

Evaluation of Low Income Residential Retrofit Program

June 2014 through May 2015

Prepared for:
Illinois Department of Commerce and Economic Opportunity

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Table of Contents

Executive Summary	ES-1
1.Introduction.....	1-1
2.Estimation of Net Savings	2-1
3.Process Evaluation.....	3-1
Appendix A: Bibliography for Literature Review	A-1

List of Tables

Table ES-1 Summary of Gross and Net Ex Post kWh Savings by Program Component	ES-1
Table ES-2 Summary of Net Ex Post kWh Savings for Residential Retrofit Program by Utility	ES-2
Table ES-3 Summary of Gross and Net Ex Post Therm Savings by Program Component.....	ES-2
Table ES-4 Summary of Net Ex Post Therm Savings by Utility.....	ES-3
Table ES-5 Summary of Gross and Net Ex Post Peak kW Reductions by Program Component	ES-3
Table ES-6 Summary of Net Ex Post Peak kW Reductions by Utility	ES-4
Table 2-1 Illinois TRM Sections by Measure Type.....	2-2
Table 2-2 Summary of Gross and Net Ex Post kWh Savings by Program Component	2-3
Table 2-3 Summary of Net Ex Post kWh Savings by Utility	2-4
Table 2-4 Summary of Gross and Net Ex Post Peak kW Reductions by Program Component ..	2-4
Table 2-5 Summary of Net Ex Post Peak kW Reductions by Utility	2-4
Table 2-6 Summary of Gross and Net Ex Post kWh Savings by Measure for Weatherization...	2-5
Table 2-7 Summary of Gross and Net Ex Post kWh Savings by Measure for Program Grantees ...	2-5
Table 2-8 Summary of Gross and Net Ex Post kWh Savings by Measure for Energy Savers Multifamily	2-6
Table 2-9 Summary of Gross and Net Ex Post Therm Savings by Program Component	2-7
Table 2-10 Summary of Net Natural Gas Savings by Utility	2-7
Table 2-11 Summary of Gross and Net Ex Post Therm Savings by Measure for Weatherization...	2-8
Table 2-12 Summary of Gross and Net Ex Post Therm Savings by Measure for Program Grantees	2-8
Table 2-13 Summary of Gross and Net Ex Post Therm Savings by Measure for Energy Savers Multifamily	2-9
Table 3-1 Measure Incentive Levels.....	3-3
Table 3-2 Performance Based Incentives	3-5
Table 3-3 Prescriptive Incentives.....	3-5
Table 3-4 Share of Net Ex Post kWh Savings by Measure Type	3-7
Table 3-5 Share of Net Ex Post Therm Savings by Measure Type	3-7
Table 3-6 Measure Share of Net Ex Post kWh Savings by Program Component and Grantee ..	3-8
Table 3-7 Measure Share of Net Ex Post Therm Savings by Program Component and Grantee	3-8

Table 3-8 Comparison of Grant Dollars and Net Ex Post kWh Savings by Program Component... 3-9
..... 3-9
Table 3-9 Comparison of Grant Dollars by Net Ex Post Therm Savings..... 3-9

List of Figures

Figure 3-1 Share of Locations by Building Type 3-9

Executive Summary

This report presents the results of the impact and process evaluations for electric program year seven and natural gas program year four (EPY7/GPY4) of the Low Income Residential Retrofit Program offered by the Illinois Department of Commerce and Economic Opportunity (hereinafter referred to as the “Department of Commerce”). EPY7/GPY4 is defined as the period June 2014 through May 2015.

The main features of the approach used for the evaluation are as follows:

- Data for the study were collected through review of program materials and discussions with Department of Commerce staff members and program participants.
- A literature review of best practices for low income programs was completed.
- An engineering desk review was performed on program measures to verify gross and net savings estimates.

The gross and net ex post kWh savings of the Residential Retrofit Program during the period June 2014 through May 2015 are summarized by program component in Table ES-1 and by utility in Table ES-2. Because the Residential Retrofit Program targets energy efficiency improvements in low income resident housing, the net ex post savings are assumed to equal the gross ex post savings. Net ex post electricity savings total 8,576,838 kWh for the period. The program net-to-gross ratio is 100% because the program targets low income residents.

Table ES-1 Summary of Gross and Net Ex Post kWh Savings by Program Component

Program Component	Utility	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated		Net-to-Gross Ratio
		Gross Ex Post kWh Savings	Net Ex Post kWh Savings	Gross Ex Post kWh Savings	Net Ex Post kWh Savings	Gross Ex Post kWh Savings	Net Ex Post kWh Savings	
Weatherization	Ameren	2,417,676	2,417,676	2,417,676	2,417,676	2,417,676	2,417,676	100%
	ComEd	2,494,151	2,494,151	2,494,151	2,494,151	2,494,151	2,494,151	100%
	Subtotal	4,911,828	4,911,828	4,911,828	4,911,828	4,911,828	4,911,828	100%
Program Grantees	Ameren	20,631	20,631	20,631	20,631	20,631	20,631	100%
	ComEd	545,961	545,961	563,707	563,707	585,255	585,255	100%
	Subtotal	566,592	566,592	584,338	584,338	605,886	605,886	100%
Energy Savers Multifamily	Ameren	913,687	913,687	935,221	935,221	1,000,742	1,000,742	100%
	ComEd	1,891,376	1,891,376	1,964,142	1,964,142	2,058,382	2,058,382	100%
	Subtotal	2,805,063	2,805,063	2,899,363	2,899,363	3,059,124	3,059,124	100%
Total		8,283,483	8,283,483	8,395,529	8,395,529	8,576,838	8,576,838	100%

Table ES-2 Summary of Net Ex Post kWh Savings for Residential Retrofit Program by Utility

<i>Electric Utility</i>	<i>Net Ex Post kWh Savings*</i>
Ameren	3,439,050
ComEd	5,137,788
Total	8,576,838

*To avoid duplication, gross savings are not presented because they are equal to net savings.

The gross and net ex post natural gas savings of the Residential Retrofit Program during the period June 2014 through May 2015 are summarized by program component in Table ES-3 and by utility in Table ES-4. Net natural gas savings total 1,052,203 therms for the period.

Table ES-3 Summary of Gross and Net Ex Post Therm Savings by Program Component

<i>Program Component</i>	<i>Utility</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
		<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	
Weatherization	Ameren	204,835	204,835	204,835	204,835	204,835	204,835	100%
	Nicor	258,409	258,409	258,409	258,409	258,409	258,409	100%
	North Shore	35,537	35,537	35,537	35,537	35,537	35,537	100%
	Peoples	205,505	205,505	205,505	205,505	205,505	205,505	100%
	Subtotal	704,286	704,286	704,286	704,286	704,286	704,286	100%
Program Grantees	Ameren	8,269	8,269	8,269	8,269	8,269	8,269	100%
	Peoples	52,526	52,526	52,603	52,603	52,603	52,603	100%
	Subtotal	60,795	60,795	60,872	60,872	60,872	60,872	100%
Energy Savers Multifamily	Ameren	29,204	29,204	30,358	30,358	37,193	37,193	100%
	Nicor	58,270	58,270	59,399	59,399	66,467	66,467	100%
	North Shore	791	791	791	791	791	791	100%
	Peoples	134,854	134,854	134,961	134,961	182,593	182,593	100%
	Subtotal	223,118	223,118	225,509	225,509	287,045	287,045	100%
Total		988,198	988,198	990,667	990,667	1,052,203	1,052,203	100%

Table ES-4 Summary of Net Ex Post Therm Savings by Utility

<i>Gas Utility</i>	<i>Net Ex Post Therm Savings*</i>
Ameren	250,297
Nicor	324,876
North Shore	36,328
Peoples	440,701
Total	1,052,203

**To avoid duplication, gross savings are not presented because they are equal to net savings.*

The gross and net ex post peak kW reductions of the Residential Retrofit Program during the period June 2014 through May 2015 are summarized by program component in Table ES-5 and by utility in Table ES-6. Net ex post peak kW reductions total 2,955.06 kW for the period.

