IMPACT: International Journal of Research in Humanities, Arts and Literature (IMPACT: IJRHAL)
ISSN (P): 2347-4564; ISSN (E): 2321-8878
Vol. 6, Issue 6, Jun 2018, 269-276

A STUDY ON GLOBAL WARMING ON THE POWER CONSUMPTION

Anjali Mondal

Research Scholar, Department of History, Tamralipta Mahavidyalaya, Tamluk, India

Received: 27 May 2018 **Accepted:** 31 May 2018 **Published:** 18 Jun 2018

ABSTRACT

It is very critical situation that rising in temperature is the cause of more electricity consumption. It is captured in data that temperature is increasing every decade. That means, power consumption is increasing very rapidly keeping population constant. This study is a review of such articles. Additionally, one experiment is done to measure the increased power supply due to increase in temperature and luxury life-style.

KEYWORDS: *Temperature, Luxury, Power Consumption, Fuzzy Logic*

INTRODUCTION

Kapsomenakis et al. [1], [2] studied the surface temperature in cities and it is well documented. Urban warmness is the combined consequence of the urban heat island advanced largely in cities with an optimistic thermal balance and of the global warming which distresses the urban climate too. Although the influence of urban heat island is very well studied, the specific impact of the global warming of the urban climate is poorly understood [3]. Urban heat island studies are available for almost all major cities in the world and the corresponding urban heat island intensity is tabulated and reported by many authors [4], [5]. The reported intensity of the UHI

Globally, urban warming has a thoughtful impact on the power consumption of the urban buildings by increasing the energy and the electric power necessary for cooling needs [7], [8]. In parallel, higher ambient urban temperatures increase the concentration of certain pollutants like tropospheric ozone, [9], deteriorate thermal comfort conditions in cities, [10], [11], exacerbate health and indoor environmental problems [12], [13]] and result in a serious increase of the global ecological footprint of the cities [14].

Weather variations have an important impact on the electricity demand and the general electricity market [15]. Several studies are carried out to examine the impact of various primary climatic parameters such as humidity, solar radiation, wind speed, etc, on the local electricity demand, while secondary climatic parameters such as the heating and cooling degree days are also considered, [16], [17]. In parallel, many economic, social and demographic indices such as the local Gross Domestic Product (GDP), the growth rate, the energy prices, the local manufacturing levels, etc., are also used as input parameters to estimate the electricity demand, [18], [19]. Most of the studies have concluded that ambient temperature is the parameter presenting the highest impact of the variation of the electricity demand [16].

The relation between the daily electricity consumption and the corresponding ambient temperature is not linear. It presents a high seasonality whereas the curve of the electricity demand obtains its peak value during the coldest period of winter in heating dominated zones or during the warm summer period in cooling dominated zones. In winter, the relation between ambient temperature and electricity demand is negative as higher ambient temperatures decrease the need for heating. On the contrary, the relation is positive during the summer period where higher ambient temperatures increase the need for cooling. The respective curve between the electricity demand and the ambient temperature is usually in asymmetric U shape, where a) the minimum consumption corresponds to the neutral climatic period when heating and cooling are insignificant and b) the energy demand is almost inelastic to the temperature and c) the maximum consumption corresponds to the periods of the lower and/or higher ambient temperatures depending on the local climate [20]. The threshold temperature over which the electricity consumption starts to increase, known as the inflection point of the response function, depends on the difference between the indoor comfort temperatures and the ambient ones. Itisastrongfunctionofthethermalqualityofthebuildingstock and of the indoor temperatures set for comfort. In an overall approach, it is presumed that the inflection point is about 18,3 C; but analysis of precise data for 15 European countries displayed that it is nearby to 14,7 C for the warming dominated countries and 22,4 C for the cooling controlled zones, [21].

