Communication Intelligence in Smart Grids

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Agenda

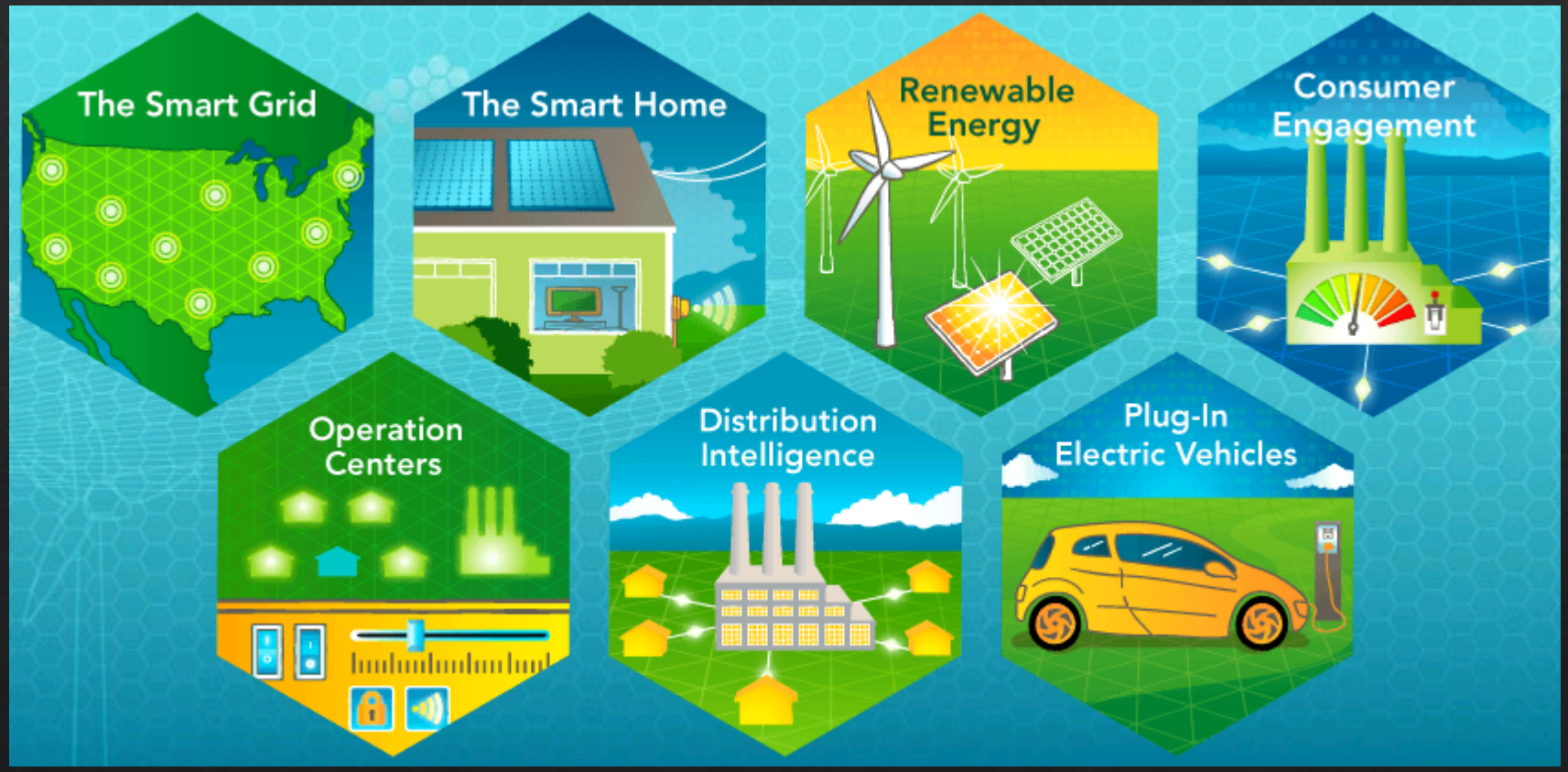
- Objective
- Smart Grid
- Design Model
- Design Methodology
- Machine Learning Models
- Data Analysis
- Output Expectations
- Future work

