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LOAD MANAGEMENT IN ELECTRIC UTILITIES:

A LITERATURE SURVEY

By

TARIQ RASHEED

Bachelor of Science

University of the Punjab

Lahore, Pakistan

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Scope of Study: Much has been written about load management in electric utilities over the past decade. A number of ideas regarding the importance and the significant attributes of an effective load management program have been presented by various experts. This paper presents an overview and synthesis of these ideas in one cohesive unit.

Load management addresses the need to improve plant utilization by making customer demand more complementary over time to the available capacity. The first part of this paper explains the importance and the objectives of load management. The second part describes the technological approach used to influence the consumers' pattern of electrical energy consumption through direct load control of appliances, thermal energy storage at the customer's site, and rate incentives to reduce the peak. The third part explores the behavioral solutions to the peaking problem and the marketing implications for utilities. A general marketing plan is then presented which can provide a starting point for utility marketing efforts and can be tailored to the specific needs of a particular utility and its service area.

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Report Approved:

Advisor

Director of Graduate Studies

Head, Department of Marketing

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CHAPTER I

INTRODUCTION

This chapter provides a perspective on load management and its importance and benefits to electric utilities, consumers, and the society in general. The economies of generating electricity are discussed in the form of different generating plants, the investment required in them, equipment operating costs, and fuel efficiency. This chapter also introduces the latest trend in load management, called "Demand-side Planning". This planning tool underscores the attention utilities are paying to strategies that can match demand with available capacity, as opposed to the traditional approach of supply-side planning. Demand-side planning is said to be superior to traditional planning approaches because of its heavy reliance upon marketing to achieve utility goals and objectives.

Introduction to Load Management

One of the problems facing most electric utilities today is synchronizing demand with available capacity. The shape of the demand curve for energy over each 24-hour day for residential consumers contributes, in part, to this problem. In the morning and afternoon, energy consumption can peak at more than three to four times the daily average in some utility areas [63]. Although most electrical energy is consumed by industrial and commercial users, the peaking problem is particularly pronounced in residential consumers.

Electric utilities in the United States traditionally have stood ready to supply whatever demands might be forth-coming from their customers. Such demands almost always display a marked variation over daily and seasonal periods. Daily loads typically rise sharply during the morning and early evening hours, and fall off late in the evening and during the night. This phenomenon is demonstrated in the daily load curves of the Southern California Energy Coalition [38], and a Vermont utility in figure 1(a), 1(b) and 1(c) respectively.

Electrical energy must be produced at the precise moment it is needed. It is not generated at one time and stored for later use.[1] The supplier for such energy must therefore design and build a facility that can meet maximum demand, however short in duration that demand might be. Since there are peaks in demand, generating facilities are used at full capacity for only brief periods of time, and some utility plant is usually idle when demand levels recede from the peak. "Average load during a year for utilities in the United States is typically 50-60 percent of the peak load" [55].

To minimize costs in the face of the need for varying amounts of capacity, three types of generation plants are combined to serve electric loads: base-load plants, intermediate-load plants, and peak-load plants. Base-load plants, primarily modern fossil fuel and nuclear steam boiler, provide the first 40-50 percent of the systems total demand [64], and are characterized by high fixed costs and relatively low energy costs. These will be run more or less continuously, thereby spreading

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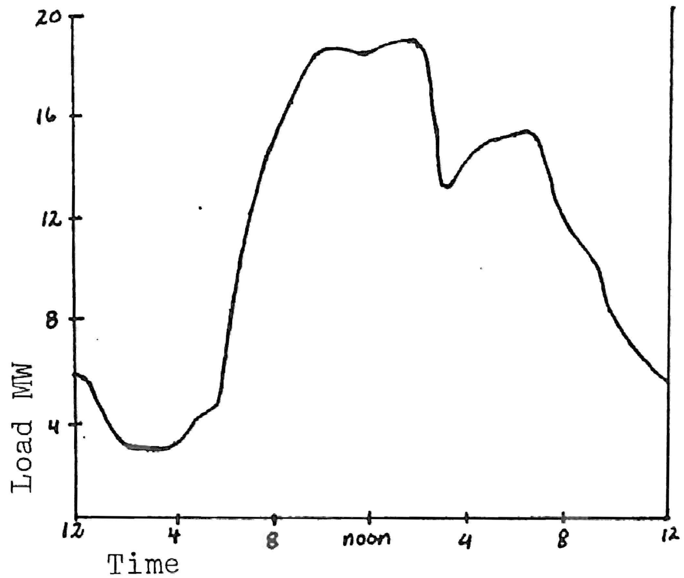
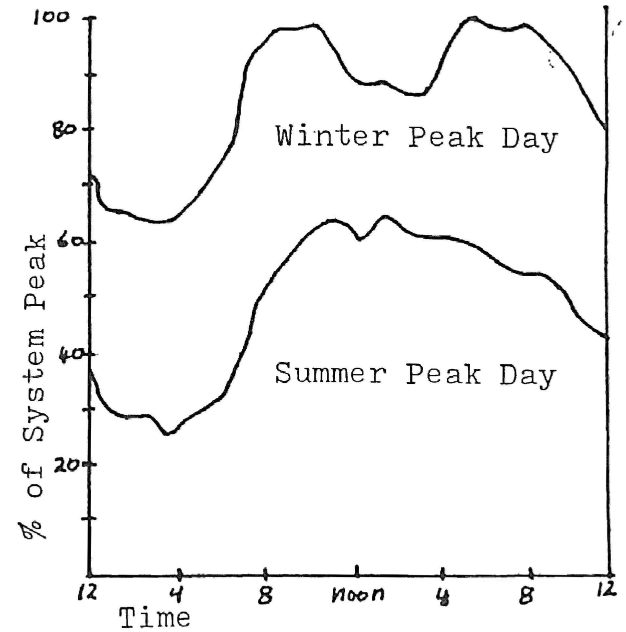
[1]Such concepts as the "Battery Storage System" and the "Compressed Air Powered Gas Turbine", which can store energy in a different form, to be converted to electricity when the need arises, are still in the experimental stage and have not been commercialized yet.



(a) Southern California Energy Coalition

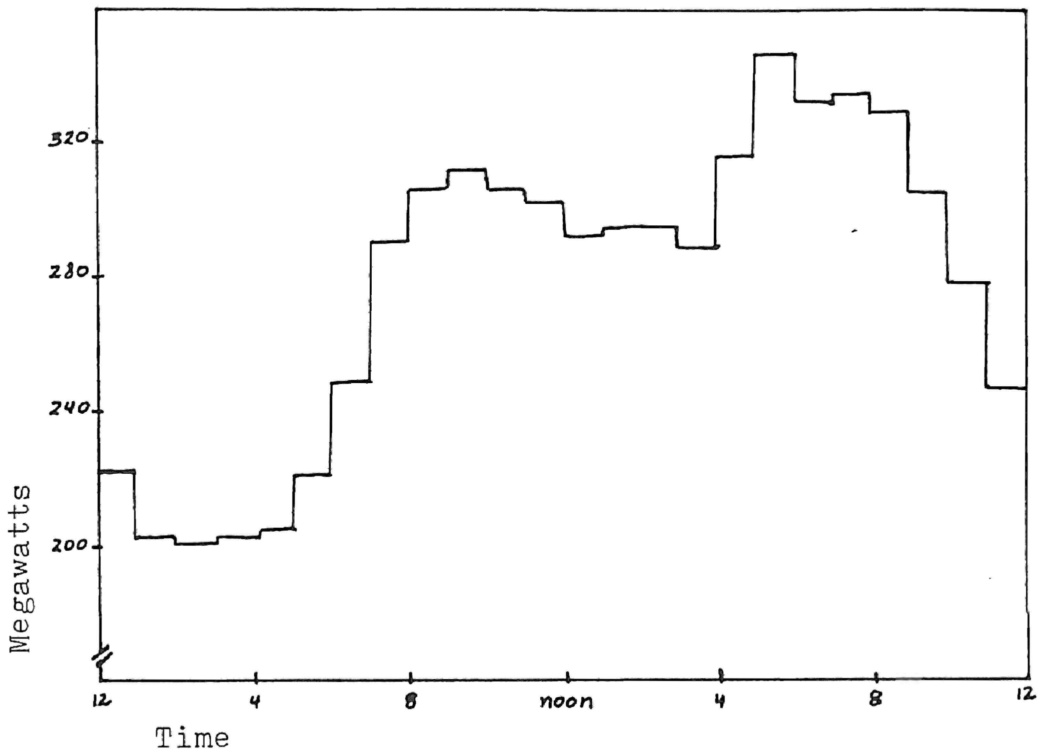
Source: Gorzelnik, E. F. "Customer Co-ops Are Big in California." Electrical World, 196 (October 1981), p.119



(b) Central Vermont Public Service Corporation

Source: Schill, R. E. "Load Management--Innovations and Techniques." Public Utilities Fortnightly, 97 (1976), p.19

Figure 1. Typical Daily Load Curve of Electric Utilities in the United States



(c) A Vermont Utility

Source: Laber. G. "A Note on Load Management in Electric Utilities." <u>University of Michigan Business Review</u>, 29 (March 1977), p.24

Figure 1 (continued). Typical Daily Load Curve of Electric Utilities in the United States their fixed costs over many kilowatt hours of output, and capturing the benefits of low operating costs. At the other end of the spectrum are peak-load plants, which are a systems oldest and least efficient equipment, and are typically used only to "shave the peak" of the load curves. Peaking plants are characterized by relatively low fixed costs, and the operating costs consist mainly of fuel costs which are relatively high for these units. They will be used to serve the relatively short-lived demands, thus minimizing fixed costs of idle time at the expense of high operating costs. Intermediate-load plants have fixed and energy costs lying between those of peaking and base plants, and will be operated for periods longer than peakers but less than continuously.

Until recently this mix practice has been fairly effective in reducing a utility's economic penalties for generation capacity used only part time. But growing load variations, rising cost of fuels, and overall higher requirements for electricity have served to change "ratios of low cost and high cost capital and running expenses which were central to this mix strategy" [64]. Since average loads are substantially less than peak loads for most utilities, peaking and intermediate capacity will stand idle for portions of a year, during which time the fixed costs will continue. If loads could be reduced at peak periods, and shifted to other times of the day, peaking capacity could be reduced and capacity costs saved; moreover, energy costs could be lowered as power is produced in intermediate or base plants rather than peakers. Thus, a given amount of kilowatt hours of electricity would be produced more cheaply with a relatively flat load curve than with a sharply fluctuating load. The purpose of load management programs is to flatten the load curves.

Definition of Load Management

Load management is defined as any action taken by a utility to modify its daily, seasonal, or/and annual load curve in a positive manner. It may elect to do this either actively or passively.

> "Active load management is any act that controls the amount of energy a consumer can use, and includes interruptible rates and the control of customer loads through various signaling and mechanical devices. Passive load management covers a gamut of concepts, from customer education programs and general appeals to time-differentiated rates and customer owned and operated load controllers" [21].

Active load management lets the utility control, interrupt, or displace a fairly precise quantity of load for a fairly precise time interval to accommodate a fairly specific need. Passive load management is subject to customer whim, and may or may not result in an optimum benefit to the utility.

In short, load management is the deliberate reshaping of the customer's load curve, either by voluntary actions of the customer or by actions of the utility to control the operation of the customer's electrical appliances. It is an activity that takes place on the customer's side of the meter, as opposed to supply management, which is before-the-meter activity. Supply management is the method which the electric utility industry had concentrated on since its inception.

Objectives of Load Management

"The objectives of load management are to minimize the average cost of electricity, to improve the economics of system operations, to improve load factor, to shift fuel dependency from limited to more abundant energy resources, to reduce capital requirements for generation and transmission capacity, and to maintain or even improve reliability" [39].