Cumulative use of air conditioning as an effect of temperature upsurge and the improvement of the living criteria had compulsory and made more noticeable the association between the electricity plea and the open-air ambient temperature above the edge levels. The problem appears to be weightier in cooling conquered zones. In fact, a study investigative the temperature resistance of the electricity demand for six countries with earnest climate (India, Australia, Indonesia, Thailand, Mexico, Venezuela), twenty one countries with slight climate (United Kingdom, United States, Denmark, Austria, Belgium, France, Germany, Luxembourg, Ireland, Switzerland, Netherlands Hungary, New Zealand, Greece, Korea, Italy, South Africa, Japan, Turkey, Portugal, Spain), and four countries with icy climate (Norway, Canada, Finland, Sweden), determined that the temperature elasticity for the warm countries is near to 1,7 %, while for the mild and cold countries is 0,54 % and 0,51 % respectively, [22].

The aim of this study is to show the impact of power consumption due to temperature increase and increase of luxury lifestyle.

The Impact of Temperatures on Electricity Demand

The electricity consumption can be managed in an efficient way and it can be forecasted future electricity demands mainly by the urban hotness and global warming. It is seen that increase of the ambient temperature by 1 % is occurring over the decades. The rise of the peak electricity demand is a severe problem for utilities as they are indebted to build extra power plants to gratify the demand, as a fact which growths the cost of the electricity cohort. Data on the effect of ambient warmness on the peak electricity demand are accessible from Tokyo [23], Ontario East Canada [25], Thailand [24], Los Angeles, Dallas, Colorado Springs, Washington, Phoenix, Tuscon [26], and part of Carolina USA [28].

Global Electricity Consumption and Its Rise for Luxury Life Style

Improved electricity consumption for cooling, persuade substantial stress to low income customers, the exposed population and also the electricity substructures and networks. About the growth of the global electricity consumption per degree of temperature rise, readings are obtainable for fifteen cities or countries. In specific, Spain, [20], Bangkok, Thailand, [19], Athens Greece, California, USA and part of the state, Hong Kong, [28] New Orleans USA, Louisiana, USA, Greece, Ohio USA, Maryland USA, Chicago USA, Massachusetts USA, The Netherlands, and Singapore. The specific impact of temperature increase in the hourly, monthly electricity demand is reviewed in those papers.

In terms of the rise of the electricity claim in countries, it is stated that in Spain the rise of the daily electricity request caused by one degree temperature increase is nearby to 8 GWh per day which is equal to the 1,6 % of the elementary daily consumption. The edge temperature under which electricity intake for cooling jumps to increase is nearby to 18 C, [20].

Evidence for the rise of the electricity claim per degree of temperature increase is available for numerous cities in the world. In New Orland, USA, it is conveyed that the daily electricity load upsurges to about 3 % per DTR and for edge temperatures between 20-25 C, [30]. In Athens, the rise is calculated close to 4,1 % per DTR for temperatures above 22 C. In Bangkok, Thailand, the consistent rise is quite high and close to 7,5 % per degree of temperature rise [19]. Lastly, in Chicago, USA, the projected increase of the hourly load is near to 200 MWh per degree of temperature increase above 15 to 17C.

Fuzzy Logic to Estimate the Power Consumption Using MATLAB16a

This section will estimate the expected increase of power supply. Nowadays, increase of power supply depends on two major parameters. They are temperature increase and increase of life style luxury. These two inputs are taken as fuzzy numbers as they are uncertain in nature. The inputs for temperature increase may be assumed in linguistic variables like low, medium and high. The same is true for life style. Population is taken as fixed for this experiment. The nature of the inputs is taken as Gaussian curves (see Figure 1). Also the outputs are taken as triangular fuzzy numbers. The number of MFs for both the inputs in MATLAB16a is three. But the number of MFs in output variable is five and they are low, moderate, average, large and heavy for power consumption.

