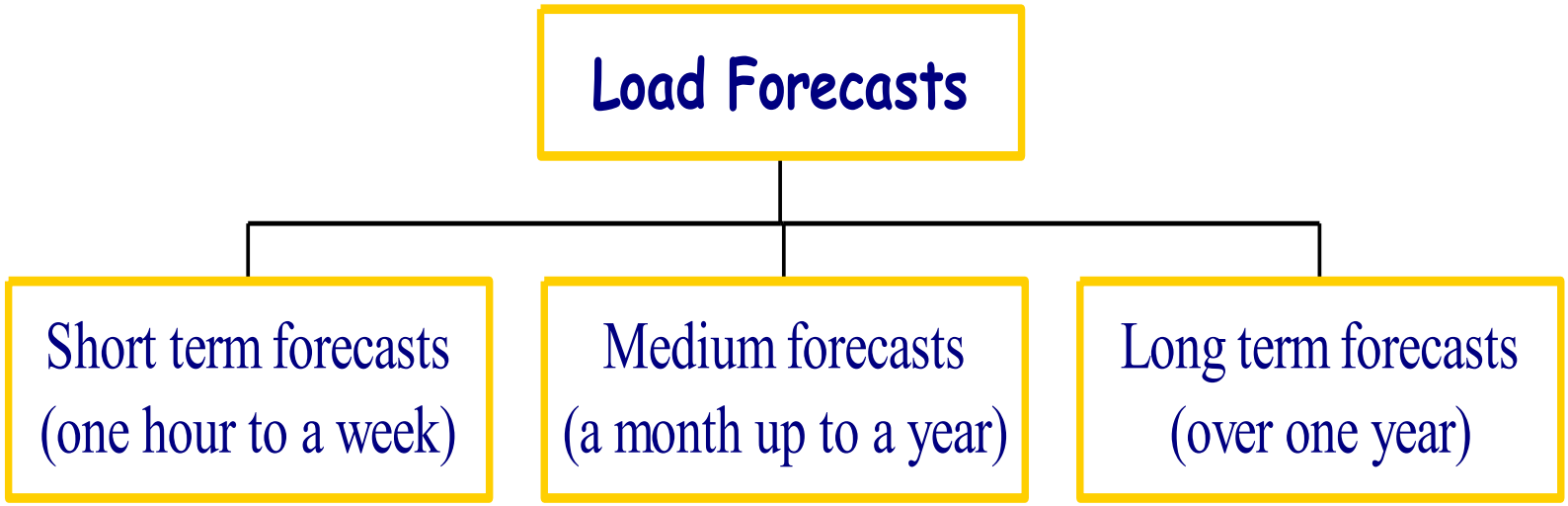
Section B

Power Generation Planning-POWER GENERATION PLANNING: Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plan t factor, capacity factor, selection of un it size, No. of Un its, reserves, cost of power generation, Depreciation, tariff.

Importance of Load Forecasting in Deregulated Markets

- Purchasing, generation, sales
- Contracts
- Load switching
- Area planning
- Infrastructure development/capital expenditure decision making

Types of Forecasting



Factors for accurate forecasts

- Weather influence
- Time factors
- Customer classes

Weather Influence

Electric load has an obvious correlation to weather. The most important variables responsible in load changes are:

- Dry and wet bulb temperature
- Dew point
- Humidity
- Wind Speed / Wind Direction
- Sky Cover
- Sunshine