Table ES-5 Summary of Gross and Net Ex Post Peak kW Reductions by Program Component

<i>Program Component</i>	<i>Utility</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
		<i>Gross Ex Post Peak kW Reductions</i>	<i>Net Ex Post Peak kW Reductions</i>	<i>Gross Ex Post Peak kW Reductions</i>	<i>Net Ex Post Peak kW Reductions</i>	<i>Gross Ex Post Peak kW Reductions</i>	<i>Net Ex Post Peak kW Reductions</i>	
Weatherization	Ameren	956.75	956.75	956.75	956.75	956.75	956.75	100%
	ComEd	1,376.61	1,376.61	1,376.61	1,376.61	1,376.61	1,376.61	100%
	Subtotal	2,333.36	2,333.36	2,333.36	2,333.36	2,333.36	2,333.36	100%
Program Grantees	Ameren	7.62	7.62	7.62	7.62	7.62	7.62	100%
	ComEd	114.70	114.70	114.91	114.91	117.37	117.37	100%
	Subtotal	122.32	122.32	122.53	122.53	124.99	124.99	100%
Energy Savers Multifamily	Ameren	151.18	151.18	155.97	155.97	164.98	164.98	100%
	ComEd	312.01	312.01	319.07	319.07	331.72	331.72	100%
	Subtotal	463.19	463.19	475.04	475.04	496.71	496.71	100%
Total		2,918.87	2,918.87	2,930.94	2,930.94	2,955.06	2,955.06	100%

Table ES-6 Summary of Net Ex Post Peak kW Reductions by Utility

<i>Electric Utility</i>	<i>Net Ex Post Peak kW Reductions *</i>
Ameren	1,129.36
ComEd	1,825.70
Total	2,955.06

**To avoid duplication, gross savings are not presented because they are equal to net savings.*

The following presents a selection of key conclusions from EPY7/GPY4:

- **Electricity Natural Gas Savings Increased from the Prior Program Year:** The program kWh savings for EPY7/GPY4 were 8,576,838 which is an increase from 5,803,322 kWh savings in the last program year. The program therm savings for EPY6/GPY3 were 1,052,203 which is an increase from 844,231 therm savings in the last program year.
- **Building Energy Consumption Data may be Needed to Evaluate Custom Measures:** Program guidelines and grant agreements do not currently have provisions for collecting and providing utility billing information to the Evaluator. This information is necessary to evaluate some custom measures.
- **ADM verification efforts determined that a limited number of major rehabilitation projects were completed through the program.**
- **Opportunity to Increase Adoption of Low-Cost Measures:** Small shares of program savings were generated through certain low cost measures, such as low-flow devices. Additionally, some projects were largely comprised of measures with high full-replacement costs that result in relatively smaller savings.

The following recommendations are offered in the interest of improving the program:

- Modify program guidelines to require grantees to provide energy consumption data to Residential Retrofit Program staff and the evaluator when custom, non-TRM measures are installed.
- Staff should consider whether or not major rehabilitation projects should be directed to the Affordable Housing Construction Program. At a minimum, project data should indicate whether or not the project scope was significant enough to require compliance with the building energy code, as this affects what baseline is used for estimating project savings.
- Consider strategies to encourage grantees to implement energy saving measures that have low costs relative to the associated energy savings such as lighting retrofits and low-flow devices.

1. Introduction

This report presents the results of the impact and process evaluations of the Department of Commerce Low Income Residential Retrofit Program during EPY7/GPY4, defined as the period June 2014 through May 2015.

1.1 Description of Program

The Residential Retrofit Program offers grants to state agencies, local governments, and other entities that administer low income home improvements. Funds used for weatherization must be targeted at households at or below 200% of the federal poverty level. Low income home improvements must be targeted at households at or below 80% of the area Average Median Income (AMI).

During EPY7/GPY4, grants were awarded to (1) other programs that are operated by the Department of Commerce, referred to as intra-agency grants; and (2) to external applicants engaged in low income construction projects.

As in prior years, intra-agency grants were awarded to the Illinois Home Weatherization Assistance Program.

During EPY7/GPY4, the grants awarded to Elevate Energy were treated as a separate program component referred to as the Energy Savers Multifamily. Through this component, Elevate Energy provides a package of services and measure incentives to multifamily building owners and operators to encourage the adoption of energy efficiency improvements to existing buildings.

Additionally, program grants were awarded to the following external organizations:

- Affordable Housing Continuum;
- The Black United Fund of IL;
- City of Springfield;
- Hispanic Housing Development Corp.;
- Historic Chicago Bungalow Association;
- Residential Options;
- Victor C. Neumann Association.

Grant funds for most participants are prescriptive and based on the measures that are outlined in the program application. Applicants may propose additional measures provided that they include estimates of the energy savings from these measures. Decisions regarding the funding of proposed measures are based on staff reviews of estimated savings. Grantees receive funds for expected electric and gas energy savings.

Total grant funds cannot exceed \$750,000 and may not exceed 100 percent of the installed cost. However, the Department of Commerce Director reserves the right to waive funding limitations and other program parameters.

1.2 Overview of Evaluation Approach

The overall objective for the impact evaluation of the Residential Retrofit Program was to determine the net electric and natural gas energy savings and peak demand (kW) reductions resulting from program projects implemented during EPY7/GPY4.

The approach for the impact evaluation included the following main features:

- Available project documentation (e.g., invoices, savings calculations) was reviewed, with particular attention given to the calculation procedures and documentation for savings estimates.
- Gross savings were verified via analytical desk review.

1.3 Organization of Report

The evaluation report for the Residential Retrofit Program is organized as follows:

- Chapter 2 presents and discusses the analytical methods and results of estimating program savings.
- Chapter 3 presents and discusses the analytical methods and results of the process evaluation of the program.

2. Estimation of Net Savings

This chapter presents the results of the impact evaluation of the Low Income Residential Retrofit Program offered by the Department of Commerce. The overall objective of the impact evaluation was to determine the net electric and natural gas savings, as well as peak demand (kW) reductions resulting from program projects during the period June 2014 through May 2015. Section 2.1 describes the methodology used for estimating gross savings. Section 2.2 presents the results from the effort to estimate savings for the Residential Retrofit Program.

2.1 Methodology for Calculating Program Savings

The methodology used for calculating program savings is described in this section. The overall objective for the impact evaluation of the Residential Retrofit Program was to determine the net electric and natural gas savings, as well as peak demand (kW) reductions resulting from projects completed during EPY7/GPY4. When applicable, the measure-level algorithms from the Illinois Statewide Technical Reference Manual (TRM) Version 3.0 (Illinois TRM) were used to estimate savings (see Table 2-1).

