87)	Prepare charts/graphs of predictions; visualize error metrics; create professional flowcharts/roadmaps; write research-style documentation; prepare team presentations.