1. If (temperature is low) and (luxury is low) then (output1 is low) (1)
2. If (temperature is low) and (luxury is med) then (output1 is moderate) (1)
3. If (temperature is low) and (luxury is high) then (output1 is average) (1)
4. If (temperature is med) and (luxury is low) then (output1 is moderate) (1)
5. If (temperature is med) and (luxury is med) then (output1 is average) (1)
6. If (temperature is med) and (luxury is high) then (output1 is large) (1)
7. If (temperature is high) and (luxury is low) then (output1 is average) (1)
8. If (temperature is high) and (luxury is med) then (output1 is large) (1)
9. If (temperature is high) and (luxury is high) then (output1 is heavy) (1)

Figure 1: The Rule Base for Fuzzy Logic Experiment

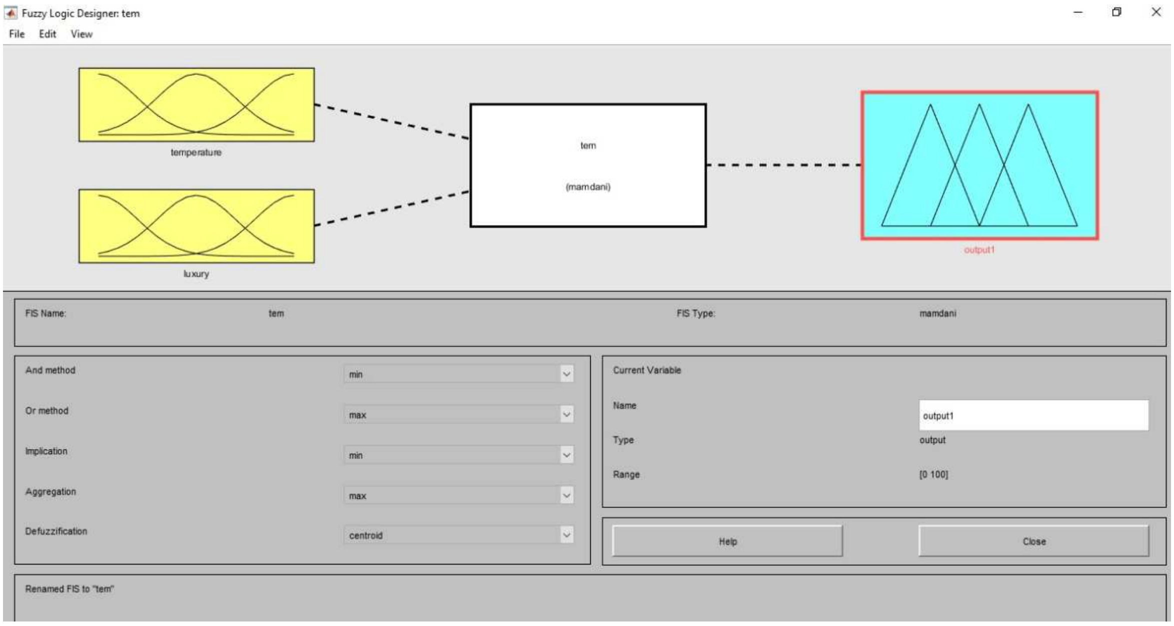

Figure 2: Inputs of Fuzzy Logic Experiment

