MARKETING ENERGY EFFICIENCY IN NORTH CAROLINA PUBLIC HOUSING: LESSONS LEARNED FROM FIELD EXPERIENCE

Patricia S. Gee and Keith Aldridge
Alternative Energy Corporation (AEC)
Dr. Yates Sorrell
North Carolina State University

ABSTRACT

The North Carolina Alternative Energy Corporation (AEC) has over two years of experience in developing a comprehensive program to improve energy efficiency in public housing, especially the smaller all-electric authorities. Elements of that program include:

1. Creating incentives to motivate public housing administrators to pursue energy efficiency.
2. Comparing alternative strategies for achieving energy efficiency in multi-family housing.
3. Demonstrating creative multi-participant financing options to fund energy improvements.
4. Developing effective ways for smaller PHAs to implement energy improvements.
5. Analyzing results to provide PHAs with feedback on energy efficiency efforts for multi-family housing.

The Phase I field test demonstrated an innovative financing mechanism for funding energy improvements in 228 multi-family public housing units. A municipal contribution leveraged PHA, Solar Bank and AEC funds. A comparison was made of the HUD audit workbook, the RCS audit and an engineering evaluation. Standard retrofit measures were chosen. Resultant savings, which ranged from 20-35% during winter months, were measured using the Princeton Scorekeeping Method.

Though designed as a financing program, Phase I demonstrated the significance of administrative and procedural barriers in achieving energy efficiency in public housing. The paper focuses on audit, retrofit and monitoring results, as well as these barriers which make comprehensive energy management in public housing an extreme challenge.

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OVERVIEW

The North Carolina Alternative Energy Corporation (AEC) has worked with public housing authorities (PHAs) since 1983 to demonstrate techniques for energy management in this electricity-intensive housing sector. In AEC's Phase I Project, an innovative joint-participant mechanism for financing energy improvements was demonstrated. Retrofit measures were installed in 228 North Carolina public housing units, with resultant savings monitored using the Princeton Scorekeeping Method (PRISM).

Phase I was designed based upon the premise that an **economic incentive** (in varying forms) was the single most important motivator to the three major participants in a public housing energy retrofit project. AEC focused on securing financing for retrofit measures from these three participants - the PHA, its municipality, and the local utility (with AEC acting in this role) - all of whom we proposed would realize economic benefit from more energy efficient PHA units.

The economic incentives to the PHA were in two forms: implementation cofunding and assurances of reduced utility costs. Over seventy-five percent of the retrofit costs was offered to PHAs in the form of grants. The direct relationship between utility costs and the amount of the Payment-in-Lieu-of-Taxes (PILOT) made to the municipalities was emphasized to the local governing bodies to justify their co-funding of the retrofit measures. To justify a future utility investment, a rigorous analysis of energy and demand savings resulting from the retrofits was intended to give utilities information on the demand-side management potential in public housing. This data would be a factor in their development of conservation and load management incentives for these consumers, including implementation grants, no-interest loans, and attractive rate structures.

During Phase I, it became clear that utilities could not achieve their demand-side management objectives easily under the current circumstances. Public housing authorities represented an anachronism, consumers with residential energy use patterns operating under commercial rate structures. PHA utility billing procedures in which 90% of the tenants paid no utility costs directly isolated the tenant from the mitigating "message of the market". The incentive payments paid residential consumers in typical utility load management programs would make no sense in this situation. Significant energy reductions occurring during the end of the heating season just after retrofits had been installed totally dissapated during the summer and the following heating season possibly due to the "takeback effect," or other impacts of resident behavior. The utility objectives of energy and peak load reductions weren't being realized. Appropriate energy management measures and tenant behavior clearly had to be addressed.

Despite the disappointing performance of the retrofits, utility interest in this consumer group increased during the period of the Phase I demonstration. The high saturation of electric water heating and resistance space heating and the continuing rise in the use of window air conditioners represented an opportunity for load management. In the absence of HUD technical assistance, PHAs were turning increasingly to their utility providers for advice on the most cost-effective retrofit measures for these multifamily units. PHAs began to look to the utility for help in setting utility allowances for tenants. These requests, plus a trend toward metering changes that would place the total responsibility for utility costs on the tenants were noted by utilities. These factors were considerations in the strong support from the utilities for the development of a method that could identify unusually high or low energy use and separate occupant effects from building and appliance stock performance. Changes in PHA utility billing procedures would also make it possible for the "message" of energy costs, as well as the "reward" of incentives to reach the tenant. The utilities were also interested in the demonstration of energy education activities effective for this low-income tenant group.

