Illinois Residential Market Analysis

Final Report

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Table of Contents

I. EXECUTIVE SUMMARY 3

II. PROJECT DESCRIPTION 9

II.1 Introduction 9
II.2 Evaluation Objectives 9

III. METHODOLOGY 10

III.1 Sampling Methodology 10
III.2 Site Audit Methodology 12
III.3 Methodology for Estimating Impacts 13

IV. HOME AUDIT RESULTS 14

IV.1. Homeowner and Home Demographics 14
IV.2 Overall Home Configurations 15
IV.3 Heating, Cooling and Hot Water 16
IV.4 Windows and Doors 17
IV.5 Insulation 18
IV.6 Electric Lighting 18
IV.7 Ductwork 19
IV.8 Appliances 20
IV.9 Conclusions 20

V. HOMEOWNER SURVEY RESULTS 21

V.1 ENERGY STAR Logo Awareness and Understanding 21
V.2 Energy Issues 24
V.3 Conclusions 25

VI. TECHNICAL ASSESSMENT OF ENERGY AND DEMAND IMPACTS 27

VI.1 Potential Energy Conservation Measures 27
VI.2 Interpretation of Field Data and Creation of DOE2 Models 28
VI.3 Technical Assessment of Program Market Potentials by Measure 41
V1.4 Additional Technical and Market Potential Analysis 50

VII. MARKET POTENTIAL: PROGRAM REVIEWS 53

VIII. CONCLUSIONS 66

List of Tables

Table 1: Final Sample Design by Service Territory 10
Table 2: Final Sampling Breakdown 11
Table 3: Final Contact and Audit Tabulation 12
Table 4: Homeowner Demographics 14
Table 5: Home Age Comparison with Census Data 14
Table 6: Homeowner Income Comparison with Census Data 15
Table 7: Overall Home Data 16
Table 8: Heating, Cooling, and Hot Water Systems Found 17
Table 9: Central Air Conditioning Percentages 17
Table 10: Window Results 18
Table 11: Insulation Results 18
Table 12: Room Lighting Summary 18
Table 13: Ductwork Insulation Summary 19
Table 14: Duct Leakage 19
Table 15: Ductwork Space Conditions 19
Table 16: Appliance Summary 20
Table 17: Other Efficiency Measures Summary 20
Table 18: Scoring of Descriptions of ENERGY STAR Label 22
Table 19: ENERGY STAR Label Awareness 22
Table 20: Participant Self-Reported Awareness of ENERGY STAR Label 23
Table 21: Channels to Participant ENERGY STAR Label Awareness 24
Table 22: Average Knowledge and Concern for Energy Issues 25
Table 23: Comparison of Home Audit Results With Behavior Claims Reported in the Illinois Energy Survey 26
Table 24: Potential Situations and Improvements Evaluated in this Study 27
Table 25: DOE2 Model Characteristics of the Baseline Home 29
Table 26: Electric and Natural Gas Savings by Measure and Heating System Type 31
Table 27: Technical Potential: Window Replacement Options 37
Table 28: Measures With Best Promising Market Potential 41
Table 29: Electric and Natural Gas Savings by Measure and Heating System Type for Preferred Measures 43
Table 30: Technical and Raw Economic Market Potentials for Preferred Measures 46
Table 31: Market Potential Summary for the Preferred Measures 48
Table 32: Statewide Savings Potentials Summary 49
Table 33: Kouba-Cavallo Study – Measures Analyzed 49
Table 34: Kouba-Cavallo Study: Final Savings Potential Results 50
Table 35: Residential 2001 HVAC Program Summaries 53
Table 36: Recent HVAC Programs – Program Description and Marketing Summaries 54
Table 37: Energy Efficient Window-specific Program Summaries 55
Table 38: Utilities and Municipalities Participating in the APPA Tree Power Program - 2002 56
Table 39: Recent Homeowner Shade Tree Programs 57
Table 40: Summaries of Lighting Programs 58
Table 41: Marketing Elements in Lighting Market Transformation Program 59
Table 42: Residential ENERGY STAR Programs (Part I) 61
Table 43: Residential ENERGY STAR Programs (part II) 62
Table 44: Major Regional/State ENERGY STAR Programs – Marketing Tools Used 63
Table 45: Weatherization Programs 65

I. EXECUTIVE SUMMARY

Background

From chronic electricity shortages to surging natural gas prices to gouging at the pump, escalating energy costs have been an issue looming in the news over the past few years. Concerns about global warming, meanwhile, have heightened the nation's sensitivity to issues surrounding energy. In this troubled climate, the quest to improve the nation's energy efficiency has never been more relevant.

Here in Illinois, that effort has made significant progress with the creation of a fund to support initiatives that reduce overall energy consumption, saving money for utility rate-payers and curbing hazardous emissions that cause air pollution and associated health threats.

To identify opportunities to fuel the growth of energy-efficiency in Illinois, the Midwest Energy Efficiency Alliance (MEEA) oversaw a comprehensive audit of residential energy usage and practices. The study was funded mainly through a grant provided to MEEA by the Illinois Clean Energy Community Foundation in 2002 and through additional funding by Commonwealth Edison and the Illinois Department of Commerce and Economic Opportunity. The assessment gauges the existing residential saturation levels of energy-efficient products, technologies, and practices of residential utility customers in the state of Illinois, as well as evaluating current consumer energy savings potential for residential conservation measures. The findings can be used to inform pending decisions about how public and private money will be spent to promote energy conservation in Illinois.

Key Findings

The survey indicated that energy-efficient products – particularly technologies that have earned the ENERGY STAR imprimatur – remain a somewhat unconventional technology within the typical Illinois Household. In fact, the ENERGY STAR standard is, itself, an obscure concept to many Illinois consumers, according to survey results. Nonetheless survey respondents were hospitable to both the quest for environmental preservation and the pursuit of reduced energy costs, assigned a high numerical value to both. This discrepancy suggests that while Illinois consumers are not well schooled in the details of energy-efficient technology, they embrace the benefits such products can provide. This report proposes a series of measures that could unleash demand for these technologies, providing the impetus to save costs for Illinois consumers, reduce the state's air pollution levels and provide more opportunity for its manufacturers.

Among its chief findings, the study concludes:

- **Illinois homeowners could save an estimated $17.6 million a year under a proposed program of strategies to stimulate the market for energy efficient products in Illinois.**
- **This same program would results in an annual reduction in electricity output of 164,000 Megawatt hours, representing over 365 millions pounds of carbon dioxide emissions avoided on an *annual* basis.**

- **Illinois consumers are only moderately familiar with energy-efficiency, as a practice, and with the ENERGY STAR standard as a seal of authenticity. Despite a limited understanding of these issues, however, these same consumers advocate the two principal benefits of energy efficiency – cost savings and environmental conservation. Public awareness of energy-efficiency, therefore, looms as a pivotal factor in the growth of the industry in Illinois.**

These findings indicate that there is a latent market for energy-efficient products in Illinois, one that could be tapped with additional educational and financial resources. To do this, this report recommends 19 measures to expand the presence of energy-efficiency in Illinois homes. These strategies – ranging from consumer rebates for the purchase of energy-efficiency lighting and appliances to tax incentives for the construction of more energy-efficient homes -- have a record of success both in Illinois and across the country. More information on some of these strategies is provided below.

Existing public resources – the state currently administers the Illinois Clean Energy Trust, a fund earmarked for energy conservation – can be harnessed to put this program into practice.

<u>Methodology</u>

MEEA used a modified stratification sampling strategy to identify and recruit single-family homeowners in five different geographic segments of the state. Within each of those segments, towns or cities with high ratios of owned homes to rental units were identified, and then a random sampling of phone numbers within each city was used to recruit homeowners. A walkthrough audit was conducted to collect data on home construction, heating, cooling, lighting, appliances, and conservation measures. A brief homeowner survey was also completed during the visit.

The site visits were conducted between June and October of 2002. During this assessment, 309 site visits and surveys were conducted in homes in Illinois from June to October 2002. DOE2 modeling was then used to analyze the technical, economic, and market potential for savings associated with 34 potential home improvement measures.

Based on this preliminary analysis, MEEA then further analyzed 19 of those options in this report, and provided descriptions of these measures as well as overviews of recent and comparable program initiatives to promote them. A homeowner survey was conducted in combination with the home audits, and the results were analyzed and compared against recent Illinois and national studies.

The technical assessment for this study used a DOE2 modeling approach calibrated for the climatic conditions in Northern and Southern Illinois. Savings analyses were conducted, and then were weighted and averaged for the entire state. After the initial 34 measures were analyzed for annual savings, a consensus was made to further analyze 19 of these measures for final market potential analysis. MEEA applied rigorous modeling steps to arrive at a final table of estimated annual market potential for each of the 19 measures. These measures are listed in the table below. Some of the improvements apply only to air-conditioned homes.

All assumptions, methodologies, data points, and references to comparative data are fully detailed in the attached report.

Proposed Conservation Programs:

MEEA has prescribed an extensive program of financial incentives and other measures to capitalize on the potential market for energy efficiency identified in this study. Examples of the some of the most beneficial measures are listed below:

1. **Energy Efficient Lighting Programs**

   In particular, the field data from the site visits indicated that 95% of the homes had less than a 10% presence of CFL's (Compact Fluorescent Lamps) by bulb count. Programs offering rebates or other incentives to encourage homeowners to purchase CFLs to replace their existing incandescent light bulbs are simple and highly cost-effective programs that should be utilized. Programs should only provide incentives for the purchase of CFLs that qualify for the ENERGY STAR label to ensure the products quality and longevity.

   Additionally, programs focusing on ENERGY STAR qualified fixtures and ceiling fans should also be considered after the market for CFLs has begun to be established. Various programs could be developed, including promotions that encourage consumers to swap energy-guzzling and potentially hazardous halogen torchiere lamps for a discount on new energy-efficient models. Such trade-in programs have been administered with much success elsewhere in the country.

   Over the last three years, the Department of Commerce and Economic Opportunity has funded a residential lighting program that has focused on retail education, incentives, promotional events and public outreach to increase the use and penetration of energy efficient lighting. DCEO should be commended for their continued support for energy efficiency and should be seen as a leader in Illinois for their support.

2. **Programs focusing on high-efficiency heating, ventilation and air conditioning units.**

   Significant savings are available for the installation of high efficiency air-conditioning systems instead of standard efficiency SEER 10 (Seasonal Energy Efficiency Rating) units. Furthermore, while most of the homes throughout Illinois employ natural gas furnaces for heat, a few (between 2% and 3%) use electric heat pumps or electric strip heat for primary heat; so, as a retrofit measure, the installation of a high-efficiency heat pump might be an option for existing homes with old heat pumps or with electric resistance heat.

   Example HVAC program include, but are not limited to rebates and financing to encourage customers to install HVAC equipment meeting ENERGY STAR requirements at a minimum. HVAC equipment rebates generally vary from $200 to $500, depending upon equipment type and efficiency. Per this assessment, the estimated annual savings from upgrading from a SEER 10 AC unit to a SEER 13 is 509 kWh, with a peak demand reduction of 0.56 kW. The potential annual savings for replacing an older SEER 10 heat pump with a SEER 13 heat pump are approximately 1889 kWh and 0.66 kW for the average home. Replacement of old electric resistance heat systems can have potential annual savings of 16,960 kWh and 8.43 kW.

Program sponsors can partner with local contractors who must meet participation-eligibility requirements, including product efficiency minimums and installation specifications. Participating contractors could be permitted to offer the program's financing and rebates to customers. Program requirements, incentives, and marketing should be coordinated, as applicable and practicable, with utilities, utility groups, and public agencies to promote market transformation.

3. **<u>ENERGY STAR qualified appliance programs</u>**

Across the country, there are numerous programs that provide consumers with incentives to purchase ENERGY STAR qualified appliances, which can generate electric, gas and water savings. The assessment revealed that Illinois consumers could reap significant savings if they replaced their existing appliance with an ENERGY STAR qualified model. The table below reflects these savings:

Appliance	Annual kWhr Savings	Annual BTUH Savings
Refrigerators	260 – 472	0
Dishwashers	43 – 180*	400
Clothes Washers	-4 – 680*	1500

* Savings depend on whether the water is heated by electric or gas.

The majority of the programs that are being implemented revolve around two key components: consumer incentives and retail education. Offering consumers incentives to lower their end cost of the appliance will afford more customers the opportunity to purchase the ENERGY STAR qualified appliances which are typically higher-end units. Additionally, programs should try to leverage their rebate dollars with matching contributions from manufacturers and provide retail education on how to properly market and sell energy-efficient products and appliances.

MEEA believes that refrigerator rebates should be available only to customers who agree to recycle an older appliance. Programs must ensure that the older refrigerator is placed out of operation, not used as a secondary unit and not resold back into the market place. Additionally, programs must ensure that proper recycling occurs and meets all federal, state and local environmental requirements.

4. **<u>Programmable Thermostat Programs</u>**

This market assessment estimates that by increasing the cooling set points three degrees F and decreasing the heating set points by four degrees F daily from 8AM to 3PM, than the estimated annual savings will be about 60 kWh and 2.01 kW, along with 26 therms and 22,413 BTUH.

Incentives for programmable thermostats generally involve either a straight rebate to the consumer -- usually around $20 -- for the purchase of a programmable thermostat, or it is added into an existing HVAC program where the incentive is coupled with the HVAC incentives.

5. **Programs focusing on proper sizing of AC systems**

For this assessment, an oversized system is defined as having a rated cooling capacity greater than 100% of a valid Manual J cooling load estimate, which is the industry standard for calculating the proper sizing for air-conditioning systems. The audits identified that about 80% of the AC systems of this study are oversized relative to this criterion. Those that qualified as oversized averaged 50% above the Manual J estimate.

Programs to address the over-sizing of AC systems would likely take the form of either training of AC installation contractors on Manual J and proper sizing of AC units for new homes, or an incentive structure to reduce the cost of the homeowner to retrofit their existing system with an AC that meets their load estimate. The incentives should be tiered and correspond to whether or not new ductwork is needed or if the new system can use the existing AC infrastructure.

6. **An ENERGY STAR homes program or equivalent or training for builders and architects on building homes beyond existing energy codes**

Homes built exceeding the existing energy code will use substantially less energy for heating, cooling, and water heating. Additionally, the energy-efficient features of these new homes keep out excessive heat, cold, and noise, and ensure consistent temperatures between and across rooms - making these homes more comfortable to live in. Builders and architects can learn how to construct and sell these homes, which have considerable appeal for the consumer and only marginal cost for the builder.

Two separate programs could be implemented: 1) A series of trainings for builders and architects on how to build beyond code home; and 2) a system of incentives for homeowners (tax incentives, rebates, low-cost financing) to build a better home. However, in states and metropolitan areas that do not have a strict energy code, adapting the training prior to the homeowner incentives is recommended so that when consumers begin to demand more efficient homes, the building and architecture community will be prepared to handle this demand.

7. **An energy-efficient windows program in conjunction with the downsizing of an AC system.**

After the initial assessment was completed, MEEA took the analysis a step further to look at the market potential of combining the planned installation of high-efficiency windows and a downsizing of the AC system at the same time. This new model estimated that the energy savings for the combinations of high efficiency windows and AC downsizing to 100% of Manual J calculated loads are as high as 784 kWh. When these two measures are applied independently, they save an average of 678 kWh (314+364) per year. When they are applied together interactively the combined savings are 16% more.
This is characteristic of downsizing only, since all other combination measures usually lead to a slight interactive reduction in total savings when applied together.

This program that combine education and awareness to contractors as well as small incentives for homeowners should be considered to achieve these desired savings.

As concerns about reliable and affordable supplies of energy continue to resurface, this is an opportune time for states like Illinois to make a political and financial investment in strategies that will curtail energy consumption and save consumers money. This study demonstrates that the public would embrace these opportunities. We hope that our public officials will, as well.

Acknowledgements

MEEA thanks the Illinois Clean Energy Community Foundation, Commonwealth Edison and the Illinois Department of Commerce and Economic Opportunity for their generous support of this study.

II. PROJECT DESCRIPTION

II.1 Introduction

The data comes from on-site work conducted in selected sample areas throughout the state of Illinois from June to October 2002. The purpose of this assessment was to evaluate the existing residential saturation levels of energy efficient products, technologies, and practices of residential utility customers in the state of Illinois, as well as evaluate current consumer energy savings potential for residential conservation measures.

II.2 Evaluation Objectives

The primary objectives of this project were to:

- Evaluate opportunities for efficiency in the residential sector of Illinois;
- Determine saturation rates of existing technologies, products, and practices/behavior in Illinois;
- Understand consumer energy decision-making and consumer energy usage; and
- Provide a baseline to help determine future programs that will most effectively impact consumers in Illinois.

The key information to meet these objectives was in the form of in-home audits and surveys.

Specifically, the audit and survey task consisted of:

- Initial telephone interviews to gather basic household information,
- 309 On-site visits to record appliances, household envelope features, and heating/cooling equipment, and
- completion of a survey by the homeowner.

The subsequent analysis of the data gathered was:

- Engineering estimation to develop potential technical savings for each on-site sample point (including interactive effects with heating and cooling systems), and
- Statistical sampling and analysis to efficiently and accurately develop estimates of net demand and energy savings potential for each appliance or measure evaluated.

After the technical potential findings were completed, an analysis of recent secondary studies was used as comparisons to the findings of the primary research. The remainder of this report reviews the methodology and results of the study.

III. METHODOLOGY

This section of the report presents the sampling methodology, and the on-site audit methodology.

III.1 Sampling Methodology

MEEA recognized that a modified stratification of the population, as opposed to purely random sampling, created the best opportunity to make the project cost- and time-effective. To achieve the best-cost value in the project work scope, the following assumptions were built into the sampling design:

1. As requested by the Illinois Clean Energy Community Foundation, the population was stratified into the following five major regions within Illinois:

- 1 - Cook County, including Chicago;
- 2 – the Collar counties surrounding Chicago;
- 3 – Northwest Illinois;
- 4 – Central Illinois; and
- 5 – Southern Illinois.

The single family detached housing population from all counties within each major region was aggregated. The ratio of that total against the state population was then used to multiply against the target sample number of 300 to derive the number of audits per region.

2. Recruitment and scheduling was targeted to selected population centers located within the five regions for three reasons: a) it made it time- and cost-effective to pull a random sample list from our contact software, b) it maximized the recruitment callers' opportunity to schedule a household in one of several number of weeks, and c) it gave auditors reasonable proximity in making daily visits. The last point was very important, because we scheduled visits on a tight time schedule in order to get the most audits within each workweek.

To ensure maximum potential in reaching single-family owners (and concurrently, to reduce the time and cost risk in rejecting renters in the phone recruitment) US 2000 Census data for towns and cities in each segment were identified for the highest ratios of owned homes to rental units.

The final sampling of 309 homes gives this study a 90% confidence interval with a 9.4% relative precision, with an assumed error ratio of 1. Table 1 below shows the sampling figures and stratification.