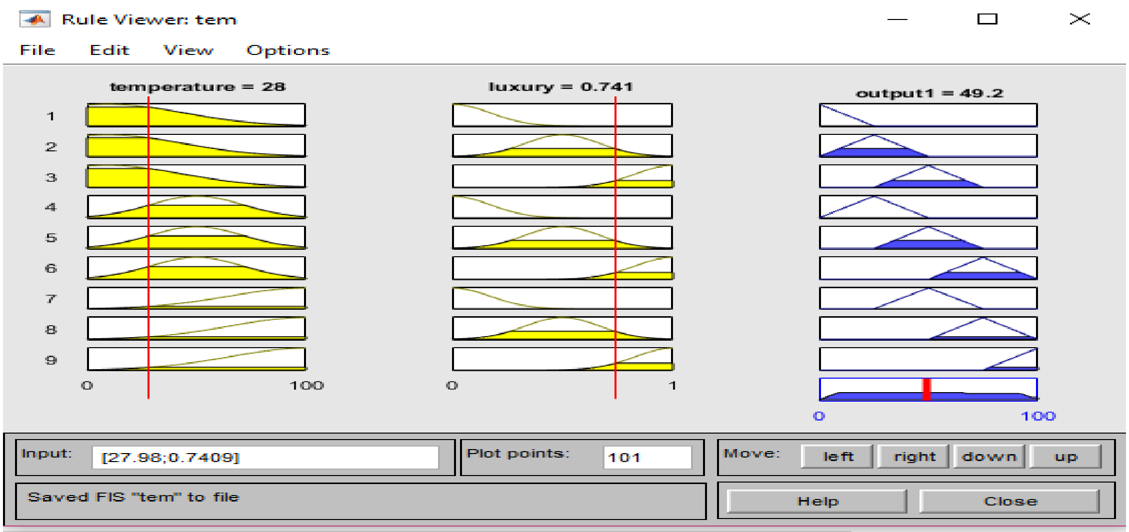

Figure 3: Outcomes of the Experiment

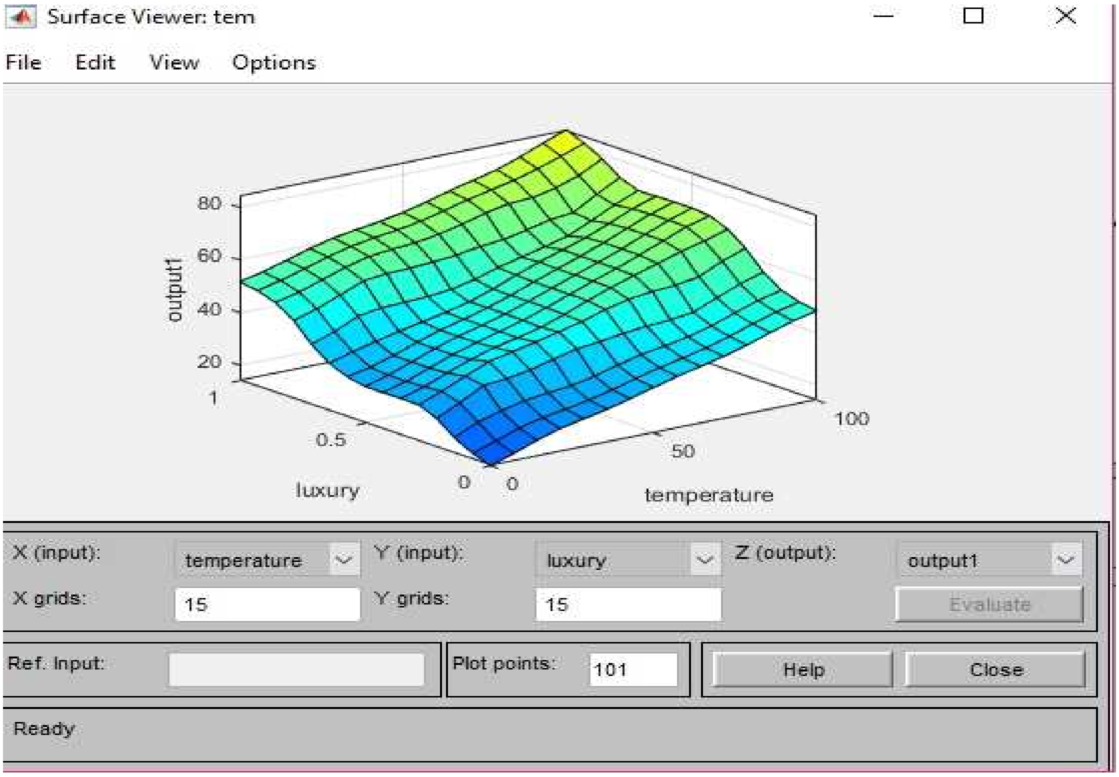

Figure 4: Surface View of the Results of the Experiment

ANALYSIS AND CONCLUSIONS

The MATLAB16a experiment shows that the temperature increase to 28% and a luxury increase of 74.1% implies the power consumption increase of 49.2% (see Figure 3 and Figure 4). The inputs percentage may be varied to get realistic results.

The major effect of ambient temperature increase is related to the possible rise of the peak electricity demand that pleases power utilities to construct extra power plants and probably growth the cost of electricity source. In accumulation the potential rise of the electrical energy consumption place under stress both the consumers and the electricity networks.