The evidence from our demonstration indicates that the availability of **financing** for retrofit measures is not **initially** a critical motivator to PHA administrators. However strong the economic incentive (either retrofit financing or reduced utility costs) might prove, much stronger disincentives exist due to HUD regulations that recapture a portion of the savings, PHA administrative procedures, and energy management attitudes of PHA staff and residents. An almost total lack of appropriate tools and technical assistance for PHAs to diagnose energy-related problems, decide what course of action to take, and evaluate the effectiveness of these actions complicated the situation further.

PHASE I DEMONSTRATION PROJECT: BACKGROUND

North Carolina's 96 public housing authorities (PHAs) own almost 39,000 units of conventional public housing, representing more than one in every twenty rental units in the state. These units are characterized by wood frame, slab-on-grade construction, with only a handful of buildings standing over two stories. Buildings usually contain five or fewer units, with many duplexes. Complex size varies, with 30-80 units common in smaller communities, 100-150 in larger towns. In the larger cities of the state, complexes containing 300-800 units are common.

Public housing in North Carolina is an unusually electric-intensive housing sector. Approximately one-third of these units are all-electric, with most using baseboard or radiant ceiling heat. Space cooling, although provided by the PHA only in the newer complexes for seniors, is becoming more and more prevalent as residents purchase their own window units. These units increase kWh usage and add better than 2KW per unit in demand.

Overall, these apartments, which average around 800 square feet, consumed over 256 million kWh in 1985, or 711 kWh per month. For the all-electric units, per month consumption averaged 1119 kWh. While procedures vary, most PHAs in the state use a check-metering system, which will be described later.

In 1982, AEC commissioned a study by Dr. Michael Stegman of the Department of City and Regional Planning, University of North Carolina - Chapel HIll, to better define energy use in North Carolina's public housing. What the study showed was alarming.

1. During this period, when the message of the market after the oil embargo was causing most of the residential sector to become more energy efficient, consumption in public housing actually was rising.

2. The rising costs caused by this increased consumption were not being covered by HUD, causing many PHAs' operating reserves to drop dangerously low.

3. After a period of HUD emphasis upon energy retrofits through the Modernization Program - the mechanism which funds maintenance of PHA buildings - energy was dropped as a priority.

The Phase I project was AEC's initial response to the problems and potential represented by public housing. It was primarily a demonstration of a method for leveraging additional financing for energy improvements in the PHA. The impact of the retrofits on both consumption and demand were monitored closely at one site so that the payback to the three investors could be documented.

Although of secondary interest, several other aspects of energy management were addressed by the demonstration project. Audit techniques, procedures for purchasing and installing the energy measures, and resident education all were included. Also, the need for monitored data afforded us the opportunity to evaluate a method for determining savings - PRISM - even though this evaluation was not an original objective.

Financing Mechanism

The first key to the financing mechanism was the use of the PILOT Rebate concept to obtain funding from the PHA's local government. The PILOT, or Payment-In-Lieu-Of-Taxes, a PHA pays each year is calculated as :

$$\text{PILOT} = (\text{Total Rent Receipts} - \text{Utility Costs}) \times 10\%$$

This means that 10¢ of every dollar the PHA saves on utility costs is paid to the local government through the PILOT. Because of this, the municipality has a direct, though often unrecognized, stake in the energy efficiency of its public housing.

This PILOT Rebate concept was pioneered in North Carolina by the Raleigh Housing Authority, which received a municipal government rebate of $142,000 in 1982 to help fund energy improvements. By 1986 the PILOT paid by the Raleigh Housing Authority already has increased enough that the City has recouped its entire investment.

In order to participate in the field test, a PHA had to obtain a small commitment of local municipal funding - $7,875. This figure was based on the average PILOT in the State for small to intermediate PHAs and was to be matched by the applicant PHA. It was recommended that the PHA use the PILOT Rebate concept to obtain the municipal funding, but this was not required.

The second innovative component of the financing mechanism was funding from the utility provider, with AEC funding initially. (In addition, the AEC was awarded Solar Bank funds for the retrofit measures.) The primary motivation for utility subsidizing of energy management in public housing is the contribution these electricity-intensive units make to peak demand. In designing the financing mechanism it was noted that significant load control potential existed since hot water is such a large component of public housing energy demand, and the State's major utilities already have residential water heater control programs that could be expanded to include public housing.

Together, these three sources of funds - municipal (PILOT Rebate), PHA (HUD), and utility (AEC/Solar Bank) - provided the financing for the project. The original commitments of funds by the municipal government and by the PHA were converted to a percentage of the total anticipated cost of the retrofits, $60,000. Actual payments in the field test were then based on these percentages, so that the government and the PHA paid approximately 13% each of the total cost, with AEC/Solar Bank funds paying the remaining 74%.

