

**RESIDENTIAL AIR CONDITIONER DIRECT LOAD CONTROL
"ENERGY PARTNERS PROGRAM"**

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ABSTRACT

Demand side management programs like Energy Partners can provide an effective peak reducing capability which within a carefully designed integrated resource plan can help to ensure that the system's load requirements are met in the most cost effective manner.

A pilot program which will be discussed in detail was conducted during the summer of 1991. Following this successful pilot the Energy Partners program began implementation in September of 1992.

Our marketing goals are aggressive, but we are currently on target with over 20,000 new installations in 1993 and project over 100,000 installations in place by the year 2000. Our peak load reduction goals approach 35MW by the end of this year, and grow to nearly 150MW by the year 2000.

An outside contractor handles customer inquiries, applications, switch installations, and tracking of participants. Cycling strategies, load control, marketing and other administrative duties are handled by HL&P staff. A FM, VHF, radio transmission system is being used to transmit the signal to our customers homes. With several thousand customers being cycled off at different intervals, the

system will provide a continuous load reduction.

INTRODUCTION

Resource planning dictates that an electric utility company consider all potential options for meeting peak demand requirements. Additionally, HL&P is committed to an integrated resource planning (IRP) approach in which both demand-side and supply side resources are evaluated. HL&P also recognizes the contribution demand-side programs make to the company's long-term ability to provide reliable and reasonably priced electric service for its customers. Through its planning process, HL&P has identified a peak reduction target of 225MW by 1995 to be met by selected DSM programs. The Energy Partners Program is committed to contributing over 40% of this goal, or 102.2MW (See Figure 1).

HL&P's Energy Partners Program is a prime example of a cost effective resource alternative to building additional generating capability. Energy Partners truly is a partnership between HL&P and its residential customers. In this partnership the customer allows HL&P to install a switch on his/her air conditioner or heat pump and periodically cycle the unit off during the hottest summer days. In return the customer benefits by receiving an

incentive payment, as well as reducing the upward pressure on electrical rates.

The Energy Partners Program is not unique. There are hundreds of direct load control programs all over the U.S., representing over 4 million controlled customer loads and over 14,000 megawatts of peak demand effected, according to EPRI. Numerous large investor-owned electric utilities are presently offering residential load control programs with great success. Arkansas Power & Light, Duke Power Company, Florida Power Corporation, Florida Power & Light, and Southern California Edison, for example, all currently have over 100,000 points of control in place. The largest load control program of an investor-owned electric utility company in the United States is at Florida Power Corporation (FPC). Currently, FPC has approximately 500,000

installed switches representing a 48% market penetration for the control of air conditioners, water heaters, electric strip heaters and pool pumps. While FPC's primary interest is winter peak reduction, the air conditioner control program provides approximately 460MW of summer peak reduction.

THE PILOT PROGRAM

Based upon the potential viability of a direct control program at HL&P, a decision was made to conduct an air conditioner control pilot program during the summer of 1991. To get volunteers, HL&P randomly picked 4,000 customers in the identified geographic zone, offering them a free air conditioning tune-up and a \$30 cash payment, plus \$5 off their monthly electric bill during the summer. Customers lived in centrally-air conditioned, single family homes using an

