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# A review of work done in forecasting electricity load

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**ABSTRACT**: Improper and inefficient usage of energy in the country/state leads to unnecessary wastage of earth's resources. The electricity once generated cannot be stored efficiently. Thus, if excess of electricity is generated, it is wasted, if less of electricity is generated, there is shortage in the state leading to power cuts. Both situations lead to unwanted results.

Successful modelling of the electricity generation can lead to effective usage of the infrastructure and the resources provided. It has environmental as well as monetary benefits. The paper will aim at understanding the dependencies of the electricity used.

If we can understand these dependencies and the pattern followed in electricity usage (if found), the electricity generation and allocation can be modelled to meet the requirements as well as reduce the wastage of the resources. In countries like South Korea, North America, Europe and Japan, the electricity generation is planned and modelled which pushes us to follow the same in India as well.

**KEYWORDS**: Electricity load, forecasting, short term electricity load forecasting, Very short term electricity forecasting

## I. INTRODUCTION

With the urbanization of the human civilizations and the dependency of the human civilizations on electricity, it becomes necessary to make sure that electricity can be provided to the humankind. The present technologies and advancements are so dependent on electricity, that if electricity is taken away from us, we shall be back to the Stone Age.

Further, since we are so heavily dependent on electricity, we must make sure we do not exhaust the resources and the means to produce electricity. The essential problem with electricity is that we still do not have the technology to store all the energy that we generate. We must generate only as much electricity as we require or we end up wasting it. Resources are required to generate this electricity, which are exhaustive as well. Care must be taken when using these resources.

To generate the right amount of electricity, we must take interest in the ways this electricity is used. This is different for different places depending on the traditional practices as well as the quality of life of the people. Electricity can no longer be generated based on the data of the previous day as it is very vague. Better models can be used which can reduce the wastage of this electricity and bring down errors in prediction to 1- 10% depending on the depth of the data collected and the model used.

Thus, electricity must be considered as an exhaustive resource and used as such. Taking as much as needed and preserving the rest for the future (in case of electricity, generating as much as needed, and keeping the rest of the resources for future) has become an important habit that must be adopted by the human kind to survive.

## II. LITERATURE REVIEW

The paper published by J.M.W Rhys [1] on Techniques for forecasting Electricity Demand forms the backbone of this research. In his paper, he examines various techniques used by the industry for forecasting electricity demand. The

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Vol. 2, Issue 6 , June 2015

motive of this paper is to look at the various available techniques of examination through econometric analysis of fundamental econometric factors that determine the electricity demand in India. The third technique stated in paper by J.M.W Rhys is the one based on detailed research into the nature of use of energy which is not exclusive of the previous technique and thus goes in hands with it. J.M.W Rhys further goes into statistical interpretation of trends which is one of the motives of this research and aims to interpret the trends or pattern in the electricity demand in India. This econometric approach certainly has limitations i.e. one of the assumptions that the past econometric relationships will continue to exist in the future which is not always true. However, J.M.W Rhys doesn't fail to show the importance of the econometric approach which is indispensable in measuring the trends in terms of cause and effect. This approach explains the dependency of the electricity demand pattern on various parameters, finding which, is the motive of this research.

N.H Skinner [2] published a paper on "Load Research and Its Application to Electricity Demand Forecasting". He based his research in England and Wales and used the data recorded by the Electricity Boards. He defined the various uses of electricity in domestic households and showed a model for the electricity demand. He presented a graph to display the average demand by domestic consumers on winter weekdays.

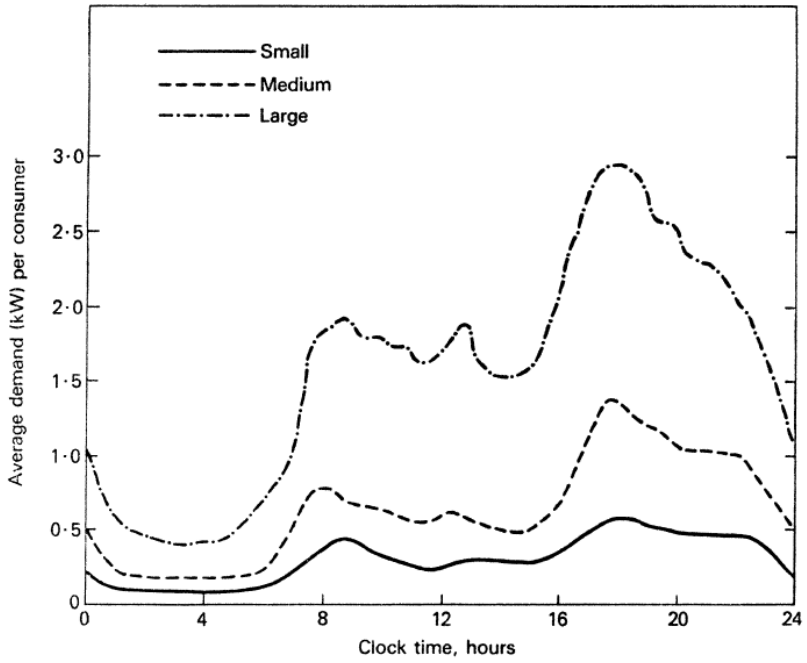


Figure 1 : By N.H Skinner [2]

