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THE RESPONSE OF LOW-INCOME ELDERLY TO TENANT INCENTIVE PROGRAMS

EDWARD L. VINE†, B. K. BARNES, EVAN MILLS, and RONALD R. RITSCHARD

Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA 94720, U.S.A.

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Abstract—In 1985, the City of San Francisco initiated a tenant-incentive demonstration project in public housing to stimulate energy-conservation behavior among its tenants. The goals of the incentive demonstration project were to demonstrate energy savings and to measure the effectiveness of financial incentives in public housing. We found that elderly tenants believed they were already using a minimal amount of energy, and several barriers prevented other tenants from reducing their heating use. Accordingly, we did not expect many elderly tenants in public housing to use less energy in response to an incentive program. Individual and social conditions prevented these tenants from responding to energy-conservation programs. Our preliminary analysis of energy use before and after the incentive program indicates increased gas consumption in both the control and experimental buildings.

INTRODUCTION

While the average energy consumption of elderly householders is less than for the average U.S. householder, the former spend a higher proportion of their income on utilities than the latter.[1] This situation is worse for low-income elderly householders, and local, state, and federal programs have been created to address the needs of this group. In public housing, where elderly householders constitute about 38% of tenant householders,[2] there is a large potential for saving energy, and public housing authorities have recently begun to address the need to contain rising energy costs through retrofit projects funded by the U.S. Department of Housing and Urban Development (HUD), utility companies, and local housing authorities.[3]

In addition to developing energy-conservation programs aimed at improving the thermal integrity of the building shell and efficiency of the heating system, the San Francisco Housing Authority recently created a program specifically aimed at elderly tenants living in public housing buildings. Because tenants pay only a fraction of their utility bills, if any at all, there is very little incentive for them to conserve energy. Accordingly, tenant-incentive programs, in which tenants receive money for saving energy, have been suggested as a promising alternative for reducing energy use in apartments in public housing and, at the same time, for getting the tenants more involved in energy-conservation programs. As part of their demonstration project, the City of San Francisco initiated in 1985 an incentive demonstration project in public housing to stimulate energy conservation behavior among its tenants. This approach to energy conservation in rental housing has not been documented in the literature, so that this evaluation of a tenant-incentive program is the first of its kind. Although the program encountered serious problems in its design and administration (as discussed below), the attempt to address the issues in the design and implementation of this kind of exploratory program are worthy of public review.

Tenant Incentive Program

The goal of the incentive demonstration project was to measure the effectiveness of a financial incentive program to encourage elderly residents of public housing to save energy. The incentive project used an experimental design to measure the effectiveness of the incentives. Tenants in one senior building (the experimental group) received tenant education (workshops conducted by the local utility company and the Housing Authority) and financial incentives for tenant conservation. A second senior building (the control group, similar in makeup to the experimental group) received tenant education, but did not receive the tenant incentives. By comparing changes in energy consumption between the buildings, one can measure the effectiveness of the incentives, controlling for the influence of educational programs.

† To whom all correspondence should be addressed.

The buildings chosen in this study had to be similar in makeup (e.g., size of building, geographic location, building design, heating, ventilation and air-conditioning (HVAC) type, and pre-retrofit energy use). The buildings also had to provide the tenants with an opportunity to conserve energy: specifically, the tenants had to have some control over space heating and domestic hot water energy use. Out of the 20 senior public housing buildings in San Francisco, two senior buildings were selected for the incentive project: one at 350 Ellis Street and the other at 1880 Pine Street. The former was a 11-story building of 95 units while the latter was a 12-story building of 126 units. Both buildings had central gas boilers with hot-water distribution systems, electric cooking, tenant associations, and similar location, building design, and pre-retrofit energy use. Tenants in both buildings did not pay for gas and electricity use. About 80% of the senior housing units were studio apartments and 20% were one-bedroom apartments, and, in general, one person occupied each unit. The tenants at Pine Street were chosen to receive the incentives.

Two workshops were held at each of the selected senior buildings. The first workshops were held in November 1985, and about 35 tenants attended the Ellis workshop and represented approximately 37% of all the tenants in the building. About 30 tenants attended the Pine workshop, representing approximately 24% of all the tenants in the building. A second workshop was held in April 1986 at each of the buildings to present a brief update on the program.

