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Demand-Side Management in Smart Grids

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Abstract Smart grids are basically electrical power system which is shaped by the integration of information and communication systems. These networks provide a secure, sustainable energy system by providing real-time bidirectional exchange of information from energy to production. This system is not only on the production and service provider side; At the same time, some solutions need to be developed between consumption and users. These solutions, also known as Demand-Side Management (DSM), include the impact and change of the user's consumption habits in response to the needs of the network. With the active use of DSM, it is possible to mitigate the burden on the electricity power grid by avoiding the required mains interruptions and by directing the consumers by evaluating variables such as daily supply-demand balance, price information coming from the market. Thus, the energy demand is balanced within the day and it is possible to distribute the peak loads homogeneously to the other hours of the day. DSM can be used for purposes such as reduction of peak demand load, load displacement, flexible load shaping and strategic demand saving. With the DSM system, the demand factor and the multipliers known as the diversity are further optimized and a sustainable and efficient energy is targeted. With the development of the smart grid, the number of producing consumers, also known as prosumers, is increasing day by day due to developments in electricity storage systems and the fact that electricity is expensive.

In this study; Demand Side Management (DSM) issue in smart grids was examined together with decision support systems and advanced control approach. The methods used are detailed.

Keywords Smart grid, Demand Side Management, Control Approach

1. Introduction

The concept of energy is changing in the world of the future. Consumers are also actively participating in the energy value chain with the increasing share of renewable energy sources such as solar, wind, hydroelectric and geothermal power in energy production, increasing environmental awareness in the society and raising awareness on energy efficiency. Thanks to distributed production, which has become widespread in recent years, consumers are now able to use some or all of the electricity they use, such as solar panels, wind turbines, etc. it can produce renewable energy sources and sell more of its needs to the electricity grid. With the spread of distributed generation and the increase in the number of producing consumers, traditional electricity networks, where information flow is designed in directionally, have been replaced by smart networks capable of providing real-time bi-directional information and data flow formed by the integration of operation, information and communication systems. Smart grids constitute the necessary infrastructure in order to ensure efficient, efficient use of energy and turn it into an economic value with the participation of the demand side at all stages of energy transfer from production to consumption. With the efficient use of demand side participation in the markets, daily supply-demand balance, weather conditions, price information from the market, etc. By evaluating such variables, consumers can be guided. Thus, by balancing the energy demand during the day, homogeneous distribution of peak loads to other times of the day and balancing of market prices in cases such as energy bottleneck.

Efficient planning of demand management and the benefit of producers and consumers from the markets require decision support systems that lead the demand management companies to fast and accurate decisions [1].

2. Demand-side Management

All applications related to changing and changing the consumption habits of the users to meet the needs of the network are collected under the heading of Demand Side Management (DSM). DSM can be used for different purposes such as peak demand reduction, low demand times, strategic demand savings, strategic demand growth, load shifting and flexible load shaping (*Figure 1*) [2].

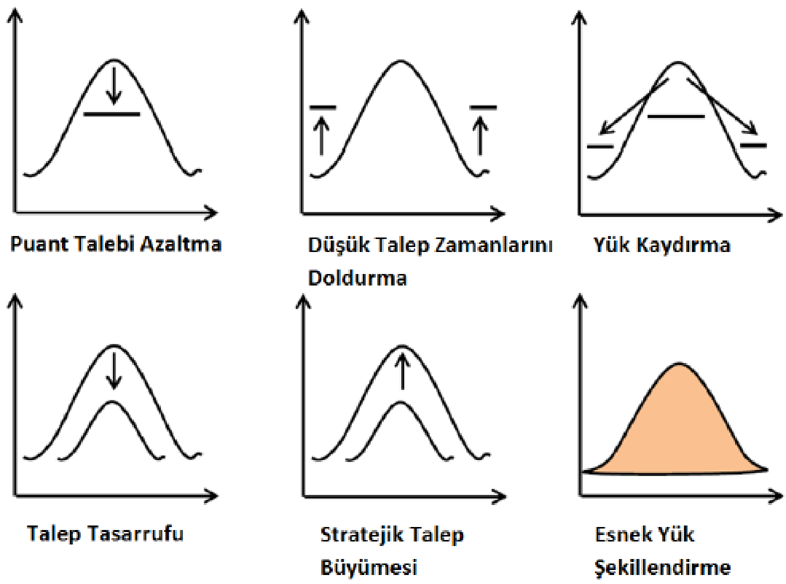

Figure 1: Demand Side Management Strategies

With load shifting from DSM methods, a particular job can be performed in a number of different ways by shifting within a limited time frame. *Figure 2* illustrates the different operating situations where the same work can be done without changing the total energy consumption.

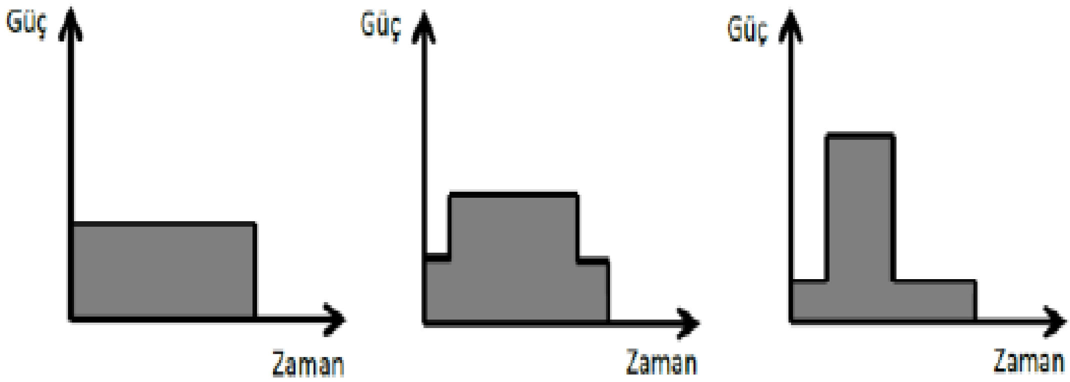

Figure 2: Different working situations where the same jobs can be performed

To achieve these objectives, Indirect Load Control and Direct Load Control methods can be used [3].

