USING CONJOINT ANALYSIS TO EVALUATE VARIATIONS IN PROGRAM DESIGN

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One of the most challenging tasks facing utilities is predicting customer acceptance of new programs. Furthermore, the uncertainties surrounding acceptance issues make it difficult to determine the best design for a particular demand-side program. Sophisticated research techniques are being adopted by utilities to examine how variations in program design may alter customer response. This paper will describe a recent application of conjoint analysis for evaluating this linkage between program design and customer acceptance.

The Consolidated Edison Company of New York, Inc. (Con Edison) wanted to evaluate the viability of a direct load control program for residential air conditioners. In addition, the company wanted to quantify which elements of the proposed program were most attractive to its customers. Conjoint analysis was used to examine the relative value of variations in incentive level, length of load interruption, frequency of interruption, and other program attributes. By establishing a common measure of value for these attributes, this methodology called Con Edison to "trade off" one program element against another. In this way, it was able to study (for example) how much an increase in interruption duration would "cost" in terms of incentive levels or participation levels. This enabled Con Edison to refine its program design to better meet its participation, cost, and reliability objectives.

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PURPOSE

Market research can be used to accomplish a variety of tasks, ranging from characterizing overall markets to evaluating satisfaction with a particular program or service. This paper describes a research approach which enables program planners to evaluate in detail how variations in the design of a single program may affect customer acceptance. A case study in the use of this approach, conjoint analysis, is presented to illustrate how this pre-program survey methodology can be applied to a specific program design problem, and how the findings can be used to developed both a program design and marketing strategy.

BACKGROUND

The Consolidated Edison Company of New York, Inc., (Con Edison) like many summer peaking utilities nationwide, is seeking ways to reduce electrical usage during hot, summer peak afternoons. One of the options under investigation is direct load control of residential room air conditioners. Con Edison selected this demand-side strategy for pilot testing because of the high saturation of residential room units in its territory and because the company desired to manage system loads on the most critical peak days of the year.

However, Con Edison also viewed this type of program as something of an unknown since the company had never before undertaken a direct control program. Consequently, customer acceptance was a key concern. Would customers participate in a program which curtailed operation of their air conditioners? And, if they would, what were the necessary program features which would lead to their participation?

Con Edison decided to undertake a market research study to ascertain whether or not a residential direct load control program was a viable demand-side management (DSM) option (viable in terms of market acceptance). Further, this study was designed to investigate:

- customer acceptance levels as a function of alternative marketing and load control strategies
- the size, location and characteristics of relevant customer segments
- the economic and behavioral barriers that may affect acceptance of a load control program.

STUDY DESIGN AND APPROACH

This study was initiated to evaluate the importance of rebate level, frequency of load control interruptions, and duration of interruption on customer acceptance. This was to be accomplished through a survey of 600 residential customers, 100 from each district served by Con Edison. Prior to initiation of the survey, two focus groups were held with customers to identify and discuss topics pertinent to the survey. These focus groups indicated that:

- Few customers understood the nature of the peak supply problem and, therefore, most customers perceived conservation activities in all time periods to be of equal value.
- Despite the fact that many households were unoccupied during the day, significant daytime air conditioner use existed, particularly on the peak days of summer.
- Air conditioner use was driven more by comfort considerations than economics and customers would probably not be persuaded to participate by "low" rebates of less than $100.
- Some customers felt very strongly that a direct load control program must allow customers the option to override the interruption at least once during the season. Without an override option these customers felt that such a program was undesirable.
- Overall, there clearly were customers interested in the idea of a load control incentive program. Participation motivations seemed split between the desire for the economic incentive and a sense of civic responsibility.

The comments of the focus group participants influenced the design of the survey in a number of ways. First, it was decided that it was critical to clearly explain the rationale for a direct load control program as well as provide a succinct description of the program concept. Comprehension of the program became a major concern for the study. The second outcome of the focus groups was the decision to alter the research design to examine the importance of an override option as well as the perceived fairness of the program. Third, the levels of the program attributes tested in the study (i.e., frequency of interruption or amount of incentive) reflected the opinions expressed in the focus groups.

The survey was designed such that it tested how much value customers placed on five program attributes:

- the number of times per summer that the air conditioner would be interrupted (2, 5, or 10 times)

- the length of the individual interruption (one half hour to 3 hours)
- the amount of remuneration offered ($50, $100, $150, or $250)
- the availability of one override opportunity
- the delivery mechanism of the load management device (i.e., picked up by the customer or mailed to his or her home).

