Smart grid : direct and indirect load control techniques

[1]Nikita vasudev parab, [2]Vasant suresh tirodkar, [3]Vikranti vitthal redkar
[1]Student, [2]Student, [3]Student
SSMPCOE

***Abstract* - With the advancement of technology the demand for the electricity increases for increase in population and industrialization. The existing electricity network suffers from blackouts, brownouts and reliability issues. Many research has been carried out for the increasing reliability and resiligent grid. The smart is a future electricity grid with two way communication which will provide reliable and efficient power supply with low cost. Demand side management is the most important part of smart grid. Smart grid try to reduce peak load and make load curve flat. The main goal of smart grid is improvement of quality of life and the enhancement of the quality of services. It is possible to making city smarter by use of information technology for collecting and analyzing data generated by several sources such as sensor networks. In smart grid system use of high power inverters, modernized communication system, smart meters, advance energy management technologies. This paper deals with the different technologies that are used in smart grid and demand side management.**

***keywords* - Smart grid; Load control technique; Smart loads**

I. INTRODUCTION

The measure of the mentioned load qualities is variable in electrical force frameworks. Since clients' utilization propensities change in their every day, month to month and yearly time. A few explanations behind the inconstancy of the heap qualities are as per the following [1]: Residential burdens are variable among summer and winter, particularly in north districts. Since when advanced towards north, the time distinction among day and night increments. Mechanical burdens act as per financial conditions. On the off chance that financial circumstance in a nation deteriorates, predominantly production lines are influenced and eased back down. Business loads are less influenced by change in atmosphere conditions, as per the private burdens. Farming burdens are occasional. Thus, they are influenced by the change in climatic conditions. A heap profile for 24 hours is appeared in Figure 1.

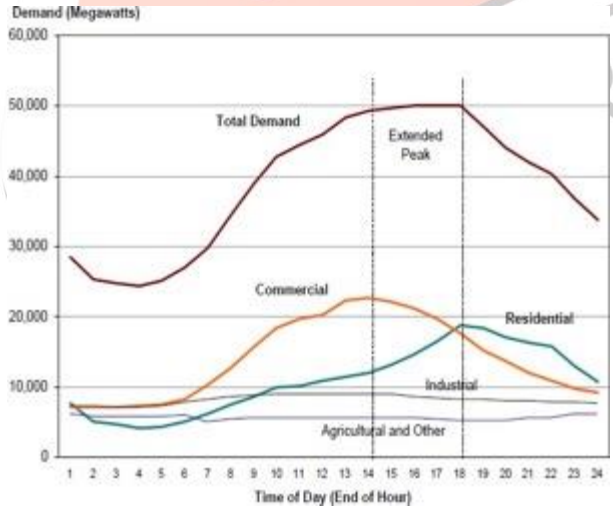

Figure 1.Total California load profile for a hot day [2].

II. SMARTGRID

In existing grid, vitality effectiveness is low and the misfortune rate is high. Hence, smart grid frameworks become important. Productively, securely and eco-accommodating vitality the board endeavors comprise the idea of smart grid.

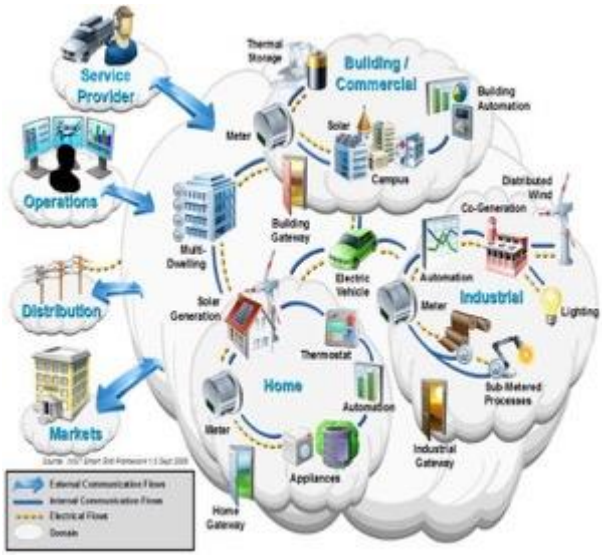

Figure 2.Customer domain diagram of smart grid [3].

Clients in smart grid, empower to deal with their energy utilization and age. As appeared in Figure 2, the client space is ordinarily partitioned into three sections: home, business/building and mechanical. Smart grid is commonly made out of five layers [4]. These layers;

Power Layer: power Layer: This layer contains the frameworks energy creation, transmission, distribution, storage and utilization layer.
Control layer: The layer contains information and savvy detecting frameworks for transmission and drive frameworks.
Data Transmission Layer: The effective communication enables by layer of data system.
*Security Layer:*The layer of information protection and encryption is for making security.
*Application Layer:*The layer for different force uses of data innovation framework is for the choice

Advantages from highlights like correspondence innovation and control innovation are utilized for full mechanization. As appeared in Figure 3, smart automation functions can be done by smart grid.