2.1. Indirect Load Control

Indirect Load Control includes various tariffs, additional payments, incentives, advertisements, trainings, etc., designed to help users change their consumption in a targeted manner applications [8]. "Multi-Time Schedule" and "Real-Time Pricing which can be realized by using Smart Meters can be given as an example of the tariff applications of Indirect Load Control [4]. With the use of smart meters, "Multi-Time Schedule based on different pricing of various hours of the day and" Real-Time Pricing "methods, which aim to separate pricing of each hour of the day, can be applied [5]. With these methods, high unit price is applied for energy consumption over a period of time in which it is desirable to reduce consumption, while hours for which energy consumption is aimed to be increased can be priced cheaply. In this way, it is aimed to reduce fluctuations in energy consumption and peak load. On the other hand, consumers have to plan their energy use according to the variable price. For consumers who have not yet planned their electricity use on a price-based basis, this is undesirable. In addition, participation and outcomes in human-based management practices may not always be of the desired or predicted extent. This increased the need for advanced load management systems that run automatically.

2.2. Direct Load Control

Direct Load Control is based on direct control of loads according to certain conditions of the network with various switching elements and systems. Existing Direct Load Control applications can be given as an example of a switch that activates and deactivates the load according to the network frequency or applies a predetermined program [6]. However, these applications do not move according to the variable conditions and affect the user comfort as they stop the operation of the load they control. In addition, since there is no communication or cooperation between traditional controllers, the independent operation of a large number of controllers carries the risk of affecting the stability of the network [7].

Since the remote monitoring and response infrastructures of the controllers are also insufficient, it is not known how much they work correctly against the events in the network and the feedback of an application cannot be received successfully enough. This causes the performance of the controllers not to be evaluated in detail, and thus the users cannot be rewarded according to this performance. As a result, there is not enough incentive for users to participate in such applications and purchase the necessary control devices, and Direct Load Control applications remain small. Load management applications have been preferred in large industrial buildings. In addition to developing smart meters and communication technologies, due to the growing share of households in total electricity consumption, load management applications are now being considered for small power users [8]. While industrial consumers can participate individually in demand management applications with special programs and incentives for their facilities, it is possible to manage the controllable loads in the workplaces and residences collectively through regional coordinators. To be successful, load management applications should be widely used by consumers [9]. There is a need to offer some privileges for the adoption of these applications by consumers which require additional investments on the existing system.

3. Conclusion

In this study, the issue of advanced local demand management system in smart grids is examined. If the peak load can be reduced by demand-side management, which will gain importance when the electricity distribution systems become compatible with the concept of smart grid, it will be possible to achieve big savings from the power plant investments. In DSM methods, manageable loads can be managed more successfully according to network events with advanced intelligent load control, especially in thermostatic controlled loads, management performance will be increased. The economic incentive required for the widespread use of this approach can be financed from the savings from the plant installation and operation expenses due to the gains that consumers can provide on their electricity bills and the decrease in peak demand.

References

[1]. Ayanoğlu, G.G.D. (2014). Dünya Örnekleri İle Yenilenebilir Enerji Kooperatifleri. Enerji Piyasası Bülteni, Enerji Uzmanları Derneği.

[2]. Gellings, C.V. (1985). The concept of demand-side management for electric utilities. *IEEE Proceedings*, 73(10), 1468-1470.

[3]. Luo, T., Ault, G., & Galloway, S. (2010). Demand Side Management in a highly decentralized energy future in 45th International Universities' Power Engineering Conference, Glasgow, United Kingdom, 31 Ağustos-3 Eylül.

[4]. Palensky, P., & Dietrich, D. (2011). Demand Side Management: Demand Response, Intelligent Energy Systems, and Smart Loads. *IEEE Transactions on Industrial Informatics*, 7(3), 381-388.

[5]. Huq, M.Z., & Islam, S. (2010). Home Area Network technology assessment for demand response in smart grid environment, in 20th Australasian Universities Power Engineering Conference (AUPEC), Perth, Australia, 5-8 Aralık.

[6]. Infield, D.G., Short, J., Horne, C., & Freris, L.L. (2007). Potential for Domestic Dynamic Demand-Side Management in the UK, in Power Engineering Society General Meeting, Loughborough, UK, 24-28 Haziran.

[7]. Stadler, M., Krause, W., Sonnenschein, M., & Vogel, U. (2009). Modelling and evaluation of control schemes for enhancing load shift of electricity demand for cooling devices. *Environmental Modelling & Software*, 24(2), 285- 295.

[8]. Alcázar-Ortega, M., Escrivá-Escrivá, G., & Segura-Heras, I. (2011). Methodology for validating technical tools to assess customer Demand Response: Application to a commercial customer. *Energy Conversion and Management*, 52(2), 1507-1511.

[9]. Schmautzer, E., Aigner, M., Sakulin, M., & Anaca, M. (2011). Load potential for demand side management in the residential sector in Austrian Smart Grids, in International Conference on Clean Electrical Power, Graz, Austria, 14-16 Haziran.