The study was conducted using a telephone-mail-telephone approach. An initial call was used to screen customers for participation. A lock box was then mailed to them containing a generic description of the load management program, a picture of the load management device involved, and a set of 16 cards containing descriptions of different programs. One week after mailing, the home was called again and the survey conducted. At that time, respondents were asked to read the program concept statement and to rate all sixteen programs on a scale ranging from "definitely will participate" to "definitely will not participate." Additional questions on air conditioner use, demographics and program-related issues were also asked.

ANALYSIS

Conjoint analysis was used to analyze customer responses to variations in program design. This technique examined an individual's rankings of all 16 programs and derived from this a measure of value for the different characteristics tested. For example, the relative importance of a change in rebate level could be compared with the importance of changing the length of an interruption in service. A common measure of value - a utility score - was established for each program for that individual. In addition, "part worth" values, or measures of the value of each level of each program component, were calculated as well. As a result of this analysis, Con Edison was able to evaluate overall attractiveness of the programs tested as well as the attractiveness of each of the specific program attributes to its residential market.

The conjoint procedure used in this study relied on an ordinary least squares regression approach to assign part worth values to specific program components. The total utility or value of a program was then inferred from the part worth values. The procedure was calculated such that the overall rank order of the utility scores paralleled that of the rankings originally assigned by the respondent.

The conjoint design used in this study presented all five of the program attributes (rebate, frequency, duration, over-ride, and delivery) in every program profile tested. This full-profile approach is advantageous in that it more closely resembles the actual participation decision than do simpler approaches. Real participation decisions require customers to assess a package of program features and to base their decisions on that entire package. Conjoint analysis likewise forces the customer to evaluate program features in combination, rather than individually as ranking or rating questions allow, or pairwise as tradeoff matrices

allow. This difference makes conjoint analysis more realistic than these other market research methods, enabling better characterization of the trade-offs customers make in weighing one program element against another.

The conjoint approach used in this study was a powerful analytical approach for another reason as well. This method can interpolate partworths for levels of attributes between those directly tested in the survey. For example, not only were values assigned for the $50, $100, $150, $250 levels posed to respondents, but the value of $60 or $145 could be inferred as well. As a result, Con Edison was provided a method for examining hundreds of program configurations - not just the sixteen included in the survey design.

One drawback to conducting a complex study of this sort over the phone is the difficulty of ensuring the respondent's comprehension of the material. To address this concern, comprehension questions were embedded in the questionnaire to ascertain whether or not respondents understood the time of the peak period, the fact that the program was voluntary, and other factors. This provided a check on the responses received. However, it is worth bearing in mind that customers may be misinformed at the time that the participation decision is made, and that data from misinformed customers is thus not necessarily "invalid."

The results of the conjoint analysis were used as inputs to a market segmentation analysis. This analysis was conducted to determine whether distinct subpopulations existed in the residential market with regard to program preferences.

RESULTS OF THE STUDY

Program Viability

Peak usage of air conditioning as well as program acceptance were examined. The survey established that most homes with room unit air conditioning had 1 or 2 units (average = 1.8 units per home). On peak days, which the survey defined as the "hottest, most uncomfortable days," 53.9% of households reported running an air conditioner. The data thus showed that there was ample use occurring during the afternoon period to target for a direct load control program. The data also indicated a good level of customer acceptance for such a potential program. In total, 62% of the respondents indicated they would definitely participate in at least one of the 16 programs tested, and another 24% said that they would probably participate in one or more programs. This suggested that a substantial proportion of Con Ed's eligible customers would be receptive to a load control program should the company offer one. Having determined that a significant market existed for a load control program of some sort, the effects of program design variations were examined in detail.

Program Design Impacts

As expected, customer acceptance was found to vary considerably according to the attributes of the specific program under consideration, and no single

program design gained acceptance levels near those for the general concept of a load control program. The proportion of respondents indicating that they would "definitely participate" ranged from 6.3% to 30.1% across the sixteen programs tested, a very substantial range. Understandably, Con Edison desired an explanation for this degree of variation. Through the conjoint analysis, it was possible to identify which program elements had the greatest influence on customer decisions. It was found that, overall, the length of each interruption in service was the most important consideration, followed closely by incentive level, and then by the number of interruptions. The availability of an override option and the means of distributing the load control device were less important for the population as a whole.