	Cook County	**Collar Counties**	**Northwest Illinois**	**Central Illinois**	**Southern Illinois**	**TOTAL**
% of state total	29%	24%	11%	18%	18%	**100%**
Targeted sample no.	88	71	33	65	42	**300**
Final sample number	69	88	33	60	59	**309**

Table 1: Final Sample Design by Service Territory

Our next step was to pull a random sample of single-family households and phone numbers from a white pages software package. Table 2 below shows the final sampling count and percentages of each of the survey areas:

Area	Towns-Area	Zip Code	Population Size	Sample Size	% of pop sampled	% of total sample
Central	Peoria	616xx	43,176	3,650	8.5%	23.7%
Collar	Barrington	60010	8,844	783	8.9%	5.1%
Collar	Algonquin	60102	7,016	862	12.3%	5.6%
Collar	Batavia	60510	7,660	901	11.8%	5.9%
Collar	Dundee	60118	1,845	528	28.6%	3.4%
Collar	Geneva	60134	6,213	792	12.7%	5.1%
Cook	Winnetka	60093	4,813	347	7.2%	2.3%
Cook	Stickney	60402	1,179	217	18.4%	1.4%
Cook	Lemont	60439	4,971	346	7.0%	2.2%
Cook	Norridge & Harwood Hgts	60706	5,255	362	6.9%	2.4%
Cook	Tinley Park & Orland Hills	60477	14,294	843	5.9%	5.5%
Cook	Chicago Hgts, Ford Hgts, Lynwood, S Chicago Hgts, & Sauk Village	60411	12,037	601	5.0%	3.9%
Cook	Niles	60714	8,495	469	5.5%	3.0%
Cook	Northfield	60093	2,040	250	12.3%	1.6%
Northwest	Rockford	611xx	50,937	1,570	3.1%	10.2%
Southern	Godfrey	62035	5,336	1,669	31.3%	10.8%
Southern	Wood River	62095	3,177	1,193	37.6%	7.8%
	Totals		**187,288**	**15,383**	**8.2%**	**100.0%**

Table 2: Final Sampling Breakdown

Matousek and Associates, a subcontractor to RLW Analytics, performed the recruitment, demographic survey, and audit scheduling by phone to sample groups chosen. Table 3 shows the final dispositions of these recruitment efforts. The ratio of successfully recruited audits to qualified sample points where contacts were made is 9.3%.

Disposition	#
No answer/busy	4,383
Recording	8,637
Disconnect/not in service	1,102
Business / fax	413
Duplicate #	17
Wrong #	176
Call back	1,158
Not at home	994
Language barrier	166
Terminate-respondent is a renter	430
Qualified, but refused	1,670
Total Unsuccessful Calls:	**19,146**
Scheduled Audit	418
Total Cancelations:	**109**
Cancelled by homeowner	42
No one home (confirmation done)	34
Rescheduled	33
Final Audits Completed	**309**
Total Attempts	**19,564**

Table 3: Final Contact and Audit Tabulation

III.2 Site Audit Methodology

To perform the site audits, we sent eight different auditors out in one- to two-week trips to conduct the audits between June and October 2002. Each auditor was provided the schedule and contact names to visit. Daily schedules normally ran from 4 to 6 homes a day.

Each auditor was experienced in residential assessments. The main audit task was the documentation and count of all the observable house characteristics, including the following:

- General home configuration – number of floors, ceiling type and height, square footage per floor
- Lighting – Counts, types, wattages, locations
- Appliances – Counts, types, age, ENERGY STAR or not, model numbers
- Ductwork – Visual observation of leakage, insulation level and location
- Wall and attic insulation – Type, depth
- Windows and window types – Number of panes, sizes
- Heating and cooling systems – Type, model number, other nameplate information
- Presence of efficiency measures – Hot water tank wraps, window seals, faucet aerators, etc.

The auditors also took exterior photos for further documentary back up.

A second task during the visit was to conduct a brief survey with the homeowner. This survey contained questions relating to ENERGY STAR label awareness and understanding, and general energy issues. A final task was to ask for the homeowner to provide their utility service account numbers and sign an approval to allow MEEA to request their billing histories from those utilities.

III.3 Methodology for Estimating Impacts

The analysis for the technical impacts included an examination of typical weather patterns for several locations throughout Illinois. This examination indicated that there is a significant difference between the northern and southern portions of the state. Comparison of typical housing characteristics, on the other hand, showed that these differences were not very significant. Therefore, MEEA chose to create one DOE2 physical model to represent the entire state, but to utilize two different weather files in conjunction with two corresponding sets of utility billing data to modify and calibrate the model independently for each region, thus creating two slightly different models for the state. These two models were applied to calculate different savings for the northern and southern portions of the state.

A complete analysis was performed for northern Illinois using Chicago TMY2 weather, while another complete analysis for southern Illinois was done using St. Louis TMY2 weather data.[1]

The DOE2 formatted versions of these weather files contain hourly dry bulb and wet bulb temperatures, humidity ratios, direct and diffuse solar radiation, wind speed and direction, precipitation, ground temperatures and other variables utilized by DOE2 to calculate hourly cooling and heating loads.

The impacts for each measure were derived by fixing the northern or southern calibrated "as-is" model with the average of the observed condition for only the homes that exceeded a reasonable threshold value. This created a specific baseline model for each measure. These baseline models, therefore, represent homes that might be expected to participate in a conservation program offering that measure. Next, a retrofit model was created for those homes by upgrading the measure of interest to a significantly higher but easily attainable standard.

Savings were obtained by running the baseline and retrofit models to obtain the hourly building demands for a typical year and subtracting the results for every hour. The sum of the hourly differences in cooling demand represents hourly savings for a typical weather year. Annual energy savings are the sum of the hourly demand savings for the whole year. Natural gas savings estimates in terms of peak BTU's per hour and therms per year were derived the same way.

[1] TMY2 weather data, used throughout the world, have been derived from actual NOAA (National Oceanic and Atmospheric Administration) hourly measured data through an elaborate statistical and analytical procedure aimed at identifying the most typical of each of 12 months of weather from 50 years of historical data, and combining these 12 months from different years to create a "Typical Meteorological Year".

IV. HOME AUDIT RESULTS

The following tables with descriptive narrative follow the formats of each of the survey and audit instruments. A total of 309 on-site audits results are tabulated in these results.

IV.1. Homeowner and Home Demographics

Table 4 summarizes the homeowner demographics of the final sample of audits. During the initial contact, those respondents who passed the basic screening questions and agreed to schedule a visit were asked basic demographic questions, as well as temperature set points they normally use for heating and cooling. The average home had 3 individuals living in it, with a median income between $50,000 and $70,000. This is higher than the average Illinois income, which is approximately $25,000 per year. This discrepancy may be due to the high sampling in Cook County and Peoria, which have higher average incomes compared to the rest of the state.

DEMOGRAPHICS	Range	Average
Home age (years)	0 – 162	38.8
No. of people in home	1 – 11	3.0

SET POINTS	Range	Average
Heating set point (in ^{o}F)	60 – 80	70.4
Cooling set point (in ^{o}F)	65 – 82	75.2

INCOME LEVELS	Percent of Respondents
Under 15K	1.7%
15 – 20K	2.3%
20 – 30K	5.0%
30 – 40K	9.3%
40 – 50K	8.6%
50 – 70K	13.2%
70 – 100K	11.9%
Over 100K	11.6%
Don't Know/Refused	36.4%

	% Yes	% No
CENTRAL A/C	92.7%	7.3%

Table 4: Homeowner Demographics

The distribution of home ages in this study was similar to the Illinois home age distribution reported in the US 2000 Census, as is evident in Table 5.

Year House Built	IL Study	2000 US census - Illinois
1999 to 2002	5.8%	1.6%
1995 to 1998	7.2%	5.3%
1990 to 1994	9.6%	5.5%
1980 to 1989	7.9%	9.7%
1970 to 1979	14.8%	16.3%
1960 to 1969	14.4%	14.6%
1940 to 1959	21.3%	24.4%
1939 to earlier	18.9%	22.6%

Footnote to top entry in census column: 2000 Census recorded homes from 1999 and 2000

Table 5: Home Age Comparison with Census Data

We were able to recruit homeowners from every income strata. Table 6 compares the income distribution of homeowners in this study to the distribution of homeowner incomes in the most recent American Housing Surveys conducted by the US Census Bureau for Chicago and St. Louis. This comparison to the Census data shows that homeowners in mid-range incomes were represented equitably in the study. The apparent smaller representations of lower and higher income ranges may be explained by the significant percentage of those who refused to disclose income or made errors in recall. Both the level of non-response and the variations are expected. The US Census Bureau explains income surveys are difficult, and large non-responses create reporting errors.[2]

Study Income Strata	% of all respondents	Chicago AHS 1999 Survey - % of all respondents	St. Louis AHS 1996 Survey - % of all respondents
Under 15K	1.7%	9.5%	12%
15 – 20K	2.3%	3.8%	6%
20 – 30K	5.0%	10.4%	15%
30 – 40K	9.3%	11.2%	12%
40 – 50K	8.6%	9.5%	12%
50 – 70K	13.2%	24.5%	25%
70 – 100K	11.9%	10.2%	8%
Over 100K	11.6%	20.9%	10%
DK/Refused	36.4%	-	-

Table 6: Homeowner Income Comparison with Census Data

IV.2 Overall Home Configurations

Table 7 shows the results for items 1 through 5 on the audit form: conditioned space, ceiling heights, ceiling area, basement, and presence of weather stripping/caulking. The average main floor of the homes visited was 1,284 square feet. Forty four percent of the homes audited had a conditioned basement.

[2] A number of US Census Bureau studies explain difficulties in self-reported income surveys, and have documented how the Bureau requires a large degree of inputation procedures in order to reduce errors: Moore, Jeffrey C., Linda L. Stinson, and Edward J. Welniak, Jr., "Income Measurement Error in Surveys: A Review", US Census Bureau (no date given); accessed via www.census.gov/srd/papers/pdf/sm97-05.pdf; Vaughan, D., "The Survey of Income and Program Participation", US Census Bureau (no date given).

OVERALL DATA		n=	Average
Total Conditioned Space		309	1,800
Conditioned Space:	1st Flr SF	309	1,284
	2nd Flr SF	164	949
	3rd Flr SF	7	537
Ceiling Heights:	1st Flr ft.	309	8.3
	2nd Flr ft.	164	8.1
	3rd Flr ft.	7	8.1
Ceiling Area:	1st Flr SF	309	1,161
	2nd Flr SF	164	953
	3rd Flr SF	7	537
Basement:	Cond. SF	136	1,076
	Uncond. SF	143	980
	Both	32	1,307
	No Bsmt	30	
Weatherstripping	% windows	309	69.4%
	total # windows	309	18
	# windows w/ WS	245	15
	# windows w/o WS	147	12
	% doors	309	78.9%
	#doors	305	1.9
	# doors w/ WS	261	1.7
	# doors w/o WS	92	1.4

Table 7: Overall Home Data

IV.3 Heating, Cooling and Hot Water

Table 8 below shows the final breakdown of the heating, cooling, and domestic hot water systems (some homes had multiple systems for heating, cooling or hot water) found in the audits. As shown, an overwhelming majority of homeowners audited had natural gas fired forced air furnaces and electric central air conditioning. One home was served by a community heating and cooling system, and 5 homes had community domestic hot water ("DHW"). The capacities shown are average heating and cooling capacities in BTU per hour and storage tank gallons for DHW, respectively.

System	Fuel	Type	Percent of Sample	Capacity
HEATING	Natural Gas	Forced Air Furnace	92.5%	95,296
		Hydro-Baseboard	4.2%	189,917
		Community Heat	0.3%	-
	Electric	Electric Baseboard	0.9%	-
		Forced Air Furnace	0.9%	-
		Geothermal Heat Pump	0.3%	42,900
		Hydro-Air	0.3%	-
		Air Source Heat Pump	0.6%	10,000
COOLING	Electric	DX-Split	90.3%	33,945
		Geothermal Heat Pump	0.3%	40,200
		Air Source Heat Pump	0.6%	42,000
		Window Dx	4.8%	9,717
		Community AC	0.3%	-
		No Air Conditioning	3.6%	-
DHW	Natural Gas	Conventional Tank	94.0%	42.8
		Community DHW	1.6%	-
	Electric	Geothermal Heat Pump	0.3%	50.0
		Conventional Tank	3.8%	46.0
		Tankless Coil in Boiler	0.3%	-

Table 8: Heating, Cooling, and Hot Water Systems Found

Table 9 shows the total percentage of respondents who had central air conditioning, with a comparison to percentages reported in the American Housing Surveys. The slightly higher percentage found in this study is not surprising. The US Census Bureau has noted the dramatic and steady increases in central air conditioning in all areas of the country, especially in the South and Midwest.[3]

Have central A/C? (n = 302)	%	#	Chicago AHS (1999)	St. Louis AHS (1996)
Yes	94.3%	280	72.2%	86.3%
No	5.8%	22	27.8%	13.7%

Table 9: Central Air Conditioning Percentages

IV.4 Windows and Doors

Table 10 shows the final averages of window and door data collected. The average number of windows per house is 20.1, and the average glass area per house is 203 square feet. The average number of glass layers ("#panes") per window is 2.0, including storm windows in place during the site audits. A small percentage (about 6%) of the windows observed during the audits were single pane without storm widows. It is probable, however, that many of these, which were observed during the summer, will be fitted with storm windows during the winter. A similar percentage (about 7%) were "triple pane" (counting storm windows as one pane in most of those cases) window assemblies. Less than one percent (about 0.7%) of the windows observed were true triple pane windows, and none of these were fitted with storm windows at the time.

[3] Found at www.eia.doe.gov/emeu/recs/recs97/decade.html#geoa-ceq.

AVERAGE WINDOW DATA			
	Average		
# windows	20.1		
# panes	2.0		
# Doors	2.1		
Area, SqFt	203.0		
Storm Windows	Yes	No	
	35.7%	64.3%	
Frame Type	Wood	Vinyl	Aluminum
	52.8%	23.2%	11.3%

Table 10: Window Results

IV.5 Insulation

Table 11 shows the number of homes that have insulation in specific parts of the building envelope, average R-value, and the average area. The "Avg. R-Value" is the average of those that have insulation, and not the average of all those in the sample. The "Avg. Area", however, is the average surface area for the entire sample.

INSULATION DATA		total n=	with insul n=	Avg. R-Value	Avg. Area
FLOOR	Over basement	234	28	11.9	1,118
	Over garage	38	29	16.8	463
	Over crawl spaces	65	23	12.0	646
	Over porch	2	2	13.5	104
	Slab on grade	52	9	7.6	813
WALLS	Cond. to ambient	309	227	11.8	1,552
	Cond. to garage	180	134	11.6	254
	Cond. to attic	39	32	12.0	503
ATTIC/ ROOF	Flat ceiling	303	275	22.2	1,233
	Vaulted ceiling	68	62	18.6	557

Table 11: Insulation Results

IV.6 Electric Lighting

Table 12 is a summary of the information obtained for electric lighting systems.

Bulb Type	# of home cases	% of homes audited	Average total of watts per home	Average watts per bulb
Incandescent	309	100%	2,836	60.3
Fluorescent	241	78%	294	52.4
Incandescent on fan	212	69%	436	49.8
CFL	70	23%	68	18.6
Halogen	107	35%	395	101.1
TOTALS	**N = 309**	**-**	**3,501**	**59.0**

Table 12: Room Lighting Summary

IV.7 Ductwork

Table 13 and Table 14 show results of data collected on ductwork in the attics and basements of the audited homes. Most of the ducts found in attic spaces had one inch of insulation and were exposed to the attic conditions. Many, however, were covered to some extent with attic insulation. As shown in the table, the majority of homes had most of their ductwork installed in the basement, where the typical practice was to use un-insulated sheet metal. In a few homes ducts in the basement were covered with floor insulation. No observable differences in duct installation practice between conditioned and unconditioned basements were apparent.

Location of Ductwork	No. of homes with ducts in this location	Average Insulation Thickness, Inches	Overall R-value
ATTIC, Exposed	37	0.88	3.1
ATTIC, Under Attic Insulation	19	8.95	29.0
BASEMENT, Exposed	275	0.09	0.7
BASEMENT, Under Floor Insul.	7	5.64	18.5

Table 13: Ductwork Insulation Summary

Duct leakage rates were estimated by the auditors based on their assessment of visible portions of the ductwork. Leakage characteristics were tabulated in three qualitative categories as high, medium or low. By far, most of the duct systems observed were assigned medium or low leakage estimates, suggesting that duct leakage is probably not a major problem with heating and cooling systems in Illinois. Supporting this conclusion is the fact that most of these systems are in basements where overall duct leakage energy losses are somewhat buffered.

Amount Of duct leakage (by auditor's judgement based on observation)				
	n=	High	Medium	Low
ATTIC	57	3.5%	33.3%	63.2%
BASEMENT	282	5.0%	44.0%	51.1%

Table 14: Duct Leakage

Table 15 shows the space conditions where the attic ductwork runs (for those homes with ductwork):

SPACE CONDITIONS where the attic ductowork runs			
	# of homes with ductwork	Yes	No
Insulated?	304	29.3%	70.7%
Conditioned?	304	35.9%	64.1%

Table 15: Ductwork Space Conditions

IV.8 Appliances

Table 16 below shows the summary of appliances found in the audits. Refrigerators tended to be the oldest appliance in the home, followed by humidifiers. ENERGY STAR compliance among the appliances inventoried was found to be very low with the highest incidence observed for clothes washers and refrigerators, which were around 4.5%.

	n=	Avg. per home	Avg. Age, years	% Energy Star Labeled
Refrigerator	387	1.25	9.3	4.4%
Dishwasher	238	0.77	7.3	3.4%
Clothes Washer	306	0.99	8.2	4.6%
Clothes Dryer	304	0.98	8.2	0.0%
Waterbed Heater	20	0.06	8.3	0.0%
Dehumidifier	79	0.26	7.0	2.5%
Humidifier	121	0.39	9.1	0.8%
			Total	**2.9%**

Table 16: Appliance Summary

While most appliances can last longer, their anticipated age is generally around 10 years. While they can be repaired and serviced to extend their life, the efficiency of the units significantly decrease beyond their expected life. Given the average age identified in the audits, there is a significant opportunity to market ENERGY STAR appliance programs.

Presence of Efficiency Measures

Table 17 below shows the percentage of energy efficiency measures found. Nearly half of the audited homes had programmable thermostats, while a little over a third had faucet aerators.

% of homes w/ these measures?	
Pipe Insulation	10.4%
Hot Water Tank Wrap	7.4%
Low flow showerhead	28.8%
Faucet aerators	36.9%
Programmable Thermostat	46.9%
Outdoor light sensor	29.4%

Table 17: Other Efficiency Measures Summary

IV.9 Conclusions

The raw aggregated data from the audits show suggest several areas where energy efficiency opportunities stand out.

The large percentage of central air conditioning in homes suggests that any initiative designed to improve efficiencies in sizing, ductwork, refrigerant levels, filter maintenance, or replacements in higher SEER models can impact a wide range of homeowners regardless of home size, location, or income level.

There are significant opportunities for replacements or upgrades to ENERGY STAR products and appliances. A large percentage of homes have incandescent and halogen lamps, and the audits show low levels of ENERGY STAR labeled appliances and lighting in the homes visited.

Finally, there are significant portions of the sample population that do not have simple conservation measures, which are normally addressed in weatherization and low-income programs.

V. HOMEOWNER SURVEY RESULTS

This section presents the results of the short consumer survey administered during the on-site visit. Aggregate responses to date are shown per question. We compared selected results with three other studies where similar queries were posed:

- Consortium for Energy Efficiency (CEE) 2001 National ENERGY STAR Awareness Survey
- 2001 Illinois Statewide Energy Survey, conducted by American Viewpoint for the Illinois Clean Energy Community Foundation
- 2001 Cook County Resident Survey by Catalyst Group for the Chicago Energy Cooperative

V.1 ENERGY STAR Logo Awareness and Understanding

Questions 1 through 4 of the consumer survey asked about recognition, awareness, and understanding of the ENERGY STAR logo. Specifically, we asked respondents to provide the first and second messages that came to mind upon viewing the ENERGY STAR label.

To score these responses, we used the scoring table shown below. This table was used for a Northeast Energy Efficiency Partnership (NEEP) ENERGY STAR Appliance metric update study in 2001. It also closely emulates the scoring used in the 2000 and 2001 CEE ENERGY STAR study. Q1 was designed to elicit any response; Q2 prompts for a second response, if any.

Response Scoring
Response Compared To These Characterizations:
Seal of approval/rating system for energy efficiency
Label describing energy efficient products
Promotes energy efficient products
Endorsed by EPA
Scoring for Response Fit:
Very Aware = Description fits closely to the characterizations above
Somewhat Aware = Description shows an understanding that E Star relates with energy efficiency (approaches these characterizations)
Not Aware = Description is not close to what Energy Star is or means
No Response: Homeowner could not come up with any other message

Table 18: Scoring of Descriptions of ENERGY STAR Label

Table 19 shows the final results based on this scoring. In total, 6.1% of respondents provided a first message that implied a high level awareness of ENERGY STAR.

