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SMART GRID CONSUMER'S ENERGY CONSUMPTION BASED ON ENVIRONMENT, CLIMATE, AND WEATHER PARAMETRIC DRIFTS

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Abstract - Electricity is the need of modern era. The increasing demand for electricity is a demanding issue. Environment, climate, and weather parameters play a pivotal role in shaping energy profiles of Smart Grid (SG) consumers. The above factors directly affect the lifestyles of SG consumers that stimuli energy consumption. Without the consideration of weather drifts in modeling, analysis, and design of SG systems, disastrous incidents may jeopardize an inter-connected system. For instance, Lightning can strike distribution substations, high-speed winds can bring down trees and branches, ice can snap lines, and hurricanes can be catastrophic. Such weather conditions have the potential to deport thousands of consumers without electrical power. Over and above, more than any other factor, the weather affects the demand for electrical power immensely. Moreover, the demand for electrical power goes sky high in periods of severe temperatures. The aim of this research is to review an intimate relationship between environmental variations and energy consumption of SG consumers. We present an overview of SG architecture and promising features with the technical concept. Our work explores detail taxonomies of environment and weather parameters in detail. Finally, a case study is presented that describe a mutual relation of external environmental inputs with the energy demand of SG consumers.

Index Terms - Smart Grid, Environmental Drifts, Consumer Energy Demand, Climatic Model, Weather Parametric Variations.

I. INTRODUCTION

High energy demand, limitation of energy resources, environmental drifts, and climate variations led to many interesting studies towards climatic and weather drifts on energy demand of SG consumers [1]. The energy consumption of various consumers, such as commercial, residential, and industrial is directly related to the environment, climate variations, and weather parameters. The prediction of climatic and weather parameters is very significant for correlating future variation in energy demand of consumer [2]. The extreme weather conditions like storms, hurricanes, and very high precipitation cause demand-supply miss-match because it effects energy flows. Similarly, the consumers can also be exposed to a trouble of power line outages, whenever any tree or any disaster occurs on the power line during heavy wind storms. According to data history relevant to transmission line power outages, most power cuts occur as a result of extreme weather conditions [3].
The energy demand increases as temperature rise that results in uneven operation SG [4]. The climatic variations mostly affect the energy system, which is a part of the economy. The demand and supply are affected by climatic variations. The cooling demand increases in summer due to the usage of more cooling appliances to reach the indoor temperature to a comfortable level. On the other hand, heating demand increases in frosty winter resulting in more usage of heating appliances to normalize the thermal layer around consumers. Climatic changes have both negative and positive impacts on energy supplying agencies. For example, the increased rainfall may increase hydroelectricity energy output, while thermoelectric power generation may become more compromised with high water temperature and lower summer flow [1]. Energy generation from wind is independent of either summer or winter. The wind generation depends on wind speed (WS) and direction that is affected by various climatic and weather parameters.
The social system, natural ecosystem, and their mutual behavior are strongly affected by impacts of climate variations in various ways. The rise and drop in temperature have a drastic impact on the consumer energy demand. For example, when the temperature rises, to cope with it, consumers switch on the cooling appliances resulting in an increase in load demand. Similarly, when the temperature falls, consumers switch-off cooling appliances resulting in a decrease of the load during summer. The temperature also influences the habitats of the consumers. The emission of greenhouse gases may increase energy demand [5].
The demand and supply is affected by climatic variations in several ways, such as: (a) efficiency and

convenience of thermal and nuclear power plant generation modified due to changes in cooling efficiency of plants, (b) hydropower potential is affected due to variation in seasonal river flow, (c) exposure to intense events result in sea level rise, and (d) heating and cooling the space [6]. Energy generation is maximum when the flow of water is at peak and generation from the hydro potential decreases with the reduction in the flow of water. The heating energy demand in winter especially in mountainous areas is more, compared to the plain region and sea-level areas. The cooling energy demand in summer is more in plain regions and sea level areas, compared to mountainous areas.

Climatic Model incorporates the use of quantitative methods to simulate the interactions of climate drivers that include; (a) atmosphere, (b) land surface, (c) oceans, and (d) snow. They are used for a variety of purposes, such as dynamic modeling and analysis of climate for future projections. Climatic changes have a great impact on the flexibility of future power system (SG) [8]. The estimation of peak-load is based on the load division in weather sensitive and non-weather-sensitive regions [9]. Therefore, analyzing the influences of above variables is obligatory for forecasting the upcoming variation in energy demand. The heating loads and air conditioning facilities in residential buildings are the key contributors to maximum electrical energy consumption. The cities like Austin and Texas have a hot climate. Thus, increased cooling load for the building leads to the formation of peak-demand [10]. The cities like Chicago and New York have very warm climate in winter. The heating load of the building is very high because of the frequent use of the heating appliances.

