

SMART GRID IMPLEMENTATION AND DEVELOPMENT IN PAKISTAN: A POINT OF VIEW

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ABSTRACT- This research paper illustrates the ideas for the implementation of the smart grid technology in Pakistan along with all sectors getting some distribution, transmission or substation design, and analysis. Upon execution of our natural resources and using technology to such an extent can remove the load shedding. Smart grid technology is overthrowing the whole grid of electric power systems that convert digital installation that changes. Power transmission has become a smart, helpful and efficient and the generator of eco-friendly consumers. The system runs the entire comprehensive electronic specific statute using a range of sources to generate, and the dispatch of electricity through distribution units that connect via a wireless system.

Keywords- AMI (Advance metering infrastructure), cyber security, demand response, distribution automation, reliability and smart system.

1. INTRODUCTION

Smart grid is the communications architecture and integration through a multi-part of electric power generation, transmission, distribution and use of the intellectual mechanism. Sensors are used to provide a real-time status of the electrical system that provides an intelligent support to a power flow network in two-way communications. Smart grids can be utilized to the reduction of losses in the transmission and distribution. By helping to change the flow of power and meeting the peak demand, smart grids optimize the use of existing infrastructure. Into the grid, smart grids can also help for the accommodation of significant volumes of renewable and decentralized energy (see [1]). Smart grids can be employed to increase the efficiency of energy by the management of spending patterns of users whom are new and existing and also connected to the grid. Which are energy security, affordable energy, and climate change mitigation, smart grids are very necessary the utilities, their suppliers, and their consumers get recommendations and predictive information by the smart grid. The power can be administered by its best way. On the limitations of network losses and outages, the remote controllers based upon the computer and the advanced sensors are used to achieve this task (see [2]). By operation management and advanced intelligent systems these devices (computer based remote controllers and advanced sensors) are attached to the integrated communication network to be able to the participation of consumer and for the management of integration energy resources which are distributed. The country's progressive economic growth relies on the extensive power generation and management. Electricity demand in Pakistan like other developing countries of the world is increasing rapidly. Pakistan is suffering from the worst electricity shortages since the preceding few years. Industrial and home customer need uninterrupted and cheap electrical energy. However, the present situation does not allow providing a stable power supply. Pakistan is facing the shortage of energy production due to less installed power capacity, power theft, and higher transmission & distribution losses which the major cause of

load shedding. For adequate prevention of occurrence of blackouts, it is extremely important to improve the existing power network. Smart grid is the only solution to this entire problem. The existing grid system could be improved with the help of a smart grid, which reduces the losses and increases the effectiveness of the electric grid. In 2005 for the first time, the practical example of the smart grid has been introduced [2]. Red efficient smart grid nominee system is achieving many refunds as energy conservation, continuous supply, the nonstop source of electricity, by reduction of maximum demands and to manage the load etc. At present, the deep-rooted electrical power grid is 33 percent effective and smart grid is 60 percent efficient [3]. Conventional installed energy production does not fulfil the energy requirement of the country, so Pakistan is also exploring into the renewable energy sector; future use of renewable energy, becoming an important asset for an effective network is a milestone, conservation, planning of large-scale renewable energy systems; smart grid would be difficult without challenging (see [4]).

New skills like smart electricity grid are also known as an intelligent system because it can handle flexible alternating current for high voltage transmission line and wide area monitoring. Some important parameters of smart grid intelligent systems are like self-remedial, compatibility; boot up, interface, assimilation, consistency, and finally sincerity.

2. LITERATURE

The supply of electrical power at maximum efficiency remains the subject the greatest of the agreements predicted. By transient at the time each method change in average shape to get high output, less loss at a minimum level of cost. Fig.1 shows in the history of power generation in Pakistan at the time of independence since 2014 [5,6].

In the last few years the progressive growth has shown in installed capacity and power demand; however, there has always remained a shortfall in the total capability besides power generation and the power demand. There are five major sectors are involved in producing electric power in Pakistan.

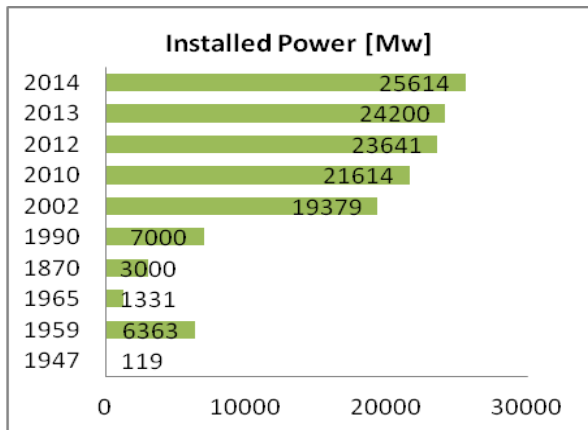


Fig.1 Installed power in MW.