Depending on the measure type, savings were calculated using up to three different approaches. These approaches were as follows:

- TRM-Calculated: Savings calculated as per Illinois' Statewide TRM Version 3.0.
- TRM-Calculated (Errata Corrected): Savings calculated as per an erratum, in Version 4.0 of the TRM.
- ADM-Calculated: Savings calculated using a non-TRM methodology. ADM-Calculated savings were performed when the measure was not in the TRM or when the methodology in the TRM was not applicable because the assumptions provided were not appropriate for that particular measure.

Table 2-1 Illinois TRM Sections by Measure Type

Measure	Section in Illinois TRM	Other Resources	TRM	Errata Corrected	ADM
Air Sealing	5.6.1	-	●		
Air Source Heat Pump	5.3.1	-	●		
Attic Insulation	5.6.4	-	●		
Bathroom Exhaust Fan	5.3.9	-	●		
Boiler - Commercial	4.4.10	-	●		
Boiler Lockout/Reset Controls	4.4.4	-	●		
Ceiling Fan	N/A.	TRM V4			●
Central AC w/ PT	5.3.3	-	●		
CFLs	5.5.1	-	●		
Dishwasher	5.1.4	-	●		
Duct Insulation	5.3.4	-	●	●	
Electric Chiller	4.4.6	-	●		
Furnace	5.3.7 & 5.3.5	-	●		
LED Bulbs and Fixtures	4.5.4	-	●	●	
LED Downlights	5.5.6		●	●	
LED Omnidirectional Bulbs	5.5.8		●		
LED Exit Sign	4.5.5 & 5.5.7	-	●		
Low Flow Faucet Aerator	5.4.4	-	●	●	
Low Flow Showerhead	5.4.5	-	●		
Occupancy Sensor	4.5.10	-	●		
Pipe Insulation	4.4.14 & 5.4.1	-	●		
Programmable Thermostat	5.3.11	-	●		
Refrigerator	5.1.6	-	●		
Room AC	5.1.7	-	●		
Smart Pump	N/A.	Engineering Review			●
Storage Water Heater	4.3.1	-	●		
T5 Fixtures and Lamps	4.5.12	-	●		
T8 Fixtures and Lamps ¹	4.5.3	-	●	●	●
VSD Hot Water Pump	4.4.17	-	●		
Wall Insulation	5.6.4	-	●		
Water Heater – Gas	5.4.2	-	●	●	
Window	N/A.	Engineering Review			●

2.2 Results of Net Savings Evaluation

This section presents the results of the impact evaluation for the Residential Retrofit Program during the period of June 2014 through May 2015.

2.2.1 Program-Level Savings Results

This subsection presents the gross and net savings for the Residential Retrofit Program. A net-to-gross factor of 100% was used because the Residential Retrofit Program targets low income residents.

The gross and net ex post kWh and kW savings for the Residential Retrofit Program during the period June 2014 through May 2015 are summarized by program component in Table 2-2 and Table 2-4, by utility in Table 2-3 and Table 2-5. Gross and net ex post kWh savings are summarized by measure for the Weatherization component in Table 2-6 for the Program Grantees component in Table 2-7, and for the Energy Savers Multifamily component in Table 2-8. Net ex post electricity savings energy savings total 8,576,838 kWh and net peak demand reductions total 2,955.06 kW for the period.

Table 2-2 Summary of Gross and Net Ex Post kWh Savings by Program Component

Program Component	Utility	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated		Net-to-Gross Ratio
		Gross Ex Post kWh Savings	Net Ex Post kWh Savings	Gross Ex Post kWh Savings	Net Ex Post kWh Savings	Gross Ex Post kWh Savings	Net Ex Post kWh Savings	
Weatherization	Ameren	2,417,676	2,417,676	2,417,676	2,417,676	2,417,676	2,417,676	100%
	ComEd	2,494,151	2,494,151	2,494,151	2,494,151	2,494,151	2,494,151	100%
	Subtotal	4,911,828	4,911,828	4,911,828	4,911,828	4,911,828	4,911,828	100%
Program Grantees	Ameren	20,631	20,631	20,631	20,631	20,631	20,631	100%
	ComEd	545,961	545,961	563,707	563,707	585,255	585,255	100%
	Subtotal	566,592	566,592	584,338	584,338	605,886	605,886	100%
Energy Savers Multifamily	Ameren	913,687	913,687	935,221	935,221	1,000,742	1,000,742	100%
	ComEd	1,891,376	1,891,376	1,964,142	1,964,142	2,058,382	2,058,382	100%
	Subtotal	2,805,063	2,805,063	2,899,363	2,899,363	3,059,124	3,059,124	100%
Total		8,283,483	8,283,483	8,395,529	8,395,529	8,576,838	8,576,838	100%

¹ ADM submitted an item into VEIC's TRM Deviation Tracker on December 17, 2015, regarding calculating energy savings for T8 fixtures and lamps in single family space types; in cases like these the calculation methodology found in chapter 4.5.3 of the Illinois Statewide TRM was used, but inputs from chapter 5.5.1 were used to properly account for the single family space type.

Table 2-3 Summary of Net Ex Post kWh Savings by Utility

<i>Gas Utility</i>	<i>Net Ex Post kWh Savings*</i>
Ameren	3,439,050
ComEd	5,137,788
Total	8,576,838

**To avoid duplication, gross savings are not presented because they are equal to net savings.*

Table 2-4 Summary of Gross and Net Ex Post Peak kW Reductions by Program Component

<i>Program Component</i>	<i>Utility</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
		<i>Gross Ex Post Peak kW Reductions</i>	<i>Net Ex Post Peak kW Reductions</i>	<i>Gross Ex Post Peak kW Reductions</i>	<i>Net Ex Post Peak kW Reductions</i>	<i>Gross Ex Post Peak kW Reductions</i>	<i>Net Ex Post Peak kW Reductions</i>	
Weatherization	Ameren	956.75	956.75	956.75	956.75	956.75	956.75	100%
	ComEd	1,376.61	1,376.61	1,376.61	1,376.61	1,376.61	1,376.61	100%
	Subtotal	2,333.36	2,333.36	2,333.36	2,333.36	2,333.36	2,333.36	100%
Program Grantees	Ameren	7.62	7.62	7.62	7.62	7.62	7.62	100%
	ComEd	114.70	114.70	114.91	114.91	117.37	117.37	100%
	Subtotal	122.32	122.32	122.53	122.53	124.99	124.99	100%
Energy Savers Multifamily	Ameren	151.18	151.18	155.97	155.97	164.98	164.98	100%
	ComEd	312.01	312.01	319.07	319.07	331.72	331.72	100%
	Subtotal	463.19	463.19	475.04	475.04	496.71	496.71	100%
Total		2,918.87	2,918.87	2,930.94	2,930.94	2,955.06	2,955.06	100%

Table 2-5 Summary of Net Ex Post Peak kW Reductions by Utility

<i>Gas Utility</i>	<i>Net Ex Post Peak kW Reductions*</i>
Ameren	1,129.36
ComEd	1,825.70
Total	2,955.06

**To avoid duplication, gross savings are not presented because they are equal to net savings.*

Table 2-6 Summary of Gross and Net Ex Post kWh Savings by Measure for Weatherization

