A REVIEW OF ENERGY MANAGEMENT SYSTEM IN SMART GIRD USING RENEWABLE ENERGY

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Abstract: In this survey paper discuss smart gird using renewable energy resources. In the current generation smart girds are using renewable energy resources. These smart grids are helpful for the energy management. In this survey paper discuss on different smart gird based energy management techniques. In the last decade there are many research work purposed different smart grid energy management in the area of renewable energy. Also discuss the different In this review paper discuss on smart gird using renewable energy resources and its specification. Also discuss the different parts of smart grid system. The next step in the field of smart grid based energy management system is hybrid energy system. In this paper focus on hybrid energy system and its different aspect in the field of smart grid based energy management system.

Index Terms - Smart Gird, Hybrid Generation, PV source, Controller, etc
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I. INTRODUCTION

Wind Power Renewable energy usage in the grids to make a hybrid/smart grid for the purpose of making a green power generation system is discussed by many authors. The disaggregated End-Use Energy Sensing has been done in the smart grid. The controlling of Hybrid Power System by Fuzzy Logic Controller. The modeling and control of the Smart/Hybrid Generation System connected to a grid by different or various techniques. To control PV Output Power fluctuations of a hybrid generation system connected to an isolated power utility. To improve the Wind-Battery-PV (Solar) hybrid generation power system. To smooth the power variations in the output of the hybrid generated power system by coordinated control. The controlling and modeling of photovoltaic PV source connected to a micro grid. The hierarchical and decentralized control for its application in smart gird. The control strategies to control the operation of D.C. micro grid.

The control and modeling of micro grid in general. The regulation Strategies for Voltage and frequency outputs in A.C. micro grid. The increase in decentralized renewable energy sources has created the need for greater coordination between both market actions and grid operations. The transitioning process for the distribution network from passive mode to active mode requires more coordination between the DSOs and TSOs in order to enhance renewable integration through advanced, scalable and secure ICT systems. Smart grid infrastructure is based on unrestricted data flow between the different parts of the grid in order to ensure flexible and reliable services through the different stages of the operation of the network and different time scales.

Information infrastructure is essential in order to meet the challenges of future business models and technical management in terms of providing connectivity between market actors and devices. This interaction between the different stakeholders should be facilitated through the design of an appropriate data exchange platform. However, this platform is also expected to have the potential to provide a flexible interface between energy data users and energy data sources and transfer data between these two parties. Such an interface can be organized by providing a mechanism that handles the data management in energy networks by providing several use cases and scenarios for the data and energy services.

The high-level use cases for the data flow are defined in this paper as an input for the smart grid conceptual model that was adopted by the National Institute of Standards and Technology (NIST), which shows the interaction among different domains. This interaction between domains in the smart grid could be performed using the Advanced Metering Infrastructure (AMI) that represents the gateway of the access for the different stakeholders such as DER and DG. Although some efforts have been made to define the (AMI) by New York State Electric and Gas Company (NYSEG), there is no specific standardized documents for the AMI operation, which could be an open area for more developments regarding the standards and operations types. Therefore, this paper focuses on creating a conceptual model based on the defined use cases in order to provide a real-time data for the control center or different stakeholders that are associated with the NIST domains.
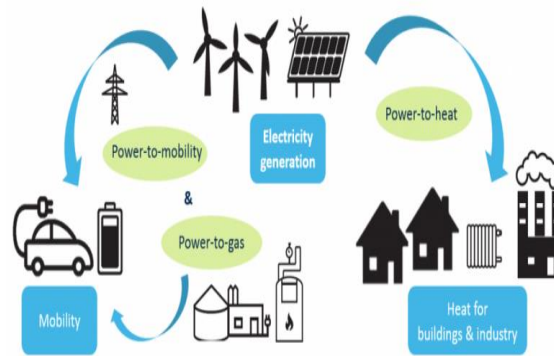
Fig 1. The Interaction between the different stakeholders in the electrical energy market

The integration of renewable energy and the continued transformation of distribution networks from passive to active mode increases the need for enhanced cooperation between the DSO and the TSO within a mechanism that reflects the smart grid concept and the new stakeholders' interaction as seen in figure 1. The provided use cases strategy in this paper enhances the coordination of the generation and consumption process between the DSOs, TSOs and generation sector including the existence of the renewable energy sources, in that it supports the bidirectional behavior of the data and energy flows.