The workshops were organized by the tenant associations in each building, the Housing Authority, and the local utility company (Pacific Gas and Electric Company (PG&E))). Representatives from the Housing Authority and PG&E presented the same information at each building, except that the discussion of incentives was limited to the workshops at the Pine building. Chinese interpreters participated in the workshops to interpret for those Chinese tenants who did not understand English. The only other difference in the workshops at the buildings was that the building manager at Pine Street, in his opening remarks, was very enthusiastic about the importance of the project to the tenants.

At the workshops, the Housing Authority representative talked about the Authority's responsibility in reducing energy use in public housing, their efforts to that end, and the need for tenants to help the Authority save energy. At Pine Street, the incentive program was also discussed. The PG&E representative addressed specific actions that tenants could take to reduce energy use. Tenants were told not to give up things if they needed them for their comfort and/or health (e.g., a jaccuzi pump in the bathtub, or portable fans). The tenants receiving the incentives were told that the program would have no effect on their rent or social security. Tenants participating in the workshop were encouraged to talk to other people in the building who had not attended the workshop and tell them what they had heard in the workshops.

Tenants were promised two thermometers, one for the room and one for the refrigerator, so that they could monitor these temperatures. Tenants were also promised a printed handout from PG&E, summarizing the workshop. A Chinese version of this handout was also to be made available but this version did not materialize. After the workshops, one thermometer was delivered to all of the apartments in the two buildings so people would know their room temperatures. No thermometer was provided for the refrigerator or freezer. Tenants had to rely on the appliance dial settings, which varied from a numbered 1 to 5 format to an A to D format, the meaning of which was left up to the tenants to determine. In addition, information sheets summarizing the workshop contents were distributed at key locations in the buildings, but were not given to each tenant.

The California Energy Commission provided the funding for the incentives. Originally, the incentives were structured along the following lines: $10 a month for each apartment in January, February, and March 1986, followed by a six month period with variable monthly payments of $5, $10, or $15, depending on the change in energy-consuming behavior of the tenants (as reflected in the building's total energy use). Due to delays, the first incentive payment was not mailed until December 1986, in the form of one $30 payment for the first three months of the incentive program. A cover note (printed only in English) was sent to the tenants, with the incentive payments, explaining that the money was for their previous attempts at conserving energy. In August 1987, the second, variable payment was delivered to the tenants: $10 to each tenant at Pine Street and $5 to each tenant at Ellis Steet.

SURVEY METHODOLOGY

We surveyed the tenants in each of the two buildings to obtain information about their energy consumption patterns, the perceived value of the financial incentives, their comprehension of the conservation program, their attitudes to energy conservation, and their sociodemogaphic profiles. For the Pine Street residents, we included a section about the effect of the incentives on their behavior. Prior to preparing the questionnaires, we visited the maintenance staff at the public housing sites to discuss energy-related problems occurring in their buildings. In addition, we attended the first workshops held at each of the two buildings and listened to the presentations by PG&E and the Housing Authority and to the concerns of the tenants participating in the workshops.

Based on the site visits and our observations at the workshops, we designed a questionnaire and pretested it at both buildings in February 1986. However, the implementation of the survey had to wait until the financial incentives had been mailed, a delay of nearly a year. Because of this delay, we decided to exclude most of the workshop-related questions since too much time had transpired for tenants to remember the workshops and remember the impact of these meetings on their behavior. We conducted a second pretest in February 1987 and revised the questionnaire for ease of comprehension. A copy of the final questionnaire is available from the authors.