Time factors

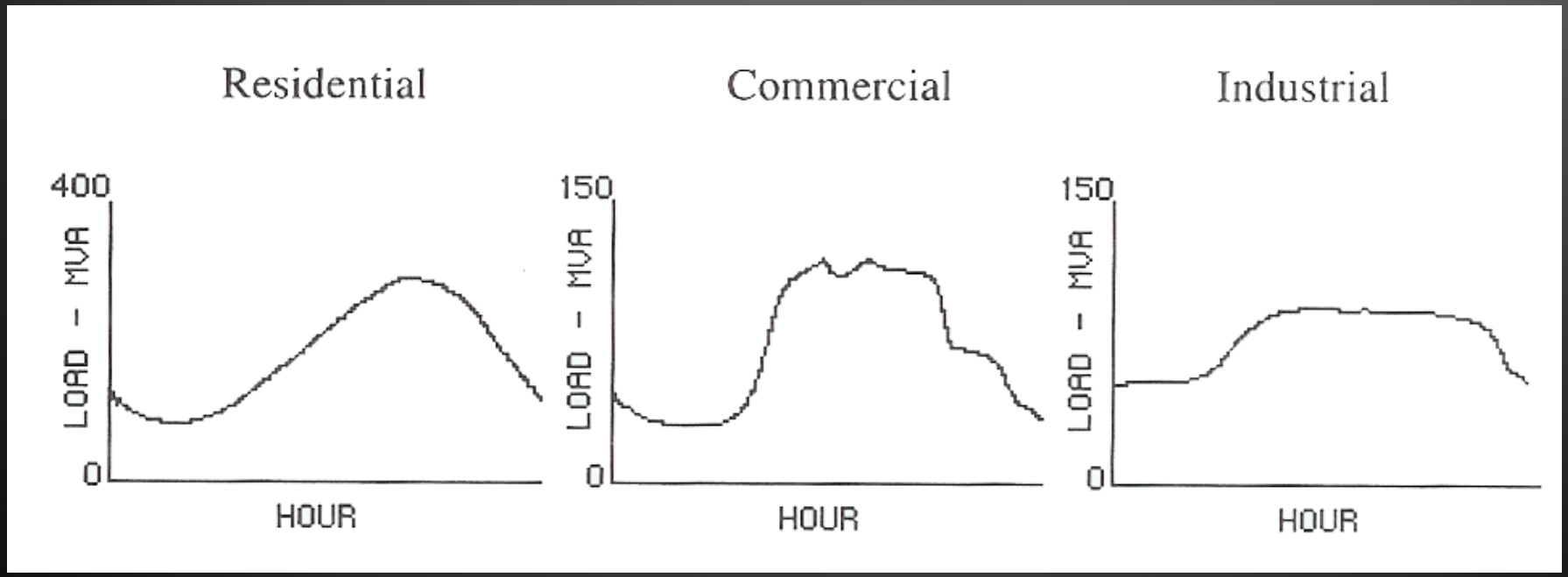
In the forecasting model, we should also consider time factors such as:

- The day of the week
- The hour of the day
- Holidays

Customer Class

Electric utilities usually serve different types of customers such as residential, commercial, and industrial. The following graphs show the load behavior in the above classes by showing the amount of peak load per customer, and the total energy.

Load Curves


Residential
400
LOAD - MVA
0
HOUR
Commercial
150
LOAD - MVA
0
HOUR
Industrial
150
LOAD - MVA
0
HOUR

Mathematical Methods

- Regression models
- Similar day approach
- Statistical learning models
- Neural networks

Our Work

Our research group has developed statistical learning models for long term forecasting (2-3 years ahead) and short term forecasting (48 hours ahead).

Long Term Forecasting

The focus of this project was to forecast the
annual peak demand for distribution
substations and feeders.

Annual peak load is the value most important
to area planning, since peak load most strongly
impacts capacity requirements.

Model Description

The proposed method models electric power demand for close geographic areas, load pockets during the summer period. The model takes into account:

- Weather parameters (temperature, humidity, sky cover, wind speed, and sunshine).
- Day of the week and an hour during the day.

Model

A multiplicative model of the following form was developed

$$L(t)=L(d(t),h(t))\bullet f(w(t))+R(t)$$

where:

- $L(d(t),h(t))$ is the daily and hourly component
- $L(t)$ is the original load
- $f(w(t))$ is the weather factor
- $R(t)$ is the random error

Model Cont:

Electric load depends:

- on the current weather conditions
- weather during last hours and days.

