The Detroit Edison Low-Income Customer Service Program: Effective Methods to Reduce High Non-Heating Electric Use

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In July 1991, the Detroit Edison Company set out to develop programs to help its low-income customers reduce their electric use and manage their electric bills. The company's approach involved extensive use of market research, as well as the development, implementation, and evaluation of pilot and full-scale efforts based on that research. The final evaluation of these programs, completed in October 1993, showed that they had been very effective in helping participants reduce their electric usage and that some participants improved their patterns of bill payment after contact with the program. This paper briefly recounts the market research that supported the design of the programs, discusses the operations of the programs and customer response to them, and summarizes the results of the evaluation of program effects on participants' electric usage and bill payment patterns.

Introduction

In early 1991, management at Detroit Edison identified high electric use and high arrears among low-income customers as major problems for the company. While these problems were by no means new, the unfolding of the Michigan state budget process made action to address them particularly urgent. In the proposed budget income support grants to families who received Aid to Families with Dependent Children (AFDC) were to be decreased, as were categorical grants (CAP payments) available to AFDC recipients to pay electric bills.

The situation was further complicated by the operation of the Customer Positive Billing system or "positive billing." Under this system, the Department of Social Service (DSS) withholds a small portion of a recipient's monthly income grant and transfers it directly to that household's utility companies. Customers were responsible for paying the balance of their bills. However, Detroit Edison could not shut off service to customers enrolled in the program for delinquent payments. Officials at both Detroit Edison and the Department of Social Service believed that positive billing system contributed to high levels of use and nonpayment because it shielded participants from the consequences of such behavior. This view was reinforced by internal Detroit Edison analyses that indicated that positive billing customers constituted about 3% of all residential customers, but accounted for 29% of all residential arrears over 30 days. In view of the pending state budget cuts Detroit Edison sought to renegotiate its positive billing contract with DDS. The result of this change was that over 10,000 customers who had received grants and protection from shut-offs were removed from the program and suddenly needed to manage their energy use and bills on their own.

Detroit Edison responded to this situation in a number of ways. First, it hired a consultant to conduct a market study of low-income customers with the ultimate objective of identifying strategies to help such customers reduce their energy use and improve their payment record. The authors have served as consultants to Detroit Edison on this project from its inception. Our work was overseen by an Advisory Committee consisting if Edison staff, representatives of DSS and the Michigan Public Service Commission, and local housing and community activists. As a result of this process, two pilot initiatives were *fielded-Energy Options* offering intensive education, direct installation of low-cost energy conservation measures, replacement of inefficient refrigerators and a feedback and performance incentive and *Energy Fitness* offering direct installation of low cost measures delivered in a concentrated geographic area. Second, the company initiated the *Energy Management Program (EMP)* in the metropolitan Detroit area. Under EMP, Detroit Edison customer service representatives conduct visit the customer's home, conduct a brief analysis of energy consumption, offer suggestions on usage reduction, and establish a monthly payment plan based on the customer's estimated usage levels if reductions are realized. A small number of EMP participants *(EMP +) also* received low-cost measures. The EMP program was initiated in June 1991 and has served over 10,000 customers as of spring 1993.

Market Research Findings and Their Use in Program Design

Objectives and Research Activities

The objectives of the market research were to:

- assess the extent and nature of the problems of high use and high arrearages among low-income customers;
- identify technical opportunities to reduce electric usage through installation of measures and implementation of energy efficiency behaviors; and,
- develop detailed plans for a pilot program that incorporated the findings of the research.

Most of the information for the market research came from an in-home survey of 391 low-income customers. The survey was designed to provide information on:

- opportunities to reduce electric usage through installation of measures and curtailment of discretionary uses;
- customers' awareness of electric usage and its relation to electric bills;
- customers' energy use habits and previous efforts to reduce usage;
- customers' interest in receiving energy-related services; and,
- basic demographic and housing characteristics.

Survey information was merged with extracts from customer records that contained information on annual usage and arrearages to support the analysis of factors associated with various levels of usage and arrearages. The survey was carried out in July and August of 1991.

Sampling

One challenge common to market research on low-income customers is to develop a representative sample. Current and some former positive billing customers were flagged in the Customer Information System (CIS); there were no flags for any other categories of low-income customers. Positive billing customers constituted only 25% of Detroit Edison's low-income customers in 1991, and they were by no means representative of the larger population. As AFDC recipients, they were exclusively families with children, most with a single parent. Families with young children typically make up roughly one-third of low-income households, with elderly one- and two-person households making up another third.

