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CONSUMERS WITHOUT A DIRECT ECONOMIC INCENTIVE TO CONSERVE ENERGY

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ABSTRACT

Individuals living in master-metered dwellings consume more electricity than their counterparts living in single-metered dwellings. Part of the reason is that individuals in master-metered dwellings do not have a direct economic incentive to conserve energy. A sample of master-metered and single-metered individuals is examined to provide some guidance in formulating appeals to achieve energy conservation.

INTRODUCTION

Energy problems continue to plague the United States. In an attempt to mitigate these problems considerable effort has been expended examining technological solutions and in exploration for new supplies of fuel tied to existing technology. However, in this quest for technological/exploration solutions to solve problems, conservation and more efficient use of our existing energy resources have received less attention. The potential is there. One source estimates that the United States could consume 30 to 40 per cent less energy and still enjoy the same standard of living [1].

Research on ways of achieving energy conservation among households falls into four main categories [2]. First, individuals can be given a monetary incentive for achieving some energy conservation goal. Second, individuals can be given feedback on the amount of energy they consumed to help them modify their future consumption. Third, information can be provided to

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individuals about specific actions that will save energy. Finally, prompts (or 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 the different approaches have explicitly assumed that the individual (or household) has a direct economic incentive to conserve. This is generally the case. However, it ignores an important segment of the energy consuming public, those living in master-metered dwellings.

Individuals living in mastered-metered dwellings use 35 per cent more electricity than individuals living in comparable single-metered dwellings [3]. The reasons behind the higher consumption are rather obvious. Individuals living in single-metered dwellings are directly accountable for all the electricity they consume. They receive periodic bills which rise, rise less, or fall depending on the amount of electricity consumed. Thus, individuals living in single-metered dwellings have a direct economic incentive to be judicious in their consumption of electricity. On the other hand, individuals living in master-metered dwellings do not pay for their electricity directly, it is included in their rent payments. Without the feedback provided by a utility bill, master-metered individuals are unaware of how their activities influence the amount of electricity consumed. Further, they have no direct incentive to conserve electricity since it is only through the combined behavior of all residents that a perceptible reduction can be achieved. Also, even if their combined efforts achieve a reduction in the amount of electricity consumed, there is no assurance that the landlord will pass the savings on.

The role of an economic incentive is underscored by instances where multiple-unit dwellings have been converted from master-metering to single-metering. In a study of three conversions, each apartment building consumed an average of 40 per cent less electricity after conversion [4]. A similar drop in consumption (45%) was observed in a study conducted on the west coast [5]. These studies pose the obvious question, why not convert all master-metered dwellings? The major drawback is that the cost of retrofitting existing master-metered dwellings can exceed the potential savings [6]. Thus, the landlord has no incentive to change the metering systems. Obviously, society in general would be better off if the scarce energy resources needed to generate the additional electricity were conserved. However, unless those involved in the process can be persuaded to comply the disparity will persist.

Thus, in the absence of a direct economic incentive as the appeal or implicitly underlying the appeal, some other approach must be used. Any strategy must begin with some knowledge of these individuals. This involves identifying the wasteful behaviors practiced by individuals living in master-metered dwellings. It also entails finding out what these individuals are like in terms of readily identifiable characteristics. The basic premise is that an effective influence strategy must identify how master-metered individuals differ. This article

provides some insight into the problem by looking at a sample of individuals in a single utility's service territory and examining the characteristics of individuals depending on whether they live in single-metered or master-metered dwellings.[1]

METHOD

Respondents

A questionnaire dealing with energy conservation was mailed to 1,000 members of Market Facts' consumer panel in the New York metropolitan area. The panel was balanced according to: annual household income, population density, age, and geographic region. As a condition for panel membership all respondents had to complete an initial questionnaire. This provided additional information on each respondent. Usable questionnaires were returned by 700 for an overall response rate of 70 per cent. In keeping with normal practice individuals who responded were sent a small gift for their compliance. Respondents were split into two groups; single-metered and master-metered. There were 556 single-metered respondents and 124 master-metered respondents. Twenty respondents failed to indicate their metering status.

