

## Demand-Side Management

Measures taken by a utility to influence the level or timing of customers' energy demand in order to optimize the use of available utility resources.

### SEE ALSO

ENERGY RESOURCES  
ENERGY-USE SURVEY  
LOAD RESEARCH  
LOAD SHAPE  
NONFIRM ELECTRIC SERVICE  
PEAK LOAD  
PUBLIC UTILITY  
REGULATORY POLICIES ACT  
QUALIFYING FACILITY  
REAL-TIME PRICING  
STATEWIDE COLLABORATIVE  
ON DEMAND-SIDE  
MANAGEMENT  
THERM  
THERMAL ENERGY STORAGE  
TIME-OF-USE RATE  
UNDERFREQUENCY LOAD  
SHEDDING  
WATT

Utilities have traditionally tended to build facilities to supply forecast peak demand without attempting to change their customers' energy-use patterns. Since the mid 1970s, however, many utilities have begun to use demand-side management (DSM) strategies to reduce demand growth. Such measures include evaluating, planning, implementing, and monitoring a wide range of conservation, energy efficiency, and load management programs. DSM strategies can be developed for each customer class.

DSM measures encourage certain types of load shape changes. For instance, conservation and energy efficiency measures reduce load by decreasing energy consumption. Load management aims to shift portions of demand from a peak to an off-peak period, or to create a more flexible load shape. Flexibility in load can be created by offering interruptible rates to large customers who can reduce their energy demand when necessary during abnormally high peak demand periods or during system disturbances.

PG&E's primary DSM goal during the 1990s is to reduce demand growth by improving demand-side energy conservation and energy efficiency. PG&E is also expanding its load management programs, which include those that encourage customers to shift their loads from the peak demand period to off-peak periods to reduce the amount of generating capacity needed. The accompanying graph shows that 1,810 megawatts (MW) of demand growth is expected not to occur because of reduced energy use resulting from energy efficiency programs, and 690 MW of load is expected to

be managed so that it does not contribute to peak load.

Emergence of PG&E's DSM Strategies  
DSM became important in the United States during the 1970s as the entire nation became aware of the increasing scarcity of certain resources. In 1978, the Public Utility Regulatory Policies Act (PURPA) was enacted to address energy issues within the utility industry. PURPA, for instance, directed state public utility commissions to consider rate structures such as time-of-use (TOU) rates and interruptible rates, which encourage more efficient use of a utility's capacity. PURPA also fostered the development of a market for power generated by means of alternative or renewable energy sources or cogeneration. (Power producers that generate power under PURPA provisions are called qualifying facilities, or QFs.)

PG&E has been developing DSM programs under the mandate of the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) since the mid 1970s. One of the first DSM strategies mandated by the CPUC to help reduce peak electric load was the development of mandatory TOU rates for customers with high electric demands. (The CPUC mandated TOU rates even before the enactment of PURPA.) TOU rate schedules charge higher rates during a utility's peak demand period and lower rates during off-peak periods. This rate structure discourages energy consumption during peak periods, and the resulting energy consumption pattern allows a utility to operate its system more efficiently and with fewer generating resources.

## Demand-Side Management Strategies

| ENERGY EFFICIENCY   | CONSERVATION   | LOAD MANAGEMENT  | FUEL SUBSTITUTION            | LOAD RETENTION                                  |
|---|--|--|------------------------------|---|
| Efficient appliance or equipment cash incentives and rebates                              | Alternative energy appliance or equipment cash incentives or rebates | Time-of-use rates<br>Nonfirm rates<br>Real-time price rates      | Fuel substitution incentives | Electric transmission voltage service rates     |
| Efficient building construction cash incentives and rebates                               | Conservation incentives  | Load-shifting incentives   |                              | Negotiated natural gas transportation contracts |
| Loan programs to finance energy-conserving improvements                                   |  | Interruptible or curtailable service options and cash incentives |                              | Community resource and growth planning          |
| Direct-assistance programs  |  | Customer emergency generation incentives                         |                              |   |
| Customer Energy Efficiency information: energy audits, surveys, seminars and publications |  |  |                              |   |
| Advanced technology demonstrations  |  |  |                              |   |

During the early 1980s PG&E made available voluntary CPUC-authorized programs that made energy-efficient technology affordable to residential customers. These programs included the *Zero Interest Program* (ZIP), which provided interest-free loans to residential customers to finance energy-conserving home improvements such as insulation and clock thermostats. The ZIP was authorized by the CPUC in 1981 and provided loans until 1987. The *Solar Financing Program* (SFP), available from 1980 to 1985, offered rebates to residential customers who installed solar water heating systems. The *Residential Conservation Service* (RCS) provided customers with such energy conservation services as estimating the energy cost savings likely to result from efficiency improvements; inspecting residences to estimate the cost of purchasing and installing these improvements; and arranging, at the customer's request, loans and implementation of these measures.