The conjoint analysis not only measured the importance of program attributes overall, but also measured the importance of each specific level of each attribute. Importance for each attribute level was measured on a single scale, allowing for direct comparisons of the perceived values of dissimilar attributes. It was also possible to examine how the importance of a single program element, such as a rebate, varied as the level of that attribute changed.

For example, as illustrated in Figure 1 the shorter the interruption in air conditioner use, the more valuable the program - from the customer's perspective. In terms of the length of interruptions, a 1-hour interruption had a value of 0.75 units (sometimes called "utiles"), compared with 0.28 utiles for a 2-hour interruption, and 0.0 for a 3-hour interruption. Another way of stating this is that the customer perceived greater value (almost twice as much) when the interruption dropped from 2 hours to 1 hour as compared to changing from 3 hours to 2.

Not surprisingly, programs with fewer interruptions were more highly valued than programs with more interruptions. Again this relationship was not precisely linear as is shown in Figure 2. There was a greater loss in value for each additional interruption between 2 and 5 incidents than for incremental interruptions between 5 and 10 incidents. Similar analyses of the other program elements showed a diminishing marginal utility per dollar of incentive above $100 and also showed virtually no value associated with either type of delivery mechanism, while offering a single override option increased the value of a program to the customer.

If Con Edison were to implement a load control program aimed at the entire population of residents with air conditioners, then, the data suggest that the company could maximize program participation by minimizing the length and frequency of service interruptions as well as by maximizing the amount of rebate offered. However, such a strategy would clearly reduce the cost-effectiveness of a direct load control program. The data also indicated that acceptable levels of participation were achievable either through a program with relatively short interruptions and low incentives or longer interruptions and higher incentives. In other words, Con Edison had a choice of viable program options. To help refine the strategy selection process, a segmentation analysis was conducted to ascertain whether there were segments of this market whose program design

Figure 1
PERCEIVED VALUE OF ATTRIBUTE LEVELS:
LENGTH OF INTERRUPTION

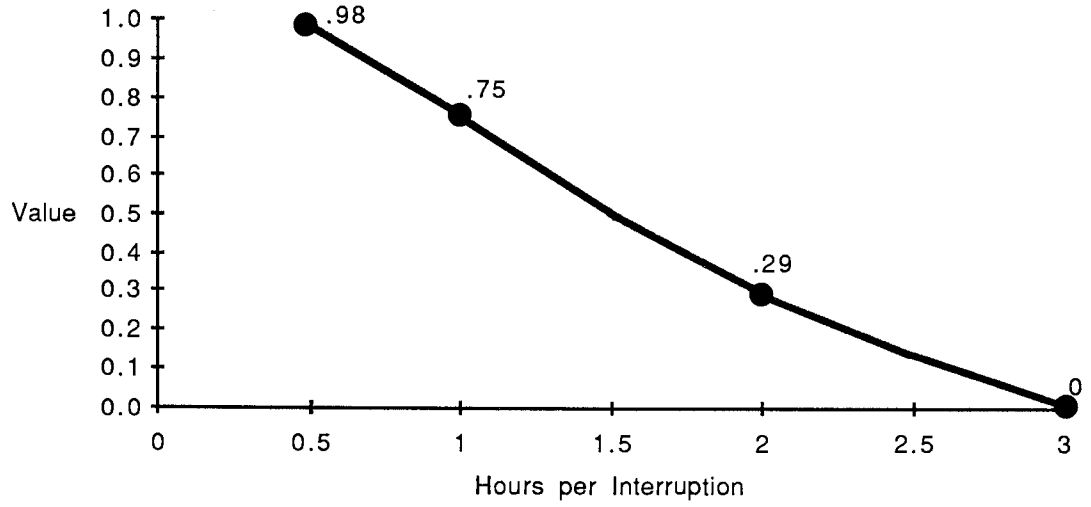
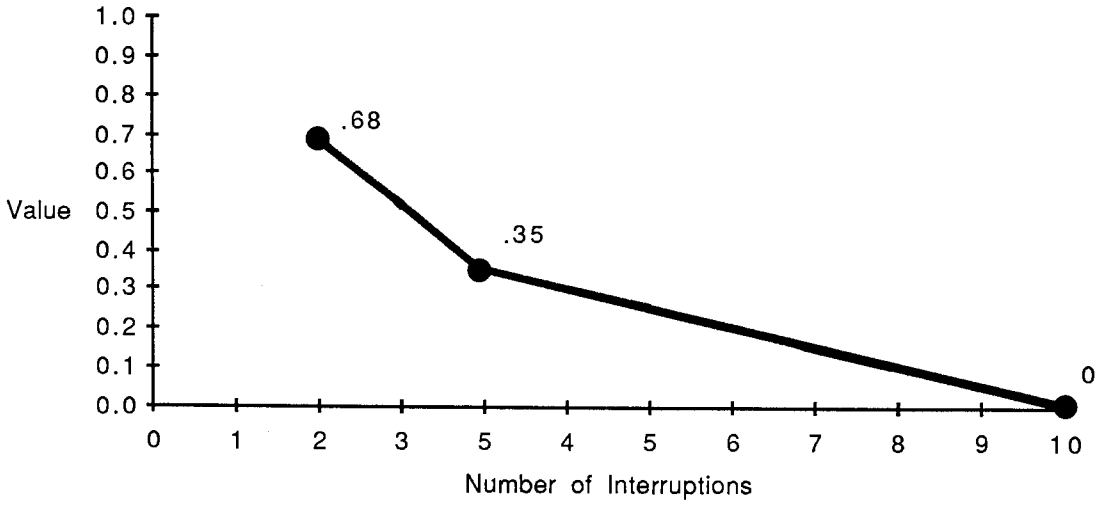