We conducted the survey in February 1987, using three trained interviewers (one spoke Spanish and one spoke both Mandarin and Cantonese). Person-to-person interviews, ranging from 10 to 45 minutes in length, were conducted during the day at each of the sites. We interviewed 39 tenants at each of the two sites; none of these people participated in the pretest, and each of the tenants were from different apartments (i.e., at each site, 39 apartments were visited). We attempted to contact all of the residents and, if there was no answer, second and third attempts were made. If a time was inconvenient, an alternate time was arranged. Apartments with no response seemed to be genuinely empty at the time. We were unable to interview a number of residents for the following reasons: they were not at home or did not answer the door when the interviews called (50% of the non-respondents), were too ill or had some physical impairment (e.g., deafness) that prevented the interview from taking place, were unable to speak English (especially Korean, Russian, and Tonkinese residents), were unwilling to participate because of special circumstances (e.g., bathing, not fully dressed, or had guests visiting), or were just not willing to be interviewed. Accordingly, the final response rate to the survey was 35% (78 units out of 221); limiting the sample to only those that were contacted, the response rate increased to 71% (78 out of 110).

SURVEY FINDINGS

In the following pages, we summarize the results of our survey. Detailed information on the survey results is contained in a larger report that is available from the authors.[4]

Household Profile

Most of the tenants interviewed in this study were single, elderly (average age was 75 years) women who have lived in the senior buildings for approximately 8 years (Table 1). The tenants interviewed came from a number of diverse ethnic backgrounds, with a strong representation from the Black and Asian communities. More than 50% of the sample had not graduated from high school; some respondents had no formal education, while a few had advanced degrees. Pine Street tenants were more highly educated than those at Ellis Street. The tenants in the two buildings were similar to one another in terms of sex, income (all low-income), and tenancy, while the tables also suggest that there were differences in marital status, ethnicity, and education, although they were not statistically significant (we use a 0.05 level of significance for indicating statistically significant relationships). Pine Street tenants were more likely to be single or widowed, more highly educated, less Asian, and more Black.

Table 1. Demographic profile of respondents.

Householder Characteristics	Pine Street (N=39)	Ellis Street (N=39)	Total (N=78)
Mean number of years in building	8	8	8
Mean age (years)	76	73	75
Sex			
Male (%)	31	28	30
Female (%)	69	72	70
Marital status			
Single (%)	95	82	88
Married (%)	5	18	12
Ethnicity			
Caucasian (%)	41	31	36
Black (%)	28	18	23
Asian (%)	23	46	35
Hispanic (%)	8	5	6
Education			
No formal education (%)	5	5	5
Elementary/some high school (%)	48	59	53
High school graduate (%)	26	22	24
Some college/college graduate (%)	18	11	15
Advance degree (%)	3	3	3

Heating Behavior

Both buildings in the study had central heating systems, hot water distribution systems, and room radiators. The heat given off by the radiators was controlled by shutoff valves. Several barriers prevented elderly tenants from using these controls. First, the age and physical condition of tenants prevented many of them from bending down and adjusting radiator valves for controlling the amount of heat during the winter. In addition, the mechanics of regulating the valve were incomprehensible to many of them. Even if the tenants were able to regulate the radiator valve, they were often afraid to turn the valve, in case they might turn the heat off (by turning the valve in the wrong direction) or make the room too hot. Consequently, settings on the radiator valve were often not changed and were left "as the man set it." For Ellis tenants, in particular, indoor temperatures were usually regulated by opening and closing windows.

Second, the physical design of apartments at Ellis Street resulted in radiators being located behind large, heavy pieces of furniture (e.g., beds and bookshelves), preventing easy access to the radiator controls, so that tenants sometimes did not know whether their radiator valve worked, and, therefore, did not change it. In contrast, at Pine Street, the radiator was usually located underneath the window, an area least likely to be obstructed by furniture and, therefore, more accessible to tenant control.

Third, the design of the buildings and hot water distribution systems (in particular, at Ellis Street) led to overheating and poor ventilation, forcing many tenants to keep their windows open during the day and at night in order to maintain comfortable indoor temperatures and fresh air. Opening windows for ventilation is a common practice in the residential sector, and public housing is no exception.[5] During the day, more than 90% of the sample reported keeping their windows open while, at night, this percentage decreased to 67%. The main difference between the two samples was that 57% of the Pine Street tenants kept their windows open at night, compared to 76% of the Ellis Street tenants.

Fourth, a number of tenants (13%) reported that their room radiators were broken or heating controls were inoperable: the radiator valve was missing, frozen, or broken so that no heating adjustments could be made. A greater percentage of radiator valves worked at Pine Street (87%) than at Ellis Street (69%).

