AIRO JOURNALS
Free / Unpaid
Peer Reviewed
Multidisciplinary
International

ISSN:2320-3714
Volume 3 Issue 3
September 2022
Impact Factor: 10.2
Subject: Engineering

ENERGY PREDICTION USING FORECASTING MODELS

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ABSTRACT

Energy is a major factor in the future development of the nation, a model system must meet the need for energy predictions in many industries. In the past two decades, the monitoring of forecasts has become an important component of business plan preparation. In this study we have discussed about the predictions for energy using forecasting models in which firstly we give the general overview about the topic then we have discussed Past Energy Consumption which includes Sector-wise and Comprehensive coal consumption in India, Sector-wise and total consumption of petroleum in India, Sector-wise and overall power usage in India, Sector-wise and total consumption of natural energy in India, then we discussed Input and Output of the Forecasting Model and Energy Demand Forecasting which includes Coal usage prediction for India, India Fuel Economy Predictions, Indian energy use forecast which concludes that The energy demand is growing quickly due to population and industrial development. Appropriate energy planning is necessary to fulfill this need after predicting energy consumption in future years.

Keywords: Energy prediction, forecast, consumption, models

INTRODUCTION

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The forecast of prospective dependent variables is based on the same or other past values. A wide variety of forecasting methods are provided in recent energy forecasting literature. The use of energy is characterized by significant changes throughout the period. It is quite a different year after year and there are changes in the season. In Energy System Planning it is of primary significance to develop a projection model that can correctly predict energy use.

In the current study, the predictive model of commercial energy use in India was attempted. For energy predictions for Commercial energy solutions, including the use of coal, oil, power, and energy, this study uses retroactive technologies, a double-moving average approach, twice exponential smoothing method, three times exponential smoothing method, an ARIMA model, and a NN (Auto-Regressive Integrated Move Average) model.

The energy forecasting for Indian coal, oil, electricity, and energy for different industries has been carried out. For future energy prediction, historical energy consumption, GNP (Gross National Product), and population expansion, all of these data are presented. For energy prediction, the various approaches applied for forecasting were regression, double moving average, double exponential smoothing, triple exponential smoothing method (ARIMA), ARIMA model, and Artificial Neural Network (ANN) model (Univariate and Multivariate). In addition, all forecasting techniques have been verified using MPE and the methodology least faulty has been adopted for forecasting.

LITERATURE REVIEW

De Gruyter (2020) A study and development of a smart energy monitoring information system, current techniques for creating a mathematical model of electricity systems. The major drawbacks and benefits of current modeling methods and their application to Ukraine and Kazakhstan energy systems are highlighted. The main variables affecting energy consumption dynamics are highlighted. A list has been created of key activities to be carried out to build algorithms to estimate power consumption for different items, industries, and levels.

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Barik's Swati Sucharita (2020) The use of electricity is one of computer architecture's largely researched areas for more than decades. One parameter in Machine Learning is Electricity Adoption. It is one of the new research fields. With no computational restrictions, it maintains an eye on excellent precision. After the forecast of electrical consumption, the article has the objectivity to evaluate the efficiency of machine learning methods. Load management and demand response are very effective variable selection, precise forecasting for the electricity market price. It maintains the biggest economic system. We aim to give the Machine Learning Community essential recommendations and fundamental knowledge about particular ways of estimating energy usage for machine learning algorithms. This paper discusses both conventional and new methods of machine learning to forecast the use of electricity. The collection of structural models and their respective applications are covered by several research publications. Depending on the past work analogy, the forecasts for the research reference are offered.

Kumar et al. Vishant (2019) Since the beginning of competitive marketplaces, demand forecasting has progressively been a key procedure for all kinds of decision-making processes inside the business. The majority of research throughout the years has concentrated on identifying patterns in prior product demand data. However, the demand for any product has seen the impact of growing uncertainty with changing technology and open market phases. Academics and practitioners realize that non-conventional prediction techniques based on probabilistic and artificial intelligence are now more essential than ever for planning and operations. This article compares conventional and non-traditional techniques of the many prediction parameters which assist to comprehend the significance of advanced approaches in the current competitive environment.