Ranging from methods of direct control of electrical loads to pricing incentives, load management is concerned essentially with changing the timing of demands on the electric utilities so as to reduce the cost of producing and distributing power. The list of activities that lead to these objectives can be accommodated in six categories: conservation, customer load control, energy storage, dispersed generation, interruptible loads, and direct load control of customer appliances.

The operating effect of load management is to smooth the load curve -- daily, seasonally, and annually. The economics of equilibrating supply to a more controlled demand results in operating ratio improvement and more intense use of plant facilities. In the short run capital requirements are reduced. These are the cost efficiencies in which everyone can benefit.

For instance, the customer has an opportunity to save on his electric bill by his willingness to have certain electric appliances, as well as the meter, respond to a time related pricing system or a control system. The society can benefit by conserving scarce resources.

A Historical Perspective

Traditional electric utility planning has, in most cases, assumed that an endless supply of the energy form known as electricity was available to the consumer. The utility made a prediction or forecast of what demand it thought this unrestricted supply of energy would be and set out to build the necessary facilities and operate its system to meet its consumers' demands.

Demand Stimulation

During the 1950's and through the 1960's, increasing economies of scale and rapid growth offered a real price of electricity that continued to decline. This signal was eagerly received by the consumer and filled his thirst for more of the product which inspired the development of new and better uses of electricity [32]. Utilities promoted additional uses of electricity and aggressively marketed "all electric homes." Some utilities sold major appliances to consumers to stimulate demand. Apart from active programs, utilities engaged in other activities that encouraged consumption. Since economies of scale and some inherent efficiencies were realized with the construction of new generation facilities, companies applied for rate reductions [16]. In addition many had rate structures that encouraged greater consumption by charging less per kilowatt hour for higher consumption.

Demand Reduction

Since the early 1970's, economic, political, social, technological, and resource supply factors had combined to change irrevocably the busness complexion and outlook for the electric utility industry. It was now faced with staggering capital requirements for new plant investments, rapidly accelerating costs for unstable fuel supplies, significant changes in growth rates of capacity and electricity usage, declining financial performance, regulatory and consumer concern about rising prices, and mandated pollution standards and control devices that increased the cost of producing each kilowatt. Utilities responded by increasing the price of electricity and, in some cases, changing the rate structure to discourage increased consumption. Bill enclosures which once suggested new uses of electricity now encouraged conservation. Media advertising also shifted its emphasis.

Demand Modification

Now, emerging slowly through the decades, the electric utility industry has embraced the concept of forcing or encouraging customers to achieve a certain pattern and amount of energy use. In other words, utilities have become concerned with demand modification, which holds considerable promise due to the time bias in the consumption of electricity. The major demand modification efforts have focused on shifting demand from peak periods to non-peak.

"In the 1960's, some European utilities filled their low off-peak winter valleys by offering incentive rates to consumers who would adopt thermal storage heating. The term 'load management' was born about this time" [32] but has achieved full prominence in the last decade.

Demand-Side Planning: A New Concept

Demand-side planning includes modifying the traditional utility planning framework to include programs which the utility may employ to alter the expected load shape and assist in meeting institutional goals. Examples include improving cash flow, improving earnings, reducing risk, or reducing consumption of critical fuels.

Traditional utility planning has treated future demand for electricity as a predetermined, fixed quantity. Demand-side management encourages working with demand as well as supply to make a match. It carefully pinpoints utility actions that can change customer demand in mutually beneficial ways.

Demand-side activity is not just for reducing loads or just for building loads. It involves both, and all the load redistribution options in between. These options include load management, electrification, load growth or increased market share, and strategic conservation [32].

For utilities with strong load growth, curtailing demand can defer the need for costly new construction. For those with ample reserve margins, building load can improve the return on investment already made. Even those utilities with a good overall match between capacity and demand can cut operating costs by redistributing demand more evenly throughout the hours of the day or the days of the year.

In this more comprehensive approach to utility planning, the planner must first identify broad utility goals. Say that one such goal is improved financial performance. The next step is defining tactical objectives, such as construction deferral or increased revenues, that will bring the utility closer to that goal. The process then narrows down to translating these tactical objectives into the desired load shapes. Future demand-side planning targets specific load objectives.

Formal demand-side planning includes eight steps [5].

1. Establish program objectives
2. Identify possible changes in load shape and demand-side options for accomplishing those changes
3. Determine methods of selecting the most beneficial changes and options
4. Forecast load shape impacts
5. Develop a marketing plan
6. Develop an implementation plan
7. Develop an impact-monitoring plan
8. Take action

A Look Ahead

In response to the electrical energy crisis and the peaking problem, two solutions are commonly proposed. The primary approach, a technological solution, is to increase the capacity to supply more power. Thus, new sources of electrical power such as thermonuclear, geothermal, and solar, would be developed, and, while needed research and development was going on, more of the present type of power-generating facilities would be constructed. Another aspect of the technological approach, the subject of Chapter II, is to control the customer's electrical consumption through direct load control of appliances, thermal energy storage at the customer's site, and rate incentives to conserve energy and reduce peak.

The second approach, a behavioral solution, is to change the consuming behavior of people such that present electrical energy sources are used more efficiently. Chapter III is devoted to understanding consumer behavior and to suggest ways and means of reducing peaking by concentrating on the variables that influence the consuming behavior of people.

CHAPTER II

STRATEGIES AND TECHNOLOGY FOR LOAD MANAGEMENT

Load management efforts can be classified broadly into two categories: (1) programs that involve or rely upon ongoing response of consumers to manage their individual loads more efficiently, and (2) programs of direct control of consumers' loads or portions of their loads by utilities.

Ongoing management of individual loads by consumers is done through peak-load pricing of electricity, conservation appeals, and to some extent by the monetary incentive programs that use direct consumer participation to reduce peak loads at the utilities request. A second thrust in load management is the direct control of customer usage of selected electrical appliances to clip system peaks.

Related to concepts of load control are methods for storing heat and cold. For example, as an alternative to direct electric heat, storage heating equipment draws power during off-peak periods to heat ceramic bricks or water. The heat is stored in an insulated container for release during peak periods. In the northern areas this equipment offers an opportunity to remove substantial portions of peak period loads from critical times during the daylight hours [23]. A similar potential exists for air conditioning loads for utilities with summer peaks with stored cooling equipment.

This chapter will cover the general and specific strategies employed for the purpose of load management. General load-shape strategies will be reviewed first, and will serve as a prelude to the pricing strategies, communication and load control strategies -- also known as direct load control, thermal energy storage, and other strategies that do not fall under any of the above categories.

Although a lot has been written about electricity rate structures in the literature, it will be covered quite briefly in this chapter. Communication and load control strategies are attracting the most attention at present, primarily because they provide utilities with direct control over customer electricity usage. This results in a predictable and sure way of reducing peak demand, thereby improving financial performance in the short-run, and new capacity deferment in the long-run. These strategies will be explained at length, and the equipment used will also be presented in detail. Thermal energy storage is a familiar method for load shifting, and will be given limited coverage in this report.

This chapter will also discuss the potential problems with load management, the reliability of load management technology, and the criteria for selecting this technology.

General Strategies

Load modifications are based on five general methods for adjusting load shapes [80], illustrated in figure 2.

1. Peak clipping: Is the removal or reduction of all demand above a predetermined maximum level. It is generally achieved by directly controlling customer's appliances. This direct control can be used to reduce capacity requirements, operating costs, and dependence on critical fuels.

2. Valley filling: Is building load during off-peak periods, which has the effect of raising the total energy in the demand profile. It is particularly desirable when long-run incremental cost is less than the average price of electricity. Adding properly priced off-peak load under these circumstances can decrease the average price.
3. Load shifting: Shifts demand from on-peak to off-peak periods. This has the effect of lowering peaks and raising minimum loads without necessarily affecting total energy. This strategy allows the most efficient use of capacity.
4. Strategic conservation: Involves a reduction in sales by lowering the total demand of energy at all times.
5. Strategic load growth: Is a targeted increase in sales, may involve increased market share of loads that are served by competing fuels, as well as development of new markets. Increased electrification is one of the possible ways of achieving this goal.

Most utilities employ a combination of these strategies to modify their load curve on a daily, seasonal, and annual basis. The effectiveness of a load management scheme on a particular utility system depends upon the following five parameters [19].

1. Magnitude of peak reduction in megawatts.
2. Amount of energy shaved from the peak, i.e., duration.
3. Megawatt drop from peak to valley.
4. Amount of energy recovered during valley fill, and
5. Number of months affected.

Successful implementation of the load-shape modification strategy can translate into dollars saved and dollars earned, having a direct and tangible effect on a utility's financial performance. It is estimated

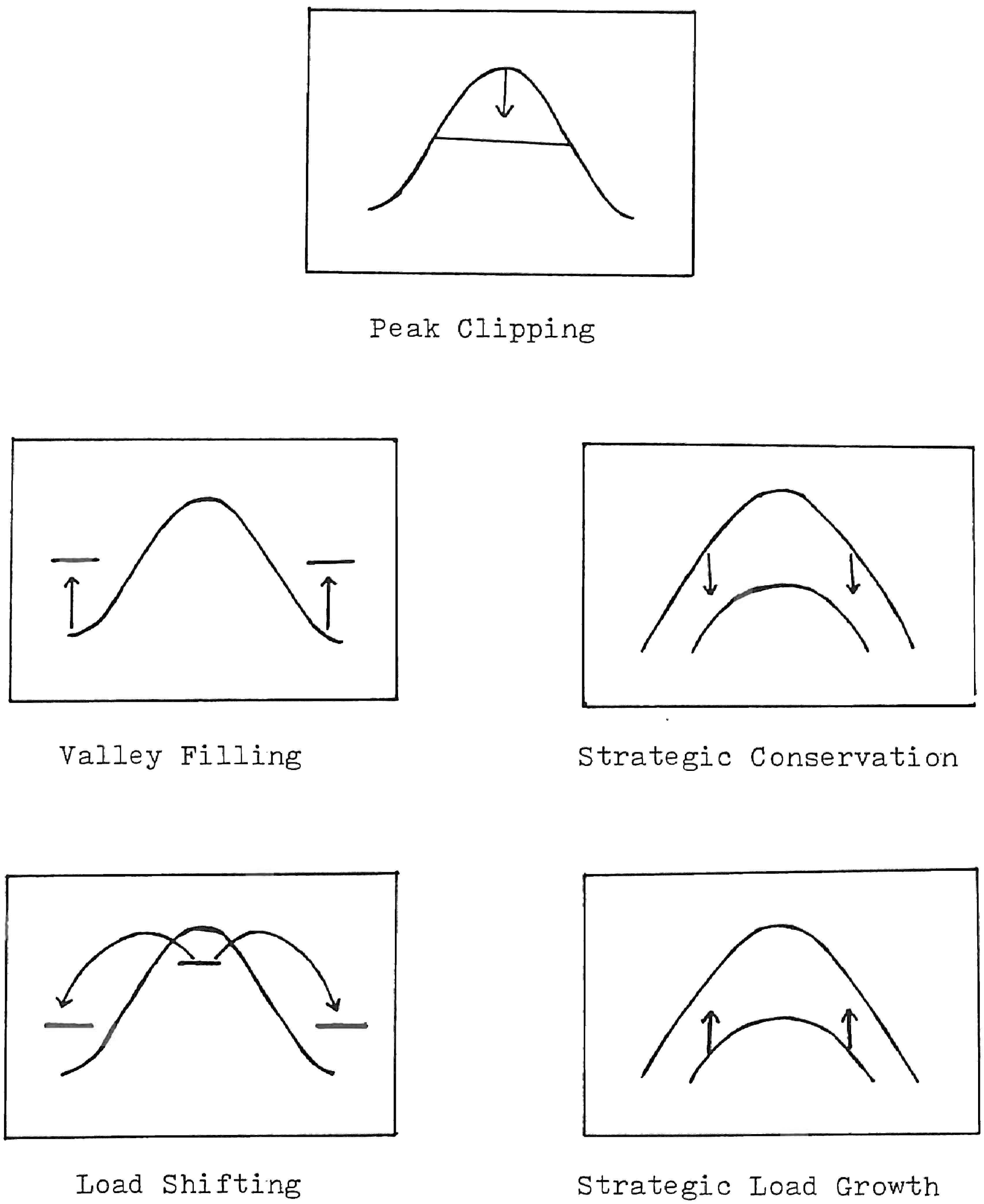


Figure 2. Load Shape Strategies

that peak clipping alone could result in a "possible 10-20 percent decrease in utility peak loads and could translate to some $100 billion in capital savings from capacity deferral over the next 10-20 years" [80].