- Water and power development authority.
- Karachi electric supply company.
- Pakistan atomic energy commission.
- Independent power producers.
- Pakistan electric power company.

The installed capacity of the major power condition involved in producing electric power as showed in Fig. 2 (See [7]).

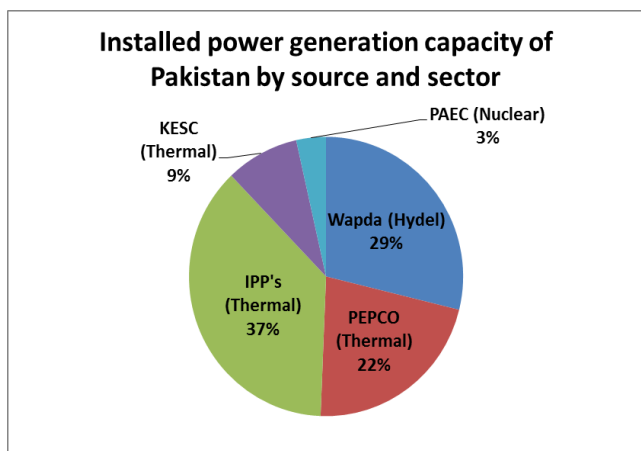


Fig. 2 Sector wise power generation in Pakistan.

Pakistan is well gifted with energy resources exhaustible renewable. Hydro, coal, oil, and natural gas are the energy sources of the four core businesses. Increase resources and growth in the power supply has not kept pace with growing demand, and therefore. Pakistan is still to face a serious shortage of energy. This has led to increasing reliance on imports to meet the energy demand. The oil and gas are the two major strategic parameters to contribute more than 79% of the annual primary energy supplied in Pakistan. Fig. 3 highlights the different energy resources to contribute to the primary energy supplied during the period of 1997-98, 2005-06 to 2010-2011 [9,10].

Pakistan is blessed with a large quantity of renewable energy, but until now did not to develop this potential with the exception of large hydropower schemes. According to the survey, only thirteen percent covered nonconventional energy of the whole power demand of Pakistan & can be raised by

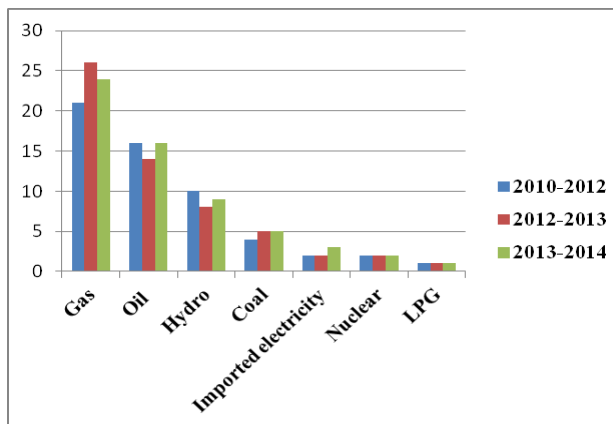


Fig.3 Contribution of energy sources for power generation.

using new technologies in fabrication by way of transition through the smart grid technology.

By innovating new challenges and ideas we can fulfill the demand of the country, but unfortunately due to some political issues and not enough resources for the advancement of energy sector we are unable to avail the actual needs of electricity. Solar, wind and biomass are some of the major sources for the production of energy that we also have, for the implementation of these sources into the smart grid system, a large part of energy can be achieved. Forecasting gives the maximum efficiency of prediction regarding renewable energy sources. Demand management, energy storage, and advanced metering infrastructure (AMI) is the primary sources of change in the smart grid system. Power can be transmitted in real time to industrial and domestic consumers by advanced metering infrastructure (communication technology). When demand is weak, a heavy load is operating in the control system by demand management. In the future, if we apply a smart grid system, then our load can be managed in an efficient way, results in less load shedding, less overloading of the power plant and the best power flow of the domestic and industrial consumers (see [8]), advanced metering infrastructure (AMI) gives an efficient communication between a load and monitoring system of the smart grid.