In summary, window opening and closing was the principal means of controlling the thermal environment in these buildings, and any suggestions for saving energy by regulating radiator valves were easily dismissed by the tenants.

Attitudes

We asked a few questions about tenants' attitudes towards the energy problem and energy conservation, personal comfort, and, for those receiving incentives, their understanding of and reaction to the incentive demonstration program. Most tenants (86%) felt they were already using a minimal amount of energy and/or did not think they could save more energy ("unable to save"). These people thought that any reductions in energy use would result in a negative impact on necessary services (e.g., cooking, heating, and lighting). Only 23% of the Pine Street tenants and 5% of the Ellis Street tenants felt they were able to save energy in their apartment. In addition, we found a statistically significant difference between the two buildings: more Ellis Street tenants (95%) believed they were already using a minimal amount of energy, compared to 77% at Pine Street.

The tenants were almost evenly divided about the relative importance of energy compared to other problems: 42% believed energy to be an important problem while 47% thought it wasn't (Table 2). There were some differences at the building sites: 50% of the Pine Street sample believed energy to be an important problem while only 33% of the Ellis Street sample felt so. Only about one-third of all the tenants believed that their individual energy-conserving efforts would affect their building's energy consumption (Table 2). About 50% of the tenants did not know what effect their efforts would have, and about 14% did not think their efforts would have any effect (21% at Pine Street and 8% at Ellis Street). Most tenants (75%) did not know whether other tenants in the building were saving energy (Table 2). However, of the few who did express an opinion, more tenants at Pine Street thought the other tenants in their building were saving energy compared to the tenants at Ellis Street. For the Pine Street residents, 65% were willing to save energy in order to get money from the Housing Authority (Table 2).

Table 2. Energy attitudes.

Energy Attitudes	Pine Street (N=38) (%)	Ellis Street (N=39) (%)	Total (N=77) (%)
Energy is important compared to other problems	50	33	42
Individual efforts will affect building consumption	37	38	38
Belief that others are saving energy	16	3	9
Willingness to save in order to get money from housing authority	65	Not Applicable	Not Applicable

Incentives

We asked a few questions about incentives for those tenants receiving money (the Pine Street residents). Only 66% remembered receiving a check in the mail; 21% reported that they had not received a check, and 13% could not remember. Most (85%) of those who remembered receiving a check reported receiving the correct amount ($30). Those tenants who remembered receiving checks in the mail were equally divided in knowing the purpose of the incentives: 42% connected the check with the general concept of energy conservation, while 46% knew specifically that the check was for their efforts in reducing energy use in their buildings as part of the Housing Authority's demonstration program. In summary, about one-third of the Pine Street sample clearly understood the intent and nature of the project.

Approximately one-half of the Pine Street sample believed the incentives would change people's energy-conserving behavior; however, many (42%) did not know what effect the incentives would have on their behavior. Moreover, only 14% felt that the incentives changed their own behavior. Most (83%) of Pine Street tenants felt that comfort and energy savings were compatible, so that other reasons prevented tenants from saving energy.

During our interviews, we found that many of the tenants assumed they were receiving the money as a result of their past conserving behavior, not as part of an experiment to see if their behavior would change with the promise of future monetary rewards. The Housing Authority attached to the check a cover note explaining that the money was not only for past energy conservation but for encouraging future energy conservation. This message, however, was not clearly presented in that note. Also, the note was printed only in English, so that those tenants unable to read English were unclear on why they received this money.

Energy-conserving Behavior

For all the tenants in the two buildings, we asked about a number of energy-conserving behaviors that had been described at the workshops. For those receiving incentives, follow-up questions were asked to see if their energy-conserving behavior was a result of the money they received during the demonstration program. There was a statistically significant difference (at the 0.05 level) in the two buildings on how the tenants kept their room temperatures. Over 65% of the Pine Street tenants reported that they kept their room temperatures at 70°F or lower while only 14% of the Ellis Street tenants reported this behavior. This difference might be attributed to the problem of overheating at the Ellis Street building. The incentive did not have any change on this behavior: the Pine Street tenants were practicing this behavior before the incentives.

