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Energy Partners Version 2
Design Plan

Prepared for:
Louisville Gas and Electric Company
Energy Partners Program

Final Report
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EXECUTIVE SUMMARY

The Louisville Gas and Electric Company (LG&E) Energy Partners Program (EP) is a weatherization program designed to reduce the energy consumption of LG&E's low income and payment-troubled customers. In 1994, The Louisville Gas and Electric Collaborative designed a pilot Energy Partners Program. Over the following three years the pilot program provided service to approximately 1100 qualified houses. In 1997 Proctor Engineering Group (PEG) performed an impact evaluation of the EP Pilot. The evaluation found that the pilot had significant impacts on participants' bills and service disconnections while identifying and repairing many health and safety problems.

Based on the impact evaluation, research into other low-income programs, and an analysis of the LG&E low income population, Proctor Engineering Group designed Energy Partners Version 2. Version 2 of the EP program is designed to improve the program's cost effectiveness by applying the lessons learned in evaluations across the United States. The keys to this effort are targeting, measure selection, cost control, and program oversight. The program targets high energy consumption customers, selects measures that will be the most effective in the individual home, limits the expenditures, and tracks the results.

Program Goals

The mean gas savings in evaluated low-income programs averages slightly over 15% at a cost of $1,717 per treated home. The goals of EP Version 2 are:

- A participant gas energy consumption reduction averaging 22% of pre-retrofit consumption.
- A participant electric energy consumption reduction averaging 10% of pre-retrofit consumption.
- An average measure cost per participant of $1400.

The key to achieving these goals is a flexible and comprehensive system. The system can be summarized as follows:

- Customers are targeted based on their energy savings potential as determined through billing analysis.
- Measures are screened and the appropriate measures are selected based on additional information about the customer and their residence.
- Appropriate measures are installed in an efficient and effective manner as a result of work flow design, training, and feedback to improve efficiency, competence, and confidence.

Targeting

The marketing and recruitment process is designed to reach high-use households. Potential participants will be selected based on a utility bill analysis. This analysis will categorize customers in three tiers:

- Tier A - Customers with the lowest energy usage. This level is a broad-based service offering available to all LG&E low-income customers. This group is the least cost effective group to serve and reduces the available funds for effective application to households that can benefit from the expenditure. Tier A customers enter the program through word-of-mouth referrals.

  Tier B - Customers with gas consumption of 1300 to 1800 ccf or electric consumption of 12000 to 16000 kWh. These customers have less cost effective measures available and will enter the program in the same manner as Tier A customers.

  Tier C - Customers with over 1800 ccf of gas consumption or over 16000 kWh of electric consumption. This group is the target market! The marketing will use direct mail and telemarketing to capture a large percentage of this group. The greatest potential for energy savings exists in these households.

Screening

The screening process is:

- In the office, an analysis of the customer's energy usage is performed. This sets the allowable expenditure based on energy savings potential.

- In the house, diagnostic testing and physical examination determine which measures are applicable.

- Priorities are set based on the usage patterns and the diagnostic results.

- A look-up table is followed until the allowable expenditure level is reached or all cost effective measures have been applied. A portion of the Tier C lookup table is displayed in Table 1.

Table ES-1. Look Up Table Example

Tier C	Annual kWh > 16000 or Annual therms>1800	
Maximum measure expenditure $2200		
Priority	Measure	Criteria
1	Second refrigerator removal	Existing unit functioning and plugged in
2	Crawlspace treatment	Ducts in crawl no standing water
3	Duct sealing	Heating therms>1200, or cooling kWh>4500, or ducted electric heat. IN ALL CASES THERE MUST BE A PRESSURE PAN READING > 2 pa.
4	Hot water leak repair	Repairable in first visit
5	Ceiling insulation and duct fluff	Attic floor ducts, Ceiling insulation < R-5, and heating therms>1200, or heating kWh>17000
6	Duct insulation	Attic ducts, existing R<4, and heating therms>1200
7	Waterbed insulated cover	Heated water bed
8	Strategic dense pack	Heating therms>1200, or heating kWh>17000

Program Oversight

Program oversight is provided through invoicing and production reports to LG&E and the Collaborative, as well as monthly evaluations prepared by an outside evaluation consultant.

Contractors are responsible for invoicing jobs completed during the invoicing period. Only completed jobs are eligible for billing, no partial completions are to be accepted. The contractor submits hard copy invoices as well as completed database records for each completed unit.

The evaluation contractor analyzes databased information monthly. They prepare a monthly report that includes production, energy savings (adjusted to actual billing data), and costs by contractor and by Tier. These results are compared against milestones. The monthly report also discusses critical issues, essential decisions, and potential program changes.

1. INTRODUCTION

The Louisville Gas and Electric Company (LG&E) Energy Partners Program (EP) is a weatherization program designed to reduce the energy consumption of LG&E's low income and payment-troubled customers. In 1994, The Louisville Gas and Electric Collaborative -- a group of stakeholders including LG&E, low-income advocates, low-income service providers, government representatives, and business representatives designed a pilot Energy Partners Program. Over a three year period through June of 1996 LG&E provided service to approximately 1100 qualified houses. In July 1996, Proctor Engineering Group (PEG) was selected to perform an Impact Evaluation of the EP Pilot. The Impact Evaluation found that the program fell short of its targeted energy savings, but had significant impacts on participants' bills and service disconnections while identifying and repairing many health and safety problems. The principal recommendation of the Impact Evaluation was that other potentially more cost effective measures and program designs should be explored. In August 1997, Louisville Gas and Electric Company selected PEG to redesign the Energy Partners Program. This report details Version 2 of the Energy Partners Program.

Report Structure

The EP Version 2 Design Report consists of this document and appendices. The appendices contain more detailed information, examples, and standards. The appendices are bound separately from this document.

Background - Results of Pilot Program Analysis

The LG&E Energy Partners Program was designed to reduce the energy consumption of Louisville Gas and Electric Company's low income and payment-troubled customers. The program provided both directly installed weatherization measures and an education component to enlist the customer as a "partner" in ensuring the energy savings. The program began in 1994 with a target production of 1500 high use households[1] over three years. The main goals of the program included saving 15-20% of the participants' energy usage; reducing bills and therefore service disconnections, arrearage levels, and collection actions; and improving the health, safety, comfort, and quality of life of the participants. The main program treatments included air sealing, attic insulation, heating system safety repairs, and energy education. All weatherization services were provided at no cost to the customer.

Savings

The impact evaluation found that participants in Energy Partners saved an average of 186 ccf of gas and 783 kWh of electricity annually due to program treatments. The gas savings equal about

[1] Defined in the pilot as natural gas consumption greater than 1200 ccf per year or electric consumption greater than 7000 kWh per year.

12% of total usage and 16% of heating usage. The electricity savings equal about 8% of a very high annual electrical usage of over 11,000 kWh. These energy savings are worth about $128 in bill reductions at current rates, or about $61 in marginal costs for LG&E. Insulation saved as much as expected while air sealing may not have performed as well, particularly for houses with extensive time applied to air sealing. Participant education may have been responsible for some of the electricity savings, but no evidence was found to indicate that heating season thermostat settings were effected[2].

The frequency of service disconnections and termination notices both dropped by 22% after treatment. These reductions are equivalent to avoiding approximately 76 disconnections and 980 termination notices annually per 1000 participants. The frequencies of late and missed payments also declined.

Numerous gas leaks and safety hazards were identified and repaired through the program with approximately three quarters of all participants receiving safety-related repairs to their heating or water heating equipment. A number of other potential non-energy benefits in areas ranging from participant health and housing affordability to economic and environmental benefits were also identified.

Cost-Effectiveness

Program costs averaged $1062 per house for direct weatherization treatments, including $122 for heater safety repairs. Overall pilot costs averaged about $1600 per house when including all start-up and evaluation costs. The cost for a continuing EP pilot was estimated at $1355 per unit including on-going training and evaluation costs. The present value of the energy savings is $1434 when these savings are valued from the participants' perspective, making Energy Partners cost effective as a continuing program. LG&E's low avoided costs make the net present value of energy savings worth $691 on an avoided cost basis. On an avoided cost basis, the EP pilot was not cost effective unless non-energy benefits are valued at more than $600 per participant.

Comparison to Goals

In comparison to the program goals, the EP pilot fell short on percent energy savings, but did have significant impacts on participants' bills and service disconnections, and identified and repaired many health and safety problems.

