PROJECT ABSTRACT

Energy Consumption Forecasting using Prophet

A Facebook Prophet energy forecaster on real smart-meter data with seasonality decomposition, horizon control and holdout backtesting — delivered as a built-to-order student project with code, notebook, report, PPT and viva kit.

01. Title

Energy Consumption Forecasting using Prophet

02. Introduction / Background

Everyone who plans electricity supply — grid operators balancing load, households choosing a tariff — needs to know how much energy will be used tomorrow, next week and next season. Classical methods like ARIMA demand statistical expertise and stationarity assumptions and struggle with several overlapping rhythms: a household uses power differently at 7 AM versus 7 PM, on weekdays versus weekends, and in January versus July. Facebook's Prophet suits this shape of problem: an additive decomposable model in which trend, multi-scale seasonality (Fourier terms) and holiday effects are fitted separately, changepoints adapt the trend automatically, and missing readings do not break the fit. This project applies Prophet to the UCI Individual Household Electric Power Consumption dataset (2,074,259 minute-level readings, December 2006 to November 2010) with full decomposition and backtesting.

03. Problem Statement

Energy planners need reliable demand forecasts, but classical time-series methods are hard to tune and opaque about what drives their predictions. The project addresses this by building a Prophet-based forecaster on real smart-meter data that separates trend, daily/weekly/yearly seasonality and holiday effects into inspectable components, projects them forward with uncertainty intervals, and validates itself with honest holdout backtesting.

04. Objectives

- Build a complete meter-data pipeline: ingestion of 2,074,259 minute-level records, gap handling and hourly/daily resampling.
- Fit a Prophet model with daily, weekly and yearly seasonality, French holiday effects and tuned changepoint sensitivity.

- Backtest on a held-out window reporting MAPE, RMSE and MAE with an actual-vs-predicted overlay — all measured by the notebook during the build.
- Deliver a forecasting dashboard with adjustable horizon, decomposition viewer and peak-demand analysis, plus the complete student kit.

05. Proposed Methodology

The UCI household power dataset is ingested, gap-checked and resampled to an hourly or daily consumption series. A Prophet model is specified with daily, weekly and yearly seasonality via Fourier terms, French public-holiday effects and automatic changepoint detection; the changepoint prior scale is tuned by comparing fits in the notebook. The model is fitted on the training history and forecasts generated for the chosen horizon with widening uncertainty intervals. A final holdout window (e.g. the last 90 days) is backtested with MAPE, RMSE and MAE, and the seasonal components are decomposed for the report's analysis.

06. System Architecture / Working

The system has four stages. (1) Data pipeline: ingestion, gap handling and resampling of the minute-level meter data. (2) Model: Prophet specification (seasonalities, holidays, changepoints), fitting and changepoint-sensitivity tuning. (3) Evaluation: holdout backtesting with MAPE/RMSE/MAE, actual-vs-predicted overlay and residual inspection. (4) Demo application: a Streamlit dashboard showing history plus forecast with 7/30/90-day horizon control and uncertainty bands, a seasonality decomposition viewer (trend, daily, weekly, yearly), a backtest panel and peak-demand analysis.

07. Hardware / Software Requirements

- Hardware: a standard PC or laptop (8 GB RAM recommended); no GPU required.
- Software: Python 3.10, Prophet, pandas, NumPy, Matplotlib, Seaborn, scikit-learn, Jupyter, Streamlit.

08. Expected Outcomes

- A fitted Prophet energy forecaster with a reproducible training and backtesting notebook.
- Evaluation artifacts: backtest error metrics, actual-vs-predicted overlay, decomposition plots — measured on the student's own build, not pre-claimed.
- A working dashboard: forecast with uncertainty bands, horizon control, decomposition viewer.
- Complete documentation: project report, presentation and viva preparation material.

09. Applications

- Household and small-grid demand forecasting studies.
- Teaching benchmark for time-series decomposition and forecasting evaluation.
- Template pipeline retrainable on any timestamped consumption series with a local holiday calendar.

10. Future Scope

- Weather regressors (temperature, humidity) as extra Prophet regressors.
- Multi-household hierarchical forecasting.
- Real-time smart-meter streaming integration.
- Appliance-level load disaggregation.