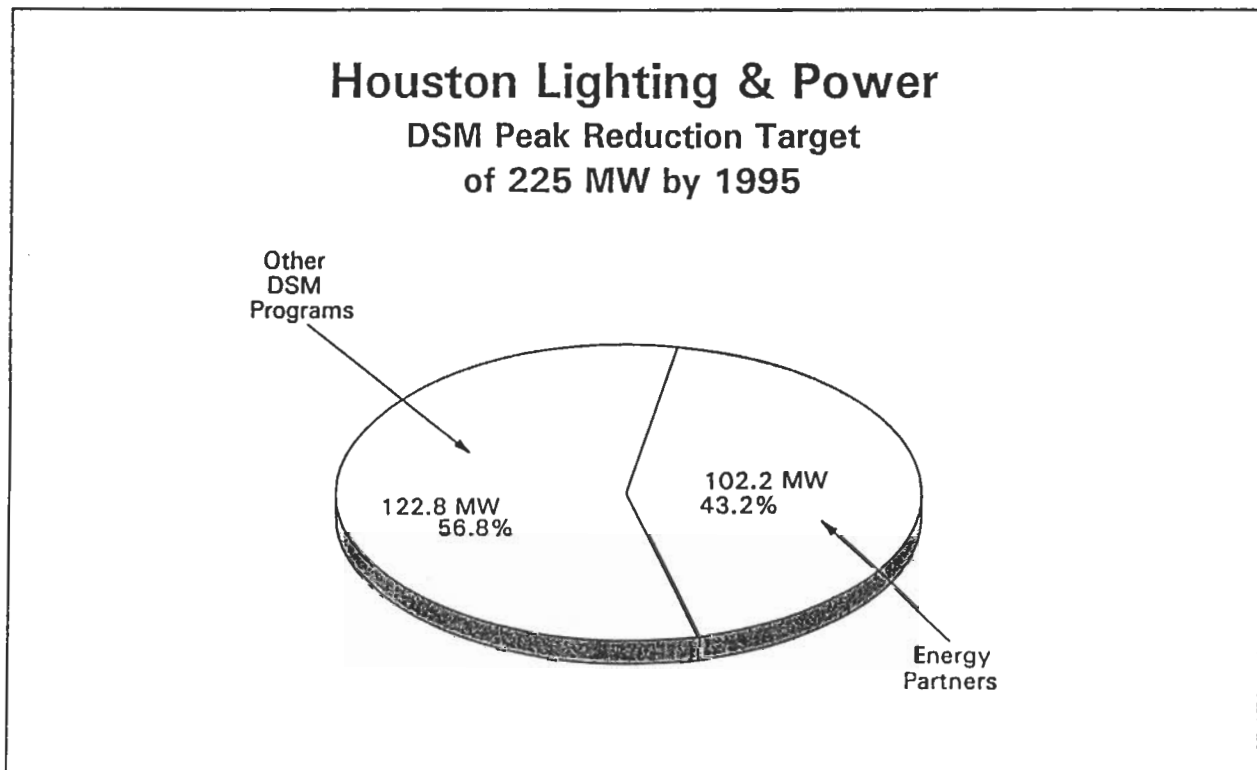


Figure 1 DSM Peak Reduction Target

average 1,000 kilowatt hours per month.

A surprising 550 customers responded, more than double the number needed for the pilot. Ultimately, 185 customers participated in the pilot program. Sub-metering to determine actual load impacts was performed at 100 of the homes.

The sub-metering analysis revealed that on peak temperature days, that is, where the outside ambient temperature is in excess of 95 degrees, HL&P could expect to receive on average a 1.46KW load reduction from each participant at a 50% cycling strategy. The 50% cycling strategy refers to the fact that for a 30 minute period the air conditioner would be remotely "shut-off" for 15 minutes and then allowed to run for the remaining 15 minutes.

In the case of a rare system emergency, where the integrity of the entire electrical system may be in jeopardy, the results indicate that HL&P could achieve an approximate 3.85KW load reduction, on a peak temperature day, for a continuous load shed. A continuous load shed is defined as cycled "off" remotely for 30 minutes out of a 30 minute period.

The analysis for the sub-metered data also indicated that the overall effect on energy consumption, for a participating customer, on a control day is essentially negligible. The reduction in energy consumption that occurs during a control period is shifted to the post-control period as the A/C unit attempts to alleviate the heat build-up in the house (See Figure 2).