Various generic state-of-the-art works are discussed in literature highlighting weather and climatic drifts effecting an energy consumption of the consumers. For example, Sasa Jovanovic et al. [1] described the effect of the mean daily air temperature variation on the consumption of electricity. James A. Dirks et al. [2] explained the consequences of climate variation on various residential and commercial building in the region of Eastern Interconnection (US). Reza Fazeli et al. [3] presented a survey of energy models for residential energy demand to temperature. Enirca De Cian et al. [4] discussed the energy dependency on the seasonal temperature variations. Maximilian Auffhammer et al. [5] gave the idea of measuring climatic consequences on the consumption of energy. D. H. VU et al. [6] elaborated the impact of climatic parameters on the demand for electricity. Zhe Wang et al. [8] discussed the estimation of demand of energy in residential buildings in China during different seasons by using a bottom-up approach. Y. H. Yau and S. Hasbi [9] discussed the impact of building on climate variations as well as climate variation impacts on the structure of the building, variation in energy demand, building cooling and heating demands, comfort, and emissions impacts. Mahelet G. Fikru and Luis Gautier [10] described the impact of weather fluctuation on energy consumption of the residential consumers. S. N. Chandramowli et al. [11] reviewed the effect of change of climate on electricity systems and markets. Juan-Carlos Ciscar et al. [12] presented a survey of the climate effects and adaptation in the energy sector. Christos Giannakopoulos et al. [13] elaborated the effects of different weather, climatic parameters, and the other factors such as lifestyle etc. on the demand for energy in Athens, Greece. Shefali Khanna [14] explained the impact of weather parameters on the temperature and the temperature in turn impact on the consumption of energy across the different building in California. M. Santamouris et al. [15] described the consequences of global warming and city heat on the demand and the consumption of energy across the world.

The preceding works elaborated the consequence of different weather and climatic variations on the consumers energy demand, they lack to incorporate the relationship between the energy consumption with the different weather parameters, climatic and environmental effects, such as dew point, forestry, dry bulb temperature, living standards of consumers, location of consumers, and solar irradiance. The relationship between dependent and independent variables are also not critically examined. Selected surveys and reviews relating the effect of environmental changes on energy demand are summarized in Table 1. The presence of the variable is presented with tick sign (✓) and the absence of the feature is shown with a cross sign (✕).

The main contributions of the survey are listed as below.

- We explained in detail the architecture, network technologies, topologies, and characteristics features of the SG technology. We also discussed in detail the mutual interactions between surrounding and environment that affect consumer’s energy demand.
- Our work explains various environmental drifts that force climate to change environmental parameters include: **(a)** emission of carbon dioxide, **(b)** forestry, **(c)** indoor and outdoor air, **(d)** living standards of the consumer, and **(e)** location of the consumer.
- Moreover, an effect of various weather parameters on energy consumption is explained in the context of the relationship between the weather parameters and energy

demand.

- To statically analyze the effects of climatic and drifts on consumers energy demand, a case study of Texas-State (USA) is considered. We used correlation models, such as Pearson, Spearman, and Kendall for the validation of our claim.

The survey is organized as follows: The relation between the smart grid and environment is described in Section 2. Section 3 elaborates the environmental drift on climate stimulation. Section 4 describes in detail the interaction of weather parameter with consumer energy demand. We evaluated inter-relationships between dependent and independent parameters using real-time data of Texas-State in section 5. Section 6 concludes the paper with a summary and proposal for future work.

Table 1: Summary of Some Generic State-of-Art Surveys

Ref.	PP	TM	HMD	WS	CDD	GHG	CWE	BED	LF	AC	CR	TEM	HDD
[1]	×	×	×	×	×	✓	✓	×	×	×	×	✓	×
[2]	×	✓	×	×	✓	×	✓	✓	✓	×	×	✓	✓
[3]	×	✓	×	×	✓	✓	✓	✓	×	×	×	✓	✓
[4]	×	✓	×	×	✓	✓	✓	×	×	×	×	✓	✓
[5]	×	✓	×	×	✓	×	✓	×	✓	✓	×	✓	✓
[6]	×	✓	✓	✓	✓	×	✓	×	×	✓	×	✓	✓
[8]	×	✓	×	×	×	✓	×	✓	✓	×	×	✓	×
[9]	×	×	×	×	×	✓	✓	✓	✓	✓	×	✓	×
[10]	✓	×	✓	✓	✓	×	×	✓	×	×	×	✓	✓
[11]	×	✓	×	×	×	✓	✓	×	×	×	×	✓	×
[12]	×	✓	×	×	✓	×	✓	×	×	×	×	✓	✓
[13]	×	×	×	×	✓	×	✓	×	×	×	×	✓	✓
[14]	×	✓	✓	×	✓	✓	✓	✓	✓	×	×	✓	✓
[15]	×	×	×	×	×	×	✓	✓	×	✓	×	✓	×
Our Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Abbreviations	PP: Precipitation	TM: Theoretical Model
	HMD: Humidity	WS: Wind Speed
	CDD: Cooling Degree Day	GHG: Green House Gases
	CWE: Climatic and Weather Effect	BED: Building Energy Demand
	LF: Load Forecasting	AC: Air Conditioning
	CR: Correlation	TEM: Temperature Energy Relationship
	HDD: Heating Degree Days	