We used a cluster sampling approach to develop a representative sample, with ZIP Codes as the primary sampling unit. In the first stage, ZIP Codes within each of the four retail divisions were selected based on their characterization along a number of variables:

- number of positive billing customers residing in the ZIP Code (a proxy for number of low-income customers);
- percent of households black, according to the 1980 Census[1];
- percent of households of Spanish Origin; and,
- percentage of dwelling units in multifamily structures.

In the second stage of sample development, we made a random selection of positive billing customers within each selected zip code. We identified low-income customers who were not positive billing customers by enumerating several blocks in areas marked by concentrations of positive billing customers and screening all households they contained for sample eligibility.

Key Market Research Findings

Dimensions of the Problem. Table 1 shows estimates of the prevalence of various indicators of problems with high use and arrears among low-income customers. These estimates were prepared using a variety of sources, including the customer records, the results of the survey, and Census Data.

For the United States as a whole, while low income families consume less energy than the non-poor, they expend more per square foot and as a percentage of income than non-poor families. Low-income families consume 22 percent less energy and pay 25 percent less on utilities than the non-poor but use 20 percent more energy per square foot of living space. Low-income families also spend about 25 percent of their income for energy compared to 7 percent for the non-poor (Vine and Reyes, 1987).

Association of usage level with payment problems. We used regression and partial F-tests to examine the strength of association between usage level and other household characteristics on one hand, and level of arrearages on the other. Table 2 summarizes the results of this analysis. As can be seen, annualized consumption in the previous 12 months explains by far the largest percentage of variation in arrears. No other variables of any prior

Table 2. Summary of Partial F-Test Results: Associations Between Usage and Arrears

	R^2	Change in R^2	Significance of Change	Significance of Coefficient
Annual kWh	.412	.412	.0000	.0000
Positive Billing	.425	.013	.0095	.0095
Family Income	.433	.008	.0438	.0438

Adjusted R^2 for the complete equation: .427. All coefficients had the expected signs.

The regression results are presented in the following equation with T-statistics in parentheses and all coefficients significant at $p < .05$:

$$ARR = 203.1 = 0.06\ kWh + 60.47\ POS - 0.01\ INC$$
$$(14.32) \quad (2.08) \quad (2.02)$$

where ARR = Account balance over 30 days in arrears in dollars.
kWh = 12 month electric use.
POS = 1 if on positive billing system/ 0 if not on positive billing
INC = Household income.

theoretical interest yielded significant increases to the explanatory value of the model. Moreover, the simple correlation coefficients between the independent variables were low. Results also indicate that status as a positive billing customer is associated with higher arrearage levels, even though the positive billing customer receives assistance with electric bills.

Several other studies conducted by the National Consumer Law Center support the existence of a direct correlation between usage and arrears. According to their 1988 study of payment plans done for the Maine Public Utilities Commission, "households having the highest usage tend to have the higher arrears." For one Maine utility, the average total arrears was $48. Households with annual consumption greater than 16,000 kWh had an average arrears of $88 compared to $10 for households with less than 5,000 kWh of use. Another study conducted for the Wisconsin Gas Company found that the interplay between consumption and income is associated with arrears (National Consumer Law Center, 1988).

Opportunities to lower discretionary use. Most of the usage reduction opportunities identified through the surveys involved reductions in discretionary uses: i.e., those that could be limited without unacceptable degradation of comfort and convenience. We observed significantly higher levels of the following discretionary uses among high-use customers than among other customers: second refrigerators, freezers, three or more televisions, and air conditioning. In addition, we found that 57% of high-use customers had five or more incandescent bulbs on three or more hours per day, versus 25.4% for low-use customers.

Opportunities to increase efficiency. Only 2% of Detroit Edison's customers have electric heat, and fewer than 10% have electric hot water. The latter figure is substantially lower in urban areas. We thus found that the major opportunity to increase efficiency was the replacement of primary refrigerators.