Relative to other low income weatherization programs, EP compared favorably by providing more percentage savings per dollar than many other programs including the national DOE Weatherization Assistance Program (WAP) study. WAP cost more and saved slightly less than Energy Partners. The moderate climate region (which includes Louisville) in the National WAP study had an average cost of $1580 per participant, gas savings of 12.4% of total usage and 18% of heating usage.

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[2] The largest potential energy savings effect from education is the reduction of thermostat settings.

2. POPULATION ANALYSIS

In order to assess the potential size and characteristics of the EP target population , Proctor Engineering Group took two approaches. First PEG analyzed data supplied by LG&E. Second, PEG analyzed 1990 census data for the zip codes served by LG&E.

Billing Data Analysis

Louisville Gas and Electric provided the design team with usage and payment related data on 27,544 residential accounts. These accounts were selected based on being either: payment-troubled (a payment owed for more than 60 days during the last year) or a fuel assistance recipient (Home Energy Assistance Program or HEAP). A total of 6987 HEAP customers were identified along with 20,557 non-HEAP payment-troubled customers. The payment troubled group is likely to include a significant number of customers who are not income-qualified for the program. While the group may not fully represent the target population, it provided one indication of the low-income target population[3]. An initial examination of the data found 368 accounts which had customer names that were clearly commercial (often builders, real estate companies or condominium associations). These customers were removed from the analysis, leaving 27,176 customers.

Analysis Approach

LG&E provided 24 months of gas and electric usage histories for the identified customers. PEG analyzed this data in two ways. We utilized the industry-standard PRInceton Scorekeeping Method (PRISM) software to develop weather normalized estimates of heating, cooling (for electric), and baseload usage. It also provided estimates of effective heating balance point temperatures. Because the target population was defined to include payment troubled customers, the usage data contained numerous service disconnections and truncated usage histories. These data problems often led to questionable PRISM results, particularly for electricity usage data. To address these problems and develop reliable usage analysis results for as many cases as possible, PEG also employed a more reliable analysis using a seasonal degree day adjustment.

The degree day approach produced normalized annual consumption estimates nearly identical to PRISM for cases with "good" data and tended to produce more reasonable results for cases with poor data quality. On average, the degree day approach produced somewhat higher estimates of baseload usage and lower weather sensitive usage estimates than PRISM.

[3] Census data was also used to expand our knowledge of the low-income population.

Energy Consumption

Table 2-1 Weather Normalized Electric and Gas Usage

Electric (kWh/yr)			Distribution of Usage (percentiles)						
	# Cases	Average	Min	10%	25%	50%	75%	90%	Max
Cooling		2477	0	435	1147	2190	3466	4819	25184
Heating		1156	0	0	121	481	1126	2845	36766
Baseload		5890	365	2102	3315	5121	7580	10471	48190
Total Use	24871	9523	389	3845	5677	8381	11914	16220	77122
Gas (ccf/yr)									
Heating		716	0	215	389	622	929	1317	20412
Baseload		345	12	142	222	316	426	557	7224
Total Use	21341	1061	24	430	649	951	1335	1811	20972

The table shows an average annual energy usage of 9523 kWh and 1061 ccf. These usage levels are substantially less than those of EP pilot participants (11,135 kWh and 1524 ccf). The pilot targeted high use households and was successful in this targeting. The distribution of household annual gas and electricity usage are shown in Figures 2-1 and 2-2.

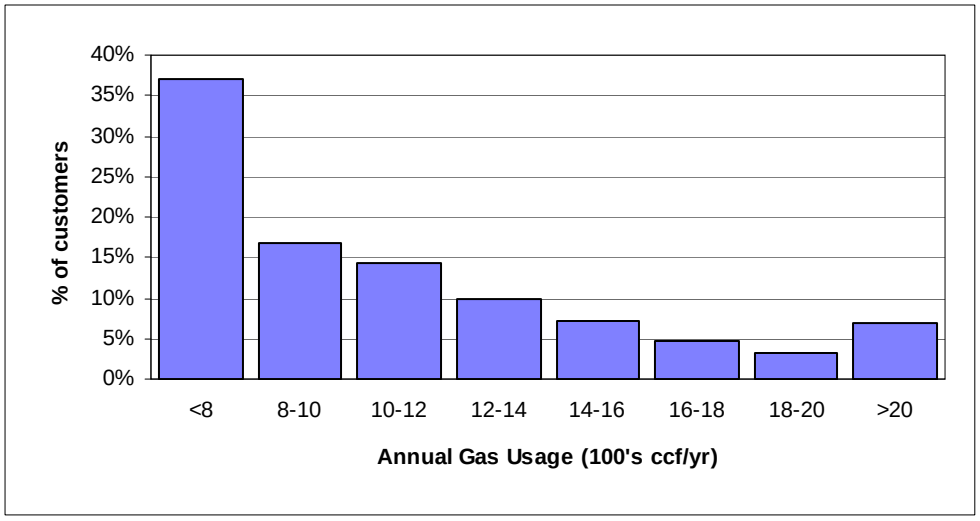

Figure 2-1 Annual Gas Consumption Distribution in Billing Sample

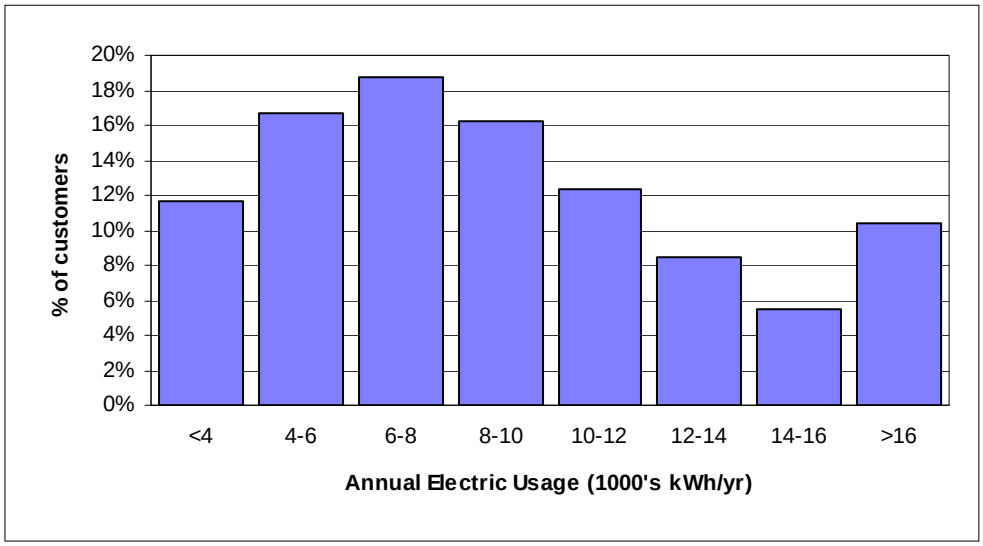

Figure 2-2 Annual Electric Consumption Distribution

Gas Baseload

PEG examined the gas baseload (i.e., non-heating) usage to estimate the potential frequency of hot water leaks (a major cause of vary high gas baseload use among low-income households). Customers who use more than 500 ccf of gas annually for baseload typically have either very large families, some commercial-oriented use of hot water (e.g., day care or take-in laundry) or have a hot water leak. Figure 2-3 shows the distribution of baseload gas consumption. A total of 8.1% of the billing sample use more than 500 ccf and 4.5% use more than 600 ccf for gas baseload (1759 and 976 customers, respectively). The frequency of high baseload use is greater among HEAP than non-HEAP houses in the group.

