# EVALUATION AND SELECTION OF DEMAND-SIDE MANAGEMENT PROGRAMS IN THE COMMERCIAL SECTOR

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## Contents





## Summary

Perhaps no other sector presents greater opportunities for energy efficiency, conservation, and load management than does the commercial buildings sector. The extent to which these opportunities are realized will depend on how well energy companies and governments can control their costs, focus on markets with the greatest demand-side management (DSM) potential, and communicate the features and benefits of their service to end users. Adopting a DSM program plan should be an important part of resource planning.

## 1. Introduction

A number of major changes are under way in the buildings sector environment that influence utility operations and sales. These changes include the following:

- changing economic base
- increasing competition
- advances in building design and technology
- more sophisticated buyers and investors
- changing customer loyalty
- changing regulatory policies

One major economic trend is the transition of the world's economy into a service economy. Many new jobs are in service-producing industries. Business services alone represented 60% of the new jobs in the 1990s.

Advances in building design and technology are exemplified by changes in energy systems that have become much more complex and efficient. The use of electronic computer controls, for example, adds flexibility to interior air-handling systems. High-efficiency lighting, thermal storage, cogeneration, and advanced heating, ventilating, and air-conditioning (HVAC) and refrigeration systems provide customers with a broad range of options. These advances represent important opportunities for some utilities and threats for others.

These equipment options have enhanced the attractiveness of the use of electricity in buildings. The growth rate of electricity in the buildings sector far exceeds all other energy forms, even though the overall consumption of energy in new buildings has diminished since the oil embargo of 1973.

In terms of energy end-use characteristics, the building market has four general end-use profiles. For retail establishments, lighting represents the largest end use. For groceries, refrigeration emerges as the most important end use. For restaurants, cooking stands out. For the remaining classes (i.e., office, lodging, health, and educational facilities), HVAC is the most significant end use. Groceries and health facilities represent the most energy-intensive facilities.

A number of factors influence building design. The type of decision maker and the goals for constructing the building are key factors. The architect, for example, emphasizes reliability and efficiency. The owner–occupant, on the other hand, pays attention to proven performance and comfort. The developer focuses first on low initial costs and gives operation, maintenance, and performance factors lower priority.

The highly diverse buildings sector represents a wide range of building types, end uses, and customer characteristics. This diversity poses problems with the design, implementation, and evaluation of DSM programs having sector-wide applicability. Until recently, this feature of the buildings sector has hindered rapid advances in penetrating the market with DSM programs.

Perhaps no other market represents a greater opportunity for load growth, conservation, and load management than does the commercial building market. The extent to which this opportunity is realized will be based on costs, and how well efforts will focus on markets with the greatest opportunity, as well as how well the features and benefits of the services that are offered can be communicated to end users.

### 1.1. Changes in the Marketing Environment

The growth rate of electricity in the buildings sector far exceeds all other energy forms, even though the overall consumption of energy in new buildings is much lower than pre-embargo years. A number of electric alternatives have emerged in the last quarter of the twentieth century to foster this growth. Building energy systems are becoming much more complex and efficient. The use of electronic computer controls allows the interior air-handling systems to be highly flexible. High-efficiency lighting, thermal storage, cogeneration, and improved HVAC and refrigeration systems constitute significant advances. These advances may represent important opportunities for some utilities and threats for others.

Electricity use in the buildings sector is expected to grow. This growth will be largely attributable to technology shifts and advances, and will reflect electricity's increasing share of the new construction market. Contributing factors include the following: increased share of space heating; increased penetration of computers and other equipment; maintenance of current share of air-conditioning; and growing employment and business stock.

Investments in energy efficiency technologies must compete with other investments. Investors and developers of new buildings typically try to minimize first costs. The operating costs of facilities are usually passed on to occupants. This tendency often places technologies with lower initial costs in a preferred position. The long-run problem, however, is that many of the technologies selected are not as efficient as they could be for both the energy supplier and the consumer. The task at hand is to present the balance between higher first cost and lower operating costs resulting from more efficient technologies.