II. Literature Survey

Radi, M., Taylor, G., Uslar, M., Köhlke, J., & Suljanovic, N. (2019). The smart grid concept could be presented within a reliable coordination for the data exchanges between the DSO and TSOs. A data management mechanism has the potential to facilitate the data flow within the new landscape of the network whereby more information is becoming a necessity for the operation of the power systems and the market process. The electricity system is evolving by the time by changing the production and consumption nature and volume, therefore a smart mechanism is needed to be evolved towards a greater flexibility and reliability in order to preserve the balance between the generation and consumption from technical and business perspectives. The data flow mechanism is elaborated in this paper as a background for a reliable data management in different use cases that have been discussed in D1.1 and D2.1 (TDX ASSIT project). The basic requirements for the data portal design and its specifications are highlighted to reflect the usability of data platform in addressing the coordination between the different stakeholders in the power networks. This kind of consideration for using various data platforms introduces more flexibility.**[01]**

Joench, R. L., Soares, J., Lezama, F., Ramos, S., Gomes, A., & Vale, Z. (2019, March)

The concept of DG becomes increasingly important in the operation of an electrical system in the current energy scenario. It can improve the stability of the electric power service, reduce the costs associated with power failures, the dependence on non-renewable sources for power generation and capacity increase in transmission lines. For representing a significant piece of the world's energy consumption, the role of SBs became crucial. For this reason, it justified the emergence of many works aimed to optimize the operation of energy resources and DR, where a well-defined control strategy can provide considerable savings in electricity costs and emission of polluting gases, as well as opportunities for changes in the energy market, in order to meet sustainable policies. **[02]**

Rehmani, M. H., Reisslein, M., Rachedi, A., Erol-Kantarci, M., & Radenkovic, M. (2018)

With the help of information and communication technologies, advanced control systems, and sensing techniques, the current electricity grid is being upgraded to the so-called smart grid (SG). One of the unique SG features is the incorporation of renewable energy resources (RERs). RERs not only facilitate the injection of surplus energy from small consumers back into the grid, but also help to reduce CO2 emissions. In this paper, we have discussed RERs and the issues arising from integrating RERs into the SG, with a focus on different types of communication networks. We have highlighted different ongoing projects around the globe that integrate disparate and intermittent RERs into the SG. We have observed that communication systems play a vital role in the integration of RERs into the SG. Without these communication systems, two-way communication, which is an integral part of the future SG, is not possible. We concluded the survey by outlining future research directions for integrating RERs into the SG. **[03]**

Ferrari, P., Flammini, A., Pasetti, M., Rinaldi, S., Simoncini, F., & Sisinni, E. (2018, September). The increasing environmental awareness is causing the progressive transition from the traditional ICE vehicles toward EVs. The wide penetration of EVs is limited not only but the higher cost of vehicles if compared to traditional one, but also from the impact the charging system could have on the distribution grid. Each of the EV represents an electric load equivalent to tens of traditional houses, and moreover mobile. Several possible solutions have been proposed in literature, and evaluated by means of numerical simulations. One of the more interesting, in particular for private charging, exploits the use of DERs, coupled with DESSs, to limit the usage of power from the distribution grid. The research work described in the paper aimed to design and deploy a testing facility for the validation of such solutions in a working environment, to overcome the issue of over-simple simulation models. The testing facility deployed at the eLUX lab of University of Brescia is formed by a PV plant, a BESS and a fast EVCS, supervised by a Labview GUI. As a first result of the testing facility, it was highlighted as the charging profile of different models of EV could differ from the ideal one, generally considered in simulation environment. In particular, the charging profile of Renault Zoe is strongly affected by the environmental conditions (over temperature), causing disturbances on the power line.**[04]**

