RESIDENTIAL LOAD MANAGEMENT - A SURVEY OF COSTS AND BENEFITS

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ABSTRACT

The results of many large scale residential load management experiments have become available within the last two years. Before this, there was great speculation over the benefits of load management which were primarily extrapolated from the results of small experiments. Now, however, the results from large programs around the country are being reported, and reported as extremely favorable in almost all cases. The purpose of this paper is to survey the results of a number of large-scale load management programs and to present summary data on the costs and benefits that are being reported. In general, the conclusion reached by utilities using large load management programs is that load management is extremely cost effective with typical investment payback times of two to three years at the most.

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Introduction

Until 1970 the electric utility industry had a continuing history of technological advances which permitted installation of more efficient electrical generation systems resulting in lower costs per kilowatt hour of energy. Since then, however, electric rates have risen substantially because both the captial costs for construction of new plants and the fuel costs for operation have increased dramatically. Inflation, construction delays, expanded environmental controls, and the OPEC oil embargo have all contributed to this reversal of lower cost energy. In the face of these increased costs for construction and operation of new electric generation plants, many utilities have begun to use load management as a tool for conservation - both of capital and of energy resources. Load management is particularly attractive in terms of its potential for conserving energy and capital in the production and distribution of electric power and for holding down the cost of electricity. The objective of load management is to alter the pattern of electrical use in order to 1) improve the efficiency and utilization of generation, transmission and distribution systems, 2) lower the reserve requirements of generation and transmission capacity, and 3) improve the reliability of service to essential loads of customers.

Load management policy is usually termed active when the utility controls the customer's load, and passive when the customer voluntarily controls his load. This report is restricted to investigation of active load management programs where the customer relinquishes control of his deferrable loads to the utility which may curtail their operation during peak demand periods. Examples of deferrable residential loads commonly controlled include water heating, space heating and air conditioning. For a discussion of individual customer control of residential or commercial loads see Capehart and Muth [12]. For a discussion of the cost-benefit analysis see Capehart and Hart [13]. These loads can be controlled via remote communications from the utility or by means of preset clock-activated switches. Price incentives offered by utilities range from direct rebates for participating customers to lower rates for all customers in the class whether controlled or not.

The benifits of load management are dependent on the rate structure in existence for a given utility. Wholesale power purchasers operating under ratchet rates can make significant savings, as reported in the following section. However, even large generating utilities can benefit since capacity saved through load management is generally cheaper than capacity served by either peaking units or purchased power. Benefits in both of these circumstances are documented in the following sections of this paper. All data and results come from documents supplied by the utilities themselves.

This study clearly shows that load management is a proven technique which can result in equivalent capacity costs of \$100 - \$200 per KW, and that most load management systems are paying for themselves in periods of less than three years.

Large Load Management Programs

In early 1979, letters were sent to eighteen utilities identified in the government report, "Survey of Utility Load Management and Energy Conservation Projects," [1] as having large load management programs. Twelve utilities responded, with nine of those providing extensive documentation describing their program and elaborating on the costs and benefits involved. These utilities were contacted again in early 1980 to obtain the current results of their programs. Of these utilities, five responded with new infromation from which this report has been updated. This project considered only residential load management programs, and within that class considered only control of electric water heaters, space heaters, and air conditioners. Table 1 lists the utilities which responded and describes the size and extent of their programs.

TABLE 1 LARGE LOAD MANAGEMENT PROGRAMS

	Utility Name	Utility Location	Number of Devices Controlled Water Heaters	A/C	Space Heaters
1.	Arkansas Power and Light Co.	Little Rock, Arkansas	-	36,000	-
2.	Buckeye Power Incorporated	Columbus, Ohio	44,000	-	-
3.	Cobb Electric Membership Corp.	Marietta, Georgia	1,125	11,885	-
4.	Detroit Edison Company	Detroit, Michigan	200,000	-	-
5.	Lumbee River Electric Membership Corp.	Red Springs North Carolina	6,000	2,000	-
6.	Minnkota Power Cooperative Incorporated	Grand Forks, North Dakota	-	-	7,000
7.	Potomac (a) Edison Company	Hagerstown, Maryland	-	104	108
8.	Water, Gas and Light Commission	Albany, Georgia	100	2,000	-
9.	Wisconsin (b) Electric Power Company	Milwaukee, Wisconsin	450	-	-
10.	Southern California Edison	Rosemead, California	12,000	15,000	-

(a) Potomac Edison is included because of the equipment being used for load ontrol rather than for the size of its program.

