

A Meta Analysis of Natural Gas Consumption

Sunil Kumar Dhal¹

¹ Sri Sri University,

Received: 13 December 2017 Accepted: 1 January 2018 Published: 15 January 2018

Abstract

Natural Gas is considered to be one of the leading energy sources for India which provide pollution free, flexible to move to our industry. Due to limited Natural Gas resource, it is a challenge to conserve, utilize our resource in an optimal way. For this a number of authors are tried to predict the natural gas consumption in short and long term basis using mathematical and computational Techniques. The objective of the paper is to meta-analysis the papers published related to Natural Gas consumption for the year 2002-2017. This research helps to find out a better and accurate prediction techniques in short and long term basis for prediction of Natural Gas Consumption(NGC).

Index terms— NGC.

1 Introduction

Natural gas(NG) is an important energy resources that is becoming more and more popular because of its environmental benefits(lower impact on environmental pollution). All most all developed countries are concerned about the natural gas consumption due to low reserve. Omer Fahrettin Dem, IREL, Selim Zaim, 2011 predicted that china's natural gas consumption will continue to grow and expected to achieve 354.1bcm by 2020. Michael Ratner(India), 2017 on his research article, he found that the natural gas portion in india's energy mix is 7% as it remains small compared to that of the US and other developed countries like Brazil, China. India's target it to double the proportion of natural gas consumption by 2022. To achieve this goal we would require major upstream, midstream and downstream investments as well as the continued political will to take necessary steps and to decrease reliance on coal and oil. Therefore, demand for this source of energy has increased considerably in recent years. The largest increase in world's primary energy consumption is attributed to N.G as per U.S Energy Information Administration 2016.

It is projected that the Natural Gas consumption as primary energy source will increase to 2040 TCF compared to the recorded consumption 120 TCF in the year 2012-2013. As per British Petroleum(BP) global 2015 NG contributes 23.8% of the primary energy consumption globally and remains as the main fuel in production of electricity and as a fuel for the industry. monthly, quarterly and yearly basis. It has reviewed that the computational models were suitable for natural gas consumption for a better input parameters. The model efficiency not only depends upon the algorithm but majorly depends upon the input parameters. Every natural gas distributor is obliged to make a nomination of natural gas by its supplier, which is the amount of gas needed for the future days. There is a certain regulated tolerance that is allowed. In case the actual consumption exceeds the nominated amount, the distributor must pay a certain penalty. On the other hand, if nominated amount exceed actual consumption, different type of penalty will be charged as well. Since the incorrect nominations lead to high costs, accurate predictions of natural gas consumption for the following day are very important due to financial reasons.

2 II.

3 Methodology

For the research purposes, literature overview analysis was conducted using PRQUEST database. The keywords "natural gas consumption", "prediction of Natural Gas" OR "demand of Natural Gas", "Consumption of Natural Gas", "Prediction models in Natural Gas", were used for searching articles. The articles were searched within three indexes: Science Citation Index Expanded (SCI-Expanded), Social Science Citation Index (SCI), and Arts and Humanities Citation Index (A&HCI) for the period of 2002 to 2017.

This search resulted with 276 papers, including article (201), proceedings paper (28) and review (47). After reviewing the title, abstracts and keywords of all found articles, articles that are not related to models for prediction of CNG for residential or commercial use were eliminated. Thereafter, 72 articles remain that met posted criteria. Those papers were analysed according to several criteria: methods used for predictions of CNG, input variables used for modelling, prediction area and prediction horizon.

Similar literature review was conducted by Soldo (2012), who analysed natural gas consumption from the year 1949 to 2010 and Dario Sebalj, Josip Mesarie, Davor Dujak, 2017, he predicted the Natural Gas consumption from the year 2002-2017 using web of science core collection (WOSCC) database. Year 2018 J As it can be seen in Table 1, in the last three years 34 papers considering natural gas prediction were A number of researchers attempted to develop models for the prediction of NGC on daily, weekly, published, which is more than 55% of all analysed papers. (2016), who forecasted NG consumption using time series methods.