Quantification of savings opportunities. We calculated the total potential energy savings for each household in the sample by summing the savings estimates for the various measures and practices identified as applicable through the survey. The weighted average savings for lighting and reductions in discretionary uses were 402 kWh per year. For high use customers, the corresponding figure was 660 kWh. When disconnection and removal of second refrigerators and freezers were added to the mix, the weighted average annual savings for the sample was 870 kWh. The corresponding figure for high-use households was 1,488 kWh. We did not include savings from the replacement of primary refrigerators in this analysis because we could not identify the specific households to which this measure would apply.

Customer knowledge and attitudes towards energy efficiency. Not surprisingly, the survey found that customers had little knowledge of actions they could take to reduce energy usage. Most could name only one or two conservation practices; 20% could not name any. Moreover, very few reported interest in learning more. Among high-use customers, 40% reported that they would not be interested in participating in *any* program activity, including receiving education visits and installations of free materials.

Design of the Energy Options Pilot Program

The implications drawn from the market research were that any effective program would need to focus on high-use customers, contain a strong educational component to address discretionary uses, address the opportunities offered by second refrigerators and inefficient primary refrigerators, and offer some form of feedback to keep customers aware of their energy use behavior.

The Energy Options pilot was designed to offer the following services.

- *Intensive energy efficiency education.* A three-session sequence of in-home visits. The objectives of the service were to help participants: understand how they use electricity; formulate an energy conservation plan; and establish a commitment to carry out the plan.

- *Direct installation of low-cost electric conservation measures.* Replacement of incandescent with screw-in fluorescent bulbs; cleaning air conditioner filters and refrigerator coils.

- *Removal of second refrigerators and underutilized freezers.* Due to problems in arranging for disposal, Detroit Edison chose not to implement this component, although customers were advised to contact the municipal authorities to have refrigerators removed.

- *Replacement of inefflcient refrigerators.* Participants were offered the opportunity to purchase new, energy efficient refrigerators for $100 ($200 for landlords), contingent upon meeting energy reduction and bill payment goals. To qualify for replacement, refrigerators needed to be metered and use more than 4 kWh per day. On the basis of these criteria, not all participants received efficient refrigerators.

- *Feedback and performance incentive. Energy* Options participants received reports with each bill comparing their usage for the month with their usage for the same month a year ago. Furthermore, outstanding arrears were reduced by $0.10 for each kWh of usage reduction, and the reduction was doubled if the customer paid his or her bill on time. Detroit Edison set up a free-standing data base to collect information on participants' consumption, billing, and payment experience to support the operation of this feedback component.

Program Implementation and Evaluation

Program Status

Energy Options. Detroit Edison initiated the implementation of Energy Options in November 1991. Enrollments began with the first education session in December 1991. Initially, 211 customers enrolled in the program. As of March 1993, 130 participants remained enrolled in the pilot. Most customer attrition was due to customers' inability to comply with the terms of the payment agreement or the company's difficulties in maintaining contact with the customer. As of April 1993, a total of 47 customers had ordered and received refrigerators through this program component.

EMP. As of April 1993, roughly 10,000 customers had been enrolled in the Energy Management program. From its inception, the program had experienced a drop out rate of roughly 15%. Most of those who dropped out had failed to make required payments.

EMP+. As an experiment, Detroit Edison delivered low-cost measures including compact fluorescent lamps to a small group of EMP participants.

Evaluation Activities

The research for this phase of the evaluation consisted of the following activities.

- *Customer survey.* We conducted in-home surveys of 172 customers who had participated in Energy Options, EMP and EMP+. The Energy Options sample included current participants as well as a number of those who had dropped out of the program.

- *Analysis of consumption records.* XENERGY analyzed the billing records of a sample of participants in all the low-income programs to assess the change in weather-adjusted, annualized consumption associated with participation. We also estimated changes in consumption "net" of broader economic influences by using the experience of a group of nonparticipants as a statistical control.

- *Analysis of bill payment behavior.* We analyzed participants' record in paying their electric bills since participation in the program for Energy Options and EMP +. For Energy Options, this analysis used information from the program database. The EMP + analysis relied on less complete information obtained from the Detroit Edison Customer Information System (CIS).

Summary of Research Findings

Changes in Conservation Behavior and Knowledge

- *General Knowledge and Behavior.* It appears that Energy Options and EMP were effective in communicating energy efficiency strategies to participants and in persuading them to adopt those strategies. In response to open ended questions, program participants reported that they had implemented between 4 and 6 "legitimate" conservation behaviors as a result of participating in the program.