Interest in conserving energy began to wane during the mid to late 1980s, and CPUC-approved funding for DSM programs began to drop off because of several factors: Fuel prices had stabilized; the Diablo Canyon Nuclear Power Plant and a large number of QF power producers began operation, creating a short-term generating capacity surplus; and the market for available energy efficiency technology was perceived to be approaching saturation. In 1989, however, a shrinking capacity surplus, pending federal environmental legislation, advances in alternative technologies, and charges by environmental and consumer groups that too little effort was being devoted to conserving energy created a second wave of interest in DSM strategies.

In 1989 the CPUC invited energy experts from utility regulatory agencies, consumer and environmental groups, power producers' trade associations, and four California investor-owned energy utilities (IOUs) to participate in what became a



15-member *Statewide Collaborative on Demand-Side Management*. The Collaborative's proposal to the CPUC, entitled *An Energy Efficiency Blueprint for California* (referred to as the *Blueprint*), called for a dramatic increase in DSM spending over previous years and also allowed financial incentives to reward utilities for developing successful energy saving strategies. PG&E, for instance, developed a shared savings approach that allots to shareholders 15 percent of the estimated dollar savings realized by customers as a result of energy efficiency programs.

PG&E's cumulative expenditures for DSM measures since the 1970s exceeded \$1.5 billion by the end of 1991. It is estimated that DSM programs have obviated the need for approximately 1,800 megawatts (MW) of new electric generating capacity. In addition, approximately 4,500 million therms of thermal energy have been saved because of increased energy-use efficiency by customers, which reduces the amount of natural gas consumed by customers directly, and also reduces the amount of fossil fuel used to generate electricity because less electric energy is consumed.

#### PG&E's Energy Efficiency Programs

The total actual energy saved as a result of PG&E's *Customer Energy Efficiency (CEE)* programs in 1990 is estimated at 288,769 megawatt-hours (MWh) of electric energy and 24.8 million therms of thermal energy. PG&E has developed CEE programs for both residential and non-residential customer classes, and these programs encompass a wide range of energy saving strategies.

**Residential Programs.** Expenditures for PG&E's residential CEE programs nearly doubled in 1990 as a result of the CPUC's acceptance of the *Blueprint* proposal. Nearly all programs were expanded, and new programs were developed, many of which became effective in the second half

of 1990. During 1990, residential CEE programs resulted in 47,132 MWh of actual electric energy savings and 5,556 MWh of committed to or accepted, but not yet implemented, electric energy savings, plus 8.3 million therms of natural gas energy savings. Following is a description of the five main residential CEE programs in 1991.

□ *The Appliance Efficiency Program*, which promotes the sale of more efficient models of such appliances as refrigerators, freezers, and air conditioners and such energy-saving devices as low-flow showerheads, water heater blankets, compact fluorescent lamps, and new filters for air conditioners and furnaces.

□ *The Residential New Construction Program*, which encourages builders to exceed California's Building Energy Efficiency Standards (BEES) by 10 percent or more. Most incentives aim to reduce cooling loads, which can be accomplished by installing high-efficiency air conditioning systems and increasing ceiling, wall, and duct insulation. Builders are also required to plant one deciduous shade tree, and homeowners are given a coupon for a second shade tree.