Measure	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated		Net-to-Gross Ratio
	Gross Ex Post KWh Savings	Net Ex Post KWh Savings	Gross Ex Post KWh Savings	Net Ex Post KWh Savings	Gross Ex Post KWh Savings	Net Ex Post KWh Savings	
Air Sealing	2,646,573	2,646,573	2,646,573	2,646,573	2,646,573	2,646,573	100%
Air Source Heat Pump	133,837	133,837	133,837	133,837	133,837	133,837	100%
Attic Insulation	828,823	828,823	828,823	828,823	828,823	828,823	100%
Central AC w/ PT	43,554	43,554	43,554	43,554	43,554	43,554	100%
CFLs	279,306	279,306	279,306	279,306	279,306	279,306	100%
Furnace	437,347	437,347	437,347	437,347	437,347	437,347	100%
Refrigerator	446,334	446,334	446,334	446,334	446,334	446,334	100%
Room AC	1,782	1,782	1,782	1,782	1,782	1,782	100%
Wall Insulation	94,271	94,271	94,271	94,271	94,271	94,271	100%
Total	4,911,828	4,911,828	4,911,828	4,911,828	4,911,828	4,911,828	100%

Table 2-7 Summary of Gross and Net Ex Post kWh Savings by Measure for Program Grantees

Measure	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated		Net-to-Gross Ratio
	Gross Ex Post KWh Savings	Net Ex Post KWh Savings	Gross Ex Post KWh Savings	Net Ex Post KWh Savings	Gross Ex Post KWh Savings	Net Ex Post KWh Savings	
Air Sealing	45,416	45,416	45,416	45,416	45,416	45,416	100%
Attic Insulation	18,785	18,785	18,785	18,785	18,785	18,785	100%
Bathroom Exhaust Fan	2,126	2,126	2,126	2,126	2,126	2,126	100%
Ceiling Fan	415	415	415	415	415	415	100%
Central AC w/ PT	19,263	19,263	19,263	19,263	19,263	19,263	100%
CFLs	20,172	20,172	20,172	20,172	20,172	20,172	100%
Dishwasher	16	16	16	16	16	16	100%
Furnace	14,963	14,963	14,963	14,963	14,963	14,963	100%
LED Bulbs and Fixtures	179,433	179,433	197,179	197,179	197,179	197,179	100%
LED Downlights	2,491	2,491	2,491	2,491	2,491	2,491	100%
LED Omnidirectional Bulbs	37,266	37,266	37,266	37,266	37,266	37,266	100%
LED Exit Sign	2,858	2,858	2,858	2,858	2,858	2,858	100%
Refrigerator	135,043	135,043	135,043	135,043	135,043	135,043	100%
Room AC	13,369	13,369	13,369	13,369	13,369	13,369	100%
Smart Pump	0	0	0	0	21,548	21,548	100%
T8 Fixtures and Lamps	66,144	66,144	66,144	66,144	66,144	66,144	100%
Wall Insulation	8,833	8,833	8,833	8,833	8,833	8,833	100%
Total	566,592	566,592	584,338	584,338	605,886	605,886	100%

Table 2-8 Summary of Gross and Net Ex Post kWh Savings by Measure for Energy Savers Multifamily

<i>Measure</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
	<i>Gross Ex Post KWh Savings</i>	<i>Net Ex Post KWh Savings</i>	<i>Gross Ex Post KWh Savings</i>	<i>Net Ex Post KWh Savings</i>	<i>Gross Ex Post KWh Savings</i>	<i>Net Ex Post KWh Savings</i>	
Air Sealing	22,105	22,105	22,105	22,105	22,105	22,105	100%
Attic Insulation	168,716	168,716	168,716	168,716	168,716	168,716	100%
Bathroom Exhaust Fan	8,858	8,858	8,858	8,858	8,858	8,858	100%
Central AC w/ PT	51,022	51,022	51,022	51,022	51,022	51,022	100%
CFLs	427,445	427,445	427,445	427,445	427,445	427,445	100%
Dishwasher	364	364	364	364	364	364	100%
Duct Insulation	6,365	6,365	8,202	8,202	8,202	8,202	100%
Electric Chiller	26,335	26,335	26,335	26,335	26,335	26,335	100%
Furnace	48,958	48,958	48,958	48,958	48,958	48,958	100%
LED Bulbs and Fixtures	859,416	859,416	944,414	944,414	1,091,089	1,091,089	100%
LED Downlights	47,199	47,199	47,199	47,199	47,199	47,199	100%
LED Omnidirectional Bulbs	245,307	245,307	245,307	245,307	245,307	245,307	100%
LED Exit Sign	193,058	193,058	200,524	200,524	200,524	200,524	100%
Occupancy Sensor	69,792	69,792	69,792	69,792	69,792	69,792	100%
Programmable Thermostat	25,337	25,337	25,337	25,337	25,337	25,337	100%
Refrigerator	372,635	372,635	372,635	372,635	372,635	372,635	100%
Room AC	30,581	30,581	30,581	30,581	30,581	30,581	100%
T5 Fixtures and Lamps	14,862	14,862	14,862	14,862	14,862	14,862	100%
T8 Fixtures and Lamps	138,507	138,507	138,507	138,507	138,507	138,507	100%
VSD Hot Water Pump	33,478	33,478	33,478	33,478	33,478	33,478	100%
Wall Insulation	14,724	14,724	14,724	14,724	14,724	14,724	100%
Window	0	0	0	0	13,086	13,086	100%
Total	2,805,063	2,805,063	2,899,363	2,899,363	3,059,124	3,059,124	100%

The gross and net ex post natural gas savings of the Residential Retrofit Program during the period June 2014 through May 2015 are summarized by program component in Table 2-9 by utility in Table 2-10. Gross and net ex post kWh savings are summarized by measure for the Weatherization component in Table 2-11, for the Program Grantees component in Table 2-12, and for the Energy Savers Multifamily component in Table 2-13. Net ex post natural gas savings total 1,052,203 therms for the period.

Table 2-9 Summary of Gross and Net Ex Post Therm Savings by Program Component

Program Component	Utility	TRM-Calculated		TRM-Calculated (Errata Corrected)		ADM-Calculated		Net-to-Gross Ratio
		Gross Ex Post Therm Savings	Net Ex Post Therm Savings	Gross Ex Post Therm Savings	Net Ex Post Therm Savings	Gross Ex Post Therm Savings	Net Ex Post Therm Savings	
Weatherization	Ameren	204,835	204,835	204,835	204,835	204,835	204,835	100%
	Nicor	258,409	258,409	258,409	258,409	258,409	258,409	100%
	North Shore	35,537	35,537	35,537	35,537	35,537	35,537	100%
	Peoples	205,505	205,505	205,505	205,505	205,505	205,505	100%
	Subtotal	704,286	704,286	704,286	704,286	704,286	704,286	100%
Program Grantees	Ameren	8,269	8,269	8,269	8,269	8,269	8,269	100%
	Peoples	52,526	52,526	52,603	52,603	52,603	52,603	100%
	Subtotal	60,795	60,795	60,872	60,872	60,872	60,872	100%
Energy Savers Multifamily	Ameren	29,204	29,204	30,358	30,358	37,193	37,193	100%
	Nicor	58,270	58,270	59,399	59,399	66,467	66,467	100%
	North Shore	791	791	791	791	791	791	100%
	Peoples	134,854	134,854	134,961	134,961	182,593	182,593	100%
	Subtotal	223,118	223,118	225,509	225,509	287,045	287,045	100%
Total		988,198	988,198	990,667	990,667	1,052,203	1,052,203	100%

Table 2-10 Summary of Net Natural Gas Savings by Utility

Gas Utility	Net Ex Post Therm Savings*
Ameren	250,297
Nicor	324,876
North Shore	36,328
Peoples	440,701
Total	1,052,203

*To avoid duplication, gross savings are not presented because they are equal to net savings.