- *High percentages of EO and EMP customers have taken steps to reduce refrigerator usage.* Of the 30 current EO customers who had second refrigerators upon entering the program, 22 have since gotten rid of them; 6 unplug them when they are not needed. Thus, 28 of 30 EO customers with second refrigerators have taken steps to reduce or eliminate this end use. Among EMP customers, 9 out of 17 have gotten rid of their second refrigerators; 3 unplug them when not in use.

- *Opportunities for high efflciency security lighting.* Seventy-six percent of customers in all programs reported that they left at least one light on at all times for security. Half of these customers reported leaving more than one light on at all times. This finding indicates potential applications for compact fluorescent, photo-sensor control, and occupancy sensor control technologies.

- *Purchase of efficient refrigerators through the Energy Options program.* Forty-seven of roughly 135 eligible EO customers (34%) purchased energy efficient refrigerators through the program. Among customers in the current EO sample who did *not* purchase refrigerators through the program, the most common reasons were that their current refrigerator was already

met efficiency requirements (36.4%) or that they did not have enough money for the customer's contribution (27.3%).

Changes in Electric Consumption. We conducted our assessment of usage impacts in two stages. In the first stage, we computed the annualized, weather-adjusted consumption for all program participants before and after program participation. We made similar calculations for a random sample of nonparticipants for corresponding time periods. We used both heating and cooling degree days in the weather adjustment model. Despite the low observed incidence of supplemental heat, we chose to include heating degree days in the model because other studies have shown that non-heating electric use varies systematically with heating degree days, which are correlated with hours spent indoors and duration of daylight. Cooling degree days were included because a relatively high portion of program participants reported the presence of cooling equipment, as well as multiple refrigerators. Table 3 presents the average weather-adjusted changes in consumption between the pre- and post-program periods for each group of program participants and for the nonparticipant group.

Not all of the weather-adjusted usage reductions can be attributed to program effects. Conceptually, the program effect is the difference between observed consumption in the post-program period and *what participants would have consumed in the absence of the program.* Typically, the change in consumption experienced by a group of nonparticipating customers who were eligible for the program is used as a proxy for the changes that participants would have experienced.

Researchers have developed a number of methods for using consumption changes experienced by comparison groups to isolate program effects. These include:

Table 3. Weather Adjusted Changes in Energy Consumption

	Energy Options No Refrigerator	Energy Options With Refrigerator	Energy Management	EMP Plus	Energy Fitness	Non-Participants
n=	93	31	138	49	117	183
Pre-program	10,735	10,615	10,110	10,816	4,125	5,346
(Relative Precision)+	2.1%	3.9%	3.2%	5.3%	7.9%	4.4%
Post-program	7,544	7,643	7,535	7,832	3,456	4,952
(Relative Precision)	5.5%	10.7%	5.1%	9.3%	8.2%	4.4%
Mean Change	(3,191)	(2,972)	(2,575)	(2,984)	(669)	(395)
(Relative Precision)*	11.2%	23.7%	11.6%	20.5%	27.0%	42.4%
Mean Change as % of Pre-program Consumption	(29.7%)	(28.0%)	(25.5)%	(27.6)%	(16.2)%	(7.4)%

+ Relative precision here is defined as follows: The *error bound b* is calculated by multiplying the standard error of the mean (*se of* $\hat{U}$) by a critical value, z, taken from the normal distribution for the chosen confidence level, i.e., $b = z\ se$. For 90 percent confidence z is equal to 1.645 and for 95 percent confidence z is equal to 1.96. The *confidence interval* is the estimated total plus or minus the error bound, i.e., $\hat{U} \pm b = \hat{U} \pm z\ se$. The estimated ***relative precision,*** rp, is the error bound as a fraction of the estimated total, $rp = b/\hat{U} = z\ se/\hat{U}$. The relative precision is often expressed as a percentage.

* Variance of the change in consumption is calculated using the formula appropriate to paired data.

$$\textit{In this case: } S^2(\bar{W}) = \frac{\Sigma(w_i - (\bar{w})^2}{n-1} \div n$$

where W_i=(*Preprogram consumption*$_i$ − *Postprogram consumption*$_i$).

- subtracting the nonparticipants' average change in consumption from the participants' average change;

- subtracting the nonparticipants' *percentage change* from the *percentage change* experienced by participants; and,

- using the records of participants and nonparticipants in regression models to control for the effects of systematic differences between the participant and nonparticipants upon the magnitude of consumption changes experienced.