Srishti Shrivastava, Dr. Krishna Teerth Chaturvedi (2018) Forecasting energy demand is a key and essential procedure for the planning of periodic operations and development of power facilities. Due to the liberalization of energy markets, the pattern of demand is almost extremely complicated. It is not, however, a simple job to find a suitable predictive model for a particular grid. Although numerous techniques of

ISSN:2320-3714
Volume 3 Issue 3
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projection have been devised, none for all patterns of demand can be generalized. Since numerous variables influence electric charge data, machine learning techniques help predict electric charge (ELF). It is essential, for an ELF pre-processing phase, to identify the irrelevant variables. Artificial intelligence methods have thus become more important in minimizing estimate mistakes. Among these methods of artificial intelligence are the artificial neural network, vector support machine, and the adaptive neuro-fuzzy inference system. This article presents a thorough up-to-date evaluation of several artificial intelligence methods for short electric load forecasting.

Cerne et al. (2018) stated that energy load forecasting is a crucial study topic for distributors trying to reduce costs. There is thus an adaptive fuzzy model, specified across the whole input space to exchange information between various regions, which solves the issue of short-term load projections for the future.

Kwon et al. (2018) have reported on weekday analyses of STLF by applying a uniform ANN algorithm and by choosing input data. The findings demonstrate that when you use the maximum minimal norm and the selection of input data of the last two days, STLF's precision is excellent.

OBJECTIVES OF THE STUDY

- To analyze the Past Energy Consumption.
- To analyze the Input and Output of the Forecasting Model
- To analyze the Energy Demand Forecasting

DATA ANALYSIS

- **Past Energy Consumption**

The energy forecasting was made in different sectors concerning coal, oil, electricity, and natural energy. For future energy prediction, historical energy consumption, GNP (Gross National Product), and population expansion, all of these data are presented. For energy prediction, the various approaches applied for forecasting were regression, double moving average, double exponential smoothing, triple exponential smoothing

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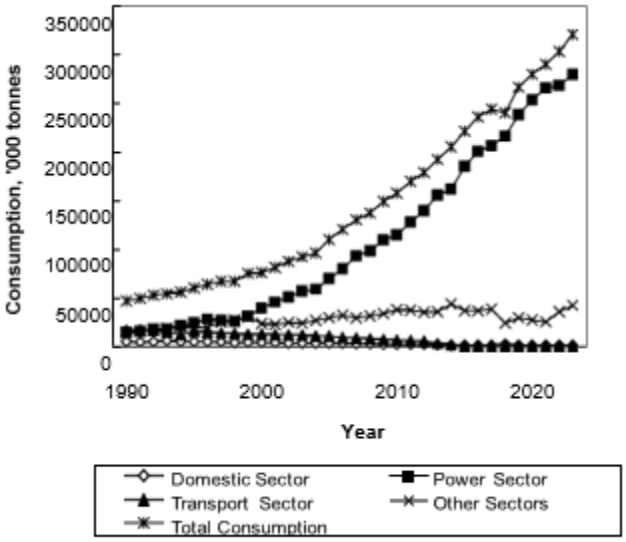

Figure 1: Sector-wise and Comprehensive coal consumption in India (1991-2020)

The consumption and total oil consumption in different industries from 1990 to 2020 are shown in Figure. The oil consumption has risen over recent years in the industrial and transport sectors, while the patterns of consumption are virtually constant in the agriculture, commerce, and residential sectors and the energy sector, and other industries. In the transportation sector, oil consumption is extremely high and followed by industrial consumption. Compared to these two sectors, the contribution of oil to the other areas is extremely low.