II. SG AND SURROUNDINGS

A. SG-An Overview

Power System is shifted from conventional system to advance, intelligent, robust, adaptive, and energy-efficient system. SG development brought a new revolution in power and energy domain. With this infrastructure, a bidirectional communication is maintained between consumers and electrical utility for reducing energy consumption during peak-hours to avoid a system collapse. SG has various applications such as AMI, Home energy management, overhead transmission line monitoring, substation automation, outage management, demand response management, meter data management, distributed energy resources and storage, Electric Vehicles (EVs) charging, and Vehicle-to-Grid (V2G) [16], [17]. SG uses wireless sensors for monitoring, prediction, management, and forecasting [18]. Table 2 gives a brief comparison between an existing grid and SG. As SG has adopted many technologies and advancements in the technologies so, the SG has become better as compared to the Existing grid as they differ in the technical and technological advancements [19].

Moreover, with increased consumer empowerment and consumer contentment, demand response programs provide price-based and incentive-based models for an optimized generation, transmission, and distribution. Furthermore, this system is robust to faults, disasters, and national disasters. The climatic and weather variations are analyzed, stored, and further investigated for estimating consumer’s energy demands [20], [21. The promising research of weather and climatic drifts in shaping consumers lifestyles is currently under study. Effects of body-dynamics in stimulating energy consumption of SG consumers are the most promising research that is a future prediction. In short, SG opened new findings in: **(a)** power and energy **(b)** communication system, **(c)** network architecture, **(d)** economic and financial department for whole-scale and retail dealers, and **(e)** development of control system theory. Table 3 elaborates the detailed classification of SG as: **(a)** Smart Protection System (SPS), **(b)** Smart Management System (SMS), and **(c)** Smart Infrastructure System (SIS). SIS consists of information and communication. SMS provides control services and functionalities and advanced management. SPS provides fault protection, reliability analysis, and security and privacy protection services.

Conventional Grid	Smart Grid
Medium Robustness	High Robustness
Blackouts and failures	Adaptive and islanding
Centrally Control System	Centrally, Distributed and Mutually Interacted
No V2G Communication	V2G and G2V Communication
Physical monitoring	Self-monitoring
Physical restoration	Self-healing
Electromechanical	Digital
Restricted control	Prevalent Control
No consumer empowerment	Full consumer empowerment
Sensors in few areas	Sensors all around
One-directional communication	Bi-directional Communication
Federal generation	Distributed Generation
More CO_2 Emission	Less CO_2 Emission

Table 2: Comparison between Existing Grid and SG [16]

III. ENVIRONMENTAL DRIFTS STIMULATING CLIMATE AND WEATHER PARAMETERS

The effects of CO2 emissions impart irrevocable damage to the environment in the form of Ozone (O3) degradation and the rise of Green House Effect (GHE) that are dismantling the ecosystem of the earth. Table 4 and Table 5 illustrate energy relationship of CO2 emissions by different blocks like the Organization of Economic Cooperation and Development (OECD) countries and Non-Organization of Economic Cooperation and Development (Non-OECD) countries, reiterating the fact that OECD countries produce the bulk of energy by carbon dioxide emissions from fuels in comparison to Non-OECD countries. The effects of carbon dioxide emissions on the environment due to different power generation sources and have reached on a conclusion that among all the different sources coal has the highest emissions in (gCO2 /KWhr) among all others.

Smart Protection System	Smart Management System	Infrastructure
Reliability and failure protection system	Management objectives	Smart energy sub-systems
System sustainability	Energy efficiency and demand response program	Power generation
Fault protection system	Demand profile shaping	Transmission grid
Fault prediction and prevention	Energy loss management	Distribution grid
Failure identification, diagnosis, and recovery	Utility, cost, and price	New grid parading: Grid to vehicle/vehicle to grid
Failure identification and localization	GHG Emission	Smart information sub-system
Self-healing Grid System	Management methods and tools	Information metering and measurement
Data recovery	Optimization	Smart metering
Micro Grid protection	Convex programming	Sensor Networks
Security and privacy	Dynamic programming	Phasor measurement unit
Advanced metering and measurement	Auction	Information management system
Information transmission	Stochastic programming	Data modeling

Table 3: Detailed classification of Smart Grid

A. Carbon Dioxide Emissions

The different efforts made by UNFCC and the Kyoto protocols according to the author [22] are considered insufficient to address the issues of climatic change. As a result, the ultimate challenge is to provide reliable and affordable sources of energy, while simultaneously limiting the GHG emissions.