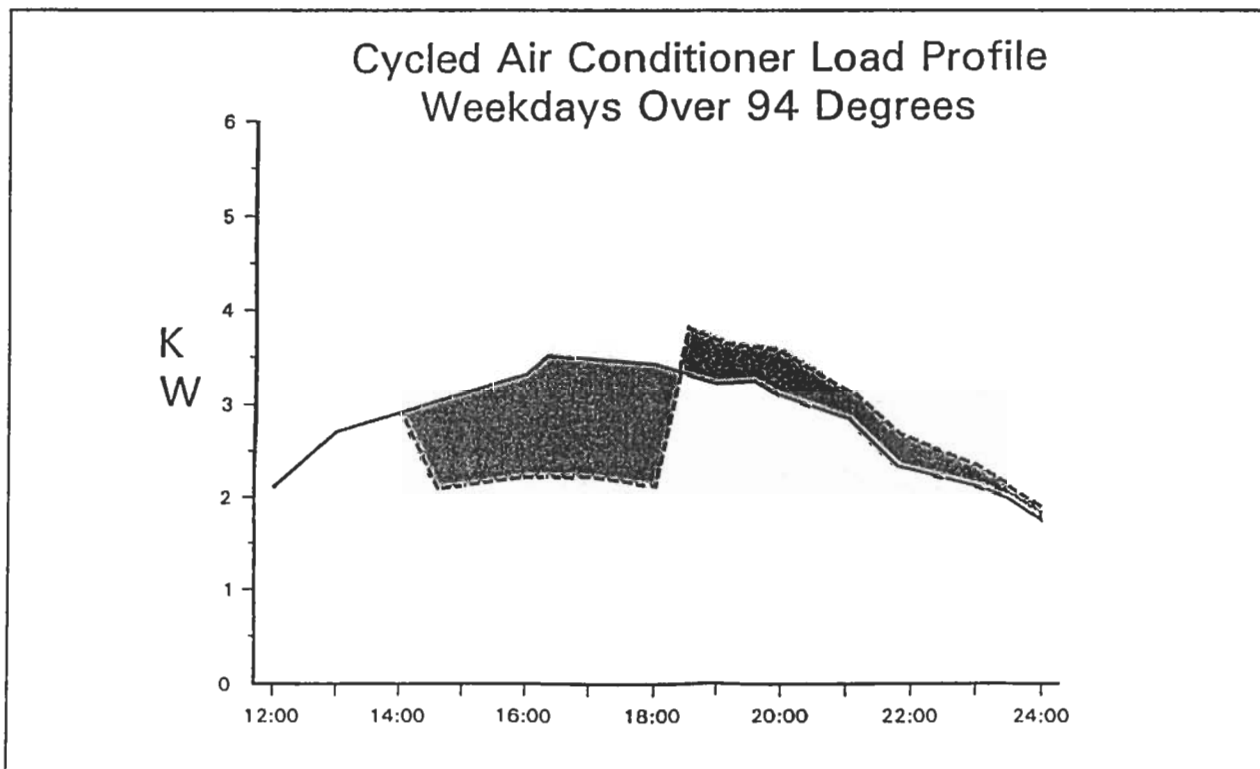


Figure 2 Cycled A/C Load Profile

With respect to customer acceptance of the program, pilot participants told HL&P through monthly surveys that generally they were very satisfied with the pilot program. The responses indicate that approximately 93% of the participants were satisfied with the temperature and humidity in their home during the four month period. Additionally, 89% of the participants indicated that they would participate in an ongoing direct load control program if offered by HL&P. This high customer satisfaction has continued during full implementation as verified by several participant surveys.

IMPLEMENTATION

Based upon the results of the 1991 pilot program, a thorough benefit-cost analysis was conducted for a proposed formal program. As a result of the success of the 1991 pilot program and the favorable results of the benefit-cost analysis, HL&P elected to pursue the formal implementation of residential direct control of air conditioners in the HL&P service area. The Energy Partners Program went into full implementation in the Fall of 1992.

A long list of HL&P departments and people have assisted the Energy Partners staff in implementing the program, and this will continue over the entire life of the program. Energy Partners is unique in that no marketing program at HL&P has ever required involvement by such a large number of areas of the Company. Some of the

departments that continue to support Energy Partners, and their basic focus follows:

Information Systems.

Monitor automated billing procedures, resolve exceptions, and implement enhancements.