There are four papers in which weekly prediction of NG consumption was reported. Those are papers written by Potocnik et al. (2007), who proposed a forecasting model in order to forecast risk estimation, and Aynar et al. (2011), who used neural network and neuro fuzzy system for prediction of NG consumption on weekly basis. Dejan Ivezi? (2006) predicts natural gas consumption on weekly basis by using ANN model in Belgrade, Serbia. Ma?gorzata Trojanowska (2014) also predict on weekly basis by using Regression model in Poland.

There are many number of authors predicted NG consumption on daily level.

Gil & Deferrari (2004) proposed a daily prediction model in Argentina, Steven R. Vitullo, Ronald H. Brown; George F. Corliss, Brian M. Marx. (2009) Tonkovic et al., who created a prediction model of NG consumption by using neural networks on a regional level on hourly scale for predicting NG consumption, Sabo et al. (2011), who proposed mathematical models of natural gas consumption, and Szoplik (2015), who forecasted NG consumption in Poland using neural network models. Krzysztof N?cka, Ma?gorzata & Trojanowska who created a prediction model by using Regression model on a particular area on hourly basis to predict Natural Gas consumption.

4 IV. Overview of Prediction Methods

There are only seven papers that predicted natural gas consumption on regional level. Gil & Deferrari (2004) presented their results for the case of Greater Buenos Aires region in Argentina. Dejan Ivezi?. (2006) investigated the prediction of NG consumption in the region of Belgrade, Serbia to predict the Natural Gas consumption using Parameters of ANN are obtained from the historical data using a Levenberg-Marquardt training algorithm.

Nil Aras (2008), Beyzanur Cayir Ervural Omer Faruk Beyca Selim Zaim (2016) used genetic algorithm to predict NGC of Turkey city Eskisehir. Istanbul, Omer Fahrettin DEM?IREL, Selim ZAIM, proposed neural networks and multivariate time series models to predict Natural Gas consumption for the city of Istanbul. Ahmet Goncu Mehmet, Oguz Karahan & Tolga Umut Kuzuba, (2013) propose a methodology which combines natural gas demand estimation with a stochastic temperature model. The model demand and temperature processes separately and derive the distribution of natural gas consumption with a conditional temperature. Hossein Iranmanesh, Majid Abdollahzade & Arash Miranian (2011) predict natural gas consumption using PSO (2017). This model hybrid computational intelligence model was tested for its robustness by prediction of day ahead natural gas demands.

Another hybrid model consisting of ANFIS and computer simulation was proposed by Zadeh et al. (2015) have presented ANFIS based techniques. The ANFIS is was also used by Aynar et al. (2011) to predict weekly NG consumption in Turkey.

Ma & Li (2010) predicted NG consumption based on the Grey system model. The same approach was using Boran (2015)

5 Conclusion

The study was conducted with seventy two number of research articles of Natural Gas prediction for various Countries in different mathematical and scientific methods. It was found that China and other developed countries are focusing this type of study for weekly, monthly and yearly basis. ANN is the most appropriate techniques for the prediction of Natural Gas consumption. The different researchers applied genetic algorithm, feed forward, Back propagation & PSO methods for this prediction. All most all researchers are agreed upon the other popular methods are neuro-fuzzy inference system, genetic algorithms, time series methods,, support vector machines/ regression, Grey system models, mathematical and statistical models or hybrid models based on several methods. Some researches use two or more methods in the same paper. But analysis has shown that for modeling, authors often use past NG consumption data and weather data (mostly temp.) as input variables. Other variables include

100 month, days of the week, wind speed, temperature, humidity & price number of natural gas subscribers, GDP,
101 inflation rate etc. Speaking of prediction are as, it can be seen that most of the papers deal with the predictions
102 on country level. Predictions can be made as well as on regional, city, or even house level. ¹ ²