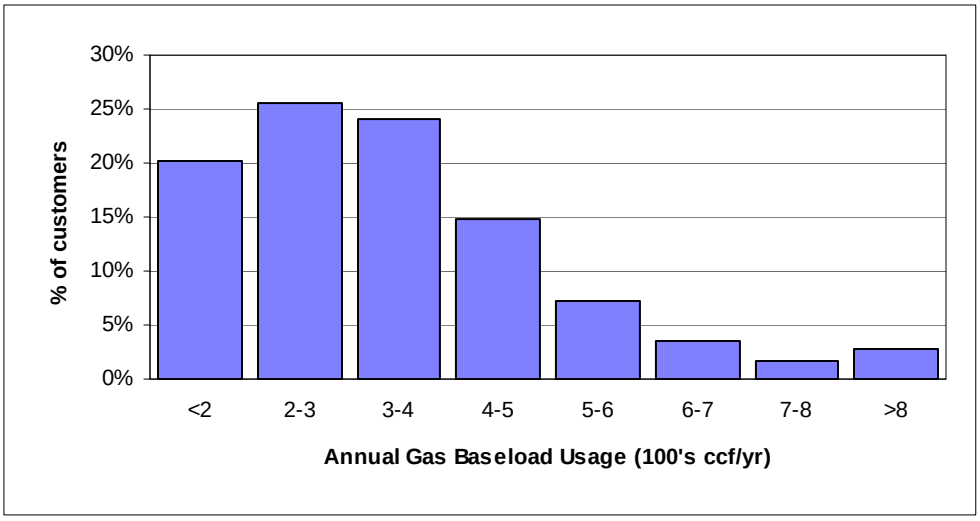

Figure 2-3 Annual Gas Baseload Distribution

Gas Heating Balance Point Temperatures

The PRISM analysis of the gas usage data provided estimates of the effective balance point temperatures for the houses. The balance point of a house is often interpreted as the outdoor temperature below which the house requires heat. It is related to the thermostat setting, the building shell thermal conductivity, the shell leakage, the house thermal mass, internal heat gains, and supplemental heating sources. For fairly similar houses, it is often used as an indicator of relative thermostat setting. PRISM was able to provide estimates of balance point temperatures with a reasonable estimated uncertainty (less than 5°F based on at least 8 real usage data points) for about 71% of the gas customers --15278 out of 21,569. The distribution of these balance point temperatures is shown in Figure 2-4.

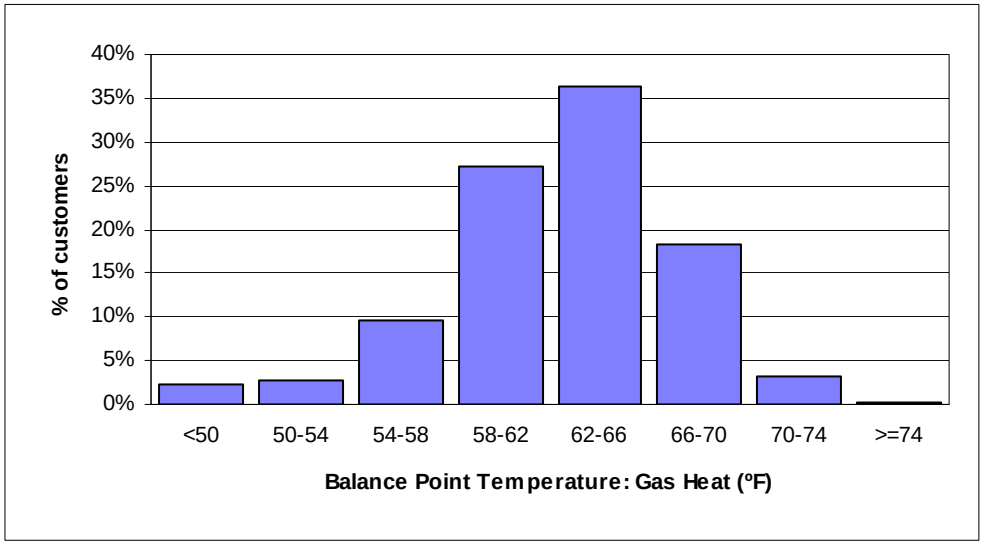

Figure 2-4 Gas Heating Balance Temperature Distribution

The average balance point temperature in the sample was 62.2°F, fairly typical of low-income program evaluation results. Houses with a balance point substantially above this average may be

worthwhile candidates for air sealing, energy education, or set-back thermostats. The figure shows that approximately 20% of the sample may qualify from this perspective. In such houses, one must keep in mind that the balance point temperatures are statistical estimates with uncertainty, and that, in some cases, high balance point temperatures are due to the needs of elderly occupants for higher room temperatures.

Electric Cooling

The distribution of estimated cooling usage in the sample population is shown in Figure 2-5. High cooling use customers may provide opportunities for air conditioner retrofits or change-outs. High cooling load houses may help make attic insulation and other thermal measures more cost-effective in gas heated houses due to added savings in the summer. High cooling houses may also provide opportunities for energy education.

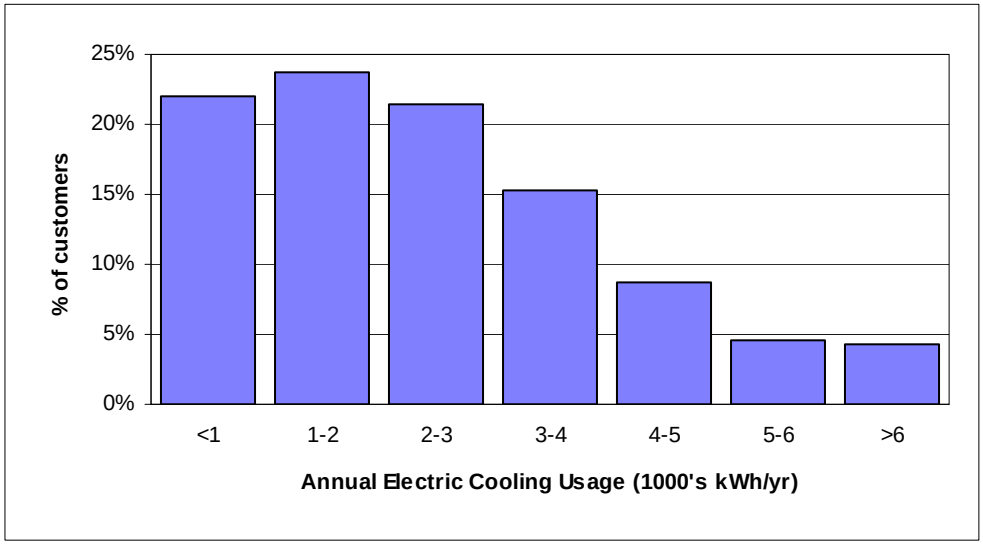

Figure 2-4 Cooling Season Temperature Sensitive Electric Usage Distribution

Electric Heating

Very few of the billing sample customers use electricity as their primary heating source. Figure 2-5 shows the distribution of estimated electric heating. More than 70% of the customers have winter temperature-sensitive electric consumption of less than 1000 kWh/yr. In these cases, the winter seasonal increase in electrical consumption can be explained from seasonality in lighting and furnace fan electric use. The 14% of customers with apparent heating usage between 1000 and 2000 kWh may include a combination of customers with stronger seasonality in non-heating end-uses (including water bed heaters) and customers who use portable electric space heaters. Many customers with apparent heating usage in the 2000-4000 kWh range probably have more significant supplemental space heat use. Some of the customers in the middle usage bins are likely to be electrically heated apartments. Only about 2% of the target group customers have apparent heating usage levels consistent with single-family electrically heated homes.

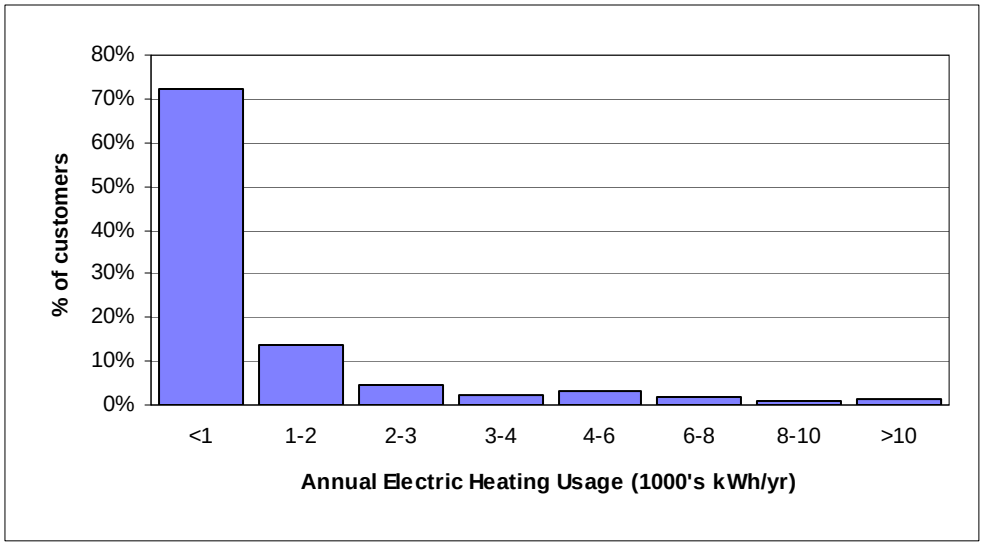

Figure 2-5 Heating Season Temperature Sensitive Electric Usage Distribution

Total Bill

PEG calculated the total annual bill for the target customers by multiplying the normalized electric and gas usage by estimated average retail rates of $0.055/kWh and $0.46/ccf and adding in the monthly service charges. The average bill for customers with both gas and electric service is $1087 annually. The distribution of bill size for these 20,027 customers is shown in Figure 2-6.