Site Selection

While technically open to all the State's PHAs, the field test was targeted toward the small- to intermediate-sized authorities (500 or fewer units), of which there are over 70 in North Carolina. The application required a PHA to obtain a letter of commitment from their local government for the $7,875, and had to document that they had the matching funds available in their own budget.

Only five PHAs applied for the three available slots. Our investigation of this low response rate identified several problems. First, the program was not aggressively advertised. The offer of matching funding simply was not enough to command the full attention of many PHA directors, especially considering the nontraditional source of funds. We discovered, too, that many of the administrators of the smaller PHAs lack experience or success in grant-writing, and were inhibited by the application process. A worthwhile suggestion that came out of this experience was that grantsmanship training be offered along with any similar program in the future.

Finally, evidence indicates that the PILOT Rebate concept itself was a barrier. Some localities view the PILOT as an unfair avoidance of property taxes. Where this attitude existed, the town government was unlikely to "forgive" the PILOT. However, in two instances that we know of, while the town government refused to rebate the PILOT, they understood the municipal interest in energy efficient PHA units well enough to fund the required amount out of general funds.

Retrofit Program

The funds secured through the PILOT Rebate mechanism were used to fund the retrofit of 228 units at the three test sites. Throughout the retrofit routine PHA procedures were followed as far as possible. This strategy maximized the potential for institutionalizing the results of the field test with minimal disruption in normal procedures.

Retrofit measures were selected based on an engineering analysis by AEC. However, in accordance with our intent to conform to established procedures where possible, the results of this analysis were compared with two audit technologies more commonly available to PHAs - the HUD audit workbook (which PHAs must use to receive HUD funding) and audits provided by the local utility provider.

This comparison indicates that the RCS audits available from the utility providers, designed largely for single-family detached housing were not appropriate. However, in our small sample, the HUD workbook produced roughly the same recommendations as did our more thorough, and more costly, engineering analysis. Based on this experience, we recommend that PHAs use the workbook to select measures. However, we feel it is critical that the results be reviewed for obvious flaws by someone familiar with retrofits, such as a local utility provider, or an architect working with the PHA on a modernization project.

It also is important for the PHA to resist the tendency to favor more visible measures, such as storm windows, even when the paybacks are not attractive. Through some PHAs may feel it is important to use municipal funds in such a visible manner, it is much more critical that savings be achieved. Particularly with storm windows and doors, it has been our experience that while they improved appearance, they rarely achieved the savings predicted for them, largely due to improper installation or use.

After measures were selected, each PHA chose suppliers and materials based on normal purchasing routines. While we have no information that any of the measures are inferior, it is clear that they were selected in a virtual vacuum of information about their quality. Past history of suppliers, rapid or easy availability and vendor's claims were the driving forces behind these purchases, not objective data on their quality or energy management performance.

The actual work of installing these measures was accomplished by a combination of PHA staff and outside contractors, again following normal procedures. When all measures had been installed to the PHA's satisfaction, AEC conducted an independent inspection to insure proper installations. No problems were found.

The measures installed at the monitoring site were storm doors and windows, flow restrictors in the kitchen and bath, low flow showerheads, water heater wraps, and fluorescent lights in the kitchen and porch. Total installed cost was $676 per unit. Even though experience and the engineering analysis indicated that indoor air temperature during winter was a problem, no measures were recommended to address this because space heat is provided in these units by baseboard heaters, with a thermostat in each room. The cost of installing three to seven setback thermostats per unit outweighed the potential savings.

Tenant Education

Tenant education programs were planned at each of the three test sites, in conjunction with the retrofit program. Because of our concern with institutionalization after the demonstration, we proposed these programs be provided either by the PHA or by some other local resource. AEC assisted in identification of local resources and provided information on successful techniques used elsewhere. Although some level of education did occur at all three sites, three barriers minimized the program's effectiveness: (1) a strong tendency among PHA personnel to blame residents entirely for any "excessive" energy use, setting up an extremely negative environment for educational activities; (2) a billing procedure that provides the residents with virtually no feedback on their energy use - they receive information on their consumption only when they exceed the energy allowance; and (3) the lack of readily available local resources. Organizations such as Councils on Aging, Community Action Programs, Legal Aid, and Agriculture Extension, which are potential resources for education programs, are all facing budget cutbacks and find it difficult to provide new programs. With great effort, an effective education program could be put together, if the PHA decision-makers were open to it. However, it is our conclusion that until PHA staff and residents are more motivated, such efforts would not be effective.