The regression model used is

$$f_{w_t} = \beta_0 + \sum_{i,\Delta} \beta_{i,t-\Delta} X_{i,t-\Delta}$$

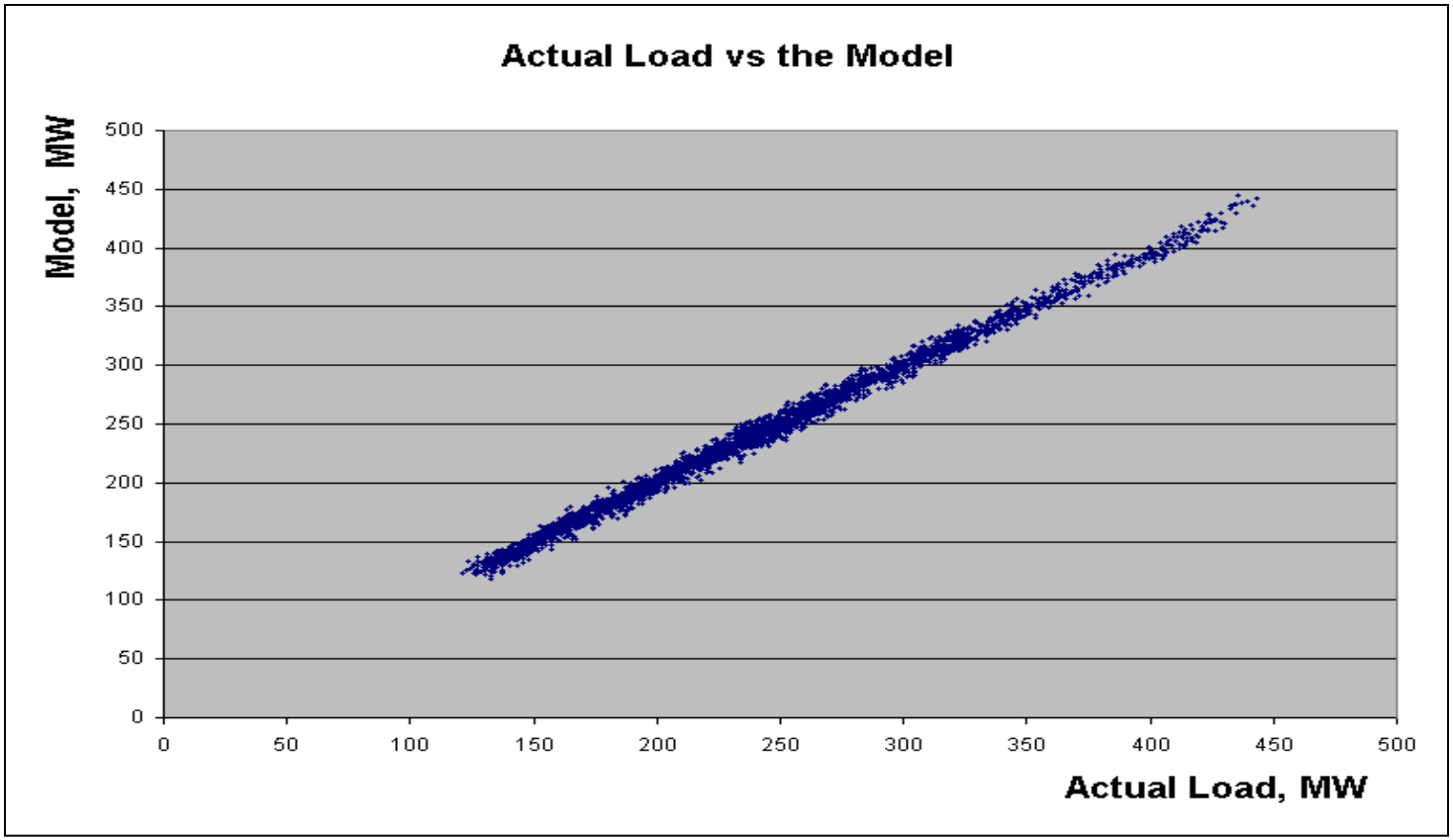
where $X_{i,t-\Delta}$ are non-linear functions of the appropriate weather parameters.