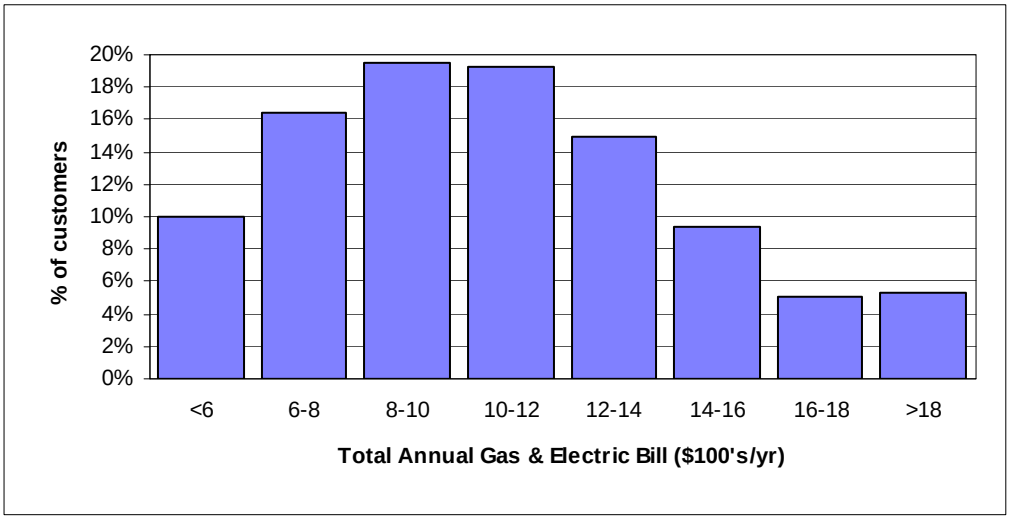

Figure 2-6 Annual Energy Bill Distribution of Payment Troubled and HEAP Customers

HEAP Clients and Payment-Troubled Customers - A Comparison

Examination of the billing sample shows that HEAP clients had higher gas usage and lower electric usage than the payment troubled sample. These findings are consistent with the belief that the non-HEAP payment troubled customers may include a significant fraction of non-low-income customers living in a newer housing stock (more insulation, tighter buildings, more appliances). In addition, 12% of the non-HEAP customers in the sample live in zip codes which

did not have any Energy Partners' pilot program participants. These customers have considerably higher electric usage and lower gas usage than HEAP customers and other non-HEAP customers.

Census Data Analysis

Proctor Engineering Group obtained 1990 census data for the zip codes in and around Louisville. These are the 31 zip codes beginning with 402. This included a 1990 population of 662,561 individuals in 262,394 households. A total of 89,632 individuals were at or below poverty level. These individuals resided in approximately 36,000 households.

Analysis Approach

The zip code specific census data was sorted by median household income in ascending order to focus on the low-income population. The data was then analyzed with respect to variables important to program design.

Dwelling, Household, and Income by Zip Code

The census data analysis is summarized in Tables 2-2 and 2-3

Table 2-2 Income and Heating Characteristics by Zip Code
(1990 data)

Zip Code	Median Income	Poverty (% of pop.)	Public Assistance	Gas Heat	Electric Heat
40202	5940	54%	31%	39%	43%
40203	7588	46%	25%	68%	27%
40210	13368	35%	21%	85%	9%
40211	14749	34%	21%	85%	12%
40209	15600	28%	18%	84%	2%
40215	16164	28%	15%	83%	11%
40208	16485	26%	10%	81%	14%
40212	16939	27%	17%	88%	10%
40217	21127	13%	6%	91%	8%
40204	22480	16%	8%	87%	10%
40218	23363	17%	7%	71%	26%
40214	24006	13%	6%	78%	17%
40213	25071	11%	5%	87%	12%
40206	25151	12%	4%	81%	18%
40216	25810	12%	6%	82%	15%
40219	27449	11%	7%	81%	16%
40258	28884	10%	5%	85%	13%

Table 2-3 Household Count and Characteristics by Zip Code
(1990 data)

Zip Code	Poverty Households	Black	White	Own Home	No Phone
40202	1351	59%	39%	1%	18%
40203	4187	54%	45%	21%	20%
40210	2415	89%	11%	56%	13%
40211	3327	96%	4%	57%	12%
40209	314	7%	91%	51%	14%
40215	2761	16%	84%	58%	8%
40208	1514	21%	77%	39%	14%
40212	2035	50%	50%	66%	11%
40217	749	6%	92%	70%	5%
40204	1282	5%	94%	49%	5%
40218	2237	35%	64%	49%	5%
40214	2233	6%	92%	58%	5%
40213	940	13%	87%	70%	4%
40206	1084	7%	91%	49%	4%
40216	1940	13%	86%	73%	4%
40219	1546	10%	89%	67%	4%
40258	857	2%	97%	84%	3%

Zips 40202 and 40203

The zip code with the highest percentage of persons in poverty (54%), highest percentage of persons on public assistance (31%) and lowest median income is 40202. This zip code is almost exclusively renters in relatively new multifamily master metered buildings. These customers heat source is equally likely to be gas or electricity. These customers are difficult to contact, 18% have no phone.

The zip code with the next highest percentage of persons in poverty is 40203. This zip code is predominantly renters (79%) in multifamily buildings and many residents do not pay their own utility bills. Electricity is still a likely source of heat (27%) for these customers (probably concentrated in the master metered multifamily buildings). Approximately 20% of these customers have no phone.

Both 40202 and 40203 have a mixed black and white population. Many of these customers cannot be effectively served since they are renters on master meters.

Zips 40210 and 40211

The most attractive targets are 40210 and 409211. These two targets have approximately 35% of the population in poverty, 21% on public assistance, 56% owner occupied, and predominantly heated by gas (85%). The electric heat is probably located in master metered multifamily buildings. Twelve percent of these customers have no phone and other means of contact must be used aggressively.

These two zips are predominantly black. Individuals of influence in the black community should be approached to write an introductory letter to be mailed to the targeted customers. These individuals include black ministers and community leaders.

Zips 40208, 40209, and 40215

The next targets are 40208, 40209, and 40215. These zips have over 25% of the population in poverty and average 15% on public assistance. Except for 40208, most of the customers own their own homes.

These three zips are predominantly white. The approach to these customers should include letters from persons of influence in their community. These are often ministers and other religious who actively serve the low-income population.

3. LESSONS FROM COMPARABLE PROGRAMS

Proctor Engineering Group performed an extensive review of weatherization programs, particularly those of comparable design and those of comparable housing, climate, and energy costs. PEG reviewed published and unpublished analyses, contacted and interviewed weatherization program administrators, and interviewed industry experts.

Program Benchmarks

Benchmarks provide one reference point for program performance. It is important to note that other programs may have been built to fulfill a different set of goals and been evaluated with a different methodology. No uniform impact evaluation method or cost accounting method exists for these programs. That noted, an analysis of other programs is extremely valuable in determining what may be possible for EP Version 2, and to find aspects of other programs that can enhance the program design.

The investigators found no evaluations of Kentucky WAP. A few programs in the states surrounding Kentucky have been evaluated recently. Those evaluations are the starting point for these benchmarks, heavily augmented by other evaluations across the United States.

Gas Savings

Table 3-1 summarizes the gas savings evaluation results from similar programs. Table 3-1 is broken into two sections. The top section shows program savings estimates based on pre-/post-weatherization analysis of both a treatment group and a comparison group. The second section of the table shows results based on pre-/post- weatherization without a comparison group. The top section of the table contains more reliable numbers.