(b) Wisconsin Electric is included because they have proposed to install 150,000 water heater control switches for their system.

Summary of Individual Utilities' Programs and Results

The utilities implementing large scale load management programs include widely varied climates of the United States from the northern states of North Dakota and Wisconsin to the southern states of Arkansas and Georgia. All types of utilities are represented: both distribution and generation-transmission rural electric cooperatives; municipal utilities; and investor-owned utilities. The residential load management program of each utility and the costs and benefits of the program as reported by that utility are summarized in Table 2.

1. Arkansas Power and Light Company [2], [3] - Little Rock, Arkansas

Arkansas Power and Light Company served 500,000 customers throughout most of the State of Arkansas. AP&L is a summer peaking system due to high use of electric air conditioners. Its load management program uses a Motorola Radio Control Switching system which covers the entire service area. By the end of 1979 AP&L had over 36,000 air conditioners under remote control. The company hopes eventually to achieve remote control of all the current 130,000 residential central air conditioners used by their customers.

AP&L's experiments determined a diversified demand per controlled air conditioner of 1.0 KW with maximum temperatures of 96 degrees F. Since the outside temperature reached 105 degrees F in 1974, AP&L believes a higher coincident demand should be established as temperatures rise. Capital cost of the load management system including installation of the control switches was $116.41 per switch. With this cost, a reduction of 1.0 KW per switch translates to a cost of $116/KW for a controlled air conditioner.

AP&L states "The estimated annual cost per KW of a radio system amortized over a 15 year life is less than the annual KW demand charge paid by AP&L to the Middle South System. In addition, installation of radio switches on all residential central air conditioners state-wide would result in a permanent deferment of 133 MW of new generation and would provide [emergency] control of approximately 532 MW of air conditioning load during periods of critical generation capacity shortage. For the above reasons, it was decided to expand the radio system to the remainder of the Company's service area."

Customer response to AP&L's control system has been excellent, with results showing that air conditioners can be shut off for 15 minutes out of each hour without causing the customer any discomfort. During the initial tests, AP&L sent out survey questionnaires with customers responding that 91% felt no discomfort during the tests and 88% could not tell when the control device operated.

As of September 10, 1979, only 449 (1.3%) of the 33,500 switches have been removed because of customer dissatisfaction.

AP&L has a load management rate for controlled air conditionerd which provides a credit of $1.44 per connected KVA per month during July, August, and September. Beginning in 1978, this service was offered to all residential customers throughout AP&L's service area.

2. Buckeye Power Incorporated [4] - Columbus, Ohio

Buckeye Power is a Generation and Transmission (G&T) Cooperative serving as the parent to 28 regional electrical cooperatives in Ohio. Buckeye is a winter peaking system because of high use of electrical space heating. This load management program uses a Motorola Radio Control Switching system with supervisory control by a PDP-11 minicomputer. As of January, 1980, Buckeye had 44,000 water heaters under remote control. However, the costs and benefits reported are based on the 43,000 switches which were installed as of mid-1979.

Buckeye's experiments determined a diversified demand per hot water heater of 1.1 KW. Capital costs of the system plus installation of the control switches was $100 per radio switch. With a cost of $100 to control a load of 1.1 KW, this translates to a cost of $91.00/KW.

During the 1978 winter peak, Buckeye reduced its peak demand by 38.5 MW and realized a wholesale power cost saving of over $2,000,000. For the 35,000 switches installed at that time, this resulted in a savings of $57.14 per switch per year and produced an investment payback time of less than two years. As of January, 1980, Buckeye's current investment in load management was $4,300,000. The annual costs of owning and operating the system are approxiamately $750,000 and the current net annual savings is $3,350,000. The Buckeye system has been easily paid for with the savings accrued during the 5 winter peak periods where the system has operated.

Buckeye recommends the use of direct consumer incentives to its member cooperatives. The incentives currently in use range from $1 - $2/month.

Participation by member coops is voluntary and 26 of the 28 have chosen to use load management. During the winter of 1977 and 1978, Buckeye activted the load management system 49 times with load deferrals of various durations, some of which kept the water heaters off for more than four hours. The total time of water heater control was 85 hours. Customer acceptance of the program was excellent, and Buckeye reports that "complaints of cold water were 'minimal'," which indicates a very low inconvenience factor. During the mild 1979 winter, Buckeye operated to control peak load only 3 times, with load deferrals of various durations, some of which kept the water heaters off for as long as 5 hours per deferral.

