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Energy Efficiency and Demand Side Management

Swati Singh[1], Surabhi Chandra[2]

Assistant Professor, Electrical & Electronics Engineering, ABESIT, Ghaziabad, India[1,2]

Abstract: This paper deals with the energy management system. It includes the study of energy efficiency by Demand Side Management (DSM) scheme. DSM represents a revolutionary approach to planning at electric utilities. It introduces the concept of DSM for residential, commercial and industrial energy users. In the later section implementation of DSM, challenges faced by DSM, and benefits of DSM have been discussed which clearly proved that DSM is boon for users, customers and at environment end.

Keywords: DSM, HVAC, IEA, off-peak.

I. INTRODUCTION

Energy efficiency is the goal to reduce the amount of energy required to provide products and services. Energy efficient products are gaining popularity in this present era and will be a boon in future. It decreases the total per capita cost of electricity bill. It also reduces the use of energy at input end and thereby increases efficiency. To implement energy efficiency Demand Side Management is gaining popularity. Demand-side management (DSM) has been traditionally seen as a means of reducing peak electricity demand so that utilities can delay building further capacity. DSM plays a vital role in deferring high investments in generation, transmission and distribution networks. There are various opportunities of reducing energy demand in all the sectors if a proper energy management program is employed. This paper examines the types of DSM measures that can reduce energy demand for the end-user, that can manage and control loads from the utility side, and that can convert unsustainable energy practices into more efficient and sustainable energy use.

II DSM-CONCEPT

Demand-Side Management (DSM) is the selection, planning, and implementation of measures intended to have an influence on the demand or customer-side of the electric meter. DSM program can reduce energy costs for utilities, and in the long term, it can limit the requirement for further generation capacity augmentation and strengthening of transmission and distribution system.

Its special features include:

- What should a customer should expect in new rate design options.
- New energy storage options including cooling, heating and electro thermal system.
- Customer load options.
- Computer aided manufacturing.

DSM programs are used to eliminate or reduce the need of for additional peak or base load generating capacity and distribution facilities.

III. REASONS FOR PROMOTING DSM

- Cost reduction
- **Environmental and social improvement:** It reduces the energy use and thereby reduces green house gas emissions.
- **Reliability and network issues:** 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

Thus promoting DSM will definitely improve environment conditions. This will have great impact on society. Therefore enumerating the key points for the promotion of DSM are:

- It reduces customer's electricity bill.
- Reduces the need for new power plant, transmission, distribution and generation network.
- Stimulation of economic development.
- Creation of long-term jobs due to new technology and innovation.
- Reduces air pollution.
- Reduction in peak power prices for electricity.
- Reduces dependency on foreign energy sources.

In a survey conducted by the International Energy Agency (IEA) between governments and utilities of 14 OECD countries1 (INDEEP Analysis Report, 2004), the top four reasons given for implementing DSM program were:

- Wanting reductions in global warming-related emissions of GHGs (environmental);
- Public image (marketing);
- Quality of service (marketing);
- Regulatory incentives (regulatory).

IV. BENEFITS OF DSM

At Customer End:

- DSM encourage the installation and use of end user technologies that will use less energy,

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thereby reducing the customers overall electric bill.

- Energy efficient technologies have higher efficiencies thus they tend to last longer and hereby reducing the operation and maintenance cost. DSM programs encourage the use of high efficiency heating, cooling and ventilation equipment HVAC. Thus DSM is very beneficial at customer end.
- DSM programs helps in energy saving.

At Utility End:

- DSM help in reducing peak power purchases on the wholesale market, thereby lowering their overall cost of operations.
- DSM can reduce energy cost for utilities in a short term.
- In the long term, DSM programs help to limit the need for utilities to build new power plants, distribution and transmission lines.

At Social End:

- DSM decreases air pollution, carbon emission and it also lowers the potential environmental threats associated with global warming.
- DSM programs can actually track the program impacts and measure the amount of carbon reduced or saved based on program activities.

V. BARRIERS PREVENTING USE OF DSM

- With the present electricity options, DSM faced several market barriers which limits customers to accept DSM measures or which reduce the incentive for electrical utilities to invest in DSM programs.
- Barriers also include lack of information and knowledge about energy efficiency and financial conditions such as affordability, competing priorities, or access to financing.
- Also there was lack of expertise and infrastructure to deliver DSM programs.

These barriers can be removed through appropriate government policy and regulations and by careful design of DSM programs.

VI. TYPES OF DSM MEASURES

DSM is mainly classified into three types:

1. **Energy Reduction Programmes:** It basically reduces the demand though more efficient processes, buildings or equipment.
2. **Load management programmes:** changing the load pattern and encouraging less demand at peak times and peak rates;
3. **Load growth and conservation programmes**.