Table 3-1 Comparable Program Gas Savings

Program	Location	Cost per treated home	Pre-treatment ccf	Percent gas savings adjusted for comparison group		Cost per first year ccf
LG&E	Louisville	$1,600	1514	12.3%	yes	$8.60
Confidential	Confidential	n/r	1165	12.2%	yes	n/a
Ohio WAP	Ohio	$2,000	1379	22.5%	yes	$6.45
Ohio - Columbia Gas	Ohio	n/r	1400	15.4%	yes	n/a
National WAP	Moderate Climate	$1,550	1468	12.4%	yes	$8.52
	Mean	**$1,717**	**1361**	**15.2%**		**$7.91**
Ohio - Columbia Gas	Ohio	n/r	1440	20.3%	no	n/a
North Carolina WAP	North Carolina	$1,713	1030	32.0%	no	$5.19
Virginia WAP Pilot	Virginia	$1,060	1530	15.7%	no	$4.42
Ohio WAP	Ohio	$1,880	1570	18.5%	no	$6.48
Virginia WAP	Virginia	$1,090	1040	6.7%	no	$15.57
Illinois WAP	Illinois	$1,110	1790	11.7%	no	$5.29
	Mean	**$1,371**	**1400**	**17.5%**		**$7.39**

Electric Savings

The major emphasis of low income evaluations has been directed at quantifying heating usage savings. Typically this is analyzing gas savings, particularly in states similar to Kentucky. This focus is the result of old federal legislation focused primarily on heating, little on base use, and ignoring cooling use. The National WAP evaluation electrical energy savings lumped baseload, heating, and cooling in a single value. In the moderate climate region the saving was 15%.

The population assessment portion of this analysis and design indicates that very little electric heating is used by individually metered low-income customers in Louisville. The population assessment did indicate electric consumption for cooling and significant electrical base use.

The EP pilot produced a 7.7% reduction in electric usage. A program in a similar climate that included effective duct sealing showed a 12.5% reduction in summer electrical use.

The best baseline data for electrical savings come from pilot programs that tested one or two individual measures.

Enhancements to Energy Partners

The PEG System

Considering field experiences, field data, evaluations, and interviews, Proctor Engineering Group developed the PEG system. The system can be summarized as follows:

1. Customers are targeted based on their energy savings potential as determined through billing analysis.

2. Measures are screened and the appropriate measures are selected based on additional information about the customer and their residence.

3. Appropriate measures are installed in an efficient and effective manner as a result of work flow design, training, and feedback to improve efficiency, competence, and confidence.

This system has been tested in a variety of locations and is being specifically adapted to the goals of the LG&E Collaborative. This investigation has reinforced the view that this system can produce superior results.

System Characteristics From Baseline Investigation

Several highly effective weatherization programs were identified. The most successful program identified was the New York state TIPS program. TIPS reported average savings of 34% of total pre-weatherization gas consumption.

The background research for this design, has produced an emerging picture of a highly effective program. The picture includes these characteristics:

- targeting high usage customers

- cost control including setting the level of expenditure based on usage and limiting the expenditure on individual measures - particularly air sealing

- a high degree of staff training

- use of advanced diagnostic procedures in selecting retrofits

- constant and effective feedback to all parties based on standards

The most common trait is targeting high pre-weatherization consumption households. TIPS, for example, sets the allowable expenditure level for each house based on the household's energy intensity level. Other programs target high usage households but do not adjust the level of expenditure based on usage.

A study of ten highly effective weatherization programs by Oak Ridge National Laboratory (Brown et al., 1993) found the following common traits:

1. Superior management systems utilizing effective tracking systems
2. Highly trained and motivated staff, with extensive experience

3. Targeting high pre-weatherization energy usage clients
4. Correctly employing advanced diagnostic procedures.
5. Measures installed include first time attic and wall insulation, heating system efficiency work, and water measures
6. Effective client education materials and presentation
7. Controlling program and installed measure costs through bulk purchase and fixed fees

4. MEASURES AND COSTS

After performing the literature review, Proctor Engineering Group compiled an extensive list of measures without regard to the low cost of energy in Louisville. Once completed, the screening process then eliminated non-cost effective measures.

Measure identification has improved over the last twenty years. Measures initially thought to be effective immediately following the oil crisis of 1973 have been proven ineffective and dropped from the list. New measures (refrigerator replacement, instrumented duct sealing, furnace efficiency work, air conditioner tune-up, and window AC replacement) have recently joined the list of potentially cost effective measures. Costs for these measures can vary significantly. When the local infrastructure has not been established, initial training costs need to be considered. Local wage levels vary across the country. Initial estimates for measure costs were established based on the EP pilot costs and modified in this pattern:

1. determine the costs in similar programs,

2. interview experts on each measure, and

3. compare estimates to the R.S. Means Residential Cost Data books[4] (Means).

For example, in our research, the cost of adding R-19 to an open attic ranged from $0.28 (the EP pilot cost) to $0.56 per square foot. The average for most programs was $0.40. The Means national average cost was $0.50. Means uses a location multiplier (0.854 for Louisville) resulting in a projected cost of $0.43. The cost estimate used in this analysis is $0.40. The actual price will be established through the contractor cost interaction described elsewhere. If the initial estimates are off by more than 10%, the cost effectiveness and measure selection criteria should be adjusted.

Table 4-1 Measures and Costs

Measure	Cost	Estimate Basis
air conditioner and heat pump tune-ups	$225 per system	Fixed cost bids to cover 4 hours HVAC technician labor and materials.
air sealing (blower door guided)	$375 per house	Historical average for two person crew. Price includes materials.
boiler pipe insulation (3/4″ R-5)	$1.25 per lin ft	Average closed cell insulation w/materials cost of $0.75 lin ft and labor cost of $0.50 lin ft. Typical house likely to have ≈ 200 lin ft.

[4]RS Means 1997 Repair & Remodeling Commercial/Residential Cost Data and RS Means 1998 Mechanical Cost Data.

boiler replacement	75k Btu $2,200 100k Btu $2,400	Cost of $1,200 to 1,400 for boiler, and $900 for labor and additional materials.
central air conditioner replacement	2 ton $1,550 3 ton $1,850 4 ton $2,100	A SEER 10 system with an outdoor unit range of $800 to $1200, indoor coil range of $200 to $350, and labor and materials of $550. The air handler is not replaced. Assuming a new lineset and time for the contractor to do the job correctly.
clothes dryer conversion (electric to gas)	$550 per house	A typical gas clothes dryer at $400 (a low end gas clothes dryer) and $150 to install gas piping and metal vent.
combustion safety testing	$55 per house	One hour of on site labor and materials.
compact fluorescent fixtures (security)	$85 per fixture	Range from $65 to $100, assuming existing fixture being replaced with a 28 watt reflective fixture, installed by a licensed electrician. No new wiring or switches
compact fluorescent light bulbs	$16 per bulb	An average, for all wattage ranges and add-on items that might have to be installed (i.e., harp extender)
crawl space floor covering	$0.10 sq. ft	A 1200 sq. ft house with vapor barrier extended up on the perimeter wall at an average cost of $120
crawlspace treatment	$400 per average home	Combines crawl space floor covering, perimeter insulation, and vent closure
duct insulation (R-6, 2" FSK Fiberglas wrap)	$2.00 per lin ft	Assumption is that the duct will be in hard to access locations such as crawls or attics. The cost per linear foot is less in easily accessible areas
duct sealing (Duct Blaster™ guided)	$375 per system	Assumes 8 person hours of testing and sealing and materials
electric baseboard thermostats	$90 per T-stat	Change out of an existing line voltage T-stat with a setback T-stat (e.g., Lightstat). Work performed by a licensed electrician.
energy audit & safety screening (includes combustion safety testing listed above)	$105 per house	Labor charge & production of 3 per day
energy education	$45 per house	Labor charge & production of 6 per day & $10 materials cost per house.
heating system efficiency tune-ups	$160 per system	Sun Power furnace program history on over 100,000 houses in various locations throughout the United States. Does not include training costs.