Count of Q1 Response Characteristics		
Q1_Characteristics	**Total**	**%**
Not Aware	181	58.6%
Somewhat Aware	92	29.8%
Very Aware	19	6.1%
(No Response)	17	5.5%
Grand Total	**309**	**100%**

Count of Q2 Response Characteristics		
Q2_Characteristics	**Total**	**%**
Not Aware	163	52.8%
Somewhat Aware	32	10.4%
Very Aware	12	3.9%
(No Response)	102	33.0%
Grand Total	**309**	**100%**

Table 19: ENERGY STAR Label Awareness

A comparison of the awareness levels with the CEE 2001 Awareness Survey shows that the Illinois residents surveyed in this study showed lower levels of awareness compared to the national levels, as illustrated in Figure 1 below.

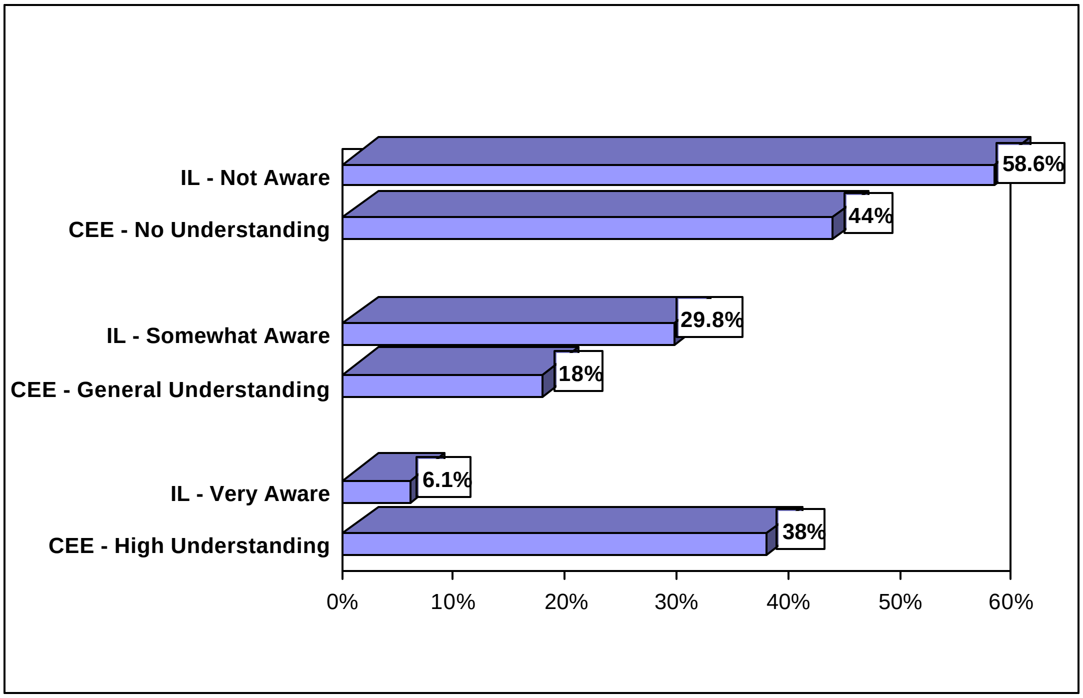

Figure 1: Comparison of Understanding/Awareness Levels With CEE 2001 National Energy Star Awareness Survey

Next, respondents were asked if they had ever seen or heard of the ENERGY STAR label, and if so, where they had seen or heard of it. These results are presented in Table 20 and Table 21 below. Each of these tables also presents a comparison column of the CEE 2001 awareness results.

"Ever heard of or seen this ENERGY STAR label before?"		
	Illinois residents	CEE 2001 Study
Yes	50.2%	40.0%
No	49.8%	60.0%

NB: CEE Mail only results

Table 20: Participant Self-Reported Awareness of ENERGY STAR Label

Of those that had seen the ENERGY STAR logo before, most claimed to have been made aware of it through utility mailings or other media (a total of 49.3%).

Response	% of total mentions
Newspaper or magazine	13.7%
TV or radio	13.4%
Utility mailing	22.2%
Friend, neighbor, relative, or co-worker	0.8%
Internet	5.8%
Sales person or contractor	8.5%
In-store displays	24.9%
Other	7.4%
Don't Know	3.3%

Table 21: Channels to Participant ENERGY STAR Label Awareness

Most of these results compare similarly to the CEE study results, except for the percentage level of media impressions. The only instance where the percent of respondents in this study was higher than that of the CEE study was with respect to the proportion that had seen or heard of the ENERGY STAR logo through a sales person or contractor.

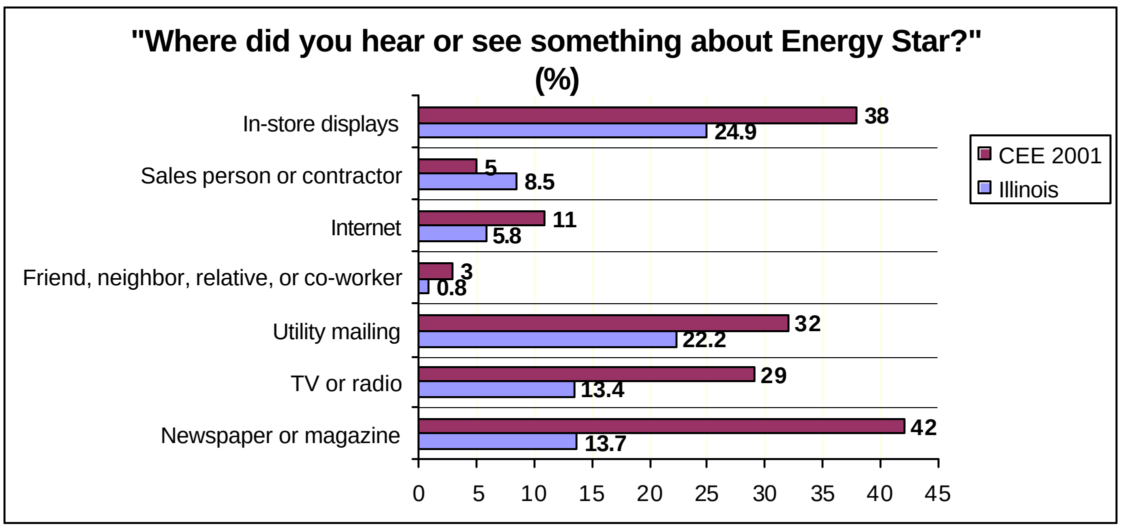

Figure 2: Where ENERGY STAR Logo was Seen or Heard

V.2 Energy Issues

The last set of questions in the survey asked the respondents to self rank their level of knowledge and concern on energy issues. The questions were asked in the form of a statement, and respondents were asked to choose a score from 1 to 9, with 1 equaling "Not at all" and 9 equaling "extremely". Table 22 below shows the average of the responses in this study, along with a comparison to similar queries posed in the 2001 Chicago Energy Cooperative Study:[4]

[4] Shapiro, Leo J., Catalyst Marketing Group, "Community Energy Cooperative – Cook County Resident Survey", August 2001. Report tables provided courtesy of the Community Energy Cooperative.

Average Knowledge and Concern for Energy Issues			
On a scale of 1 to 9 (1 = none, 9 = very much)	**n=**	**Avg.**	**CEC 2001 Study**
Of all household expenses, importance of energy costs	289	6.9	-
Of all issues, importance of environmental topics	290	6.4	6.8
Knowledge of environmental issues	289	5.2	5.2

Table 22: Average Knowledge and Concern for Energy Issues

Both studies show that Illinois homeowners are self-admittedly uncertain about environmental issues, with fairly significant concerns for energy costs and environmental topics. These results generally corroborate with the results released in the 2001 Illinois Statewide Study, where 75% placed significant importance on the purchase of energy efficient appliances and products, and similar percentages supported government funded energy efficiency initiatives.[5] These concerns for energy and environment from this short homeowner survey are also generally similar to opinions about the importance of energy efficiency collected in a 2001 statewide random sample energy and environment survey conducted by the University of Illinois.[6]

V.3 Conclusions

It may seem something is wrong when the low numbers of energy efficient measures found in the audits are compared to the stated values and desires in this and other recent studies. However, this is not surprising. We believe that there are three broad and interrelated explanations for this apparent incongruity: socially desirable response bias, a lack of readily available and accessible information, and an accurate understanding about energy efficiency.

Socially desirable response bias – this is a recognized challenge in survey work, where respondents will tend to give answers that are *socially desirable* rather than disclose *actual behavior*. This has lead to increased concerns by researchers to identify and overcome this bias in marketing research for "green" and other cause issues.[7] For example, in a 2002 baseline assessment of ENERGY STAR homes for Northeast Utilities, RLW Analytics found an obvious disconnect between homebuyer actions perceived by market actors and even in the self-perceptions by homeowners themselves.[8]

Lack of information – This is a common market barrier found by researchers when evaluating marketplaces for ENERGY STAR products and appliances. Without a sustained program initiative to provide consistent and unbiased information about energy efficient products, most consumers will rely on whatever contractor and salesperson information is given them, as well as anything from the national media, such as Consumer Reports or on-line resources.

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[5] Wilson, John H. of American Viewpoint, "Illinois Statewide Energy Survey", prepared for the Illinois Clean Energy Foundation, September 2001, page 4.

[6] "UIS Survey Research Office Summer 2001 Energy & Environment Survey", accessed at http://sro.uis.edu/Energy.htm.

[7] Nancarrow, Clive, Bristol Business School UWE, and Ian Brace, BJM Research and Consultancy, "Saying the 'right thing': Coping with Social Desirability Bias in Marketing Research", *Bristol Business School Teaching and Research Review*, Issue 3, Summer 2000; accessed via www.uwe.ac.uk/bbs/trr/Issue3/Is3-2_2.htm. Agreements between socially desirable self-reports and observed actions vary widely, as reported in Gosling, Samuel D., Oliver P. John, Kenneth H. Craik, and Richard W. Robins, "Do People Know How To Behave? Self-Reported Act Frequencies Compared With On-Line Codings by Observers", *Journal of Personality and Social Psychology*, 1998, Vol. 74, No. 5, pp. 1337-1349.

[8] Recent research relating to the disconnect in values and behavior include Jane Peters and Shel Feldman, "I Can Do It! The Role of Self-Efficacy in Motivating Changes in Attitudes and Behavior Relating to Energy Efficiency and Renewables" (IEPEC Proceedings, August 2001); Rick Diamond and Mithra Moezzi, "Revealing Myths about People, Energy, and Buildings" (2000 ACEEE Summer Study Proceedings, August 2000); and Willett Kempton and Max Neiman, Editors, "Energy Efficiency: Perspectives on Individual Behavior" (ACEEE publication, 1987).

Lack of accurate understanding of energy efficiency and energy efficient products – This is a subtle but important customer perception challenge in promoting energy efficiency. As shown earlier, about one-half of homeowners in this study recognized the ENERGY STAR label, but a much lower proportion of them could adequately explain what it stood for. Research has found in recent market baseline studies that consumers with inadequate understanding of energy efficiency (as well as contractors and retailers who sell to them) can have misperceptions of what truly is "energy efficient" as opposed to what is "standard".[9]

The results of this study compared to some of the results of the Illinois Energy Survey illustrate the effect of these three issues. As shown earlier, there are low percentages of energy efficient products and appliances in the homes sampled, but the Illinois Energy Survey reported high percentages of respondents who claimed they make an effort to buy these products. For illustration, Table 26 below juxtaposes these two kinds of results:

Behavior	This Study: % of Homes With This Item/Measure	IL Energy Survey: % who state they attempt to undertake these measures
Purchase **energy efficient appliances** and products	3.2%	85%
Purchase **energy efficient air-conditioners and refrigerators**	4.5%	77%
Use **energy saving light bulbs**	23%	67%

Table 23: Comparison of Home Audit Results With Behavior Claims Reported in the Illinois Energy Survey

The intent here is to simply demonstrate how these issues explain the apparent disconnect between audit and survey results. Many respondents in the Energy Survey may have good intentions, an inaccurate understanding of "energy efficiency", a lack of correct information, or some combination of the three. We believe, then, that the results show that the majority of Illinois homeowners indeed believe in the general values of energy efficiency, but may not necessarily follow through or understand what it entails.

[9] For example, in a residential HVAC study done in 2002 by RLW in CT, MA, and RI, about half of the respondents who recently installed central air conditioning claimed they knew a lot of about efficiency, and about the same amount could cite the main benefits of high efficiency systems and the technical factors that affect energy use. However, few could correctly cite SEER as the measure of efficiency, and a majority of them did not assess the cost effectiveness of the new unit they were considering. In addition, contractors appeared to be inconsistent in discussing the benefits of high efficiency equipment and efficiency options with customers.

VI. TECHNICAL ASSESSMENT OF ENERGY AND DEMAND IMPACTS

VI.1 Potential Energy Conservation Measures

MEEA analyzed 34 potential home improvement options, as listed in Table 24, and calculated average annual savings for each in terms of kWh and kW electrical energy and demand and therms of natural gas. Some of the improvements apply only to air- conditioned homes, while others may apply to any home. Shaded ID options represent 19 measures and options that have been identified by MEEA as priority measures, to be more fully developed in the market assessment section of this report.

ID	Potential Situation	Improvement	Quantity
1	Refrigerant under charged	Add refrigerant	1 Lb R22
2	Refrigerant over charged	Remove refrigerant	1.5 hour
3	Low evaporator airflow A	Increase duct sizes or add new ducts	75 SF
4	Low evaporator airflow B	Increase blower speed	1.3 hour
5	High duct leakage (25%)	Reduce ductair leakage to 5%	2.83 tons
6	Oversized AC units A	Size AC units to 100% of Manual J	3.52 tons
7	Oversized AC units B	Size AC units to 100% of Manual J	3.52 tons
8	One inch insul. on ducts in attic	Add one more inch of insulation	2.83 tons
9	Gas heat and 10 SEER AC	Install AC SEER = 13	2.83 tons
10	Home has 10 SEER heat pump	Install Heat Pump SEER = 13	2.83 tons
11	Home has electric strip heat	Install Heat Pump SEER = 13	2.83 tons
12	Attic insulation = R-7	Add another R-23 attic insulation	1290 SF
13	Attic insulation = R-11	Add another R-19 attic insulation	1290 SF
14	Exposed walls not insulated	Add R-11 wall insulation	1770 SF
15	Floor over basement not insulated	Add R-19 Insulation to floor	450 SF
16	House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	2290 SF
17	Standard double pane windows A	Install Low E triple pane windows	203 SF
18	Standard double pane windows B	Add storm windows	203 SF
19	Standard double pane windows C	Install Low E double pane window	203 SF
20	Standard double pane windows D	Install Low E double pane window	203 SF
21	No E & W window shading A	Add solar screens to E & W glass	96 SF
22	No E & W window shading B	Plant deciduous trees on E & W sides	6 each
23	No Compact Fluorescent Lamps	Use 13 CFLs throughout house	13 CFLs
24	Refrigerator needs to be replaced	Purchase Energy Star refrigerator	1 each
25	Refrigerator early retirement	Purchase Energy Star refrigerator	1 each
26	Dishwasher to be replaced A	Purchase Energy Star dishwasher	1 each
27	Dishwasher to be replaced B	Purchase Energy Star dishwasher	1 each
28	Clothes washer to be replaced A	Purchase Energy Star clothes washer	1 each
29	Clothes washer to be replaced B	Purchase Energy Star clothes washer	1 each
30	No prgrammable thermostat	Install programmable thermostat	1 each
31	No faucet aerators	Install faucet aerators	1 each
32	No low flow shower heads	Install low fow shower heads	2 each
33	Hot water pipes not insulated	Insulate hot water pipes	1 each
34	Gas water heater not wrapped	Wrap gas water heater	1 each

Table 24: Potential Situations and Improvements Evaluated in this Study

Several of the listed improvement options represent multiple ways of dealing with a single potential situation. For example, a low-evaporator airflow (ID 3 and 4) may be rectified by increasing duct capacities or increasing the speed of the blower. The potential situation in this case is denoted as "A" or "B", respectively. The cost of implementation of each improvement option is based on the "Quantity" defined in the last column of the table.

VI.2 Interpretation of Field Data and Creation of DOE2 Models

Information gathered during the site visits included detailed house construction features and demographic information from 309 single family detached homes throughout the state. Monthly electric billing data were obtained from the utility companies for 177 of these homes.

MEEA employed specially created DOE2 models based on the average shell and demographic characteristics of all the sampled homes to estimate potential savings. These models were designed to exhibit weekday, weekend and monthly variations in energy consumption derived from over 100 hourly schedules, which in turn were created from previously metered hourly end-use data. Each model is capable of producing valid seasonal energy savings and peak demand savings. Savings are actually based on differences in hourly demand over a full 8,760 hours. Demand savings can be observed for any hour of interest, but those reported for this study are non-coincident annual peak demand savings. As such, they are not truly additive.

First, an "as-is" model for each region was created to represent the average characteristics of all homes in the sample. The state was divided into two weather regions: one representing the northern part and another the southern part of the state. Monthly billing data from 104 homes in Commonwealth Edison (ComEd) territory were used to calibrate the model representing northern Illinois, while combined billing data from 44 sites in the CILCo service area and 29 sites in Illinois Power territory were used to calibrate an independent "southern" model. Independent adjustments of uncertain variables such as monthly base loads and temperature set points for cooling and heating were made to obtain calibration of these models to within 10% each month of their actual average monthly kWh usage.

Many of the descriptive components of the "as-is" or baseline home that were used in the DOE2 models are listed in Table 25 below. This is a two-story house with a full basement, part of which is heated and cooled. The floor areas of each space are the averages of those measured during the site visits, except that the actual average of third floor areas (about 12 square feet) is included in the second floor of the model. The total conditioned area of the house is 2290 square feet. The total window area is 203 square feet, distributed by N, S, E and W orientations documented in the audits.

The basic model also contains four unconditioned zones to capture the effects of the heat transfer through the attics, garage wall and floor over the unconditioned basement. These buffer zones also provide a method of modeling duct supply and return air leakage to these spaces and duct heat transfer to and from the attic.

Exterior shading is modeled by two-foot eaves on the north and south sides and 60-foot high non-deciduous "trees" on the east, south and west faces of the house. The solar transmissivities of these trees is 0.5, which represents about 50% of the full shading effect, or the average, for all homes. Interior shading of the glass is modeled by light drapes that are fully open at times and partially closed at other times, according to a realistic schedule of occupant behavior.

Characteristic	DOE2 Model Value
First floor conditioned area, sq. ft.	1,290
Second floor conditioned area, sq. ft.	520
Conditioned basement area, sq. ft.	480
Unconditioned basement area, sq. ft.	450
Garage area, sq. ft.	280
% glass to cond. Floor area	8.3%
Window glass type	Double-paned clear
Solar screens?	No
Infiltration ACH	0.50
Wall insulation R-value	7.0
Attic insulation R-value	15.0
Number of occupants	3
Lighting connected load kW	4.38
Lighting peak usage kW	2.73
Misc connected load kW	3.36
Misc peak usage kW	2.56
Base elec. usage, kWh/year	6,914
Base gas usage, kWh/year	324.3
Cooling system type	DX Split
A/C rated SEER	10.50
A/C rated tons	2.83
Metering device (TXV, Capillary)	CAP
Air flow factor	0.93
Refrigerant charge factor	0.95
Operating SEER A/C	9.66
Operating tons A/C	2.59
Supply air cfm/ton	372
Supply duct air loss	17%
Duct heat gain factor U*A	24.0
Portion of ductwork in attic	50%
Haeting sytem type	Gas
Heating system operating efficiency	82%
Heating capacity, Btu/hour	96,000

Table 25: DOE2 Model Characteristics of the Baseline Home

Internal and external energy (electricity and gas) used for lighting, appliances, and hot water vary hourly according to end-use metered data from other studies. These also vary monthly to allow calibration of the model to match actual utility billing data. Cooling and heating temperature set points were also allowed to vary both hourly and monthly to represent measured data from other studies, as well as to provide fine tuning of the model for calibration.