Table 2-11 Summary of Gross and Net Ex Post Therm Savings by Measure for Weatherization

<i>Measure</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	
Air Sealing	375,878	375,878	375,878	375,878	375,878	375,878	100%
Attic Insulation	168,487	168,487	168,487	168,487	168,487	168,487	100%
Furnace	143,342	143,342	143,342	143,342	143,342	143,342	100%
Wall Insulation	16,578	16,578	16,578	16,578	16,578	16,578	100%
Total	704,286	704,286	704,286	704,286	704,286	704,286	100%

Table 2-12 Summary of Gross and Net Ex Post Therm Savings by Measure for Program Grantees

<i>Measure</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	<i>Gross Ex Post Therm Savings</i>	<i>Net Ex Post Therm Savings</i>	
Air Sealing	28,126	28,126	28,126	28,126	28,126	28,126	100%
Attic Insulation	15,551	15,551	15,551	15,551	15,551	15,551	100%
Dishwasher	1	1	1	1	1	1	100%
Furnace	9,815	9,815	9,815	9,815	9,815	9,815	100%
Wall Insulation	7,074	7,074	7,074	7,074	7,074	7,074	100%
Water Heater – Gas	227	227	305	305	305	305	100%
Total	60,795	60,795	60,872	60,872	60,872	60,872	100%

Table 2-13 Summary of Gross and Net Ex Post Therm Savings by Measure for Energy Savers Multifamily

<i>Measure</i>	<i>TRM-Calculated</i>		<i>TRM-Calculated (Errata Corrected)</i>		<i>ADM-Calculated</i>		<i>Net-to-Gross Ratio</i>
	<i>Gross Ex Post kWh Savings</i>	<i>Net Ex Post kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Net Ex Post kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Net Ex Post kWh Savings</i>	
Air Sealing	7,924	7,924	7,924	7,924	7,924	7,924	100%
Attic Insulation	59,392	59,392	59,392	59,392	59,392	59,392	100%
Boiler - Commercial Boiler Lockout/Reset Controls	68,620	68,620	68,620	68,620	68,620	68,620	100%
Dishwasher	135	135	135	135	31,973	31,973	100%
Duct Insulation	17	17	17	17	17	17	100%
Furnace	842	842	1,997	1,997	1,997	1,997	100%
Furnace	49,443	49,443	49,443	49,443	49,443	49,443	100%
Low Flow Faucet Aerator	796	796	796	796	796	796	100%
Low Flow Showerhead	2,152	2,152	2,152	2,152	2,152	2,152	100%
Pipe Insulation	18,684	18,684	18,684	18,684	18,684	18,684	100%
Programmable Thermostat	6,321	6,321	6,321	6,321	6,321	6,321	100%
Storage Water Heater	357	357	357	357	357	357	100%
Wall Insulation	5,251	5,251	5,251	5,251	5,251	5,251	100%
Water Heater – Gas	3,184	3,184	4,421	4,421	4,421	4,421	100%
Window	0	0	0	0	29,698	29,698	100%
Total	223,118	223,118	225,509	225,509	287,045	287,045	100%

3. Process Evaluation

This chapter presents the results of the process evaluation for the Department of Commerce Low Income Residential Retrofit Program. Because the program did not change in its design or operations during the program year, a limited process evaluation was performed.

The most significant change made to the program was the addition of the Energy Savers program component operated by Elevate Energy. Although Energy Savers is now a separate program component, Elevate Energy's delivery of program services and retrofits are largely consistent with their operations in prior years.

3.1 Methodology for Process Evaluation

The purpose of this process evaluation is to examine program operations and results, and to identify potential program improvements that may prospectively increase program efficiency or effectiveness in terms of levels of participation and program satisfaction.

Key research questions to be addressed by this evaluation of EPY7/GPY4:

- What were the primary changes that occurred during EPY7/GPY4?
- Are there any planned changes for EPY8/GPY5?
- What were the program's greatest successes and challenges?

The primary evaluation activities completed for the program evaluation effort were as follows:

- **Analysis of Program Activity:** Program savings were analyzed by measure type, building type, and in relation to grant dollars awarded. The data used for the analysis was compiled from tracking data supplied for the weatherization component, workbooks submitted by program grantees, and information culled from program documentation.
- **Review of Program Documentation:** ADM completed a review of program documentation supplied by program staff. This documentation included applications submitted by grantees and signed grant agreements.
- **Literature Review:** A review of the literature on best practices for low income energy efficiency programs was performed. This review was performed to inform future program design and implementation considerations. The literature reviewed included papers published by the American Council for an Energy-Efficient Economy (ACEEE), papers of the International Energy Program Evaluation Conference (IEPEC) proceedings, publications of other groups such as Energy Efficiency For All and the Applied Public Policy Research Institute for Study and Evaluation (APPRISE), and publically available evaluation reports of programs that provide incentives for energy efficiency improvements to low-income housing.

3.2 Summary of Findings and Recommendations

The following are the primary conclusions from the analysis of the program process.

- The program guidelines and grant agreements do not currently have provisions for collecting and providing utility billing information to the Evaluator. This information is necessary to evaluate some custom measures.
- ADM verification efforts determined that a limited number of major rehabilitation projects were completed through the program.
- Small shares of program savings were generated through certain low cost measures, such as low-flow devices. Additionally, some projects were largely comprised of measures with high full-replacement costs that result in relatively smaller savings.

ADM offers the following recommendations for the improvement of the Residential Retrofit Program.

- Modify program guidelines to require grantees to provide energy consumption data to Residential Retrofit Program staff and the evaluator when custom, non-TRM measures are installed.
- Staff should consider whether or not major rehabilitation projects should be directed to the Affordable Housing Construction Program. At a minimum, project data should indicate whether or not the project scope was significant enough to require compliance with the building energy code, as this affects what baseline is used for estimating project savings.
- Consider strategies to encourage grantees to implement energy saving measures that have low costs relative to the associated energy savings such as lighting retrofits and low-flow devices.

3.3 Detailed Findings

3.3.1 Program Description

The Residential Retrofit Program offers grants to state agencies, local governments, and other non-profit entities that administer low-income home improvements. The objective of the program is to provide comprehensive retrofits of low income housing to reduce electricity and natural gas consumption. Similar to previous program years, intra-agency grants were awarded to the Illinois Weatherization Assistance Program. Additionally, nineteen grants were awarded to eight external applicants.²

The program provides prescriptive incentives for a variety of measures including ENERGY STAR[®] appliances, compact fluorescent lamps, and energy efficient heating and cooling equipment. The prescriptive measures remained largely unchanged for EPY7/GPY4 with two exceptions: prescriptive incentives for clothes washers and reflective roof coatings were dropped. Applicants may also propose additional measures to be approved by program staff.