VI.1 Energy Reduction Programmes

These programs contribute to almost every sector. As an example: there are several energy saving tips used in various fields like commercial and industrial sectors. Few of these are:

- BOILERS: poor boiler represents the significant energy losses. Thus the performance improvement indicates the low consumption of energy and hence reduces the energy loss.
- STEAM SYSTEMS: this represents an important cost for many companies and industries. Thus energy consumption can be reduced by using various energy efficiency and DSM techniques.
- LIGHTING: lighting consumes a lot of energy in all the sectors. To reduce energy in the lighting sector has becomes the prime most target. Use of energy efficient techniques plays a vital role in solving this issue. Low energy light sources like fluorescent tubes, CFL should be used. Also proper lighting levels should be used for different work areas. Natural lighting can be used during daytime.
- MOTORS AND DRIVING SYSTEM: In all the sectors, motors significantly consume a lot of energy. In many industries, power plants; motors and drives consume 50% of the electricity. Thus it necessitates the use of energy efficient motors because poor motor performance causes great energy loss.

In the same way, there are various areas where consumption of energy, needs to get reduced. For example: at homes, different shops, schools, colleges, industries etc.

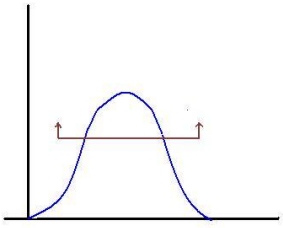
VI.2 Load management programmes

Types of load management techniques:

1. Valley filling
2. Peak Clipping
3. Load shifting
4. Strategic Load Growth
5. Strategic Conservation
6. Flexible Reliability

VI.2.1 Valley Filling (increased demand at off-peak)

It increases the load during off-peak hours. It consists of building off-peak loads. This may be particularly desirable where the long-run incremental cost is less than the average price of electricity.



VI.2.2 Peak Clipping (reduction in peak demand): This is mainly a reduction of peak load through utilities direct control on equipment used by the customer or through tariff clauses where by customer curtails his load at certain hours of the day.

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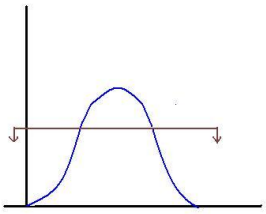
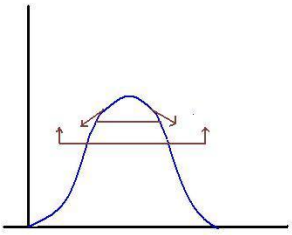
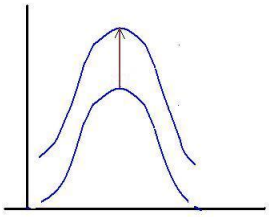


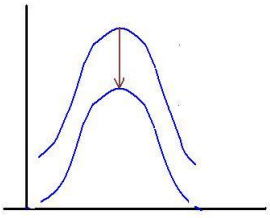
VI.2.3 Load Shifting (demand shifting to non peak): It involves shifting of peak loads to off- peak hours. Popular applications include use of storage water heating, storage space heating, and coolness storage. In this case, the load shifting associated with thermal storage involves load shifting related to conventional electricity applications e.g. building heating by electric convectors.



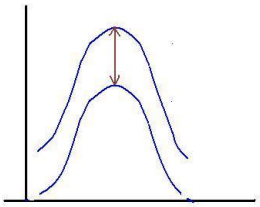
VI.2.4 Strategic Load Growth: (increase of utility load) It refers to overall increase in sales. It involves increased market share of loads through the development of new application (electric cars, automation etc.)



VI.2.5 Strategic Conservation: (the reduction of utility load, more or less equally, during all or most hours of the day) is one of the non traditional approaches to load management and results from utility-stimulated conservation. Not normally considered load management, it also involves a decrease in sale as well as modifications in the way electricity is used.



6.2.6 Flexible Reliability: (interruptible agreements by utility to alter customer energy consumption on an as-needed basis) is a concept which may be conveniently perceived as a load-shape change. Utilities must make sure that they can curtail a customer's load demand if need be (either for an immediate need or as a constituent for their energy reserves), in exchange for various incentives.



VI.3 Load Growth and conservation programmes

Electricity suppliers can influence the redistribution of the demand and time of electricity usage by load management by their customers. Similar activities can be encouraged by gas utilities. Load management of any kind will generally be conducted so that the energy user will be able to continue production while the utility achieves a modified load curve. The types of load management techniques are:

- Load leveling;
- Load control;
- Tariff incentives and penalties.

VII. MPLEMENTATION OF DSM

VII.1Develop end –use Demand forecasting

- This step is an essential part for effective DSM planning and implementation.
- Long term and mid-term forecasts of power demand variations and plays a vital role in the development of a DSM program.
- These forecasts must be prepared at the beginning of the DSM program planning activity since load curve modifications are based on them.

