

# Smart Grid Technology: A Review

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**ABSTRACT---** *Smart grid has been replaced with traditional electrical power grid with its various technologies. In today's world smart grid has emerged in as solution of increasing demand. They deliver energy at low cost and high quality as possible. The smart grid successfully uses of renewable energy resources and smart pricing technique in order to achieve energy efficiency. Information communication technology helps the grid in collection of data from various consumers. Basically advanced metering infrastructure comprises of collection, storing and using energy usage data are assumed to be the main tool of smart grid. So AMI transfers data from smart meter to the utility consumer. There is another tool like phasor measurement unit which measures the state of electric power grid. It increases the power transfer capacity. This review paper deals with the role of smart grid technology.*

**Keywords—** *Smart grid, advanced metering infrastructure, load forecasting, demand side management.*

## I. INTRODUCTION

(i) In numerous electrical companies may no longer be the source provider for both industry purpose and home application purpose. There was price differences bound to influence consumer choices [1]. The larger power plants have generated most of electricity due to economic and scale merits. They have generated and transmitted electric power over long-winded and at different voltage levels [6]. To control, product and maintain of distribution system these hierarchical operations have done. Traditionally it is assumption that electrical energy simply always flows from substations to the end of the feeders. However distributed generator is introduced under deregulated environment which results in reversal of power flow and troublesome voltage profiles in the distribution system. Therefore it is essential to modify the planning and operation techniques in the distribution system. Another term Grid computing is an important factor. It differs from traditional method in order to achieve goal on large scale resource. Hence the advancement of grid computing deals with programmers to exploit this technology [8].

(ii) An advancement with grid introduces wireless sensor networks which have become ongoing improvement in smart grid technology. These sensors make a provincial decision and the information is collected to generate a comprehensive model of its environment. The strength of sensors make nodes to cooperate like in sampling, data aggregation and status monitoring [10]. Further there is adoption of Grid paradigm to implement an extensible multimedia server. The objective of this technology is to

support coordinated different resources in virtual organization. Current grid systems are built on X.509 public key infrastructure. Today security management is an important issue. So smart card technology is employed to prevent data from unauthorized users.

(iii) Various technologies collectively are gathered into the phrase distributed computing. These computing systems give backing the future of power and energy services distribution system. An automatic meter reading is also installed to make competence for power consumption reading of users. It is dependent on various communication techniques for transferring data over far distances [19-21]. The realization of smart grid hinges on steady data transmission by virtue of information and communication structure. So power line communication technology is installed to enlarge power communication network to customers [30-31].

(iv) Demand side management is also an important mechanism which ensures stability and accuracy of power system. There are numerous techniques of demand side management which depict in residential, commercial and industrial energy management [47-48]. There are uncertainties handling techniques which depict with the perspective of emerging smart grid issues. There is different class of forecasting techniques on Artificial Neural Network which mimics the human brain to attain regularities and produced generalized results. Further demand response is described by U.S. Department of Energy as changes in electrical power consumption by user from their utilization methods to change electricity cost ever time [52-53]. In this paper a systematic and comparative analysis of different smart grid technologies in reference with security and development of electrical power has been discussed.

## II. REVIEW METHODOLOGY:

The literature review carries review about smart grid with its components and various technologies to secure data management. This has been done by using methodological model which is based on some phases framework such as i) definition of scoping review, ii) conception, iii) literature search, iv) literature summary

i) **Definition of scoping review:** The definition includes five characteristics of literature review as a) focal point, b) aim, c) management, d) audience, e) report

a) **Focal point:** First of all it is the central part of interest. This part concerns about research methods, research outcomes, approaches, utilizations etc.

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b) **Aim:** This views how the author concerns the review fully. The aim of study is to synthesize previous literature and to find the central issue of literature review about smart grid.

c) **Management:** In this section management concerns how the reviewer can manage his research study. This literature could be managed by any one of chronological order, methodological order or conceptual order.

d) **Audience:** It totally involves about class of people whom the review is addressed. The audience may be scholars or industry builders.

e) **Report:** It shows how the reviewer investigates the literature and decides the suitability of research.

ii) **Conception:** In this section we must know about smart grid and its broad working with numerous technologies keeping in mind to secure data protection and data management. To understand term “smart” we may refer several papers by virtue of smart grid is a very broad concept comprising many aspects like economic improvement, technologies and so on.

iii) **Literature research:** This section comprises database, previous and further search in addition to an ongoing estimation of sources. To regulate literature search process, we have some following steps such as to select the database source, to select keywords and search criteria, to choose if to appeal previous and forward search, to figure out literature suitability.

iv) **Literature summary:** In this section we have synthesized about smart grid during the last twenty years. We have analyzed smart grid and its technology by using previous papers and it explores how and when smart grid has been conceived.

Hence to locate studies we have searched many articles in IEEE Explorer, Science Direct and Scopus databases. We have selected articles in the various domains like energy, demand side management and load forecasting with respect to smart grid technology. We have selected articles from 1988 as our starting point of our review. In starting emerging methods were used for negotiating of electricity use. On further moving other smart technologies were employed for the best utilization of electricity and also to secure our data. The field of interest is shown of power system sector so we have eliminated other sectors like transportation, manufacturing and construction.

**RESULTS & DISCUSSIONS**

S. No.	Issue	Formation Criterion
1.	Publication Style	Peer Reviewed
2.	Language	English
3.	Area	Power System, Smart Grid
4.	Duration	1988-2018
5.	Availability	Online as full text
6.	Research	Experimental

	Methodology	
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**Table 1. Selection Criteria of Systematic Review**

The total numbers of annual publications have increased within the past twenty decades on the reliability improvement of power system. During the first decade, the number of publication was relatively low with an average of two to three publications per year. But after 2009 the number of publications has increased remarkably with a maximum of 10 to 15 papers published annually. So the number of publications has to increase more during 2018-2019. These trends result in obtaining more results and knowledge about the contributions of energy storage and data securing to encourage the development of smart grid globally.

