DECIDING WHICH DEMAND-SIDE MANAGEMENT ACTIVITIES TO PURSUE

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Contents

Summary

This article describes a process for determining which energy efficiency, conservation, and load management programs, activities, and technologies could best be pursued. It describes a systematic way of determining how best to focus time and attention to get the most results.

1. Introduction

Although customers and suppliers act independently to alter the pattern of demand, the concept of demand-side management implies a supplier/customer relationship that produces mutually beneficial results. To achieve that mutual benefit, suppliers must carefully consider such factors as the manner in which the activity will affect the patterns and amount of demand (load shape), the methods available for obtaining customer participation, and the likely magnitudes of costs and benefits to both supplier and customer prior to attempting implementation.

Because there are so many demand-side alternatives in energy utilization, the process of identifying potential candidates can be carried out more effectively by considering several aspects of the alternatives in an orderly fashion. Demand-side activities can be categorized in a two-level process in which the second level has three steps: level I (load-shape objectives) and level II (end use, technology alternatives, and market implementation methods).

Load-shape objectives, end uses, and technology alternatives are presented in this article. Market implementation methods are described separately in *Market Implementation Methods*.

2. Load-Shape Objectives

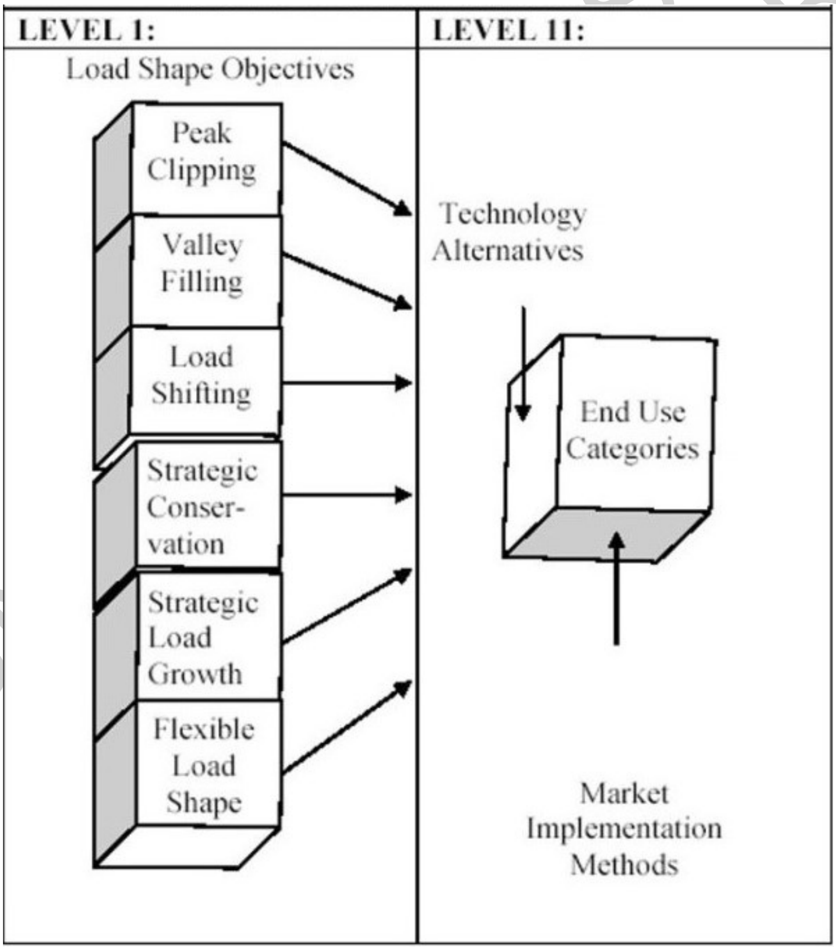

Figure 1. Characterization of demand-side management alternatives

The first step in identifying demand-side alternatives is typically the selection of an appropriate load-shape objective to ensure that the desired result is consistent with goals and constraints.Figure 1 refers to the change of load-shape objectives available. For example: electric load forecasts for an area, country, or market may indicate that existing and planned generating capacity will fall short of projected demand plus targeted reserve margins by 100 megawatts within 7 to 10 years. Several supply-side alternatives may be available to meet this capacity shortfall: additional peaking capacity can be built, extra power can be purchased as needed from other generating utilities, or perhaps a reduction in reserve margin can be tolerated.There are also a number of demand-side alternatives, including direct load control, interruptible rates, and residential thermal storage, that can augment the number of planning alternatives available.Choosing between meeting the 100-MW peak unit versus reducing the peak becomes a balance between the costs and benefits associated with the range of available supply-side and demand-side alternatives.

3. End Use

Once the load-shape objective has been established, it is necessary to find ways to achieve it. This is the second level in the identification process, which involves three steps or dimensions. The first dimension involves identifying the appropriate end uses whose peak load and energy consumption characteristics generally match the requirements of the load-shape objectives. In general, each end use (e.g., residential space heating, commercial lighting) exhibits typical and predictable demand or load patterns. The extent to which load pattern modification can be accommodated by a given end use is one factor used to select an end use for demand-side management.

In this article, nine major residential electric end-uses of electricity have been selected as examples for having the most potential for electric demand-side management. They are space heating, space cooling, water heating, lighting, refrigeration, cooking, laundry, swimming pools, and miscellaneous other uses. Each of these end uses provides a different set of opportunities to meet some or all of the electric load-shape modification objectives that have been discussed. Some of the end uses can successfully serve as the focus of programs to meet any of the load-shape objectives, while others can realistically be useful for meeting only one or two of these objectives. In general, space heating, space cooling, and water heating are the residential end uses with the greatest potential applicability for achieving both gas and electric load-shape objectives. These end uses tend to be among the most energy intensive and among the most adaptable in terms of having their usage pattern altered. However, some have achieved significant load-shape modifications by implementing programs based on or including combinations of other end uses.