Telecommunications.

Coordinate the installation of future transmitter sites and perform periodic testing of signal reception.

Energy Control.

Maintain EMACS interface with the master control unit.

Transmission & Distribution.

Assist Tele-communications with the installation and maintenance of transmitter sites.

Public Affairs.

Provide media and creative advertising revisions, and serve as liaison with the advertising agency and area printers and promotional materials suppliers.

Through a competitive bid process, the Demand Management Company (DMC) was chosen to be responsible for the installation of all control switches and for all scheduling and ongoing maintenance of customer installations. DMC's Houston staff of nearly 30 works exclusively on the Energy Partners Program and interfaces daily with Energy Partners staff. Many issues, such as customer satisfaction, switch inventory, program marketing, and database

management, are addressed routinely. Regular meetings with DMC are held to facilitate this process.

MARKETING

The marketing goals for the program are aggressive. Currently the program is on target to achieve over 20,000 new installations each year from 1993 through 1995. Additionally, the program projects over 100,000 installations in place by the year 2000. The peak load reduction goals approach 70MW by the end of this year, and grow to over 100MW by 1995, and then to nearly 150MW by the year 2000 (See Figure 3). It is HL&P's goal to sign up approximately 10% of single-family residential homeowners and renters who have central air conditioners or heat pumps in the HL&P service territory in order to achieve these goals.

The basic marketing technique is direct mail. However, total response rate is greatly improved with the use of "layered" marketing. Layering is the use of several media resources and/or messages at one time. HL&P has been successful using direct mail, radio, newspaper, and special promotions all at the same time. Throughout the year the following marketing promotions are implemented to target as many potential customers as possible:

- * Direct mail
- * Radio
- * Newspaper (City-wide & neighborhood)
- * Special promotions (discount coupons)
- * Telemarketing
- * Trade shows