3. IMPLEMENTATION OF SMART GRID

1.1 EFFECTS ON ECONOMY

Pakistan economy is strongly affected by the crisis of energy. Electricity consumptions in different sectors are shown in Fig.4 [7,11,12,13]. The industrial sector is closed due to a shortage of electricity. Commercial activity is reduced because of communications and infrastructure shutout. As a result of price and crisis, the production and sale of electrical appliances have decreased. In order to avoid power plants from overloading a source of power crisis as well as to take full advantage of power generation, government authorities must ensure that all countries should reform their existing power stations. To prevent from overloading of power plants, periodically shut down one plant at a time of maintenance and overhauling.

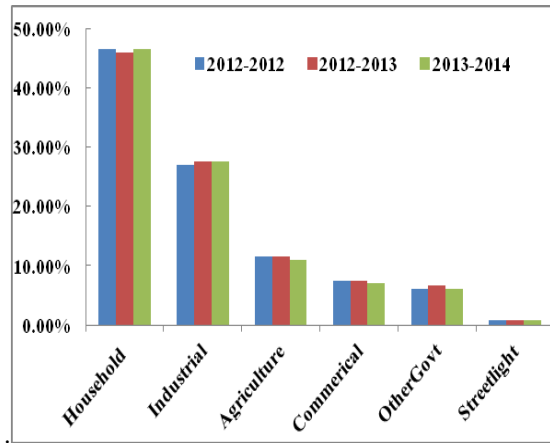


Fig.4 Consumption of electricity by different sectors.

Relax fees and taxes on energy to maintain electrical appliances, such as energy saving lamps, lights, LED, and solar energy and wind turbine devices [6].

Economic transmission lines can replace the high voltage transmission lines to reduce line losses. Twelve, 500 kV grid stations covering 5077km transmission lines and twenty-nine 220 kV grid stations covering 7359km transmission line in Pakistan are operated and maintained by NTDC (National transmission and dispatch company).

4. ELECTRIC POWER LOSSES

Electric power transmission and distribution losses to consumers the source of supply and distribution point and distribution to consumers (see [6]).

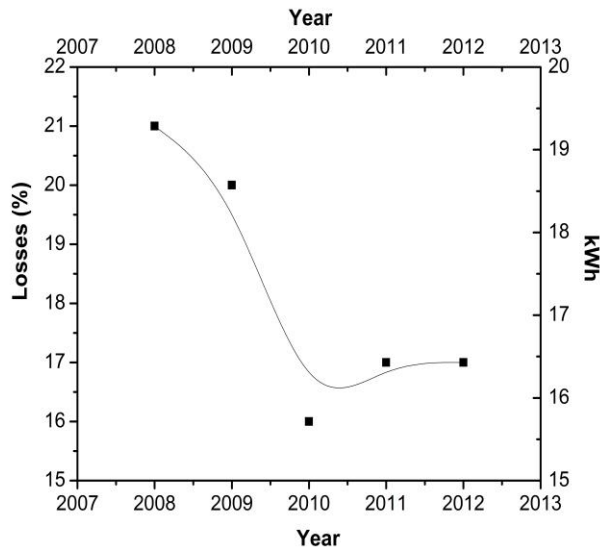


Fig.5 Energy loss over the different years.

The transmission & distribution losses should not be more than 5 per cent as frequently shown, can be done only with the connivance of the staff theft, as any loss of these standards should be treated because financial statements for DISCO’s operating under NEPRA (National Electric Power regulatory authority). The Pakistan government should take serious steps in practice for the benefit of the economic sectors. To turn the whole system in a smart time to prepare, and there is a need for investment and planning. Intelligent terminals, the adapter is attached to a wireless communication system power must be built [15]. Simple

energy meters can be amended by replacing introducing the use of smart meters.