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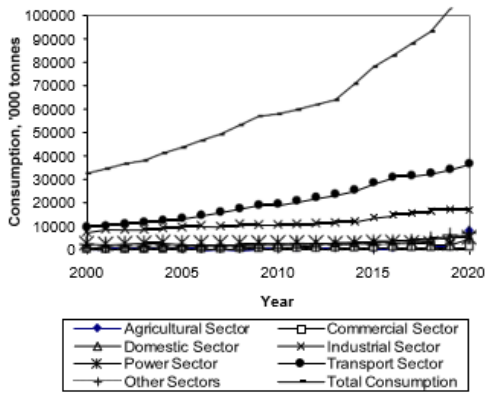

Figure 2: Sector-wise and total consumption of petroleum in India(2000 - 2020)

Figure 3 shows the electricity consumption and its total energy consumption in various sectors between 1971 and 2020. Data from the last 54 years have been utilized to carry out the analyses and electricity consumption in the industry has been on the rise in recent years. With the farming sector and the domestic sector, the consumption of electricity remained steady until 1985 then quickly increased. When compared to other sectors, electricity consumption was decreased in both the business and transportation sectors. Although there was a steady upward trend in total electricity consumption until 2000, significant growth thereafter reached 3609372 GWh in 2020.

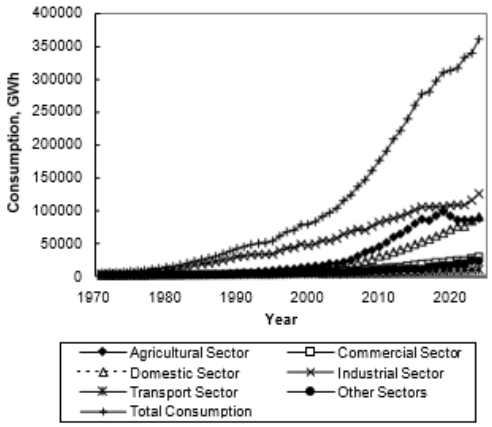

Figure 3: Sector-wise and overall power usage in India (1971-2020)

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Natural energy consumption is presented in Figure 4 for several sectors for the years 1972 to 2024. In the agricultural, domestic, and other sectors, the pattern of natural energy consumption was much lower, while in the industrial and power sectors there was a rising trend. Total natural energy consumption was steady until 1996, then consumption increased steadily and consumption reached 30900 million m^3 in 2004.

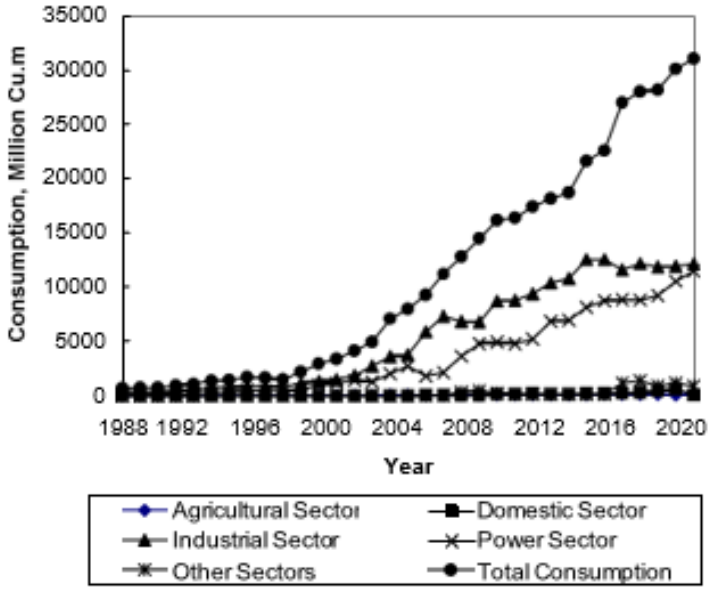

Figure 4: Sector-wise and total consumption of natural energy in India(1988 - 2020)

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- **Input and Output of the Forecasting Model**

For the planned use of business electricity usage, such as linear design, exponential systems, power and square models, double average move-by-move approach, dual single exponential, three-fold exponentials, ARIMA and ANN models (Univariate and Multivariate). The ARIMA model and multiple regression ANN model receive income from past consumer data, GNP, and birthrate, and only preceding consumption data for time serial regression models, namely linear, exponential, power model and quadric, double-speed, double-exponential, twice exponential, and univariate neural networking. Energy demand from various sources of energy such as coal, oil, electricity, and energy was forecast for the efficiency of all models The validation model was done, and any lower MPE was selected for the energy demand forecast.