² Grantees may receive multiple grants because grants are based on the utilities providing service to the location. For example, a single project may be funded for electric measures through a ComEd grant and funded for natural gas measures through a Nicor Gas grant.

Table 3-1 displays the incentive amounts for the measures included in the program. The incentive amounts listed are the maximum funds available for the measures. The amount of the incentive cannot exceed the total installed cost of the measures. Total grant funds cannot exceed \$750,000 except for applicants proposing statewide multifamily programs that may receive grants up to \$2,000,000. However, the Department of Commerce Director reserves the right to waive funding limitations and other program parameters.

Table 3-1 Measure Incentive Levels

<i>Energy Saving Measure</i>	<i>Maximum Amount</i>
ENERGY STAR rated refrigerator	\$700
ENERGY STAR rated fluorescent light fixtures	\$95/fixture
CFL Installation	\$5/lamp
ENERGY STAR rated bathroom exhaust fan	\$450
ENERGY STAR rated dishwasher	\$550
SEER 14.5 central air conditioner w/ programmable thermostat	\$3,100
ENERGY STAR rated ceiling fan	\$250
ENERGY STAR rated room air conditioner (per window AC unit)	\$400
ENERGY STAR rated heat pump	\$2,500
Replace existing PSC motor with electronically commutated motor or equivalent advanced air handler	\$600
Attic insulation and bypass air sealing	\$1,200
Wall insulation	\$1,300
Air leakage reduction of 30% with blower door guided sealing work	\$400
New electric water heater (minimum EFF 0.93), if all electric	\$600
ENERGY STAR rated natural gas water heater	\$600
High efficiency furnace with 92% AFUE or greater with electronically commutated motor or equivalent advanced air handler	\$1,500
Boiler controls (for multifamily housing)	*
Steam system balancing (for multifamily housing)	*
Steam/hot water pipe insulation (for multifamily housing)	*

* Incentive amounts reviewed on a case-by-case basis.

The program has three components: Weatherization Assistance, Elevate Energy Multifamily Program, and Residential Retrofit External Grants.

3.3.1.1. Weatherization Assistance

The Weatherization Assistance (Weatherization) program is administered through the Department of Commerce Office of Energy Assistance. EEPS funds are provided in the form of intra-agency grants awarded to the Office of Energy Assistance. These funds are pooled with federal funding to deliver efficiency improvements in single and multifamily homes. The grant agreements

stipulate the prescriptive measure incentives provided (as shown in Table 3-1). Funding is for use in residences located in a participating utility service territory.

Program services are delivered through a network of local community action agencies. Services are only provided to homes that meet the 200% of the federal poverty level standard. Multifamily properties are qualified either by being included on HUD or USDA lists or through building owner/landlord provided documentation on resident income and demographics. Multifamily buildings not qualified through the above means may be qualified if the Local Action Agency completes the program standard application process for each tenant of the property.

Energy assessments are performed for single family and manufactured homes through using the WeatherWorks system developed by the state. This software calculates savings-to-investment ratios (SIR) for measures identified during the assessment. For multifamily properties, energy assessments are performed using the Targeted Residential Energy Analysis Tools (TREAT) software. This software also provides SIRs to justify the expenditures of weatherization funds.

All sites that receive services through the program receive a final inspection of the work completed.

3.3.1.1. Elevate Energy Multifamily Program

Elevate Energy implements the Multifamily Program that receives grants through the Residential Retrofit Program. The program is designed to provide one-stop services to building owners to implement energy efficiency measures in multifamily buildings with rents that are affordable for households with less than 80% of the area Average Median Income (AMI).

The program provides a variety of services to building owners as described below:

- Energy audits of multifamily buildings including blower door testing as appropriate;
- Develop project financing packages that combine measure incentives and loans to finance projects. Staff provides additional support for buildings that are bond financed that include property tax benefits and energy tax credits.
- Assist with the selection of Elevate Energy approved contractors for the project. Approved contractors are required to hold liability insurance and pass a background investigation.
- Provide energy education as program outreach and training on measures installed and building operations.
- Provide construction oversight and provide ongoing monitoring of buildings energy use through data collected through agreements with utilities.

The above services are funded through the Residential Retrofit Program with grants that are based on energy savings. The performance based incentives are summarized in Table 3-2.

Table 3-2 Performance Based Incentives

<i>Fuel Type</i>	<i><10,000 therms / < 25,000 kWh</i>	<i>>10,000 therms / > 25,000 kWh</i>
Natural Gas (per therm)	\$1.30	\$0.90
Electricity (per kWh)	\$0.25	\$0.20

In addition to these rates, the program provides incentives for measure installation. The rates are summarized in Table 3-3 and are largely consistent with the prescriptive incentives provided to other program grantees.

Table 3-3 Prescriptive Incentives

<i>Energy Saving Measure</i>	<i>Maximum Amount</i>
ENERGY STAR rated refrigerator	\$700
ENERGY STAR rated fluorescent light fixtures	\$95/fixture
CFL Installation	\$5/lamp
ENERGY STAR rated bathroom exhaust fan	\$450
ENERGY STAR rated dishwasher	\$550
SEER 14.5 central air conditioner w/ programmable thermostat	\$3,100
ENERGY STAR rated ceiling fan	\$250
ENERGY STAR rated room air conditioner (per window AC unit)	\$400
ENERGY STAR rated heat pump	\$2,500
Replace existing PSC motor with electronically commutated motor or equivalent advanced air handler	\$600
Attic insulation and bypass air sealing	\$1,200
Wall insulation	\$1,300
Air leakage reduction of 30% with blower door guided sealing work	\$400
Boiler controls (for multifamily housing)	\$5,000
Steam system balancing (for multifamily housing)	\$3,000
Steam/hot water pipe insulation (for multifamily housing)	\$16.00 / linear foot

Elevate Energy uses the performance based incentives to encourage building owners to implement energy efficiency measures. Through provision of energy assessments, assistance developing project financing, and project management support, the program is often able to encourage building owners to implement energy efficiency measures. In cases where additional financial assistance is needed, Elevate Energy provides the prescriptive incentives provided through the Residential Retrofit Program.

3.3.1.2. Program Grantees

During EPY7/GPY4, program grants were provided based on the prescriptive measure incentives to the following additional seven organizations:

- Affordable Housing Continuum
- Black United Fund
- City of Springfield
- Hispanic Housing Development Corp.
- Historic Chicago Bungalow Association
- Residential Options Inc.
- Victor C. Neumann Association

The grantee organizations have varying social and economic objectives, but are generally focused on improving housing conditions for low-income residents. Some grantees have a specific focus on energy efficiency as part of their mission, while others include efficiency as part of improving affordability and living conditions.

Proposed projects must be targeted at households at or below 80% of the area Average Median Income (AMI). All grantees are reimbursed for implementation of measures installed based on the prescriptive incentives.

3.3.2 Program Activity

This section summarizes findings from the analysis of program data.

3.3.2.1. Share of Savings by Measure Type

Table 3-4 displays the share of electricity savings by measure type. As shown, building envelope improvements, LED lighting, and appliances, accounted for nearly three-quarters of program electricity savings.

