UNIT – VII
DEMAND SIDE MANAGEMENT – I

Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi – utility power exchange model, time of day models for planning.

Introduction to DSM

Demand side management (DSM) has been traditionally seen as a means of reducing peak electricity demand so that utilities can delay building further capacity. In fact, by reducing the overall load on an electricity network, DSM has various beneficial effects, including mitigating electrical system emergencies, reducing the number of blackouts and increasing system reliability. Possible benefits can also include reducing dependency on expensive imports of fuel, reducing energy prices, and reducing harmful emissions to the environment. Finally, DSM has a major role to play in deferring high investments in generation, transmission and distribution networks. Thus DSM applied to electricity systems provides significant economic, reliability and environmental benefits.

When DSM is applied to the consumption of energy in general—not just electricity but fuels of all types—it can also bring significant cost benefits to energy users (and corresponding reductions in emissions). Opportunities for reducing energy demand are numerous in all sectors and many are low-cost, or even no-cost, items that most enterprises or individuals could adopt in the short term, if good energy management is practiced.

Concept of DSM

Cost reduction – many DSM and energy efficiency efforts have been introduced in the context of integrated resource planning and aimed at reducing total costs of meeting energy demand;

Environmental and social improvement - energy efficiency and DSM may be pursued to achieve environmental and/or social goals by reducing energy use, leading to reduced green house gas emissions;

Reliability and network issues – ameliorating and/or averting problems in the electricity network through reducing demand in ways which maintain system reliability in the immediate term and over the longer term defer the need for network augmentation;

Improved markets - short-term responses to electricity market conditions ("demand response"), particularly by reducing load during periods of high market prices caused by reduced generation or network capacity.

Advantages to Demand Side Management

1. Better usage of existing generating and distribution infrastructure.
2. Less efficient/environmentally unfriendly generating capacity can be decommissioned.
3. Load can be matched to variable renewable energy availability.
4. Lower generating and transmission costs.
5. Lower transmission and distribution losses.
6. Reduction in "spinning reserve" costs.
7. Less intrusive load shedding.
8. More consumer growth capacity.
9. Better maintenance opportunities.
10. More availability (less black-outs).

The aims of the DSM are:

- To introduce the concept of demand-side management for residential, commercial and industrial energy users.
- To give an overview of the different types of demand-side measures.
- To show how housekeeping and preventative maintenance in commerce and industry can be used to reduce energy demand.
- To describe energy auditing and routine data collection and monitoring, and to indicate their benefits.
- To outline information dissemination on demand-side management.
- To provide an overview of the major implementation challenges for DSM Programmes.

Benefits of DSM

Demand Side Management (DSM) is a program that encourages energy users to make use of energy efficient designs. DSM presents a great chance for different power utilities to limit their GHG emissions while promoting energy conservation as well as lower emissions. This DSM approach is actually aimed at both the customers and the utility companies encouraging lower and more effective energy consumption. The following are a few benefits of DSM.

1. Environmental benefits

Rather than building new electrical plants for responding to the increase in customer demand for electricity, electricity producers could possibly attempt to limit the demand for power. Usually, they offer incentives of special programs having lower tariffs as well as higher efficiency appliances. This greatly assists in meeting the environment protection goals since it is going to reduce the emissions of pollutants into the atmosphere.

2. Controls load

It is an undeniable fact that the demand for electricity varies from one person to the next and there is a huge difference between night and day consumption. On the other hand, utility firms prefer constant usage in order to make the most out of their investment. Such a problem is easily solved with the assistance of demand side management. In such cases, lower night tariffs are introduced or other financial incentives to ensure constant power usage.

3. Cost effective

Through using the DSM approaches, you can be able to save a lot of money in electrical costs as well as maintenance costs. There is a large market nowadays of energy efficient appliances that you can use. Through using these appliances, the energy consumption will go down significantly and thus you will not require spending as much money in comparison to other firms that do not use the DSM approach.

The major drawback of DSM is that DSM based resolutions usually increase the complexity of the situation and they are not competitive.

• Reducing generation margin.

• Improving efficiency of system operation.

