Chapter 13
Demand-Side Management: Energy Efficiency and Demand Response

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ABSTRACT
Growing demands are causing increased pressure on the electrical infrastructure and perpetually escalated energy prices. Utilities around the world have been considering demand-side management in their strategic planning. The costs of constructing and operating a new capacity generation unit are increasing every day as well as transmission, distribution, and land issues for new generation plants, which force the utilities to search for other alternatives. Here, demand-side management has been implemented as it is less expensive to intelligently influence a load than to build a new power plant or install electrical based storage device. In this chapter, the author has discussed energy efficiency and demand response fulfilling the criteria of energy management which usually tries to take influence onto the energy consumption of a number of energy consumers. The explained demand-side management technical objectives are peak clipping, valley filling, load shifting, load building, energy conservation, and flexible load shape.

INTRODUCTION
The chapter gives an overview of demand side management (DSM) which reduces electricity utilization through programs that promote conservation or more efficient load management. It is basically a portfolio of selection, planning, and implementation of measures intended to have an influence on the demand or customer side of the electric meter, either caused directly or stimulated indirectly by the utility. DSM programs are classified into EE and DR programs. Energy audit and load research is an important part of DSM for precise understanding. Load variations in electrical consumption patterns

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have been described with an example of a commercial body. Different technical load-shape objectives are defined which can be used to alter the load duration. The main objective of this chapter is to understand DSM in broad perspectives in order to modify the energy consumption of different customers by various programs based on load management.

BACKGROUND

DSM involves planning, implementation, evaluation and activity monitoring which can be selected from a variety of technical alternatives. The wide range of different technical alternatives mandates DSM as there are a large number of technical alternatives and there is a wide variety of choice for appropriate alternative selection. The selection of a suitable alternative is little difficult especially when the alternatives are influenced in a strong manner due to the specific local and regional factors. These factors include mix generation, expected growth in load demand, plans for expanding capacity, reserve margins, climate regulation, load factor, and shape of the load for normal and extreme conditions. As a result, transfer of the above factors from one region to another is inappropriate without proper adjustments.

DSM is the planning and implementation of those activities that are designed to modify the energy consumption that would further reflect desired changes in energy magnitude and time pattern. A program of DSM encompasses load management, new uses, strategic conservation, electrification, distributed generation and market share adjustments of energy consuming appliances. DSM extends beyond load management and conservation of load to design programs particularly to change energy use in both on-peak and off-peak time periods. Cost control or customer options include a fair partnership between energy service supplier and the customers. But ultimately, it is the customer who decides whether to participate in a program or not. Load managing programs totally focus on the reduction on consumer’s premises at the time of the rise in utility system loads. The main aspiration is to avoid buildup of generation, production and the delivery facilities that would be required for a small time operation in hours per year.

On the other hand, EE focuses on the annual reduction of loads but load management techniques target specific moments and it has fewer impacts on the total energy consumption. Load management programs are proven to be more stable and reliable over time periods than any other customer programs. The main components of load management activities are direct load control, pricing based choices, and thermal energy storage. There were several important objectives that were to identify the technologies that were efficient in peak clipping, valley filling and load shifting and shift them in market places. Moreover, the conservation efforts were also met that could focus on annual load reduction.

The decrease in the energy demand and consumption in power distribution systems, can free up generation, transmission and distribution capacity. Sinha et al. (2011) observed that with DSM measures the cost of energy saved has been estimated to be as low as 10% of the cost of the added capacity. For a more efficient future planning process and better service, there should be support for EE at customer’s installations which also bring the utility in closer contact with the consumers. It does encourage the consumers to make decisions prior to their energy consumption contributing to energy providers to reduce the maximum load demand. Hence, the reshaping of load profile can be done in an effective manner (Esther, Priya, and Kumar, 2016). Also, Kumar et al. (2015) have developed a simulation model of the synchronized operation of the grid power, solar power and battery for energy management at home level.

To lessen the system instabilities caused due to the increasing electricity demand, an appropriate objective of DSM activities can modify the shape of load curve (Logenthiran, 2011). This can be
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