Computational Results

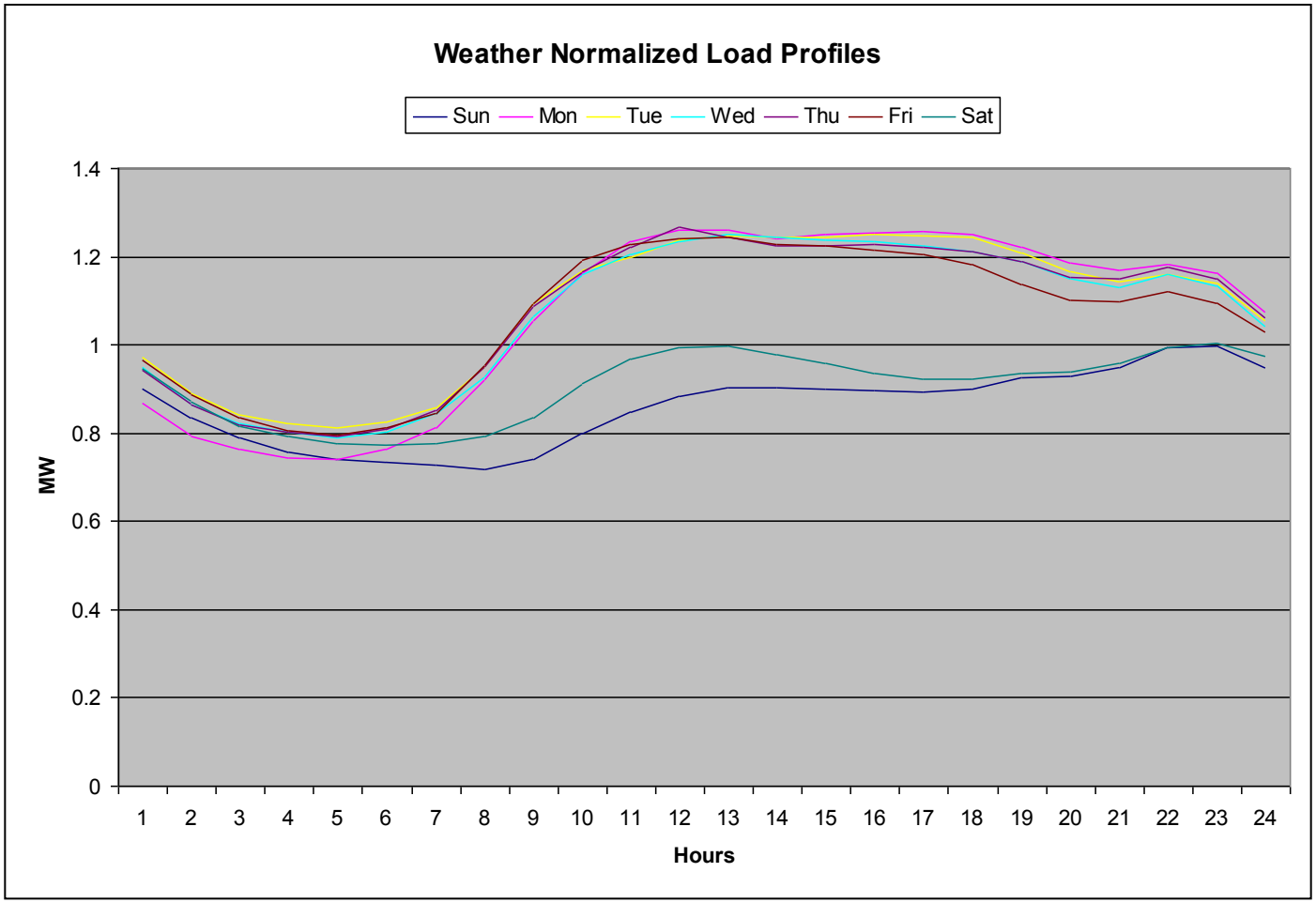
The performance of proposed method was evaluated from the graphs of the weather normalized load profiles and actual load profiles and from the following four statistical characteristics:

- Scatter plot of the actual load versus the model.
- Correlation between the actual load and the model.
- R- square between the actual load and the model.
- Normalized distance between the actual load and the model.