- **Energy Demand Forecasting**

Figure 5 shows the forecast of coal consumption in several sectors in 2030, 2040, and 2050. Total coal consumption has been shown to increase every decade. This rise is because past coal consumption increases for electricity production every year. For the years 2030, 2040, and 2050 coal consumption in the Indian power sector was forecast to be 615857, 873724, and 994814 thousand tonnes. The predicted total coal consumption was estimated at 695518, 890143, and 159484 thousand tonnes in India in 2030, 2040, and 2050. The consumption of coal was found to be insignificant in the domestic, transport, and other sectors.

Figure 6 shows oil consumption forecasts for 2030, 2040, and 2050 in several sectors in India, such as the agricultural, trade, domestic, industrial, power sector, transport, and others. The report also highlights the projections of Indian total oil consumption for 2030, 2040, and 2050. Oil usage is gradually increasing every year in all sectors. The following sectors have been estimated to be 1899, 3242, and 5435000 tonnes, for agriculture: 1694, 2591, and 3650 000 tonnes, 28803, 42005, and 57719000 tonnes, according to the Indian oil consumption projection for 2030, 2040, and 2050. In India, the projected volume similarly stood at 221020, 415373, and 720688 thousand tonnes, for the years 2030, 2040, and 2050.

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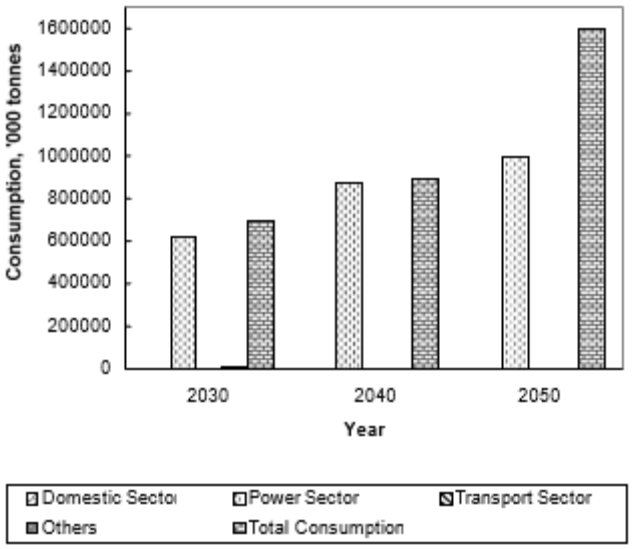

Figure 5: Coal usage prediction for India

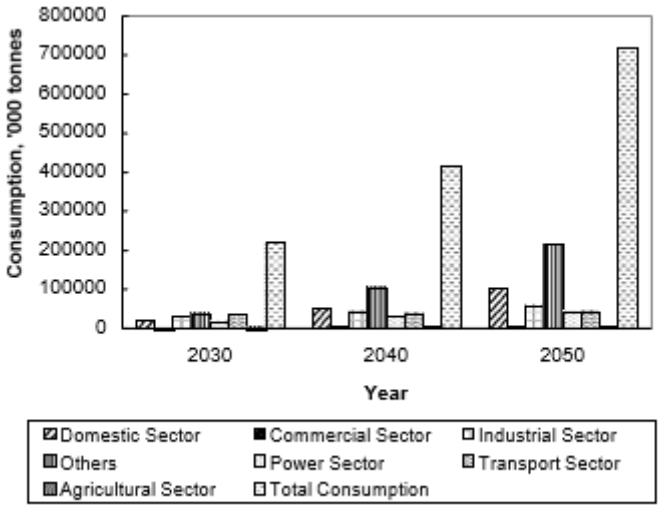

Figure 6: India Fuel Economy Predictions

Figure 7 illustrates the estimates for energy consumption in the world for 2030, 2040, and 2050, across various sectors, such as agriculture, commerce, households, industries, transport, and others. It has been discovered that, due to technical advances and an upsurge in human living standards and lifestyle, overall power consumption increases fast every year. The agriculture sector is expected to have 2,350117, 414754 and 669158 GWh, 43166 and 72740 and 114210 GWh, respective in commercial

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sectors, 160524 and 467619 GWh in domestic markets, and 43166,72740 and 114210 GWh, in the industrial sector 160392, 210974 and the industrial sector 268385, in the industrial industry 68461, 101553 and 118126 GWh, respectively, Furthermore, for the years 2030, 2040 and 2050 India had a forecast total energy use of 603382, 993385 and 1395754 GWh.