VII.2 Undertake load/Market Research to identify end-use patterns and market barriers.

- To implement DSM it becomes important to know how electricity is used and barrier are preventing customers from using efficient technologies.
- Load research should be done to estimate load curves for each sector or region, using local sub-metering, customer bill analysis and customer surveys.
- Market research is needed to understand the target market, identify barriers and evaluate possible solution. This research can be done by customer surveys which can be used determined current equipment usage, decision making criteria etc.

VII.3 Define load-shape Objectives

- Base on the results of the load research in the utility, load-shape objectives need to be selected from the current situation.
- Different load shape curves are:
    1. Valley filling
    2. Peak Clipping
    3. Load shifting
    4. Strategic Load Growth
    5. Strategic Conservation

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6. Flexible Reliability (refer section 6.2)

VII.4 Identify target sectors, end users and measures

- At this stage, the collected information is useful in determining a typical load curve for each end use.
- Choose sectors and end-users that account for the largest power consumption and peak loads or will do so in future.
- Select DSM measures which will have the largest impact on peak demand and electricity use.
- Target localities, sectors, end users and measures where DSM programs are most likely to make a difference or have the highest benefit utilities. For example: Where losses are high or tariffs are below.

VII.5 Identify sources of financing

- In any of the DSM programs, financing is needed for an individual projects undertaken by participants.
- Types of financing that can be used by participating to sum different project of DSM measures are:

1. Direct contracting by the utility.
2. Performance contracting by the utility.
3. Leasing.

- Major sources of project financing are:

1. Energy service companies.
2. Revolving funds
3. Self financing
4. Multilateral, bilateral or other international development agencies dedicated to promoting energy efficiency services.

VII.6 Review cost sharing Viability Options

- Cost sharing in DSM program should try to maximize viability for each partner (participant utility and government)
- If current tariffs are below the marginal cost of the new power supply options, it is financially viable for the utility to share in the cost of the efficient technology and maximize participation in the program.

VII.7 Program Selection and Design

- In this steps, the planner package, the measures identified in step 4 into logical groups for program delivery.
- In order to ensure consistent program, the planner should use a proper format to specify each program.
- Once the limited no of measures are chosen the planning proceeds with the overall analysis method like productivity etc.

VII.8 DSM Cost/Benefit Analysis

- Energy savings are achieved by DSM
- Cost is reduced
- Less maintenance is required

VII.9 Identify local Socio- Economic and environmental Impacts

- DSM programs directly provide economic and environmental benefit. It also reduces emissions and other impacts from power supply facilities.

VII.10 Implementation Plan

- Implementation of DSM program, requires a core DSM staff or cell within a power utility to develop a plan for the management of implementation.
- DSM implementation should have following elements.

1. Staffing plan and job descriptions for different aspects of the program.
2. Standard contracting procedure for direct installation, marketing etc.
3. A promotion/marketing plan to maximize participation.

- Monitoring/Evaluation plan includes verification protocols, templates for customer bill analysis and participant surveys.

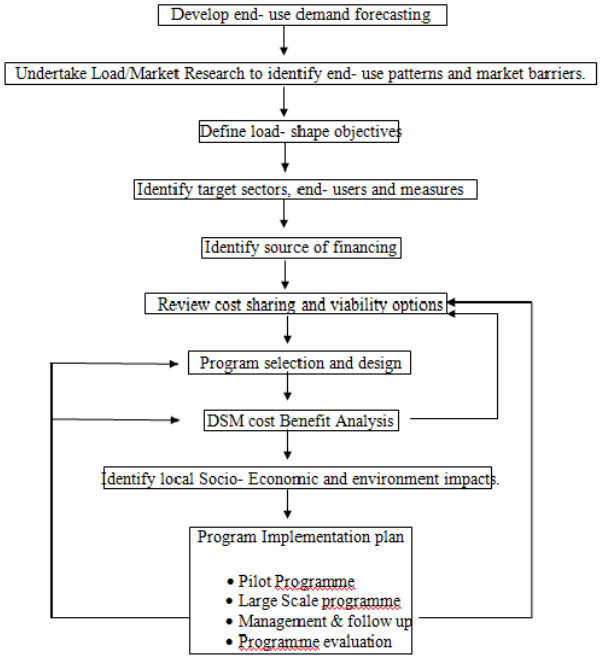

Figure 1: Flowchart for implementation of DSM

VIII CONCLUSION

DSM, thus, if implemented, will prove to be a boon for all the customers using electricity, as well as, it's a perfect measure because of its environmental friendly impact. It's a new scheme which should be accepted because of its multi merits at users, utility as well as environment end.

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