This review covers the period from 1988-2018. Here two types of publications are considered as: academic journals and conference papers. Academic journal covers large amount of studies as comprising in literature review. IEEE Transactions on smart grid has published more articles to the relevant studies. Below table refers to the journals or conferences publications.

S. No.	Journals	Number of articles
1.	IEEE Transactions on Smart Grid	5
2.	Renewable	5
3.	IEEE Transactions on Power System	1
4.	IEEE Transactions on parallel & distributed systems	1

**Table 2. Publishing Journals**

S. No.	Conferences	Number of articles
1.	IEEE PES	5
2.	Power Engineering Society	3
3.	Energy	1

**Table 3. Publishing Conferences**

Different techniques for smart grid are discussed in (A.R. Khan et al., 2016). So there are two main goals of smart grid technology which perform an important role in load forecasting and demand side management. The authors state about reconfiguration distribution network in order to reduce loss, balanced loads and improved quality [48]. Here different DSM strategies and technologies and load forecasting schemes are used for load prediction and real time pricing.

(i) **Demand Side Management:** It used for planning and controlling the utilization of energy during highly hours. The main goals of demand side management are: load shifting, load growth, peak clipping etc. The strategy of demand side management depends on interaction among consumers in order to diminish cost of energy and peak to average ratio of demand.



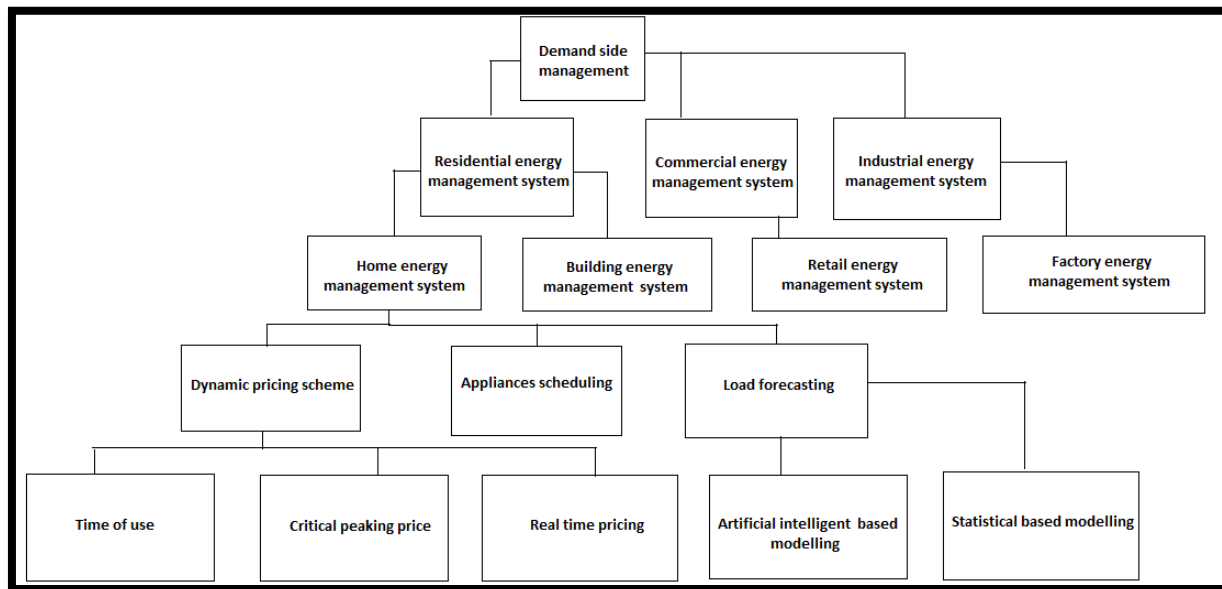


Fig.1. Classification of Demand side management

(ii) **Load forecasting:** Load forecasting methods are used for prediction of future energy requirements on the basis of various parameters such as weather condition, electricity prices, demand response, renewable energy resources, storage cells etc. So this ensures balance between demand and energy supplied. It varies from fraction of hours up to several years.

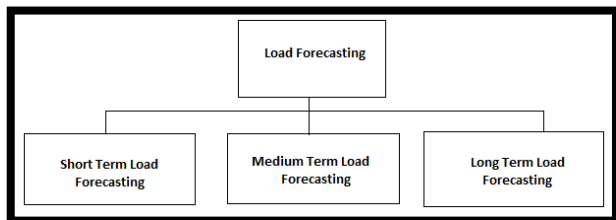


Fig.2. Load forecasting

The above figure shows the types of load forecasting which help to predict future load on daily, weekly, monthly and up to yearly basis. These load forecasting techniques are used for prediction of energy requirements on the basis of following parameters such as weather condition, demand response, renewable energy sources etc. Load forecasting ensures balance between demand and energy supplied. An error in load forecasting model may create problem such as operational cost so an accurate model is required which ensures balance between load and influential parameters such as weather condition, time and economic aspects.

**Conclusion:** In this paper review of smart grid terminologies has been done to understand the objective of smart grid technology. Load forecasting and demand side management help to predict for future planning of load and operation of the system. We have observed that smart grid is an emerging technology with its various applications to enhance electricity. Broad number of papers have been reviewed to know about smart grid with its components like demand side management, smart meters, demand response. So here this paper emphasizes the capabilities of smart grid

technologies with respect to overcome the limitation of traditional grid.

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