

# A Deep Learning Based Strategy to the Energy Prediction

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## ABSTRACT

*With the high industrialization in a rapid pace, optimizing the production and distribution of energy has become a popular issue in this century. As for the energy planning, the analysis of supply usually starts from the perspective of the supplier that takes into account production at the minimum cost while meeting demand. On the other hand, the analysis of demand gradually draws much more attention in recent years, as it mainly focuses on finding out the demand pattern. Inasmuch as the rapid progression of AI technology in the industrial field, the application of AI technology in the technology management has become an increasing issue as an interdisciplinary study. To fulfill this advanced analysis in an intelligent way, this work focuses on the analysis of demand starting from predicting the demand for energy by deep learning. This work predicts the future energy demand by giving historical production data to the neural network and estimates the energy demand. Once the energy demand is predicted through the proposed method, the enterprise can use it as a basis for the decision making of production policy or investing policy.*

**Keywords: Deep learning, Energy industry**

## 1. INTRODUCTION

In recent years, with the rapid pace of industrialization, more and more factories were set up in Taiwan. The demand for energy has been dramatically increased since 1970. Most of the increment comes from commercial power which almost double in the past 20 years, and the percentage comes to 55.82% among total demand for electricity.

However, shutting down of the nuclear power plant makes a lot of enterprises start to worry about the shortage of electricity. Factories may encounter loss if the electricity suddenly runs out, while enterprises

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considering to invest in Taiwan take electricity limitation into consideration.

It seems that whether to the companies that already have factories in Taiwan or the enterprises which are considering to invest in Taiwan, the prediction of electricity demand become a critical problem. Accurate prediction of electricity demand can help company avoid dilemma of running out of electricity for two reasons. First is that they can negotiate with Taiwan Power Company for the guarantee amount of electricity. Second is that they can calculate the amount of electricity that they need to generate themselves or buy from other electricity supplier.

On the other hand, prediction of the electricity price could help companies to manage their cost. Cost management is always a issue in company management. With a precise control of cost, the company can think about a long-term strategy which can push the company to a better development.

## 2. RELATED WORK

### 2.1 Case I

In Japan, household electricity market is going to be liberalized in 2016. As a result, they will need to propose a method of short-term electric demand prediction of the following days, so that they can control the balance of electricity supply and electricity demand. Yusuke Kobayashi, Rikiya Abe, Kenji Tanaka[1] propose a naive and easy-to-use method to predict the hourly or half-hourly electric demand of the following days. This method consists of two parts. The first is a prediction of an aggregate electric demand of a day, and the second part is to predict an electricity demand curve of a day.

In the first part, they divided the past days into four part by the temperature of the day and the average temperature of the previous day and two days before

with k-means algorithm. Later they make demand predicting function of each cluster by undertaking multivariate analysis which take the day of the week and weather data as parameters. In the second part, they first divide the past days data into forty-two clusters, and then calculate the demand base and the peak pattern of each cluster.

## 2.2 Case II

Energy consumption can be affected by many reasons, for example, external macroeconomic environment, population, level of industrialization ...etc. Wang Jin-ming, Liang Xin-heng [2] took primary industry output value, output value of the secondary industry, tertiary industry output value, GDP, population, urbanization and energy use efficiency respectively as input variables, while the output variable is energy consumption. As mention above, the structure of neural network is seven input neurons with one output neuron. The optimal number of the hidden layer is 8, which is gotten by try and error. Taking the data from 1978 to 2004 as the training data, 2005 to 2007 as testing data, the model could get the error mostly lower than 0.15 with 2000 times training.

## 3. METHOD

The method proposed here is a simple one and it has two sections. The first is to clustering the history data by the amount of production of the day, previous day, and 2 days ago into several cluster. The clustering algorithm would be k-means. Later we take the separated data and feed it into neural network to try to get the demand prediction of electricity of each cluster.

### 3.1 K-means

K-means is a widely used unsupervised clustering method[3]. The goal of k-means is to allocate data points(for example  $x_1, x_2, \dots, x_n$ ) into several(for example k) sets( $s_1, s_2, \dots, s_k$ ), which can maximize the similarity between data points within the same set and minimize the similarity between data points in different sets. The process of K-means is down below:

1. Initialization: First we randomly select k points as the initial centers
2. Allocation: Group the data points to the nearest center
3. Update: Calculate the new center by getting the mean of each set of data points
4. Allocation: Group the data points to the nearest center again

5. Iteration: Repeat step 2 and 3 until data points stay in the same cluster

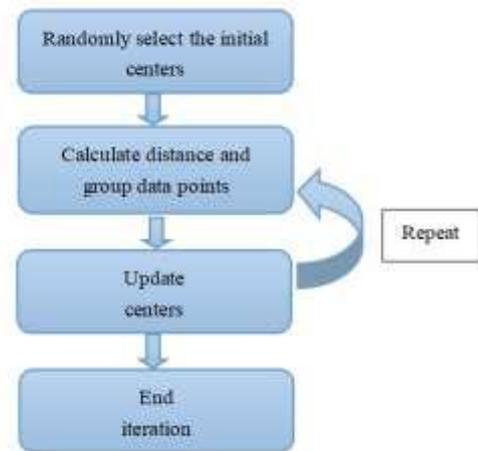


Fig 1: K-means.

### 3.2 Artificial Neural Network

Artificial neural network[4] is a machine learning method which is inspired by biological neural networks. It basically contains three layers, which are the input layer and the output layer. Each layer is based on a collection of processing nodes, which is called neurons, with adjustable weight. The number of neurons in input layer, hidden layer, output layer, initial weights, activation function, connection way between layers could be designed by the user.

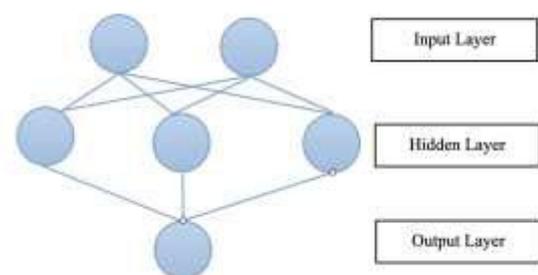
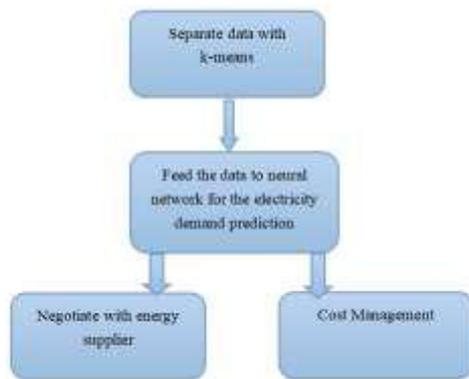


Fig 2: Artificial neural network

### 3.3 Process of the proposed method

With the precise demand prediction, the company can negotiate with the energy supplier to get the guaranteed amount of energy. Besides getting rid of the emergency of running out of electricity, electricity demand prediction can also help cost management. It's the whole process of the model below:



**Fig 3: Process of the proposed method.**

#### **4. Conclusion**

With the propose method, we hope to help company that is encountering the problem of unknown demand electricity. Once the company learns their energy demand pattern, they can search for other energy supplier if Power Company cannot provide enough electricity. For the company that are considering to invest new factories, they could find the most suitable place with the minimum cost.

#### **5. REFERENCE**

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