In parallel, the progress and use of innovative urban adaptation and extenuation techniques and technologies with the perspective to decrease the temperatures in cities may also cut significantly urban temperatures, [40], [41]. The mixture of the urban adaptation and extenuation techniques and technologies requires to be discriminated per urban area as it is contingent on the inflection point of the urban area concerned.

REFERENCES

1. *J. Kapsomenakis, D. Kolokotsa, T. Nikolaou, M. Santamouris, and S. C. Zerefos, "Forty years increase of the air ambient temperature in Greece: The impact on buildings," Energy Conversion and Management, vol. 74, pp. 353–365, 2013.*

2. *I. Livada, M. Santamouris, and M. Assimakopoulos, "On the variability of summer air temperature during the last 28 years in Athens," Journal of Geophysical Research D Atmospheres, vol. 112, no. 12, 2007.*

3. *M. J. Alcoforado and H. Andrade, "Global Warming and the Urban Heat Island," in Urban Ecology, J.Marzluff, E. Wilfried, G. Bradley, C. Ryan, and U. Simon, Eds. New York, NY: Springer, 2008.*
4. *M. Santamouris, "Heat Island Research in Europe – The State of the Art," Advances Building Energy Research, vol. 1, no. 1, pp. 123–150, 2007.*
5. *C. P. Tso, "A survey of urban heat island studies in two tropical cities," Atmospheric Environment, vol. 30, no. 3, pp. 507–519, 1996.*
6. *G. Mihalakakou, H. A. Flocas, M. Santamouris, and C. G. Helmis, "Application of neural networks to the simulation of the heat island over Athens, Greece, using synoptic types as a predictor," Journal of Applied Meteorology, vol. 41, no. 5, pp. 519–527,2002.*
7. *S. Hassid, M. Santamouris, N. Papanikolaou, A. Linardi, N. Klitsikas, C. Georgakis, and D. N. Assimakopoulos, "Effect of the Athens heat island on air conditioning load," Energy and Buildings, vol. 32, no. 2, pp. 131–141, 2000.*
8. *M. Santamouris, N. Papanikolaou, I. Livada, I. Koronakis, C. Georgakis, A. Argiriou, and D. N. Assimakopoulos, "On the impact of urban climate on the energy consuption of building," Solar Energy, vol. 70, no. 3, pp. 201–216,2001.*
9. *E. Stathopoulou, G. Mihalakakou, M. Santamouris, and H. S. Bagiorgas, "On the impact of temperature on tropospheric ozone concentration levels in urban environments," Journal of Earth System Science, vol. 117, no. 3, pp. 227–236,2008.*
10. *K. Pantavou, G. Theoharatos, M. Santamouris, and D. Asimakopoulos, "Outdoor thermal sensation of pedestrians in a Mediterranean climate and a comparison with UTCI," Building and Environment, vol. 66, pp. 82–95,2013.*
11. *K. Pantavou, G. Theoharatos, A. Mavrakis, and M. Santamouris, "Evaluating thermal comfort conditions and health responses during an extremely hot summer in Athens," Building and Environment, vol. 46, no. 2, pp. 339–344,2011.*
12. *A. Sakka, M. Santamouris, I. Livada, F. Nicol, and M. Wilson, "On the thermal performance of low income housing during heat waves," Energy and Buildings, vol. 49, pp. 69–77, 2012.*
13. *M. Santamouris, J. A. Paravantis, D. Founda, D. Kolokotsa, P. Michalakakou, A. M. Papadopoulos, N. Kontoulis, A. Tzavali, E. K. Stigka, Z. Ioannidis, A. Mehilli, A. Matthiessen, and E. Servou, "Financial crisis and energy consumption: A household survey in Greece," Energy and Buildings, vol. 65, no. 0, pp. 477–487, Oct.2013.*
14. *M. Santamouris, K. Paraponiaris, and G. Mihalakakou, "Estimating the ecological footprint of the heatislandeffectoverAthens,Greece,"ClimaticChange,vol.80,no.3–4,pp.265–276,2007.*
15. *C. Cartalis, A. Synodinou, M. Proedrou, A. Tsangrassoulis, and M. Santamouris, "Modifications in energy demand in urban areas as a result of climate changes: an assessment for the southeast Mediterranean region," Energy Conversion and Management, vol. 42, no. 14, pp. 1647–1656, 2001.*