Energy Savings Analysis

Data Acquisition and Analysis. Two types of data were obtained. The first was monthly billing data for the period January, 1982, to December, 1985. These data were regressed against the local weather, using the "Princeton Scorekeeping Method". This method is described in detail in Fels, et al (1983)[2], and an application of the method is given in Hirst (1984)[3]. The historical data base was taken from January, 1982 to November, 1984, which is when the first conservation measures were instituted. A comparison is then made between the energy consumption predicted by the model developed from the historical data and the actual energy consumption in 1985. It is assumed that the predicted energy represents the energy consumption that would occur without the retrofit measures. Measured energy data for two different sites were obtained: Cannady Courts in which no conservation measures were instituted; and Preston Street where the conservation measures were put in place. The two sites are located in the same town, and have similar size, construction and occupancy. It was originally believed that Cannady Courts could serve as a baseline against which to measure any changes at Preston Street. However, due to differences in energy use patterns at the two complexes, this turned out not to be possible. Since Cannady Courts did not undergo any changes, it was subsequently used to evaluate the accuracy of PRISM under these conditions.

In addition to energy consumption, information on how the conservation measures impacted peak demand was also desired. Accurate historical data on the maximum demand each month was believed to be available. In November, 1984, a strip chart demand meter was installed at Preston Street. This meter provided the demand at 15 minute intervals, and was used to determine the day and hour of the maximum demand each month. Although the historical demand data subsequently proved to be in error, the data from the strip charts were used to produce a picture of the current demand profiles. These profiles offer some insights to ways that may successfully reduce demand charges.

<u>Energy Consumption Results</u>. A comparison of the historical energy consumption at both Cannady Courts and Preston Street appears in Figure 1. It is apparent that the energy use pattern of the two sites is significantly different, with Preston Street using more energy in the winter and approximately the same in the summer. Furthermore, additional analysis showed more use of air conditioning at Cannady Courts. Because of these differences, any attempt to quantify savings at Preston Street through a simple comparison to Cannady Courts is not likely to be accurate.

A much better approach is to use historical data to establish the sites energy consumption as a function of weather, and then compare energy consumption as predicted by analysis and the current weather with the energy consumption that actually occurs.

The validity of this approach is demonstrated by examining the historical and current data for Cannady Courts. Because there were no retrofit or behavior changes at Cannady Courts, predicted and measured energy use should agree. The difference between the two indicates the accuracy of the methodology. Table 1 gives the measured and predicted energy consumption at Cannady Courts. As can be seen, the monthly agreement is within 10% for all but two months. These two months are May and September, which are the two months with the least energy used for heating or cooling. The percent error over a year period is 4%, and if May and September are omitted, the error falls to 2%.

The comparison of measured and predicted energy consumption for Preston Street is given in Table 2. Installation of the conservation measures took place in November and December, 1984. Our one year's measured data spans January - December, 1985.

The results show a substantial reduction in energy consumption for the 1985 heating season which is immediately following installation. This trend continues into the summer, and a savings of 17% was achieved in the first six months.

However, during the summer, this trend dissipated and, in fact, some energy losses were recorded. When the errors inherent in the analysis are taken into account, it appears that energy consumption basically has returned to the level prior to installation of measures. Subsequent data not included in the tables confirms this trend in January, 1986. As a result, savings for the entire year of measured data total approximately 9%.

Based on these two contradictory trends, the following payback information can be calculated:

	Following Trend of First Heating Season	Actual Measured Annual Savings
Total Project	7.4 years	17.0 years
PHA/HUD (90% of savings)	1.0	2.5
Municipality (10% of savings)	9.7	22.3

At this time we have no definitive answer as to why the savings trend disappeared. PHA personnel report that the measures are still in place and that no other modifications to the buildings have been made. However, they also report that after the residents became accustomed to the storm doors, there has been a tendency on the part of residents to use the storm doors as though they were primary doors. This has been observed during both summer and winter, but no effort has been made to quantify the behavior. Since almost one-third of these units are air-conditioned this could possibly account for the loss of savings. In addition, storm windows opened during periods of warm weather during the winter (not unusual in North Carolina), were often not closed afterwards. This was not considered a maintenance staff responsibility.

It is our conclusion that the measures themselves are effective in reducing energy costs, and by a substantial amount. By taking a more comprehensive approach to energy management in these units, the factors that currently are contravening the savings can be identified and corrected.

Energy Demand Results. The historical demand data were found to be in error and could not be used. This was not a major loss, since no demand management programs were available, and the measures installed were aimed primarily at reducing consumption, not demand. We went ahead and measured demand at Preston Street throughout 1985 to investigate the factors that influence peak demand and to document when it occurs in these units. This information wiil be useful to utility planners in judging what program may be effective in public housing and will give us a baseline if we chose to implement a trial demand management program at the monitoring site.