furnace & boiler repairs	Average $75 per participant	These are repair costs above and beyond the items included with the Sun Power procedure.
furnace replacement	75k Btu $1,500 100k Btu $1,700	A cost of $700 to $900 for furnace, and $800 for labor and additional materials.
building repair (including wall/ceiling repair, roof repair, door replacement, glazing and sash replacement, etc.)	$200 per house	Average low income house will need some repairs which allow for other measures to be implemented.
hot water leak repair (faucet replacement)	$110	Cost of typical faucet, new risers and labor to install.
hot water leak repair (sink or tub)	$25 per faucet	An easily repaired leak that just requires the washer change out
hot water pipe insulation	$10 per house	Insulating the first 5 foot of both cold and hot water pipes at the water heater
hot water tank wrap	$20	Typical tank wrap.
insulation truck set-up charge	$50	Range of $25 for EP pilot to $100 for others. Average approx. $50.
insulate crawl space perimeter	$0.50 per sq. ft	R-19 fiberglass installed from rim joist space to floor.
insulate marginally insulated attics - unrestricted (R11 to R-30)	$0.40 per sq. ft	Range $0.28 to $0.65 (venting not included)
insulate uninsulated floored attics 6″	$0.70 per sq. ft	Range $0.65 to $0.90 (venting not included)
insulate open unisulated attics to R-30	$0.60 per sq. ft	Range $0.39 to $0.71 (venting not included)
insulate sloped ceilings	$0.50 per sq. ft	Range $0.40 to $0.65 (venting not included)
insulate uninsulated kneewalls (R-11)	$0.40 per sq. ft	Range $0.35 to $0.65 (venting not included)
insulate uninsulated walls (dense pack)	$0.90 per sq. ft	An average cost that covers both interior and exterior applications on all wall types. Range $0.50 to $1.10 sq. ft.
building key juncture (strategic dense pack)	$2.00 per lin ft	Strategic dense pack for air sealing purposes. Range $1.50 to $3.50 per linear foot.
low flow shower heads	$25 per shower	$15 materials $10 labor
mechanical ventilation (new)	$300 per fan	Estimate based on 110 CFM Panasonic fan with a timer
mechanical ventilation (replace existing)	$200 per fan	Estimate based on 110 CFM Panasonic fan with a timer

refrigerator replacement	$650 per house	Mid-efficiency 18 cu ft refrigerator. Recycling old refrigerator. Some documented lower costs ($450-475) in high volume.
secondary refrigerator removal and recycle	$50	Costs seen in similar programs and estimate from national recycler
roof vents	$80 per house	2 vent average
setback thermostat	$50 per T-stat	Installation of a Lightstat or Hunterstat heating thermostat.
washing machine replacement (horizontal axis)	$800 per unit	ACEEE estimate $200 above typical Sears typical = $500 to $600 Numerous sources $800 & up
water bed mattress pad	$30 per bed	Materials and labor.
water bed mattress replacement	$350 per bed	Materials and labor for the removal and replacement with standard mattress.
water heater conversion (electric to gas)	$650 per house	High efficiency 40 gallon heater, labor and materials: plumb, run vent system and gas line. (from 100 home pilot)
water heater temperature reduction	$5 per house	Less than 10 minutes
window air conditioner replacement	$650 per unit	12,000 BTU unit with labor electrical work, if necessary, not included
window replacement	$250 per window	Based on a non low-E window (vinyl clad double pane) up to 89 u.i.

5. GOALS

One of the keys to a successful program is the determination of realistic goals supported by attainable, measurable, and specific objectives. These goals and objectives cannot be set without interaction with the Collaborative, and a buy in by the Program Administrator.

A tentative set of goals has been established based on our research. These include:

- A participant gas energy consumption reduction averaging 22% of pre-retrofit consumption.
- A participant electric energy consumption reduction averaging 10% of pre-retrofit consumption.
- An average measure cost per participant of $1400.

These proposed goals are in line with the philosophy that:

> Louisville Gas & Electric (LG&E) provides the Energy Partners Weatherization Program to help reduce the energy consumption of LG&E's low-income and payment troubled customers. LG&E is committed to pursuing all opportunities for cost-effective energy savings within the low-income residential market sectors. LG&E provides comprehensive energy efficiency programs that encourage participation from eligible low-income households and offers effective customer education to ensure greater energy savings, improved customer health, safety and satisfaction, and reduce utility shut-offs and bill arrearages.

These proposed goals are also in line with the EP pilot goals: Saving 15-20% of the participants' energy usage; reducing bills and therefore service disconnections, arrearage levels, and collection actions; and improving the health, safety, comfort and quality of life for participants.

Projected Results

Based on the design, the goals stated above, the projected penetration rates, and the projected unit costs, EP Version 2 should result in savings with a present value of approximately $2200 from the participants' perspective. A detailed design sensitivity analysis, including non-energy benefit evaluations, is contained in the appendices.

6. OVERVIEW OF PROGRAM DESIGN

Version 2 of the EP program is designed to improve the program's cost effectiveness by applying the lessons learned in evaluations across the United States. The keys to this effort are targeting, measure selection, cost control, and program oversight. The program targets high energy consumption customers, selects measures that will be the most effective in the individual home, limits the expenditures, and tracks the results.

There are multiple entities involved in this design. These are: Program Administrator, Installation Contractors (2), Inspection Contractor, and Evaluation Contractor.

Prior to the first contact with clients, measure costs need to be finalized, contractor recruitment and selection needs to take place, billing analysis software needs to be obtained and tested, targeting needs to be agreed to, marketing pieces need to be produced, and the database needs to be built and tested.

Once those tasks have been completed, billing data for all the customers in two low income zip codes will be analyzed. A listing of the high use customers in these zip codes will be divided between the two contractors, then training, marketing, and recruitment will begin.

The flow of the program is depicted in Figure 6-1

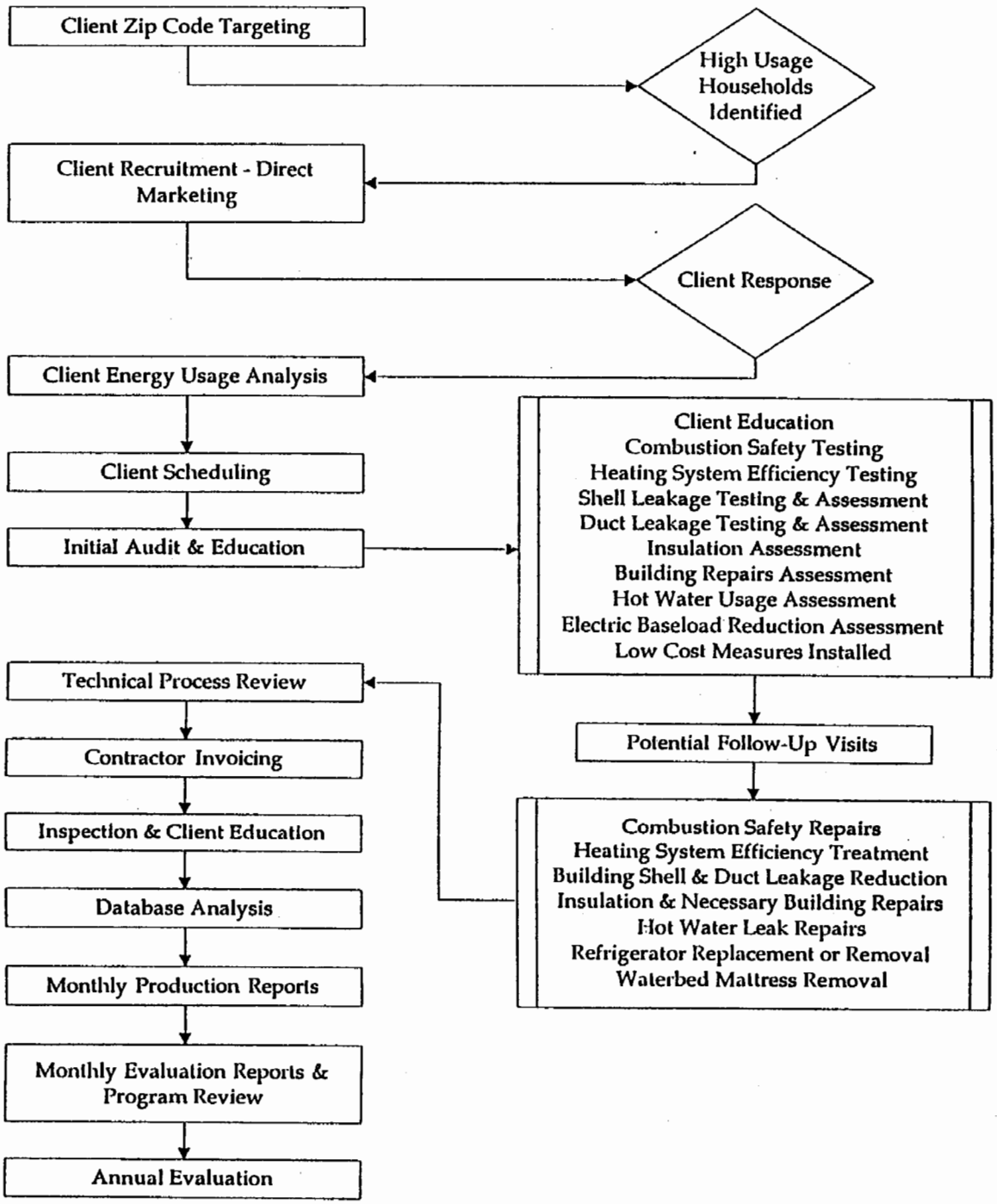

Figure 6-1 Energy Partners Program Flow

7. PROGRAM TARGETING AND MARKETING

Program targeting and marketing are intimately related. The cost effectiveness of EP Version 2 is highly dependent on the proportion of high use customers served. If the desire to have the program open to all low-income customers produces a high percentage of lower-use non-targeted customers, then the economic benefits to the low-income community in general will be reduced.

