International Journal of advancement in electronics and computer engineering (IJAECE)
Volume 10, Issue 1, Jan. 2021, pp.128-132, ISSN 2278 -1412

Renewable Energy Based Smart Management Micro grid System of A User -A Review

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Abstract – As the current electricity network shifts towards a more efficient and smarter grid, there is a strong desire amongst the new energy market participants to be able to quantify the return on investment of smart grid initiatives. Additionally, the electricity industry faces the major task of understanding how energy storages contained in smart grids perform at the different stages of their life cycle. Grid management is major task to manage user and power management. In this paper we are analysis idea how to make smart grid.
Keyword: Grid, Smart Grid, Smart User, Renewable energy

I. Introduction

For years, technology will update. Electricity is initial element of today life and day by day it is using new vertical. Indeed, climate change, new technologies and continuous innovations disrupt the traditional models of the current electricity system, gradually transitioning to what is termed as a Smart Grid (SG).

Even-though there appears to be no unique definition for an SG, an interpretation by Dr. I. Colak from the Electrical and Electronics Engineering department of the Ni¸santa¸si University (Istanbul, Turkey) adequately summarises the different perspectives from academia, industry and compe- tent authorities regarding this subject. Indeed, he states that an SG "can be defined as [a set of] self-sufficient systems, which allow integration of any type and any scale of generation sources to the grid that reduce the workforce, [allowing to deliver] sustainable, reliable, safe and quality electricity to all consumers" [10]. This definition, supported by the renowned Institute of Electri- cal and Electronics Engineers (IEEE), therefore encompasses the three following trends which are currently converging to produce game-changing disruptions in the electrical field:

1. The rapid and growing Electrification of the majority of everyday life assets such as domestic appliances, heating, as well as Electric Vehicles (EVs). As a matter of fact, the INDIA is at the forefront of the EV revolution, with projections from the National Grid Plc (NG) suggesting a leap from 195,000 vehicles at the end of February 2019 [11], to EV stocks which could total as high as 10.6 million by 2030 [12];

2. The rise in Decentralization of energy generation and storage, also referred to as Distributed Energy Resources (DERs). This term depicts the wide range of local energy production and storage technologies which do not rely directly on the high-voltage electricity grid and are present "within the distribution networks or on the customer side of the [electricity] network" [13].

3. The ongoing process of Digitalization, which according to Gartner's IT Glossary can be de- scribed as the "use of digital technologies to change a business model and provide new revenue and value-producing opportunities" [14].

These three trends act in a virtuous cycle, enabling, amplifying and reinforcing the development of an SG beyond their individual contributions. In addition, three factors fuel the potential for disruption by grid edge technologies. First is their exponentially decreasing costs and continuous technical enhancements. Second, is their enabling role for innovative business models built around empowered customers. Last, is the sizeable improvement potential of the electricity network's as- set utilization rate. Indeed, in the INDIA the ratio of maximum electricity load to total potential energy generation capacity was calculated to be only 67% in 2014 [15]. Furthermore, a comparative study between

the China Southern Power Grid (CSG) and the NG showed that such value remained in a 65% to 71% interval between 2009 and 2014 [15], hence exposing the ample room for improvement possible in this sector.

II. LITERATURE SURVEY

The In order to overcome the issues associated with standard electricity meters and gradually shift towards a smarter electricity grid, the British Government launched the Smart Metering Program (SMP) in 2011. Its initial aim was to ensure that "every home and small business in the [INDIA] is offered a smart meter by the end of 2020" [13]. The SMP is currently in the second phase of its delivery. In the first stage, the Government instated commercial and regulatory frame- works to support smart metering, ensuring the proper functioning of the system, and protecting the privacy of the customers [13]. The second phase, the meter rollout, began in November 2016 and should run at least until the end of 2020. This is the period during which households and small businesses receive their SMs, which are installed by their electricity supplier . As of the 31st of December 2018, 12.65 million SMs were in operation in households, representing 25% of all domestic meters [13]. Similarly, smaller non-domestic sites saw the installation of 1.12 million SMs, accounting for 35% of all non-domestic meters .

