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A Survey on Smart Grid Load Balancing Techniques and Challenges

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***Abstract*- The electric grid is radically evolving into the smart grid, which is characterized by improved energy efficiency of available resources. Here detail survey of different techniques of grid management for load balancing was discussed. This paper work presents an extensive survey of the existing load balancing techniques proposed so far. These techniques are applicable for various systems depending upon the needs of the computational Grid, the type of environment, resources, virtual organizations and job profile it is supposed to work with. Each of these models has its own merits and demerits which forms the subject matter of this survey. A detailed classification of various load balancing techniques based on different parameters has also been included in the survey.**

***Keywords*- Electric power Grid, Dynamic load balancing, Renewable resources**.

I. INTRODUCTION

The smart grid is the innovative future electric power system that will improve the conventional electrical grid network to be more clean, reliable, secure, cooperative, and efficient.

The growth and evolution of the smart grid is expected to come with the plug-and-play integration of the basic structures called microgrids. Specifically, microgrids are small-scale low voltage power supply networks designed to supply electrical load for a small community such as a university campus, a commercial area and a trading estate, etc.

Microgrids can autonomously coordinate local generations and demands in a dynamic manner. It can operate in either grid-connected mode or island mode [1]. There have been world wide deployments of pilot microgrids, such as those in US, Germany, Greece and Japan [2].

RE is a growing component of electricity grids around the world due to its contributions to.

- energy system decarbonisation,
- long-term energy security,
- Expansion of energy access to new energy consumers in the developing world.

RE is implicated in all of these elements, and is critical to transforming energy grids to meet the environmental, economic and social challenges of the future. Globally, RE's share of electricity generation will increase substantially over the next two decades and beyond

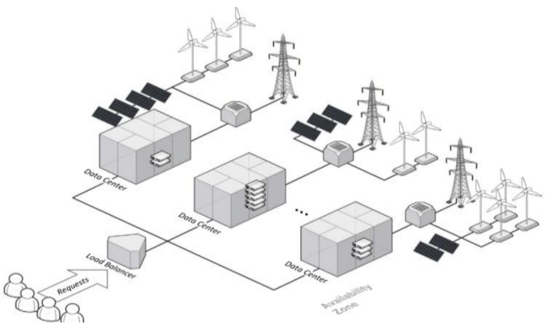

Fig. 1 Architectural overview of sustainable data centers and green load balancing.

Indeed, this is already occurring governmental action at the international, national and subnational levels has created a wide variety of laws and policies to promote RE development. These include:
1.carbon taxes: taxation of greenhouse gas emissions, so as to internalize the climatedisruption costs of fossil-fuel use.
2.cap-and-trade systems: provision of tradable annual emissions allowances to greenhouse gas emitters coupled with reduction in the quantities of allowances issued each year;
3.RE goals: mandates requiring load-serving entities to source a specifi ed proportion of energy sold from renewable sources.
4.Feed-in tariffs (FiTs): guaranteed wholesale prices for RE coupled with a requirement that load-serving entities take renewable power whenever it is available.
5.Tax credits: credits against taxable income for generation or installation of RE.

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6.The development of smart grids: advances in the architecture, functionality and regulation of electricity grids so as to enable higher penetrations of RE; and ▯ removal of long-standing fossil fuel subsidies.

II.CHALLENGES WITH RESOURCES

RE grid integration challenges Wind and solar generation both experience intermittency, a combination of non-controllable variability and partial unpredictability, and depend on resources that are location-dependent [per11]. These three distinct aspects, explained below, each create distinct challenges for generation owners and grid operators in integrating wind and solar generation.

1.Non-controllable variability: Wind and solar output varies in a way that generation operators cannot control, because wind speeds and available sunlight may vary from moment to moment, affecting moment-tomoment power output. This fl uctuation in power output results in the need for additional energy to balance supply and demand on the grid on an instantaneous basis, as well as ancillary services such as frequency regulation and voltage support. Figure 2-17 provides a graphical example of hourly wind power variability.

2. Partial unpredictability: The availability of wind and sunlight is partially unpredictable. A wind turbine may only produce electricity when the wind is blowing, and solar PV systems require the presence of sunlight in order to operate. Wind power can differ from forecasts, even when multiple forecast scenarios are considered. Unpredictability can be managed through improved weather and generation forecasting technologies, the maintenance of reserves that stand ready to provide additional power when RE generation produces less energy than predicted, and the availability of dispatchable load to "soak up" excess power when RE generation produces more energy than predicted.

3. Location dependence: The best wind and solar resources are based in specifi c locations and, unlike coal, gas, oil or uranium, cannot be transported to a generation site that is gridoptimal. Generation must be co-located with the resource itself, and often these locations are far from the places where the power will ultimately be used. New transmission capacity is often required to connect wind and solar resources to the rest of the grid. Transmission costs are especially important for offshore wind resources, and such lines often necessitate the use of special technologies not found in land-based transmission lines.