Cooling and heating system characteristics are shown in Table 25. These values are typical of those observed in this study or borrowed from other similar studies. The airflow factor and system charge factor, for example, are from other studies in which air conditioner performance data were measured. These are used in the model to adjust rated capacity and efficiency to typical operating values.

About 98% of the homes had a natural gas fired furnace for heating. Therefore the model was created with that system. About 2% of the homes in the sample had electric heat, which are candidates for high efficiency heat pumps. To model these, the gas furnace in the average home base case was temporarily replaced with a standard efficiency heat pump or electric strip heat, listed in Table 24 above and Table 26 below as ID numbers 10 and 11.

Calculation of Individual Measure Impacts

The savings for each measure were calculated separately for the northern and southern counties of the state. The statewide savings per house were then calculated as the population-weighted averages of the regional savings. The 2000 U.S. Census data for the northern population of single-family detached homes is 2,549,792, and 519,092 for the southern population. The related weighting fractions, therefore, are about 0.83 and 0.17.

The Chicago metropolitan area dominates the population of northern Illinois. Although there are numerous other population centers in northern Illinois, Springfield and East St. Louis are the only two major population concentrations in southern Illinois.

Savings estimates for each measure and optional retrofit improvement are summarized in Table 26, which includes estimates for the relatively small numbers of electric heated homes. Electric savings occur for all measures except the last four. Savings for these rely on the type of water heater in the home, and the typical home uses gas water heating. Electric savings for those homes (about 4% of the population) with electric water heaters were calculated, and the results are reported in the specific sections of this report that address each measure.

The shaded ID numbers represent the measures and options that have been identified by MEEA as priority measures. The blank shaded cells represent housing types that the respective measure does not apply. For example, ID 10 is a heat pump replacement measure that applies only to homes with heat pump heating systems, and ID 11 is a heat pump replacement of an existing electric strip heating system.

Savings for ID numbers 22 through 34 (except for ID 30) in Table 26 are not directly calculated by DOE2, so the savings for these were taken from the results of previous studies. Direct impacts for lights and appliances located within the conditioned space were programmed into the DOE2 models, however, to capture their secondary impacts on cooling and heating loads.

					Gas Heated Houses					Electric Strip Heat Houses			Electric Heat Pump Houses		
	Electric Savings Per Home			Diff.	Gas Savings Per Home			Total	Payback	Elec Ht	Total	Payback	Elec Ht	Total	Payback
ID	kW	kWh	$ Saved	Cost	BTUH	Therms	$ Saved	$ Saved	Years	$ Saved	$ Saved	Years	$ Saved	$ Saved	Years
1	0.49	470	$42	$110	0	0	$0	$42	2.6	$0	$42	2.6	$0	$42	2.6
2	0.20	105	$9	$90	0	0	$0	$9	9.6	$0	$9	9.6	$0	$9	9.6
3	0.60	530	$48	$807	0	0	$0	$48	16.9	$0	$47	17.0	$0	$47	17.0
4	0.34	257	$23	$78	0	0	$0	$23	3.4	$0	$23	3.4	$0	$23	3.4
5	0.31	305	$27	$500	10318	118	$77	$104	4.8	$255	$283	1.8	$111	$138	3.6
6	0.17	121	$11	-$1,858	0	0	$0	$11	0.1	$0	$11	0.1	$0	$11	0.1
7	0.36	314	$28	-$1,000	0	0	$0	$28	0.1	$0	$28	0.1	$0	$28	0.1
8	0.12	52	$5	$506	2692	81	$53	$57	8.8	$176	$181	2.8	$77	$81	6.2
9	0.56	509	$46	$425	0	0	$0	$46	9.3						
10	0.66	1889	$170	$708									$125	$170	4.2
11	8.43	16960	$1,523	$4,245						$1,488	$1,523	2.8			
12	0.74	484	$43	$839	9080	101	$65	$109	7.7	$218	$261	3.2	$95	$138	6.1
13	0.52	299	$27	$671	6546	62	$41	$67	9.9	$135	$162	4.1	$59	$86	7.8
14	1.10	762	$68	$2,584	22381	451	$294	$362	7.1	$976	$1,044	2.5	$424	$492	5.3
15	0.13	-430	-$39	$270	9089	61	$40	$1	99.0	$134	$95	2.8	$58	$20	13.6
16	0.50	209	$19	$400	16749	265	$172	$191	2.1	$573	$592	0.7	$249	$268	1.5
17	0.73	350	$31	$2,432	5368	41	$27	$58	41.9	$89	$120	20.3	$39	$70	34.9
18	0.31	120	$11	$914	3169	27	$17	$28	32.5	$58	$68	13.4	$25	$36	25.6
19	0.80	364	$33	$384	2007	-14	-$9	$24	16.3	-$30	$2	155.8	-$13	$19	19.7
20	0.80	371	$33	$460	2868	-3	-$2	$31	14.8	-$7	$26	17.7	-$3	$30	15.3
21	0.64	293	$26	$432	103	-5	-$3	$23	18.6	-$10	$16	27.3	-$5	$22	19.9
22	0.62	365	$33	$600	5	-4	-$3	$30	19.8	-$8	$24	24.7	-$4	$29	20.7
23	0.43	786	$71	$85	0	-20	-$13	$57	1.5	-$44	$27	3.2	-$19	$52	1.6
24	0.27	260	$23	$163	0.000	-5	-$4	$20	8.2	-$12	$12	14.0	-$5	$18	8.9
25	0.32	472	$42	$700	0.000	-10	-$6	$36	19.5	-$21	$21	33.6	-$9	$33	21.2
26	0.04	43	$4	$133	400	4.2	$3	$7	20.2	$0	$7	20.2	$0	$7	20.2
27	0.13	180	$16	$133	0	0.0	$0	$16	8.2	$0	$16	8.2	$0	$16	8.2
28	0.00	-4	$0	$404	1500	21	$14	$13	30.3	$0	$13	30.3	$0	$13	30.3
29	0.49	680	$61	$404	0	0	$0	$61	6.6	$0	$61	6.6	$0	$61	6.6
30	2.01	60	$5	$150	22413	26	$17	$22	6.8	$56	$61	2.5	$24	$29	5.1
31	0.00	0	$0	$5	500	5	$3	$3	1.7	$0	$3	1.7	$0	$3	1.7
32	0.00	0	$0	$20	3001	27	$18	$18	1.1	$0	$18	1.1	$0	$18	1.1
33	0.00	0	$0	$50	152	13	$9	$9	5.8	$0	$9	5.8	$0	$9	5.8
34	0.00	0	$0	$50	217	19	$12	$12	4.0	$0	$12	4.0	$0	$12	4.0

Table 26: Electric and Natural Gas Savings by Measure and Heating System Type

Differential costs shown for each measure are the average costs to install the measure, or the difference in cost between a standard retrofit and the high efficiency option. Payback is the simple payback in years, (the ratio of annual fuel dollars saved and differential installed cost).

Total fuel dollars saved are based on annual electric and gas savings and their respective marginal unitary rates. For the measures that strongly affect heating energy usage, monetary savings and payback differ significantly with heating system type, as evidenced by different numbers in the three payback columns. Payback times for ID numbers 6 and 7 are not defined because they cost less to install than their standard retrofit choices, as indicated by the negative differential costs. A fictitious non-zero payback value of 0.1 was used here to permit MEEA to estimate market penetration rates based on payback.

Situation and Measure Improvement Descriptions

The following are descriptions of each listed measure and improvement option, explanations of the assumptions made, and the technical approach to estimating impacts. These measurements include both potential energy efficiency improvements and weatherization measures.

Undercharged AC Systems – ID 1
Published accounts from several other studies, including a recent New England HVAC study conducted by RLW Analytics in 2002, were used to estimate the technical potential percentages for AC systems. From these studies, about 36% of the measured systems are probably undercharged with refrigerant, enough to exhibit recognizable symptoms. The average undercharged condition was modeled as a 20% reduction in both cooling capacity and efficiency. This 20% reduction represents a general consensus of the other studies.

In the baseline DOE2 models, the refrigerant charge factor was adjusted to 0.8 to reflect this 20% loss. In the retrofit models this factor was set to 1.00 to reflect a properly charged system. At this point the operating capacities and efficiencies were still slightly below rated values due to the fact that evaporator airflow is still a little low. This refrigerant charge correction resulted in an estimated annual savings of 470 kWh, and a peak demand reduction of 0.49 kW.

Overcharged AC Systems - ID 2
About 31% of the measured AC systems in other studies were found to be overcharged with refrigerant. The average effect of this situation, however, is not nearly as dramatic, with only a 5% reduction in both cooling capacity and efficiency. This was represented in the models by a refrigerant charge factor of 0.95, which is in fact the average operating condition. The frequency, degree, and impact of overcharging are not as great as undercharging.

In the retrofit models the refrigerant charge factor was set to 1.00. This resulted in an estimated annual savings of 105 kWh, and a peak demand reduction of 0.20 kW.

AC Systems With Low Evaporator Air Flow – ID 3 and 4
According to recent studies, about 70% of residential AC systems have a problem of significantly low evaporator airflow. The threshold for this performance characteristic is considered 350 CFM per ton, which is generally used as the lowest acceptable flow rate before capacity and efficiency are appreciably reduced. The average airflow for all those below the threshold was about 300 CFM per ton.

In the baseline DOE2 models the system airflow rate was set at 300 CFM per ton. In the retrofit models this was increased to 400 CFM per ton.

Two different approaches to the correction of a low airflow problem were examined because the associated costs and impacts of each are significantly different. The easiest, and least expensive, solution is to increase the blower speed whenever practical. In many cases, however, this might not be possible due to the presence of single speed blowers or a limited remaining blower capacity.

The other approach is to reduce airside system operating pressures by locating and removing restrictions or by increasing duct capacities. In an existing system the only practical ways to increase supply duct capacity are to replace existing ductwork with larger run outs to several rooms, or add more run outs at or near the supply plenum to new supply grilles.

In past studies, it was found that many return duct systems are simple but undersized. Return duct under-sizing often occurs with systems in the attic that have one central return air filter grille in the ceiling of a corridor with one large flexible duct to a return plenum. In most, if not all, cases these can be replaced with larger ducts and return grilles, or new ducts and grilles can be added in parallel. Specifically, our audits found a total of 57 units (18%) were located in attics.

Any reliable and practical correction to the problem of low airflow would have to be determined by a careful on-site analysis of each problematic system. Often it may be necessary to combine fan speed corrections along with increased supply and return duct capacities to obtain proper airflow at a reasonable cost.

The retrofit DOE2 model for increased duct capacity, ID 3, assumed that the total static pressure of the air distribution system could be reduced enough to allow the existing blower to deliver the required air flow without increasing the blower speed. The blower power was increased linearly with the increased airflow rate, and the system capacities and efficiencies were increased to rated conditions. This resulted in an estimated annual savings of 530 kWh, and a peak demand reduction of 0.60 kW.

The retrofit model for increasing blower speed, ID 4, required an increase in motor power equal to the square of the ratio of the flow rates. The increased fan power offset about half of the energy savings due to increases in system capacity and efficiency. This resulted in an estimated annual savings of 257 kWh, and a peak demand reduction of 0.34 kW.

AC Systems With High Duct Leakage – ID 5
The recent New England study found that about 73% of the AC systems had a problem of significantly high supply duct leakage to the outside. The threshold for supply air leakage was 15% of actual system airflow. The average leakage for all those above the threshold was 25 percent. The systems with high duct leakage do not seem to correlate at all with duct location or plenum static pressure. Based on field observation, however, these systems were characterized by poor installation workmanship, and they tended to be older than the others.

Qualitative field data from this study suggest that this problem is probably not so drastic throughout the state of Illinois.

The DOE2 model treats duct leakage as primary air delivered to and returning from unconditioned spaces such as attics and basements. One third of the leakage was assigned to the unconditioned portion of the basement, and the remainder went to the first and second floor attic spaces. This leakage air actually tends to cool these spaces slightly, and they are modeled as buffer zones so that return air from them approximates actual zone conditions. In this way, the primary effects of both supply and return air leakage to these spaces are captured in the model.

The baseline model used 25% duct leakage, and this was reduced to 5% in the retrofit case. This resulted in an estimated annual savings of 305 kWh, and a peak demand reduction of 0.31 kW, plus 118 therms of gas per year and 10318 BTU per hour (BTUH) of peak gas consumption due to the reduction in gas heating.

In this analysis the inherent but small reduction in evaporator airflow was not modeled because an average value was not known.[10] Many systems with leaky ductwork also suffer from insufficient airflow. The New England study found that 19 systems, or 79% of those with high duct leakage, also had low airflow below 350 CFM per ton. Additionally, it was observed that 29% had a high blower motor power over 150 Watts per ton. In practice, it is necessary to measure the existing system airflow and blower motor power to determine if these other two potential problems need to be corrected before duct sealing is attempted.

Proper Sizing of AC Systems – ID 6 and 7

An oversized system in this study is defined as having a rated cooling capacity greater than 100% of a valid Manual J cooling load estimate. Based on an average Manual J estimate of capacity in terms of square feet per ton and the individually observed home sizes and installed capacities, about 80% of the AC systems of this study are oversized relative to this criterion. Those that qualified as oversized averaged 50% above the Manual J estimate.

The DOE2 models estimate the cooling system efficiency each hour as a function of a part load ratio. This is the ratio of system load and cooling capacity, and the function is empirically designed to approximate the efficiency penalty due to system cycling.

In the baseline model for ID 6 the oversized system rated capacity is 3.52 tons, and in the first retrofit case the size is reduced to 2.35 tons, with a proportional reduction in airflow and duct sizing to maintain 372 CFM per ton. The rationale for maintaining this airflow rate is the probability that the same duct sizing practice is applied by the contractor independent of system size. This would be applicable to new AC systems that are installed where there is no existing ductwork. The estimated annual savings is 121 kWh, with a peak demand reduction of 0.17 kW.

On the other hand, if a new system is to be installed to replace an old system or with an existing forced air furnace that already has supply and return ductwork, there would be no need to install new ductwork. In this scenario, ID 7, there is even more to gain by keeping the system size to a minimum. This is due to the fact that the existing ductwork would be able to deliver the same airflow as before (which would become a proportionately higher CFM per ton) with the same fan power, thus reducing the system losses due to low airflow and excessive system cycling.

The retrofit DOE2 models for this case assume that the duct sizes, airflow rates, and fan static pressures remain unchanged. Even though the fan power is not increased, the annual fan energy consumption increases due to the fact that the system operates for longer periods of time, and this is accounted for in the models. The estimated annual savings for this scenario is 314 kWh, with a peak demand reduction of 0.36 kW.

The advantages of reducing system size are all positive as long as the system capacity is sufficient to maintain acceptable comfort conditions about 97.5% of the time (which are all but a few hours

[10] The effect on energy usage is even smaller due to offsetting effects of fan power and system efficiency.

of the typical cooling season). The smaller system will typically maintain better humidity control, last longer, make less noise, use less energy and cost less to install.
Most of the problems of low evaporator airflow in houses with evaporator coils added to existing forced air furnaces could be greatly reduced or avoided if the AC system is properly sized for the application. In recent studies, about 70% of the systems that are oversized also have evaporator airflow below 350 CFM per ton.

Unfortunately, downsizing is not a viable option after the system has been installed. Therefore, as an effective conservation program component, information and incentives will need to be presented to prospective participants before the fact. Information and incentives should also be directed toward the contractors.

Addition of Duct Insulation – ID 8
It was observed that most ducts in the basements were not insulated, whereas nearly all ducts in the attics had at least one inch of insulation. The only appreciable savings available would be due to the addition of another inch of insulation to exposed ducts in the attic. Exact modeling of this was not within the scope of this project, but some assumptions were made regarding the duct heat gains due to conduction from a hot attic.

In the baseline DOE2 models it was assumed that 90% of the ducts were located in the attic and the product of U*A (i.e. thermal conduction coefficient times duct surface area) would be about 36, yielding an approximate peak air temperature rise of 1.0 degree Fahrenheit during the cooling cycle. In the retrofit case this U*A value was reduced to 20. The estimated annual savings for this measure is 52 kWh, with a peak demand reduction of 0.12 kW, plus 81 therms of gas per year and 2692 BTUH of peak gas consumption.

There were a few instances observed by our auditors of what appeared to be uninsulated ducts in the attic spaces, but most or all of these were probably internally lined sheet metal. Also, only small portions of most of these "uninsulated" duct systems were located in the attic spaces. Therefore, it may be assumed that the existence of significant portions of uninsulated ductwork in attic spaces is rare in Illinois. If, however, 2" of insulation were added to uninsulated ducts primarily located in an attic space, the savings would be about five to seven times as much as shown above in the previous paragraph.

High Efficiency SEER 13 AC – ID 9
Significant savings are potentially available for the installation of high efficiency AC systems instead of standard efficiency SEER 10 units. In the existing home retrofit market this might be applied to homes with old existing systems that are at the end of their useful operating lifetimes and need to be replaced. This might also apply to an existing home in which air conditioning was never before installed and the homeowner wants to install a new central AC system.

Modeling the unit savings for this measure was straightforward. The baseline DOE2 models were assigned a rated efficiency of SEER 10, and the retrofit model used SEER 13. All other conditions remained unchanged. The estimated annual savings for this measure is 509 kWh, with a peak demand reduction of 0.56 kW.

High Efficiency SEER 13 Heat Pump – ID 10 and 11
Although most of the homes throughout the state employ natural gas furnaces for heat, a few (between 2% and 3%) use electric heat pumps or electric strip heat for primary heat. As a retrofit measure the installation of a high efficiency heat pump might be an option for existing homes with old heat pumps or with electric resistance heat.

The base case model for an old heat pump replacement, ID 10, assumed the baseline replacement heat pump would have been an SEER 10. The retrofit model was the same except the heat pump would be an SEER 13. Potential savings for this option are about 1889 kWh and 0.66 kW for the average home.

The base case models for an old electric resistance heat system replacement, ID 11, assumed the replacement equipment would be same as above. Potential savings calculated for this option were an astounding 16,960 kWh and 8.43 kW. Actual average savings for electric heated homes might be much lower due to the possibility that the average electric strip heated home is smaller and more fully insulated, and the probability that the occupants are more frugal in their energy usage practices (due to excessively high heating costs). In such cases the savings might be more like 50% to 75% of those calculated by these typical DOE2 models.

Add Attic Insulation – ID 12 and 13
Savings achievable for increasing attic insulation vary greatly with the amount of insulation already in place, as well as the amount of extra insulation added. Whether this is cost effective depends more on the amount of existing insulation. Two different baseline insulation values of R-7 and R-11 were assumed. In both retrofit scenarios the final R-value was about R-30. Addition of any more than this is typically not cost-effective.

In the first scenario, ID 12, the baseline models were given an attic insulation value of R-7 with a retrofit to R-30. The calculated savings are 484 kWh and 0.74 kW, plus 101 therms of gas annually and 9080 BTUH of peak gas consumption.

In the second scenario, ID 13, the base case was R-11 and the retrofit was R-30. Savings were estimated to be 299 kWh and 0.52 kW, as well as 62 therms and 6546 BTUH.

Add Wall Insulation – ID 14
Similar to attic insulation, achievable savings by increasing wall insulation vary greatly with the amount of insulation already in place, as well as the amount of extra insulation added. Whether this is cost effective depends more on the amount of existing insulation. MEEA evaluated this measure with a baseline of no wall insulation, and added R-11 insulation to represent a realistic best-case scenario.

The calculated savings are 762 kWh and 1.1 kW, plus 451 therms of gas per year and 22,381 BTUH of peak gas consumption due to the reduction in gas heating. Because of the high cost of adding insulation to existing walls, however, the simple payback for this measure is relatively long at about 7.1 years.

Although the potential savings are high, the long payback suggests that it would not be cost-effective to insulate existing walls with some insulation already in place. In fact, the existence of any batt insulation in existing walls renders it impractical to add more insulation by the normal method of blowing it through holes drilled into the stud cavities because the batts would tend to block the flow of new insulation in many places.