Pricing Schemes

Since capacity needs are determined by the usage of electricity during the season of highest demand, pricing strategies reflect the allocation of all or major portions of fixed costs during this season. In addition, these rates reflect relatively high energy costs of peaking generators. Since incremental loads during these times are being provided by peaking units. The following are some of the important pricing schemes used by the utilities in the United States as part of their load management programs.

Peak-Load Pricing

Peak-load pricing of electricity requires rates during potential peak periods to be set higher than rates at other times. There are two dimensions to the peak problem: the general level of load curve is typically higher in one season of the year, and within the seasons the load varies by time of day [55]. Pricing schemes designed to recognize the peaking problem therefore have both time-of-day and seasonal features.

The most important aspect in peak-load pricing is to make sure that the cost reflected in price is strong enough to induce a shift in usage [67]. The price must have a signal strength so that the consumer reacts by deferring some electricity usage from peak to off-peak periods. The rate structure is designed to influence customers to restrict use of large electricity consuming appliances during peak hours. Appliances which may be kept off during peak hours include electric water heaters, clothes washers and dryers, dishwashers, and space conditioning equipment.

Time-Of-Day Pricing. This scheme, also referred to as time-of-use rates, is based on marginal cost so that the rate at any given time period reflects the cost of providing the customer with an additional kilowatt of electricity. Thus, if a day is broken down into two or more periods, the part to which the costs of providing electricity are greatest, would be the part to which higher rates are charged. The loss of load probability (LOLP) serves as a proxy for relative costs in determining the appropriate period for time differentiated rates [19].

Consumers responding to the relatively higher peak-period rates by shifting loads out of peak times or by foregoing some use of electricity would cause a savings in both capacity and energy costs of the utility. Such savings are not net cost reductions, however, because additional metering costs must be incurred to effect t-o-d prices. Additionally, customers receiving service under optional t-o-d rates are sometimes required to install a signal device to alert when peak hours are in effect. It is, therefore, obvious that a key economic consideration in peak-load pricing proposals is the extent to which consumers can shift or forgo enough use of electricity to cover the cost of additional metering and signaling devices.

Seasonal Pricing. An alternative to t-o-d pricing schemes is the seasonal differential in the prices of electricity. Seasonal differentials can be implemented without additional metering costs, provided meters are read frequently enough to capture changes in seasons. Under this proposal, consumers are given incentives to reduce consumption of power during peak seasons, but the t-o-d dimension of the peak problem is not recognized. Given the ease of implementing seasonal rates it is not surprising to find them creeping into the tariffs of many utilities in recent years [55].

Interruptible Rates

An interruptible rate schedule is often offered to customers, both residential and commercial, that allows the utility to remote control the use of certain customer appliances (space conditioning equipment, water heaters, clothes dryers, electric range, etc.) at times of peak demand. Industrial customers can be on this rate schedule by agreeing to an interruption of service, usually with advance notice, at times when the utility finds it necessary to clip system peaks.

The incentive to customers is in the form of a lower rate schedule, or a direct rebate -- usually a specific amount per month -- from the utility, which can go towards paying the electric bill. The rebate is usually over and above what the consumer saves from reduced electric bills.

Declining Block Rates

This method is often used by utilities with excess capacity. The rate paid is based on usage, with higher usage levels paid at lower rates.

Communication and Load Control

Direct load control of customer appliances is part of a broad approach to load management, and can be used to control and shape system curves. Direct load control equipment is used by utilities on a wide variety of customer loads. The two principal loads on a nationwide basis are residential water heaters and central air conditioners. Other controlled loads include residential electric space heating, swimming pool filter pumps, whole-house loads (demand subscription service), irrigation pumps, and industrial and commercial space conditioning.

To induce customers to let the utility control its appliances at times of peak demand, the utility offers an interruptible rate schedule or a direct rebate, which can go towards paying utility bills. This rebate is usually over and above the savings realized by the customer on his or her electric bills.

Direct load control equipment is also used for many utility applications, such as capacitor and load-tap-changing, t-o-d metering, automatic meter reading, load research, and various test aspects of automated distribution [66].

Load control is not new. It has been used at least for 50 years to control water heaters by time clocks [39]. The big change is the techniques used, and the type of appliances controlled. Various techniques are now available to control customer loads faster and more precisely, including radio, ripple, powerline carrier, telephone, cable television, and hybrid systems. The rest of this section is devoted to an explanation of these techniques, but first, a discussion of the basic system involved in direct load control, and the one-way versus two-way system is warranted.

Basic System

Each system consists of four basic subsystems: a central load controller, a signal transmitter or injection device, a communication link, and a signal receiver/switch. The central controller is the heart of the system. It initiates a series of commands to shed or restore load, and receives input on system status. It is connected to various peripherals for data processing, signal generation, encoding and monitoring [39].

The signal transmitter or injection device impresses the control signal on the communication link, which carries the signal to a receiver, which in turn acts on the command to open or close a switch to control a customers' load.

The receiver consists of an antenna, a receiver, a decoder, and a control switch. It compares the incoming signal to a preprogrammed signal in the decoder and, if the two match, the decoder orders the switch to operate. The usual operation is to open the switch and interrupt the power flow to the load under control. Typically, this interruption is seven and one half minutes [39]. In practice, this time varies by plus or minus two minutes, to avoid dropping or restoring large blocks of load on the utility system. To keep the load turned off, a follow-up signal must usually be sent.

One-Way Versus Two-Way Systems

For direct load control, only a one-way signal -- used to tell a receiver to open or close -- is necessary. There is an advantage however, to knowing that the switch has operated as it was supposed to, and that the load was actually switched. Verification of switch status or two-way capability, can be important with direct load control, but it has a far greater significance than that from the stand point of utility-system operation. For example, a two-way communication system would permit automatic meter reading, equipment load monitoring, and all the other advantages of automating the distribution system [72].

Unfortunately, this return communication link in a two-way system is subject to interference from circuit noise, and "detection and verification of the information returned to the controller has not yet achieved the high degree of reliability considered necessary for commercial success" [39].

William E. Blair, project manager in Electric Power Research Institute's Electric Systems Division sums it up as:

> "It looks like one-way communication is more credible at this point in the eyes of the utilities, and has a better pay-back than two-way. However, two-way communication has more versatility, and is a complete system for utility operations" [39].

Radio Control

This is the most dominant and widely used of load control technologies, based on the number of systems or receivers installed in the United States. "Data developed by EUS for Oak Ridge National Laboratories indicate that there were 728,000 radio-controlled load receivers in use at the end of 1981"[39].

Its technology is well advanced, so cost, performance, and reliability are predictable. The cost per consumer control point is the lowest, but receiver address capability is limited. Signal propagation can be affected adversely by hilly terrain and man-made objects. Failure rate for receivers, except for some newly designed units used on irrigation control, are low (1-3%), and transmitter and central-control failures are virtually zero [36].

Although two-way communication via radio is not available commercially, several possibilities are being developed. One is the use of broadcast radio, both AM and FM. The advantages of commercial broadcast stations include low downtime and greater transmission power [39].

Ripple Control

Ripple systems have been used to control customer loads in Europe for over 35 years. Worldwide it is a dominant form of load control, "accounting for about 97 percent of load management systems in use" [39]. Because it has been in use for quite some time, its technology has been proven on different kinds of distribution networks.

The cost per control point of the ripple system is higher than radio, but it offers greater receiver address capability and signal reliability than radio [36]. It is considered a unidirectional system, but limited bi-directional capability exists.

One of the major refinements that has taken place with ripple control is the Americanization of a European technology. When ripple was first introduced in the U.S., the equipment was large and bulky. Since then, injection and receiver devices have shrunk significantly in size, requiring less substation space and a less obtrusive appearance in customers' homes.

Powerline Carrier (PLC)

Powerline carrier is a relatively new system compared to radio and ripple, and uses the powerlines themselves to carry commands to the transponder units [66]. In a unidirectional mode of operation, PLC can perform the same functions as radio and ripple, but is much farther developed in the return mode than either one.

Unidirectional PLC is similar to ripple, but by using higher frequency, less signal power is needed to achieve an acceptable signal-to-noise ratio, resulting in lower injection (transmission) equipment cost. Also, more rapid signaling is possible than is practical at lower frequency levels. One offsetting disadvantage is greater signal attenuation over long distances; also, additional equipment may be required to overcome signal penetration problems, through transformer and capacitor banks [36].

The advantage of going to PLC is the "versatility and flexibility it affords the utility in automated distribution, meter reading, and knowing which receivers may not be working" [39]. The newest PLC is the Two-Way-Automatic Communication System (TWACS), which is explained in greater detail next, due to its increasing importance and acceptance in the electric utility industry.

Two-Way Automatic Communication System (TWACS)

The TWAC system offers a more advanced two-way communication capability, using the power lines themselves to carry commands to the transponder units and, in turn, the transponders use these same power lines to send signals back to the utility [66].

In addition to controlling multiple loads, TWAC features include remote reading of electric and gas meters, ability to locate power outages immediately, remote control of transmission and distribution switches, capacitor banks, and voltage regulators. In addition, the system can monitor customer loads for load-research purposes [25].

Telephone

The telephone system is a bidirectional system that uses existing telephone lines as a communication link. The only difference between the telephone system and other control options is that the central controller and some point-of-system equipment are owned by the electric utility, while transmission and major point-of-control equipment is controlled by the telephone company.

The telephone system has the potential of being the least expensive of any, because the communication link already exists in most homes and businesses. However, existing telephone tariffs probably make this system one of the more expensive [39].

Cable Television (CATV)

CATV offers a great deal of potential once some of the unresolved questions regarding the cost of service and hardware availability and reliability have been resolved. The plethora of companies in the business in any given area, and the speed of reacting to emergencies are also among the issues that have created strong doubts regarding the use of CATV for load management purposes.

A Note Of Caution-The Payback Phenomena

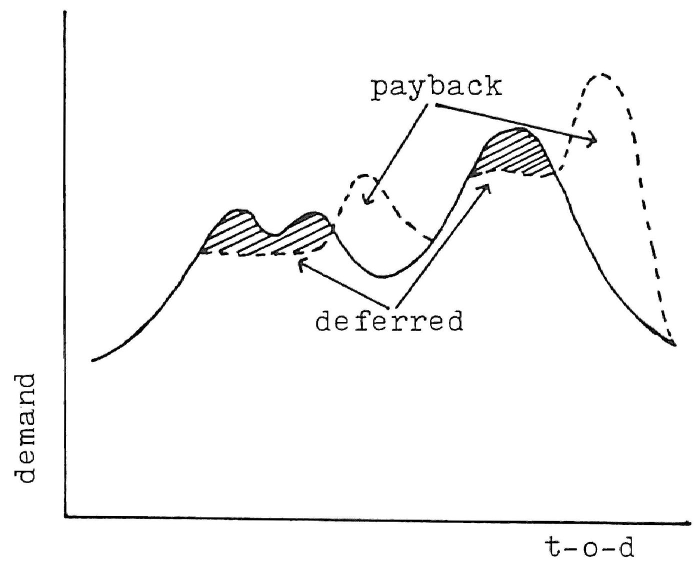
An important consideration as to the effectiveness of load management pertains to the shape of the residential customer class load curve [68]. If the load pattern is plateau shaped, then deferring load for some uses (air conditioners or water heaters), for a short period of time may only result in shifting the peak to the time when this load is paid back. Figure 3(a) illustrates this. Load management of this type is more effective when the load demand curve is needle shaped, as in figure 3(b).