The monthly peak demand at Preston Street consistently occurred during a weekend morning, usually Sunday, although high levels of demand also occurred on week day mornings. Thus, in winter, the peak demand would occur on the morning of the coldest Saturday or Sunday, rather than on the coldest week day. This highest peak in the morning continues through the summer, on the weekend. The presence of the morning peak through the summer, in spite of air conditioning in almost one-third of the units, indicates strong cooking and hot water components.

Conclusions

The results of the Phase I Demonstration Project indicate that municipal funding is a viable option for providing limited amounts of financing for energy improvements in public housing. A retrofit program following the most routine PHA procedures achieved initial savings of approximately 17%. By implementing follow-up energy management practices, the PHA should be able to maintain this level of savings, thus providing a payback to the Town attractive enough to encourage such an investment.

The case for utility funding remains unproven. Data gathered at Preston Street evidence strong potential for both time of use rates and load control for water heaters. However, the amount of savings and demand reduction that could be achieved has not been quantified.

Because of the incomplete answers produced by Phase I, a second phase of activities in the public housing sector was planned. The remainder of this paper will describe the barriers to be confronted and the approach being taken by AEC to surmount these barriers and to institutionalize energy management in this sector.

PHASE II: INSTITUTIONAL BARRIERS

Dependence on HUD

Public housing authorities are chartered by their local government, but in practice are subunits of the federal Department of Housing and Urban Development (HUD). Since the first Housing Act passed in the 1930's, HUD has directed the development and maintenance of public housing. Although levels have fluctuated, HUD always has supplied funding for new construction, maintenance, energy improvements and other needs in public housing. HUD also has attempted to provide a comprehensive program of technical assistance to assist PHAs.

Over the years PHAs have become reliant on this system. Even though they sometimes question the wisdom of HUD's directives, they look almost entirely to HUD for leadership in defining and solving problems.

However, the landscape is changing. Not only has HUD virtually eliminated funding for new development, but its technical assistance role also has been curtailed severely. This leaves many PHAs, particularly the smaller ones who lack the staff resources found in the larger authorities, in an informational and directional vacuum. Simply put, in the absence of a HUD directive, the typical PHA administrator is not motivated to undertake new procedures, especially those for which he may lack adequate knowledge or resources.

Performance Funding System

In addition to the information barrier just described, some aspects of the HUD/PHA system reduce the benefits to the PHA of energy management. Chief among these are certain aspects of the Performance Funding System, the funding mechanism which makes up the difference between a PHA's operating budget and the amount of money it makes in rents.

The amount of funding a PHA receives through the Performance Funding System for energy is governed by the following provisions:

1. A fiscal year's allocation for energy determined by a three year "rolling base" computation. Energy consumption is averaged for the previous three years and multiplied by current energy costs to calculate the next year's allocation for energy.

2. If the PHA exceeds the allocation in a given year, HUD will pay 100% of the excess if it is due to a rate increase, 50% if due to other factors, but only if leftover funds are available in HUD's budget.

3. If the PHA comes in under the allocation, HUD allows the PHA to keep only 50% of the "savings". Also, the lesser consumption figure, whether due to HUD-funded improvements, local initiative improvements, anomolies of weather, or pure chance, goes into the three year rolling base, and lessens the PHA's next allocation. In three years, any savings to the PHA are completely eliminated.

We contend that this lack of reward is a powerful disincentive and, therefore, a major barrier. If more of the savings could be kept by the PHA and could be translated into rewards such as new office equipment, enhanced staff training or special residents' programs, motivation to pursue energy efficiency would be greatly enhanced.

Relationship with Local Environment

Phase I demonstrated that, the political sensitivity of the PILOT not withstanding, local governments are a viable source of at least small amounts of funding for energy improvements. However, this requires a positive relationship between the PHA and the local government, a situation that does not always exist.

Furthermore, even if the relationship between the PHA and the local governing board is cordial, the tendency of PHA administrators is to keep a very low profile. Since new construction of public housing is almost always opposed by someone, and usually opposed vigorously, PHAs tend to try to stay out of the public eye. For this reason, having to go to a public meeting to request funds, even for retrofits of existing units, may be a strong enough disincentive to keep some PHAs from seeking funding.

Billing Procedures

Just as the Performance Funding System lessens the administrators incentive to reduce energy consumption, the billing procedure employed by most N. C. PHAs insulates the tenants from any useful feedback that could serve to motivate them.