Analysis

Multiple discriminant analysis was used to determine how the two groups of individuals differed. Individuals were first categorized into two mutually exclusive groups, single-metered households and master-metered households. Then a linear discriminant functions was calculated in the following general form:

$$Z_i = b_o + b_1 X_{1i} + b_2 X_{2i} \ldots + b_n X_{ni}$$

where Z_i is an individual's discriminant score, the b's are weighting functions and the X's the standardized values of the n discriminating variables incorporated in the analysis.

Two types of variables were used as predictors in the discriminant analysis, demographic variables and attitudinal. The demographic variables provide an indication of what the individuals are like in terms of readily identifiable characteristics. The attitudinal variables suggest how individuals differ in terms of how they feel about energy consumption and conservation.

Demographic Variables—A number of studies have found demographic variables to be important predictors of energy consumption or conservation

[1]The problem of master-metering has been looked at in terms of group-contingencies [7] and pro-rated pass-throughs [8]. These approaches have met with some success, but they do not provide any insight into the characteristics of the individuals.

behavior [9, 10]. Demographic variables most consistently related to energy related behavior are: age, income and education. In addition to these three variables, the respondent's marital status, race, and family size were included. Certain aspects pertaining to the physical aspects of the dwelling were also included. These were dwelling type, size of dwelling, number of air conditioners and number of air conditioners per room.

Attitudes—A limited set of attitudinal variables were included in the discriminant analysis. Three of the variables tapped the conative dimension of an attitude. These focused on three energy wasting practices, not turning the lights off when leaving a room, leaving the television on when no one is watching, and leaving the air conditioner running when no one is at home. A fourth variable reflected belief about what the average citizen can do to conserve electricity. The fifth attitudinal variable had to do with a respondent's belief about their energy consumption relative to their neighbors'. All attitudinal measures were on a five-point scale, ranging from strongly agree to strongly disagree.

RESULTS

The overall discriminant function was highly significant (chi-square 95.23, $df = 15$, $p < .001$) indicating that there are substantial differences between individuals living in single-metered and master-metered dwellings (see Tables 1 and 2). Demographic characteristics are not very important in discriminating between single-metered and master-metered individuals. Only marital status and family size were significant. People living in master-metered dwellings are more likely to be non-married (single, widowed, divorced or separated). These individuals tend to have smaller families, however, the difference between the two groups is smaller than would be expected (.3) given that there is no spouse. Consequently, master-metered individuals have more children in the family (.7 more than single metered).

Characteristics of the dwelling are important in discriminating between the two groups. As would be expected master-metered individuals are much more likely to inhabit multiple-family dwelling units. Also not surprisingly master-metered dwellings tend to have fewer rooms (1.5 fewer). Interestingly there is no difference in the number of air conditioners each group owns, but there is a significant difference in the number of air conditioners per room.

Attitudes play a major role in discriminating between the two groups of individuals. For the more general attitudinal statements reflecting beliefs about energy consumption, the results are somewhat curious. People living in master-metered dwelling believe they use less electricity than people living in comparable single-metered dwellings. However, this belief may be true, if neighbor is defined narrowly enough. People living in master-metered dwellings were more likely to feel that the average citizen could do something to save electricity.

Table 1. Characteristics of Single-Metered and Master-Metered Individuals

Variable	*Single-Metered*	*Master-Metered*
Marital Status (percent married)	79%	67%
Income	17,399	16,365
Age	44	46
Education	High School plus	High School plus
Race (percent white)	92%	88%
Family size	3.0	2.7
Dwelling type (percent multi-family)	38%	98%
Dwelling size (number of rooms)	5.9	4.4
Number of Air Conditioners	2.1	2.1
Number of Air Conditioners per room	.38	.51
There is not much the average citizen can do to save electricity[a]	1.9	1.6
I use less electricity than my neighbors[a]	3.2	3.5
I turn lights off when leaving a room[a]	4.2	3.5
I leave the television on even though I am not in the room to watch it[a]	2.2	2.8
I leave the air conditioner running when no one is at home[a]	1.3	1.8

[a] Scaled, strongly agree = 5 to strongly disagree = 1

Attitudinal variables reflecting the conative component of attitudes were also important in discriminating between the two groups. These variables also provide some insight into the practices responsible for the higher consumption among master-metered individuals. Specifically, individuals living in master-metered dwellings are less likely to turn the lights off when leaving a room, more likely to leave the television on when no one is watching it and more likely to leave the air conditioner running when one is home.