Objective

- The primary goal of the team project is to develop a methodology, how to corelate the production of solar and biogas power with the demand of the consumer resulting in a simulation software application. The application also simulates introduction of plug-in vehicles (eCars) and how the batteries could buffer the difference between production and consumption.
- The team will study how the immense potential for optimization and forecast presented by artificial intelligence can be best harnessed to enhance the efficiency and environmental compatibility of the power supply and to ensure the supply security.

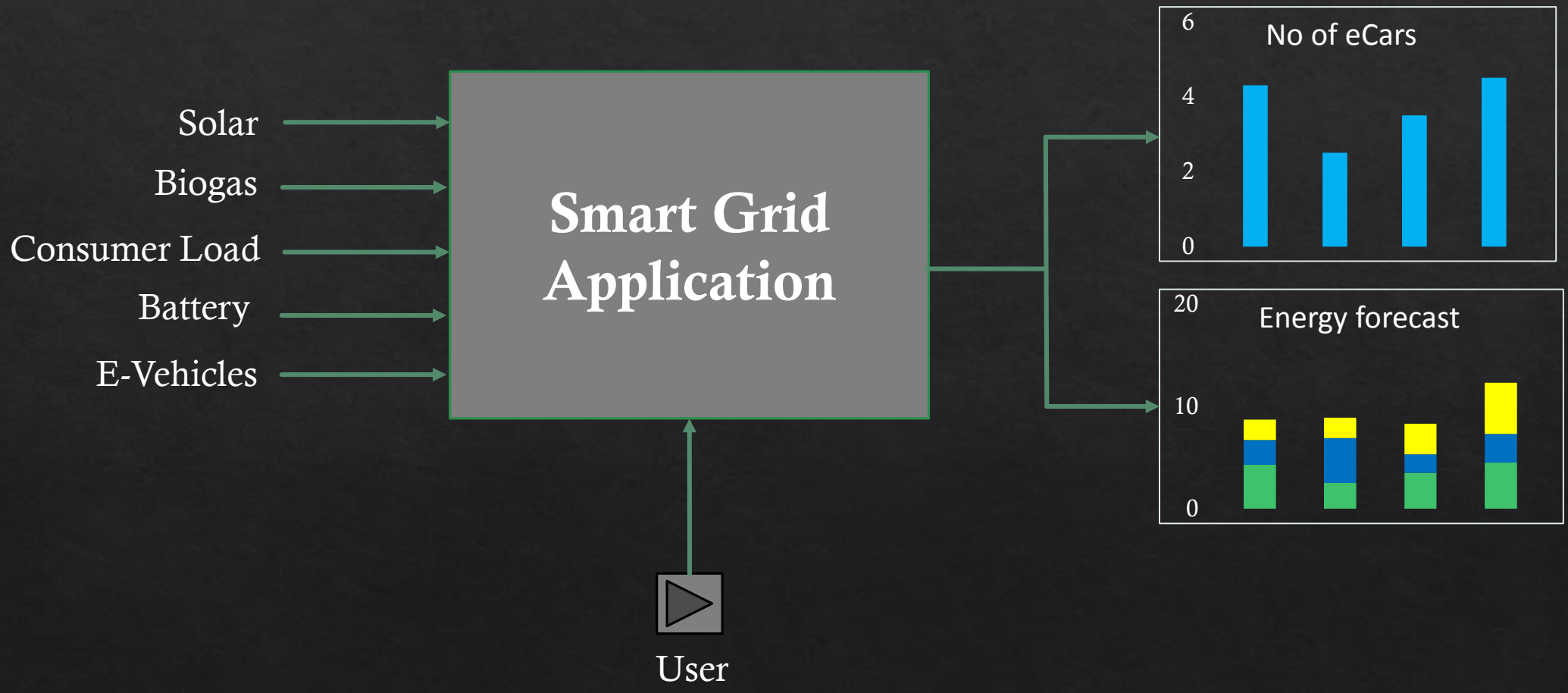
Smart Grid

The digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines makes the grid smart