In most cases, the PHA is responsible for all utilities, with energy being metered through a master meter. Each individual resident's consumption is monitored by a check meter, but the resident is charged only if the allowance set for that unit is exceeded. However, if the resident consumes less than the allowance, no funds flow in the resident's direction. In fact, the resident generally does not even receive an accounting of his or her energy use unless the allowance is exceeded.

Current billing procedures do not promote energy management for the following reasons.

1. Given that the energy allowance system (which is discussed in more detail later on) is designed so that relatively few residents ever pay an excess charge, there is no economic incentive, no message of the market, to motivate the resident to conserve energy.

2. The almost total lack of consumption information insures that residents will be unaware of the impact of their habits on their energy use. Wise users of energy are not rewarded. Only an arbitrary percentage of the highest (whether wasteful or not) users are required to pay excess charges.

3. The negative incentive aspect of the billing system - a carrot and stick approach with no carrot - exacerbates the usually negative feeling residents have about utilities in general. In short, it is a system with all negatives, no positives for the resident.

Energy Allowance System

A final barrier peculiar to the institution of public housing relates to the system for establishing energy allowances for individual units.

In 1979, HUD implemented a system for calculating energy allowances that instructed PHAs to set allowance levels such that, in a given month, 10% of the residents in that PHA's units would pay an excess charge. No matter what the weather or the condition of the units, allowances were to be set so that 90% of the residents would receive no charge - and no information - and the other 10% would pay. This set the initial allowance level.

For future revisions, PHAs were instructed that if, due to weather or any other cause, as many as 25% of the residents exceeded the allowance, then the allowance would be raised up to the 10% level for that same month the following year. No provisions were made for ever lowering the allowances.

Like other barriers discussed, this system had several deleterious side effects. It completely and totally failed to recognize that different buildings perform differently. To say that, regardless of the tremendous variation in the upkeep and energy efficiency of the buildings across the state, 10% of all residents in every PHA must pay an excess charge seemed illogical.

Secondly, our data indicate that whole communities of residents behave differently from other communities. In other words, if buildings and weather conditions are factored out, some communities would appear to have no members who "over-use" energy, while in others, virtually all appear "wasteful."

Finally, the 25% rule had the effect of periodically racheting up the allowances. Given that (1) no residents ever know how much energy they are using unless they exceed the allowance and (2) no provisions allowed the allowances to ever be reduced, the overall allowance levels gradually rose, putting ever more distance between the residents and the market.

PHAs are no longer required to use this system. In 1984 a new regulation was promulgated which instructs PHAs to set allowance levels that "approximate what a reasonably conservative family of modest means would consume." Unfortunately, due to HUD cutbacks in technical assistance, no instructions have been or are in the near future forthcoming from HUD on how to determine what this means. Consequently, most PHAs are still using some variation of the old system, but now with no advice or backing from HUD. Again, the impact of this situation falls hardest on the smaller PHAs.

Changes in Project Direction/Recommendations

The net impact of our encountering these barriers was a change in the direction of our efforts in this sector. While we still are committed to addressing the financing question, we recognize now that financing is not a sufficient catalyst to motivate most PHAs to pursue energy efficiency. Rather, a comprehensive approach to energy management must be marketed to the PHA administrator. Actions must be taken to identify achieveable results that will motivate the PHA staff, its municipality, and the local utility to address energy management in this sector. The institutional barriers must be removed. Only then will financing be enough of a carrot to coax the PHA into action.

When effective incentives have been identified and barriers removed, the PHA administrator will need certain tools to assist in the implementation of energy management. Without these even the motivated PHA may be unable to accurately diagnose energy problems, design effective solutions, or evaluate the effectiveness of its actions.

Finally, we have recognized the need for more emphasis on technical assistance. Even when a strategy has been selected, most PHAs need assistance in choosing products, designing education programs and so on. As we have learned at Preston Street, even an initially successful energy efficiency program requires expert follow-up, something most PHAs cannot provide themselves and which HUD can no longer offer. Clearly, potential sources of such assistance, such as the utility providers need to be explored.

FUTURE AEC ACTIVITIES

Utility Allowance Calculation Model

The cornerstone of AEC's follow-up efforts to institutionalize energy management in our State's public housing is the development of the Utility Allowance Calculation Model. This Model, which is being developed based on billing, structural and occupancy data from North Carolina PHAs, will provide the PHA with the major tools it needs to effectively manage energy in its buildings. AEC will coordinate its efforts closely with the Lawrence Berkeley Laboratories who are conducting related work.

The primary function of the Model is to establish utility allowances in an accurate or equitable manner, by setting the allowance based on the actual structural conditions found in the apartment, occupancy, and on weather. This will allow the PHA to deliver more of the message of the market to its residents, without risk of penalizing some because of differences from one unit to the next. This feature also will provide the basis for more effective resident incentive and education programs.