Given the specific attributes of the program participants and nonparticipants — particularly the large difference in their pre-program period consumption — and limitations on the kinds of data available for the analysis, we chose the difference between participant and nonparticipant groups in percentage change in consumption as the best representation of the net results of the programs. Among Energy Options customers, for example, the program effects are calculated using the formula (Percentage change for participants — Percentage change for nonparticipants) x Pre-program consumption = (29.7% - 7.4%) x 10,735 kWh/year = 2,393 kWh/year. Results for all programs are shown in Table 4.

Participants in all of the programs realized substantial reductions in their actual energy use. Participants in Energy Options, Energy Options with new refrigerators, and EMP Plus reduced their weather-adjusted electric consumption by 18.7%, 19.7%, and 21.5% respectively. Participants in the Energy Management program reduced their consumption by 12.9%. In terms of electric bills, these results represent average annual reductions of $140 to $220.

The weather-adjusted usage reductions realized by participants in Energy Options and EMP far exceed the estimates of "technically available" savings made in the 1991 market study. The large difference between the average reductions for EMP customers versus Energy Options and EMP + customers should be regarded with some caution, given the small number of "post-program" observations available for the analysis.

- *Controlling for the effects of non-program influences results in net usage reductions that are significantly less than the annualized, weather-adjusted changes.* Some decrease is to be expected because electric use among nonparticipants decreased over the corresponding periods.

Duquesne Light Company ran a similar low-income pilot program in 1992. The pilot included home visits, installation of low-cost measures and replacement of inefficient refrigerators. Pre- and post-treatment electricity consumption was analyzed for pilot participants and a group of nonparticipants. Based on average savings calculated from only three months of post-treatment usage data, pilot participants saved 1,698 kWh per year, a savings of $217 (Gregory, 1993).

Changes in Bill Payment Behavior

In analyzing patterns of bill payment, we faced very severe obstacles in terms of data availability and quality. For Energy Options customers, program staff had maintained a database of charges and receipts on a monthly basis since the inception of services. Using these records we were able to develop a detailed picture of customer payments. However, given the volume of calls they needed to handle, program staff only maintained records for active participants. We thus have complete records for only 125 of the 210 original Energy Options enrollees.

For participants in all other programs, we relied on information from the Detroit Edison "Shop File", an extract of selected information from the CIS system. The Shop File contains historical information on monthly net amounts billed and the current account balance. However,

Table 4. Changes in Consumption Attributable to Program Effects

	Energy Options No Refrigerator	Energy Options With Refrigerator	Energy Management	EMP Plus	Energy Fitness
Change Attributed to Program Effects in kWh per year	2,394	2,188	1,829	2,186	365
Relative Precision	(23.9%)	(35.7%)	(23.9%)	(31.7%)	(58.9%)

it did not contain information on amounts paid, Detroit Edison is now implementing changes to the Shop File which will make customer payment histories available in the future.

Our initial strategy was to use the change in the current account balance from the date of the first data extract to the date of the second as a measure of customer payment behavior. Our working hypothesis was that the account balance would stay the same or decrease from one draw to the next if the customer paid the full amount billed. Upon inspection of the individual records, we found that changes in account balance often reflected internal transactions and adjustments that had nothing to do with payment of current bills. Records of these transactions are not available in the Shop File. We thus concluded that the change in account balance alone without an adjustment for other transaction details was not a valid measure of customer payment behavior.

As a first approximation, we identified the EMP+ records in which there were obvious anomalies and deleted them from the sample used to analyze changes in account balance. However, given the data problems discussed above, the results of this analysis are far from definitive. The key results are as follows.

- *55% of current Energy Options customers were able to pay the entire net amount billed from the time program enrollment to November 1992.* On average, current Energy Options customers paid an amount equal to 116% of the amount billed for current usage. The additional extra payments reflect the difference between the negotiated payment agreements and charges for actual use.

- *On average, EMP+ customers reduced the amount of their account balance by $150 over the period from July 7, 1992 to December 12, 1992.*

Lessons Learned

Our two-year involvement with the design and evaluation of the Energy Options pilot and its sister programs has offered valuable perspective on the design of efficiency programs for low-income customers and on the interaction between evaluation and program design. To those engaged in similar pursuits, we offer the following reflections.