¹© 2018 Global Journals

²Year 2018 J © 2018 Global Journals

1

		A Meta Analysis of Natural Gas Consumption	
Year	Publication No.	%	Authors
2004	1	1.38%	Gil & Deferrari.
2005	2	2.76%	Aras; Gutierrezetal.
2006	2	2.76%	Hillard G. Huntington, Dejan Ivezi?
2007	4	5.52%	2.76% Brabecetal., Nil Aras. Potocnik et al, Hongjie Lu, Hongjun You
2008	2		
2009	3	4.14%	9.66% Tonkovic, Omer Fahrettin Dem? IREL, Selim Zaim;
2010	7	9.66%	9.66% Steven R. Vitullo; Ronald H. Brown; George F. Corliss,
2011	7		Brian M. Marx. Azadeh.; Forouzanfar.; Ma&Li;
2012	7		Mustafa Akkurt , Omer F. Demirel, Selim Zaim; Kay-
XVIII			nar, Oguz Yilmaz, Isik Demirkoparan, Ferhan; F. B.
Is-			Gouucu; Ebrahim Kamrani Kaynar; Saboe; Zia Wadud,
sue			Himadri S Dey, Md. Ashfanoor Kabir, Shahidul I
I			Khan; Omer Fahrettin Dem, ? IREL, SelimZaim ;
Ver-			Junchen Li, Xiucheng Dong, Jianxin Shangguan, Mikael
sion			Höök; Hossein Iranmanesh, Majid Abdollahzade, Arash
I J			Miranian; Hossein Iranmanesh, Majid Abdollahzade,
			Arash Miranian Demirel.; Olgun, Mahbubur Rahman,
			Mohammad Tamim & Lutfar Rahman; Fahim Faisal;
			Yi-Shian Lee, Lee-Ing Tong; Azari, Ahmad; Shariaty-
			Niassar, Mojtaba; Azari, Ahmad; Shariaty-Niassar, Mo-
			jtaba; Alborzi, Mahmoud
Global	2013 4	5.52%	6.90% Taspinar; AhmetGoncu, Mehmet, Oguz Karahan, Tolga
Jour-	2014 5	15.18%	13.8% Umut Kuzuba; Hongjie Lu, Hongjun You; Mohsen Ha-
nal	2015 11		jabdollahi, Mostafa Hosseinzadeh, M.M Ghanadi Arab
of	2016 10		Soldo, Nguyen Hoang Viet, Jacek Mandziuk; Mustafa
Re-			Akpinar, Nejat Yumusak; Krzysztof N?cka, Ma?gorzata
searches			Trojanowska: Ma?gorzata Trojanowska Azadeh.; Boran;
in			Izadyar; Szoplik; Wu.; Zhuetal.; Wei Zhang, Jun Yang;
En-			Halle Bakhteyar, Abbas Maleki; Jolanta Szoplik; Jun-
gi-			wei Miao; Junghwan Jin, Jinsoo Kim
neer-			
ing			

[Note: Akpinar & Yumusak; Bai & Li; Baldaccietal.; Zeng&Li; Sergas Sergipe Gas S. A., Aracaju; Mustafa Akpinar, M. Fatih Adak, Nejat Yumusak; Beyzanur Cayir Ervural, Omer Faruk Beyca, Selim Zaim; Gaurav Bhattacharya; Hans-Holger, Rogner; Miha Kova?i?, Bo?idar ?arler, Uro? ?uperl 2017 8 11.04% Akpinar & Yumusak; Panapakidis & Dagoumas; Almir; Beserra dos Santos, Erika Christina Ashton Nunes Chrisman; Xiaoyu Wang, Dongkun Luo, Jianye Liu, Wenhuan Wang, and GuixinJie; Zhenwu Zhang, Xiantao Liu; Michael Ratner; Dublin Sanjay Kumar Kar; Tim Boersma, Akos Losz, Astha Ummat Total 72 100.00% a) Overview of prediction of various time horizon]

Figure 1: Table 1 :