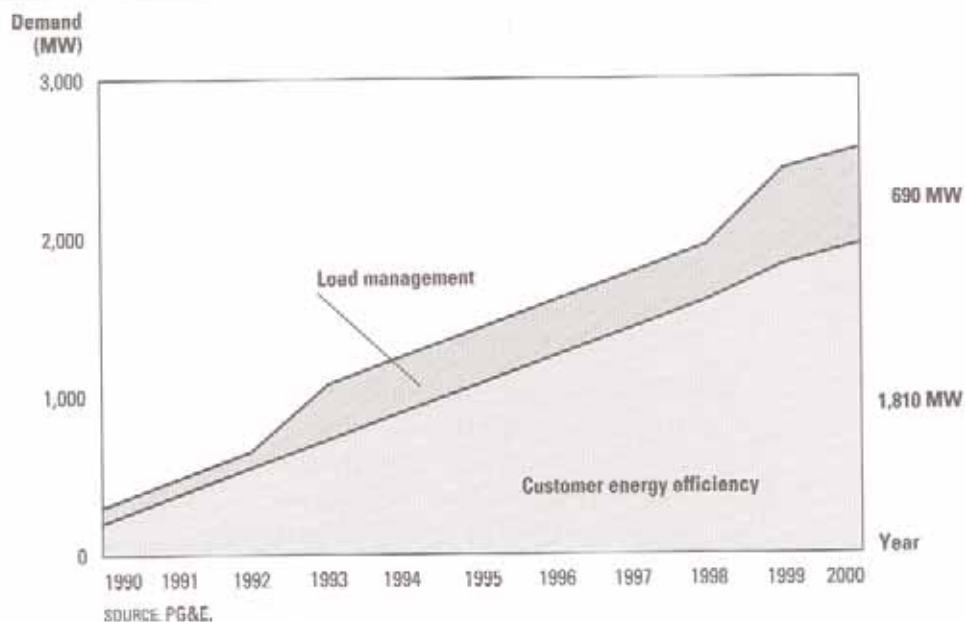
□ *Energy Management Services*, which include on-site and do-it-yourself energy surveys to identify energy efficiency opportunities. The 1991 surveys included an appliance-use survey and an energy savings plan that itemized the energy use of specific appliances.

□ *Direct-assistance programs*, which help eligible low-income customers control their energy consumption and costs by offering them free services and appliances. In 1991, PG&E offered free weatherization materials, such as attic insulation and weather stripping, under its *Energy Partners* program, and also offered to eligible customers other energy efficiency materials, such as low-flow showerheads and water heater blankets. *The Target Customer Appliance Program*

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Load management and Customer Energy Efficiency (CEE) are integral parts of PG&E's long-term Electric Resource Plan. The plan current in 1991 relies on demand-side management (DSM) strategies to meet 2,500 MW of anticipated electric demand growth in the next 10 years. DSM programs generally cost less than one-half of new supply options.

**The Demand-Side Management Component of PG&E's Electric Resource Plan**  
(in megawatts)



(TCAP) replaces older, inefficient appliances, most commonly refrigerators.

□ *Information programs*, which publicize PG&E's various conservation programs by developing and distributing educational brochures in several languages and responding to customers' telephone inquiries. PG&E has also developed an energy education presentation for elementary school students. Other information campaigns distribute informative calendars and coupons for various rebate offers. The *Shade Tree Program* advises customers on the most appropriate shade tree for their area and climate.

**Nonresidential Programs.** PG&E's nonresidential CEE program expenditures more than doubled in 1990. As with the residential programs, nearly all programs were expanded, and new programs were developed. During 1990, nonresidential CEE programs saved 241,637 MWh of electric energy, and a further 99,222 MWh of energy savings were committed

to or accepted, but not yet implemented. In addition, 16.5 million therms of gas energy savings were realized. Following is a description of the five main nonresidential CEE programs in the industrial, commercial, and agricultural sectors in 1991.

- The *Commercial New Construction Program*, which encourages developers of new commercial buildings to exceed California's building efficiency standards for such systems as lighting and cooling and also encourages developers to use high-performance window glazing and high-efficiency motors.
- The *Direct Rebate Program*, which offers rebates on purchases of specific electric or gas energy-saving equipment.
- The *Customized Rebate Program*, which offers rebates on the development of large or complex projects that save electricity or gas.
- *Energy Management Services*, which provide a wide range of incentive program



information by means of seminars and rate analyses. These services also include evaluation tools such as energy audits and energy efficiency recommendations.

□ *Information programs*, which include demonstrations that introduce advanced technologies. Other information programs focus on power quality enhancement, which could be vital to customers with power-quality-sensitive equipment such as computers.