Smart Meters are a new generation of meters which give consumers half-hourly information on their energy consumption (expressed in pounds and pence) . This half-hourly demand is also automatically transmitted to the customer's supplier through the Data Communications Company (DCC). This data is then aggregated by the DNOs to determine the exact volumes of energy moving across the various parts of their distribution network at each point in time. For users (retail market), SMs effectively put an end to estimated billing and allow the customers to access a broader range of energy tariffs with more specific time periods, replacing the traditional dual peak/off-peak rates [44, 64, 65]. At a wholesale market level, SMs also allow to more accurately predict the consumption for each half-hourly Settlement Period, thus reducing the system imbalance and associated costs at the gate closure. This permits the more efficient running of the grid, and ultimately a reduction in end-user energy tariffs. Further- more, SMs are central to the INDIA's shift to a more flexible energy network. Indeed, their ability to communicate with a measurement device within a micro-generator opens up new sources of flexibility and promotes customer engagement in the electricity market. This enables a shift from the traditional consumer role, to a "prosumer" position. The term "prosumer" refers to a user both locally producing and consuming energy (e.g. roof mounted Solar Panels) .
In 2007, the European Union leaders agreed on a binding legislation for all EU members regarding climate and energy targets for the year 2020. This plan, entitled the Climate and Energy Package and enacted from 2009 onwards, defined the 20–20-20 targets to be met. These are:
• the reduction by 20% of the greenhouse gas emissions based on 1990 levels;
• the fact that 20% of the EU energy supply must come from renewable energy sources;
• a 20% increase in energy efficiency of each national electricity network.
Renewable energy production capacity has been 2000 . Additionally, following the establishment of these European directives , GB saw a considerable uptake of electricity generation from wind and solar sources. In fact, in 2017 wind and solar supply rose by 29.1% from a year earlier to reach a total output of 61.5TWh [44]. This came thanks to an increase in wind and solar capacity of 22.6% and 7.3% respectively (with re- spect to 2016). Great Britain has in fact surpassed the EU targets, as in the second quarter of 2018 its renewables accounted for 31.7% of the national energy production [14].
In the near future, these trends are set to be bettered, as renewable energy sources, particularly at a local scale (e.g. domestic or office building installations), undergo continuous performance improvements as well as price reductions. This is especially true for Solar Panels (PVs), which have seen their price per power output fall by approximately 20% every year since 2011 . In June
2018, the average solar energy cost was estimated to be approximately £1.8 per W. Nowadays, PVs are technologically extremely consistent and can operate at maximum capacity over long time scales measured in multiple years if not a full decade. Their main limitation actually comes from
the amount of solar irradiance they receive, making it difficult to further improve their efficiency. The latest innovation developed in 2012 and put on the market three years later, consists in bifa- cial PVs. These effectively capture light both directly from the sun as well as from the surrounding reflecting surfaces. This technology is claimed to be able to improve by up to 50% the efficiency of PVs, however it is still not widely spread . In the INDIA, the main constraint to the implementa- tion of local panels arose from the energy metering system as explained in Section 2.2.1. However, with the current rollout of Smart Meters allowing two-way communication, an exponential rise of their integration into households is to be expected, reinforcing the ongoing trend of Distributed Energy Resources .
One of the most advanced smart grid initiative to date, is Demand Side Response (DSR). This technology is identified by Ofgem as the first of three "new flexibility methods". It is seen as an essential characteristic of current and future smart grid systems, giving the possibility to an energy supplier to control the electricity consumption at the consumers' premises. As defined by the INDIA Government, DSR is a "way in which users can participate in a smart energy system,

shifting the time that they use energy, or turning their consumption up or down in response to [Price Signals (PSs)]". Said PSs are described as "financial incentives that influence the behaviour of generators and end users". This innovation once again relies on Smart Meters and their half-hourly energy demand readings for a "live" assessment of the user's consumption. The fact that it does not require the use of any other smart grid installation such as PVs or batteries, explains this technology's advanced market penetration. The principal aim of DSR is therefore to impact consumer behaviour through "time-of-use" tariffs, and thus benefit the overall system by helping to balance supply and demand. one of the main limitations of the current grid is the peak time demand occurring during the 18:00-21:00 period.