## 2. Buildings and Energy

The buildings sector represents significant opportunities for energy efficiency. The anticipated growth in this market will no doubt mean an increase in total demand for energy. In addition, there will be a number of opportunities to employ load management.

An initial consideration for developing a demand-side management (DSM) program for the building sector is the concept of derived demand. This concept states that energy consumers do not purchase goods or services for their intrinsic value, but that the goods and services are purchased for the value provided. Thus, in order to understand the factors of energy use in the buildings, providers need to understand how market conditions influence the demand for energy products and services.

As an example of derived demand, suppose that an area is experiencing significant residential tract development on the outer fringes of an urban area. This development often leads to an increase in such commercial developments as convenience stores and fast food restaurants. These establishments may be owned by franchises or "chain accounts" that prefer to select end-use technologies on the basis of overall life cycle costs (rather than first costs alone) in anticipation of an extended occupancy time in the

facility. In addition, because energy use plays a significant role in refrigeration and commercial cooking, energy cost control may be a great concern to the customer.

If the example development consisted of an office park instead of the residential tract and supporting convenience stores and fast food restaurants, energy providers probably would not opt for a DSM program that promotes life cycle energy cost control. Because office park development is often the product of developers seeking to sell their investment quickly, it may be best to develop a DSM program based on lower first-cost end-use technologies.

### 2.1. Changes in Construction

Construction activity in buildings varies significantly from year to year by region. A number of factors influence these activities, including trends in the economy, tax policy, local demand for services, shortage/surplus of office space, etc.

The maturing of the health care and lodging industries and their surplus capacity may limit new and retrofit construction. Because of birth rate and population shifts, there may be a change in education-oriented buildings constructed. As a basis for developing a DSM program, an early consideration should be to define the size, type, and location of developments in the service territory.

Although the buildings sector can be characterized in many ways, an activity-oriented approach is often used to segment the market by building type. Because investigators have different reasons for segmenting the sector and have different information needs, they often use very different segmentation schemes. Consequently, little consistency is found across information sources. Table l shows one way of segmenting the sector.

| Category | Building types |
|---|---|
| Residence | single-family home, townhouse, apartment, high-rise apartment |
| Office building | small, large |
| Retail | small, large, shopping center |
| Education | elementary, secondary, college |
| Restaurant | table service, fast food |
| Health care | hospital, nursing home |
| Lodging | hotel, motel |
| Warehouse | refrigerated, nonrefrigerated |
| Assembly | civic center, assembly building, movie theater, church |

Table 1. Commercial building types

## 3. Buildings Sector Strategies and Programs

Strategies can be defined as generalized courses of action designed to achieve an objective. For utilities, they link corporate objectives and market-based problems to DSM program plans.

This section begins with a review of the two major types of DSM strategies, followed by reviews of building sector technology options, market implementation methods, utility programs in the building sector, and DSM screening matrices.

### 3.1. Building Sector Demand-Side Management Technology Options

Building sector DSM activities encompass a broad range of interactions, including almost any type of program involving consumers. Activities such as energy surveys, energy audits, rate programs, load control, and the like, could all be viewed as DSM activities. However, not all activities give customers options for managing their energy expenditures or are a part of a systematic effort to achieve a specific objective.

Builder's sector DSM technology options presented here have demonstrated the potential to enable customers to exercise some level of control over their monthly electric bills while simultaneously reducing their consumption.

Any such option is a technique, device, or system that can be used to serve an end-use load in a manner of mutual benefit to the utility energy provider and the consumer.

Four general categories of technology options are considered here: building envelope options, efficient equipment options, thermal storage equipment options, and building and subsystems control options. These four main categories cover many of the currently available commercial cost control–customer options.

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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 US 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 R&D 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 US Congress Office of Technical Assessment panel on energy efficiency, and he currently serves as a member of the board of directors for the California Institute for Energy Efficiency and EPRI Power Electronics Applications Center (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 US

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.