#### PG&E's Load Management Programs

Load management differs from conservation and CEE in that load management aims to shift load, whereas conservation and CEE reduce energy use. Most of PG&E's load management programs shift load from the peak period to an off-peak or partial-peak period and thereby distribute load more evenly. To shift portions of their loads to an off-peak period, customers are encouraged to invest in energy storage systems or to change energy consumption patterns. A decreased peak load allows a utility to generate electricity more cost effectively and efficiently, to reduce stress on the transmission and distribution systems, and to avoid building facilities that are needed only to meet peak demand.

PG&E's load management programs consist of *dispatchable*, or hardware-controlled, and *nondispatchable*, or price-signal-controlled, programs. Dispatchable programs provide emergency load relief, whereas nondispatchable programs provide residual peak demand reduction. Dispatchable load management programs current in 1991 provided over 540 MW of load that could be disconnected in an emergency. Following is a description of the main programs available in 1991.

**Nondispatchable Programs.** PG&E's nondispatchable programs include the following:

□ *TOU rates*, which charge lower energy prices during off-peak and partial-peak periods and higher prices during the peak period. Currently, all PG&E customers with a monthly peak demand above 500 kilowatts (kW) are on mandatory TOU rate schedules; voluntary TOU rate schedules are available to all other retail customers.

□ The *Real-Time Pricing (RTP) Program*, which is an experimental program that provides hourly energy prices to participants, who then use this pricing schedule to plan their energy consumption for the next business day. On a maximum of 10 days per year, energy prices may be increased to alleviate unusually high system load.

□ The *Load Shaping Program*, which gives industrial customers price incentives for shifting industrial process electric loads to off-peak hours.

□ The *Thermal Energy Storage (TES) Program*, which offers incentives for shifting a cooling load from the peak period to an off-peak period by installing a TES system.

**Dispatchable Programs.** PG&E's dispatchable programs include the following:

□ The *Nonfirm Rate Program*, which is available to customers with a demand above 500 kW during the peak period. Under nonfirm service, customers receive a rate discount in return for their guarantee that they will reduce their electric loads to a predetermined firm service level whenever PG&E requests it, such as when an electric supply shortage may be imminent or when a major system disturbance occurs. Further, rates current in 1991 offered participating customers the option of receiving a discount in return for allowing their loads to be interrupted during an underfrequency disturbance.

□ The *Small Load Curtailment (SLC) Program*, which provides participants with two separate incentive payments: One payment compensates the customer for

being available to curtail energy use during the summer peak period, and another payment compensates the customer for load actually curtailed at PG&E's request. Participants either determine a firm service level, which must be a minimum of 200 kW less than their average peak demand during PG&E's peak demand period, or have available a generator that can provide 200 kW or more of generating capacity upon request. The SLC program replaced both the Group Load Curtailment (GLC) program and the Small Commercial/Industrial Project (SCIP).

#### Other DSM Programs

In addition to the CEE and load management programs already described, PG&E also supports the following:

- Fuel substitution programs*, which promote the use of one fuel over another, such as the use of natural gas rather than electricity for space heating.
- The Advanced Customer Technology Test (ACT<sup>2</sup>) for Maximum Energy Efficiency*, which is a research and development (R&D) demonstration project for evaluating the cost effectiveness of modern high-efficiency end-use technologies.
- The Pacific Energy Center*, which is a model center open to the public that displays the latest energy-efficient technologies, designs, and products. The center includes classrooms and laboratories for testing and demonstrating state-of-the-art energy conservation devices and techniques.
- The Super-Efficient Homes Program*, which supplements the Residential New Construction Program by showcasing, in a limited number of new homes, advanced energy-efficient technologies such as high-performance glass, spectrally selective window glazing, advanced lighting technology, and efficient appliances.
- The Super-Efficient Refrigerators Program*, which encourages manufacturers to

exceed 1992 efficiency standards by at least 25 percent by offering sizable rebates to residential customers to stimulate the market for energy-efficient residential refrigerators.

- Food and agricultural technology projects*, which include the *Agriculture and Food Processing Technology Center*, which serves as a technical and information resource for agricultural and food processing industries, and the *Food Service Technology Center*, which tests the relative efficiency of commercial cooking appliances.