Add Insulation to Floor over Unheated Basement – ID 15
Most basements are enclosed by thick masonry foundation walls and have intimate contact with the earth. As such, they are naturally cooled by relatively low ground temperatures typical of Illinois, where the averages are about 64 degrees Fahrenheit during the summer and about 43 during the winter.

As a result of the low ground temperatures, the savings are negative for most of the cooling season. The base case for this measure assumed no insulation and the retrofit provided for the addition of R-19 to the floors over the basements. Calculated savings are -430 kWh and 0.13 kW, plus 61 therms of gas per year and 9089 BTUH of peak natural gas consumption. Due to major differences in the costs of electricity and gas, the monetary savings from gas are offset by the increase in electricity, and the simple payback exceeds 100 years (99 was used in the market analysis).

Reduce Infiltration by Caulking and Weather stripping – ID 16

For this measure MEEA assumed a baseline infiltration value of 0.8 ACH (Air Changes per Hour) and a retrofit of 0.35 ACH. MEEA learned from several studies in different parts of the country that the average home infiltration rate is about 0.5 ACH. Calculated savings for weatherization measures are 209 kWh and 0.5 kW, 265 therms of gas per year, and 16,749 BTUH of peak natural gas consumption

Replace Standard Double Pane Windows – ID 17, 18 19 and 20

The average house in this study has about 203 square feet of window area. Less than 1% of the windows in this study were triple pane, but another 6% were double pane with storm windows, thus with a triple pane effect. About 64% were double pane windows and another 23% were single pane with storm windows, thus having a double pane effect. The remaining 6% were bare single pane windows, but many of these are fitted with removable storm windows during the winter. The overall average number of glass panes is 2.0, based on the study sample.

MEEA used a typical double pane window with a U_0 (thermal transmission coefficient) value of 0.45 and a SHGC (Solar Heat Gain Coefficient) of 0.76 for the base case, and applied three different potential retrofit scenarios to estimate savings for each. Table 27, below, shows the performance characteristics and results of these glazing options.

Retrofit Scenario	ID No.	Provided for:	U_0	SHGC	Savings
A	17	Low E triple pane windows	.17	.47	350 kWh, 0.73 kW 41 therms, 5363 BTUH
B	18	Addition of storm windows	.32	.68	120 kWh, 0.31 kW 27 therms, 3169 BTUH
C	19	High performance Low E double pane windows	.35	.40	364 kWh, 0.80 kW -14 therms, 2007 BTUH
D	20	Very high performance Low E double pane	.32	.40	371 kWh, 0.80 kW -3 therms, 2868 BTUH

Table 27: Technical Potential: Window Replacement Options

Retrofit Scenarios A and B yield both summer and winter savings, as expected. Scenarios C and D, however, cause slight increases in winter fuel consumption (therms of natural gas). The latter is due to the low SHGC of 0.40 for these options, eliminating enough free solar heat to more than offset the savings due to reduced conduction (low U_0).

Obviously low E double pane windows perform better than double pane clear glazing with storm windows, in spite of the fact that storm windows create a triple glazing effect. Addition of storm windows costs about the same whether the existing windows are old or new. The total cost of replacing existing windows, however, is prohibitive from an energy conservation perspective alone. Therefore the three window replacement options must be reserved for old homes with original windows that already need to be replaced. The conservation program goal would be to identify these homeowners and encourage them to choose high performance Low E windows in lieu of standard clear ones, thus incurring only the differential costs of the two alternatives.

Add Shading to East and West Facing Windows – ID 21 and 22

Although external window shading might be added to all four faces of a house, the east and west faces offer the greatest potential savings. Also, to obtain maximum energy savings, the shade would have to be applied during the cooling season and removed during the heating season to avoid increasing the heating loads during the winter.

MEEA considered and analyzed two different ways of shading east and west facing windows for this study, because one method will apply to some, while the other method is better for others. Neither alternative will be applicable to homes with significant east and west shading from existing trees or other things. To model these measures MEEA removed all but 10% of the external shading from the baseline model.

One practical method, ID 21, of shading windows from the exterior is the addition of solar screens that can be removed during the heating season. To model this retrofit, MEEA reduced the east and west glass shading coefficient (SC) from 0.5 to 0.25 and the U_0 value from 0.8 to 0.7 for the period of June 1 to October 31. Estimated savings for this scenario are 293 kWh, 0.64 kW, -5 therms and 103 BTUH. There was a slight increase in natural gas usage during the swing seasons because, in the model, screens are not removed and reinstalled as the ambient temperatures swings cause homeowners to switch often from cooling to heating mode and back.

The other (and more desirable from both an aesthetic and practical perspective) method is the planting of deciduous trees in strategic locations to the east and west of the house. In this scenario, (ID 22) MEEA assumed that three deciduous trees had been planted at 20 feet from each side of the house (a total of six trees) to shade the windows as much as possible, and that they had grown to an effective height of 16 feet. Their solar transmissivities were changed from 0.1 during the summer (June 1 through October 31) to 0.9 during the winter. Resultant savings are 365 kWh, 0.62 kW, -4 therms and 5 BTUH. As these trees continue to grow, the savings will also grow.

Install Compact Fluorescent Lamps – ID 23

Field data from the site visits indicated that 95% of the homes had less than a 10% presence of CFLs (Compact Fluorescent Lamps) by bulb count. Hence, there is a high technical market potential for this measure. In the impact analysis MEEA assumed that each program participant would install and use an average of thirteen 15 Watt CFLs in place of thirteen 60 Watt incandescent lamps, for a connected load reduction of about 580 Watts.

Lighting hourly usage patterns utilized in the models are based on actual measured hourly residential lighting usage patterns from a large number of long-term and short-term end-use studies. Calculated savings amounted to 786 kWh, 0.43 kW, –20 therms and 0 BTUH. The peak heating load was not measurably affected because it occurred during the night when the lights are not being used. The increase in gas usage is due to the fact that the reduction in internal heat gains requires that the heating system provide enough heating energy to make up the difference.

Notice that the peak kW savings was 0.43, or 430 Watts, whereas the reduction in connected load was 580 Watts. This is due to natural diversity in the lighting usage patterns so that all ten of these lamps are never on at the same time. These electric savings include both direct and indirect savings due to the reduction in internal heat gains that reduce the need for cooling.

Purchase ENERGY STAR Qualified Refrigerator – ID 24 and 25
Two options for replacing an existing refrigerator with an ENERGY STAR certified unit were examined in this study. The first option assumes that an existing refrigerator is at the end of its functional life and the homeowner has already decided to replace it. The other option examines the potential of enticing a homeowner to retire an existing refrigerator before the end of its functional life.

For the first option, ID 24, it was assumed that a standard new refrigerator on the market today uses about 660 kWh per year, and an ENERGY STAR refrigerator will use about 432 kWh per year (10% below the 2001 federal standard average of about 480). The difference is 228 kWh per year. This direct energy reduction was modeled into the retrofit DOE2 model, and the resultant total interactive savings are 260 kWh, 0.27 kW, -5 therms and 0 BTUH. Some secondary impacts are seen due to the fact that the refrigerator is in the conditioned space. Actual BTUH impacts are not zero, but less than 0.5, and the zero shown is due to roundoff.

The baseline for the second option, ID 25, was 850 kWh per year, representing an average of annual consumption of residential refrigerators from about 1987 to about 1992. The replacement unit was an ENERGY STAR equivalent using 432 kWh per year. The resultant total interactive savings are 472 kWh, 0.32 kW, -10 therms and 0 BTUH.

Purchase ENERGY STAR Qualified Dishwasher – ID 26 and 27
An average new dishwasher uses about 121 kWh per year, and an equivalent ENERGY STAR dishwasher will use about only about 78 kWh per year if the water heater is not electric. Estimated savings for a house with gas water heating, ID 26, are 43 kWh, 0.04 kW, 4.2 therms and 400 BTUH.

On the other hand, more substantial electric savings are possible if the water heater is electric. In this scenario, ID 27, the savings would be about 180 kWh per year and 0.13 kW peak demand.

Purchase ENERGY STAR Qualified Clothes Washer – ID 28 and 29
Maximum electric savings for high efficiency clothes washers can be achieved if both the water heater and dryer are electric, although by far most of the savings is due to the dryer. The most common Illinois home, however, uses natural gas for both. Since a significant number of homes had electric dryers (29%) and a few had electric water heaters (about 4%), MEEA calculated savings for both a typical home and one where both dryer and water heater are electric.

For the typical home, ID 28, MEEA estimated annual savings to be about -4 kWh, 0.0 kW, 21 therms and 1500 BTUH. The ENERGY STAR clothes washer actually uses slightly more electric energy during the spin cycle to wring more water out, thus reducing the time required for drying.

For the all-electric scenario, ID 29, MEEA estimated annual savings to be about 680 kWh and 0.49 kW.

Install Programmable Thermostat – ID 30

About half of the homes visited already had programmable thermostats. The others either had manual thermostats or were not air-conditioned. MEEA modeled the potential impacts of programmable thermostats by increasing the cooling set points three degrees F and decreasing the heating set points by four degrees F daily from 8AM to 3PM.

For this scenario MEEA estimated annual savings to be about 60 kWh and 2.01 kW, along with 26 therms and 22,413 BTUH. High positive demand savings are due to the fact that the action of the thermostat sometimes causes the systems to cycle off completely during times that they would normally run under high loads. In reality, there is also a high negative demand savings of about –1.17 kW occurring sometime in the afternoon when the thermostat is returned to its normal setting. A similar effect occurs during the heating mode.

Relatively low energy savings are due to the fact that much of the energy saved during the "setback" mode is lost again as the cooling and heating systems attempt to "catch up" after they are returned to normal.

Install Faucet Aerators – ID 31
It was found during the field audits that about 63% of all single-family detached homes in Illinois do not have a faucet aerator. MEEA estimated the impacts of these by assuming that one faucet aerator would be installed on the kitchen sink, and that the energy savings would occur through a reduction in the use of hot water. In this study the typical home will see no electric savings, because the water heater is gas fired.

The estimated savings for the typical home are 5 therms per year and 500 BTUH. For the 4% of homes with electric water heaters, the annual electric savings would be about 107 kWh and 0.12 kW peak demand. These savings are not shown in Table 26 but were calculated from the natural gas savings.

Some homeowners may be willing to install and keep a faucet aerator in the bathroom. Although savings for these are not well defined, MEEA has previously estimated that they might achieve about one tenth to one third the savings of the kitchen aerator. The reduced savings are, of course, due to the fact that the average bathroom sink utilizes significantly less hot water.

Install Low Flow Showerheads – ID 32
Field results of this study show that about 71% of all single-family detached homes in Illinois do not use a low flow showerhead. MEEA estimated the impacts of these by assuming that two low flow showerheads would be installed, and that the energy savings would occur through a reduction in the use of hot water. Again, the typical water heater is gas fired.

The estimated savings for the typical home are 27 therms per year and 3001 BTUH. For the 4% with electric water heaters the annual savings would be about 641 kWh and 0.72 kW peak demand.

If there are more than two showers in a home, the low flow showerheads should be installed on the two most frequently used showers. If more than two devices are installed in a single home, the savings for the third one will probably be significantly less than those of the first two, but it will depend on how much the showers are actually used. On the other hand, if only one showerhead is installed because there is only one shower present, the savings for the one will probably be more than half the savings shown.

Insulate Hot Water Pipes – ID 33

All the audited homes of this study have hot water piping, but only portions of the pipes are easily accessible. MEEA estimated conservation impacts by assuming that the exposed pipes could be insulated, and that the energy savings would occur through a reduction in the hot water standby losses. Again, the typical water heater is gas fired.

The estimated savings for the typical home are 13 therms per year and 152 BTUH. For the 4% with electric water heaters the annual electric savings would be about 312 kWh and 0.04 kW peak demand. Actual savings will vary significantly, depending on the amount and locations of exposed piping and the hot water usage patterns.

Insulate Water Heater Storage Tanks – ID 34

MEEA found that about 84% of the homes visited had gas water heaters that were not externally wrapped. The estimated savings for the typical home are 19 therms per year and 217 BTUH. For those with electric water heaters the annual electric savings would be about 267 kWh and 0.03 kW peak demand. Savings for this measure will vary with the ambient temperatures surrounding the hot water tank.

VI.3 Technical Assessment of Program Market Potentials by Measure

Preferred Energy Conservation Measures

MEEA initially analyzed 34 potential home improvement options. Of these, it was determined that 19 of these measures represent the best current opportunities for energy conservation programs in the state of Illinois. These measures are listed in Table 28. Some of the improvements apply only to air-conditioned homes.

ID No.	Situation	Treatment or Measure
6, 7	Oversized CAC units	Size replacement units to 100% of Manual J
9	Gas heat and 10 SEER CAC	Replace with ENERGY STAR labeled SEER 13 units
17, 18, 19, 20	Standard double pane windows	Replace with ENERGY STAR labeled windows, or install storm windows
21, 22	No/little east & west window shading	Plant deciduous trees on east and west sides, or add solar screens
23	Incandescent light bulbs	Replace with compact fluorescent bulbs
24, 25	Standard refrigerator	Replace with ENERGY STAR rated refrigerator
26, 27	Standard dishwasher	Replace with ENERGY STAR dishwasher
28, 29	Standard clothes washer	Replace with ENERGY STAR clothes washer
30 –32	Lack of temperature management and hot water flow restrictors	Install: - programmable thermostat - faucet aerators - low flow showerheads

Table 28: Measures With Best Promising Market Potential

Differential installed costs and annual monetary savings for these measures are shown in Table 29, which is an extract of Table 26. These costs and savings are estimates of what it might cost an average homeowner to install the measure and what can be saved on utility bills annually without monetary rebates or other conservation program interventions. Payback for each measure is the simple ratio of installed costs to annual monetary savings from a homeowner perspective.

					Gas Heated Houses					Electric Strip Heat Houses			Electric Heat Pump Houses		
	Electric Savings Per Home			Diff.	Gas Savings Per Home			Total	Payback	Elec Ht	Total	Payback	Elec Ht	Total	Payback
ID	kW	kWh	$ Saved	Cost	BTUH	Therms	$ Saved	$ Saved	Years	$ Saved	$ Saved	Years	$ Saved	$ Saved	Years
6	0.17	121	$11	-$1,858	0	0	$0	$11	0.1	$0	$11	0.1	$0	$11	0.1
7	0.36	314	$28	-$1,000	0	0	$0	$28	0.1	$0	$28	0.1	$0	$28	0.1
9	0.56	509	$46	$425	0	0	$0	$46	9.3						
17	0.73	350	$31	$2,432	5368	41	$27	$58	41.9	$89	$120	20.3	$39	$70	34.9
18	0.31	120	$11	$914	3169	27	$17	$28	32.5	$58	$68	13.4	$25	$36	25.6
19	0.80	364	$33	$384	2007	-14	-$9	$24	16.3	-$30	$2	155.8	-$13	$19	19.7
20	0.80	371	$33	$460	2868	-3	-$2	$31	14.8	-$7	$26	17.7	-$3	$30	15.3
21	0.64	293	$26	$432	103	-5	-$3	$23	18.6	-$10	$16	27.3	-$5	$22	19.9
22	0.62	365	$33	$600	5	-4	-$3	$30	19.8	-$8	$24	24.7	-$4	$29	20.7
23	0.43	786	$71	$85	0	-20	-$13	$57	1.5	-$44	$27	3.2	-$19	$52	1.6
24	0.27	260	$23	$163	0.000	-5	-$4	$20	8.2	-$12	$12	14.0	-$5	$18	8.9
25	0.32	472	$42	$700	0.000	-10	-$6	$36	19.5	-$21	$21	33.6	-$9	$33	21.2
26	0.04	43	$4	$133	400	4.2	$3	$7	20.2	$0	$7	20.2	$0	$7	20.2
27	0.13	180	$16	$133	0	0.0	$0	$16	8.2	$0	$16	8.2	$0	$16	8.2
28	0.00	-4	$0	$404	1500	21	$14	$13	30.3	$0	$13	30.3	$0	$13	30.3
29	0.49	680	$61	$404	0	0	$0	$61	6.6	$0	$61	6.6	$0	$61	6.6
30	2.01	60	$5	$150	22413	26	$17	$22	6.8	$56	$61	2.5	$24	$29	5.1
31	0.00	0	$0	$5	500	5	$3	$3	1.7	$0	$3	1.7	$0	$3	1.7
32	0.00	0	$0	$20	3001	27	$18	$18	1.1	$0	$18	1.1	$0	$18	1.1

Table 29: Electric and Natural Gas Savings by Measure and Heating System Type for Preferred Measures

Market Potentials for the Preferred Measures

The realizable market potential of a measure may be defined to represent the extent to which a measure might actually be applied annually throughout the state over a reasonable period of time, which can be 5 to 10 years of full implementation of a well-designed conservation program.

Statewide market potentials for each measure were calculated by multiplying together the individual savings per measure, the realizable market potentials in terms of percentages, and the total current number of single-family detached homes throughout the state. These realizable potential savings are presented in terms of a) total electric demand in megawatts, b) electric energy savings in megawatt-hours, c) natural gas in kilotherms and d) thousands of dollars. Effects of possible population growth over the projected time period were not considered in this study.

Figure 3 below shows a general market potential schematic. Moving from left to right, the "Technical Potential" for the intended program or measure can be defined as the percentage of all targeted customers who are eligible for the program. The "Raw Economic Potential" reflects the percentage of eligible homes in which the measure can be economically applied.

The expected actual penetration rates under different program scenarios, or the "Market Potential", involves the estimation of how many customers would participate in a specific program over a given time period. That is, the "Market Potential" indicates the percentage of targeted homes that would install the measures delivered by well-defined and aggressively executed programs. The values, of course, depend on the measures, the length of time the program is offered, the specific markets, numbers of customers targeted, and finally the level of subsidy (if any).

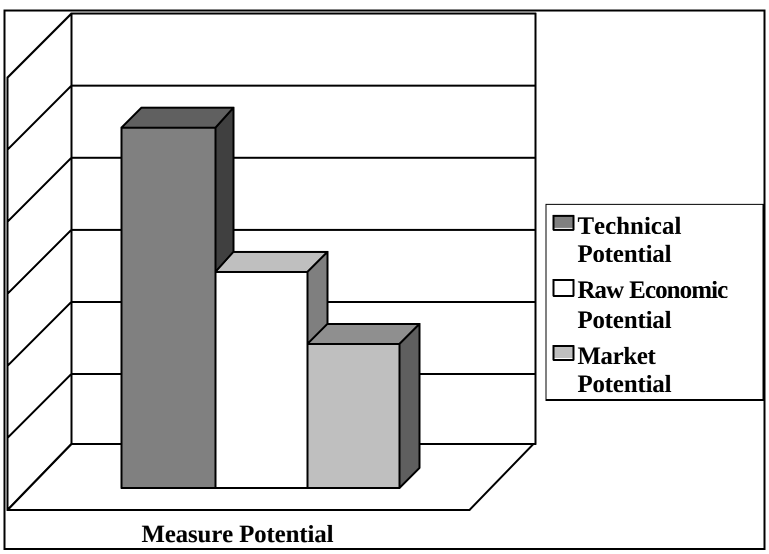

Figure 3: Market Potential Schematic

This measure potential schematic can be applied to the residential population of Illinois as follows:

(1) The "Technical Potential" is the total number of single-family detached homes in Illinois that are eligible for each measure type. Using deciduous shade trees as an example, the

"Technical Potential" for this study is the percentage of all single-family detached residential customers who have air-conditioned homes and have space in their yards to plant trees on the east and west sides of their houses. Homes that are not air-conditioned will not be eligible for this measure because there would be no basis for obtaining energy savings.

(2) The "Raw Economic Potential" was determined through analysis of the in-home audits to assess what percent of qualified customers could achieve savings through installation of the measure within the realm of economic feasibility. For example, it would not be economically feasible for a homeowner to replace existing double pane windows with higher performance windows solely for the purpose of saving energy, even though the home is technically eligible. The total cost of replacing windows is far too great to incur on these terms alone. If, however, the windows need to be replaced for other reasons (such as excessive age and unacceptably poor condition) the much smaller differential cost of choosing high performance windows over standard windows is economically feasible from an energy savings perspective.