Ahmadian, A., Hamidreza, J., Golkar, M. A., Elkamel, A., & Almansoori, A. (2018) In this paper, the use of renewable energy sources in distribution networks based on reducing costs and improving the voltage profile was analyzed. In this method, due to the stochastic behavior of this energy resources artificial neural networks were applied to predict the intensity of sunlight and wind speed. Artificial Neural networks are one of the most powerful methods based on machine learning theory. Compared to statistical methods, artificial neural networks have high accuracy and are very resistant to input data noise. In this paper in addition to reducing cost, the improvement of voltage stability is also considered. In this case, the voltage stability and total cost are considered simultaneously and the pareto-front solution is applied. In this way, the confined space between the total cost and voltage stability axes is minimized. According to simulation results, simultaneous use of wind and solar resources will have a better role in reducing costs and improving the voltage profile. According to the results obtained in this study, considering operation constraints such as voltage stability improves network reliability and is recommended in the design of distributed networks with high penetration of renewable energy resources.**[05]**

Fallahzadeh-Abarghouei, H., Hasanvand, S., Nikoobakht, A., & Doostizadeh, M. (2018) This paper proposes a hierarchical and decentralized voltage management method for smart distribution systems with the participation of reactive power of distributed generators. In this paper the partitioning of distribution networks into different independent areas, the modeling of optimal coordinated control level and a novel local realtime control level for reactive power capability of distributed generators have been described for regulating distribution system's voltage based on the sensitivity matrices. Using the proposed method in this paper leads smart grids' operators to more comfortably use renewable energy sources with low energy loss and significantly reduced voltage deviations. In the suggested method, local real-time controllers besides coordinated control center minimize the transient voltage fluctuations. The proposed decentralized method is compared with the centralized one in two different modes: with and without the local real-time level. Different scenarios with varying generation conditions and load level are evaluated on two distribution test systems. Simulation results show significant reduction in energy ore power loss and the maximum voltage deviation caused by transient fluctuations of DGs' active power. Also, it verifies the implementation of the proposed method for online voltage management in smart grids equipped with distributed generators which have reactive power control capability. **[06]**

Wang, Y., Huang, Y., Wang, Y., Zeng, M., Li, F., Wang, Y., & Zhang, Y. (2018) -In this paper, the energy management problem of a smart micro-grid is studied in the context of renewable distributed energy generation and Demand Response program. Firstly, a typical intelligent micro-grid is introduced, and its modeling and scheduling strategy is studied. Then, on the basis of the scheduling strategy with the Demand Response, the operation optimization model of the micro-grid is established. The model takes the minimum operating cost as the objective function, and takes into account the multiple constraints such as load, power, electrical satisfaction and so on. Finally, the validity and practicability of the model are verified by the Genetic Algorithm and the simulation of a smart micro-grid project in China. Using the proposed energy management model of micro-grid has obtained several achievements as follows**.[07]**

III. Hybrid Power Generation System

The In hybrid power systems, we use many different modelling techniques to design various components such as a wind turbine model, fuel cells, a battery storage system with discharge and charging mechanisms connected all together to an electrical power grid. The main aim of designing a hybrid power generation system is to provide the load with optimal power through renewable fuel power sources as mentioned above. [8]

Hybrid power are combinations between different technologies to produce power. In power engineering, the term 'hybrid' describes a combined power and energy storage system. It does not mean a "method," such as the popular use of hybrid to mean a hybrid electric vehicle like the Toyota Prius. Although the drive train in the Toyota Prius can accurately be described as a hybrid power system.Examples of power producers used in hybrid power are photovoltaics, wind turbines, and various types of engine-generators – e.g. diesel gen-sets. Hybrid power plants often contain a renewable energy component (such as PV) that is balanced via a second form of generation or storage such as a diesel genset, fuel cell or battery storage system. They can also provide other forms of power such as heat for some applications. [9]
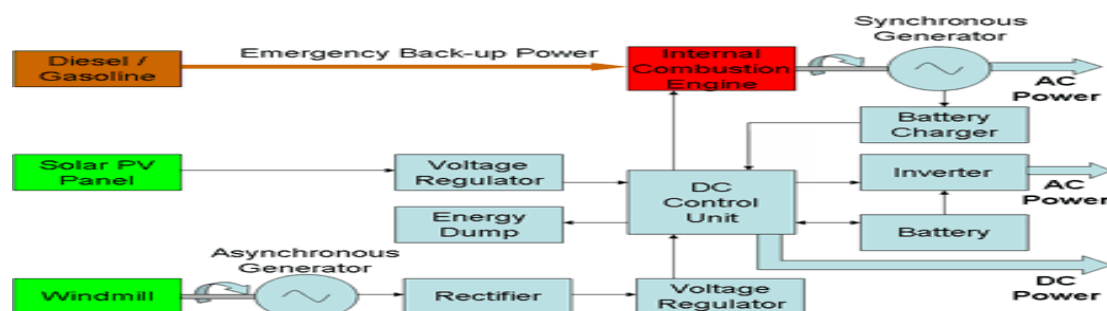