• Improving transmission and distribution grid investment and operation efficiency.
• Managing demand-supply balance in system with intermittent renewable and distributed power systems.
- Reduction in customer energy bills.
- Reduction in need for new power plant, transmission and distribution network.
- Stimulating economic development.
- Creating long term jobs due to new innovation and technologies.
- Increases the competitiveness of local enterprises.
- Reduction in air pollution.
- Reduces dependency on foreign energy source.
- Reduction in peak power prices for electricity.
- reducing dependency on expensive imports of fuel,
- reducing energy prices, and
- reducing harmful emissions to the environment.

Different techniques of DSM

- Night-time heating with load switching.
- Direct load control: remotely controllable switch that can turn power to a load or appliance on or off.
- Load limiters: limit the power that can be taken by individual consumers.
- Commercial/industrial programs: i.e. load-interruptible programs.
- Frequency regulation: dealing with fluctuation in frequency.
- Time-of-use pricing: reflect the production and investment cost structure where rates are higher (lower) during peak (off-peak) periods.
- Demand bidding: customer reduces the consumption of electricity at a certain predetermined price.
- Smart metering: tracking amount of electricity using to manage costs and consumption.

Time of day pricing

It is widely recognized that the cost of producing electricity varies from hour to hour. This conclusion holds true under virtually any method of calculating costs. As indicated previously, the most significant type of cost is marginal cost. The marginal cost of producing electricity varies widely, depending upon the total load and the particular generating units used to serve this load. The theory behind time-of - day rates is simply to vary the price of electricity in accordance with fluctuations in production costs. When the cost of production is high, the price would also be high. Conversely, when the cost of production is low, the price would be low.

Time of day pricing is actually a special case of marginal cost pricing. Since marginal cost theory suggests that prices should be equal to marginal cost s, and marginal costs vary from hour to hour, the price of electricity should logically vary from hour to hour. The efficiency advantages of such a pricing system are readily apparent. For example, if additional electricity costs 20 cents per KWH at a particular moment, it is hardly efficient to charge just 3 cents per KWH. If the utility charged the higher amount, some (perhaps many) customers would cut down on their usage of electricity by adjusting thermostats, turning off lights, and the like. Obviously, for these "flexible" or "adjustable" uses, customers are willing to pay the lower amount of 3 cents per KWH, but not 20 cents. Yet for every KWH which is eliminated, the utility's costs will be reduced by 20 cents. The situation is economically inefficient: the utility spends 20 cents per KWH to produce electricity which is worth far less to its customers. If the utility charged a price equal to the marginal cost of producing electricity, consumers would continue only those uses which were worth as much as the cost of producing the electricity.

The equity advantages of time- of - day pricing are also apparent. To illustrate, there are two customers who are the same in every way except for their consumption patterns. The first customer only uses electricity l ate at night when the marginal costs of production are very low, like 1 cent per KWH; the second customer only uses electricity at the peak usage hours of the day when the marginal costs of production are very high, like 10 cents per KWH. Given their usage, it is hardly fair to charge them same price. Under a time- of -day pricing system, this inequity can be corrected because the nocturnal user is charged less than the peak- hour consumer.

Practical Difficulties with Time- of - Day Pricing

In theory, marginal cost pricing can be applied with a high degree of exactness: a different price is charged every hour, depending upon the marginal costs of the system. In fact, many utilities use this type of pricing system when they interchange power with other utilities. The actual marginal costs of the selling utility are calculated for each hour when the power is interchanged; this rate is used as the price charged the purchasing utility.

Realistically, such a pricing system cannot be applied to all customers, even though it is theoretically possible. When two utilities interchange power, a rather substantial amount of electricity is normally involved. Thus, the transaction cost of calculating the bill under such a complicated pricing system is small, relative to the tot al value of the transaction. But if the transaction costs per KWH are very high for small customers, a complicated pricing system would not be appropriate.

Can Time- of - Day Pricing be Practically Applied to Industrial Customers

For smaller industrials and large commercial customers, the situation is less clear. Although it might be impractical to implement a time- of - day pricing system where the price changed every hour, it does seem feasible to adopt a more simplified approach with two or three different price levels. If properly designed, this approach would be a major improvement over the timeless rates now used; it could be simple enough for customers to understand and modify their usage patterns, if they wished.