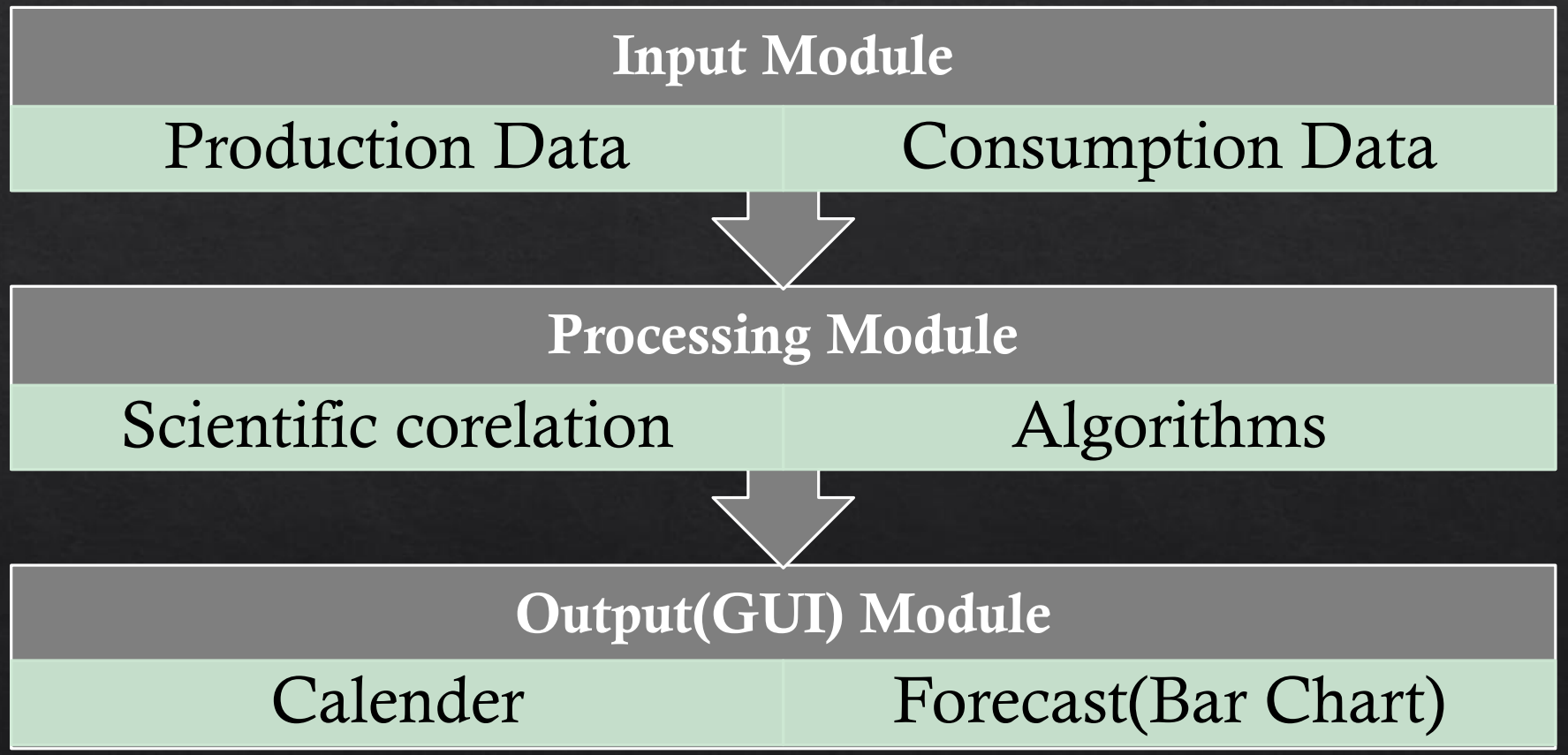
Design Model

- Smart-Grid Application:



