## **📘 Project Report: Household Power Consumption Analysis**

### **🧾 1. Title Page**

**Project Title:** Household Power Consumption Analysis  
 **Author:** Jeelani  
 **Tools Used:** Python, Pandas, Matplotlib, Seaborn, Scikit-learn, Jupyter Notebook

### **📌 2. Project Overview**

This project focuses on analyzing household electric power consumption over time. The aim is to gain insights into usage patterns, identify periods of high consumption, and apply statistical or machine learning models to forecast future energy needs.

### **📊 3. Dataset Description**

**Dataset Name:** Individual household electric power consumption  
 **Source:** UCI Machine Learning Repository  
 **Features Include:**

* **Date** and **Time**
* **Global\_active\_power** (kilowatts)
* **Global\_reactive\_power** (kilowatts)
* **Voltage** (volts)
* **Global\_intensity** (ampere)
* **Sub\_metering\_1**: Kitchen
* **Sub\_metering\_2**: Laundry
* **Sub\_metering\_3**: Climate control and other appliances

### **🔍 4. Exploratory Data Analysis (EDA)**

* Checked for missing and anomalous values.
* Converted date and time into datetime format.
* Visualized Correlation heatmap between variables.

### **🛠️ 5. Data Preprocessing**

* Removed or imputed missing values.
* Combined date and time into a single datetime index.
* Filtered data to a specific time range (e.g., 2007–2010).
* Resampled data into daily or hourly intervals for clarity.
* outlier removal
* skewness correction
* Feature engineering

### **📈 6. Modeling & Forecasting**

Used time series models such as:

* **Random Forest Regression**
* **Linear Regression**
* **Gradient Boosting**
* **Neural Networks**

**Evaluated using metrics:**

* RMSE (Root Mean Squared Error)
* MAE (Mean Absolute Error)
* R2 (R squared)

### **📌 7. Visualizations**

* **Feature importance bar plot in random forest model**
* **Summary table including all models' performance**

### **📍 8. Conclusion**

This project provided key insights into how household electricity is consumed and identified potential opportunities for optimizing energy usage.