Sl. No.	Author	Year	Region	Remarks
1	S. Gil, J Defer-rari	2004	Argentina	ANN is used to predict the maximum consumption in the intermediate range.
2	DejanIvezi?	2006	Belgrade	applications are classifications problems, pattern recognition
3	Hongjie Lu, Hongjun You	2007	China	approximation. It results in good economic and social benefits in China.
4	Nil ARAS Omer Fahrettin	2008	Turkey	ANN used as an alternative solution approach to forecast the future demand of natural gas. China will be the number one natural gas
5	DEM? IREL, Selim ZAIM, Hossein Iranmanesh	2011	Istanbul	consumption country in the asia pacific region by 2015. The optimized model (ANN) which is
6	Majid Abdollahzade Arash Miranian	2011	Iran	employed for prediction of annual natural gas consumption in Iran and Unites States.
7	Hongjie Lu Hongjun You	2013	Canada	The practical experimental values & Natural gas consumption in China can be accurately estimated through prediction models
8	Ma?gorzata Trojanowska	2014	Poland	Predict the daily demand for natural gas by rural consumers.
9	Nguyen Hoang Viet Jacek Mandziuk	2014	Poland	The neural network model is most efficient techniques and the result is accurate
10	Wei Zhang Jun Yang	2015	China	ANN model can be used as an effective tool to estimate natural gas consumption
11	Halle Bakhteyar Abbas Maleki	2015	Iran	A trial-and-error procedure used to identify the suitable parameters for prediction
12	Jolanta Szoplik	2015	Poland	Focused to predict gas consumption on any day of the year and any hour of the day
13	Junghwan Jin Jinsoo Kim	2015	Korea	GARCH model is more suitable model than ANN techniques to forecast the natural gas
14	Sergas Sergipe Gas S. A., Ara-caju Mustafa Akpinar	2016	Brazil	Daily the producer adjusts its production capacity considering the availability of transportation pipelines, gas pipelines demands from consumers. The ANN model with two hidden layer gives
15	M. Fatih Adak Nejat Yumusak	2016	Ukraine	better results in demand forecasting than the other model.

Figure 2: Table 2 :

2

numbers of authors were predicting NG

Figure 3: Table 2 :

A Meta Analysis of Natural Gas Consumption

Yumusak (2016) predict NG consumption using technique hybrid neural networks in Ukraine. Beyzanur Cayir Ervural, Omer Faruk Beyca & Selim Zaim (2016) predict natural gas consumption using methods Genetic algorithm in Turkey. Xiaoyu Wang, DongkunLuo, Jianye Liu, Wenhuan Wang, and Guixin Jie (2017) predict the NG consumption using methods hybrid MVO-NNGBM model in China. Zhenwu Zhang & Xiantao Liu (2017) predict the natural gas consumption using the method PSO & Gray neural network in China. Sanjay Kumar Kar& Michael Ratner (2017) predict the natural gas consumption using techniques ANN in India. Techniques used for prediction of NG in this paper are Neural Network and Adaptive neural network(NNANN) based, Fuzzy Inference System (ANFIS). An interesting model which is a combination of

generate algorithm, ANFIS and feed forward neural network was proposed by Panapakidis & Dagoumas

Natural gas consumption is predicted by using various predicting techniques and methods or even a combination of several methods. Soldo (2012)

discovered that among the first tools for prediction of CNG was the Hubbert curve model used in 1950s. Since 1960s, when statistical models were developed, various statistical models have been used for predictions of NG consumption. From the late 1970s and 1980s, the artificial neural networks became very popular forecasting tool. Lately, there are new methods used in predictions of NG consumption such as Grey models or genetic algorithms. Optimized least squares in Iran. Hongjie Lu & Hongjun You (2013) predicts NG consumption using the methods Back propagation & Gray model in Canada. Ma?gorzata Trojanowska (2014) predict natural gas consumption using the methods Regression model in Poland. Nguyen Hoang Viet & Jacek Mandziuk (2014) predict the NG consumption using methods Neural & Fuzzy Neural network in Poland. Wei Zhang & Jun Yang (2015) predict the consumption by using the techniques Bayesian model , Averaging model & linear regression in China. Halle akhteeyar & Abbas Maleki (2015) using PSO model to predict the NG consumption in Iran. Jolanta Szoplik (2015) & Junghwan Jin Jinsoo Kim(2015) predict the NG consumption using ANN in Poland & Korea. Sergas Sergipe Gas S. A., Aracaju (2016) predict the natural gas consumption using Arima model in Brazil. Mustafa Akpinar, M. Fatih Adak & Nejat

Global Journal of Researches in Engineering () Volume XVIII Issue I Version I 25 Year 2018