Because the presence of wind and sunlight are both temporally and spatially outside human control, integrating wind and solar generation resources into the electricity grid involves managing other controllable operations that may affect many other parts of the grid, including conventional generation. These operations and activities occur along a multitude of time scales, from seconds to years, and include new dispatch strategies for rampable generation resources, load management, provision of ancillary services for frequency and voltage control, expansion of transmission capacity, utilization of energy storage technologies, and linking of grid operator dispatch planning with weather and resource forecasting [per11].

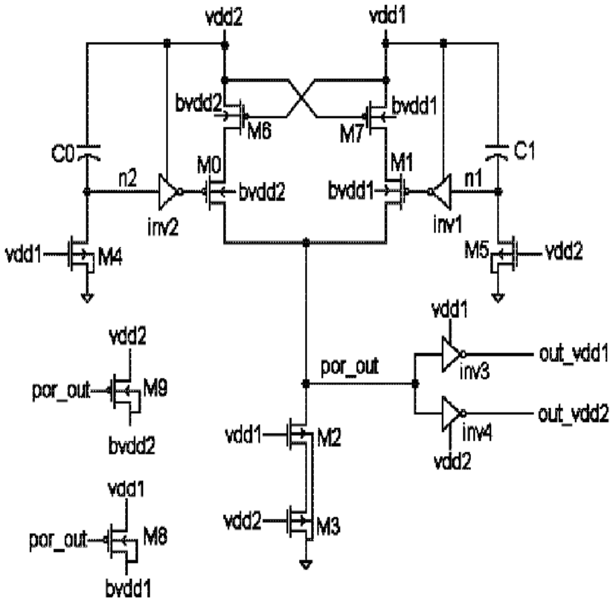

Fig.2 Dual Supply POR with Ultra low current consumption.

IV. RELATED WORK

In [1] Solar and wind resources are considered at variable spatial scales across Europe and related to the Swiss load curve, which serve as a typical demand side reference. The optimal spatial distribution of renewable units is further assessed through a parameterized optimization method based on a genetic algorithm. It allows us to explore systematically the effective potential of combined integration strategies depending on the sizing of the system, with a focus on how overall performance is affected by the definition of network boundaries.

Upper bounds on integration schemes are provided considering both renewable penetration and needed reserve power capacity. The quantitative trade-off between grid extension, storage and optimal wind-solar mix is highlighted. This paper also brings insights on how optimal geographical distribution of renewable units evolves as a function of renewable penetration and grid extent.

In [2] Solar and wind resources are considered at variable spatial scales across Europe and related to the Swiss load curve, which serve as a typical demand side reference. The optimal spatial distribution of renewable units is further assessed through a parameterized optimization method based on a genetic algorithm. It allows us to explore systematically the effective potential of combined integration strategies depending on the sizing of the system, with a focus on how overall performance is affected by the definition of network boundaries.

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In [16], a scalable solution for a fully decentralized microgrid, the Overgrid is presented. The proposed system architecture is a peer-to-peer virtual representation of the physical grid. The nodes communicate using the Gossip protocol, and information about the overall consumption and production profiles is obtained using an average updating scheme. The performance of the network was studied using a simulator of 10,000 nodes with realistic power profiles, and achieved promising results. An experimental validation was conducted using several campus buildings.

However, important aspects of decentralization are not discussed, such as Byzantine tolerance, security, and integrity of data. An automated DR program based on Message Oriented Middleware to provide an asynchronous communication paradigm between the network's components is presented in [17]. The system is not fully decentralized, since the DR programs are considered at the level of energy aggregators and not for each individual DEP part of the smart grid.

In [18], the authors propose a multi agent system aiming to provide grid decentralization leveraging on learning techniques. The presented architecture proposes each energy consumption device to be controlled by an intelligent agent which may respond to signals from the network. Each agent learns over time the most suitable set of actions to be taken according to the overall system's state and following a set of predefined polices (i.e., use available renewable energy, charge battery, etc.).

In [19], the authors define a decentralized mechanism for determining the incentive signals in a smart grid using a communication-based decentralized pricing scheme. The proposed mechanism defines and implements a decentralized method to compute the Lagrangian multiplier which is then used for computing the price signal during DR events. However, one of the most notable drawbacks is data privacy. A decentralized price based DR system is presented in [20]. The price signal is internally computed iteratively based on the forecasted energy production and demand ratio and on the user's willingness to provide load shifting on demand inside an energy sharing zone.

The authors of [21] propose algorithms for shifting the individual energy consumption profiles from peak load periods. The centralized approach implements an algorithm for an automation controller that is responsible for inferring the standby consumption of several Sensors 2018, 18, 162 5 of 21 devices and then computing the maximum monetary reduction. The decentralized algorithm runs in a distributed manner on each smart device, where each device is responsible for its own optimization, without having overview information about the entire system.

V.CONCLUSION

In this paper, studied of a fundamental problem of using a microgrid system central controller to optimally schedule the demand and supply profiles so as to minimize the fuel consumption costs during the whole time horizon. We focused on a scenario where the control of customer appliances is delegated to the grid operator. To tackle the randomness of renewable energy, various researcher introduces a reference distribution. So model allows convenient handling of fluctuating renewable generation as long as the renewable energy generation profile is not too drastically different from the past observation or empirical knowledge. In this Paper a various techniques of load balancing was discussed. Here challenges of the renewable resources were also explained.

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