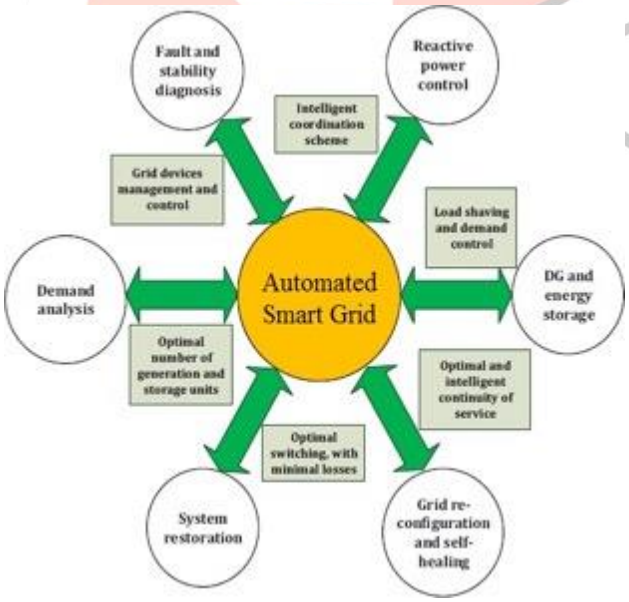

Figure 3. Smart grid automation functions [5].

Some advantages of smart grids from the traditional grids are as follows [6];

- High power quality.
- High energyefficiencyand lowlossrate.
- Easy to control and manage thesystem.
- The system is vulnerable to creating innovation and development.
- Fast detection of faults.
- Provides elective energy costs to customers.
- Bi-directional powerflow provided by system.

III. LOAD CONTROLTECHNIQUES

Due to the distinctions in load qualities, now and then the mentioned energy sum is decreased very down and in some cases it can arrive at very high qualities. All applications identified with the guideline to react burden can be called smart load control. Smart load control can be separated into indirect load control and direct load control [1].

A. Indirect load control

The indirect load control can be considered as request reaction the executives of smart grids. It covers an assortment of uses that have been created to change clients' utilization in the ideal way, for example, taxes, extra installments, motivating forces, publicizing, instruction, etc. Indirect load controls are partitioned into two classifications; request reconciliation applications and cost based applications[7-9].

Demand joining applications are for changing the load profile and these applications are partitioned into four segments;

Load shifting: In this approach, the loads are shifted from peak hours to non-peak hours. Along these lines, the requirement for additional generation required for high demand will be prevented.

Walley filling: It is the process of filling the off-peak time periods. Receiving energy storage units are provided by system to the grid.

Peak clipping: Clipping of peak load in energy framework. These applications are prescribed for home or little scope consumers. For instance, when moving toward the constraints of interest for feeder or transformer, electric warmers and cooling units are turned off by the program administrators. It by and large diminishes the comfort of purchasers.

Energy efficiency:. It is decrease of energy without reducing the comfort of the customers. Hence, the state of the load is moved downwards. Energy efficiency programs are intended to diminish the all out utilizing of energy.

Load change by consumers in light of changes in energy price tag is called cost based applications. These applications are;

Time of use pricing:. The use of various costs at specific periods during a day, for example, multi-time duties.

Real-time pricing: The cost of power is typically set for one hour or shorter time frames. Customers are educated in advance about costs.

Critical peak price: When the system security is in danger or when energy costs are excessively costly, the basic peak cost is utilized. This applications utilize high valuing.

Direct loadcontrol:. Direct load control depends on the control of loads as indicated by their particular circumstances with different switching devices and system.

Smart lighting: Lighting issue is identified with everybody. Lighting utilized in a house roughly 30% of all energy in the house. A reduced fluorescent light has a more drawn out life expectancy and uses significantly less energy than glowing light. With new innovation being built up significantly less energy expending lights which are called e-lights [10].

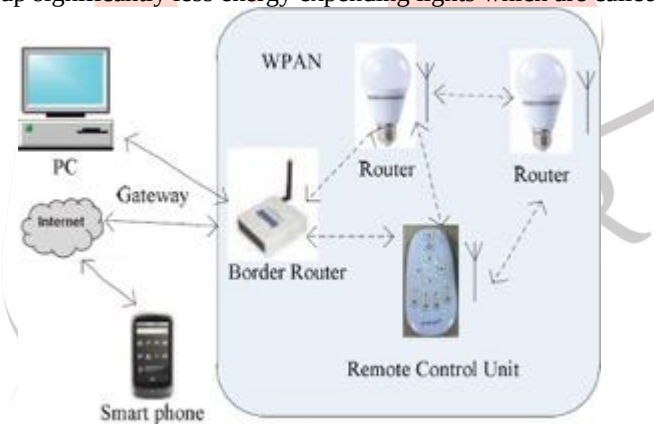

Figure 4.Smart lighting system [11].