5. PLANNING OF SMART GRID SYSTEM

Improve the weak areas of the power grid system replace the smart grid. The concept of smart grid systems is outside the system of the existing network. Currently, the smart grid has been observed in most European countries as well as American e [16]. They replace with a new one, which leads to that at the current stage, which can greatly improve the system through simple changes only. Pakistan has installed the smart grid to reduce the losses. This current stage of their resources to develop the system and nobody is willing to give time requires a lot of progress in its effect at the beginning, the public sector must start the spread of note for smart grids in financial circles, as well as various technical, so that they can create an atmosphere of understanding of the smart grid. In Pakistan, many experts are high, as well as the technique does not even think the concept of the smart grid. In this regard, investors invest the money takes the interesting development in the smart grid. Both are technically not even are known the concept of the smart grid [17]. The second problem encountered by many countries, including Pakistan, which is one of the smart grid related policy making. The smart grid will help in the design and development of some parameters or guidelines should be. In Pakistan, all government departments which are in charge of the electrical system of the smart grid concept to reality may apply and be accepted by everyone; to develop such a policy should you decide to collect data and expertise there. The third important issue in the progress of intelligent, smart technology in Pakistan is that no one is willing to invest his money as the system is such a great loss in a large supply system. In such cases, the investors should be provided with the financial security by the local government. The next thing is that. The Ministry of planning should have all the power in this matter, and no authority should be given to any person or department to intersect in their effort in any case. Some phases will support in discovering ways to certainly implement smart grid [18]. Also, we can be able to say that the planning department has all the ability in this appreciation and no one has authority to interrupt in their efforts. Inventive ladders would assistance to discover their techniques and definitely, the smart intelligent system would be implementing. The fourth challenge is scheduled to begin to raise public awareness as well as the private sector so that they can create an atmosphere for the benefit of the development of the smart grid. Management should take creativities to permute the intelligent, smart grid scheme. In Pakistan and microelectronic media to increase awareness and promote interests are very important. Any project can do not succeed without the support of the people and the private sector. So for the benefit of workshops and seminars should be developed smart grid [19]. In Pakistan, there is nothing practical about the smart grid so there is a lot of work to be done. Consideration should be paid to the security of the smart grid as a vital role in this issue [20]. The system is connected to the smart grid through the whole communication linkage so as to communicate in the double way system can receive or transmit the data.

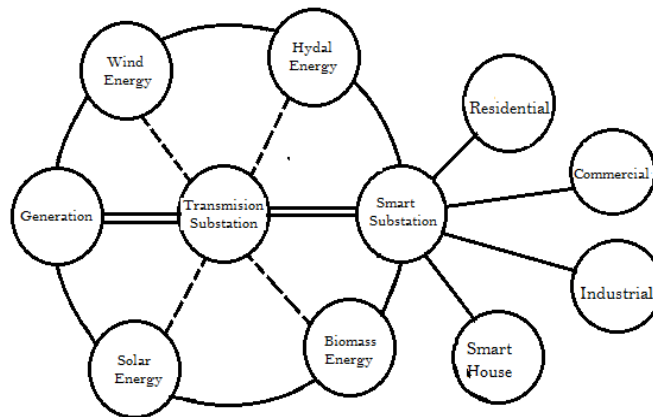


Fig. 6 Block Diagram of Smart Transmission.

6. CYBER SECURITY

If we want to introduce “smart grid” then its solution applies such that cyber security and power system communication systems should be dealt at a large level. For the proper transmission of electricity, it is essential for these parts to join together, where there is complexity about the basic physical and organizational structure.

The basic reason for writing this paper is that here the characteristics’ of cyber security and the combination of PCS with one another has been stressed and where the structure of information is very complex physically. There is also given the history of growth perspective, which is utilized to explain the realities of using today the PCS system, which is used to contain the structure which is vulnerable to some extent. In the field of power communication system, the work which has been stated in this paper is actually based on many years and developed by the working group effort of CIGRE. In addition to this when the “smart grid” term and these developments will introduce and accelerate then the issues of cyber security will become very important. It’s very clear for using smart meters and wind power introduction which are used to form a “smart grid system.”

7. SMART METERS

Smart meters enable appliances to do work with their users to minimize the peak loads in duration when electricity supply is less and bills are high or when the system is not trustworthy by using the modern data collection and demand response capabilities. The need to minimize peak loads by using controlling loads, requirements and time-based rates strengthens the users to choose about energy consumption, increases system reliability and can also decrease high prices and environmental issues linked to growing population and energy delivery effects to compensate growing energy demand. Electric grids present today are not able to fulfill energy demands. Depending on the utilities present and how they can be predicted in the future, the Smart grid is the only way their survival. The acceptance of smart meters is compulsory and cannot be ignored because it is the fundamental component of grid stations. The use of smart meters changes the average pattern of appliances by inserting

actual smart grid stations. We can not only install modern technologies, but also introduce beneficial automatic operations. Evolutionary changes are required when smart meters deal with increasing energy costs, regulatory policies, energy efficiencies, homeland security and large environmental awareness reject manual and automated meter reading processes and accepts advanced metering infrastructure. AMI also produces a protected network between advanced meters and appliance business system. Firstly, a smart meter, with other utilities is utilized to collect and distribute information and provide it to users and competitive retail suppliers.