Buckeye also states that deferring water heater load does not result in loss of KWH sales since only the time period for water heater recharge heating is altered.

3. Cobb Electric Membership Corporation [5] - Marietta, Georgia

Cobb Electric Membership Corporation is a distribution cooperative serving 43,000 customers in an area within a 12-mile radius of Marietta, Georgia. High use of electric air conditioners makes Cobb a summer peaking system. Its load management program utilizes a Motorola Radio Control Switching system and a Supervisory Control and Data Acquisition System. As of November, 1979, Cobb had 1,125 water heaters and 11,885 air conditioners under remote control. However, costs and benefits are reported based on the 500 water heaters and 10,050 air conditioner switches which were installed as of June, 1978.

Cobb's experiments determined a diversified demand of 1.0 KW per water heater and 0.71 KW per air conditioner with no sustained period of high temperatures. Capital cost of the system including installation of the control switches was $129.20 per water heater switch and $91.04 per air conditioner switch. These costs along with a reduction of 1.0 KW per water heater and 0.71 KW per air conditioner yield a net result of $129.20/KW for water heater control and $128.23/KW for air conditioner control.

During the July, 1978 summer peak, Cobb reduced its peak demand by 7.64 MW resulting in a wholesale power cost savings of over $400,000. For 500 water heater switches this translated into a savings of $52.45 per switch per year; for 10,050 air conditioners the savings was $36.26 per switch per year. The resultant payback time is 2.5 years for both the water heater controls and the air conditioner controls.

The total savings for 1979 was $1,199,595 with $672,973 from control of air conditioners, $74,375 from control of water heaters, and $452,247 from voltage control. The resultant payback time is 1.76 years for the air conditioner controls. After four years of operation, the total savings to date is $3,280,314. Currently, Cobb uses a participating customer rebate plan which pays an average credit of $21 a year for a controlled air conditioner and $5.40 a year for a controlled water heater. The continuance of this credit into 1980, however, is uncertain.

The Cobb System controls air conditioners with a 7 minute off-time and a 20 minute on-time. This 26% inhibit cycle has been expanded on occasion to a 35% inhibit cycle of 7 minutes off and 13 minutes on. Cobb reports that after one six-hour control period "not even one call resulted regarding high inside home temperature and led to the conclusion that still higher percentages of curtailment could be utilized for short periods of time."

4. Detroit Edison Company [6] - Detroit, Michigan

Detroit Edison Company is an investor - owned utility system located in Eastern Michigan. In 1976 ninety-four percent of its 1.7 million customers were residential. Detroit Edison is a summer peaking system. It is unique among North American utilities in that it has had nine years operating experience with a radio-controlled load management system. In June, 1978 Detroit Edison had 200,000 water heaters under remote control.

Detroit Edison's load surveys determined a diversified demand per hot water heater of about 1 KW. Capital cost of the system including installation was $50 per switch in 1968. Using a 210% inflation factor, this would become $105 per switch in early 1979 dollars. With a cost of $105 to control a load of 1.0 KW this translates to a cost of $105/KW.

Operating benefits to the utility are estimated at $900,000 a year, which is only $4.50 per customer-controlled water heater. However, Detroit Edison also states that there was a one-time capacity deferral of 60 MW when the system was installed. With present plant capacity costs of around $800/KW this is a savings of 48 million dollars. Thus, a determination of the benefit from this load management system would also have to account for this savings distributed over the 200,000 controlled switches.

Detroit Edison does not give a customer rebate in the direct sense but does charge 35% higher rates for water heaters that are not controlled. Therefore, controlled customers do get lower rates, and only about 1000 customers have elected to take the higher, uncontrolled rate.

5. Lumbee River Electric Membership Corporation [7] - Red Springs, N.C.

Lumbee River EMC is a rural electric cooperative which serves a four-county area in southeastern North Carolina, and has approximately 17,00 member-customers. Lumbee River is a summer peaking system due to high electric air conditioner use. The company uses a Motorola Radio Control Switching system for load control. Lumbee River EMC was the first electric utility in North Carolina to begin a full scale load management program. As of summer, 1978, they had 6,000 water heaters and 2,000 air conditioners under remote control.