Fig 2 Hybrid Power Generation System

Hybrid power system

Hybrid systems, as the name implies, combine two or more modes of electricity generation together, usually using renewable technologies such as solar photovoltaic (PV) and wind turbines. Hybrid systems provide a high level of energy security through the

mix of generation methods, and often will incorporate a storage system (battery, fuel cell) or small fossil fueled generator to ensure maximum supply reliability and security. [10]

Solar Thermal Hybrid Systems

Though Solar PV generates cheaper intermittent power during the day light time, it needs the support of sustainable power generation sources to provide round the clock power. Solar thermal plants with thermal storage are clean sustainable power generation to supply electricity round the clock. They can cater the load demand perfectly and work as base load power plants when the extracted solar energy is found excess in a day. Proper mix of solar thermal (thermal storage type) and solar PV can fully match the load fluctuations without the need of costly battery storage. [11]

During the day time, the additional auxiliary power consumption of a solar thermal storage power plant is nearly 10% of its rated capacity for the process of extracting solar energy in the form of thermal energy. This auxiliary power requirement can be made available from cheaper solar PV plant by envisaging hybrid solar plant with a mix of solar thermal and solar PV plants at a site. [12]
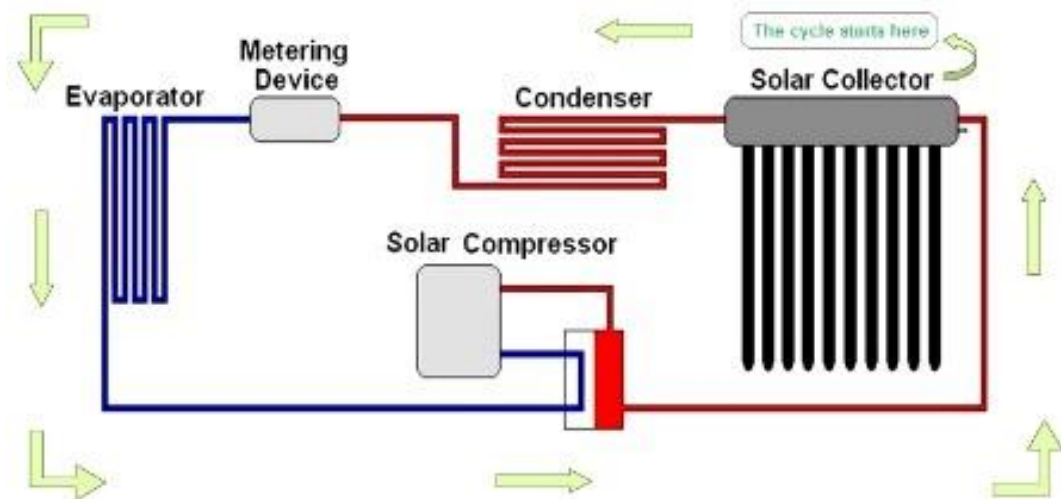