About 50% of the tenants reported that they wore thicker and more clothing in the winter to stay warm, and there was no statistically significant difference between the two buildings. Again, the incentives made no difference on the behavior of the tenants at Pine Street.

Only a small percentage (12%) of tenants cleaned the coils of their refrigerator as recommended in the workshops, and while there was no statistically significant difference between the buildings, a few of the Pine Street tenants reported that they practiced this behavior because of the incentives. There was a statistically significant difference between the buildings in the way tenants heated their apartments. Over 60% of the tenants at Pine Street closed their windows before turning on the radiator; in contrast, only 29% of the tenants at Ellis Street practiced this behavior. Again, this difference might be attributed to the problem of overheating and poor ventilation at Ellis Steet, forcing many tenants to keep their windows open, whether the radiator was on or off, with the poor accessibility of the radiator valve as a contributing factor. Four of the Pine Street residents reported they changed their behavior as a result of the incentives.

ENERGY ANALYSIS

A comprehensive evaluation of tenant-incentive programs, or any other energy-conservation program, is based on measured energy data (utility bills). Once normalized (standardized) for changes in occupancy rates and for deviations of actual-year weather from long-term normals, the difference between pre- and post-incentive data provides a ready estimate of energy savings. Inclusion of a control building makes it possible to adjust for decreases (or increases) in energy use that result from factors other than the conservation programs.

In this study, several years of pre-incentive utility data were available for the treatment and control buildings. Although the tenant workshops were conducted in November of 1985, distribution of the incentives was delayed for 13 months. As a result of this delay, our energy savings evaluation is based on only three months of post-incentive data. Fortunately, these three months embrace the 1987 heating season and thus span a period when most of the savings can be expected to have occurred.

We applied three methods for viewing changes in gas use following distribution of the incentives: simple heating degree-day scaling and two applications of a widely used regression technique.[4] In the simple heating degree-day scaling analysis, gas use was summed for the three-month, 1987 post-incentive period and the same three months during 1985 (mid-November through mid-March). A fraction of this total consumption (40%) was assumed for space heating (water heating and cooking account for the remaining gas use). The result was multiplied by the ratio of heating degree-days in the pre-incentive period to those in the post-incentive period. By inflating usage for the relatively warm post-incentive winter, this method provides an estimate of what post-incentive heating use would have been were weather conditions in 1987 identical to those in 1985. Using this analysis, we estimated an increase in gas use at both buildings (Table 3). After the workshops, which occurred between the 1985 and 1987 heating seasons, heating energy use at the control building (Ellis) increased 22% (18 therms/apartment) whereas use at the treatment building (Pine) increased by only 5% (5 therms/apartment).

Table 3. Energy savings.

Project	Gas Savings† (Therms/apt/day)	(%)	Electricity Savings (kWh/apt/day)	(%)
350 Ellis	-18	-22	3	17
1880 Pine	-5	-5	1	2

† In the analysis, we normalize energy use to heating degree-days (base 61°F) in the pre-incentive year. Normal-year heating degree-days were not used due to data unavailability. Positive values correspond to savings; negative values correspond to increases in energy use.

Our second method used the Princeton Scorekeeping Method (PRISM) to adjust the heating fuel (gas) use at Ellis and Pine for variations in monthly weather conditions. PRISM uses utility bills to determine a weather-adjusted index of annual energy use called normalized annual consumption (NAC).[5] The PRISM method produces several other energy-use indicators: weather-independent daily base load energy use (α), the heating rate or the amount of energy used per heating degree-day (β), and the reference temperature (τ) from which the heating degree-days are computed. Together, the last three parameters provide a simple linear model of energy use as a function of weather:

$$NAC = (365\ days \times \alpha) + 365\ days\ (\beta \times HDD_{\tau})$$

where α has the units of energy per day (kBtu/day), β has the units of energy per heating degree-day (kBtu/°F-day), and the heating degree-days are calculated to the base τ selected by PRISM as the most representative of the building being analyzed.[6] The parameter τ is found as that value which maximizes the fit of the model, as indicated by the R^2 statistic.[6]

We used the simple linear model generated by PRISM to identify the α, β, and τ parameters for the pre-incentive period. Using the above equation, these parameters (in combination with the number of post-incentive days and heating degree days) were used to derive an estimate of gas use following the incentives. This estimate represents what gas use should have been in lieu of the incentives. In this way, savings are estimated by subtracting the actual post-incentive gas use from the use predicted by the model. Using this technique, gas savings of 20% occurred at Pine and 11% at Ellis.