The result of the classification analysis (see Table 3) provide a further indication of the usefulness of the discriminant function. In this analysis the coefficients (unstandardize b's) are used along with the observed values for each individual on the different variables (X's) to develop a discriminant score (Z_i). Based on the discriminant score an individual is predicted to be in either the master-metered group or the single-metered group. Of the 566 actual single-metered individuals 75 per cent were correctly classified as such. Of the 124 actual master-metered individuals, 72 per cent were correctly classified. This suggests that the variables in the discriminant function are very useful in distinguishing between the two groups of individuals.

Table 2. Standardized Canonical Discriminant Function Coefficients and Univariate F-Ratios

Variable	*Coefficients*	*Univarite F's*
Marital Status	-.01	3.75[a]
Income	-.08	< 1
Age	.22	1.65
Education	.05	< 1
Race	-.07	< 1
Family Size	.13	3.96[a]
Dwelling Type	.36	25.74[c]
Number of Rooms	-.30	29.49[c]
Number of Air Conditioners	-.15	< 1
Number of Air Conditioners Per Room	.35	11.60[c]
Average Citizen[d]	-.42	6.06[b]
Use Less[d]	.31	5.43[a]
Lights[d]	-.38	16.84[c]
Television[d]	.31	12.96[c]
Air conditioner[d]	.34	14.55[c]

Canonical Correlation .49[c] Wilks' Lambda .76[c]
Chi-Squared 95.23, d.f. = 15

[a] $p < .05$
[b] $p < .01$
[c] $p < .001$
[d] See Table 1 for a full description of the variable

DISCUSSION

Individuals living in master-metered dwellings consume on the average 35 per cent more electricity than individuals living in comparable single-metered dwellings. The main reason for the higher consumption appears to be the lack of a 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 are confronted with an incentive to use less electricity, they reduce their consumption by 30 to 40 per cent [4, 5]. However, given that in many instances the cost of retrofitting existing master-metered dwellings exceeds the potential savings, we are left with a group of individuals that consume disproportionately more electricity and has little if any reason to conserve.

Table 3. Classification Results: Percent Correctly Classified

	Predicted Group	
Actual Group	*Single-metered*	*Master-metered*
Single-metered[a]	75	25
Master-metered[b]	28	72

[a] n = 566
[b] n = 124

Apart from the obvious fact that master-metered individuals are more likely to live in multi-family dwellings units there are few demographic differences between the two groups of individuals. There are no significant differences with regard to age, income, education and race. Master-metered individuals are more likely to be non-married and have slightly smaller families. Both groups have equal numbers of air conditioners, but relative to their dwelling size, master-metered individuals have more units. Thus, even though master-metered individuals have smaller families, fewer rooms and the same number of air conditioners, they use more electricity.

Insight into why they use more electricity is provided by the attitudinal variables. Master-metered individuals are significantly more likely to engage in energy wasting behaviors. Specifically, they are more likely to leave the lights, television and air conditioner on when no one is directly using them. Consequently, this group is an important target for programs aimed at influencing consumption. While individuals living in single-metered dwellings should not be ignored, the price mechanism functions normally, providing feedback on consumption and more importantly a direct economic incentive to conserve.

Based on experience with conversions, it is clear that the potential for conservation is there among individuals living in master-metered dwellings. However, in the absence of a direct economic incentive to conserve electricity, some other means of effecting conservation must be devised. As master-metered individuals live in defined residence, they are relatively easy to reach with persuasive message. Also, compared to individuals living in single-metered residences they are more likely to engage in certain energy wasting behaviors. These behaviors provide the focus for persuasive message aimed at reducing consumption. While no substitute for a direct economic incentive, conservation information can be instrumental in helping reduce the amount of energy consumed (see references [11-13] for examples of such approaches). Further, these individuals have a belief that facilitates persuasion, i.e. that there is something that the average citizen can do.

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