8. DEMAND AND LOAD BALANCING

With the gesture of modern infrastructure of metering, the concept of smart grid has been started, which is used to make better the demand side management, the efficiency of energy and the self-healing electric grid, so that it is used to improve the reliability of supply and natural disasters or malicious sabotage response. Whatever the way the expansion of initially perceived scope of smart grids has been led by several developments and the new face of the industry of electricity has been also shaped by these several developments. These developments are consisting of the force on the protection of the environment which also includes renewable energy (solar, the wind, etc.). They also consist of demand response (DR); the drive for beneficial asset utilization which includes the operating closer to “knee of the curve” while the system operation is maintained reliably. They also consist of the need for the choice of enhancing customer. This schematic figure shows the factors, which are related to the paradigm of modern emerging smart grids and the place of the DR and generally distributed energy resources (DER) are also illustrated in this diagram distributed generation; demand response and distributed energy storage are essential components emerging smart grid concepts. For simplicity, we call these resources as distributed energy resources. Most of the DER involved in smart grids are focused on the distribution level. These resources are very important for suitable and management operation of the wholesale business and transmission system.

Actually, sometimes these operations are termed as arbitrary power plants.

9. PROTOCOL INTERFACE FOR SMART METERING

In order to perform any function, smart grids depend on communication among its different parts. There are distinct demands of communication for every component. The communication requirements have a collection of security demands and their limit from lower latency to higher data. The smart grid will require many communication protocols to compensate for the changing connection demands. The security of smart grid communications is essential due to the reason that the network communication is the fundamental support of smart grids. A large number of smart grids cannot function without communication. The security is important because it tells which component of is communicating and what data is shared. This is a security challenge because different types of components are contacting their own set of communication demands. Another matter is to complete smart grid technology with inherited power systems and many other critical constraints. Owing to failing of security

11. BENEFITS OF SMART GRIDS

The smart grid technology is beneficial and effective in all parts of the electrical system [21].

Technical Situation in Pakistan	Benefits of Smart Grid IF Implemented in Pakistan
The power generation in Pakistan is centered.	Power generation will be stationed and distributed smart grid technology can recover the fault automatically.
If there is a fault in Transmission and distribution system can cause automatically, identified but it can't Recover automatically.	It can reduce additional transmission lines atomized and processing in real-time Information from the sensors and meters for fault location, automatic reconfiguration of feeders, voltage, and reactive power optimization.
The distribution system is not atomized. No modern technology to cut transmission loss.	The smart, intelligent grid system can decrease the (Q) reactive power & real power will increase finally narrow the transmission losses.
One of the main reasons for load Shedding is attributable to the sufficiency of the circuit breakers and distribution network in this radio is not automatic breakers controlled.	Smart Grid and digital radio needed in order to control the distribution network wirelessly. According to this area of the system is divided into 2 very small and if something goes wrong, then the whole region will be a victim.
More than a meter is the electromechanical system and the security of these matters is very unproductive and the poor.	Globally all energy, electric meters are the digital meters. It can detect non-working electric meters and by passing energy meters.
Only you can integrate distributed resources electromechanical system and the security of these matters is very unproductive and the poor only you can integrate distributed resources. Billing issue is a major problem. Meter readers concerned about the collection, but consumers are not so worried about the abuse and corruption.	These con-conventional sources can be integrated and disseminated. To detect non-payment of this invoice, you can eliminate billing errors, remotely disconnect for non-paying consumer and reconnect after payment.

12. CONCLUSION

A smart system implemented in developed countries since it was introduced this technology. Mostly investment and technical research in the power sector in Pakistan as compared to developed and. They invest lots of money in an energy sector. The energy sector was 22 billion dollars invested European Union (EU), and yearly exceeding the revenues 112 billion dollars. GDP of EU about 1.5%.The great importance of investment in the smart grid, because the power crisis in Pakistan mostly industries is being shifted to China, Bangladesh and United Arab Emirate. The above-mentioned factors showed the implementing smart, intelligent

support, inherited devices may be normally defined as security susceptibilities into the system.

10. POWER ELECTRONICS FOR SMART GRID

In smart grids, the electronic power devices are used and they need to have a function which is able of making changes in voltage and frequency and it also requires a function with a power system for interconnection to be safe. The demands and physical trends of modern electronic devices are described in this paragraph.

A short time ago, it had been possible to make the products of electronic power on a large scale and so there is an expansion of suitably applied range of electronic technology of power. In addition to this, in the distribution of energy, it is to apply the complex control and so for the public infrastructure; it is used to enable very efficient utilization. For the system to function more efficiently it is necessary to optimize system information, power generation, distribution and its consumption in the sensors and smart meters monitor. The tool examples, including the power generation and distribution, can be used in smart grids for power rechargeable technology.

grid system. This new implemented electrical system is very easy to keep and operate from theft control and two-way messages. Consequently, it will take less quantity of resources for the operation of the whole system of the country; it will be run the project to save the energy and money, as well as power. Finals will come to a generation of smart, transmission and distribution, use and optimized to a great extent.

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