Figure 2
PERCEIVED VALUE OF ATTRIBUTE
LEVELS: NUMBER OF INTERRUPTIONS



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preferences were more favorable to Con Edison, i.e., to identify target markets (and strategies) for the program.

Market Segments

Three distinct market segments were identified on the basis of their preferences for the various program attributes. Accordingly, these three segments were labeled the "Override-sensitive segment," the "Duration-sensitive segment," and the "Frequency-sensitive segment," respectively. The largest of these segments was the Duration-sensitive segment which represented 42.2% of the market. The Override-sensitive segment accounted for 36.4% of customers and the Frequency-sensitive for 21.1%. Figure 3 illustrates the relative importance of various program attributes for each segment. Further description of the three segments is provided below.

As this figure shows, the Override-sensitive segment placed the greatest value on the availability of an override option followed by size of the incentive. This group thus differed substantially from the norm in placing a great deal of emphasis on an attribute which, on average, received less attention from most customers.

This group exhibited some other attitudinal differences which set it apart from other customers. Override-sensitive customers placed less emphasis on general energy-related issues and they were less likely to feel that it is important for them to do more to save energy. Despite this apparent barrier, this segment on average had the highest likelihood of participating in a load control program and thus is a key target market. This higher likelihood of participating seemed to be related to their perception that the program was fair, as Override-sensitive customers were significantly more likely than others to believe that a load control program was fair to both participants and nonparticipants.