Here we can clearly see that load management has resulted in a reduction of peak demand. However, deferring the peak demand to the shoulder peak period increases the kilowatt demand during this period.

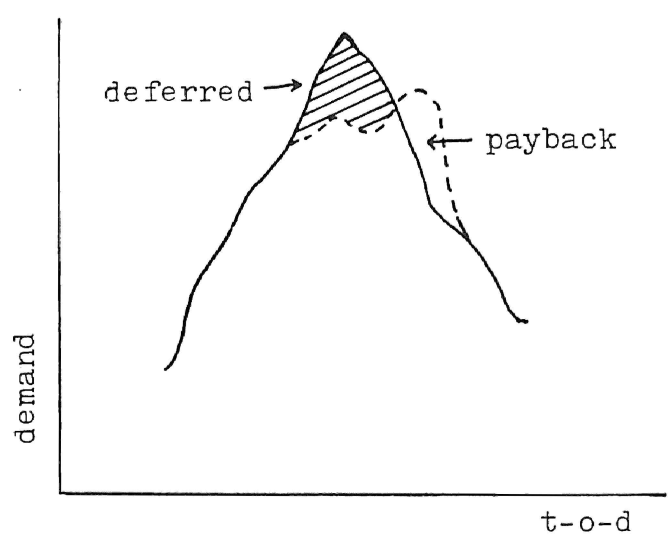
The longer the load controlled appliances (water heaters, space conditioning equipment, etc.) are kept from recovering, the greater the number of units that will require energy later, known as the payback phenomena. Care must be taken when load is restored, and the load controlled appliances are allowed to recover, so a greater system peak later in the day is not allowed to occur in place of the one that was reduced.

A related problem is that not all of the load under control can be called upon at any given time without the generation of a new peak load during the payback period. To illustrate this, let us assume that we have a very simple load pattern as represented in figure 4(a), such that demand is 100 megawatts above the base load for only three hours per day. Further, we will assume that all of this load over the base is under load management control.

Let us suppose that all of the interrupted demand must be paid back within two hours of interruption. If all 100 megawatts are called upon

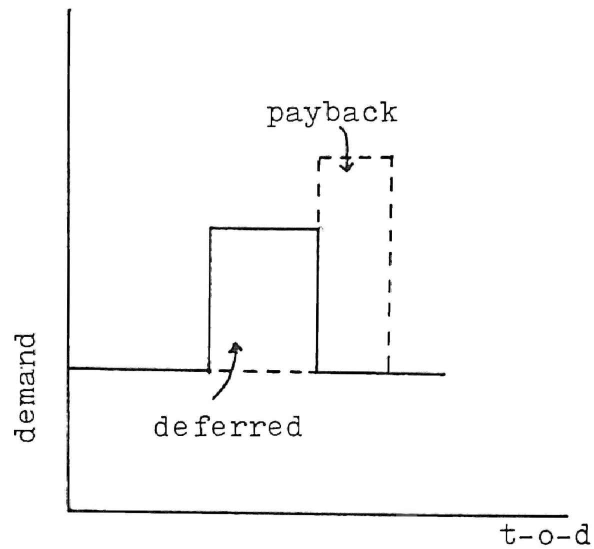


(a) A Possible Effect of Peak Shifting in a Plateau Shaped Load Pattern

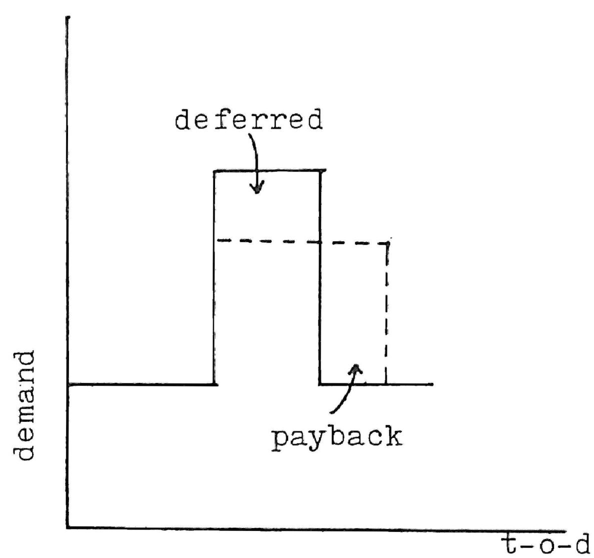


(b) A Possible Effect of Peak Shifting in a Needle Shaped Load Pattern

Figure 3. The Payback Phenomena



(a)



(b)

Figure 4. An Example of the Payback Phenomena

during the three hour peak period, an even larger peak will be created during the payback period. If the load is cycled in such a way that the peak period demand (100 megawatts) over the base is spread over the available five hours -- the three-hour peak period and the two-hour payback period--then the load pattern looks as it does in figure 4(b). It would appear that only about 40 percent of the load under load management can be called upon during peak periods.

Further complications arise in considering the use of multiple curtailments. If the customer's air conditioning is interrupted for, say ten minutes, and a second interruption occurs soon afterwards, then the second interruption cannot be as long as the first, or the time between interruptions must be of longer duration. This is to ensure that the interior temperature does not rise to such an extent that the customer demands to be removed from the load management program. Interruptions would have to be of shorter durations and more infrequent as the outside temperature increases -- just when load curtailment is most called for.

Several factors related to the usage of electricity determine the effectiveness of load control and can be summarized as follows [68]:

1. The amount of load available for control relative to the total load.
2. The duration of interruptions
3. The characteristics of payback requirements
4. The initial load pattern
5. The extent to which multiple interruptions are possible
6. The effectiveness of load control during the remaining hours of its implementation

Conclusion

Utility commitments for permanent and test installations of load management communication and load-control-system points of control had reached 500,000 by mid 1980. Radio and ripple systems were the most numerous, with 23 utilities conducting experimental programs, including seven that were commited to total or partial system wide installations. PLC projects were the second most numerous, with 11 utilities actively pursuing projects totalling 153,000 points. Eight utilities were testing ripple systems with 12,400 points [36].

By the end of 1981, nearly 170 direct load control projects had been implemented by 78 electric utilities in the United States [39]. A recent nationwide survey of utility end-use projects [4] shows more than a five-fold increase in utility load control projects between 1977 and 1983. Further, nearly 75 percent of these projects are now classified as broad-based implementations rather than tests, whereas the split was nearly even as recently as 1981.

The 218 utility control projects reported in the survey involve more than 1.5 million separate loads. Most of them are residential, with electric water heaters (650,000), and central air conditioners (515,000) topping the list. Other applications include residential space heating systems (50,000), swimming pool (260,000), and irrigation pumps (14,000). More than 85 percent are directly utility controlled by installation of remote communications link, such as radio, ripple, or PLC. The remainder use "smart" controllers, which are set according to utility parameters or depend on customer self control in response to some incentive offered by the utility [80].

There is almost complete unanimity that one-way direct load control will give way to two-way automated distribution systems that incorporate direct load control as one of many functions. The only disagreement is on when this will happen on a wide scale [39].

The importance of evaluating all the benefits and costs of direct load control programs cannot be overemphasized. They can have significant costs, and can pose potentially serious reliability problems to power systems, if they are not properly incorporated into operations. In addition, the makeup of and justification for such programs cannot be considered homogenous on a national or even regional basis.

Thermal Energy Storage (TES)

Thermal storage allows electric utilities to supply energy economically for space conditioning and water heating, that would not be possible during peak demand periods. This concept of thermal storage is doubly important if the utility experiences a high peak relative to its base-load [23].

TES can be used effectively to improve load profiles, provide dependable and automatic operation with normal comfort levels [35], and can also be compatible with solar systems [1]. To ensure success, appropriate electric rate incentives are necessary to offset higher capital cost of TES systems.

Historically, electricity has not had a major role in supplying space heat to commercial buildings, though more recently its role has begun to expand. Its main use is still in predominately warm climates in the South and West, where heating loads are small and of short duration. Since utilities in these areas are generally summer peaking, they cannot benefit from a TES heating system. Thus, in general, there is still a comparatively small market for TES in commercial space heating.

Electrically driven air conditioners represent a large thermal load where TES systems could be used to improve the system load profiles in summer peaking utilities. About one-sixth of all commercial hot water is electrically supplied [46], therefore, at least in some utility areas, additional potential exists for TES load management through the use of storage hot water heaters.

TES systems for providing climate control and hot water services in the commercial sector were found to be more economically attractive than similar residential systems for load leveling because of the economies of scale available to larger systems.

Hot Water Systems

Since the hot water requirements of commercial establishments vary considerably, the systems are usually designed from standard components to handle specific loads. Commercial designs cover a wide range of demands, from as little as 30 gallons per hour to 1000 gallons per hour for a large commercial user [46].

For hot water storage systems intended for long discharge periods without electrical input, special provisions are made to ensure good thermal stratification in the storage tank. This usually includes a pumping system to place the hottest water (from the heater element) at the top of the tank, and deflector battles to keep incoming cold water near the tank bottom. Thus, the thermal stratification remains stable and a large percentage of the hot water can be withdrawn with no drop in outlet temperatures. Vertically oriented tanks will have better thermal stratification characteristics and should be used whenever possible [35]. Small systems also have to be well insulated to reduce surface heat losses.

Air-Conditioning Systems

Air conditioning systems utilizing electrically driven chillers can provide a load management function. If adequate storage capacity is provided, previously chilled water can provide cooling during peak periods. Thus the electrically driven chillers can be shut down, and the total system load reduced to circulating both air and water.

TES air-conditioning appears to be most economical in very large systems, which constitute a considerable fraction of the total installed capacity. The incremental costs of adding TES to an air-conditioning system are the chilled water storage tank, and additional piping, valves, and controls needed to operate the system [46].

There is no consensus among consultants over whether a chilled-water or re-storage system is better [40]. One thing is certain, however: T-O-U rates are an important factor, regardless of which type of system is used. The absence of residential T-O-U rates with significant differentials between on-peak and off-peak prices is one of the primary reasons that there are only a negligible number of residential cool-storage systems [40].

Space Heating Systems

One of the commercially available devices for space heating is the ceramic storage heater, commonly used in European countries. These are individual room units controlled by individual room thermostats [73]. They contain magunsite brick which can be heated to 1300 degrees Farhenheit during an eight hour charge period. A central control system regulates the charge level based on the outside temperature during the charge period. Heat is then extracted as required by the room thermostat by circulating air through the brick core with a small fan.

Conclusion to TES

Thermal energy storage is at an early stage of development and testing. The most advanced system is ceramic-brick room-type heat storage, developed and extensively used in Europe. Cool storage and combination heat-and-cool storage was found in about 30 utilities with experimental projects in the United States by mid 1980 [36].

Several institutional mechanisms exist that are used commercialize TES systems for electric utility load leveling. These include: demand charges, t-o-d rate schedules, load management contracts, and utility ownership of TES equipment. Each mechanism has certain advantages and disadvantages. However, for commercial TES systems, it is sufficient to analyze their economic feasibility in terms of t-o-d rates, because the systems tend to have a higher utilization factor and their load profiles are not strongly seasonally dependent [46].