Lumbee River's experience determined a diversified demand per hot water heater of 1.2 KW and per air conditioner of 1.4 KW. Capital cost of the system plus installation was about $95 per radio switch. With a cost of $95 to control a load of 1.2 KW per water heater and 1.4 KW per air conditioner, this translates to a cost of $80 per KW for a controlled water heater and $68 KW for a controlled air conditioner.

During the 1978 summer peak Lumbee River estimates that it reduced its peak by 10 MW for a wholesale power cost savings of $570,000. For 8,000 switches this results in a savings of $71.25 per switch per year and produces a payback time of just over one year.

Lumbee River EMC gives a rebate to its controlled customers at the rate of $1.25 per month per switch installed.

During the summer of 1977, Lumbee River experienced peaks of an average length of two to four hours, and load control was exercised a total of 17 times. Water heaters were controlled on four additional occasions during the following January and February when demand exceeded pre-set values. Devices were controlled for as long as six hours during one summer day.

Lumbee River reports that load management "has been a successful problem solver" and "It reduces demand for electricity, it does not inconvenience volunteers, it is a viable alternative to peak load pricing, and although it will not stop the rise in power costs, it will go a long way toward slowing the rise down."

6. Minnkota Power Cooperative, Inc. [8] -Grand Forks, N.D.

Minnkota Power Cooperative, Inc. is a G & T cooperative and serves as the parent to twelve Rural Electric Cooperatives located in North Dakota and Minnesota. Minnkota is a heavily winter peaking system because of a substantial amount of electric heating. Their system uses a Landis & Gyr Ripple Control, and in 1979 a computer interface was added to expedite the shedding of load. As of January, 1980, Minnkota had 7000 receivers installed and the ability to shed 45 MW of load. Of these switches, 2000 were controlling special dual heating systems that can use oil or electricity.

Minnkota's load examination has shown that an average dual heating system can defer 10 KW of load during peak times. Capital cost of the system including installation is about $663 per control switch. However, since each switch controls a 10 KW load, the net cost is only $66.30/KW. Completion of coverage for the entire service area was done for $1.2 million less than estimated. This yielded a reduced capital cost of $55/KW.

During the 1978 winter peak, a total of 3,500 installed switches reduced the peak 30 MW. This 30 MW peak reduction produced spare capacity that was sold for $600,000. Due to a mild winter, only 20 days of load management were required in 1979-80.

Minnkota does not state whether a customer rebate is given or not. However, cost data does not include an amount for rebates, so a voluntary system is assumed. Minnkota reports their program has strong endorsement of the rural electric consumers. This is attributed to a careful program of communication conducted by the progressive staff and managers of the associated distribution cooperatives and a regular monthly newsletter to the rural electric consumers.

Cass County Electric Cooperative is one of the twelve members of Minnkota Power Cooperative. Mr. Willard Grager is General Manager of Cass County Co-op and he reports: "We at Cass County Electric are very serious about our load management program. We have developed this program in such a manner as to have the least derogatory effect on the members' standard of living. We have prided ourselves that we have been able, with the members' cooperation, to develop the program so that the customer's way of life would not have to change to his dissatisfaction or discomfort." "Load management is effective -- it makes a lot of sense, not only for members of CCEC but also for our nation as we face energy shortages throughout the world."

7. Potomac Edison Co. [9] - Hagerstown, MD

Potomac Edison Company is a part of the Alleghany Power System and serves customers in the state of Maryland. Potomac Edison Company is a winter peaking system due to high use of electric space heating. The company uses General Electric Home Comfort Control Center time and thermostat control units to load control electric space heaters and air conditioners. As of summer 1978, Potomac Edison had 108 space heaters and 104 air conditioners under control. Complete costs and benefits have not yet been computed.

Potomac Edison's experiments determined a diversified demand per air conditioner of 1.5 KW and 7.0 KW per space heater. The cost of 300 GE load controllers plus installation is $65,000, giving a cost per control device of about $220. With a cost of $220 to control the 1.5 KW air conditioning load, this translates to $147/KW. For the 7.0 KW heating load the cost is only $31.50/KW.

The Potomac Edison system is unlike the radio control or ripple systems which turn off heaters or air conditioners for a short time on a cyclic basis. This system turns heaters off completely during the winter peak hours of 9:00 a.m. - 2:00 p.m. and 5:00 p.m. - 9:00 a.m., and air conditioners during the summer peak hours of 12:00 noon - 7:00 p.m. Even with these extremely long control times, customer discomfort is reported as minimal.