Table 3-4 Share of Net Ex Post kWh Savings by Measure Type

<i>Measure</i>	<i>Share of kWh Savings</i>
Building Envelope	45%
LED Lighting	19%
Appliances	11%
HVAC	9%
CFLs	8%
Linear Fluorescent	3%
Lighting Controls	1%
Room AC	1%
Duct Sealing	<1%
Programmable Thermostat	<1%
Other	3%

Table 3-5 displays the share of natural gas savings by measure type. Building envelope and HVAC replacements accounted for nearly all of the program’s natural gas savings. Measures that have relatively low cost in relation to the energy savings they generate, namely low-flow devices and duct sealing, accounted for a small share of program savings.

Table 3-5 Share of Net Ex Post Therm Savings by Measure Type

<i>Measure</i>	<i>Share of Therm Savings</i>
Building Envelope	68%
HVAC	29%
Pipe Insulation	2%
Programmable Thermostat	1%
Water Heater	<1%
Low Flow Device	<1%
Appliances	<1%
Duct Sealing	<1%

As shown in Table 3-6, the projects completed by program grantees varied considerably from in terms of the energy saving measures implemented. For example, Grantee 7 83% of energy savings were the result of the installation of efficient appliances, where as 86% of savings for Grantee 4 was the result of LED retrofits. Nearly all of the electricity savings from the project implemented by Grantee 6 came from HVAC replacements. The project implemented by Grantee 2 was the most comprehensive in terms of the types of measures implemented. Building envelope improvements, lighting, appliances and HVAC replacements were each a component of this project.

A diverse set of measures were also implemented through the Energy Savers and Weatherization components.

Table 3-6 Measure Share of Net Ex Post kWh Savings by Program Component and Grantee

Measure Type	Program Grantees						Energy Savers Multifamily	Weatherization
	Grantee 1	Grantee 2	Grantee 4	Grantee 5	Grantee 6	Grantee 7		
Appliances	56%	17%	0%	27%	<1%	82%	12%	9%
Building Envelope	0%	26%	0%	72%	0%	0%	7%	73%
CFLs	8%	16%	0%	0%	0%	0%	14%	6%
Duct Sealing	0%	0%	0%	0%	0%	0%	<1%	0%
HVAC	0%	30%	0%	0%	100%	0%	<1%	13%
LED Lighting	0%	<1%	86%	0%	0%	0%	45%	0%
Lighting Controls	0%	0%	0%	0%	0%	0%	<1%	0%
Linear Fluorescent Programmable	30%	<1%	<1%	0%	0%	0%	5%	0%
Thermostat	0%	0%	0%	0%	0%	0%	<1%	0%
Room AC	6%	<1%	0%	<1%	0%	18%	<1%	<1%
Other	0%	6%	9%	0%	0%	0%	8%	0%

As with the program overall, natural gas savings for the individual projects were largely the result of building envelope improvements and HVAC replacements (see Table 3-7).

Table 3-7 Measure Share of Net Ex Post Therm Savings by Program Component and Grantee

Measure Type	Program Grantees				Energy Savers Multifamily	Weatherization
	Grantee 2	Grantee 3	Grantee 5	Grantee 6		
Appliances	<1%	0%	0%	<1%	<1%	0%
Building Envelope	66%	77%	100%	0%	36%	80%
Duct Sealing	0%	0%	0%	0%	<1%	0%
HVAC	31%	23%	0%	100%	52%	20%
Low Flow Device	0%	0%	0%	0%	<1%	0%
Pipe Insulation	0%	0%	0%	0%	7%	0%
Programmable Thermostat	0%	0%	0%	0%	<1%	0%
Water Heater	<1%	0%	0%	0%	<1%	0%

The analysis of measures energy savings suggests that there may be additional opportunities for the program to encourage the adoption of measures that result in large energy savings relative to their cost. For the program overall, the electricity savings were the result of a diverse set of measures with varying implementation costs. However, the electricity savings for several of the projects implemented by individual grantees were the result of measures that have relatively high full-replacement costs relative to the savings they produce (e.g., appliance and HVAC measures). Natural gas savings were largely the result of HVAC and building envelope improvements. Low-flow devices and duct sealing may represent additional low-cost energy saving opportunities.

3.3.2.2. Share of Savings by Housing Type

Figure 3-1 displays the share of participating locations and energy savings by building type. As shown, the majority of locations were single family homes. In terms of energy savings, multifamily

properties accounted for approximately one-half of the electricity savings and one-third of natural gas savings.

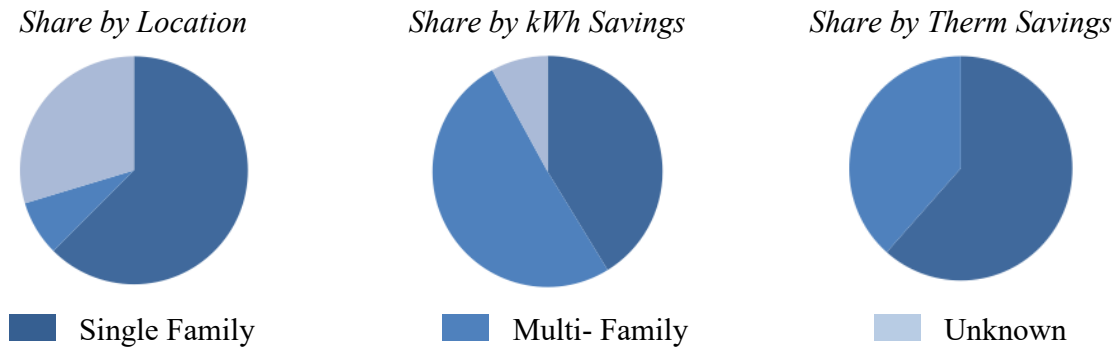


Figure 3-1 Share of Locations by Building Type

3.3.2.3. Comparison of Energy Savings and Grant Dollars

Table 3-8 and Table 3-9 display a comparison of ex post electricity and natural gas savings and grant dollars awarded for each program component. In comparison to the prior program year, the grant dollars per kWh and therm saved was lower and the differences between program components were smaller.

Table 3-8 Comparison of Grant Dollars and Net Ex Post kWh Savings by Program Component

<i>Program Component</i>	<i>Net Ex Post kWh</i>	<i>Electric Grant Amount</i>	<i>Dollars per Net Ex Post kWh Saved</i>
Weatherization	4,911,828	3,215,000	\$0.65
Program Grantees	605,886	987,497	\$1.63
Energy Savers Multifamily	3,059,124	2,000,000	\$0.65
Total	8,576,838	6,202,497	\$0.72

Table 3-9 Comparison of Grant Dollars by Net Ex Post Therm Savings

<i>Program Component</i>	<i>Net Ex Post Therms</i>	<i>Electric Grant Amount</i>	<i>Dollars per Net Ex Post Therms Saved</i>
Weatherization	704,286	1,285,000	\$1.82
Program Grantees	60,872	211,582	\$3.48
Energy Savers Multifamily	287,045	750,000	\$2.61
Total	1,052,203	2,246,582	\$2.14

3.3.3 Program Operations Perspective

Discussions with program staff held throughout the program year informed the following discussion of program changes during the program year.

3.3.3.1. EPY7/GPY4 Program Changes

During the program year, staff reviewed the current program guidelines and revised incentive levels to make them more commiserate with expected energy savings and incremental costs. These changes will be in effect when funding is approved for the EPY8/GPY5 program year.