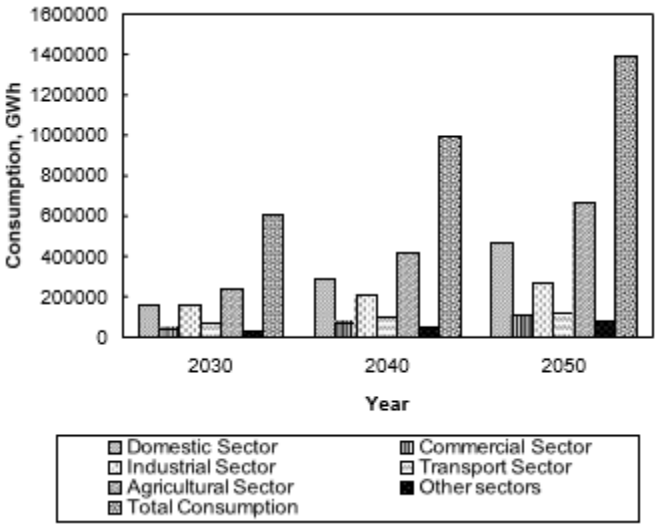

Figure 7: Indian energy use forecast

The prediction for energy usage in the country in 2030-2050 in different sectors such as agricultural, residential, industry, energy, and other fields indicates that energy consumption in every sector is increasing every year. Figure 4.8 illustrates the predictions. In the Indian consumption sector respectively 189 million, 231 million, and 257 million m^3, 947, 2554 million m^3 and 6905 million m^3, respectively, in the domestic sector in 2010, 2020, and 2030, 18729, 25992 million $m^{3,}$ and 34663 million m^3, in the industrial sector 16565, 25915 and 37396 million m^3 and in the power sector 754, 13899 and 20044 million m^3. In addition, for 2010, 2020, and 2030 India has forecast total natural energy consumption at 49033, 83709, and 137169 million m^3, respectively.

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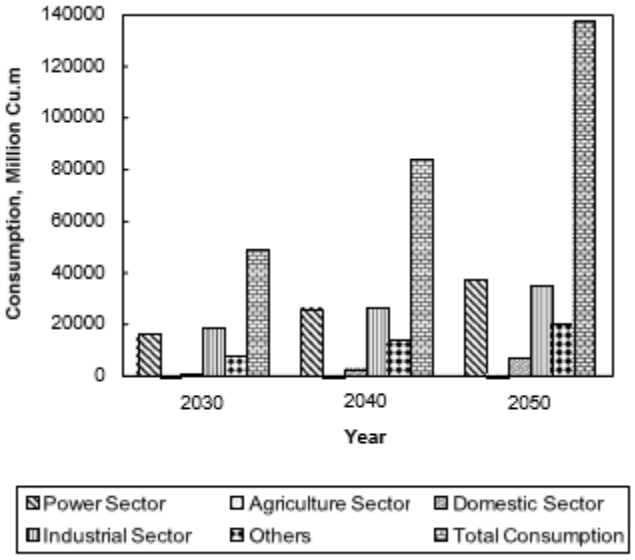

Figure 8: Indian Energy usage forecast

CONCLUSION

From this study we had concluded that the energy demand is growing quickly due to population and industrial development. Appropriate energy planning is necessary to fulfill this need after predicting energy consumption in future years. The current energy situation shows that more trade sources of energy, such as coal, oil, and electricity, are used. In the future, it will not be healthy in the environment if the same tendency is maintained. Renewable energy sources, such as solar, wind, and biomass, may be introduced to maintain a clean environment and protect the deteriorating nature of fossil fuels.

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