The planet earth energy consumption was 1 Billion GigaWatts (GW) in 1990, and now the consumption is on the verge of 10 billion GW [23]. One of the most important components of the global climate change is energy consumptions whereas the bulk of the world anthropogenic GHG emission corresponds to CO_2 release. Quoting the report of world energy, CO_2 emission has raised from 31.2 x 10^9metric tons to 36.4 x 10^9 metric tons from 2010-2020 reaches 45.5 x 10^9metric tons in 2040, as illustrated in Table 4 and Table 5 [24]. OECD comprises of a 35-member countries group founded in 1961 for stimulating economic progress and world trade. The Non-OECD countries consist of 78 members. Table 4 and Table 5 shows a comparative analysis of carbon dioxide release during energy consumptions with respect to the various type of fuels in OECD countries and Non-OECD countries.

Table 4: Shows OECD Countries regarding Energy used during release of CO_2 emissions by different kinds of fuels from 1990-2040 (10^9 Metric Ton) [24]

CDEF	AAP	2040	2030	2020	2010	1990
Coal	-0.2	4.0	4.0	4.0	4.2	4.1
Liquid Fuels	-0.1	5.7	5.6	5.7	5.8	5.5
Natural Gas	1.1	4.1	3.7	3.4	3.0	2.0
Abbreviations: • **CDEF** = Carbon Dioxide Emission by Fuels. • **AAP** = Average Annual Production.						

Table 5: Shows Non-OECD Countries regarding Energy used during release of CO_2 emissions by consumption of different kinds of fuels from 1990-2040 (10^9 Metric Ton) [24]

CDEF	AAP	2040	2030	2020	2010	1990
Coal	1.8	16.6	15.5	13.0	9.6	4.2
Liquid Fuels	1.7	9.0	7.7	6.6	5.4	3.6
Natural Gas	2.2	6.0	4.9	3.8	3.6	2.0
World Total	1.3	45.5	41.5	36.4	31.2	21.5

- **Green House Effect (GHE)**

The bulk of GHG emissions formsCO_2, followed by CH_4 and (Nitrous Oxide) N_2O Green House Effect (GHE) [24]. The primary anthropogenic driver of the climatic change is carbon dioxide released from cement manufacture through the burning of fossil fuels [25]. The principal concern that arose due to the cement manufacture and combustion of fossil fuels, that are the primary sources for the anthropogenic sources for carbon dioxide emission, is requiring serious efforts to redress the anthropogenic climatic change [24]. The bulk of CO_2 release in this sector is the primary cause of the road transport, passenger's cars which form the 12% of the total carbon dioxide emissions. The calculation of the GHE is calculated by three methods that are as follows: **(a)** concentration of the gas in air, **(b)** total time for which the gas stays in the air and **(c)** how strongly it reacts with the environment. GHE is lessened by using low-carbon electric power industry. Coal Based Energy (CBE) production is the main source of carbon emission. When Renewable Energy Sources (RES) are injected into power grid station, they can minimize the emission of the carbon efficiently and even up to optimal level. Though, it lacks the systematized line of action to predict a medium and long-term carbon emission for a power grid station.

Consequently, for overcoming and predicting problems of carbon release from the RES, many authors have proposed different models and methods. By high expensive penalties consumers for the high release of CO_2 and maximizing Demand Response (DR) are two ways to minimize the release of carbon dioxide. By implementation of SG, the

Technology	Emissions (gCO_2/KWHR)	Specifications
Biogas	11	Anaerobic Digestion
Diesel	778	Various types
Natural	443	Gas Turbine (Combine Cycle)
Solar PV	32	Polycrystalline silicon
Wind	9	2.5 MW, offshore
Coal	960	Various Types + Scrubbing
Solar Thermal	13	80 MW. Parabolic Trough
Hydroelectric	10	3.1 MW, reservoir
Fuel Cell	664	Hydrogen from gas reforming
Bio Mass	14	Co-combustion (wood + coal)
Geothermal	38	80 MW, Hot Dry Rock

Table 6: Emission estimated from different power generating options (gCO_2/KWHR) [26].

Demand Side Resources (DSR) plays a very vital part in demand and supply power balance. Moreover, Low Carbon Smart Grid (LCSM) needs few special units such as Carbon Emission Trading (CET). Under the prevalent circumstances, a better idea is to devise a unit commitment model. The proposed model performs two main work, it not only takes the benefit from different resources on demand side, like Electric Vehicle (EV), distributed generation and demand response but also reflects CET effects on generation schedule. For sorting out the problem, we use Improve Particle Swarm Optimization (IPSO) algorithm. The energy saving dispatch increases the power per unit time used and limits the carbon dioxide outburst, ultimately resulting in the progress of a country. The researcher in proposed latest Energy Saving Dispatch (ESD) puzzle by considering Emission Reduction Potentials (ERP) of generation and energy saving along with Demand side or interaction.