Program Design for Low-Income Customers

- *Target marketing efforts to high-use customers.* Participants in Energy Options and the Energy Management sample had very high pre-program energy use: 11,520 kWh/year and 10,765 kWh/year respectively. Weather-adjusted gross savings for both programs averaged over 2,000 kWh per year. The simple correlation coefficient between pre-program weather adjusted use and changes in use was small, but highly significant. Concentrating on high-use households will maximize energy savings and cost-effectiveness. Given the demonstrated relationship between high bills and payment problems, targeting high-use customers will also pay off in terms of reduced financial stress.

- *Customer education is a key component of any program aimed at curbing abnormally high use.* The results of the billing analysis indicated that, on average, program participants reduced their usage by more than what we would have expected on the basis of an engineering analysis. The likely reason for this is that customers sharply reduced discretionary electric uses based on their exposure to customer education. These findings are consistent with numerous other evaluations of customer education programs.[2]

- *Measures as incentives to good practice.* Customers naturally ascribed a great deal of value to the opportunity to purchase a new refrigerator at a deep discount. This served as an incentive to exercise care in using electricity and to keep up with agreed payments.

Integration of Evaluation and Program Design

- *Two-way synergy: the key advantage.* The narrative of the development of Energy Options shows how findings from market research (which bears a close family resemblance to many aspects of evaluation) and evaluation itself can be used to enhance program design. Our initial market research on customer attitudes and behaviors demonstrated the need for the kinds of education and feedback mechanisms that were built into the program. Our early inspections pointed toward the opportunities available in replacing primary refrigerators. Less obvious, but no less valuable, is the guidance for evaluation we gained from overseeing implementation of the pilot. For example, we learned from the education visits that customers left interior lights and televisions on for extended periods as a security measure. This helped sharpen questions for the evaluation survey. We learned that many customers felt they needed a second refrigerator because their shopping trips were timed to the monthly receipt of food stamps. Finally, without the data base set up to administer the incentive system, we would have had no reliable information on customers' payment patterns.

- *Disadvantages.* Pilots require nearly the same detailed level of program development and management as larger efforts. This tends to distract attention and resources from some of the pre-planning required for good evaluation. With a bit more time, the amount of evaluation information available from program documents such as inspection forms, payment agreements, and quality control sheets could have been increased substantially. A clear example of this problem was the loss of payment records on customers who dropped out of the Energy Options program.

Using Billing Records to Analyze Payment Patterns

Most of the analyses of the effects of energy efficiency programs on customers' payment patterns have run into the same kinds of data problems we experienced.[3] In our case, the published experience of other investigators enabled us to anticipate what some of those problems might be, but we ran afoul of them nonetheless. For example, we dutifully examined the record layout for the Shop File and conferred with Detroit Edison's analysts on the availability of payment information. All of us thought that we had identified fields that contained historical payment records, but it turned out these fields recorded something else entirely. Moreover, due to the sheer volume of transaction details recorded for each customer, the CIS holds only a few months of historical information. We gather the situation is similar at other utilities. These circumstances will encourage us to look for approaches to analyzing bill payment behavior other than the quasi-experiments familiar from consumption analyses.

Endnotes

1. Detroit Edison has since developed a more sophisticated market segmentation and projection method based on Geographic Information System coded at the nine-digit ZIP Code level.

2. Additional space heating savings of 6 to 8 percent have been achieved by programs that combine weatherization and energy education (Quaid 1990). Preliminary results of a Niagara Mohawk low-income weatherization/education program indicate that participants who received weatherization plus in-home energy education and feedback on their energy use saved 26 percent, while the groups that received weatherization only saved 17.8 percent over their weather-normalized gas consumption for the control period (Harrigan 1990).

3. See, for example, Quaid, Maureen, and Scott Pigg. "Measuring the Effects of Low-income Energy Services on Utility Customer Payments," *Proceedings from the 1991 International Energy Program Evaluation Conference,* Chicago: National Energy Program Evaluation Conference (1991).

There were similar obstacles encountered in analyzing payment behavior of low-income participants enrolled in a Central Maine Power Company's low-income program which assists qualifying customers in paying their electric bills by limiting bills to a predetermined portion of income. In order to retrieve historical customer billing system data in a readable format, a complex computer system was designed to capture customer billing histories (Hart, 1993).

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