Our third method followed variations in the NAC over time. We determined the normalized annual consumption for a twelve-month period beginning in 1984. This twelve-month "window" was then moved ahead three months at a time until the post-incentive period was fully incorporated. The resulting history of changes in NAC provides an indication of energy-use trends. The results of this method are shown in Fig. 1. Throughout the period from October 1984 to March 1987, gas use was slightly higher (3 to 7%) at Ellis (control building) than at Pine. Consumption started to drop at both properties beginning in 1986. Although this small change in consumption occurred following the tenant workshops, the differences are generally not greater than the error estimates for each year's NAC and do not come close to the estimated savings generated by the second technique.

In summary, the three methods for gas use analysis yield markedly different results. We are more confident in heating degree-day scaling because it employs the simplest correction technique and is, hence, less prone to estimation error. The second method is highly sensitive to various parameters (especially when employed over only a three-month period). In addition, due to effects specific to the San Francisco climate, the R^2 statistic is rather poor in some cases. The fact that the second approach predicts greater savings at the control building also suggests the possibility of error with the regression technique. The third technique provides only a qualitative indication of savings as it is too soon to compute a complete annual post-incentive NAC.

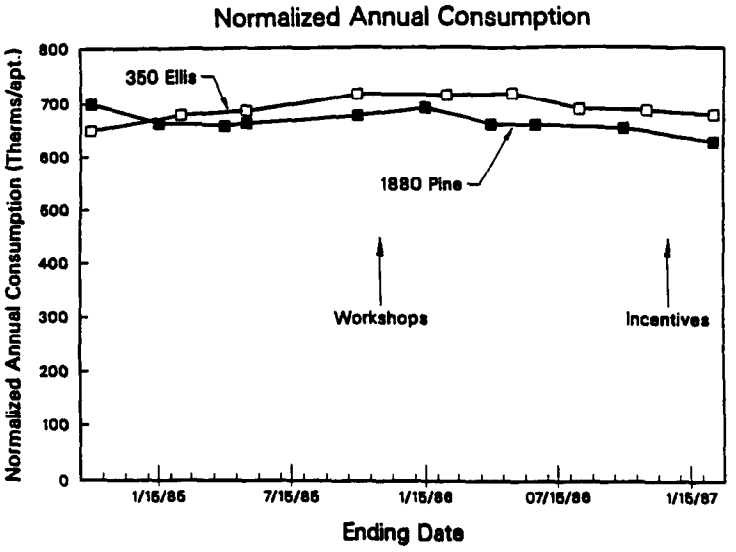

Fig. 1. PRISM window analysis of gas consumption.

A secondary objective of the tenant-incentives program was to achieve electricity conservation by encouraging tenants to turn off lights and to slightly raise the temperatures of their refrigerators. To evaluate changes in electricity use, we simply compared consumption per apartment, per day, for the mid-November to mid-March periods beginning in 1984 and 1987. Our analysis of changes in electricity use (no weather correction) showed a 2% (1 kWh/apartment/day) decline at 1880 Pine and a 17% (3 kWh/apartment/day) decline at 350 Ellis. This is somewhat surprising since the tenants at Ellis did not receive incentives.

In summary, given the limited post-incentive utility data, a definitive estimate of changes in gas or electricity use could not be made. Gas use appears to increase at all projects while electricity use declines, showing little correlation with the receipt of incentives except perhaps at 1880 Pine where the increase in gas use was less than at the Ellis. Savings in electricity were greater at the control building than at the treatment building.

DISCUSSION AND CONCLUSIONS

In conclusion, we found that elderly tenants thought they were already using a minimal amount of energy and were not very responsive to the tenant-incentive program. In addition to the factors mentioned in the previous section, other factors were important in limiting the amount of energy conservation in these buildings, as discussed below.

