Smart Grid: Implementation Challenges in Pakistan

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ABSTRACT

The traditional electricity generation and power wastage control mechanisms have been used over the years. As far as Pakistan's electric power supply (EPS) is concerned, there come some major problems in mind including power outage, electricity downfall, blackout and brownouts etc. In addition to these problems, customer satisfaction with billing system of electric supply is another debate in which electricity consumed by customer is not apparent and hence the bill generated is always a question mark. Smart grid (SG), with its all-smart features, seems to be an effective solution for the complete process from power generation to power consumption in Pakistan. As the name depicts, it can automate the process of power generation, transmission, distribution, power consumption, demand response, and user liaison along with the overall information flow throughout. Besides these features, other additional features of smart grid over traditional electricity grid are bidirectional flow of energy, self-controlled demands and generation, customer participation and real time data analysis. Increased energy efficiency, improved reliability and maximum utilization of resources are some of the key benefits of it. This study takes into account critical issues faced by electric power industry in Pakistan. Furthermore, we present a smart grid infrastructure that can solve these critical problems. We also discuss the challenges in implementing smart grid, specifically in Pakistan.

Keywords: Smart Grid, Advanced Metering Infrastructure, Electric Power Supply, Renewable Energy Resources

INTRODUCTION

When the issue of growing population of Pakistan is discussed, the matter of increasing requirement of gas and electricity also comes under consideration [1]. According to [2, 3], the demand for energy will enhance in upcoming years by 500-1500 megawatts. Despite of having considerable amount of renewable energy resources and strong potential for production of energy with these resources, Pakistan is still deficient in power supply as compared to demand and estimated consumption. Rural areas in Pakistan are facing more electricity crisis relatively [4]. These factors open path for critical issues related to power management system in Pakistan. Some of these issues are being focused here.

- Due to poor governance and weak management control check, power theft is on the top of major issues. Some areas are still in developing phase in which there is no check on electricity consumption. Power is being utilized in these areas out of cost without billing.
- Growing population in Pakistan is another cause which requires grids to produce tremendous amount of electricity. Since demand is increasing, there is need of generating sufficient power to satisfy this additional need. Power outage is a clear consequence of limited power generation which is prolonging with time.
- High energy rates offered to consumers is another big problem that must be revised.
- Increasing load on feeders results in tripping grids and hence leads to blackouts.
- Further, the practicing electricity supply system is taking part in carbon emissions which is considered to be hazardous of living and non living creatures.

- As the technology is modernizing, the addition of more appliances as households is usual and hence a source of load on power grids.

These issues altogether constitute demand for a fully functional system, which along with addressing basic problems adequately, equally satisfies customers' need. To cope up with energy crisis, Smart grid infrastructure is proposed and has been implemented in different countries.

Smart Grid Infrastructure

Smart grids are electrical grids integrated with smart data communication network the purpose of which is to acquire and analyze data in real time from power generation to power consumption [6]. It is an autonomous digital system which provides two-way power flow and transparent power usage to customers [7]. Energy utilization in smart grids is refined by providing consumers with energy feedback along with real-time pricing information in which consumers are not only provided information regarding energy usage they are also informed about costs of their electricity consumption. This helps customers to cut down their usage in peak hours, in which electricity rates are high as compared to off peak hours, hence improving real-time demand response. This elegant operation of smart grid is equally useful for suppliers and their customers to effectively manage power supply and consumption.

Fig. **1** shows electricity flow in smart grid power system architecture having four modules from Generation, transmission, distribution, and Customers while market, operation and service provider domains are also linked with these modules [8]. Power generation module is responsible for bulk generation of power using renewable and non-renewable energy resources. Solar, wind, water (hydro), biomass, and geothermal do not deplete with time thus given name renewable while coal, nuclear, oil, and natural gas, are non-renewable resources which are available for limited use. Substations are used to transmit electricity to Power Transmission Grids then to distribution centers usually consisting of Microgrids. It is therefore provided to customers using smart meters where communication among home area network, Industrial area network, Building area network, smart electric vehicles and etc takes place. The systems in Advanced metering infrastructure AMI acquire data from smart meters and analyze it for efficient energy consumption.

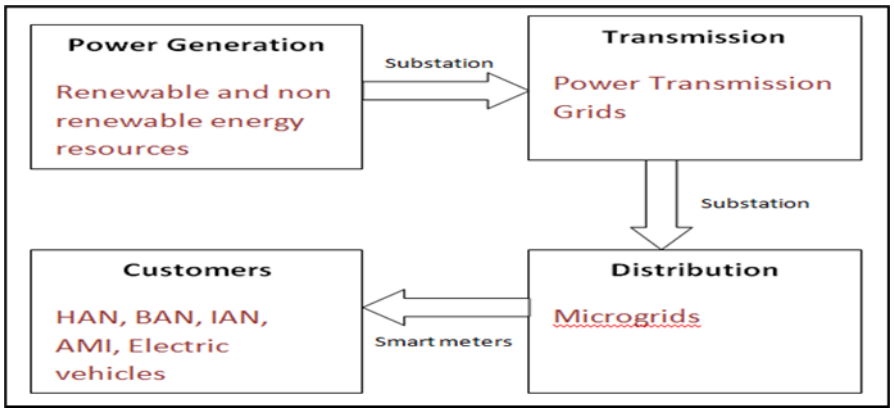

Figure. 1. Smart grid power system architecture.