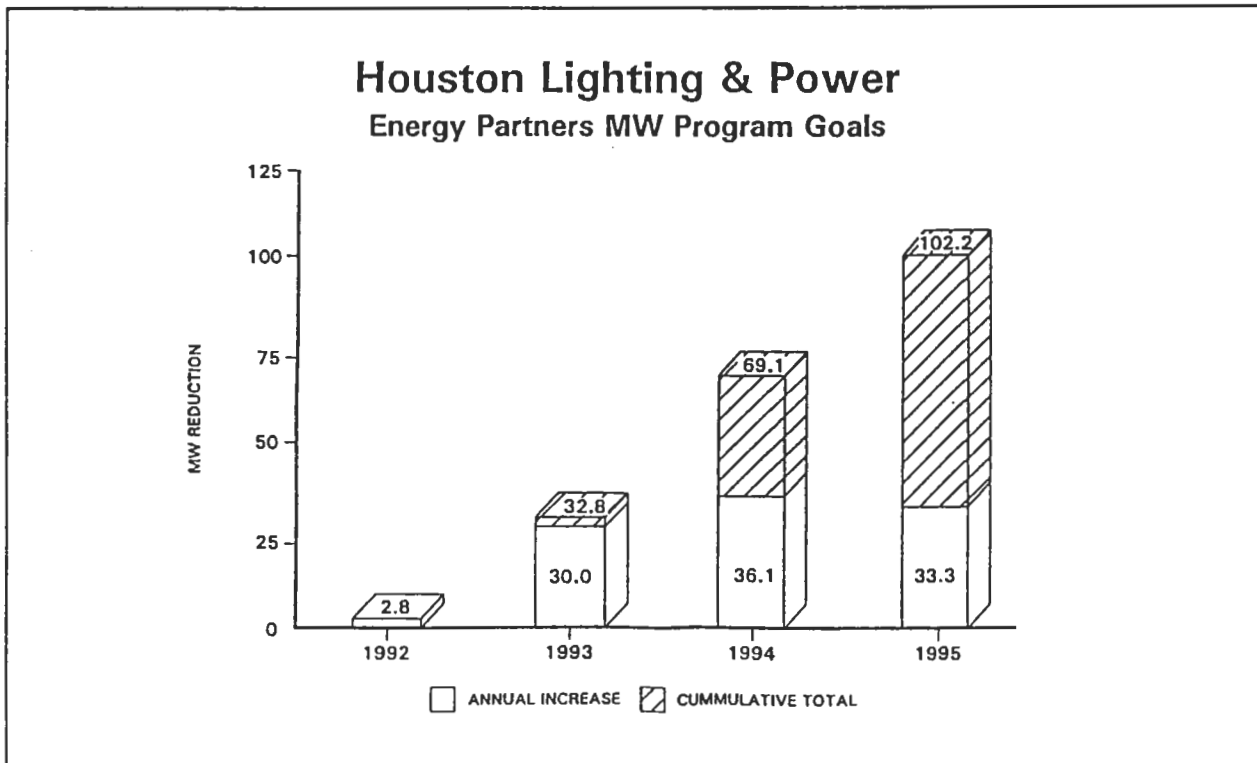


Figure 3 Energy Partners MW Program Goals

- * Participant newsletters
- * A/C contractor organization participation
- * Presentations to community organizations
- * Internal HL&P presentations

at a maximum 50% cycling rate, "off" for 15 minutes and "on" for 15 minutes. Other administrative constraints placed on the program in 1993 were a four hour per day maximum cycling time, and a limit of sixty hours total cycling within the four summer month period. These constraints will be modified for 1994 based on customer satisfaction survey results and system load considerations. Additionally, HL&P has retained the right to conduct a total load shed in the event of system emergency.

CURRENT OPERATIONS

The basic requirements for program participation are a single family home with a central air conditioner or heat pump in good working order, and, if the customer is renting, a landlord permission form must be signed. Participating customers will be cycled only during the four summer months of June through September. Cycling will occur on weekdays only, excluding holidays, between 12 noon and 8 PM. Initially, HL&P cycled

The Load Management Control System involves the installation of a remotely controlled switch on the air conditioner or heat pump of a participating residential customer. The load control switch is mounted directly to the outside condensing unit of a participant's central air conditioner or heat pump. The