Fig 3 Solar Thermal Hybrid Systems

Also to optimize the cost of power, generation can be from the cheaper solar PV plant (33% generation) during the day light whereas the rest of the time in a day is from the solar thermal storage plant (67% generation from Solar power tower and parabolic trough types) for meeting 24 hours base load operation. When solar thermal storage plant is forced to idle due to lack of sunlight locally during cloudy days in monsoon season, it is also possible to consume (similar to a lesser efficient, huge capacity and low cost battery storage system) the cheap surplus / infirm power from solar PV, wind and hydro power plants by heating the hot molten salt to higher temperature for converting stored thermal energy in to electricity during the peak demand hours when the electricity sale price is profitable.. [14]

IV. Renewable Energy Resources And The Smart Grid: An Overview
A. Smart Grid

The smart grid (SG) is the next generation electric grid which merges information and communication technologies (ICT) and control systems with the power grid. The SG becomes "smart" when it fully supports two-way information (communication) flows and two-way energy flows that are efficiently controlled based on real-time information. An SG consists typically of home area networks (HANs),neighborhood area networks (NANs), and a wide area network (WAN). A HAN is a local SG network segment that interconnects distributed renewable energy generators (e.g., solar panels) and electricity consuming devices in a home. HANssupport the charging of electric vehicles (EVs) and account for a large portion of the overall electricity consumption; it is estimated that over 50% of the electricity is consumed in homes. The NAN gathers information from multiple HANs and relays this information to the WAN. The WAN serves as a communication backbone to connect sub-stations, DERs, data aggregation points, network gateways, and utility data centers. In addition to HANs, NANs, and the WAN, the SG also contains thousands of smart meters that are located at user premises, forming the advanced metering infrastructure (AMI).

B. Renewable Energy Resources (RERs) RERs, such as light, vibration, biogas, biofuel, heat, radio frequency (RF), and wind, are abundant energy resources in the natural environment around us. Renewable energy can be gained from light which can be in the form of sunlight(e.g., large scale solar farms) or artificial light (e.g., indoor environments in homes or office buildings). Photovoltaic cells are normally used to obtain solar energy, however, solar energy is seasonal and its availability varies with the geographic location. Wind is another form of renewable energy in which linear air motion is used by wind turbines in wind farms to generate electricity. Similar to solar energy, wind energy also depends on the climate and geographic location. Vibration, heat (e.g., arising from chemical reactions), and RF are forms of renewable energy that are typically not integrated back into the power grid due to their small scale generation capacity.

One common perception is that due to the intermittent and disparate nature of RERs, a complete reliance on RERs is not feasible; until sufficient RER based energy storage capacities become available [14]. Another perception is that RERs have numerous advantages; thus utilities should carefully plan and move toward achieving a 100% renewable grid, i.e., an inverter-dominated grid.

C. Virtual Power Plant:

The Stitching Entity of SG Resources One of the core questions is how to manage the conventional energy resources, diversified distributed RERs, and moving small power plants, e.g., in the form of EVs that feed back into the grid, in the future Smart grid. How can these resources be effectively stitched together and how can these different entities in the SG be efficiently coordinated? One promising answer is through the concept of the virtual power plant (VPP) [5]. We define a VPP as a central virtual entity that combines, manages, and controls geographically distributed energy resources. These energy resources generate electricity and sell the generated power (that is not used by the resource itself) to the main electricity grid [5], [15]. Fig. 1 shows the concept of the VPP which is basically a power plant generator created through software. In fact, the VPP is a virtual entity and does not have any physical infrastructure, e.g., no physical turbines. The VPP acts as central control entity that combines traditional energy resources, moving power plants (EVs), and RERs.

V. Conclusion

In this survey paper discuss on smart gird using renewable energy resources. The important outcomes of this paper are shown in the section of comparative analysis. In this survey paper observe that smart gird using renewable energy resources is the major problem in smart gird. Hybrid energy generation is better way for smart grid management system. In the next section discuss the future scope of smart grid management system.

IV. Future Work

In future try to design smart gird based energy management that can perform better result in terms of better energy management system. In future try to implement the problem in signal transmission and generate noise in the impulse noise for energy management system. [22][23][24] In future try to implement the better energy management techniques and analysis in power stability. For better energy management system require better communication between grid and unit for this require smart antenna system [21] [25][26][27][28][29]. In future try to implement the method that is correlate with internet of things for energy management and send acknowledgement of the power generation unit and grid management units.[30].

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