Smart grid implementation challenges in Pakistan

Since Pakistan is economically weak from the day of its establishment and it is still included in the list of developing countries, the idea of implementing smart grid here with all well-tuned functionalities seems impracticable. Although USAID have been working on smart meters installation project in the country and it is also running multiple such projects in different regions [9], there are multiple challenges in full fledged functioning smart grid which are documented below.

Financial issues

Rising inflation rate, declining foreign exchange rates, limited overseas trade, decreasing financial profit and poor economical structure are some of the main reasons of uneven energy demand and supply ratio in Pakistan. The current pandemic in the state is worsening the situation more. These financial crises hinder the economy to install such state-of-the-art technology.

Installation of Microgirds in existing setup

The cost of installing microgrids in current electrical grid systems is another add-on on the feeble economy of Pakistan [10].

Deployment of emerging technologies

From home appliances to microgrids and grid stations, all levels of implementation of smart gird make use of emerging technologies which require support from international manufacturing companies for uninterruptable power setup as local manufacturing companies need to be upgraded [11].

Using Renewable Energy Resources

Pakistan government needs to focus on the production of energy using renewable energy resources [12]. Solar and wind are considered to be the two most useful resources in which Pakistan is self-sufficient but utilizing these resources also requires proper functional systems.

Lack of awareness

Utilization of resources in regard of deploying Smart power grid in Pakistan need awareness campaigns for not only consumers but also for the service providers so that Demand Response stability and Consumer Efficiency can be achieved.

Weak policy infrastructure

Government should thoughtfully contemplate this issue and make significant policies for smart grid installation throughout the country.

CONCLUSION

Traditional electric power grid in Pakistan is undergoing various issues as energy consumption since last few decades has been increased gradually. Consumers are facing power outage problems along with high electricity bills. Smart power grid implementation in Pakistan can solve these issues intelligently. Somehow, smart meters have been installed in some regions but proper setup will face challenges some of which have been discussed.

REFERENCES

1. Ullah, Akbar, Zobia Neelum, and Sara Jabeen. "Factors behind electricity intensity and efficiency: An econometric analysis for Pakistan." Energy Strategy Reviews 26 (2019): 100371.
2. Rehman, Abdul, and Zhang Deyuan. "Investigating the linkage between economic growth, electricity access, energy use, and population growth in Pakistan." Applied sciences 8.12 (2018): 2442.
3. Shah, Syed Ahsan Ali, and Yasir Ahmed Solangi. "A sustainable solution for electricity crisis in Pakistan: Opportunities, barriers, and policy implications for 100% renewable energy." Environmental Science and Pollution Research 26.29 (2019): 29687-29703.
4. Ali, Akhter, and Muhammad Imtiaz. "Effects of Pakistan's energy crisis on farm households." Utilities Policy 59 (2019): 100930.
5. Kazmi, Hussain, et al. "Electricity load-shedding in Pakistan: Unintended consequences, opportunities and policy recommendations." Energy Policy 128 (2019): 411-417.

6. Al-Turjman, Fadi, and Mohammad Abujubbeh. "IoT-enabled smart grid via SM: An overview." Future Generation Computer Systems 96 (2019): 579-590.
7. Dileep, G. "A survey on smart grid technologies and applications." Renewable Energy 146 (2020): 2589-2625.
8. Gunduz, Muhammed Zekeriya, and Resul Das. "Cyber-security on smart grid: Threats and potential solutions." Computer Networks 169 (2020): 107094.
9. Masih, Adven. "Renewable energy potential and the challenges to implement the idea of smart grid in Pakistan." International Multidisciplinary Scientific GeoConference: SGEM 19.4.1 (2019): 441-448.
10. Yousaf, Adnan, et al. "Overview of Implementing Microgrid, Its Policies, Incentives and Challenges in Pakistan." 2019 6th International Conference on Electrical and Electronics Engineering (ICEEE). IEEE, 2019.
11. Syed, Fahad, et al. "ADVANCE METERING INFRASTRUCTURE TECHNOLOGY AND CHALLENGES IN PAKISTAN."
12. Naseem, Shahid, et al. "Rural Areas Interoperability Framework: Intelligent Assessment of Renewable Energy Security Issues in PAKISTAN." Wind Energy 49 (2020): 1-227.