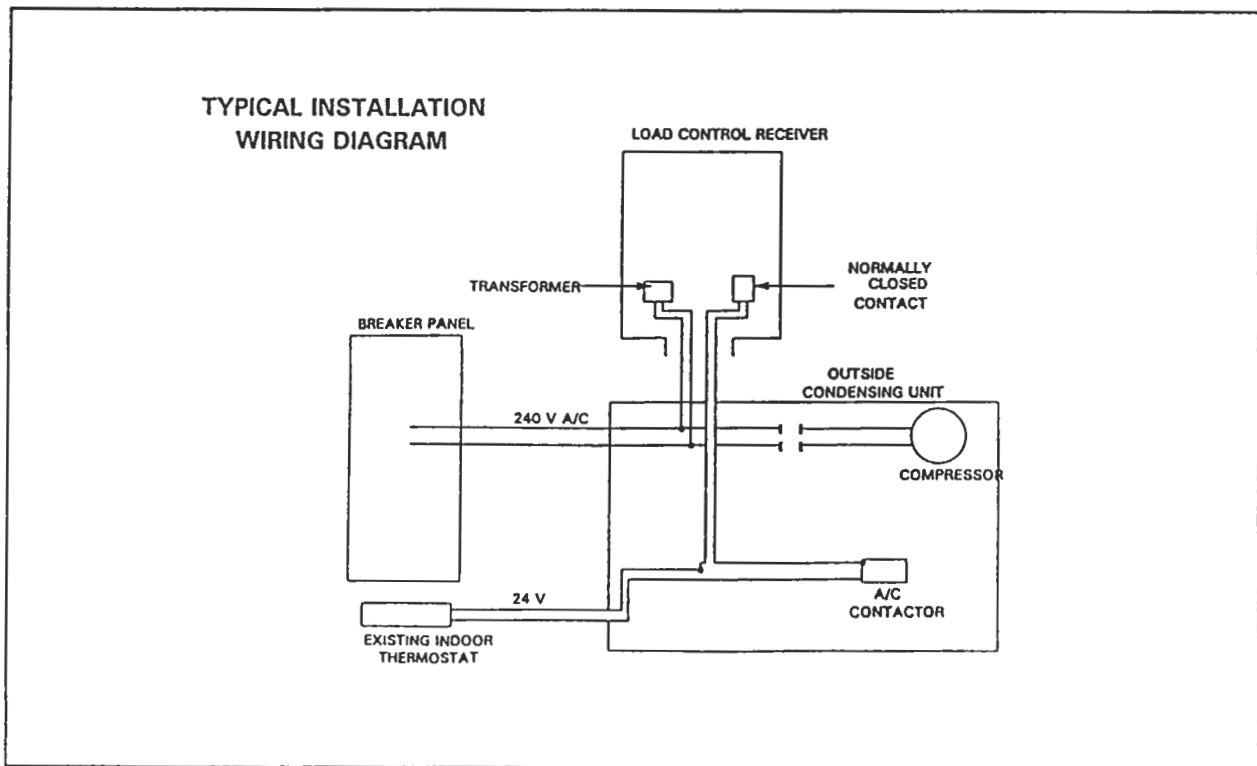


Figure 4 Typical Installation Wiring Diagram

control switch is not utilized on window units or gas air conditioning units. The installation requires the insertion of a normally-closed relay contact, located inside the switch, into the existing 24 volt thermostat circuit. An additional connection is made to the 240 volt compressor circuit to power the control switch (See Figure 4). The regulating jurisdictions in the Houston area all agreed that this work can be performed under a state issued HVAC license, thus eliminating the need for individual site permits.

A radio signal, operating on an FCC allocated frequency, is transmitted via HL&P's existing pager system to initiate load control. The switch, upon receiving the radio signal will typically cycle the unit "off" for up to 15 minutes out of a 30 minute period. With several thousand customers being cycled "off" at different intervals, the system will provide a continuous load reduction. The participant, as compensation for any inconvenience or reduction in comfort level, receives a monthly bill credit of 8 dollars for each of the four summer months that the program is utilized to provide load relief.

The computer software that is employed to transmit the radio signals can be pre-programmed to shed load in discreet increments and at specified time intervals. The software can also be configured to initiate control based on a variety of control variables such as time,

temperature, demand level, or by remote supervisory control. The equipment provides the flexibility of changing "on-line" the cycle "off" time to different levels or of conducting a continuous load shed ("off" for 30 minutes out of 30 minutes) in the event of a system emergency. The Load Management System equipment is integrated into HL&P's Energy Control operations.

When load control is initiated, a FM one-way radio signal is transmitted to the control switch. The radio signal uses a frequency that is licensed exclusively to HL&P. The radio signal will not interfere with the operation of TV's, radios, or other home appliances such as automatic garage door openers. The switch responds by opening the normally-closed contact, installed in the thermostat circuit, for anywhere from 7.5 minutes to 15 minutes out of a 30 minute period. Additionally, a red LED located on the face of the switch energizes to indicate that the system is being controlled remotely by HL&P.

During the remainder of the 30 minute control period the air conditioner is allowed to run as normally required by the thermostat setting. The switch only controls the outside compressor circuit, the inside air handler is allowed to run if the thermostat is calling for cooling. Thus the fan on the system will continue to operate, blowing already cooled air throughout the home. The customer may not even be aware that the compressor is being remotely

cycled.

LOOKING AHEAD

Energy Partners has become an important and significant part of HL&P's Integrated Resource Plan and Demand Side Management process. Additionally, it is currently enjoying a high level of customer satisfaction, as well as successful program implementation and ongoing operations. However, continuous improvement has become a way of life at HL&P's Energy Partners program. Projects are currently underway to improve customer acceptance, database management, and equipment performance. We know that no matter how successful or large the program becomes, we will never complete the improvement process now underway.