For residential and small commercial customers, there are considerable practical difficulties with adopting a universal time- of - day pricing system. Metering costs alone are a major obstacle. Also, these customers are less likely to acquire the necessary knowledge to adapt their purchasing decisions to a time- of - day pricing system.

Multi-utility power exchange model

Multi-utility relates to companies offering a wide range of services and/or products. In the business market, this type of service provision usually relates to energy, environmental services, waste issues, infrastructure and/or telecom services. In the consumer market, it often concerns a combined offering of services in the field of energy and digital products and services (telephony, internet and television). Providers like these are also referred to as multi-service providers. So it often concerns services and products in relation to public utilities. Multi-utility has a relation with cross-selling, offering complementary products and services.

In a multiple (multi-utility or multi-country) integrated system setting, each integrated system “speaks” with its neighbor in terms of spot prices at their common borders; they buy or sell energy at the spot price of the specific instant and location. The resulting operating point is the same as the one achieved under a fully centralized dispatch. When dispatching the utilities, the control center associated to each system must not discriminate between its own generators’ power and power offered by the neighboring systems through tie-lines, except for economic reasons. A multi-utility setting consisting of three coordinated areas is shown in Fig. 1. Each regional ISO operates its own power system and interacts with the RSC. When power exchanges are to be scheduled, the RSC starts an iterative procedure in which the utilities send tie-line power-flow information to the RSC

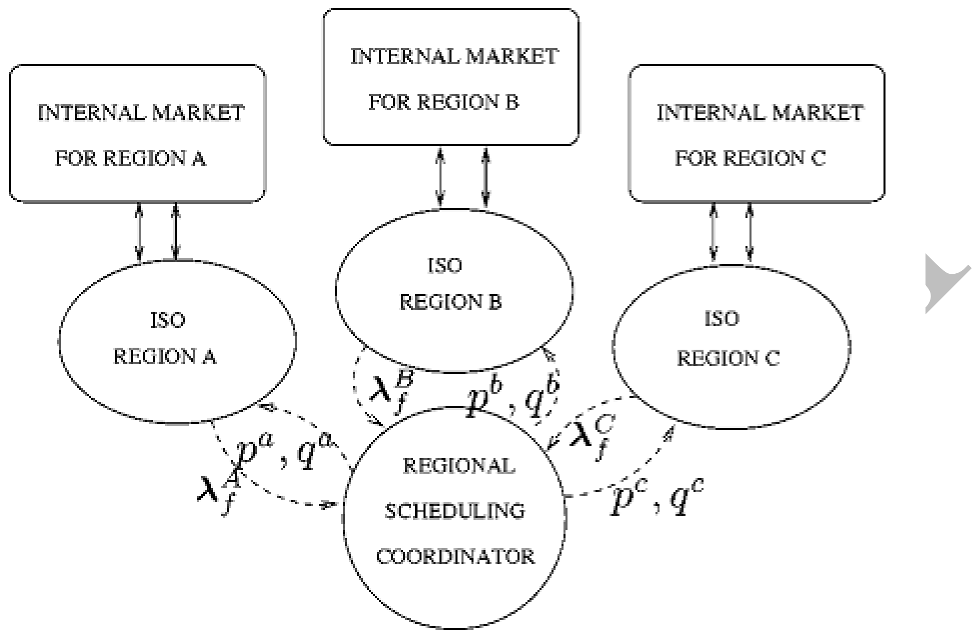

Fig. 1. Scheduling regional coordinator.

Time of day models for planning

Time of day modeling procedures integrated into the four-step travel demand modeling process offer a more accurate and robust mechanism for obtaining time-of-day based estimates of travel demand and link volumes. These procedures account for differences across trip purposes, modes, and origin-destination pairs. Some of the issues that motivate the modeling of travel demand by time of day include, but are not limited to the following:

- Design hour traffic volumes for roadway design and level of service analysis
- Transit analysis
- Vehicular emissions and air quality analysis
- Assessing impact of congestion management programs
- Evaluating travel demand management strategies
- Evaluating variable (time-of-day based) pricing policies
- Analysis of peak spreading (time of day of travel choices)
- Analysis of intelligent transportation systems