An EPRI study [36] involving eight generic types of TES systems concluded:

1. Heat-storage systems are commercially available which are cost effective given even a modest differential between regular rates and off-peak rates.

2. TES economic feasibility would be enhanced if the utility were to own and maintain the equipment, leasing it to the consumer, thus overcoming resistance to high initial investment.

3. Except in limited geographic areas, no residential cool-storage system is available that would be economically feasible.

4. Cool-storage projects have concentrated on state-of-the-art hardware that has not had the benefit of prior research in other countries as has heat storage.

Other Strategies For Load Management

This section will discuss various other methods for load management that do not fall under any of the three previously discussed generic strategies.

Battery Storage Systems

Ever since the need to decrease the use of petroleum fuels upon which present day intermediate- and peak-load generation largely depend, has gained importance, the emphasis is being given to technologies that can improve the utilities' ability to store power for times of heavy demand. The 'superbattery' concept presently being researched has its most obvious and identifiable market in this sphere.

While several other methods of meeting peak demand with a 'generation mix' of equipment are proven commercially successful, the battery system concept has inherent advantage when the above mentioned fuel considerations and others involving the whole load-leveling picture are taken into account [64].

Presently three battery storage systems are being given a lot of importance: zinc-chlorine battery, sodium-sulfur battery, and lithium-metal sulfide battery. An efficient one-kilowatt zinc-chlorine batter has been successfully tested and cycled 100 times. On a four-hour charge-discharge regime, the prototype reportedly demonstrated a 74 percent energy efficiency with no degradation in performance over the first 100 cycles [64].

Battery storage systems are quite flexible because their modular nature will present the opportunity to install storage capacity at the same rate as there is demand for it, with very short lead times. Such systems also have dispersed sitting capabilities and their environmental impact is minimal.

Compressed Air Powered Gas Turbine

A conceptual design for a new kind of gas turbine-based generating station, powered in part by highly compressed air from underground storage caverns, is an old concept made newly viable by the increased prices of premium fuels. "Until now, such plants have been difficult to justify on economic grounds" [65]. It is claimed that gas turbines in the compressed air plant would consume fuel at less than half their normal rate, thereby realizing sizeable savings of premium fuels [65].

During peak demand periods, the new compressed air plant would be used in conjunction with base-load steam turbine generating units. High-pressure air would be released from the storage caverns to help spin the plants' turbine generators, providing additional electricity.

The plants' air storage reservoirs would be "recharged" late at night and over weekends when demand for electricity is at its lowest. Air would be compressed and injected into the storage caverns using readily available off-peak power from large base-load generating units.

On-site Generation

On-site generation, the generation of electricity away from the utility and generally at the customers premises, can be explained with the help of two related concepts: on-site peak shaving and cogeneration.

On-site peak shaving is defined as "the use of an on-site generator set to complement the utility in minimizing overall electric costs by reducing peak demand" [34]. As such, it is a demand management tool, and generation of kilowatt-hour is intentionally held to the minimum practical level necessary to achieve the desired reduction in peak load.

A cogeneration facility produces "electric energy and steam, or other forms of useful energy, which can be used for industrial, commercial, heating or cooling purposes" [34]. Cogeneration is an energy management tool, whose economies derive from the recovery and use of heat normally rejected in the generation process.

The heart of an on-site generation system is the engine generator set. This unit is nearly identical for both peak-shaving and cogeneration. The housing, air intake, fuel, and lubrication systems are also similar, although they may be slightly more complex for cogeneration owing to requirements of continuous operation. Control systems for both on-site generation approaches are similar in hardware, but very different in software.

It should be obvious, of course, that the load management strategy of on-site generation is feasible only for industrial and commercial customers. A utility can study the specific customers' load profile and shave off coincident peaks by on-site generation by either installing its own equipment or by persuading the customer to invest in one. In the latter case, appropriate incentives have to be present for the customer, e.g., t-o-d rates, etc.

In fact, nowhere is the influence of utility rate structure more evident than in the case of customer generation. If utilities pay high prices for customer power and charge low rates for backup, they encourage customer generation. Low purchase rates and high backup rates have the opposite effect [80].

Peak-shaving is most likely to be economically attractive where the utility has a high peak demand charge and the customer has a poor load factor. Cogeneration, on the other hand, has more economic benefit where the utility has a high energy charge and the customer has a relatively high load factor [34].

Energy-Efficient Appliance Rebate

Some utilities are encouraging its residential customers to buy high efficiency equipment by giving them rebates that can, amongst other things, be used to pay their electric bill. These rebates are rationalized by utilities as representing part of the money that utility does not have to invest in new facilities to meet larger peak loads caused by the continued use of less efficient household appliances. Bonus value varies with the type of equipment purchased and whether it is used in a new or existing home. The program also seeks active participation by appliance dealers [37].

In essence, the program offers customers who purchase and install energy-efficient appliances -- heat pumps, room air-conditioners, central air-conditioners, refrigerators, freezers, electric water heaters with heat recovery, and solar-assisted electric water heaters -- credits that can be used to pay their electricity bills, or rebates of $5 to $275, when they purchase these appliances from participating dealers [12].

For the program to be effective, utilities must create a strong working relationship with household electrical appliance dealers. The dealers must be convinced to stock high-efficiency equipment and to tell their customers about the utility's rebate program that will help cut electricity bills over and above what the new equipment is designed to do. "Utilities should also provide retailers with a kit of sales materials including stickers, wall banners, and slicks, and forms for customers to fill out to obtain their rebates" [12]. Some utilities have gone so far as to pay dealer's salesmen $5 to $30 per unit, for recommending and installing qualified equipment [37].

A Note Of Caution Regarding Load Management

Load management is a valuable technique, which, when used intelligently, can make a major contribution to the electric utility industry and to the nation. A key concern is that load management seems rapidly to be becoming synonymous with load shedding, "and that would be a step towards the defeatist philosophy of managed scarcity" [45].

Load management in utilities today consists primarily of shedding electric water-heating or air-conditioning load. As such, it is an excellent tool for shaving peak in a capacity-constrianed system without deprivation to the customer. Load shedding, or load control, is also effective in reducing the demand component of the cost of purchased power which is why distribution cooperatives have accepted it so eagerly. However the primary reason given by generating utilities for its adoption is that it enables them to defer future capacity additions.

"Load management implemented on the basis that it will defer capacity will inevitably result in capacity being deferred," says William C. Hayes in an editorial comment in Electrical World [45]. He adds that:

"the prospect of future capacity shortages already looms large if load growth should turn out to be just a little higher than forecast -- and load not supplied is not a substitute for capacity. Large-scale substitution of load control for new capacity can only exacerbate this highly risky and unacceptable condition."

CHAPTER III

MARKETING IMPLICATIONS FOR UTILITIES

The consumers' actual behavior regarding electricity consumption is determined by two specific actions: the purchase of appliances, and the utilization of those appliances [10]. Gelling [32] has identified five measures that can be used to influence consumer actions:

1. Regulation: The mechanisms include building codes, conservation/load management laws, prescribed standard and efficiency levels for electrical appliances, and tariff restrictions.

2. Pricing schemes: These include the level of pricing as well as the structure of pricing.

3. Incentives/subsidies: Examples are: direct payment to the customer, low- or no-interest loans for investment in conservation/load management actions, and free load management devices.

4. Tax credits: Where government income or property taxes are paid, credits can be allowed for investments in load management. This is possible both on a national and state level.

5. Promotion, advertising and education: Consumers can be influenced by increasing their level of knowledge and through proper communication.

Measures other than regulation and taxation can be accommodated under the umbrella of marketing, whose principles and practices hold considerable promise for dealing with energy consumption problems. The purpose of this chapter is to devise marketing strategies which will aid in fulfilling load management objectives of the electric utility industry.

The Importance of Marketing

Many examples of specific load management activities can be envisioned, but not all will be suitable for any one utility. The first task, therefore, is to determine the specific activities that offer the best prospect for an individual utility. This evaluation requires substantial knowledge of the reactions that can be expected from customers to any specific activity. After all, no load management program will work successfully without customer cooperation.

In fact, load management requires a continuing interface with the customers. They must first be sold a product, such as insulation, a load management device, or TES equipment, or be sold a concept, such as voluntary load management, or be convinced that a utility should be allowed to control their electric use, or be satisfied that the company is really trying to help them conserve energy. Then they must be kept satisfied with the results of whatever they were sold in the first place.

By now it must be evident that load management activities are marketing activities, and should be fully integrated into the planning process. In taking a broad view of marketing one should include most, if not all, of those functions that involve contact with customers on a routine basis. It should also include those functions intended to influence the customer's use of electricity and his or her relationship to the company.

Since, "electricity is being regarded today more and more as a service than as a commodity" [33], utility marketing of necessity is much broader in scope, and has expanded to include conservation, load management, and load growth. The utility's objective is to develop marketing incentives that fit customer preferences and behavior -- incentives that will be of mutual benefit to both. Marketing activities spotlight customer wants and needs in all their diversity, and "utilities are finding that they need a more detailed understanding of the factors that influence customer decision" [80].

Electric utilities cannot function if the customer's demands exceed the capacity available to satisfy those demands. Therefore, it is logical to assume that few utilities will be able to maintain control over their costs unless they engage in a comprehensive and sustained effort in load management. "The marketing effort, including the selling effort, to do this successfully will far exceed any marketing effort the industry has made in the past", says Peter J. McTague, President and CEO of Green Mountain Power Corporation [59], adding that "those companies that do not make the effort will find their lack of marketing can be quite disastrous."

Consumer Studies: Promoting the Concept of Load Management

With respect to electrical energy use, behavioral interventions can be aimed at two dimensions of the problem: (a) patterns of consumption, and (b) levels of consumption. The first has to do with greater demand for electrical power at certain peak periods, and the second is concerned with overall levels of consumption. Although most of the studies quoted in this section were conducted for the purpose of conserving energy, the author feels that they have broader implications, and are equally applicable to, and provide valuable insights in understanding consumer behavior for the purposes of load management.

Energy conservation appeals to homeowners stressing patriotism and social responsibility have not been effective [70]. Only when people see that it is in their own best short-run and long-run interest will they take actions to save energy [48]. To the typical consumer these benefits usually boil down to the money savings, a message strategy successfully used in Canada [3].

Stern and Gardner [77] note that behavioral research on households has identified four types of independent variables intended to stimulate energy conservation: (1) Individuals can be given some monetary incentive (direct payments) for achieving some energy conservation goal, (2) Individuals can be given feedback on the amount of energy they consumed to help them modify their future consumption, (3) Information can be provided to individuals about specific actions that will save energy, and (4) prompts (exhortations and admonitions) to conserve energy can be used. In implementing any of these approaches, the individual consumer (or household) is the focal point. In adopting this focus, the studies assessing the effectiveness of different approaches have explicitly assumed that the individual or household has a direct economic incentive to conserve.