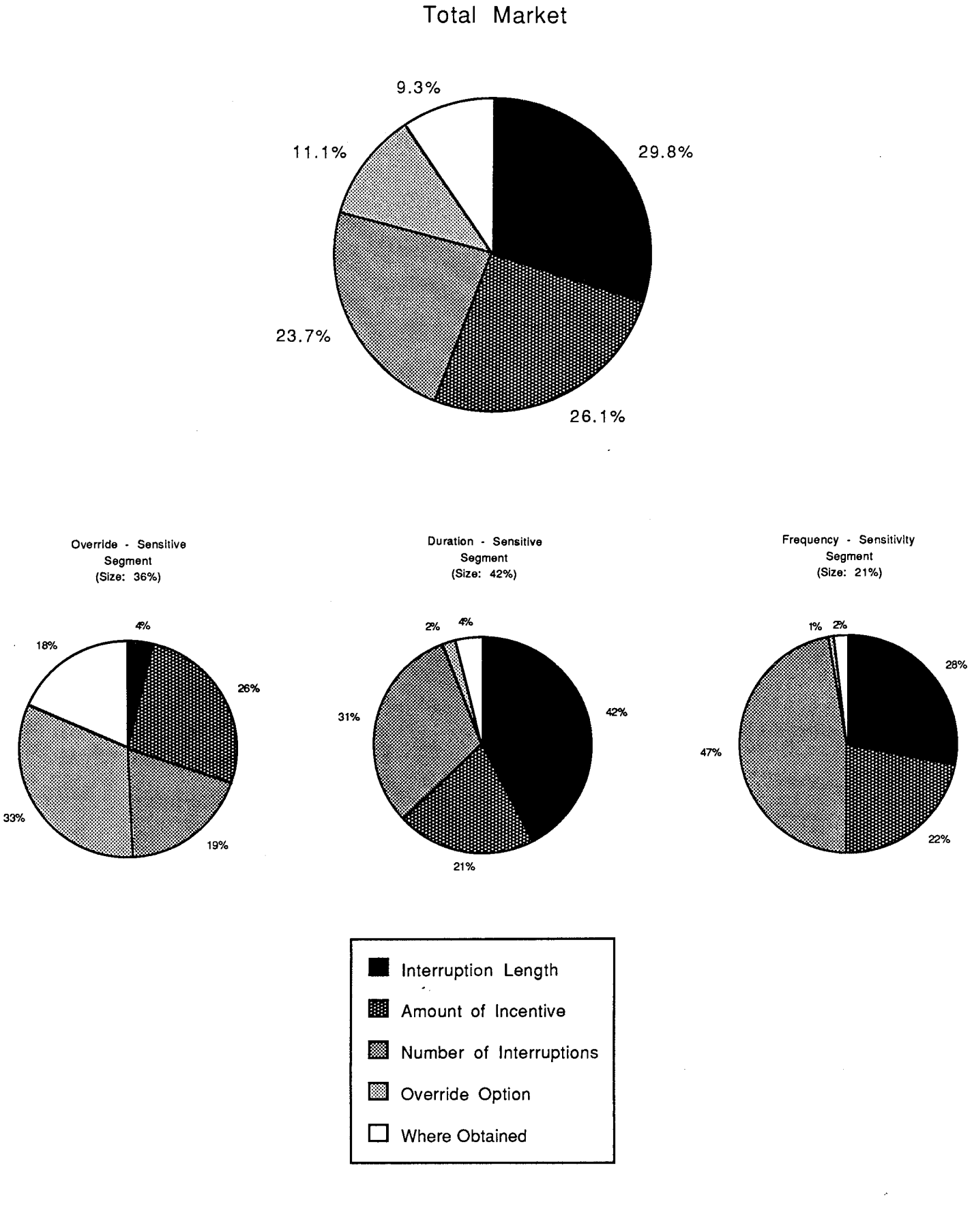
The Duration-Sensitive Segment, the largest of the segments, was most concerned with the length of each interruption and the number of interruptions over the course of the summer. The attribute of next greatest concern was the size of the incentive. In these preferences, the Duration-sensitive segment was closest to the norm for the total residential market.

The Duration-sensitive segment was somewhat less likely than the Override-sensitive segment to participate in any load control program. The Duration-sensitive customers were also less likely than those in the Override-sensitive segment to feel that the program is fair. However, they were more likely than the third segment - Frequency-sensitive customers - to participate and were therefore recommended for targeting.

The last segment, the Frequency-sensitive segment, ascribed the greatest importance to the number of interruptions, followed by the length of the interruption and the size of the incentive. Although these customers were innovators who exhibited greater likelihood of trying new products and services,

Figure 3

IMPORTANCE OF PROGRAM ATTRIBUTES



they were least likely to feel that the program was fair and least likely to participate.

RECOMMENDATIONS RESULTING FROM THE STUDY

This survey of residential customers of Con Ed who have and use room air conditioners indicated sufficient interest in a direct control incentive program to warrant a pilot/test program. The market research results showed that the program should be designed to appeal to the two preference segments of most importance: the Duration-sensitive and Override-sensitive customers. The results thus indicated that special emphasis should be placed on short interruptions and on providing an override option. Rebate levels also need to be evaluated carefully to ensure that they are sufficient to elicit the desired levels of participation. However, it appears that Con Edison may be able to exercise greater flexibility in the frequency of interruptions as this element of the program's design is of less concern to the target markets identified.

STATUS OF CON EDISON'S PROGRAM

At this writing, Con Edison is preparing a limited pilot test of direct load control of residential air conditioning for the summer of 1988. Now that the market potential for the program has been examined, the technical viability of the program and the load management equipment will be studied. The 1988 pilot program will be limited to employees of the company. At the end of the summer, the results of this pilot program will be weighed along with the findings of this market research to determine whether or not to proceed to a full-scale program for 1989. Con Edison will then examine the general recommendations from the market research in greater detail using a market penetration model based on the conjoint results. Alternative program designs will be examined in a "what if" fashion to screen for those program designs offering the most promise for meeting Con Edison's objectives.