(3) The final "Market Potential" was estimated through existing utility research and past participation rates in other programs.

Table 30 below lists the 19 measures that represent the best opportunities for energy conservation programs in Illinois, showing ID numbers, their potential situations, improvement options, and three columns of market potential estimates. The "Technical Potential (% of Homes that Qualify)" is the "Technical Potential" previously described. The last column, "Raw Economic Potential (% of General Population)" is the previously defined "Raw Economic Potential". It is simply the product of the "Technical Potential (% of Homes that Qualify)" and the "Economically Feasible (% of Technical Potential)".

ID	Potential Situation	Improvement	Technical Potential (% of Homes that Qualify)	Economically Feasible (% of Technical Potential)	Raw Economic Potential (% of Population)
6	Oversized AC units A	Size AC units to 100% of Manual J	12.00%	5.00%	0.60%
7	Oversized AC units B	Size AC units to 100% of Manual J	68.0%	7.0%	4.8%
9	Gas heat and 10 SEER AC	Install AC SEER = 13	97.0%	7.0%	6.8%
17	Standard double pane windows A	Install Low E triple pane window	80%	26%	21%
18	Standard double pane windows B	Add storm windows	54%	100%	54%
19	Standard double pane windows C	Install Low E double pane window	80%	26%	21%
20	Standard double pane windows C	Install Low E double pane window	80%	26%	21%
21	No E & W window shading A	Add solar screens to E & W glass	84%	100%	84%
22	No E & W window shading B	Plant deciduous trees on E & W sides	76%	100%	76%
23	No Compact Fluorescent Lamps	Use 10 CFLs throughout house	100%	95%	95%
24	Refrigerator needs to be replaced	Purchase Energy Star refrigerator	94%	12%	12%
25	Refrigerator early retirement	Purchase Energy Star refrigerator	94%	88%	83%
26	Dishwasher to be replaced A	Purchase Energy Star dishwasher	91%	24%	22%
27	Dishwasher to be replaced B	Purchase Energy Star dishwasher	4%	24%	0.9%
28	Clothes washer to be replaced A	Purchase Energy Star clothes washer	64%	17%	11%
29	Clothes washer to be replaced B	Purchase Energy Star clothes washer	2.2%	17%	0.4%
30	No prgrammable thermostat	Install programmable thermostat	41%	100%	41%
31	No faucet aerators	Install faucet aerators	63%	100%	63%
32	No low flow shower heads	Install low fow shower heads	71%	100%	71%

Table 30: Technical and Raw Economic Market Potentials for Preferred Measures

The final “Market Potential” estimates of this study are based partly on historical penetrations of existing programs in other states and partly on an analytical model designed to utilize the differential costs and simple payback periods calculated for each measure. A qualitative adjustment aimed at accounting for known (non-economic) market barriers was also included in the model.

Table 31 shows the results of the market analyses for the 19 preferred program measures and options. The “Quantity” column shows the quantity of each item that was modeled in the impact analysis and used as a basis for estimating the associated installed cost of each measure.

“Raw Economic Potential %” is the same as that shown in Table 30 under “Raw Economic Potential (% of General Population)”. The qualitative “Market Barrier Factor” is shown in the fourth column of the table. The column labeled “Annual Market Capture %” shows the results of the analytical model previously mentioned. It represents the probability that a given measure will be adopted based solely on its installed cost, simple payback, and market barrier factor. In the model this probability is inversely proportional to the installed cost, the simple payback and the market barrier factor. First cost was assigned an importance equal to three times that of the payback period.[11]

The market barrier factor captures the effects of known non-economic market barriers by using a discreet value of 1, 2 or 3. A 1 will indicate little or no known barriers exist, a 2 will indicate average barriers and a 3 will indicate the existence of formidable barriers. For example, ID 21 represents the option of adding solar screens to the east and west facing windows for shading. This option was assigned a market barrier factor of 3 because major non-economic market barriers here are the diminished appearance of the home perceived by most homeowners, and the fact that they have to be removed and replaced each year to achieve their potential savings.

The analytical model also includes a scaling constant to permit calibration of the model to known conservation program results. Annual market penetrations expressed as percentages were found for recent programs throughout the country for several of the measures, including high performance windows, compact fluorescent light bulbs, and ENERGY STAR refrigerators, dishwashers and clothes washers. The analytical model was calibrated by iteratively adjusting the scaling factor until the model agreed with the average of the percentages of these existing programs.

[11] In previous market assessment and market potential studies done by RLW, we have found that after other barriers are diminished or eliminated, first cost continues to remain as the primary barrier.

ID	Quantity	Raw Economic Potential %	Market Barrier Factor	Annual Market Capture %	Yearly Realizable Potential %	Multiple Options Fraction	Annual Savings Potential MW	Annual Savings Potential MWh	Annual Savings Potential kTherms	Annual Savings Potential k$
6	3.52 tons	0.6%	3	15.00%	0.090%	1.00	0.5	333	0	30
7	3.52 tons	4.8%	3	15.00%	0.714%	1.00	7.8	6,877	0	618
9	2.83 tons	6.8%	1	2.30%	0.156%	1.00	2.7	2,391	0	215
17	203 SF	21%	2	0.19%	0.040%	0.04	0.0	18	2	3
18	203 SF	54%	3	0.24%	0.129%	0.13	0.2	64	13	14
19	203 SF	21%	1	2.18%	0.456%	0.44	5.0	2,236	-85	145
20	203 SF	21%	1	1.92%	0.402%	0.39	3.8	1,786	-16	150
21	96 SF	84%	3	0.48%	0.408%	0.27	2.1	977	-16	77
22	6 each	76%	1	1.46%	1.114%	0.73	15.5	9,098	-95	755
23	13 CFLs	95%	2	5.49%	5.225%	1.00	69.1	124,990	-3,207	9,134
24	1 each	12%	1	4.99%	0.578%	1.00	4.8	4,572	-94	349
25	1 each	83%	2	0.58%	0.480%	1.00	4.7	6,901	-143	526
26	1 each	22%	2	2.44%	0.526%	1.00	0.6	703	66	106
27	1 each	0.9%	1	5.94%	0.053%	1.00	0.2	294	0	26
28	1 each	11%	2	0.85%	0.089%	1.00	0.0	-3	57	37
29	1 each	0.4%	2	1.18%	0.004%	1.00	0.1	88	0	8
30	1 each	41%	2	2.45%	1.014%	1.00	62.4	2,120	780	699
31	1 each	63%	3	15.00%	9.450%	1.00	0.0	186	1,296	861
32	2 each	71%	3	10.00%	7.102%	1.00	0.0	840	5,845	3,884

Table 31: Market Potential Summary for the Preferred Measures

The "Yearly Realizable Potential %" column shows the actual estimated "Market Potential" for each measure. It is the product of the "Raw Economic Potential %" and the "Annual Market Capture %".

Two of the measures in the preferred list were analyzed with multiple retrofit options that represent different improvement choices. Four window upgrade options, ID 17 through 20, were analyzed to represent different possible homeowner choices. For a single house, however, only one option can be applied. A similar choice of mutually exclusive options is represented by ID 21 and 22 for external window shading. Each option was assigned a fraction proportional to its realizable potential so that all the fractions for each measure sum to unity. This was necessary to avoid double counting of the annual statewide savings when they are summed across all the measures and options.

Savings

Annual statewide savings for each measure and option are shown in the last four columns of Table 31. They are products of weighted individual home savings and the total target population of the state. Savings are presented in terms of total electric demand in megawatts, electric energy savings in megawatt-hours, natural gas in kilotherms, and thousands of dollars. The monetary savings represent annual savings to the homeowner for both electricity and natural gas, and each of these is based on recent average marginal costs taken from published information from the major utilities serving the state of Illinois. For electricity the estimated marginal cost was $0.09 per kilowatt-hour, and for natural gas it was $0.652 per therm.

The total annual statewide potential savings for the preferred measures and options are shown in Table 32, and totals for all 34 measures that were analyzed in this study are also shown for comparison purposes. If all 19 of the preferred measures are implemented within the framework of a reasonably aggressive statewide conservation program, and those programs are executed over a period of 5 to 10 years, the annual impacts on the state of Illinois will potentially be about 179 megawatts of electric demand reduction at the meter, 164,471 megawatt-hours of electrical energy savings at the meter and 4.4 million therms of natural gas savings. Homeowner savings will be almost $17.6 million per year.

Statewide Annual Savings Potentials				
Measures and Options	MW	MWh	kTherms	k$
Top 19 Measure Options	179	164,471	4,403	17,638
All 34 Measure Options	245	209,444	25,405	35,360
Top 19 % of All	73%	79%	17%	50%

Table 32: Statewide Savings Potentials Summary

The preferred measures were selected by MEEA based on priorities of savings and market potentials and reflective of other issues beyond the scope of this study. Although the 19 preferred measures comprise only 56% of the evaluated measures by count, they will potentially achieve about 73% of the electric demand savings and 79% of the total potential electric energy savings, while at the same time delivering some ancillary natural gas savings and significant cash savings to participating Illinois homeowners.

Comparative Savings Analysis

Kouba-Cavallo Associates Study – Potential for Energy Improvement

As a comparison to this study, MEEA reviewed an Illinois energy savings potential study commissioned by the Illinois DCCA in 2002.[12]

In their study, Kouba-Cavallo examined what the energy savings would be if five conservation or energy efficiency measures were widespread and readily available to residential consumers. This analysis assumed a 12-year period in which the following measures would be readily available and used:

Measure	Data Source
Envelope and furnace measures that reduce space heating	70 home energy ratings performed under the Illinois Energy Wise Homes program
Envelope and air conditioner efficiency and sizing measures that lower space cooling needs	Same
Electric water heater conversions in homes that have a natural gas connection or use LPG for space heating	2000 US Census
Replacement of incandescent bulbs with CFLs in high use areas	RECS microdata for the 2000 East North Central census division
Replacement of high energy use refrigerators	RECS microdata for the Midwest

Table 33: Kouba-Cavallo Study – Measures Analyzed

We combined the county and regional tables from the study into north, south, and total Illinois data tables.

[12] Cavallo, James, PhD, Kouba-Cavallo Associates, “Residential Energy Characterization of Illinois”, ibid.

By Fuel Type (in billions of BTUs)				
	NG	Oil	LPG	Electricity
North IL	49,809	676	573	18,099
South IL	5,257	474	(109)	4,199
Total	55,066	1150	464	22,298

*LPG is negative because it represents the consequence of households switching out electric water heaters for LPG water heaters; the net electricity savings is much larger than the subsequent increased use of LPG.

Table 34: Kouba-Cavallo Study: Final Savings Potential Results

The results show about a two times higher savings totals than this study. We feel the reasons for the difference mainly lies in the assumptions built into the modeling approaches between the two studies. In particular, we incorporated market barriers as factors that impact market potential, and therefore the potential savings total would come up less compared to a complete capture of all available opportunities.

V1.4 Additional Technical and Market Potential Analysis

After the 34 measures were modeled and analyzed, MEEA decided to couple two measures and determine what the technical and market potential impacts of the combined measure might represent. The combination measure option provides for the installation of high efficiency (low-e, double-pane) windows characterized by a U-value of 0.35 and a SHGC of 0.40 and the downsizing of a new air-conditioning system form 3.52 tons (150% of Manual J load with typical windows) to 2.0 tons (100% of Manual J with the high efficiency windows).

Table 35 below shows measure ID's 7 and 19 from the previous study and new measure option numbered 35.

New measure ID 35 is the combination of downsizing (previous ID 7) and high efficiency windows previously analyzed as ID 19.

ID	Potential	Improvement	Quantity
7	Oversized AC	Size AC units to 100% of Manual J	3.52 tons
19	Standard double pan	Install Low E double pane	203 SF
35	O'size B and Std DP	Low E DP Windows and 100% of Manual J	3.52 tons

Table 35: Potential Situations and Improvements Evaluated in this Study

The savings for the new measure were calculated separately for the northern and southern counties of the state. The statewide savings per house were then calculated as the population-weighted averages of the regional savings.

Savings estimates for the new measure in Table 36 on the next page, which includes estimates for the relatively small numbers of electric heated homes. Again, measures designated by ID's 7 and 19 from the previous study are included for reference purposes because they were used again in the new combination measure numbered ID 35.

Energy savings for the combinations of high efficiency windows and AC downsizing to 100% of Manual J calculated loads are 784 kWh. These savings exceed the sum of savings for AC downsizing and high efficiency windows. This is due to the fact that the new windows reduce the cooling loads so that downsizing results in even smaller AC systems than downsizing alone. In the scenario applied here, MEEA assumed that the ductwork was already installed and typically sized for a typical system. Therefore, blower motor power is decreased proportionally to the downsizing, and this results in savings in addition to those due to increased cycling efficiencies.

Combination measure ID 35 saves 784 kWh per year in a typical gas heated home. The two measures, ID's 7 and 19, applied independently save an average of 678 kWh (314+364) per year. When they are applied together interactively the combined savings are 16% more. This is characteristic of downsizing only, since all other combination measures usually lead to a slight interactive reduction in total savings when applied together.

The differential installed costs for the two combination measures are not only negative, but close (around -$900) to those of the downsizing only (-$1000). This is due to the fact that, on average, the degree of downsizing, and resultant installed cost savings, is greater when high efficiency windows are installed first. The additional cost savings for the smaller AC system offsets some of the differential costs of the high performance windows.

Whenever possible, downsizing to 100% of a valid Manual J estimate should be encouraged alone or in combination with other cooling load reduction measures. This will nearly always serve the best interest of the homeowner.

Differential costs shown in Table 36 for each measure are the average costs to install the measure, or the difference in cost between a standard retrofit and the high efficiency option. Payback is the simple payback in years, (the ratio of annual fuel dollars saved and differential installed cost).

					Gas Heated Houses					Electric Heat Strip Houses			Electric Heat Pump Houses		
	Electric Savings Per Home			Diff.	Gas Savings Per Home			Total	Payback	Elec Ht	Total	Payback	Elec Ht	Total	Payback
ID	kW	kWh	$ Saved	Cost	BTUH	Therms	$ Saved	$ Saved	Years	$ Saved	$ Saved	Years	$ Saved	$ Saved	Years
7	0.36	314	$28	-$1000	0	0	$0	$28	0.1	$0	$28	0.1	$0	$28	0.1
19	0.80	364	$33	$384	2007	-14	-$9	$24	16.3	-$30	$2	155.8	-$13	$19	19.7
35	0.85	784	$70	-$916	11822	-21	-$14	$57	0.1	-$40	$28	0.1	-$17	$50	0.1

Table 36: Electric and Natural Gas Savings by Measure and Heating System Type for Preferred Measures

Marketing Potentials for the New Measure

Table 37 below lists the measures involved in this supplemental analysis, showing ID numbers, their potential situations, improvement options, and three columns of market potential estimates. The "Technical Potential (% of Homes that Qualify)" is the "Technical Potential" previously described. The last column, "Raw Economic Potential (% of General Population)" is the previously defined "Raw Economic Potential". It is simply the product of the "Technical Potential (% of Homes that Qualify)" and the "Economically Feasible (% of Technical Potential)".

ID	Potential	Improvement	Technical Potential (% of Homes that Qualify)	Economically Feasible (% of Technical Potential)	Raw Economic Potential (% of Population)
7	Oversized AC	Size AC units to 100% of Manual J	68 %	7.0%	4.8%
19	Standard double pan	Install Low E double pane	80%	26%	21%
35	O'size B and Std DP	Low E DP Windows and 100% of Manual J	54%	1.8%	1.0%

Table 37: Technical and Raw Economic Market Potentials for Prefe rred Measures

VII. MARKET POTENTIAL: PROGRAM REVIEWS

In this final section, we review recent or current programs that promote each of the 19 measures identified as the best energy savings opportunities. Market progress or final evaluations of a number of these programs were used to calibrate the market penetration rates for their respective measures.

CENTRAL AIR CONDITIONING REPLACEMENT

Situation:	**Oversized CAC units**
Measure	Size replacement to Manual J

Situation:	**Gas heat and 10 SEER CAC**
Measure:	Replace SEER 10 or less with ENERGY STAR SEER 13

There are a number of residential HVAC programs currently offered by utilities and agencies, some with significant budget amounts, and many designed as ongoing, multi-year efforts:

Sponsor	**State**	**Program End**	**2001 Budget (Millions)**	**Financing**	**Incentives**	
					Equipment	**Installation**
NEEA	OR, WA, ID, MT	Dec. 2002	0.7	No	-	-
Oregon Office of Energy	OR	Ongoing	-	No	$300-500	$100-400
PG&E	CA	Dec. 2001	5.5	Yes	$250-750	$400
SCE	CA	Ongoing	-	No	$250-450	
SMUD	CA	Ongoing	-	No	-	$200
City of Anaheim	CA	Jan. 2002	0.27	No	$100	-
Xcel Energy	MN	Dec. 2001	-	Yes	$200-300	-
Muscatine Power & Water	IA	Ongoing	-	No	$100-150	-
Indianola MU	IA	Ongoing	0.02	No	$200	-
NEEP	NY,NJ	Ongoing	-	No	$370-710	-
NYSERDA	NY	Ongoing	-	Yes	5% Financing	-
LIPA	NY	Dec. 2001	2.0	No	$320-500	-
Florida Power & Light	FL	Ongoing	20.0	No	$40-925	$154
Southern Maryland Electric Cooperative	MD	Ongoing	-	No	-	-

Source: CEE Residential HVAC Initiative – Program Summary – June 2001

Table 35: Residential 2001 HVAC Program Summaries

A majority of them create a dual targeting of both consumers and contractors, while a few also target distributors. We would recommend the comprehensive strategies that develop a sustainable marketplace and a general professional certification process for correctly fitted and installed ductwork and CAC systems, similar to what NEEA, SMUD, NEEP, and NYSERDA have been offering:

Sponsor	Program	Marketing
NEEA	Develop methods for test and retrofit of systems; train and certify contractors; certify homes	Support materials and mkt. assistance to contractors
Oregon Office of Energy	Tax credits for AC systems and ductwork upgrades; installation tax credits; rebates for blower door tests and duct sealing	Web site advertising
PG&E	Contractor training; perform spot checks for installations; customer education; contractor and consumer rebates for equipment and installation	Direct mail, PR, TV advertising
SCE	Contractor incentives for duct sealing and AC tune-ups	-
SMUD	Duct sealing program; includes certification, testing, and consumer rebates; distributor rebates for products	Listed on SMUD website
City of Anaheim	Product incentives and promotion of high efficiency products	Direct mail, ads, inserts, PR
Xcel Energy	Rebates on ENERGY STAR CAC	TV ads, inserts, established network of HVAC contractors
Muscatine Power & Water	Consumer incentives and promotional information	Inserts, PR articles, special events
Indianola MU	Rebates on SEER 12 CAC	Brochure, newsletter, dealer info, website
NEEP	Consumer incentives; consumer education, contractor training	[Promoted individually by participating utilities]
NYSERDA	Home Performance w/ENERGY STAR program – build consumer awareness, develop contractor infrastructure by training, certification; provide consumer incentives, education, and financing	Multi-media advertising; public event displays; complete branding strategy
LIPA	Consumer rebates, customer and contractor education, installation verification	Advertising, mailings, inserts, public event displays
Florida Power & Light	Duct Repair and Central H/C Program; combination of incentives with contractor training	Inserts, TV ads, web site
Southern Maryland Electric Cooperative	Contractor certification	Web site, inserts, flyers

Source: CEE Residential HVAC Initiative – Program Summary – June 2001

Table 36: Recent HVAC Programs – Program Description and Marketing Summaries

WINDOW REPLACEMENT

Situation:	Standard windows, either double pane or single pane with storm
Measure:	Replace with ENERGY STAR labeled windows matched to Illinois climate conditions

Window-specific programs are relatively new compared to other energy efficiency initiatives. The most successful had been the recently completed NEEA program, which took a comprehensive approach targeting all points along the product chain, and ended with a successful transformation of the marketplace:

Sponsor	Agency	State	Program
CA and WA utilities	Northwest Energy Efficient Alliance	OR, WA, MT, ID	ENERGY STAR Residential Fenestration Program: Decreased high-efficiency windows' initial cost premiums and increased awareness of high-efficiency windows; increased market share for the residential fenestration up to 66% by 2001; worked directly with manufacturers and distributors to make energy efficient windows more available and closer in cost as standard windows
CT, MA, VT, RI utilities	NEEP	CT, MA, VT, RI	Recently finished a New England baseline study to assess the current marketplace; currently developing a program initiative based on the results
LIPA	KeySPAN	Long Island (NY)	ENERGY STAR Window Program: Provided rebate incentives and customer education
U.S. Department of Energy & the State of Florida	Florida Solar Energy Central	FL	Central Florida High Performance Windows Initiative: Interaction and intervention with manufacturers and market actors; consumer and market actor education, presentations; training of window sellers
America Electric Power Company	-	TX	Texas Window Initiative: Promoted the installation of high performance windows in the residential new construction and remodeling markets; created interventions with manufacturers, distributors, and retailers to develop availability of product, standardization, and reduced first cost

Table 37: Energy Efficient Window-specific Program Summaries

RLW Analytics recently researched ENERGY STAR windows programs as part of a baseline study for Oncor (formerly Texas Utilities). We found that there has been a steady national market penetration of Low E coated window products, which appears to be the result of previous market transformation efforts in the Northwest, the Northeast, and California. This has been pushing the manufacturing sector to provide the necessary products at reasonable prices.