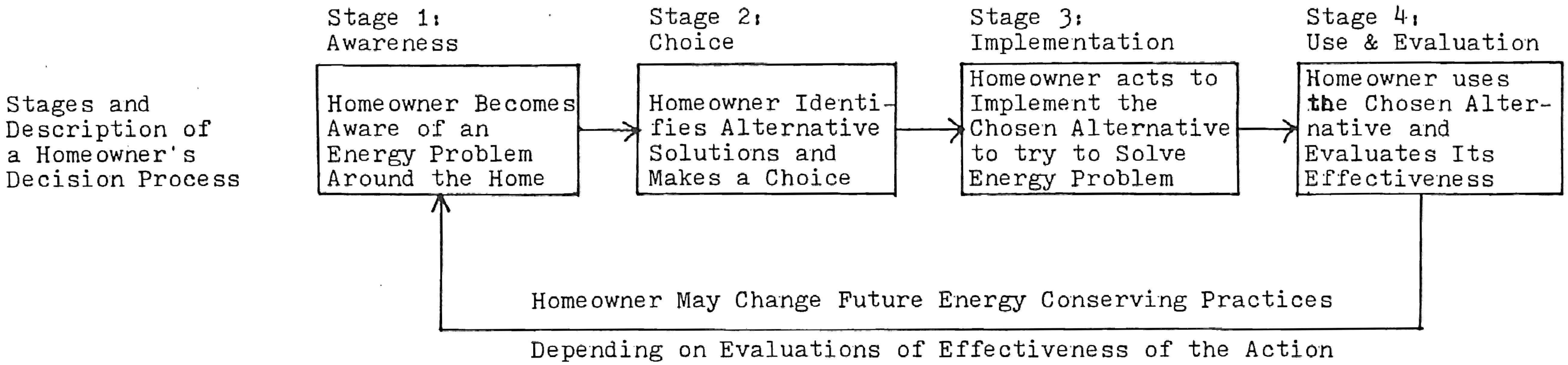
The four main categories (economic incentive or payments, feedback, information, and prompts) will be discussed following a description of the stages a household goes through in taking an energy-conserving action. It is important to note here that the terms conservation and load management will be used interchangeably throughout this section.

Consumer Decision Process

Decisions by households regarding which energy-saving actions to take always involve time to acquire information and possible self-help training, and they often require cost commitments as well. They are sufficiently complex that they typically involve a sequence of specific steps to be taken by households. Rudelius et al. [70] have proposed a four stage sequence, and the top half of figure 5 describes these stages that a household goes through in making a conscious energy-saving decision: (1) awareness, (2) choice, (3) implementation, and (4) use and evaluation. It is useful for analyzing both high-cost decisions (installing a new furnace or load control device) and low cost ones (installing weatherstripping or caulking). Weijo and Hartley [81] have validated these four stages in a homeowner's decision to conserve energy using a unidimensional unfolding model. This four-stage sequence has the added advantage of addressing the barriers that tend to impede households energy decisions in each of the four stages. These barriers, which are adapted from Deutscher and Munro [20], appear in the bottom half of figure 5. This is not an exhaustive list of the barriers to consumer adoption of load management and further discussion of the subject will take place later.

Effect of Information, Feedback, Prompts, and Payments

One of the few studies aimed at changing the pattern of electricity consumption of households was undertaken by Kohlenberg et al. [52]. The effects of payments, information, and feedback on electrical energy peaking of private residences were investigated with three volunteer families who had responded to a newsletter ad. Results indicated that



Potential Barriers for Homeowner at Each Stage of the Decision Process	Lack of Information to determine Whether a Problem Exists that the Homeowner can Solve	Inability to Determine and Understand the Benefits and Costs of Alternative Energy Saving Actions	Inability to Understand Action; to Find Satisfactory Contractor or Suppliers; to Finance the Action	Difficulty in Evaluating the Savings Provided by Completed Energy Conserving Actions

Source: Rudelius, W., R. Weijo and G. Dodge. "Marketing Energy Conservation to Homeowners: An Action Program from Public Policy Research." Journal of Public Policy and Marketing, 3 (19),

Figure 5. Stages a Homeowner Goes Through in Taking an Energy-Conserving Action and Potential Barriers to that Action

information alone (telling families the effects of peaking on the environment and appliance wattage ratings in terms of 100-W light-bulb equivalents) produced no change in peaking, while feedback alone (indicator light showing excess current being used) had a moderate effect. The greatest change occurred with the feedback plus payment condition (double the monetary value of their electric bill for a 100 percent reduction in peaking).

Studies by Winett and Nietzel [84], Seaver and Patterson [74], and Palmer et al. [62], have addressed the problem regarding the overall levels of consumption. Winett and Nietzel examined the effects of information (manual containing energy reduction suggestions), feedback (self-recording form for monitoring weekly meter readings), and payments (up to $5 per week for reductions greater than 20 percent) on the consumption of electricity and natural gas in private residences. In a design permitting both within -- and between -- group comparisons, one group of households received information and feedback, and the other received weekly monetary payments as well. both groups apparently reduced electricity and gas consumption from baseline levels. There was a between-group effect for electricity only, however, with the payment group showing a greater reduction in use. (It should be noted that payments by the experimenter were in addition to the savings incurred as a result of lower consumption).

Hayes and Cone [44] employed monetary payments, energy information, and daily feedback on consumption in four units of a university housing complex. Payments produced immediate and substantial reductions in consumption in all units, even when the magnitude of payments was reduced considerably. Feedback also produced reductions, but information about ways to conserve and about the cost of using various appliances did not. It was also found that, in general, payments combined with either information or feedback produced no greater effect than payments alone.

On the other hand, Rudelius et al. [70] believe that more precise information for the home-owner showing the specific dollar costs and savings for various energy actions will stimulate meaningful and beneficial trade-offs for the individual. They further believe that broadly conceived, publicly sponsored marketing strategies can help individual consumers make more informed energy conservation choices from among the continuous, seasonal, and one-time actions available to them. Unfortunately, consumers generally do not know what actions to take to save energy, the size of their potential benefits, and the time and cost involved [9, 26]. If consumers are to take energy saving actions around the home, they need more precise information on the dollar costs and savings (benefits) of such actions [79] and an increased awareness of the prices increases in energy [47].

For the purpose of providing some form of information to homeowners on ways to conserve energy, Public Service Commissions and energy utilities appear to be equally credible sources [15]. But research on the effectiveness of such information gives mixed results. Some suggest that it may be effective in reducing household energy use only when combined with public commendation [44,52,60,82], and feedback and goal setting [7]. Gaskell, Ellis, and Pike [29] found that while information plus feedback led to the greatest reduction in household fuel consumption, information alone was also effective. And, information plus a free shower-flow restrictor caused New England residents to take low-cost and no-cost energy conservation actions [51].

Craig and McCann [14] provide a possible explanation against the evidence that the information paradigm is less effective than other energy-conservation strategies. They argue that it is equally plausible that the information approach is ineffective because it has been poorly conceived and executed. If the observed ineffectiveness is due to poor message execution, then improving the quality of communication may enhance the value of the information paradigm. In fact, their results strongly suggest that properly designed persuasive communications alone can affect conservation behavior positively. In a related study, Allen [2] points out that endorsement strategies offer a potential for overcoming some problems regarding lack of confidence or ill will towards an information source and can help in enhancing the impact of the communication. But he warns that though endorsements may be useful in affecting the individuals initial reaction towards a program, they prove ineffective in alleviating apprehension about the accuracy, adequacy, and reliability of the program.

Several recent studies have investigated the effects of daily energy consumption feedback on the use of electricity. Electricity savings of 10 to 20 percent over study periods of three to eight weeks were found. Savings generally were larger in periods of more extreme weather, indicating a primary effect on heating and cooling energy [7,75,83]. A study by McClelland and Cook [57], however, reported that the conservation action taken by households with monitors primarily affected energy uses other than heating and cooling. One explanation of this discrepancy could be that the monitors may have served more to teach residents what activities consume the most energy than simply to draw attention to the cost of energy. Most people already know that electric heating and cooling are high energy users, and whether these systems are on or off can be sensed quite easily without a monitor. Conversely, the relative energy needs of other household appliances are not well known, and cannot be readily obtained from feedback delayed a month (such as a utility bill) or even a day. It is thus perhaps not unreasonable that the effects of continuous-display monitors differ from those of daily feedback, which seems to be most effective in promoting conservation of heating and cooling energy [7,83]. Feedback could be maximized by an on-line, in-house meter similar to that used by Kohlenberg et al. [52]. It would seem feasible to build a meter to report continuously the amount of energy (in dollars and cents) consumed for a day and the month to date, project a total monthly bill at current rates of consumption, and turn on an indicator when certain consumption levels were exceeded. Many consumers would probably purchase such a meter as an add-on device if power companies did not furnish them [44].

Seaver and Patterson [74] examined the separate and relative effects of feedback and feedback plus "We are saving oil" decals on the use of home heating oil. A combined within -- and between -- groups design was used with families randomly assigned to one of the above conditions or to an untreated control group. Overall analysis of variance and internal analysis showed significantly less consumption for the feedback plus decals group after intervention than for the control and feedback only groups, which were not significantly different from one another.

Palmer et al. [62] also tried to reduce levels of consumption. Using four volunteer families in a series of withdrawal designs, they examined the effects of two types of feedback and two types of prompts.

Feedback involved either (a) daily use in terms of kilowatt hours, or (b) daily use plus projected monthly cost. Prompts were (a) daily requests for conservation, and (b) a personal letter from a government official urging conservation. Palmer et al. concluded that prompts and feedback were effective, but differential effectiveness within or between the two approaches was not established.

A majority of homeowners take conservation actions that are most likely to be quick-payback actions that can be done without a contractor's assistance and do not affect their life style in an important way [8]. This desire for a quick payback applies to homeowners in general, with lower income households wanting faster payback [18]. Russo [71] notes that in energy decisions the increase or decrease in the benefit of an action is relatively clear (the discomfort of a lower thermostat), but the dollar cost is known very imprecisely. Hanna [42] argues for standardizing the way financial returns from energy-saving investments, like payback and rate of return, are described to facilitate informed consumer choice. Because of the important regional differences in energy use, local governments or energy utilities may be especially effective in facilitating energy savings. It is important for them to tailor-make information to consumers in an understandable format [66], perhaps through such channels as hardware stores, neighborhood groups, do-it-yourself outlets, contractors, or community-action groups [31] that have unique access to specific consumer segments.

Of the four independent variables researched, the most effective is paying for reductions. Kohlenberg et al. [52] have shown experimenter payments to be effective in altering patterns of electricity use, and Winett and Nietzel [84] and Hayes and Cone [44] reduced levels of consumption by using this strategy. Furthermore, Craig and McCann [17] conclude that individuals living in master-metered dwellings consume on the average 35 percent more electricity than individuals living in single-metered dwellings due to a lack of direct economic incentive to conserve electricity. The importance of the economic incentive is dramatically demonstrated when dwellings that have been converted from master-metering to single-metering are considered. When individuals were confronted with an incentive to use less electricity, they reduced their consumption by 30 to 40 percent [17].

Conclusion. The incentive approach has generally met with the greatest success in reducing energy consumption, with direct incentive (payments) achieving more dramatic results than the indirect (i.e., time-of-day) approach [14]. Also, Corney, Nixon, and Yantis [13] and Dyer [22] found little resistance to centralized control of air-conditioning units. Next in overall effectiveness is the feedback approach, with more frequent feedback appearing to have a greater impact than monthly feedback. The results obtained with information provision indicate that this is the least effective means of reducing energy consumption. Table I provides a quick reference to some of the studies mentioned in this section and their effects on the above mentioned paradigms.