Targeting

Almost universally, programs that achieve high savings have a strategy of targeting households with high pre-weatherization usage levels. Most recent evaluations, including PEG evaluations and the National WAP evaluation performed by Oak Ridge National Laboratory (Brown et. al. 1993) have found a correlation between higher pre-treatment usage levels and savings. In a review of ten low-income program evaluations Schlegel and Pigg (1990) concluded, "programs can target high energy users, reflecting the strong correlation between pre-weatherization energy consumption and energy savings". A meta-evaluation performed by Oak Ridge National Laboratories (Berry 1997) reviewed state level evaluations in fourteen states (eleven published and six unpublished evaluations) and concluded "A common feature of the high saving state level programs is the targeting of high-consuming households." Basing expenditure level on the pre-usage level of the household has become common practice and is the proposed methodology for EP Version 2.

Marketing Strategy

The marketing and recruitment process is designed to reach high-use households. Potential participants will be selected based on an energy consumption analysis that projects a weather normalized annual gas and electrical consumption for each customer. This analysis will be performed by the program administrator. The analysis will categorize customers in three tiers:

Tier A - Customers with the lowest energy usage (less than the threshold for the other two categories). This level is a broad-based service offering available to all LG&E low-income customers. This group is the least cost effective group to serve and reduces the available funds for effective application to households that can benefit from the expenditure. The marketing will seek to avoid this group.. It is assumed that participation by this group will flow from word-of-mouth advertising or community outreach and networking.

Tier B - Customers with gas consumption of 1300 to 1800 ccf or electric consumption of 12000 to 16000 kWh. These customers will not be marketed to directly. These participants will result from general program awareness and word-of-mouth advertising.

Tier C - Customers with over 1800 ccf of gas consumption or over 16000 kWh of electric consumption. This group is the target market! The marketing will use direct mail and telemarketing to capture a large percentage of this group. The greatest potential for energy savings exists in these households.

Marketing, recruitment, and production scheduling will be targeted to limited areas using Zip Code+4. The direct marketing to individual areas will be staggered so that one area can be completed before moving to another area. This not only reduces crew travel time, but also allows the field personnel to become more efficient as they learn the idiosyncrasies of the housing within the area.

Reaching Target Market

Usage analysis

To define target market, the administrator will conduct a weather normalization analysis of all customers in concentrated low-income zip codes. This analysis will produce a targeted list of customers for the contractors' marketing and recruitment efforts[5]. The contractor will be the primary marketing arm of the program. They will do direct marketing through mail and telephone solicitation.

Direct Mail Marketing

Direct mail campaigns will be conducted in specific geographic areas to contain service requests within selected regions. This will help increase scheduling efficiency and reduce travel time. Geographic targeting is a proven, efficient method for improving productivity and reducing service costs. The amount and frequency of mailings to targeted high-use households will be dependent upon production needs.

The marketing will begin with a direct mail piece consisting of three components: a straight forward letter from LG&E, a letter of support from an influential member of the local community (minister or other individual), and a return mailer for the customer.

The LG&E letter, on LG&E stationary, will cover the following points:

1. Your home consumes a significantly higher amount of energy than most of your neighbors.

2. There is a program available that may provide improvements to your home or appliances to help you reduce your bills.

3. This program is available at no cost to you if you income qualify.

4. The income qualifications are ...

5. You are automatically qualified if you are on ...

6. The actual items applied to your home will depend on a free analysis of your home by a specialist hired by LG&E. These items might include ...

7. Introduces the contractor

---

[5] This is the most effective option as long as it meets acceptance by all parties. Other options are available (LG&E does the marketing and successful recruits are turned over to the contractor). These other options have major drawbacks including the lack of control of contractor work flow.

8. Provides telephone contacts for LG&E and the contractor.

The initial mailing is followed in two weeks by another mailing. The second mailing contains three items: a letter from the contractor, a fact sheet on the program, and a letter of support from a different influential member of the local targeted community.

Telemarketing

Beginning one day after delivery of the second direct mail piece, telemarketing will be conducted to direct mail recipients who do not respond to the service offer. Telemarketing is most effective when conducted one week after the direct mail.

Targeting and Marketing Goals

The goal of targeting is to provide a steady stream of high use (Tier C) potential participants to the contractors. This stream needs to be sufficient to provide consistent work for the contractor's crews. It is expected that this will be fine tuned in the first few months of the program.

The goal of the marketing is to recruit and schedule a high percentage of the eligible Tier C customers in the area being worked. It is to the contractor's advantage to refine and improve on this marketing plan in a way that maximizes Tier C participants.

8. PROGRAM OVERSIGHT

The primary source of information on program oversight comes from interviews with program directors and other personnel.

DOE Weatherization Programs are ordinarily administered by a state office in charge of technical, qualitative, and fiscal oversight. Generally, the level of funding and the staffing required to manage a WAP is much larger than that required or desired by utility programs.

The majority of utility programs require little "in-house" staffing. Utility programs identified as effective tend to have most management functions contracted to an outside firm. The major responsibility of the utility staff is to ensure production schedules are met, the evaluation and tracking database is kept current, and fiscal matters are under control. The utility staff make the final decisions on the contractors, performance, and expenditures.

The contractor generally provides intake services (if needed), audit, and weatherization services. Dependent on the contractor's capabilities they may elect to sub-contract part of the weatherization work. The contractor is responsible for maintaining the program database and providing monthly reports and invoices. A separate contractor is usually retained to provide inspection services.

Program oversight is essential to a successful program. Program designs need to respond to the actual situations presented in their applications. Problems will be presented in the implementation of EP Version 2. Solutions to problems come about through the repeated application of a system that includes the following items:

1. There is a standard for performance.

2. Everyone is informed of the standard.

3. There is a system in place that works to the standard and checks results against the standard.

4. Everyone is aware of how the results compare to the standard (results and standards are made visible).

5. Failures to meet the standard are investigated and solutions are pursued (the system is changed).

6. The standard is revised only for a very good reason.

Program oversight is provided in EP Version 2 through: invoicing and production reports to the Program Administrator as well as monthly evaluations prepared by an outside evaluation consultant.

Monthly Evaluation

An outside consultant will prepare a monthly evaluation report from the database and billing data. The monthly evaluation will track program savings on all treated customers beginning when their completion invoice is entered into the data base. This monthly evaluation will project base gas and electric consumption changes every month. In summer months it will project cooling related electrical savings, and in the winter it will project heating savings. These results will be reported against established monthly milestones.

Program Tracking and Database

Program tracking databases are an important issue for both program implementors and evaluators. Complete and accurate data to assess progress toward program goals. Proctor Engineering Group has refined the list of database fields to meet these purposes. The complete field listing is in the appendix packet.

Having a database that supplies an accurate and complete representation of the program will make it much easier for LG&E to review the program at any point and to make mid-course corrections to the program.

9. CONTRACTOR RELATIONSHIPS

DOE weatherization does not provide a good model for EP Version 2. WAP is limited by federal regulation and rules that increase program difficulty and reduce effectiveness.

A characterization study by Oak Ridge National Laboratory (Mihlmester, 1992) found that only 18% of local agencies had any funding other than that directed at low-income weatherization. Programs are often run on a time and materials reimbursement structure. Utility sponsored programs, on the other hand, often utilize contractors that are more involved in private sector work and often use a fixed cost structure.