The second, and perhaps equally as important, function of the Model is to identify buildings with unusual energy problems. This diagnostic tool will allow the PHA to easily and accurately identify which, if any, of its buildings need to be considered for an energy management program.

Finally, by providing the PHA with a routine and understandable flow of energy consumption data on its buildings, the Model will allow the PHA to monitor the impact of its energy management efforts.

The Public Housing Energy Management Series

Phase I identified the lack of credible information and poor access to information as a major barriers to energy management in PHAs. This is particularly true in the smaller PHAs, which lack staff resources to assist the director in recognizing, analyzing or acting on energy problems. The tools offered by the Utility Allowance Calculation Model will provide needed data, but information non how to implement an energy management program is equally as important.

To address this issue AEC will develop the Public Housing Energy Management Series. This Series of workshops and complementary materials will be offered over a two year period, and will, in effect, constitute a training curriculum in energy management. The workshops, which will be offered in conjunction with the semi-annual meetings of the state's PHA association, will be AEC's primary vehicle to market energy management to

PHAs. They will cover topics such as how to best use the Utility Allowance Calculation Model, how to select the most energy efficient measures and appliances, and how to design effective resident incentive and education programs. A separate track will be developed for maintenance personnel on such issues as HVAC maintenance, retrofits and up-keep of energy improvement measures.

The workshops will be accompanied by the publication and promotion of a series of relatively brief, easy to understand manuals, workbooks, factsheets, and video materials, covering the major issues relating to controlling energy use in PHAs.

Demonstration of Additional Energy Management Strategies

A key component of AEC's efforts is to provide information on the most effective energy management strategies available to PHAs in North Carolina. To be sure we are providing the most accurate information possible, we will conduct small demonstrations on three approaches that were not adequately addressed in Phase I.

First, we will provide training on infiltration control to maintenance personnel at several PHAs and will assist them in implementing a program of infiltration control in their units. Second, we will assist PHAs in developing tenant incentive and education programs based on offering a positive financial incentive for reduced energy consumption. Third, we will demonstrate load control for water heaters and time of use rates in public housing. The resultant savings from these demonstrations will be monitored and compared to those of the retrofit program.

Financing Options

Phase I demonstrated that municipal governments are a viable source of limited amounts of funding for energy improvements in PHAs. But, this source is not nearly enough to meet the needs of the state's PHAs in the face of ever-diminishing federal support.

In our follow-up activities, AEC will provide information through the Energy Management Series, on how to maximize funding through conventional HUD channels. We will continue to investigate the potential for utility provider funding, in addition to PHA use of load control programs and time of use rates. Finally, we will work with HUD to eliminate current regulatory barriers to peformance contracting in PHAs and to demonstrate this as an approach to funding energy improvements in PHAs.

SUMMARY

AEC remains convinced that public housing holds strong potential for both reductions in electrical consumption and in peak demand. This energy management could benefit the PHA and its tenants, the local municipality, and the state's utilities. Energy managment in PHAs can effectively be marketed based upon economic incentives only when significant insitutional barriers have been removed, and systems of technical assistance for PHAs have been developed.

AEC has designed a series of activities to be implemented over the next two years. These activities will focus on providing the administrator, especially in the smaller PHAs, with easy to use tools and technical assistance to assist in diagnosing energy problems, implementing effective strategies, and monitoring results. In essence, we are seeking to improve the energy efficiency of an entire residential sector - some 39,000 units - by upgrading the energy management skills and tools of the managers of those units, and persuading those managers to pursue energy efficiency. This represents a different track, a different approach from that followed by some other organizations who promote energy management by working intensively with one building or complex at a time.

Can our approach work? We feel it can, and for a variety of reasons. First of all, the housing stock in North Carolina's PHAs is relatively simple and does not vary as much as does other types of housing. Because of this, training on how to diagnose and address problems in these buildings can be more effective.

Secondly, PHAs are accustomed to looking to someone else for advice and leadership. In the past HUD has filled this role, but is unable to do so adequately any longer. AEC seeks to build new support mechanisms, which will be developed by AEC and institutionalized in other organizations, such as utility providers, to fill this vacuum.

Finally, the PHA administrators and other personnel who manage these units perceive of themselves as a community, an institution. They communicate with each other routinely, and they look to each other for information, for support and for motivation. Because of this community feeling, an approach that works for one will be picked up by others. Our job, then, is to market energy efficiency to a relatively few of the "right" PHAs and then be sure that the needed information, tools and technical assistance are available to the rest to make our approach a success.