- **CO_2 Emission Effect on the Environment**

Table 6 illustrates Life Cycle (LC) emissions of several kinds of the energy production technologies. The amount of CO_2 released that occurred during the preparation of equipment for facility remains extremely remarkable in LC emission in comparison with different processes. In many processes, where the emission is not fixed as a consequence is not able to demonstrate in the LC Emission Numbers. Scientists arrived on deductions illustrating that energy relationship of carbon dioxide emissions in blocks like OECD countries and Non-OECD countries, is reiterating the fact that OECD countries produce the bulk of the carbon dioxide emissions from fuels, in comparison with Non-OECD countries. The effects of carbon dioxide emissions on the environment due to different power generation sources and have reached on a conclusion that among all different sources, coal has the highest emissions in (gCO_2 /KWHR) among all other sources.

B. Weather Parametric Interactions with Consumer's Energy Demand

The energy demand of consumers depends upon numerous characteristics, such as population, the price of electricity, weather parameters, advancement, and industrialization. The daily peak energy demand also varies with weather parameters. The consequences of weather parameters on consumers' energy consumption are analyzed and discussed in this section. Weather parameters such as solar irradiance, dew point, relative humidity, raining, wet bulb temperature, and air temperature affect the consumer energy demand. A detailed taxonomy of weather parameters is presented in Figure 1. The motive of this work is to critically investigate environment effects on climate, thus drifting weather parameters. The weather parameters, in turn, affect consumer lifestyle that directly effects energy consumption.

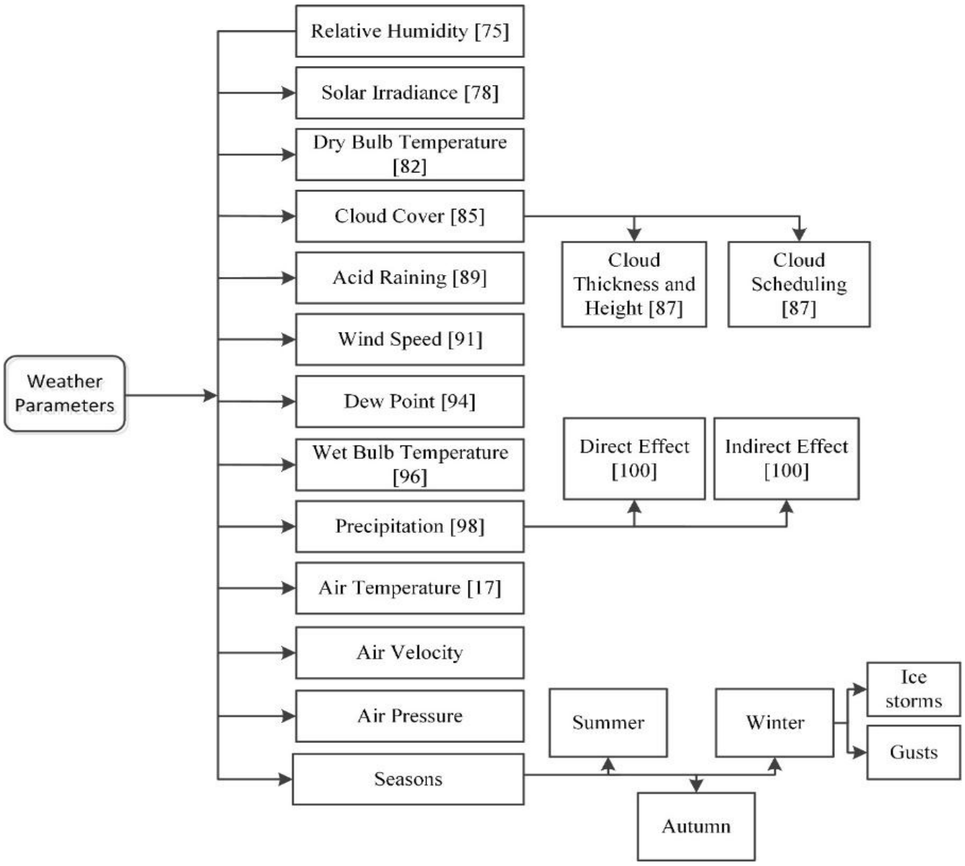

Figure 1: Taxonomy Tree of Weather Parametric Interactions with Consumer's Energy

The consumer energy demand depends on numerous characteristics, such as population, the price of electricity, weather parameters, advancement, and industrialization. The weather parameter, like humidity, affects the energy consumption of the consumer. When RH is high, the consumers feel warm. The consumers feel cold when RH is low. The effect of SI is less in morning, resulting in a negligible effect on energy consumption. The effect of SI at noon and afternoon on consumer bodies is very high; subsequently, it increases or decreases the load consumption depending upon the season. The consumers feel warm when the DBT is high and feel cold when the DBT is low. The CC scheduling, height, and thickness affect the energy demand depending on climate and season. On rainy days, the temperature is low, the water vapors evaporate and takes away the heat gain, with enough energy to escape into the atmosphere. Rain increases or decreases the peak loads depending on the season.