This research follows a similar path in identifying the parameters and the uses of electricity in India and trying to define a model which can explain the electricity demand in India that can predict to a good accuracy the demand in electricity, thus, saving energy and avoiding unnecessary power cuts in the cities.

R. Fildes, A. Randall and P. Stubbs [3] conducted two case studies to show how complex multivariate approaches involving data on the effects of weather proved to be better than simpler extrapolative methods. Their research encourages us to take up the econometric approach even though it is more complex.

Trying to increase the accuracy of these methods, J. D. Bermúdez, J. V. Segura and E. Vercher [4] did work on the same using non linear programming software. They claim that their approach gives much more accurate forecasts using less data.

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 2, Issue 6 , June 2015

A. **SHORT TERM ELECTRICITY LOAD FORECASTING**

T.N Goh and S.S Choi [5] tried to describe an approach to short term forecasting which was based on the procedures followed in load management. They tried to make the procedure theoretically acceptable in 1983. They worked on the electricity supply of the Republic of Singapore which is managed by the Public Utilities Board (PUB). They proposed a much developed model of the one which was in use already. The existing model didn't use any mathematical model except visual reference to the load demand curve.

Georges A. Darbellay, Marek Slama [6] focus on the importance of electricity management and the incentives behind the same. They question the very nature of the data. They used the data available from Czech Republic. They presented the national electric consumption in the first 700 hours in January.

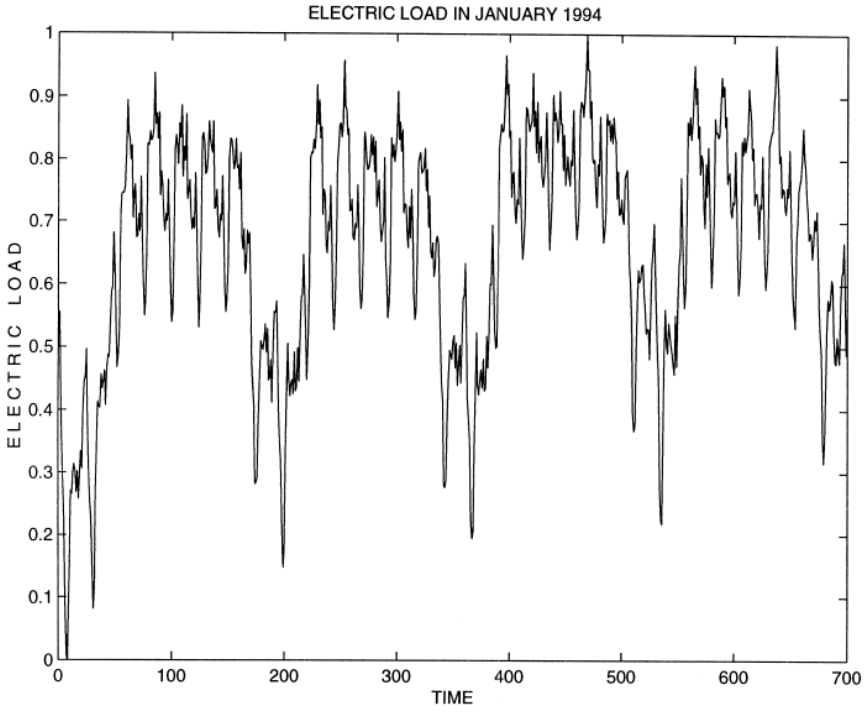


Figure 2 : By Georges A. Darbellay, Marek Slama [6], National electricity consumption for the first 700 h of January 1994 in the Czech Republic.

The nature of the randomness (linear or nonlinear) affects the choice of model. In the year 2000, there was much debate between the effectiveness of nonlinear models and linear models. Georges A. Darbellay and Marek Slama brought forward artificial neural networks as part of nonlinear models in short term forecasting.

James W. Taylor, Lilian M. de Menezes , Patrick E. McSharry [7] compared univariate methods for short-term electricity demand forecasting with the assumption that for very short lead times, multivariate methods can be replaced by univariate methods. The methods compared include exponential smoothing method for double seasonality and principal component analysis (PCA).

We are trying to relate electricity demand to various parameters. Temperature is one of them. D. J. Pedregal and P. C. Young [8] gave a univariate model to relate electricity demand with temperature. Their models went very well with other alternatives in forecasting load demand.