One of the INDIA leaders in DSR is the new electricity supplier Octopus Energy which began trading in 2016. To take full advantage of the SM capacities, this company launched Agile Octopus in 2018. To replace the traditional and inefficient on/off peak double tariff scheme commonly applied by other suppliers (e.g. Economy 7), Octopus Energy offers a pricing profile to its customers. This system implemented directly in their SMs, provides a "time-of-use" tariff to the users with half-hourly rates based on daily load profiles [24]. This therefore allows the customers to adjust their consumption to the times when the wholesale price of energy is cheapest and the strain on the grid lowest. Additionally, Octopus Energy also guarantees that the electricity supplied is generated by renewable sources, thus further promoting the idea of a smart grid, integrating low carbon energy generation coupled to consumption control.

The second primordial "new flexibility method" stated by Ofgem, is the integration of Distributed Energy Resources into the electrical grid. DERs refer to low carbon electricity generated locally at individuals' households or offices. This type of energy flexibility is mainly dependent on the reduction in cost of solar and wind power and its presence is thus expected to increase dramatically in the coming years following the ongoing trend of cheapening PVs. Additionally, through the use of local matching. it has the potential to significantly reduce energy transmission and distribution losses by shortening the distances between the energy generators and the loads (consumption). Diminishing losses would ultimately improve the grid efficiency and reduce its overall operational cost, therefore reducing the energy bills of the end-users. On the wholesale market level (above 11kV to 415/230V transformers), DER consists of renewable energy sources on an industrial or aggregator scale. On the retail market level which is the "interface" between customers and suppliers/DNOs (415/230V network), DER is supported by local energy generation at both residential and Small and Medium Enterprise (SME) scale [17].

In 2018, DERs accounted for 30% of the INDIA's energy mix, and according to the Crown Commercial Service they are expected to increase to 71% by 2030 [26]. In order to better assess their integration into future smart grids, the Smart Energy Cities (RM6108) program was launched in 2019 by the Crown Commercial Service. The aim of this project is to get increased access to data to make informed decisions and consider the cities' energy needs in a solution based approach rather than as individual product areas. These Smart Energy Cities encompass smart street lights, Electric Vehicle charging, as well as renewables. Additionally, the Smart Cities will include sensors to monitor electricity usage, pollution, temperature and other environmental factors [26].board.

III. Problem and Method

Following onto this exhaustive literature review) on the current grid's limitations and impossibility to satisfy future demand governed by the three trends of Electrification, Decentralization and Digitalization, it became clear that significant benefits can stem from the modeling of smart micro-grids. Keeping in mind the ultimate objective of delivering a future software able to quantify the ROI of SG initiatives for all stakeholders, the development of the initial simulation model prioritized robustness and flexibility to support the future iterations of the model. A Smart Grid consists of numerous entities interacting with each other, forming a closely tied and interconnected network. To model this multi-agent system, it was therefore necessary to select an appropriate simulation environment, keeping in mind the restricted time frame . The results of comparative studies on the advantages and limitations of the different agent-based modelling softwares available (AnyLogic and Mosaik amongst others) were examined, such as that of R.J. Allan and its Survey of Agent Based Modelling and Simulation Tool, as well as the work of M. Pipattanasomporn et al. on Multi- agent systems in a distributed smart grid: sesign and implementation . Additionally, the option of Model-Based Design (MBD) was also studied.

MBD consists in a technique to visually address complex network problems associated, for example, to the creation and usage of a mathematical model, as well as the design of complex control, signal processing, or communication systems. From the underlying model, it is then possible to "derive an executable specification" which permits to simulate the real behaviour of the sys- tem modelled. Model-Based Design is one of the preferred methodology applied to the design of embedded software in the power industry.

IV. Conclusion

As review different author work we get the idea about the smart grid and user management in electrical system. This analysis also put in light the multiple smart grid initiatives being undertaken following the rollout of Smart Meters. Through a thorough analysis of this evolving energy landscape, it was explained that the three trends of Electrification, Decentralisation and

Digitalisation acted in a virtuous circle, permitting a rapid shift towards a Smart Grid.

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