First, these tenants did not pay for energy costs and assumed the Housing Authority would continue to pay for these costs without burdening the tenants, so that energy would continue to have a negligible impact on their household budget. The absence of a monthly utility bill also resulted in the lack of feedback indicating to tenants how much energy they used each month. Second, for at least one-half of the tenants, energy was not an important issue, compared to other problems they were facing.

Third, most of the tenants believed their personal efficacy was low: they did not think their efforts in saving energy would have any impact on the total energy consumption of the entire building. Fourth, monetary rewards (incentives) were not considered to be adequate incentives for people who felt they already were using minimal amounts of energy, though the money itself was greatly appreciated by the tenants.

Fifth, there was very little effort in promoting the energy-conservation ethic in public housing buildings at a group or community level. There was little communication among tenants, so that no one knew how many others were trying to conserve energy. The communication problem was exacerbated in these buildings due to the heterogeneity of the tenant population: many of the residents were from foreign countries and were unable to read and speak English, further isolating themselves from the rest of the tenants. Furthermore, a number of the racial minorities were organized into groups in each of the buildings, were actively involved in tenant organizations, and were very reluctant (if not hostile) in participating with other minorities in any programs, limiting the potential of cooperative efforts. Consequently, tenants in these buildings practiced energy conservation by themselves without knowing the effects of their actions and of others in their building.

Sixth, the Housing Authority, in particular, was seen by many tenants as not being responsive to tenants' complaints. A number of tenants mentioned that they had contacted the Housing Authority a number of times for repair work, but to no avail. Also, during one period of the program, there were no building managers in the buildings; as a result, in one building, the furnace failed several times, including one four-day period, leaving the tenants without heat. This negative perspective was undoubtedly a motivating factor for some tenants to not participate in the demonstration program.

Finally, the demonstration program itself had a number of problems during its implementation. For example, there was an extended period of time (over one year) between the time of the first workshop and the mailing of the incentives that resulted in some tenants losing interest and/or weakening their belief in the integrity of the program. Also, the cover letter accompanying the incentive did not sufficiently explain the purpose of the program and the check: many tenants thought the money was solely for their previous low energy usage and did not associate it with a need to change their energy-conservation behavior in the future.

We do not expect many elderly tenants in these public housing buildings to use less energy than they presently are consuming because of the problems described above. Individual and social conditions prevent these tenants from responding to energy-conservation programs. Consequently, we expect future attempts at saving energy in these buildings to occur at the Housing Authority level, rather than at the tenant level: for example, further improvements to the supply and distribution of heat and to the thermal integrity of the building shell (e.g., wall insulation and reduced infiltration).

We are not sure how generalizable our findings are for other incentive programs at other public housing sites around the country; however, we would expect some of the same problems and results. While the results are not encouraging, we expect those interested in this type of program to see this project as exploratory and as the first step in the design and implementation of a better organized and managed program. Accordingly, we offer the following suggestions for those individuals and organizations planning a tenant-incentive program for the elderly and other groups.

First, programs should be targeted first to tenants who pay for some, if not all, of their utilities. Tenants who do not pay for utilities do not have the economic incentive for saving energy. Second, all maintenance concerns need to be addressed regularly before an incentive program is introduced. Maintenance staff should respond to requests for repair within a day or two. In particular, if energy-related maintenance problems remain, tenants will not look favorably upon a program that encourages tenants to save energy.

Third, tenants should understand how they can control energy-related equipment. Workshops and apartment visits are necessary to enforce this understanding. Fourth, target all groups in the public housing sector. Because the populations in these buildings are heterogeneous, educational and informational materials must be prepared in different languages so that everyone can understand the purpose of the program and help endorse and promote the program.

Fifth, provide feedback mechanisms to tenants as part of the program: for example, room thermostats to measure indoor temperature and graphs of monthly utility bills (by building and, if possible, by apartment) to chart energy use over the lifetime of the program. Finally, make sure incentives occur soon after information workshops are conducted so that the continuity of the program is maintained. Similarly, monthly payments are the preferred type of payment in order to maintain interest in the program. The payments provide essential monthly feedback to the tenants on how well they are saving energy.

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