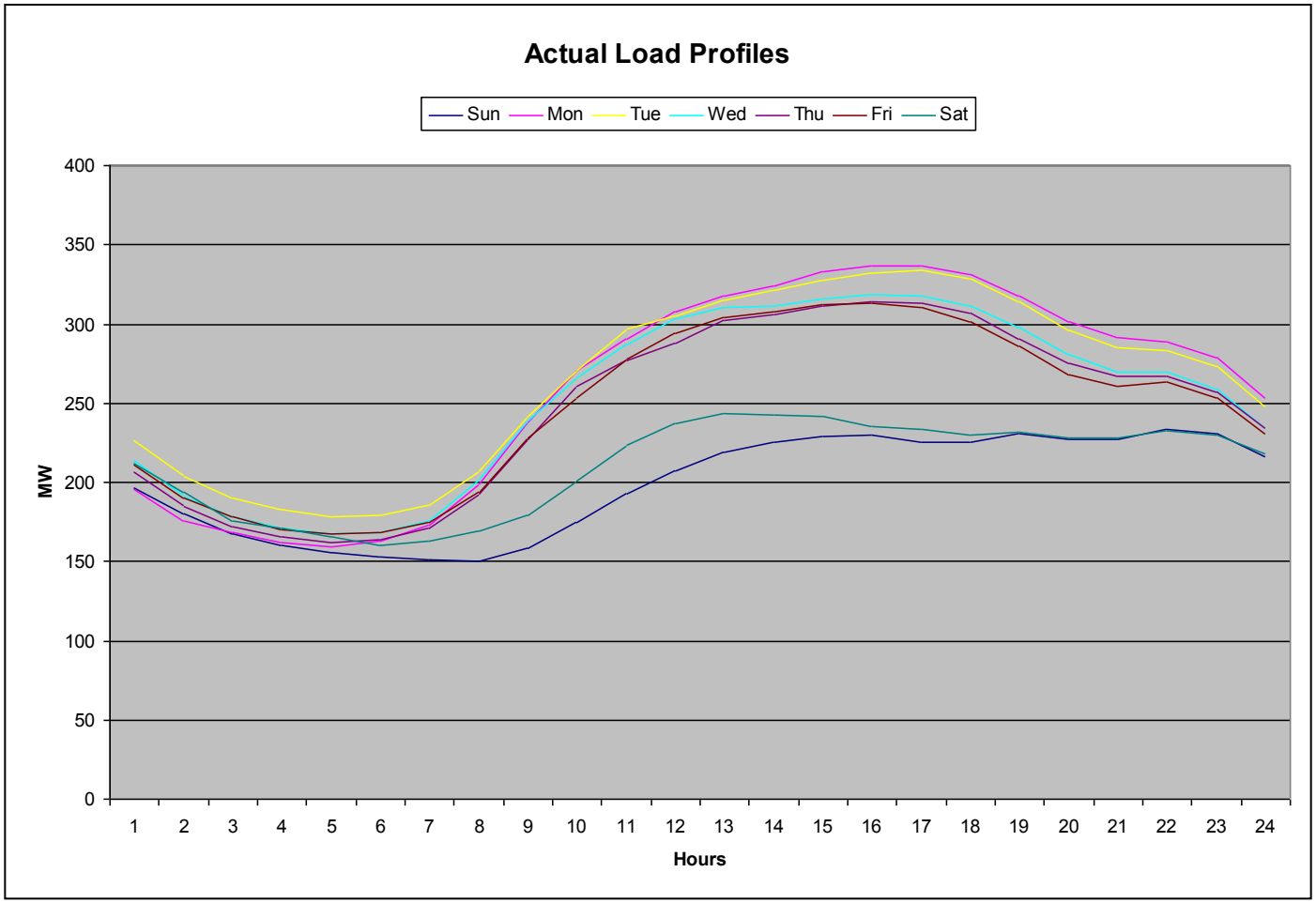
Scatter Plot of the Actual Load Vs the Model