Key conclusions from evaluation of the U.S. Department of Energy In-house Residential Conservation Service (RCS) audit: People conserve energy to save money, are discouraged from energy conservation by high-cost measures, don't want to make lifestyle changes, and don't understand which conservation measures are most effective [9]. The appeals that

TABLE I

A REFERENCE TABLE OF STUDIES ON
CONSUMER BEHAVIOR

AUTHOR(S)	REPORTED EFFECT OF VARIABLES										PURPOSE OF THE STUDY
	I	F	Pr	Pa	F + Pr	F + Pa	I + F	F + Pa	I + Pa	I + F + Pa	
Becker [7]		+					+				Effect of feedback & goal setting on conservation
Booz, Allen & Hamilton [9]	+	+		+							Survey of utility residential energy conservation programs
Craig & McCann [14,15,16]	+										Impact of Communication on Conservation
Farhar et al. [26]	+										Literature survey of public opinion about energy
Hanna [42]	+										Investments in conservation efforts
Hayes & Cone [44]	o	+		++				+	+		Conservation
Helsop, Morgan & Cousineau [47]	+										Conservation
Kohlenberg, Phillips & Proctor [52]	o	+		++		++					Peak clipping
McClelland & Cook [57]		+									Conservation
Palmer, Lloyd & Lloyd [62]		+	+								Conservation
Rudelius, Weijo & Dodge [70]	+										Conservation
Seaver & Patterson [74]		+				++					Conservation
Seligman & Darley [75]		+									Conservation
Verhallen & VanRaaij [79]	+										Conservation
Winnet, Neale & Grier [83]		+									Strategic conservation
Winnet & Nietzel [84]				+			+			++	Strategic conservation

I: Information, F: Feedback, Pr: Prompts, Pa: Payment/Incentive
++: strong positive effect, +: positive effect, o: no effect

are seen as most effective by consumers speak of saving money through conservation. They do not stress lifestyle changes, sacrifice, and the national interest [9].

Consumer Studies: Selling Load Management Devices and Equipment

Due to their very nature, most load management activities require an investment, either by the utility or by the consumer, in certain devices (e.g., meters, TES equipment, and direct load control devices). It is of vital importance to the electric utility industry to pass on the cost of this investment to the consumer in order to maintain the feasibility of the load management program. This section is, therefore, devoted towards understanding consumer behavior and purchase criteria of untried, energy-saving devices and equipment. It is not intended to be a literature survey of marketing energy-efficient consumer durables like refrigerators and air-conditioners or gasoline-efficient automobiles.

The literature on marketing load management devices is virtually non-existent. Therefore, it is necessary to draw analogies from studies done on consumer purchase of untried, energy-saving durable goods. The goal is to identify variables by which an effective communication strategy can be formulated and the market segmented for the purpose of targeting the most promising consumer segments. Successfully promoting the concept of load management itself can effect the perceptions and intentions of consumers and substantially influence the actual acceptance rate of these untried, energy-saving durable goods [49].

Life cycle cost is one of the most widely advocated methods for evaluating energy-related durables. The costs and benefits of a durable are calculated over its lifetime and discounted at a market rate of interest for the individual. The investment with the lowest life cycle is preferred to all others.

The use of life cycle cost to evaluate energy-related durables is widely recommended by economists and equally widely ignored by individuals [11]. As one advocate of life cycle cost admits, "all the consumer wants to know is the payback of the system." The futility of trying to convince individuals to use sophisticated life cycle methods has been recognized by Lunde [56], who recently proposed a variation of the traditional life cycle cost which he termed "alternative equivalent life cycle payback time."

Gately [30] found that extremely high discount rates were applied by consumers in the purchase of an energy-using durable. In a similar study of durable purchases, researchers at Oak Ridge National Laboratories calculated very high implicit discount rates by single-family homeowners. Rates of 50 to 100 percent were typical [78]. High discount rates not only reduce the likelihood of investment, but also imply a short payback period. It is thus not surprising that consumers, most of whom have little understanding of discount rates, uniformly demand short payback investments.

The above studies strongly indicate that the payback of the investment along with its cost is a major factor in the purchase of untried, energy-saving durable goods. The userborne program costs -- cost of analysis, cost of household labor in implementation, and the cost associated with resale or disposal -- should be considered by the rational investor [49]. Second, the device's potential complementary (or substitutability) with existing household energy stocks may alter the value of the device and the chosen discount rate. It is, therefore, imperative that the utility provide this information in an easily understandable format to the consumer. It is hypothesized by the author that complete and easily digestible information should negatively affect the discount rate of the consumer. The useful life of the device, its reliability, service/maintenance, and the savings that can be expected by making this investment should also be included in the information package.

In a 1980 study of the willingness of New Jersey consumers to invest in energy conservation, the most frequently mentioned reason for not making improvements with rapid paybacks was "I don't have the money to invest right now!" [61]. Though the author has not come across any study that has gauged the impact of low-cost or no-cost financing on consumer attitudes towards investing in direct load control devices or energy-efficient durables, one would be strongly tempted to believe that the impact would be significant. It would, therefore, be advisable for utilities to investigate financing such measures themselves or to at least provide consumers with information on how financing can be obtained. A study done by Booz, Allen, and Hamilton [9] concludes that the most effective conservation programs include loans made by utilities.

Answers to some other questions that would facilitate consumer acceptance to invest in load management include: Is the device or equipment portable, i.e., can the consumer take along this equipment if he or she is changing residence? Are enough people aware of this program to consider these devices an asset to the property on which it is installed? Clearly, more precise and extensive information would make the task of investing in load management easier.

Houston [49] has identified four conditions that should negatively affect the discount rate of consumers with intentions to invest in a technology with many unclear or unstated attributes. Since lower discount rates would increase the likelihood of investment, these four conditions can also be used to qualify consumers in the target market for the initial thrust of selling load management devices and equipment.

(1) Greater experience and more planned actions for saving energy should negatively affect the discount rate: For an investment in untried, energy-saving technology, a consumer's dependence on prior experience with investment goods sharing similar general characteristics is hypothesized to reduce the expected cost from implementation of an investment program. For example, the recent purchase and installation of insulation or a heating unit may increase the consumer's confidence that he or she can easily incorporate more improvement into the household.

The implication for utilities is that they should keep in close touch with electrical appliance dealers and conservation contractors, and monitor the sales of energy-efficient household goods and other conservation materials. The names of recent purchasers can be obtained from these sources and information regarding the costs and benefits of load management and related devices can be directed towards them.

(2) Higher household income should negatively affect the discount rate: There are several effects of income upon the discount rate level. First, and most important, is that income may be positively correlated with educational level. Individuals with more education not only have a higher degree of social awareness than lower income individuals, but may be more capable of understanding the investment proposal than those with

less education. Secondly, Hausman [43] has reported that low income consumers use very high implicit discount rates when faced with such investment proposals. Utilities can begin their marketing process by targeting consumers that have a higher household income, are well educated, and are socially aware.

(3) Greater household size, measured in square footage of heated dwelling space, should negatively affect the discount rate: For household square footage to directly reduce the discount rate and make the investment more attractive, the consumer must expect cost savings (beyond the direct functioning of the device) from a larger household. Household size, for example, may be positively correlated with heating and cooling system stocks and other energy-using capital. It could be correctly pointed out to the consumer that additional savings could be anticipated beyond those ordinarily stated for the device due to scale economies with respect to energy-using household capital.

(4) As the number of household members increases, the required discount rate should also increase: As the number of individuals under one roof increases, the income available to each falls. There is considerable evidence that lower per capita income leads to a decrease in the short-run savings-to-consumption ratio [27]. Assuming the average household members well-being is considered in spending decisions as income falls, an increase in the required discount rate on any given investment is expected. Utilities can combat such situations by directly financing the investment for this segment of the market and providing a schedule that can be adjusted each month in the customer's electric bill.

Barriers to Customer Acceptance of Load Management

Being able to efficiently overcome the barriers to customer acceptance of load management can reduce the cost of successfully implementing the program. Except for the customers of a few utilities, most customers are not adequately informed to have an opinion on load management [10]. It is incumbent upon the utilities to present a positive image of load management and to address the issues that might create barriers to the successful marketing of the program. In the author's opinion, these issues must be addressed well in advance of a full-scale implementation of load management to insure better understanding and participation by the customer.

Booz, Allen, and Hamilton [9], and Rudelius et al. [70] have identified these issues from an energy conservation standpoint, and the Economic Assessment Subgroup of the IEEE Load Management Working Group [10] have investigated them from the standpoint of load management. They are:

(1) Awareness: As mentioned before, most utility's customers do not have adequate information about load management, and are unaware that a problem exists that the homeowner can help solve to his or her own benefit.

(2) Cost: Generally speaking, cost is the number one barrier and an important element of the customer's self-interest. In this case, the first cost of installing load management devices and equipment is a serious barrier, and will be unacceptable to the customer unless it is shown to be in their best self-interest.

(3) Reliability of technology: Since load management technology is relatively new, customers will be concerned about its reliability. The compatibility of the equipment and devices with other household electrical appliances will also be of concern.

(4) Lifestyle modification: What level of impact will load management have on customer lifestyle? Can it be predicted with any degree of reliability? There is an element of fear and uncertainty when it comes to altering lifestyles.

(5) Degree of severity: Customers will not accept load management if they see it in extreme forms, such as shutting down air-conditioners for hours at a time.

(6) Aesthetic considerations: Is load management equipment going to be ugly? With regards to metering devices and TES equipment, the visual aesthetic effects may be a barrier.

(7) Privacy Issues: Is load management a "big brother" intent on taking away personal rights? Is it an intrusion into an individual's privacy? Will load management take away the customer's control over his or her electrical appliances?

(8) Irrational fears of new concepts: Many people fear new concepts, especially if the concepts directly affect them in their homes or place of business.

(9) Utility rates: Low utility rates discourage customer participation because the economic incentive is not great. Also if utility rates are low then the payback on customer investment in load management devices is often prohibitively long. In case of peak-load pricing, if

the differential between on-peak and off-peak prices is not substantial then voluntary load management by the customer will be adversely affected.

(10) Turnover in houses: The rapid turnover in houses (approximately 3 to 5 years) inhibits investment in load management.

(11) Customer confusion: People do not understand which utility programs will result in most energy-saving due to their inability to determine the benefits and costs of alternative energy-saving actions. The problem is compounded by the fact that the conservation field has been inundated with many different groups, all of whom are trying to provide consumers with conservation advice (e.g., local energy offices, extension services, utilities, state energy office, etc.). This multiple effort has confused people and they don't know whose advice to follow.

(12) Prior conservation measures: Once certain conservation measures have been taken by the consumers, they tend to believe that they have done their part and need not make any more modifications.

(13) Landlord participation: Because most of the low income population resides in multifamily rental units, it is crucial to involve landlords in the load management program.

(14) Public perception of the energy crisis: Customers still view the energy shortages as somewhat of a hoax and are skeptical as to the motives of utilities offering conservation and load management programs. Until people believe that there is an energy problem, they will not be motivated to conserve energy.

(15) Utility credibility: Many people blame for the current energy situation and therefore are reluctant to take advantage of the various utility conservation and load management programs.

(16) Utility customer service: An efficient customer communication program, quick response to customer request for information or audit, good equipment installation and service procedure, and quality hardware are essential to the success of load management.

A Marketing Plan

There is considerable evidence to suggest that energy problems will continue to plague the United States for some time to come. On a long term basis technological solutions offer a lot of promise, however, they do little to ameliorate more immediate concerns. On a short term basis, considerable opportunity exists to influence consumers' behavior regarding the level as well as the pattern of electricity usage. In short, marketing principles and practices hold considerable promise for dealing with energy consumption problems.

Marketing management can be viewed generically as the "problem of regulating the level, timing, and character of demand for one or more products of an organization" [53]. Simply put, "marketing management is demand management" [54]. The organization forms an idea of a desired level of transactions with a market. At any point in time, the actual demand level may be below, equal to, or above the desired demand. Kotler [53] has segmented these demand states into eight distinguishable categories, listed in table II on the next page.

For example, there is a state of "no demand" for load management equipment and devices in most utility areas, therefore, the marketing task is to "create demand" by "stimulational marketing". Similarly, "developmental marketing" can be used to build loads and "demarketing" for conservation of electricity for utilities having excess capacity and

Table II

Basic Marketing Tasks

Demand State	Marketing Task	Formal Name
Negative demand	Disabuse demand	Conversional marketing
No demand	Create demand	Stimulational marketing
Latent demand	Develop demand	Developmental marketing
Faltering demand	Revitalize demand	Remarketing
Irregular demand	Synchronize demand	Synchromarketing
Full demand	Maintain demand	Maintenance marketing
Overfull demand	Reduce demand	Demarketing
Unwholesome demand	Destroy demand	Countermarketing

limited capacity respectively. The problem with most utilities is of "irregular demand" by time of day or by season, and the marketing task most relevant to load management is to "synchronize demand" using "synchromarketing" strategies.