The wind has a great impact on both generation and energy consumption. WS increases the generation of energy independent of the winter or summer. WS decreases the temperature causing increases or decreases the energy consumption during winter and summer respectively. WBT is directly proportional to RH. WBT increases when RH increases and WBT decreases when RH decreases. RH, in turn, is inversely proportional to temperature. The precipitation of any type such as rain, snow etc. directly reduces the temperature. The consumers use less energy in summer by turning off the appliances and use more energy in winter by switching on the heating appliances. The weather parameters like WS, RH, and P etc. depend on the AT. When AT increases or decreases the consumption of energy also increases or decreases in summer. In winter when the AT is low or high, consumer consume more or less energy by using more or less heating appliances. All the weather parameters are interlinked with each other and can increase or decrease the energy demand depending on the different situation.

IV. ENERGY DEMAND ANALYSIS WITH WEATHER PARAMETERS

A simple rule of thumb is described between surrounding, environment, consumer, and energy consumption. Surrounding drifts stimulate environment parameters that in return effects consumer psychology, consumer behavior, and internal blood dynamics of the consumer. With disturbance in comfort level of consumer blood variations activates the Central Nervous System (CNS) of the brain. The hypothalamus of CNS orders to regain the optimum level of body comfort. Either consumer is coming from the sun to shade, or moving from shade to sun, or outdoor to the indoor building, transients are produced inside consumer body. To stable the comfort level of the consumer, CNS forces consumer to actuate the heating/cooling devices that effects energy consumption.
Copano Bay, United States is the region we are taking into consideration and the data is obtained from http://www.nyiso.com/public/index.jsp [19]. This data contains load consumption, power consumption and weather parameters such as CC, WS, and DBT of this region. In this section different statistical analysis such as (a) Load and WPA, (b) Correlation Analysis and WPA, and (c) GA optimization are presented. We calculated the relationship between weather parameters (CC, WS, and DBT) and load consumption. Figure 2 shows the relation of load and Dry Bulb Temperature (DBT) for Spring (April) season. Figure 3 describes the load and Dry Bulb Temperature (DBT) relation for Summer (July) season. Figure 4 presents the load and Dry Bulb Temperature (DBT) relation for Winter (Jan) season.