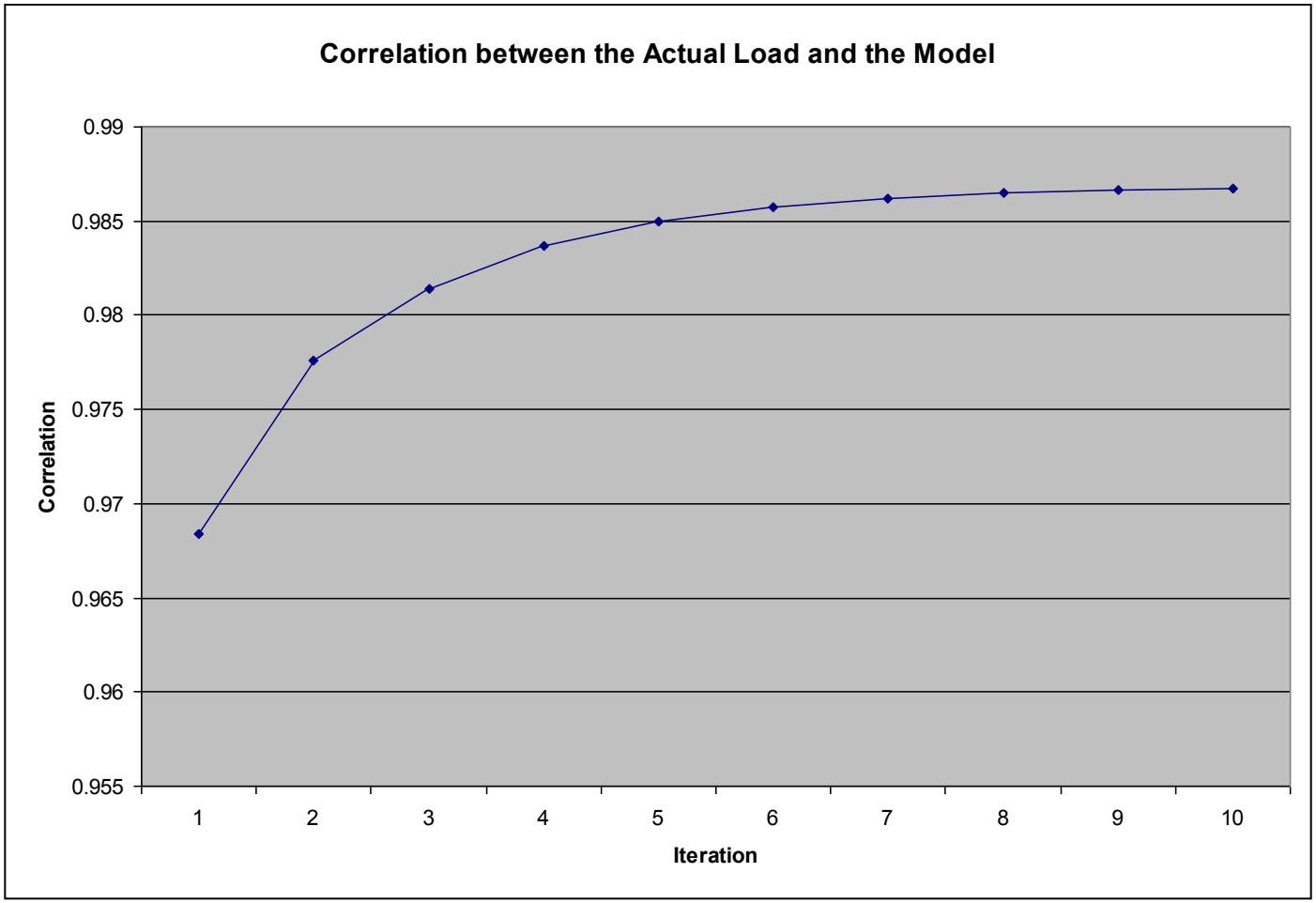
Weather Normalized Load Profiles



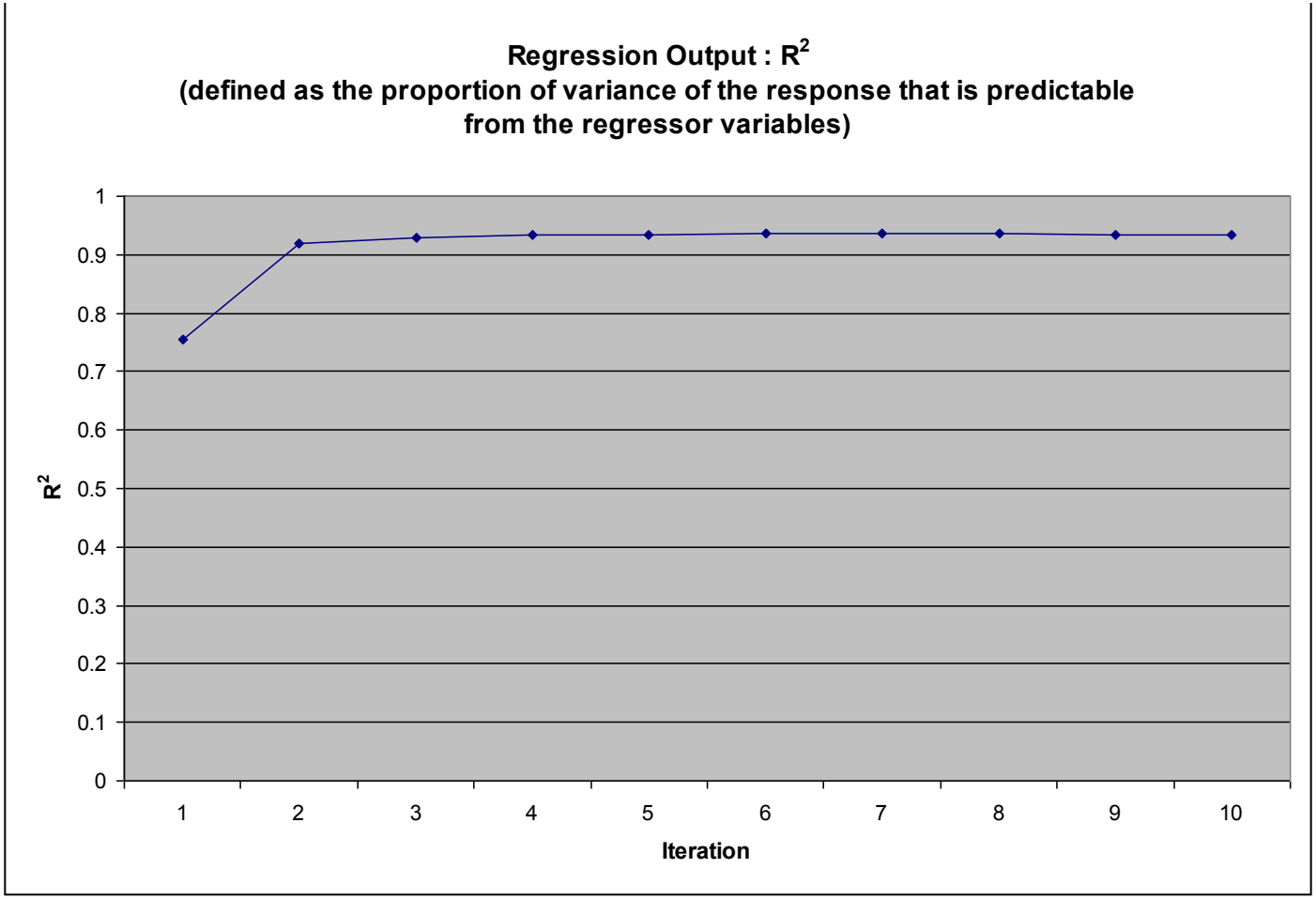
Actual Load Profiles



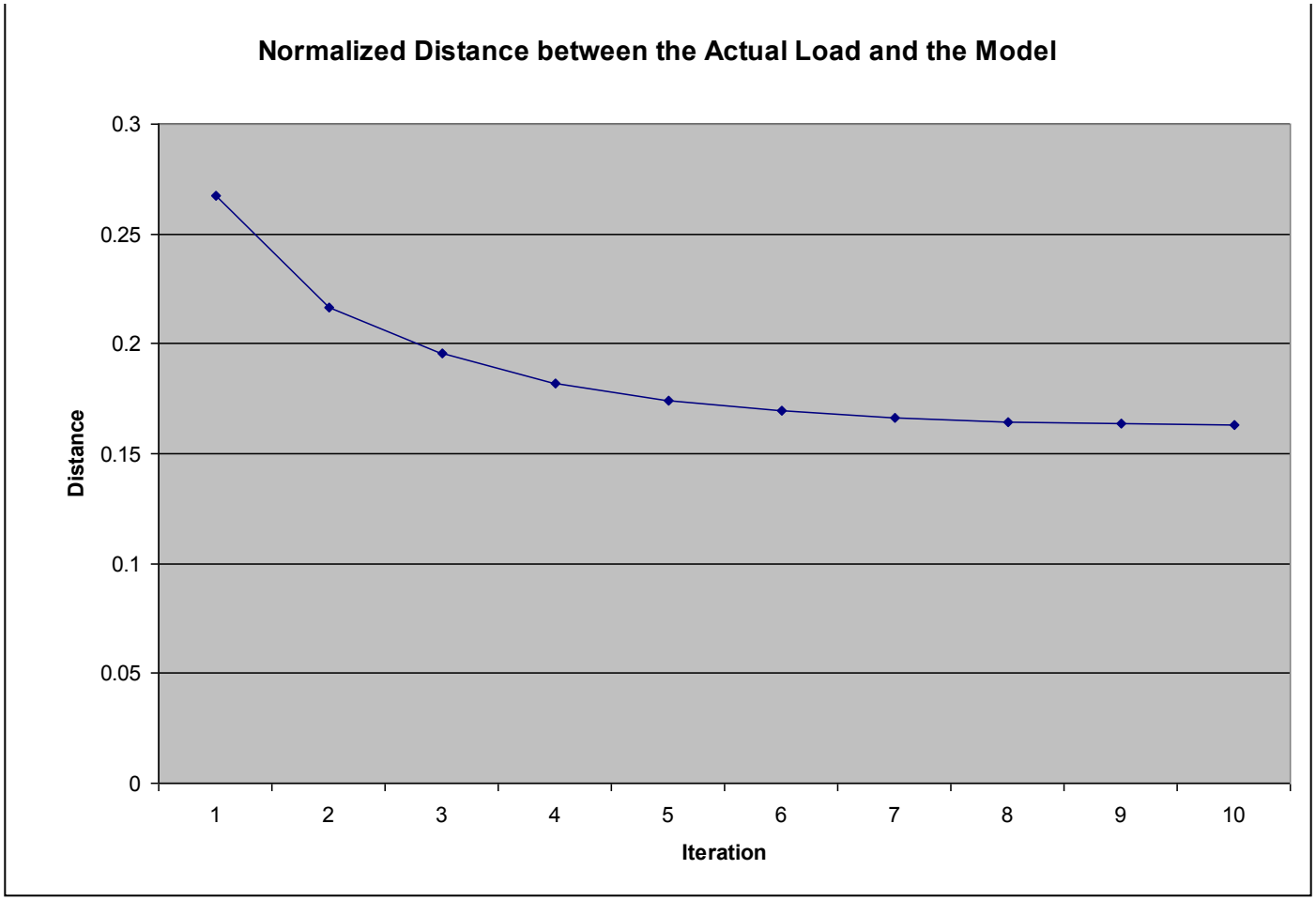
Correlation Between the Actual Load and the Model



R-square Between the Actual Load and the Model



Normalized Distance Between the Actual Load Vs the Model



Short Term Forecasting

The focus of the project was to provide load pocket forecasting (up to 48 hours ahead) and transformer ratings.

We adjust the algorithm developed for long term forecasting to produce results for short term forecasting.

Short Term Load Forecasting