16. *D. J. Sailor, "Relating residential and commercial sector electricity loads to climate - Evaluating state level sensitivities and vulnerabilities," Energy, vol. 26, pp. 645–657, 2001.*
17. *J. C. Lam, H. L. Tang, and D. H. W. Li, "Seasonal variations in residential and commercial sector electricity consumption in Hong Kong," Energy, vol. 33, pp. 513–523, 2008.*
18. *Z. Mohamed and P. Bodger, "Forecasting electricity consumption in New Zealand using economic and demographic variables," Energy, vol. 30, pp. 1833–1843, 2005.*
19. *K. Wangpattarapong, S. Maneewan, N. Ketjoy, and W. Rakwichian, "The impacts of climatic and economic factors on residential electricity consumption of Bangkok Metropolis," Energy and Buildings, vol. 40, no. 8, pp. 1419–1425, Jan.2008.*
20. *A. Pardo, V. Meneu, and E. Valor, "Temperature and seasonality influences on Spanish electricity load," Energy Economics, vol. 24, no. 1, pp. 55–70,2002.*
21. *M. Bessec and J. Fouquau, "The non-linear link between electricity consumption and temperature in Europe: A threshold panel approach," Energy Economics, vol. 30, pp. 2705– 2721, 2008.*
22. *E. De Cian, E. Lanzi, and R. Roson, "The Impact of Temperature Change on Energy Demand : ADynamicPanelAnalysis," no. I. The Fondazione Eni Enrico MatteiNote di LavoroSeries Index, 2007.*
23. *K. Yabe, "Evaluation of energy saving effect for the long-term maximum power forecast (title only in original language)," in National Convention of the Institute of Electrical Engineers of Japan (IEEJ), 2005.*
24. *S. J. Parkpoom and G. P. Harrison, "Analyzing the Impact of Climate Change on Future Electricity Demand in Thailand," Power Systems, IEEE Transactions on, vol. 23, pp. 1441– 1448, 2008.*
25. *A. F. Colombo, D. Etkin, and B. W. Karney, "Climate Variability and the Frequency of Extreme Temperature Events for Nine Sites across Canada: Implications for Power Usage," Journal of Climate, vol. 12. pp. 2490–2502, 1999.*
26. *H. Akbari, S. Davis, S. Dorsano, J. Huang, and S. Winnett, "Cooling our communities: A guidebook on tree planting and light-colored surfacing," Cooling Our Communities: A Guidebook on Tree Planting and Light-Colored Surfacing.1992.*
27. *Reddy, KV Nageswara, and B. Venkata Krishna Reddy. "Global Warming Brings Economical Recession." International Journal of Humanities and Social Sciences (IJHSS) 3.2 (2014): 9-12.*
28. *M. Segal, H. Shafir, M. Mandel, P. Alpert, and Y. Balmor, "Climatic-related Evaluations of the Summer Peak-Hours' Electric Load in Israel," Journal of Applied Meteorology, vol. 31. pp. 1492–1498, 1992.*
29. *G. Franco and A. H. Sanstad, "Climate change and electricity demand in California," Climatic Change, vol. 87, 2007.*
30. *Samanta S, Pal M (2012) Irregular bipolar fuzzy graphs. Int J Appl Fuzzy Sets 2:91–102*

31. *Samanta S, Pal M (2013) Fuzzy k-competition graphs and p-competition fuzzy graphs. Fuzzy EngInf 5(2): 191–204*

32. *Samanta S, Pal M (2014) Some more results on bipolar fuzzy sets and bipolar fuzzy intersection graphs. J Fuzzy Math 22(2):253–262*

33. *Samanta S, Pal M (2015) Fuzzy planar graphs. IEEE Trans Fuzzy Syst 23(6):1936–1942*

34. *Samanta S, Pal M, Akram M (2014) m-step fuzzy competition graphs. J Appl Math Comput. doi:10.1007/ s12190-014-0785-2*