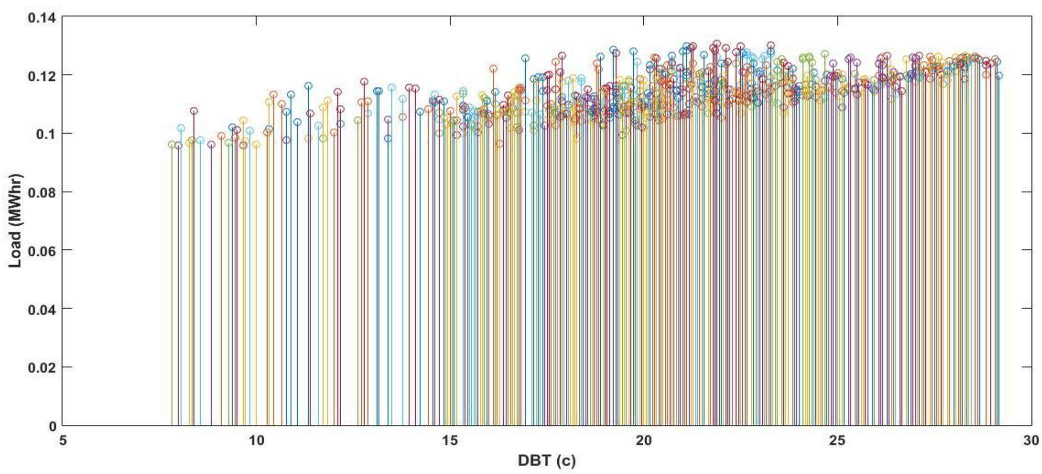

Figure 2: Spring (April) Load and Dry Bulb Temperature (DBT) Relation

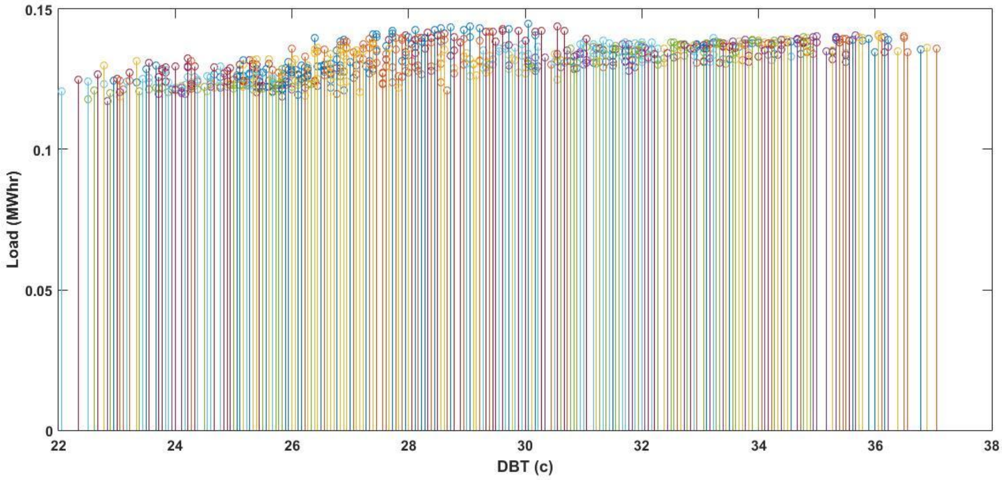

Figure 3: Summer (July) Load and Dry Bulb Temperature (DBT) Relation

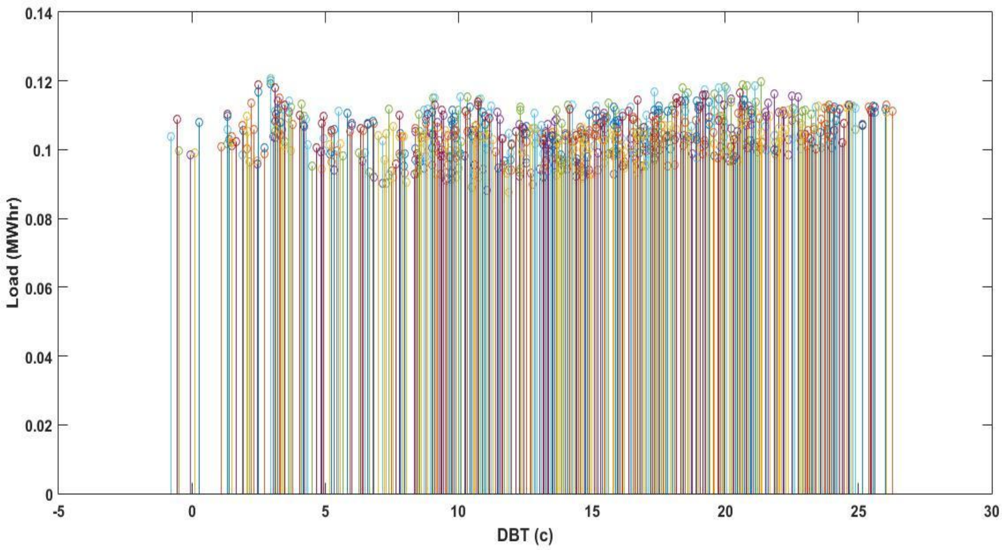

Figure 4: Winter (Jan) Load and Dry Bulb Temperature (DBT) Relation

The correlation analysis between CC, DBT, and WS is analyzed. Three types of correlation nodes namely Pearson, Spearman, and Kendall are evaluated for weather parameters and energy demand. Moreover, three seasons are also considered to show demand consumer variations with various climatic and weather parameters. These are described as: Spring (April), winter (Dec-Jan), and summer (July). Figure 5 shows Pearson correlation analysis between load and WPA. Figure 6 presents Spearman correlation analysis between load and WPA. Figure 7 describes Kendall correlation analysis between load and WPA.