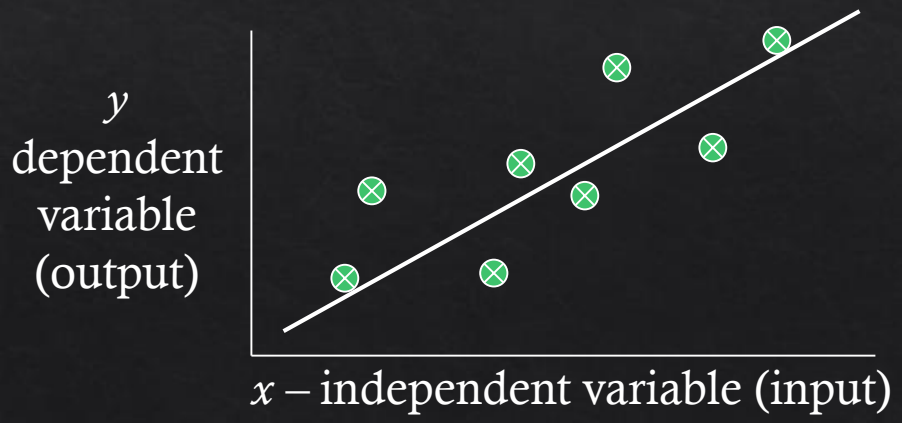
Design Methodology

- Modular Approach:



Regression

- For classification the output(s) is nominal
- In regression the output is continuous
  - Function Approximation
- Many models could be used – Simplest is linear regression
  - Fit data with the best hyper-plane which "goes through" the points



Simple Linear Regression

- Simple linear regression is a statistical method that allows us to summarize and study relationships between two continuous (quantitative) variables:
  1. predictor, explanatory, or independent variable
  2. response, outcome, or dependent variable.