Potomac Edison reports a customer incentive in the form of an initial $50 rebate to each controlled customer, and another $50 rebate payable one year later.

8. Water, Gas and Light Commission [10] - Albany, Georgia

Water, Gas and Light Commission of Albany, Georgia, is the largest municipally owned electric utility in the State of Georgia, serving a city of 85,000 people. The high use of electric air conditioning in the South Georgia climate makes Albany a summer peaking utility. The load control system is a hybrid using both radio frequency and carrier current communications, and is directed by a supervisory control and data acquisition system. As of summer 1978, Albany had 2,557 air conditioners and 100 water heaters under remote control. However, only 2,039 customers were under load management at the time of the system peak for which benefits are computed.

Albany's experiments determined a diversified demand of 0.83 KW per switch which did not separately identify the air conditioner and the water heater demands. The capital cost of the entire system plus switch installation was $416,000. Taking this entire cost and dividing it by 2,657 switches gives a maximum cost of $157 per switch. This translates to a cost of $190/KW based on a peak reduction of 0.83 KW per switch.

During the 1978 summer peak Albany reduced its peak demand by 9.5 MW resulting in a wholesale power cost savings of over $541,000. For 2,657 switches, this translates to a savings of $204 per switch per year and produces an investment payback time of just under ten months.

Albany reports that no direct rebate to customers was provided, but participants were informed that their next year's bills would be higher without the load management program. Controlled air conditioners were turned off for 7.5 minutes out of 30. During those 7.5 minutes, only the compressor of the air conditioner was cut off leaving the circulating fan in operation.

In a total time of just six months, Albany planned, purchased and installed their load management system, obtained voluntary participation by 3000 customers, and trained their personnel to operate the equipment. Switch installation costs were $16 per unit for air conditioners and $25 per unit for water heaters.

Albany reports "that with the proper system design and equipment, load management can pay its way almost immediately, can provide the flexibility needed in these uncertain times, and can operate without discernable effect on consumers."

9. Wisconsin Electric Power Company [11] - Milwaukee, Wisconsin

Wisconsin Electric Power Company is a large utility serving over 600,000 customers in the Wisconsin area. Their Belgium - Cedar Grove load management experiment involved remote control of water heaters of 450 farm and residential customers.

Wisconsin Electric's experiments determined a diversified demand of 0.75 - 0.80 KW per water heater. This result was lower than expected. Peak diversified demands above 1 KW per water heater were expected in the winter months along with demands above 0.9 KW during summer months. Some of the reasons for this somewhat lower value are that the customers in the experiment were lower energy users compared to the average WEP Co. residential customer, there were fewer people per home (3.1 vs 3.3), about 10% of the homes were used as summer cottages and contribute little to the total energy use for water heaters, and finally many of the homes used well water at a constant temperature which was above that of municipal water sytems. No cost benefit data is given for this experiment.

Wisconsin Electric viewed the results of their load management experiment as such a success that they have proposed installing load management for 150,000 customers. As of January 1978, WEP Co. estimated that they had 175,000 water heaters in customer homes, and their goal was to get 75% of the electric water heating customers to allow them to install controls.

The estimated cost of purchasing and installing 150,000 control switches is $22.5 million dollars in 1977 dollars. At a load of 0.75 KW per water heater this gives an estimated cost of $200/KW.

Wisconsin Electric has proposed a customer incentive of $1.50 per month to obtain a 75% acceptance rate for load control. Estimated benefits of load control are such that an incentive of $1.69 per month would be available based on a system wide savings on generation and operating costs of $40 million over the 28 year project life.

10. Southern California Edison [14] - Rosemead, California

Southern California Edison serves an area of 50,000 square miles which encompasses an extreme range of weather conditions. SCE is a summer peaking utility with temperatures ranging from 94°F in the moderate zone to 116°F in the super hot zone. For air conditioner control, this load management program uses a scientific Atlanta digital radio system incorporating seven separate transmitter sites. Water heater control is accomplished with Motorola radio control receiver devices. Current tests involve 12,000 water heaters and 15,000 air conditioners.

SCE's experiments determined a KW reduction ranging from .21 KW per air conditioner in the super hot zone with 25% off time to .84KW per air conditioner in the hot zone with 50% off time. The reduction per water heater was approximately .35KW. The air conditioner cycling related cost, including installation, was $170 per unit. SCE reported that overall systemwide program costs exceeded the benefits by 3 to 1.