One of the most important extensions of this research can be about the electricity demand in rural areas and the most important parameters on which electricity demand is dependent in those areas. V. Ranganathan [9] worked on the same. He stated that "about 70% of rural electricity demand arises from agriculture, the model concentrates on electricity

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International Journal of Advanced Research in Science, Engineering and Technology

Vol. 2, Issue 6 , June 2015

demand forecasting for agriculture. " His claim makes venturing into the rural areas and taking agriculture as an important parameter necessary.

James W. Taylor [10], in year 2010, extended the three double seasonal methods (double seasonal ARMA, an adaptation of Holt–Winters exponential smoothing for double seasonality, and another recently proposed, exponential smoothing method.) to triple seasonal method to include the intrayear seasonal cycle.

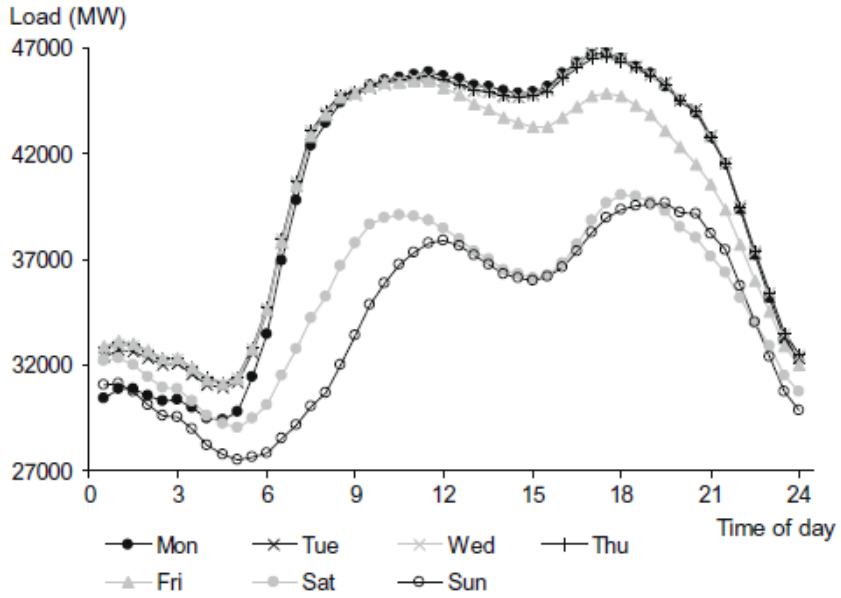


Figure 3 : By James W. Taylor [10], Average intraday cycle for each day of the week constructed using only in-sample observations for Great Britain.

Further, they proposed the use of combination of the forecasts from two of the triple seasonal methods.

### B. VERY SHORT-TERM ELECTRICITY LOAD FORECASTING

Anthony Setiawan, Irena Koprinska, and Vassilios G. Agelidis [11] presented a new technique for predicting electricity load using vector regression every 5 minutes using historical data from the Australian electricity operator NEMMCO for 2006-2008. They presented this new approach in 2009 and showed that this approach could outperform the traditional neural networks which are widely used in the industry and by researchers.
Han Lin Shang [12], in 2012, presented various models and forecasting methods for very short term electricity load forecasting.

## III.CONCLUSION

The review summarizes the work done in the field of electricity demand and shows the importance of research on the same in India. It points out various models and techniques which can be used to improve electricity load forecasting in India.

## IV. GLOSSARY

**a)** **Load forecasting –** The prediction of future consumption of a commodity or utility. In context of the paper, load refers to electricity demand or consumption.
**b)** **Modelling –** The process of making a set of assumptions about the course of generation of the data.
**c)** **Econometric approach –** Use of mathematics, statistics or economics to find a relation between different economical quantities.

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International Journal of Advanced Research in Science, Engineering and Technology

Vol. 2, Issue 6 , June 2015

**d)** **Multivariate approaches –** The study and analysis of more than one variable or economic quantity simultaneously.

**e)** **Extrapolative methods –** Methods based on the assumption that previous trends and patterns will not cease to continue and thus, can be used as effective factors for forecasting.

**f)** **Load demand curve –** Graphical plot between load demand and a specific time interval.

**g)** **Randomness –** Chance or unpredictability leading to results which cannot be explained through logical reasoning. This property is called randomness.

**h)** **Neural networks –** A group of statistical models which is used as a statistical tool to predict or forecast results which depend on various factors.

**i)** **Univariate model –** A model based on the definition of one single variable which is responsible for the variation in the results.

**j)** **Exponential smoothing –** A statistical technique used to produce a smoothed time series by assigning exponentially decreasing weights as time increases (gets older).

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