The NEEA program is one of the best to emulate. Over the lifetime of the program, they achieved a market penetration of 66% of all fenestration products. NEEA took a detailed, comprehensive approach to target all actors within the product chain. The program staff and contractors used traditional marketing, promotion, and advertising to attract customer interest, and built upon existing business relationships between manufacturers and retailers, distributors, builders and remodelers to deliver the ENERGY STAR message to customers. Incentives and support were provided to manufacturers to encourage promotion through traditional channels, and sales training and materials were provided to retailers.

DICIDEOUS TREE PLANTING FOR SHADE	
Situation:	**No or little east & west window shading**
Measure:	Plant deciduous trees on east and west sides

The American Public Power Association detailed a comprehensive list of utilities and municipalities that are participating in their TREE POWER program. In 2002, the APPA reported about 170 utilities are participating.[13] There are 25 tree programs in the Midwest identified by the APPA. Of those, 12 provide a specific benefit program for homeowners to plant shade trees:

Utility or Municipal Shade Tree Programs - Midwest		
Sponsor	**City/State**	**Homeowner Shade Tree Incentive or Program**
Columbus Water & Light	Columbus, WI	$15 rebate per shade tree
Coon Rapids Utilities	Coon Rapids, IA	Free trees to electric customers; $10 subsidized charge for delivery and planting
Loup River Public Power District	Columbus, NE	Distributes seedlings to the public
Osage Municipal Utilities	Osage, IA	Distributes trees to customers annually
Paulina Municipal Electric Utility	Paullina, IA	Reimburses homeowner ½ price of tree or $20 (least amount) – reimbursement is made as Chamber of Commerce Bucks
Richmond Power & Light	Richmond, IN	Distributes 5,000 trees a year
Sikeston Board of Municipal Utilities	Sikeston, MO	$25 coupon per customer for a shade tree
Wadena Light & Power	Wadena, MN	Gives away 250 seedlings annually
Waterloo Water & Light	Waterloo, WI	Two-tiered incentive: $15 a shade tree, plus $15 for shade trees planted on W or SW side of house
Waupun Utilities	Waupun, WI	$35 or 50% off cost of a shade tree
Waverly Light & Power	Waverly, IA	Subsidized prices for shade trees, with further discounts for planting in "energy efficient locations"
Zeeland Board of Public Works	Zeeland, MI	Gives away about 500 trees annually to electric customers

Source: APPA Tree Power Report

Table 38: Utilities and Municipalities Participating in the APPA Tree Power Program - 2002

[13] APPA "TREE POWER Report", Summer 2002, accessed via the internet at www.appanet.org

A handful of other utilities nationwide also offer residential shade tree programs:

Utility or Municipal Shade Tree Programs – Other Regions		
Sponsor	**City/State**	**Homeowner Shade Tree Incentive Program**
Key Energy Services	Key West, FL	Gives away 3,000 shade trees a year
Riverside Public Utilities	Riverside, CA	$25 rebate per tree, up to three trees annually
Braintree Electric Light Department	Braintree, MA	Offers to plant two maple trees on south or west side of homes

Table 39: Recent Homeowner Shade Tree Programs

The other utility programs not listed have tree programs that benefit the community at large (versus individual homeowners). Of those shown above, the majority of these are non-specific to tree placement, which implies that these programs are designed to also help on broader objectives such as public relations or carbon sequestration. Three utilities – Waterloo Water & Light, Waverly Light & Power, and Braintree Electric Light – have program elements specifically addressing sun shading on the home to reduce energy use.

We recommend that a utility program that emulates the approach of these last-mentioned utilities would be best effective in reducing solar heat gain in homes. In particular, the Waterloo, MN approach diplomatically moves them towards two compatible goals: inducing ratepayers to at least plant additional shade trees, and providing additional inducements for those who can and want to plant those trees in strategic shading locations.

INCANDESCENT LIGHT BULB REPLACEMENT	
Situation:	**Incandescent bulbs used for interior lighting**
Measure:	Replace frequently used lamps with CFLs

CFL lamp and fixture replacement programs are, of course, the most ubiquitous of energy efficiency promotional initiatives used throughout the country. As the subsequent tables show below, the most common programs utilize two basic strategies of providing incentives for purchase and turn-ins as well as using a comprehensive array of marketing tools to educate, inform, and enhance awareness.

Since MEEA has conducted lighting programs already, it may be superfluous to suggest program strategies. However, since we discovered that only 23% of our audited homes had CFLs while a large majority of Illinois homeowners claim a desire and readiness to purchase and use energy efficient lighting, it appears that a strategy of consumer education combined with active intervention methods of such things as rebates, incentives, and torchiere turn-ins will continue to yield useful results.

Table 40 on the next page shows the wide distribution of lighting programs throughout the U.S., which shows similar first cost buy down incentives across the programs for CFLs, fixtures, torchieres, and ceiling fans. The subsequent table shows the depth of marketing elements used in the larger programs to promote lighting.

Sponsor	State	Program End	2001 Budget		CFLs		Hardwired Fixtures		Torchieres		Ceiling Fans	
			Total ($M)	Incentives ($M)	Incentive	Type	Incentive	Type	Incentive	Type	Incentive	Type
NEEA	OR,WA,ID, MT	June 2003	1.5	-	-	-	-	-	-	-	-	-
BPA	OR,WA,ID, MT	-	-	-	-	-	-	-	-	-	-	-
SCL	WA	Ongoing	-	-	Full	Giveaway	-	-	-	-	-	-
Puget Sound Energy	WA	Ongoing	-	-	-	-	$25	Mail-in	-	-	-	-
Snohomish PUD	WA	Dec. 31 2001	1.65	-	$2 $3	Buy down Instant	-	-	-	-	-	-
PG&E	CA	Dec. 31 2001	5.8	-	$2	Instant	$10	Instant	$10	Instant	$20	Instant
SCE	CA	Ongoing	-	-	Full	Giveaway	-	-	-	-	-	-
SDG&E	CA	Ongoing	1.5	-	$2	Buy down	$10	Buy down	$10	Buy down	$20	Buy down
SMUD	CA	Ongoing Dec. 2002	1.67	0.77	$4	Mail-in	-	-	$10 $20	Mail-in Retailer	-	-
LADWP	CA	Dec. 2002	3.0[(a)]	-	-	-	-	-	-	-	-	-
Anaheim	CA	Feb. 8 2003	0.3	-	$5	Mail-in	-	-	-	-	$50	Mail-in
MEEA	OH,IL,MN, MO, KY	Dec. 2002	0.5	-	$3	Instant	-	-	-	-	-	-
WECC	WI	June 2004	2.4[(a)]	-	$3	Mail-in	$10	Mail-in	$20	Mail-in	$15	Mail-in
IL DCEO	IL	Ongoing	.6	-	$3	Mail-in	-	-	$20	Instant	$35	Instant
Xcel Energy	MN	Ongoing	-	-	-	-	-	-	-	-	-	-
MG&E	WI	Ongoing	-	-	-	-	-	-	-	-	-	-
Muscatine Power & Water	IA	Ongoing	0.002	-	Half purchased price	Mail-in	-	-	-	-	-	-
NEEP Utilities	MA,RI,CT, VT,NH	Dec. 2002	20.0	8-12	$3 - $4	Instant	$10 outdoor $15 indoor	Instant	$15	Instant	$10-$15	Instant
NYSERDA	NY	Ongoing	2.2[(a)]	7.0	-	-	-	-	$25	Mail-in	-	-
LIPA	NY	Dec. 2003	3.0[(a)]	2.0[(a)]	$3	Instant	$10	Instant	$15	Instant	-	-
Totals			**43.4**	**19.8**								

Source: CEE Residential Lighting Programs National Summary, May 2002

Table 40: Summaries of Lighting Programs

Region	State(s)	Main Agent	Program Name	Retailer Participation	Incentives	Coop Funds	Field Reps	Manufacturer Outreach	Publicity Campaigns	POP Materials	Product Catalog	Special Events
-	CA	California Utilities	CA Residential Lighting and Appliance Program	X	X	X	X		X	X		X
Sacramento	CA	SMUD	Residential Retail Lighting Program	X	X		X		X	X		X
Long Island	NY	LIPA	Residential Lighting and Appliance Program	X	X		X		X	X	X	X
New England	MA, CT, VT, RI	NEEP	Residential Lighting Market Transformation Initiative	X	X		X		X	X	X [a]	X
Pacific Northwest	WA, ID, OR, MT	NEEA	ENERGY STAR Residential Lighting Program	X	X		X		X	X		X
-	NY	NYSERDA	Energy $mart ENERGY STAR Appliances and Products Program	X	X		X	X	X	X		X
-	WI	WECC	ENERGY STAR Program	X	X		X		X	X	X	X

[a] Lighting fixtures offered through Northeast Utilities/United Illuminating Smart Living Catalog

Adapted from Vrabel, Paul, Kathryn Gaffney, Heidi Curry, "A Comparison of Lighting Market Transformation Programs in New York, New England, Wisconsin, California, and the Pacific Northwest", ACEEE 2000 Summer Study Conference Proceedings, Washington DC.

Table 41: Marketing Elements in Lighting Market Transformation Program

ENERGY STAR APPLIANCE REPLACEMENTS

Situation:	**Old standard appliances set to be replaced: refrigerator, dishwasher, clothes washer**
Measure:	Replace with ENERGY STAR appliances

ENERGY STAR appliance programs have also become a frequent element in utility and agency residential initiatives. The most common and successful has been ENERGY STAR clothes washer promotional programs. Since these washers provide a significant amount of energy cost reduction, it is not surprising to see so many entities, from small municipal utilities to large multi-state agencies, provide promotions and incentives to raise market share for these products. Table 42 and Table 43 below show that ENERGY STAR clothes washers are the most prevalent appliance promoted.

The opportunity to promote ENERGY STAR clothes washers grows even further in 2004. Clothes washers manufactured to meet the 2004 standard will be 22 percent more efficient than today's baseline clothes washer. Units that meet the 2007 requirements will be 35 percent more efficient that today's baseline clothes washer.

As the tables depict, the incentive range for ENERGY STAR appliances is wide. Clothes washers rebates are the most prevalent, and they run from $50 to $150. We have seen from past evaluations and market progress reports that rebates, combined with a well-planned marketing campaign, are a useful element in early market intervention programming. However, qualitative research done in 2002 in support of the marketing strategy development for the NYSERDA residential ENERGY STAR Appliances and Products program found that significant manufacturers have appeared to position their products in a higher price point categories as high quality, high value products geared towards specific consumer segments. Secondary source price research found that price differentials for ENERGY STAR appliances actually increased between 2000 and 2001. NYSERDA uses a program design theory of creating sustainable market transformation in appliances without direct cash incentives.

This is not without precedent. The NEEA Tumble Wash program purposely trimmed back rebates as ENERGY STAR clothes washers gained market share after several years of program intervention. These two examples, plus the recent research evidence, suggests that the strategy of consumer education and awareness, plus a purposeful appeal towards the “high quality, high value” proposition, creates a sustainable path towards true market transformation, and one that we would recommend as well.

Sponsor	Service Territory	State	Program End	2002 Budget Tot($M)	Clothes Washers		Dishwashers		Refrigerators		Room Air Conditioners	
					Incentive	Type	Incentive	Type	Incentive	Type	Incentive	Type
Blachly-Lane	Eugene	OR	Dec. 31 2001	0.005	$50	Mail-in	$20	Mail-in	$25	Mail-in	-	-
BPA	OR,WA,ID, MT	OR,WA, ID,MT	-	-	-	-	-	-	-	-	-	-
Emerald PUD	Eugene	OR	Ongoing	0.135	$100	Mail-in	$30	Mail-in	$75	Mail-in	-	-
Eugene WEB	Eugene	OR	Ongoing	-	$45-$125	Mail-in	$30	Mail-in	-	-	$40	Mail-in
Lane Electric	Eugene	OR	Ongoing	0.05	$85	Mail-in	$50	Mail-in	$65	Mail-in	-	-
LOTT	Western WA	WA	Ongoing	-	$100	Mail-in	-	-	-	-	-	-
MEEA	Chicago, ComEd	IL	July 2002	.6					$50	Mail In	-	
NEEA	OR,WA,ID, MT	OR,WA, ID,MT	Dec. 2003	2.0	-	-	-	-	-	-	-	-
OOE	OR	OR	Ongoing	-	$160-$230	Tax Credit	$60	Tax Credit	$30-$70	Tax Credit	-	-
Seattle City Light	Seattle	WA	-	-	$75	Mail-in	-	-	-	-	-	-
Snohomish County PUD	Snohomish County	WA	Dec. 31 2002	0.48	$100	Mail-in	$35	Mail-in	-	-	-	-
Springfield Utility Board	Springfield	OR	Ongoing	-	$130	Mail-in	$30	Mail-in	$60	Mail-in	-	-
City of Anaheim	Anaheim	CA	February 2004	.23	$100	Mail-in	$50	Mail-in	$100	Mail-in	$50	Mail-in
City of Millbrae	Millbrae	CA	Ongoing	.006	$75	Mail-in	-	-	-	-	-	-
EBMUD	Oakland	CA	Ongoing	.5	$150	Mail-in	-	-	-	-	-	-
LADWP	Los Angeles	CA	Ongoing	3.0[(a)]	-	-	-	-	-	-	-	-
MWD	Southern California	CA	Ongoing	0.57	$25-$75	Mail-in	-	-	-	-	-	-
PG&E	Northern and Central CA	CA	Dec. 31 2002	12[(a)]	$75	Mail-in	$50	Mail-in	-	-	$50	Mail-in
Riverside Public Utilities	Riverside	CA	Ongoing	-	$100	Mail-in	$50	Mail-in	$100 $25	Mail-in Recycling	$50	Mail-in
SMUD	Sacramento	CA	August 2002	1.57[(a)]	$75-$125	Mail-in	-	-	$50	Recycling	$50	Mail-in
SDCWA	San Diego County	CA	June 30 2004	2.8	$125	Instant	-	-	-	-	-	-
SDG&E	San Diego	CA	Dec. 31 2002	.57	$75	Mail-in	$50	Mail-in	-	Mail-in	$50	Mail-in

Table 42: Residential ENERGY STAR Programs (Part I)

Sponsor	State Territory	State	Program End	2002 Budget Tot ($M)	Clothes Washers		Dishwashers		Refrigerators		Room Air Conditioners	
					Incentive	Type	Incentive	Type	Incentive	Type	Incentive	Type
SCVWD	Santa Clara Valley	CA	June 30 2004	-	$100	Mail-in	-	-	-	-	-	-
Silicon Valley Power	Santa Clara	CA	Ongoing	0.13	-	-	$50	Mail-in	$75	Mail-in	-	-
SCE	Southern California	CA	-	-	-	-	-	-	-	-	-	-
SoCal Gas	Southern California	CA	May 31 2001	1.8	$75	Mail-in	$50	Mail-in	-	-	-	-
Austin Energy	Austin	TX	Ongoing	8.7[a]	$100	Mail-in	-	-	-	-	$50	Mail-in
City of Albuquerque	Albuquerque	NM	Ongoing	0.1	$100	Bill Credit	-	-	-	-	-	-
City of Austin	Austin	TX	Ongoing	0.1	$100	Mail-in	-	-	-	-	-	-
City of Boulder	Boulder	CO	Ongoing	0.03	$75	Main-in	-	-	-	-	-	-
ComEd	Chicago	IL	Ongoing	0.03	-	-	-	-	-	-	-	-
Denver Water	Denver	CO	Ongoing	_	-	-	-	-	-	-	-	-
MGE	Madison	WI	Ongoing	-	-	-	-	-	-	-	-	-
Minnesota DOC	MN	MN	Ongoing	0.007	-	-	-	-	-	-	-	-
Muscatine Power & Water	Muscatine	WI	Ongoing	-	$50	Mail-in	$50	Mail-in	$50-$100	Mail-in	$25-$50	- Mail-in
Waverly Light & Power	Waverly	MN	Ongoing	-	$100	Mail-in	$25-$50	Mail-in	$50	Mail-in	$25-$50	Mail-in
WECC	32 Utilities in WI	WI	June 2003	2.9[a]	-	-	-	-	-	-	-	-
Xcel Energy - MN	MN	MN	Ongoing	12.0[a]	-	-	-	-	$55	Mail-in	$30	Mail-in
LIPA	Long Island	NY	Dec. 2003	3.1	$75	Mail-in	-	-	-	-	$75	Bounty
NYSERDA	NY	NY	Ongoing	20.7[a]	-	-	-	-	-	-	$75	Bounty
NEEP Utilities	MA,RI,CT,VT, NH,NY		Ongoing	10.0	$25-$75	SPIFFS & mail-in	$25	Mail-in	$25	Mail-in	$25	Mail-in
State of Maryland	MD	MD	July 2004	-	5%	Tax exemption	-	-	5%	Tax exemption	5%	Tax exemption

Table 43: Residential ENERGY STAR Programs (part II)

Source: CEE Residential ENERGY STAR Appliances Program Summary, 2001

Table 44 below shows the wide range of marketing tools and strategies found in major ENERGY STAR appliance program promotions. In this study conducted by RLW Analytics for the Massachusetts utilities in 2001, it was concluded through program results and interviews with most market actors that the most sustainable and successful programs utilize a wide range of marketing tools. As shown in the table, these tools range from high impact and cost effective public promotions to mass media advertising. In particular, the clothes washer program run by the Northwest Energy Efficiency Alliance was notable in the significant market growth created by creative limited budget promotions that were geared toward high consumer visibility.

ENERGY STAR Programs	Region	Main Agent(s)	Marketing Tools Used
Residential Appliances	New England	NEEP	Rebates, PR events, advertising, brand awareness (displays, sweepstakes, referral services, and others)
ENERGY STAR Home products	Northwest	NWEEA	PR events, dealer/salesperson incentive, selected utility rebate, financing (selected municipal utilities), brand awareness advertising
Downstream Appliance Program	California	Four major public utilities	Rebates, dealer/salesperson incentive, billing inserts, retailer training, coop advertising, brand awareness (contest, sweepstakes, public display)
Energy $mart Residential Appliances and Products Program	New York	NYSERDA	Rebates for clothes washers (LIPA), dealer/salesperson incentive, PR events, retailer outreach, consumer education materials, advertising
Appliances and Lighting Program	Wisconsin	WECC	Consumer education, rebates, dealer/salesperson incentive, advertising, PR events, retailer outreach

Source: Adapted from RLW Analytics, "ENERGY STAR Appliances Research Study", for NSTAR Services Company, Western Massachusetts Electric Company, National Grid USA Service Company, Inc., Fitchburg Gas and Electric Light Company, August 15, 2001.