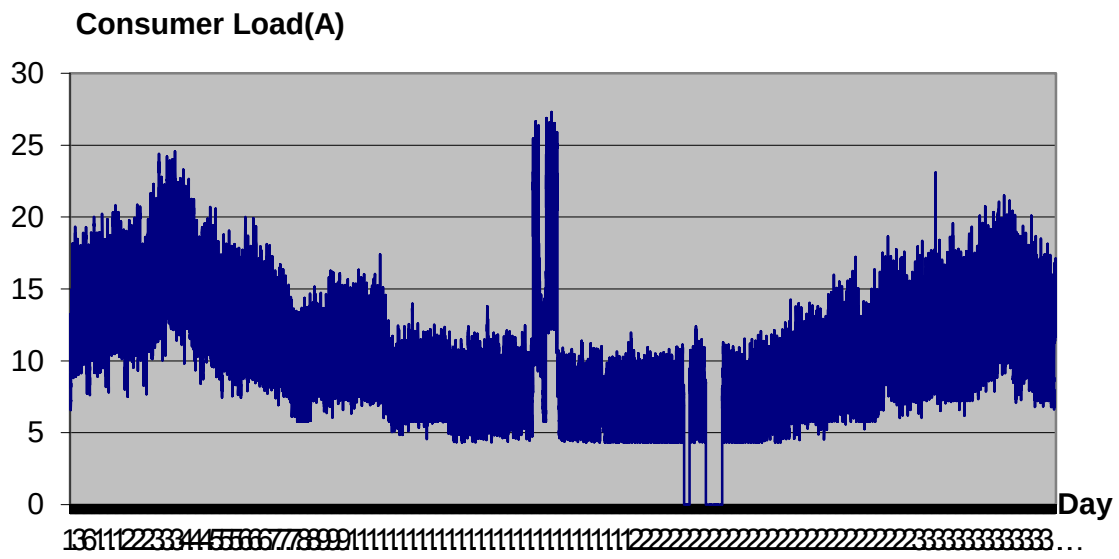
$$Y = b_0 + b_1 X$$

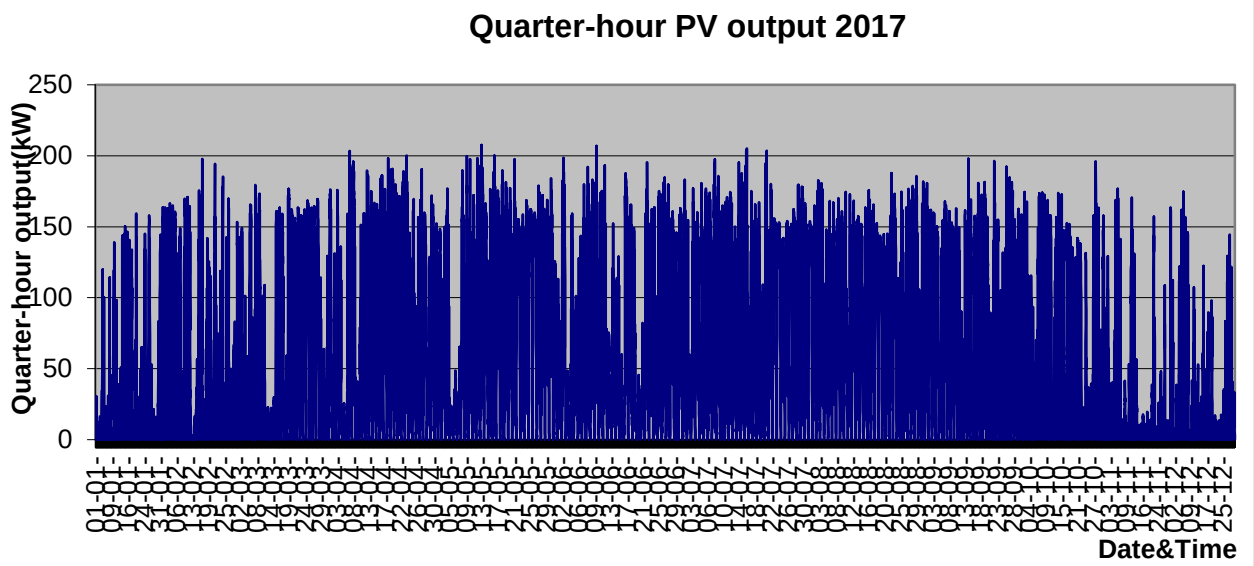
One nice advantage of linear regression modelS is the potential to look at the coefficients to give insight into which input variables are most important in predicting

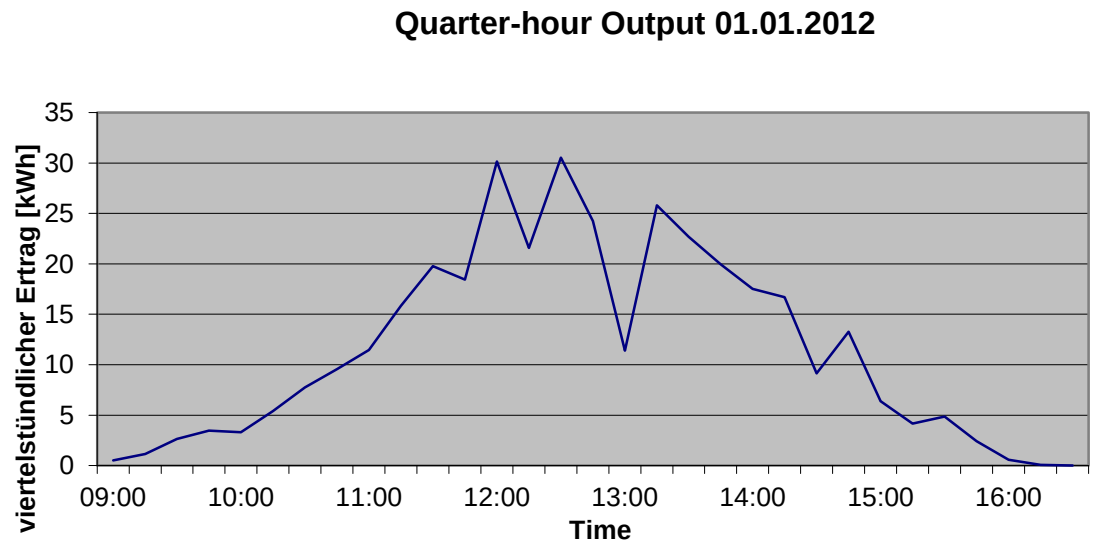
- The variables with the largest magnitude have the highest correlation with the output
  - A large positive coefficient
  - A large negative coefficient
  - A small or 0 coefficient suggests - uncorrelated with the output