4. Technology Alternatives

The second dimension of demand-side management alternatives involves choosing appropriate technology alternatives for each target end use. This process should consider the suitability of the technology for satisfying the load-shape objective. Even though a technology is suitable for a given end use, it may not produce the desired results. For example, although water-heater wraps are appropriate for reducing domestic water-heating energy consumption, they are not appropriate for load shifting. In this case, an option such as electric water-heating direct load control via receiver/switches would be a better choice.

Residential demand-side technologies can be grouped into four general categories: building envelope alternatives, efficient equipment and appliances, thermal storage equipment, and energy and demand control options. These four main categories cover most of the available, residential, cost-control/customer options. Many of the individual options can be considered as components of an overall program and thereby offer a very broad range of possibilities for successful residential demand-side program synthesis and implementation. These options are described in greater detail in Table 1.

<table>
<tr><th colspan="2">Residential Demand-Side Technology Alternatives</th></tr>
<tr><td>Efficient Equipment and Appliance Alternatives
• Heat Pumps
- Room Heat Pump
- Central Air Source Heat Pump
- Ground-Water Source Heat Pump
- Ground-Coupled Heat Pump
- Multizone Heat Pump
• High Efficiency Appliances
- High-EER Air Conditioner
- Energy-Efficient Cooking Appliances
- Energy-Efficient Washers and Dishwashers
- Energy-Efficient Refrigerators and Freezers
- Efficient Lighting Fixtures and Lamps
• Dual Fuel and Electrical Heating
- Dual Fuel Heating Systems
- Add-On Heat Lamp
- Active Solar Space Heating
- Task Heating
- Zoned Resistance Heating
• Water Heating Equipment
- Heat Pump Water heater
- Heat Recovery Water Heater
- Solar Water Heating
-</td><td>Thermal Storage Equipment
• Heat Storage
- Central Ceramic Heat Storage
- Room Ceramic Heat Storage
- Slab Heating
• Cool Storage
- Residential Ice Storage Air Conditioning</td></tr>
</table>

Building Envelope Alternatives	Energy and Demand Control Equipment
• Thermal Treatment - Insulation (ceilings, Walls, Floors) - Storm and Thermopane Windows, Storm Doors - Window Treatments (Shades, Solar Screens) - Duct and Pipe Insulation - Water Heater Blanket • Infiltration and Indoor Air Quality - Infiltration and Indoor Air Quality Control • Passive Solar Design and Daylighting - Passive Solar Design Daylighting	• Direct Utility - Receiver Switches - Water Heater Cycling Control - Air Conditioner Cycling Control • Local Utility or Consumer Control - Variable Service-Level Devices - Timers - Appliance Interlocks - Programmable Controllers - Temperature-Activated Time Switches - Load Management Thermostats - Swimming Pool Pump Control

Table 1. Residential demand-side technology alternatives

4.1. How To Select Alternatives

Selection of the most appropriate demand-side management alternatives is perhaps the most crucial question. The question is difficult since the number of demand-side alternatives from which to select is so large. In addition, because the relative attractiveness of alternatives depends upon specific characteristics, such as load shape, summer and winter peaks, generation or product system mix, customer mix, and load growth, transfer of results from one area to another may not be appropriate. In other words, what is attractive to one area, state, or country may not be attractive to another.

Completing detailed evaluations of demand-side programs can be complex and may even appear overwhelming. These evaluations typically require a great deal of data and a computer model for processing. However, a detailed analysis of demand-side alternatives is not the starting point in the selection process.

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Biographical Sketch

Clark Gellings' 30-year career in energy spans from hands-on wiring in factories and homes to the design of lighting and energy systems to his invention of "demand-side management" (DSM). Mr. Gellings coined the term DSM and developed the accompanying DSM framework, guidebooks, and models now in use throughout the world. He provides leadership in EPRI, an organization that is second in the world only to the Department of Energy (in dollars) in the development of energy efficiency technologies. Mr. Gellings has demonstrated a unique ability to understand what energy customers want and need and then implement systems to develop and deliver a set of R&D programs to meet the challenge. Among Mr. Gellings' most significant accomplishments is his success in leading a team with an outstanding track record in forging tailored collaborations—alliances among utilities, industry associations, government agencies, and academia—to leverage research and development dollars for the maximum benefit. Mr. Gellings has published 10 books, more than 400 articles, and has presented papers at numerous conferences. Some of his many honors include seven awards in lighting design and the Bernard Price Memorial Lecture Award of the South African Institute of Electrical Engineers. He has been elected a fellow in the Institute of Electrical and Electronics Engineers and the Illuminating Engineering Society of North America. He won the 1992 DSM Achiever of the Year Award of the Association of Energy Engineers for having invented DSM. He has served as an advisor to the U.S. Congress Office of Technical Assessment panel on energy efficiency, and currently serves as a member of the Board of Directors for the California Institute for Energy Efficiency and EPRI PEAC. He is Chairman of the Board of PRIMEN, Inc., and Global Energy Partners, LLC.

Mr. Gellings has received distinguished awards from a number of organizations, including The Illuminating Engineering Society, the Association of Energy Services Professionals, and the South African Institute of Electrical Engineers.

Mr. Gellings is a registered Professional Engineer, a Fellow in the Institute of Electrical and Electronics Engineers (IEEE), a Fellow in the Illuminating Engineering Society (IES), a Vice President of the U.S. National Committee of CIGRE' (International Council on Large Electric Systems), and is active in a number of other organizations. He has degrees in Electrical Engineering, Mechanical Engineering, and Management Science.