Customer acceptance of SCE's air conditioner cycling program was fair. After 25 days of cycling, the withdrawal rate ranged from 4% in the moderate zone to 20.4% in the super hot zone. The major reason for withdrawal was customer discomfort with results showing a direct correlation to percent off time. Incentives ranging from $0 to $6/ton/year were offered, but SCE concluded that no direct correlation existed between incentive levels and sign-up rates.

From the results of the first summer of tests, SCE reported that cycling of residential central air conditioners was not cost-effective, given present generation alternatives. The current residential cycling program, with some simple modifications, will continue for one additional summer, and similar results are expected. Control of water heaters alone was determined to be feasible during the evenings.

Table 1. Summary of Load Management Programs Surveyed

Utility Name and Device Controlled	Type Utility	Number Devices Controlled	Winter or Summer Peaking	Control Method	Cost per Switch	Demand Reduction per Device	Equivalent Capacity Cost	Direct Customer Rebate
1. Arkansas Power and Light Corp. [2,3]								
Air conditioners	IOU	36,000	Summer	Radio	$116	1.0 KW	$116/KW	Yes
2. Buckeye Power Incorporated [4]								
Water Heaters	Co-op	44,000	Winter	Radio	$100	1.12KW	$89/KW	No
3. Cobb Electric Membership Corp. [5]								
Water heaters	Co-op	1,125	Summer	Radio	$129	1.0 KW	$129/KW	Yes
Air conditioners	Co-op	11,885	Summer	Radio	$91	0.71 KW	$128/KW	Yes
4. Detroit Edison Company [6]								
Water heaters	IOU	200,000	Summer	Radio	$105	1.0 KW	$105/KW	No, but higher rate charged uncontrolled customers
5. Lumbee River Electric Membership Corp. [7]								
Water heaters	Co-op	6,000	Summer	Radio	$95	1.2 KW	$80/KW	Yes
Air conditioners	Co-op	2,000	Summer	Radio	$95	1.4 KW	$68/KW	Yes
6. Minnkota Power Cooperative, Inc. [8]								
Space heaters	Co-op	5,000	Winter	Ripple	$550	10 KW	$55/KW	No

7. Potomac Edison Company [9]								
Air conditioners	IOU	104	Winter	Time switch	$220	1.5 KW	$147/KW	Yes
Space Heaters	IOU	108	Winter	Time switch	$220	7.0 KW	$31/KW	Yes
8. Southern California Edison Company [14]								
Air conditioners	IOU	15,000	Summer	Radio	$170	0.21-0.84KW	$810/KW $203/KW	Yes
Water heaters	IOU	12,000	Summer	Radio	$170	0.35KW	$486/KW	Yes
9. Water, Gas and Light Commission, Albany, Georgia [10]								
Water heaters	Municipal	100	Summer	Hybrid Radio/	$157	0.83 KW	$190/KW	No
Air conditioners	Municipal	2,000	Summer	Carrier	$157	0.83 KW	$190/KW	No
10. Wisconsin Electric Power Company [11]								
Water heaters	IOU	450	-	Two-way	$150	0.75 KW	$200/KW	Yes

Conclusion

The results of this study demonstrate quite clearly that large load management programs are extremely cost effective for both generating and non-generating utilities, and that customer acceptance of utility control of their non-essential loads is excellent. Radio control systems are used by the majority of the utilities studied, and the resulting costs per installed control switch are under \$200 (1978 dollars). Average peak demand reduction for each hot water heater and for each air conditioner is around one KW. Therefore, the equivalent capacity cost through load control of water heaters and air conditioners by radio is approximately \$200/KW. Average peak demand reduction for electric heaters is quite variable, but a value of 7 KW was the minimum reported in this study. This gives an equivalent capacity cost of less than \$30/KW. The benefits of load management to utility ratepayers are significant, and are passed on either as direct rebates to participating customers or as lower rates to all customers. Two large utilities felt load management was so cost effective that they recommended the control program be extended to all residential customers. Arkansas Power and Light currently offers such a plan and hopes to eventually control all 150,000 central air conditioners belonging to its residential customers. Load management programs have successfully moved through the experimental stages and implementation now appears to be standard accepted practice for both generating and non-generating utilities.

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