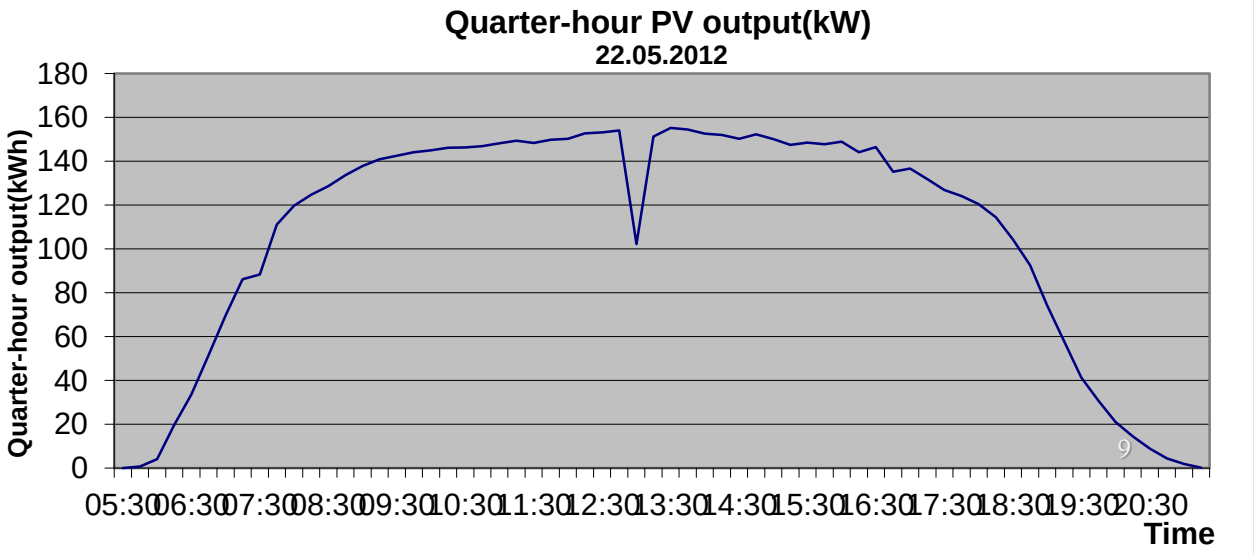
    Linear regression can be used to find best "indicators"

Data Analysis









Output Expectations

- Accuracy by trial- and error methods
- Stacked Bar Plot Visulaization:
  - Predictions of number of eCar‘s that can be charged
  - Daily load (Energy Demand) forecasting
  - Correlation of Consumption of Energy with that of Generation
- ..

Future Scope

- Extending operation of the application to monthly/yearly load forecasting
- Integration of smart meters into the application for consumer engagement
- Predicting dynamic changes in cost of elctrical energy
- Inclusion of Distributed Generation (small scale power generation)