Replacing motors: In the United States, over half of mechanical power utilization is a direct result of the electric engines [10]. The accompanying strategies are utilized to improve the exhibition of the motor[12];

Using high-quality core for smaller energyloss Optimum structure of stator and rotor

- Optimum air gap
- Prevention of immersion
- Reducing leakage reactance
- Reducing harmonic
- Optimization of plan parameters
- Optimization of equivalent circuit parameters

With these changes, a 12 kW motor speed can increment from 1747 rpm to 1766 rpm. This speed expanding diminishes energy utilization by 3.3%.

Smart house systems: Electricity utilization of housing is significant and having a developing offer in all out utilization. Local load can be controlled with smart house frameworks. In the mid year months, this control permits the peak decreases between 1-5 kW for every house and in the winter months 1-2 kW for each house. Inside the structure stacks right off the bat differentiation must be made as unmanageable and reasonable loads. Unmanageable loads, for example, TVs, PCs, sound systems which working time is in the client's immediate control. In any case, keen attachments empowering observing of gadgets can be utilized to screen energy utilization of unmanageable loads. Sensible loads are progressively appropriate for

utilizing in load management applications. At the point when the client settings or time of utilizations are changed consumers won't be influenced [8].

As shown in Figure 5, a smart house has PV system, solar collector (SC), heat pump (HP), electric vehicle (EV) andbattery.

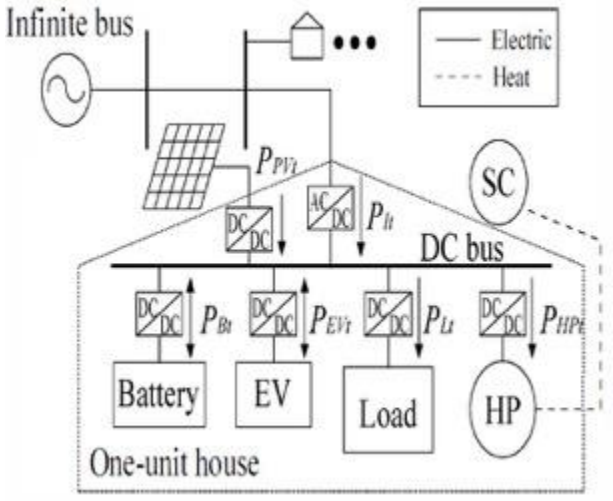

Figure 5.Smart house model [13].

Smart inverters: A smart inverter has computerized design, bi-directional correspondence capacities and vigorous programming foundation. Smart inverters are significant parts in energy framework interface. They increment effectiveness of smart grids and dependability. The utilization of smart inverters in smart framework gives progressed MPPT (Maximum Power Point Tracking).Together with smart network innovation, smart inverter on the planet showcase sharing is developing, as appeared in Figure 6.

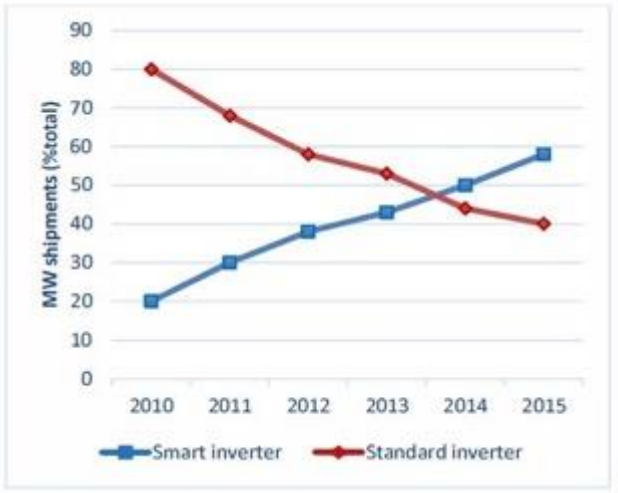

Figure 6.World market share of inverters [14].

Reactive compensation: The most sensible method for compensation is to put reactive current maker to closest the consumer device.. In this manner, the power losses in smart network will diminish extensively and the circulation limit of framework will increment. A smart load can be made by setting a capacitor in arrangement among supply and load as appeared in the Figure 7.