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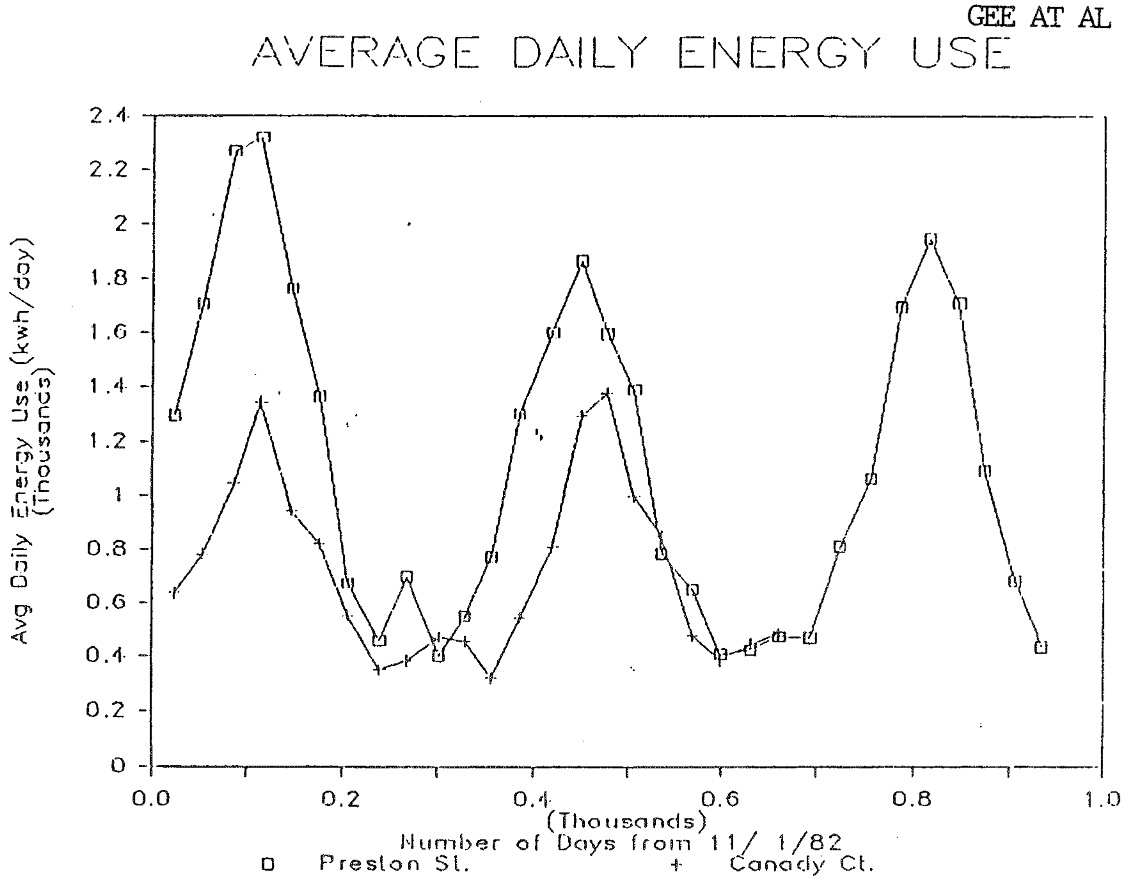

Figure 1: Measured Energy Use for Both CC and PST.

TABLE 1

CANADAY COURTS ENERGY CONSUMPTION ANALYSIS

Measured and Predicted Energy Consumption

Energy in Hundreds of Kwh

Month-Yr	Measured Energy	Predicted Energy	Percent Diff
Jan, 85	333	352	-6
Feb, 85	462	463	0
Mar, 85	297	278	6
Apr, 85	225	204	9
May, 85	132	101	23
Jun, 85	132	129	2
Jul, 85	117	122	-4
Aug, 85	156	145	7
Sep, 85	147	123	16
Oct, 85	108	101	6
Nov, 85	129	117	9
Dec, 85	183	185	-1
Total	2421	2320	4
Omitting May and Sept			
Total	2142	2096	2

TABLE 2

PRESTON STREET ENERGY CONSUMPTION ANALYSIS

Measured and Predicted Energy Consumption

Energy in Hundreds of Kwh

Month-Yr	Measured Energy	Predicted Energy	Percent Diff
Jan, 85	564	654	-16
Feb, 85	547	683	-25
Mar, 85	294	392	-33
Apr, 85	205	225	-10
May, 85	126	138	-10
Jun, 85	146	169	-16
Jul, 85	147	123	16
Aug, 85	147	114	22
Sep, 85	180	154	14
Oct, 85	180	178	1
Nov, 85	228	241	-6
Dec, 85	462	450	3
Total	3226	3521	-9