Synchromarketing

Irregular demand is defined as a "state in which the current timing pattern of demand is marked by seasonal or volatile fluctuations that depart from the timing pattern of supply." The marketing task of trying to resolve irregular demand is called "synchromarketing" [54]. Many marketing steps can be taken to alter the pattern of demand. For example,

> "the marketer can (i) promote new uses and desires for the product in the off-season, (ii) charge a higher price in the peak season and a lower price in the off-season, and (iii) advertise more heavily in the off-season than in the peak season" [53].

Consumers have three basic strategies in response to synchromarketing or demand modification efforts of the utility marketer [16]. They can:

(i) Forego consumption (demand denial) by denying themselves full or partial use of particular appliances during peak periods.

(ii) Postpone consumption (demand deferral) of electricity by postponing the use of appliances such as dishwashers, clothes washers and dryers from peak to off-peak periods, and

(iii) Store energy at off-peak to be utilized at periods of peak demand.

Target Audience

The efficiency of any marketing program depends on whether it can selectively reach members of the target audience. Since the excess supply of electricity occurs during the evening and early morning hours, the target audience for activities (synchromarketing) aimed at fostering demand deferral becomes individuals who not only own appliances that can be operated during those hours but also individuals who could do so easily [16]. Many people own appliances the use of which is easily deferrable; however, the likelihood of demand deferral strategies succeeding is much greater if the usage pattern advocated does not deviate radically from existing patterns. Strategies that advocate radical shifts in life-style are unlikely to succeed [9].

Craig and McCann [16] applied the concepts of demarketing and synchromarketing to the problem of load management among residential consumers who were heavy users of electricity. The assumption was that if these people could be identified and understood, a strategy could be devised which would lead them to reduce consumption or to transfer at least some of their appliance use to the off-peak period. Based on a survey of heavy users of electricity of the Con Edison (New York) Service area, a profile of these individuals was developed. Significant differences were found between the target audience for demarketing and synchromarketing strategies versus the non-marketing audience.

The synchromarketing target audience tends to live in larger homes that they own rather than rent. Their incomes are higher as are their electric bills. They have a higher level of education and are more likely to be employed in managerial positions [16].

Marketing Aspects of Load Management Program

Utilities should utilize all assets of their disposal to ensure the success of the load management program. Such assets include a substantial public relations and marketing staff, utility employees in general, rapport with the mass media, intimate working relationships with community leaders, and a significant reservoir of customer goodwill [10]. Exploiting these assets, utilities can utilize means of communication to educate and persuade customers in accepting load management. Such means include the same tools that the public relations department has been using in the past (e.g., speeches, distributing literature and brochures, exhibits and displays, briefings and seminars, etc.). Subjects for such tools to be most effective include professional, social and business organizations, schools, regular utility customers and mass media. If there are no dealers of new technology products (like communication and load control devices, clock thermostats, metering devices and TES equipment) in the utility service area then the utility itself should make them available to customers and distribute them through standard outlets.

People tend to accept new ideas more easily if they see them accepted and used by their peers. "Peer persuasion" for load management will be especially helpful with business and professional people [10]. Other forms of subtle persuasion may be called "leader and personal persuasion". People who are seen as community, society and political leaders are trend setters of a utility service area. They should be sought out to accept load management and then publicized. Customers also tend to accept load management if they personally discuss it with utility people they know and trust [10]. These utility people include all utility employees.

Utilities could offer free audits to customers to promote understanding and confidence. These audits, preferably conducted in a similar fashion to the Residential Conservation Service (RCS) audits, will enhance customer education, increase customer goodwill, serve to disseminate information, and prompt consumers to accept the load management program. Residential audits should not be inordinately expensive for the utility if the same staff providing RCS audits is given additional training to also perform load management audits.

It is advisable to carry out a pilot test to serve as a microcosm of the system-wide programs. Utilities can learn from these pilot tests and sharpen their skills for maximizing customer participation in load management. Pilot tests could also help in resolving the procedural and implementation issues. The utility also needs to understand the customers and the market for the program. Market surveys are a good means by which to identify market characteristics and incentives that will increase customer participation in the program. Utilities should initially survey the potential market by mail to obtain at least an estimate of the potential market response to the program to determine operational issues. Needs of the market should be determined and efforts should be focused on finding a match between utility needs and market needs.

Cooperation with contractors is also an important aspect of the marketing program, because some measures of the load management program (e.g., the sale, installation and modification of load management and related equipment and devices) will be done by private companies and individuals. The utility can provide lists but the contractor who is contacted by the customer will provide cost estimates for the work to be performed. An effort should be made to involve contractors in the program, not only for marketing purposes, but also to keep the utility informed about the average market prices for the products and services and to provide customer response to the program. Contractors should be induced to sell the concept of load management and to make an effort to explain the various components of the utility program. After all the success of their business is at least partially dependent upon the success of the load management program. A list of contractors should be separate and divided as to the services each performs which would subsequently be provided to the utility customers.

It is worthwhile to meet with local agencies and offices that may receive inquiries about programs similar in nature to load management. Program promotion may result in inquiries to these offices; prior explanation about the program will result in proper channeling of the inquiries as well as a good working relationship with local agencies. Before starting the program, utility personnel should meet with key media personnel to inform them about the program and the message to relay to consumers regarding the program. Full media support will help in proper advertising of the program.

In a survey of residential energy conservation programs of various utilities, Booz, Allen and Hamilton [9] have suggested that the optimal time to initiate the conservation program is just prior to the high billing season. This is equally applicable to the load management program and will maximize initial consumer response.

Customer Information/Education. Rudelius et al. [70] suggest that homeowners be given comprehensible information at each stage of the energy decision -- from more precise information on the dollar costs and savings of alternative energy actions (at the awareness and choice stage) to the names of approved energy auditors, contractors, and lenders (at the implementation and use-evaluation stages). If the purpose is to educate customers and increase their awareness of utility programs, then the specific alternatives available to utilities include [80]: bill inserts, brochures, information packets, displays, direct mailings, and newspaper ads. Direct customer contact to encourage customer response can be achieved through the utility public relations department, the utility telephone hot-line, T.V. and radio talk shows, and on-site energy audits. Utilities can also organize community meetings, neighborhood workshops and energy clinics, and provide speakers and films for such occasions to generate enthusiasm for load management programs.

Prompts. Customers can be prompted into acquiring information on or joining the load management program through newspaper, television and radio advertisement. Frequent requests by utility personnel, prominent citizens, government officials, and celebrities through mass media and direct mailings can also be an effective method. Bill inserts, bangtail envelopes and billboards are also effective in prompting consumers towards the program.

Feedback. Feedback is an important ingredient in maintaining the success of the program and gaining word-of-mouth advertisement. The most effective method of providing feedback would be through an on-line in-house continuous display meter, similar to the one used by Kohlenberg et al. [52]. This type of meter indicates when peak hours are in effect, how much electricity is being used and the cost of electricity at that time. Monthly electric bills that compute the savings of the billing month due to joining the load management program are also effective.

Incentives. The best way to encourage customer participation in the load management program is to provide some type of incentive, either direct or indirect. These incentives will have to be utility specific, and each utility will have to determine the incentive that will be most effective for its market.

Utilities can provide customers with pricing signals (indirect incentive) to encourage a desired market response. Such pricing schemes include "demand rates, time-of-use rates, off-peak rates, seasonal rates, inverted rates, interruptible rates, and promotional rates" [80]. Direct incentives can consist of direct monthly payments of a specific dollar amount to consumers on load management, or low- or no-interest loans, cash grants, rebates, and subsidized installation or modification of equipment to reduce the up-front purchase price of hardware to increase market penetration.

Studies show that the most effective conservation programs include loans made by utilities [9]. Utilities can offer low- or no-cost loans, either by themselves or in cooperation with a lending institution, of up to a certain amount and with a specified payback period for customers who join the program and are willing to invest in load management devices and equipment. The loan can be treated as a separate account on the utility bill, and monthly payments can be made by the customers along with their bill.

Advertising and Promotion. The various methods that can be used to increase customer awareness of the load management program, and to influence customer response through advertising and promotion include: radio, television, newspapers, magazines [80], bill inserts, truck and bus posters, billboards, bangtail envelopes, door hangers, thermograms, point of purchase materials, and appearances at fairs and shopping centers with energy displays [9].

The timing of advertising is important and should be climate adjusted to coincide with the times of greater use, depending upon peak seasons for heating and cooling. During the initial kick-off stage the utility should involve the media so that it can get free advertising for the program in the form of press releases and T.V. and radio talk shows. In some cases this type of advertising could significantly cut the amount of paid advertising that the utility must undertake [9]. The utility can also embark on a "cooperative advertising" strategy with participating load management contractors and dealers. The utility could conduct "focus group" interviews and "talk shows" on radio and television to determine public response to the program and to answer any questions that the consumers might have regarding the program. Radio, T.V. and newspaper testimonials by customers, celebrities and community leaders are also effective promotional tools.

The load management concept must be an integral part of advertising, however, the utility's perspective is not the most important pitch to the customer [9]. The utility should stress what customers want to know, e.g., "What's in it for me?" types of questions. The utility's marketing should be aimed at answering this question in terms of dollars and energy saved. Load management options need to be highlighted and explained in the advertising. The idea of comfort and minimal lifestyle modification must be stressed. The communication appeal should be to "maintain your present lifestyle with careful investment in major energy-saving actions" [70]. The aesthetic and personal privacy issues regarding load management must be addressed. The public should be told that load management will provide more choices than what they have presently, and as such is an advancement in the customer's freedom of choice.

Although advertising is crucial to the success of load management it must be fully coordinated with the operation of the program. Otherwise, uncontrolled promotion could lead to customer dissatisfaction and withdrawal.

A Note of Caution

Up front planning is considered a key element to developing any program. The scope and goals of the program must be clearly defined and objectives established before the marketing phase. Additionally, procedures need to be established to ensure smooth day-to-day operation. Booz, Allen and Hamilton [9] recommend running a pilot program in advance of large-scale implementation in order to better understand the issues involved. Among their other suggestions are:

Acquire commitment of top management to the program

Before the program is started, the utility should attempt to judge potential demand to ensure availability of adequate resources

Hire qualified people, with at least one full-time program manager. The entire program staff should be ready by the time the program is initiated, and

Make sure the program is completely in place and fully workable <u>before</u> going public. If the program initially receives poor public relations, it will affect its total success.

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VITA

TARIQ RASHEED

Candidate for the Degree of

Master of Business Administration

Report: LOAD MANAGEMENT IN ELECTRIC UTILITIES: A LITERATURE SURVEY

Major Field: Business Administration

Biographical:

Personal Data: Born in Karachi, Pakistan, October 1, 1955, the son of Ghulam and Salma Rasheed.

Education: Graduated from Cantt Public School, Sialkot, Pakistan, 1971; received the Intermediate Certificate from Murray College, Sialkot, Pakistan, December 1973; received the Bachelor of Science degree from University of the Punjab (Lahore, Pakistan) with a major in Chemical Engineering, February 1981; completed requirements for the Master of Business Administration degree at Oklahoma State University, May 1985.

Professional Experience: Manager Trainee, Hotel Indus (Lahore, Pakistan), December 1973 to May 1974; Assistant Manager Rooms, Hotel Indus (Lahore, Pakistan), May 1974 to May 1975.