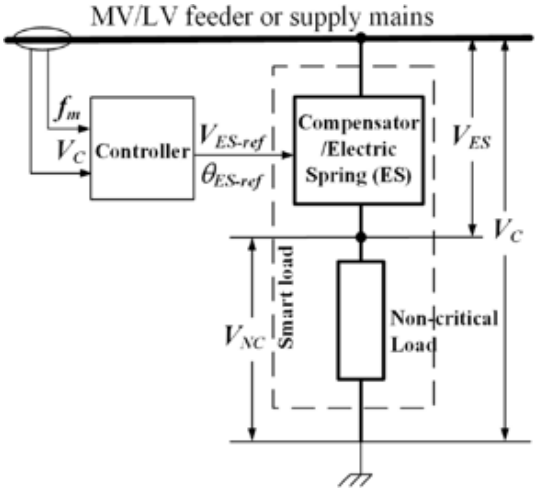

Figure 7.Smart load configuration [15].

Harmonic filtering: In smart framework, different devices and exchanging segments comprise harmonic current flows. Harmonic current flows cause voltage distortion in power system. A few issues brought about by harmonic current flows are follows [16-17];

- Increased power losses
- Power estimation results to be off base
- Overheating of conductors and transformers
- Reduction of the ostensible limit of the transformer
- Damage to the compensation capacitor
- The event of resonance

IV. CONCLUSION

On 3 March 2010, The European Commission has been distributed a few focuses for 2020. These objectives included diminishing ozone depleting substance emanations by 20% and expanding energy effectiveness by 20%. The expansion of energy efficiency and decrease of ozone harming substance discharges are additionally among Turkey's 2023 targets. Along these lines, smart grids and load control methods have gotten significantly more significant.

This paper surveys smart grids. Additionally, some examination and advancement pattern of load control systems are concentrated in the paper. By and large, indirect load control procedures are situated to energy the management methodologies and direct load control techniques contain smart systems. This paper is useful for future investigates and applications on load control technique penetration.

V. REFERENCES

[1] Yogesh Kumar, Bharag Modi, Anu Prakash," Fundamentals of Smart Grid Technology"

[2] Gellings Clark W," The Smart Grid- Enabling Energy Efficiency and Demand Response "

[3]Ahmet Nur,Department of Electrical-Electronics Engineering, Adiyaman University, Adiyaman, Turkey ,Asim Kaygusuz ,Department of Electrical-Electronics Engineering ,Inonu University Malatya, " Load Control Techniques in Smart Grids", 978-1-5090-0866-7/16/$31.00 ©2016 IEEE

[4]Hamed Mortaji, Siew Hock Ow, Mahmoud Moghavvemi, and Haider A. F. Almurib, Senior IEEE," Load Shedding and Smart-Direct Load Control Using Internet of Things in Smart Grid Demand Response Management", 0093-9994 (c) 2017 IEEE.

[5]Suryatapa Roy, Biswajeet Bedanta, S. Dawnee, Department of Electrical and Electronics Engineering M.S. Ramaiah Institute of Technology Bangalore, India," Advanced Metering Infrastructure for Real Time Load Management in a Smart Grid", 978-1-4799-8371-1/15/$31.00 c 2015 IEEE

[6]Gaurav Gaur, Nishtha Mehta, Rintu Khanna, Sandeep Kaur PEC University of Technology, Chandigarh, India," Demand Side Management in a Smart Grid Environment", 978-1-5386-0504-2/17/$31.00 ©2017 IEEE

[7]Xiaojing Liao, Student Member, IEEE, Preethi Srinivasan, Student Member, IEEE, David Formby, Student Member, IEEE, and Raheem A. Beyah, Member, IEEE," Di-PriDA: Differentially Private Distributed Load Balancing Control for the Smart Grid", 1545-5971 (c) 2016 IEEE

[8]Karim MANSOURI, Mouna BEN HAMED, Lassaad SBITA and Mehdi DHAOUI, SPEG/UR11ES82/ENIG Photovoltaic, Wind and Geothermal Systems Research Unit Gabes Tunisia," Three-Phase Balancing in a LV Distribution Smart-Grids Using Electrical Load Flow Variation: "L.F.B.M.", 978-1-4673-9234-1/15/$31.00 ©2015 IEEE

[9]George Koutitas School of Science and Technology International Hellenic University 14 Km Thessaloniki-Moudania 57001, Thessaloniki, GreeceLeandros Tassiulas Computer Eng. Telecommunications University of Thessaly 38221, Volos, Greece," A Delay Based Optimization Scheme for Peak Load Reduction in the Smart Grid"

[10]Alpana Sinhal and Mala De IElectrical Engineering Department, National Institute of Technology, Patna, Bihar, India 2Electrical Engineering Department National Institute of Technology Patna, Bihar, India," Load Shifting Technique for Reduction of Peak Generation Capacity Requirement in Smart Grid", 978-1-4673-8587-9/16/$31.00 ©2016 IEEE