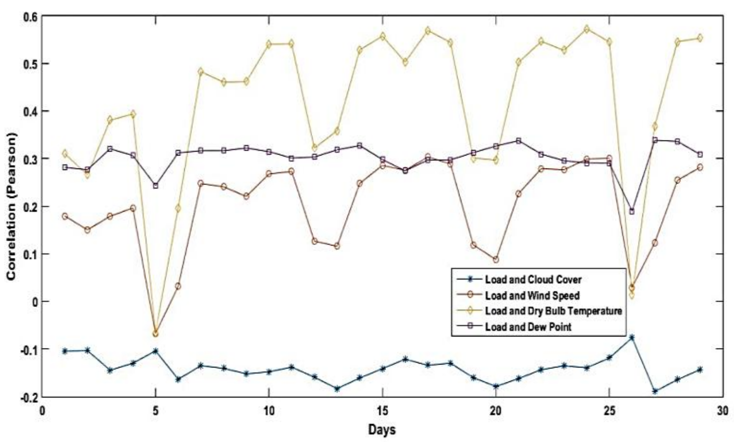

Figure 5: Pearson Correlation Analysis between Load and WPA

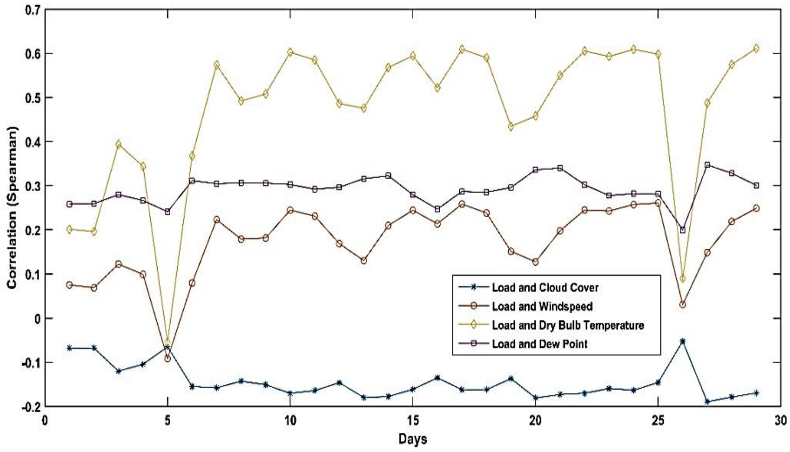

Figure 6: Spearman Correlation Analysis between Load and WPA

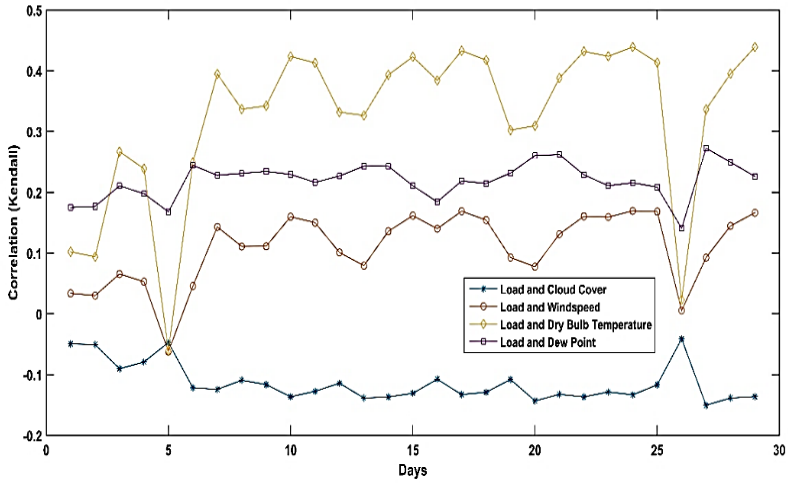

Figure 7: Kendall Correlation Analysis between Load and WPA

Weather and climatic drifts play a momentous role in Smart Grid (SG) operation with correlation models and statistical analysis. Gone are the days, when the effects of climate and weather on consumer energy demand within Smart Grid (SG) were shunned. The environmental and climatic drifts have no or even less impact on the consumer energy demand within SG was a false perception, but this ends up on a complete annihilation if for a consumer if Energy demand is not managed properly under the environmental drifts paradigm. Environmental and climatic changes play a pivot role in consumer energy demand within SG. The SG is strongly affected by the environmental drifts, which ultimately dismantle the consumer's energy demands. This paper meticulously nails down the relationship of the weather parameters such as: **(a)** Solar Irradiance, **(b)** Dry Bulb Temperature, **(c)** Dew Point, and **(d)** Cloud Cover and effects of several other factors on consumer energy demand. The consumer's demand is invincibly associated with weather or climatic drifts such as Solar Irradiance (SI) which if taken into account remarkably affects energy consumption. The energy consumption due to SI on SG in afternoon is exceptionally high which is least in the morning. The influence of climate on consumer demand, their relationship is distinctly discussed in details with case studies.

CONCLUSIONS AND FUTURE WORK

This research opens a new paradigm for consumers to forecast the weather and climatic drifts beforehand, to reduce its energy demands by accurately responding to the changes in the weather parameters. This is the main idea propagated from the paper, in order to understand the weather parameters on consumer energy demand to save energy in a longer run. In addition to, a decrease in energy demands that leads to saving money, the weather parameters also affect the designs of houses for reducing energy demands in case of SI. The energy efficient houses are built with windows opening towards equator side.

This survey opens new gateways for researchers and scientists to explore the methodologies involved within SG to maximize energy efficiency. In near future, we will develop an Advanced Smart Grid

Infrastructure System (ASGIS) in which climatic and environmental drifts will be forecasted automatically and optimized energy management scheme will be implemented.

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