Table 44: Major Regional/State ENERGY STAR Programs – Marketing Tools Used

As discussed earlier under the Technical Potential section, refrigerator replacements are also a strong opportunity because of the low percentage of households found with ENERGY STAR labeled refrigerators, a high average age level, and the significant savings differential potentially available. In addition, a recent study conducted for the Chicago Energy Cooperative shows that Cook County residents queried about possible replacement purchases mentioned refrigerators above many other home appliances (Figure 4 below):

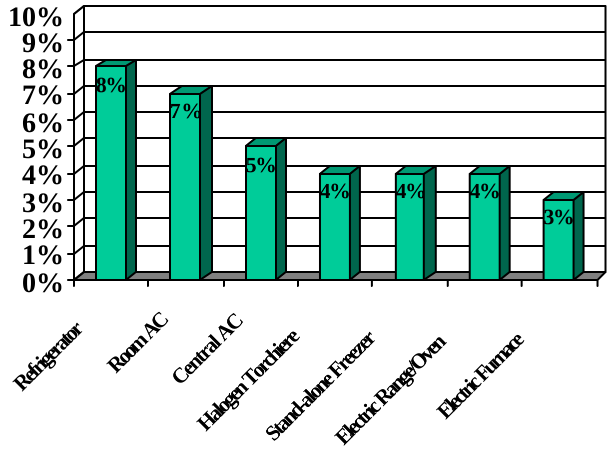

Figure 4: CEC 2001 Study –Those who probably/likely to buy these appliances in the next 12 months

In our market potential analysis, we used 19 years old or older as the median retirement age for refrigerators. For early replacement programs, there is significant analytical progress towards determining the best means for determining what refrigerators can be targeted for a return and recycling program. An ACEEE 2002 Summer Study paper presented by Kouba-Cavallo provides a very good foundation for setting rules on qualifying refrigerators to be recycled.[14]

WEATHERIZATION AND SIMPLE CONSERVATION

Situation:	**Lack of temperature management, hot water management, and weatherization measures**
Measure:	Install: - programmable thermostat - faucet aerators - low flow showerheads - insulation around hot water pipes - Insulation around gas water heater - Window caulking and door weather stripping

Low-income weatherization and conservation programs usually target weatherization, conservation measures, and temperature controls. The Department of Energy funds weatherization programs in all 50 states to serve low-income populations, and utility programs have normally targeted multifamily housing units for weatherization and conservation measures. Illinois in particular has a number of statewide programs:

- Illinois Bureau of Energy and Recycling public education and awareness programs

[14] Cavallo, James, PhD, Kouba-Cavallo Associates, and James Webb, PhD, Wisconsin Division of Energy, "Evaluating Alternative Simple Rules for Choosing Refrigerators to Replace", ACEEE 2002 Summer Study Proceedings (accessed via www.kouba-cavallo/art/rules02.pdf.

- Weatherization Assistance Program
- Rebuild America funding and support provided through local entities

This study and report was aimed at single family owned homes. However, the table below provides a snapshot of the weatherization implementation strategies used by utilities within their multi-family housing programs:

Utility Multifamily Housing Efficiency Programs			
Sponsor	**State**	**Pgm End**	**Program**
Austin Energy	TX	Ongoing	Technical and financial search assistance; Rebates for efficient heating, cooling, and lighting equipment; rebates for efficiency measures such as ceiling insulation and duct repair
Bay State Gas	MA	Ongoing	Free energy audits; financial assistance for controls, insulation, and other weatherization measures
Berkshire Gas	MA	Ongoing	Incentives for controls, insulation, and weatherization measures
California Utilities	CA	Ongoing	Integrated approaches of information, education, energy management services, and customer incentives
Efficiency Vermont	VT	Ongoing	No-cost technical assistance, project-based financial incentives
Long Island Power Authority	NY	Ongoing	Education and free installation of controls, insulation, and CFLs
Madison Gas & Electric	WI	Ongoing	Education and Neighborhood Revitalization Grant Program
NGRID	MA	Ongoing	Free analysis and installation of insulation, water heating measures, lighting, and other measures to electrically heated apartments of five or more
NEEA	OR, WA, ID, MT	March 2001	3-year project to demonstrate benefits of public housing efficiency initiative
NSTAR	MA	Ongoing	Comprehensive weatherization, energy conservation, and education services
NYSERDA	NY	Ongoing	Multifamily Building Program provides comprehensive energy audit with financial incentives; Bulk Purchase Program provides cash incentives for bulk purchases of energy efficient residential products
Ohio Dept. of Development	OH	Ongoing	On-site audit; client education; comprehensive weatherization measures based on audit results
Tacoma Public Utilities	WA	Ongoing	Installation of energy efficient technologies and weatherization measures
United Illuminating	CT	Ongoing	No-cost installation of conservation and weatherization measures
Wisconsin Div. Of Energy	WI	Ongoing; new statewide effort in 2002	Direct installation of conservation measures

Source: CEE Multifamily Housing 2002 Program Summary

Table 45: Weatherization Programs

Our audit results show that about 2/3 of all audited homes across income levels lacked a number of the energy conservation measures we looked for, such as hot water wraps, faucet aerators, and low flow showerheads. This suggests that basic weatherization and conservation offerings should find plenty of opportunities within Illinois.

VIII. CONCLUSIONS

This section provided a comparative overview of recent programs that have been implemented towards raising share and consumer acceptance of high efficiency home products and measures. The strategies and program designs, to be sure, are driven in large part by the existing markets for the "standard" product the promoted item is meant to replace. Given that, there are common threads that can be incorporated into the program designs for any of these measures that were analyzed at length here.

Utilize a wide variety of marketing tools and elements. As discussed earlier, the best programs for sustainable market share growth utilized a comprehensive set of marketing and promotional tools to build and sustain knowledge, interest, and product desirability. Successful strategies have not just used the traditional means – bill inserts, advertising – but also used creative and highly visible promotional campaigns and events to build "top of mind" awareness and recognition. Conversely, program managers that RLW interviewed in a recent study felt that a marketing campaign built on only one or two elements made only limited impact and will not generally move consumers to any notable degree.

Engage the market actors at all levels of the product sales cycle. Successful programs have outreach tasks that identify and engage key players on each step of the product sales cycle – manufacturer, distributor, retailer, contractor, and consumer. The complementary "push" and "pull" strategy creates buy-in from the market actors on each level, and helps reinforce the message between them (ex. in a balanced approach, the distributor knows and understands the energy efficient product as well as the contractor, who in turn can reinforce or corroborate the information known by the consumer).

Position the energy efficient product as a desirable "high quality, high value" item. Appliance manufacturers in particular have added a variety of special features and functions to their ENERGY STAR models. Although no literature explicitly explains why, it appears these features, many of which are "high tech" in design and function, creates a "high value" perception. This high value perception is likely geared toward those consumers who can afford, and less likely to balk at, the higher price premium comparable to "standard" models that lack these specialized designs and functions. This kind of product positioning is typically built towards consumers who are comfortable paying a premium for products that are perceived to be of a high quality, reliability, or safety, whether it's cars, appliances, or organically grown foods.[15]

A recent example of the product promotional shift from a "green" to a "high value" message are CFLs sold by Phillips Electronics, who have now shifted emphasis on the marketing message. Originally billed as "eco-friendly" energy saving "Earthlights", Phillips shifted the marketing message recently to promote a more successful campaign of convenient, long lasting "Marathon" bulbs.[16] This does not necessarily mean that Phillips has abandoned the environmental message, but the company has broadened the message to promote personal benefits of cost and convenience.[17]

We recommend these marketing approaches as safe and proven approaches towards capturing the market potentials found in this study.

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[15] De Lisser, Eleena, "Is That $5 Gallon of Milk Really Organic?", Wall Street Journal, August 20, 2002, page D1. In the article, the Organic Trade Association s states that organic food sales have been growing about 20% annually, even though organic products have a price premium of 10% or more; Rathke, Lisa, Associated Press, "Farmers see new niche in organic milk products", Troy Sunday Record, September 15, 2002, p. A7. The article reports the number of organic dairy farms have tripled from 20 to 61 in the past six years to capture demand.

[16] Fowler, Geoffrey, A. "'Green' Sales Pitch Isn't Moving Many Products", Wall Street Journal, March 6, 2002.

[17] Ottman, Jacquelyn A., "The Real News About Green Consuming", from the J. Ottman Consulting website (www.greenmarketing.com/articles/gbl_may02.html). In this article and in a recent keynote presentation at the ACEEE Market Transformation Symposium in March 2002, Ms. Ottman stressed that marketing green products can work if consumer desires for improvements or enhancements of personal cost, comfort, and convenience is appealed to as well.

Specifically, the assessment has identified the following energy efficiency and weatherization programs that the State, the Clean Energy Trust or the various Illinois utilities could undertake that will have a significant impact on the market:

Energy Efficiency Programs:

1. **Energy Efficient Lighting Programs.** In particular, the field data from the site visits indicated that 95% of the homes had less than a 10% presence of CFLs (Compact Fluorescent Lamps) by bulb count. Programs offering rebates or other incentives to encourage homeowners to purchase CFLs to replace their existing incandescent light bulbs are simple and highly cost-effective programs that should be utilized. Programs should only rebate CFLs that qualify for the ENERGY STAR label to ensure the products quality and longevity. Additionally, the CFL industry is making tremendous strides with the technology and have produced ENERGY STAR qualified lighting products ranging from a simple CFL, reflector lamps, outdoor application lamps all with a wide array of sizing and wattages to meet the needs of consumers. In the assessment, lighting hourly usage patterns utilized in the models are based on actual measured hourly residential lighting usage patterns from a large number of long-term and short-term end-use studies. Calculated annual savings amounted to approximately 786 kWh, 0.43 kW, –20 therms and 0 BTUH.

   Additionally, programs focusing on ENERGY STAR qualified fixtures and ceiling fans should also be considered after the market for CFLs has begun to be established. Various programs could be undertaken including torchiere turn-in events that emphasize both the energy and safety message of turning in a halogen torchiere and replacing it with a fluorescent torchiere, incentives on ceiling fans that have a lighting component as part of the fixture, outreach to lighting showrooms and builders to encourage them to stock and market the benefits of energy efficient fixtures.

2. **Programs focusing on high-efficiency heating, ventilation and air conditioning units.** Significant savings are available for the installation of high efficiency AC systems instead of standard efficiency SEER 10 units. Furthermore, while most of the homes throughout Illinois employ natural gas furnaces for heat, a few (between 2% and 3%) use electric heat pumps or electric strip heat for primary heat; so, as a retrofit measure the installation of a high efficiency heat pump might be an option for existing homes with old heat pumps or with electric resistance heat. Example HVAC program templates include, but are not limited to:
   - Rebates and financing to encourage customers to install HVAC equipment meeting ENERGY STAR requirements at a minimum, and to test and seal HVAC ducts using Aeroseal diagnostics protocol and sealing technology. Program implementers can partner with local contractors who must meet participation-eligibility requirements, including product efficiency minimums and installation specifications. Participating contractors could be permitted to offer the program's financing and rebates to customers. Program requirements, incentives, and marketing should be coordinated, as applicable and practicable, with utilities, utility groups, and public agencies to promote market transformation.
   - Programs focusing on incentives, customer education, and contractor training. Contractor training includes combustion appliance safety testing, duct diagnostic testing and sealing, HVAC system tune-ups, ACCA Manual J, Manual D, and zoning. PG&E also educates customers on the importance of quality installation through a video on duct sealing and a requirement of proper installation for some rebates.

HVAC equipment rebates generally vary from $200 to $500, depending upon equipment type and efficiency. Per this assessment, the estimated annual savings from upgrading from a SEER 10 AC units to a SEER 13 is 509 kWh, with a peak demand reduction of 0.56 kW. The potential annual savings for replacing an older SEER 10 heat pump with a SEER 13 heat pump are approximately 1889 kWh and 0.66 kW for the average home. Replacement of old electric resistance heat systems can have potential annual savings of 16,960 kWh and 8.43 kW

3. **ENERGY STAR qualified appliance programs.** Across the country, numerous programs use incentives to reward consumers who purchase ENERGY STAR qualified appliances. There are substantial electric, gas and water savings that can be achieved through these programs. The assessment revealed that Illinois consumers would reap similar benefits if they replaced their existing appliance with an ENERGY STAR qualified model. The table below reflects these savings:

Appliance	Annual kWhr Savings	Annual BTUH Savings
Refrigerators	260 – 472	0
Dishwashers	43 – 180*	400
Clothes Washers	-4 – 680*	1500

* Savings depend on whether the water is heated by electric or gas.

The majority of the programs that are being implemented revolve around two key components: consumer incentives and retail education. Offering consumers incentives to lower their end cost of the appliance will afford more customers the opportunity to purchase the ENERGY STAR qualified appliances which are typically higher-end units. Additionally, programs should try to leverage their rebate dollars with matching contributions from manufacturers and provide retail education on how to properly market and sell energy-efficient products and appliances. However, MEEA does not feel that refrigerators should be just given rebates without coupling the program with the recycling of the older appliance. Programs must ensure that the older refrigerator is placed out of operation, not used as a secondary unit and not resold back into the market place. Additionally, programs must ensure that proper recycling occurs and meets all federal, state and local environmental requirements.

4. **Programmable Thermostat Programs.** This market assessment estimates that by increasing the cooling set points three degrees F and decreasing the heating set points by four degrees F daily from 8AM to 3PM, the estimated annual savings will be about 60 kWh and 2.01 kW, along with 26 therms and 22,413 BTUH. High positive demand savings are due to the fact that the action of the thermostat sometimes causes the systems to cycle off completely during times that they would normally run under high loads. Programs for programmable thermostats generally involve either a straight rebate to the consumer, usually around $20, for the purchase of a programmable thermostat or it is added into an existing HVAC program where the incentive is coupled with the HVAC incentives.

5. **Programs focusing on proper sizing of AC systems.** For this assessment, an oversized system is defined as having a rated cooling capacity greater than 100% of a valid Manual J cooling load estimate. The audits identified that about 80% of the AC systems of this study are oversized relative to this criterion. Those that qualified as oversized averaged 50% above the Manual J estimate.

The energy savings from retrofitting the baseline capacity of 3.52 tons and in the first retrofit case the size is reduced to 2.35 tons, with a proportional reduction in airflow and duct sizing to maintain 372 CFM per ton. The rationale for maintaining this airflow rate is the probability that the same duct sizing practice is applied by the contractor independent of system size. This would be applicable to new AC systems that are installed where there is no existing ductwork. The estimated annual savings is 121 kWh, with a peak demand reduction of 0.17 kW.

On the other hand, if a new system is to be installed to replace an old system or with an existing forced air furnace that already has supply and return ductwork, there would be no need to install new ductwork. This is due to the fact that the existing ductwork would be able to deliver the same airflow as before with the same fan power, thus reducing the system losses due to low airflow and excessive system cycling. The estimated annual savings for this scenario is 314 kWh, with a peak demand reduction of 036 kW. The advantages of reducing system size are all positive as long as the system capacity is sufficient to maintain acceptable comfort conditions about 97.5% of the time (which are all but a few hours of the typical cooling season). The smaller system will typically maintain better humidity control, last longer, make less noise, use less energy and cost less to install.

Programs to address the over-sizing of AC systems would likely take the form of either training of AC installation contractors on Manual J and proper sizing of AC units for new homes, or an incentive structure to reduce the cost of the homeowner to retrofit their existing system with an AC that meets their load estimate. The incentives should be tiered and correspond to whether or not new ductwork is needed or if the new system can use the existing AC infrastructure.

6. **An ENERGY STAR homes program or equivalent or training for builders and architects on building homes beyond existing energy codes.** Homes built exceeding the existing energy code will use substantially less energy for heating, cooling, and water heating. Additionally, the energy-efficient features of these new homes keep out excessive heat, cold, and noise, and ensure consistent temperatures between and across rooms - making these homes more comfortable to live in. Builders and architects can learn how to build and sell these homes that have significant consumer benefit and the incremental cost to the builder is low. Specifically, this assessment identifies several home system components and envelope components may not be cost-effective or practical to implement in retrofit applications, however, in new construction applications, the incremental cost of executing these recommendations are extremely cost-effective.

   Two separate programs could be implemented: 1) A series of trainings for builders and architects on how to build beyond code homes; and 2) a system of incentives for homeowners (tax incentives, rebates, low-cost financing) to build a better home. However, in states and metropolitan areas that do not have a strict energy code, adapting the training prior to the homeowner incentives is recommended so that when consumers begin to demand more efficient homes, the building and architecture community will be prepared to handle this demand.

7. **An energy-efficient program in conjunction with the downsizing of an AC system.** After the initial assessment was completed, MEEA took the analysis a step further to look at the market potential of combining the planned replacement of window to a high-efficiency window and then downsizing the AC system at the same time. This new model estimated that the energy savings for the combinations of high efficiency windows and AC downsizing to 100% of Manual J calculated loads are as high as 784 kWh. These savings exceed the sum of savings for AC downsizing and high efficiency windows. This is due to the fact that the new windows reduce the cooling loads so that downsizing results in even smaller AC systems than downsizing alone. When these two measures are applied independently, they save an average of 678 kWh (314+364) per year. When they are applied together interactively the combined savings are 16%

more. This is characteristic of downsizing only, since all other combination measures usually lead to a slight interactive reduction in total savings when applied together.

Furthermore, the differential installed costs for the two combination measures are not only negative, but close (around -$900) to those of the downsizing only (-$1000). This is due to the fact that, on average, the degree of downsizing, and resultant installed cost savings, is greater when high efficiency windows are installed first. The additional cost savings for the smaller AC system offsets some of the differential costs of the high performance windows.

So, programs that combine education and awareness to contractors as well as small incentives for homeowners should be considered to achieve these desired savings.

Weatherization Programs:

1. **A weatherization program focused on duct and wall insulation.** The market assessment observed that most of the ducts in the basements of the Illinois homes were not insulated, whereas nearly all ducts in the attics had at least one inch of insulation. In our baseline models, it was assumed that 90% of the ducts were located in the attic and the product of U*A (i.e. thermal conduction coefficient times duct surface area) would be about 36, yielding an approximate peak air temperature rise of 1.0 degree Fahrenheit during the cooling cycle. In the retrofit case this U*A value was reduced to 20. The estimated annual savings for this measure is 52 kWh, with a peak demand reduction of 0.12 kW, plus 81 therms of gas per year and 2692 BTUH of peak gas consumption. Additionally, if 2" of insulation were added to any uninsulated ducts located in an attic space, the savings would be about five to seven times as much.

   Additionally, there are energy savings potential with attic and wall insulation retrofits. The models demonstrated that retrofitting R-7 attic insulation to R-30 insulation would yield savings of 484 kWh and 0.74 kW, plus 101 therms of gas annually and 9080 BTUH of peak gas consumption. Furthermore, we modeled a baseline of no wall insulation, and added R-11 insulation to represent a realistic best-case scenario. The calculated savings are 762 kWh and 1.1 kW, plus 451 therms of gas per year and 22,381 BTUH of peak gas consumption due to the reduction in gas heating.

   Although the potential savings are high, the long payback suggests that it would not be cost-effective to insulate existing walls with some insulation already in place. So, programs could be focused on reducing the retrofit cost to the homeowners so they would be more inclined to add more insulation to their attic and walls.

2. **Insulation of hot water pipes and water heater storage tanks.** MEEA estimated conservation impacts by assuming that any exposed pipes could be insulated, and that the energy savings would occur through a reduction in the hot water standby losses. The typical water heater is gas fired, so the estimated savings for the typical home are 13 therms per year and 152 BTUH. For the 4% with electric water heaters the annual electric savings would be about 312 kWh and 0.04 kW peak demand. Additionally, MEEA found that about 84% of the homes visited had gas water heaters that were not externally wrapped. The estimated savings for the typical home are 19 therms per year and 217 BTUH. For those with electric water heaters the annual electric savings would be about 267 kWh and 0.03 kW peak demand. Savings for this measure will vary with the ambient temperatures surrounding the hot water tank.