Considering PEG experiences and the interview results with program administrators, we conclude that the time and materials reimbursement structure is probably the least cost effective and least efficient of the available options. Time and materials systems do not provide adequate incentive to search for ways to be more effective or to lower delivery costs.

Contractor Recruitment

Potential for work reduction is a leverage point with the contractors. It should not be used indiscriminately, but it needs to be available if contractor work quality or production does not meet standards. This means that there must be multiple contractors in EP Version 2.

Quality contractors must be actively recruited.

The pool of potential contractors should be as large as possible and not be limited to contractors with which LG&E is now familiar. The Administrator will build a broad list of potential contractors working from referrals. The contractors will be contacted, interviewed, and references checked. The program will not benefit by getting contractors that provide low quality, low cost services.

Once a pool of high quality contractors has been identified, they need to be persuaded to participate in the bid process.

Contractor Cost Interaction

The interested contractors will be sent an introductory packet that: explains the program, explains the bid process, provides program standards and specifications, and asks for unit pricing. The contractor price form is contained in the Appendices. The contractor will determine their costs to provide the listed service to program standards. Their projected price includes all labor, overhead, materials, and markup.

Based on the contractor responses, the universal measure prices are fixed and all responding contractors are asked to bid on the fixed cost program. The bid is limited to seven pages plus biographic information and contains the following:

1. Company description and history (a brochure can be added as an attachment). (one page)

2. Discussion of previous experience with this type of project (two pages)

3. Description of the company's qualifications to perform the specified services. (one page)

4. Reference list including name, address, and telephone number including a contact at each of the locations listed in #2. (maximum of six references)

5. Description of current and proposed internal quality control procedures and activities. (one page)

6. Summarize why LG&E should pick the company for inclusion in the project. (one page)

7. Complete biographical information on all personnel (maximum of one page per individual) that will be assigned to the program including: name, years of experience, employment history, relevant courses or training completed including dates. If the personnel are not currently on staff, describe the company's plans for acquiring the appropriate staff.

The administrator will evaluate the qualifications of the responding contractors.

1. Technical capability, quality assurance system, and experience of company. (40%)

2. History of company in delivering similar programs. (20%)

3. Ability to assign an adequate number of qualified and experienced personnel to assure timely performance, technical capability of personnel proposed for the actual work. (40%)

Invoicing and Payment Procedures

The invoicing and payment procedures must be equitable to the contractors without placing undue burden on the administrator. Many contractors in the weatherization business are small business enterprises. Most do not have the capital needed to carry large accounts receivables. For this reason, invoicing should take place monthly with a maximum of 30 days to payment.

Contractors are responsible for invoicing jobs completed during the invoicing period. Only completed jobs are eligible for billing, no partial completions will be accepted. All sub-contracted work will be billed through the primary contractor.

The invoice has two components. The first is a document similar to Figure 9-1.

Date of invoice				
	6/1/98			
Customer Account Number				
	5000407342222			
Date of intake				
	3/13/98			
Date of site visit				
	4/17/98			
Date of job completion				
	5/22/98			
Contractor responsible for work				
	ABC Weatherization Services			
Measure Description	Count	Unit Type	Unit Cost	Total Cost
Energy audit	1	n/a	$95.00	$95.00
Energy education	1	n/a	$40.00	$40.00
Water tank wrap	1	40 gal	$20.00	$20.00
Compact flourescent bulb	3	18 watt	$12.00	$36.00
Heater repairs	1	gas leak	$35.00	$35.00
Attic insulation	700	sq ft	$0.40	$280.00
Replacement sash	1	48 u.i.	$65.00	$65.00
Replacement sash	1	28 u.i.	$35.00	$35.00
Refrigerator removal	1	n/a	$50.00	$50.00
TOTAL CHARGES				$656.00

Figure 9-1 Sample Hard Copy Invoice

The second invoice component is the database. At the time of invoicing the contractor will supply the completed database record for each invoiced customer. The database is essential to program control.

The database will be checked for completeness and accuracy prior to processing payment.

Any problems with either the database or the invoice will disallow the invoice. Disallowed invoices will be returned to the contractor for correction and resubmitted during the next invoicing period.

10. MEASURE SCREENING

Measure screening procedures guide the program personnel in identifying the appropriate measures for individual houses. To facilitate these decisions, program personnel will be supplied simple tools to assess the relative potential of each of the measures.

Numerous methodologies and selection approaches have been identified, however, two types of procedures dominate. These two are computerized energy audits and decision trees/look-up tables. Within these two methods many subgroups exist. Decision tree methodologies should not be confused with the old priority list systems that base the decision to install an item based solely on the priority list. The decision tree methodologies referenced here use advanced diagnostics to inform the decisions.

Within the DOE WAP the computerized energy audit has become quite popular. The reason for the popularity is not necessarily that computerized audits are superior. The use of a DOE approved audit brings with it a waiver to the DOE 60/40 rule (requiring no more than 60% of funds be spent on labor). Since most cost effective weatherization treatments are labor intensive (i.e., duct sealing), agencies have adopted the computerized energy audit as a way of getting more funds allocated to labor. The typical computerized energy audit uses information about the house and the customer's usage patterns to provide a list of recommended measures, and predicted savings.

The most widely used computerized energy audit is the DOE National Energy AudiT (NEAT). According to a recent study over half of the state weatherization programs have adopted the NEAT computerized audit (Dalhoff 1997). Most state agencies not using NEAT have developed their own version or adapted another DOE approved computerized audit. While the computerized energy audit is intended to help guide the program personnel in selecting cost effective measures recent evaluations have shown that the NEAT audit may be over-predicting measure savings. An evaluation performed in North Carolina of an early version of NEAT found a realization rate of 57% for predicted versus measured savings (Sharp, 1994). A recent study conducted in Iowa found that the NEAT audit over-estimated the energy savings of some measures by a factor of more than two (Dalhoff, 1997). Not only were the true savings over-predicted but the measure priorities may have been skewed.

Decision trees/look-up tables take a more open approach. They allow the program personnel to make decisions based on a priority system and the circumstances found at the house. Many programs have successfully used this approach. The basic concept of the decision tree is to pre-determine the breakpoint for individual measures based on the usage levels and cost of the measure. Decision trees have the advantage of not requiring the purchase of existing software or development of customized software.

PEG recommends the look-up table approach for Energy Partners. Since the program is not subject to the DOE 60/40 rule, the most effective and least costly method should be applied.

Screening Details

Proctor Engineering Group has designed a look-up table methodology for EP Version 2. Computer program outputs and decision trees are contained in the appendices.

The process uses a computer analysis and prioritized look-up tables. The computer analysis will define base, heating, and cooling usage levels, present a graphic illustration of the customer's usage patterns for educational and exploratory purposes, and capture data about the house, customer, and proposed treatments for use in the programs database.

The process is:

- In the office, an analysis of the customer's energy usage is performed. This sets the allowable expenditure based on energy savings potential.
- In the house, diagnostic testing and physical examination determine which measures are applicable.
- Priorities are set based on the usage patterns and the diagnostic results.
- The look-up table is followed until the allowable expenditure level is reached or all cost effective measures have been applied.

Program Treatments

The treatments allowable under Energy Partners have been expanded. The pilot program was limited in the range of allowable measures. The research, analysis, and redesign have added several measures that will provide valuable and cost effective additions to the program.

While the allowable measures list has been expanded, the criteria for installation have been tightened. This provides cost control and improves the cost effectiveness of the program. Many of the new measures will be limited in application.

The measures included in the Energy Partners program are:

- air sealing (blower door guided)
- attic insulation and ventilation
- building repair (including wall/ceiling repair, roof repair, door replacement, glazing and sash replacement, etc.)
- central air conditioner system efficiency tune-up
- combustion safety testing and repair
- compact fluorescent fixtures (security)
- compact fluorescent light bulbs
- crawl space thermal treatment (vent closure, floor covering and perimeter insulation)

Measure Screening

- dense pack sidewall insulation
- duct insulation
- duct sealing (Duct Blaster™ guided)
- electric baseboard thermostat replacement
- energy audit & safety screening
- energy education
- heating system efficiency modifications
- hot water leak repair (both leak repair and faucet replacement)
- hot water pipe insulation
- hot water tank wrap
- low flow shower heads
- refrigerator replacement
- removal of secondary refrigerator
- setback thermostat installation
- water bed mattress replacement
- water bed thermal mattress cover
- water heater temperature reduction
- window air conditioner replacement