One of the grantees that worked with the program in prior years, Elevate Energy, received a larger grant in EPY7/GPY4 to make energy efficiency improvements in multifamily housing. Elevate Energy has programs in place that provide a comprehensive set of services to multifamily properties to help them reduce their energy use.

3.3.4 Literature Review of Low-Income Program Best Practices

This section presents a review of literature pertaining to best practices in the design and delivery of energy efficiency programs targeting low-income customers. The purpose of the review is to provide perspective on low-income program design and procedures to inform future development of the residential retrofit program.

The literature reviewed included papers published by the American Council for an Energy-Efficient Economy (ACEEE), papers of the International Energy Program Evaluation Conference (IEPEC) proceedings, publications of other groups such as Energy Efficiency For All and the Applied Public Policy Research Institute for Study and Evaluation (APPRISE), and publically available evaluation reports of programs that provide incentives for energy efficiency improvements to low-income housing.

Low income residents may reside in single-family, multifamily, or manufactured housing. Most energy efficiency incentive programs target single family and multifamily housing. Relatively few programs target manufactured housing specifically, although manufactured homes are often eligible for incentives through programs targeting other housing types (Talbot, 2012). As such, the practices described below are generally applicable for manufactured retrofits as well.

The review of best practices is presented in four sections. Practices that are applicable to both program types are discussed in the first section. This section is followed by a discussion of practices for programs targeting single family homes followed by multifamily program practices. The final section reviews practices for low-energy efficiency kit programs.

3.3.4.1. Practices Common to All Program Types

All programs require basic processes such as quality assurance, verification, and data collection and monitoring. The following represent the best practices for efficiently and effectively delivering low-income energy efficiency programs.

- **Use paperless processes to the extent practicable.** Reduction of paper forms can improve the efficiency of administration processes and reduce data entry errors. Field data can be collected through tablet computers to record building and customer characteristics, assess energy savings, develop recommended measure lists, and record measure installations. Data validation elements can improve the quality of the data collected, however, electronically collected data need to be reviewed periodically for quality.
- **Collect and monitor data in real-time.** Real-time data collection and monitoring can enable the program to track program progress towards energy savings goals and monitor cost-effectiveness at the program, participant, and measure level (Reeves, Drakos, and Khawaja, 2013).
- **Conduct verification visits that verify measure installations, seek to identify opportunities missed, and assess customer satisfaction.** Depending on the project type and number of program projects, a sub-sample of sites may be selected for verification visits. In addition to confirming appropriate measure installation, site visits create an opportunity for program representatives to assess if any energy saving opportunities were missed and to assess customers' experience with the program. This information can be used for ongoing program development.
- **Provide training and education to contractors and other providers and monitor performance.** Training is needed to ensure that program providers understand program procedures and guidelines. Use the information collected on performance to further train program providers and to discontinue their participation as needed.
- **Incorporate product specifications into program guidelines.** Incorporation of product standards can help to ensure that measures funded by the program meet efficiency standards and product quality standards.
- **Develop detailed procedure manuals and other program documentation to coordinate and ensure consistent program delivery.** Several low income program models deliver services through multiple program partners. Developing detailed procedure manuals and other documentation can help to create a common understanding of program requirements and operating procedures.

3.3.4.2. Single-Family Comprehensive Program Practices

Comprehensive low-income programs provide measures for a variety of end-uses. These programs typically utilize an energy assessment to identify energy saving measures, may include low-cost direct install measures, and often screen measures or projects for cost effectiveness.

3.3.4.2.1. Targeting Participants

Choices about targeting program participants involve determining what low-income standard will be used and to which sub-groups of the low income residents the program will targeted.

- **Programs typically target households that or below 150% to 225% of the federal poverty level.** However other standards referencing state median income are also in practice (APPRISE and Fisher, Sheehan, and Colton, 2007). For example, Entergy Louisiana uses the Low Income Home Energy Assistance (LIHEAP) guideline of 60% of state median income to qualify participants.
- **Target based on energy usage to maximize savings potential.** Some programs target households that have high energy usage on the assumption that building envelope and equipment make it particularly inefficient and likely to generate the most savings. However, it should be noted that household energy usage is also a function of residents' behavior and choices unrelated to the equipment efficiency, such as thermostat settings, also affect home energy usage (APPRISE and Fisher, Sheehan, and Colton, 2007).
- **Target homes that participate in or are eligible for assistance through other programs.** The benefit of targeting homes that participate in affordability programs is that reduction in energy use saves funds used to offset energy costs (APPRISE and Fisher, Sheehan, and Colton, 2007). Additionally, targeting homes eligible for Department of Energy Weatherization Assistance Program and other available funding sources enables programs to leverage these funds to complete the retrofit project (Kushler, York, and Witte, 2005).

3.3.4.2.2. Identifying Measures

Comprehensive programs offer replacements for measures covering a variety of end-uses. However, this approach can limit cost effectiveness. Targeting specific measures can improve program cost effectiveness (Reeves, Drakos, and Khawaja, 2013).

- **Use analysis tools to select measures, or packages of measures, for which benefits exceed the cost.** A common approach in single family homes is it to use software that calculates metrics such as the savings-to-investment ratio (SIR) to evaluate whether or not to fund the installation of a measure (Kushler, York, and Witte, 2005).³ This approach allows programs to target measures with the greatest financial benefits and to efficiently use the available dollars.

³ The savings-to-investment ratio is the lifetime energy savings divided by the installation cost.

- **Incorporate diagnostic testing in the energy assessment.** Air infiltration and duct testing can identify whether or not relatively low cost measures to reduce leakage are appropriate for a site.
- **Prioritize measures for installations.** Provide guidance that some measures with greater energy savings relative to the cost need to be installed prior to implementing other measures. In conjunction with a cap on expenditures allowed per home, this approach can prioritize funding for higher payback measures.
- **Discuss home behaviors with residents to identify retrofits likely to have the greatest savings impact.** Discussions with residents can help identify measures likely to have the greatest impact by identifying household behaviors such as which lights get used most often. (Kushler, York, and Witte, 2005; Mapp and Smith, 2009).⁴
- **Install low-cost direct install measures during the home energy assessment.** Installing measures such as energy efficient light bulbs and low-flow faucet aerators provide the opportunity to quickly generate low-cost energy savings.
- **Bulk purchases of measures can reduce replacement costs.** Some programs have opted to purchase program measures in bulk in order to reduce the purchase cost (Mapp and Smith, 2009).

3.3.4.2.3. Financial Incentives

Programs targeting low-income residents typically cover the full cost of the measure installed or require residents to pay a small portion of the cost, such as 10% of the measure cost (Kushler, York, and Witte, 2005). Consequently, the measures typically include energy efficient lightbulbs, low-flow showerheads and faucet aerators, perimeter air sealing, duct sealing, ceiling insulation, water heater pipe wrap, water heater jackets, and refrigerator replacements. Less commonly provided measures include room air conditioning units, window replacements, and HVAC replacements. These measures are less frequently included because they generate lower savings relative to the full-replacement costs. However, replacements may remain cost effective under certain baseline considerations or when considered as a component of a package of measures.

3.3.4.2.4. Outreach and Delivery

Partnerships with other entities that have experience with providing services to low-income residents are considered a best practice for program delivery.

- **Partner with community organizations that are trusted by low income residents.** Many low-income programs partner with community action agencies because of their relationships

⁴ While useful in concept, measures for which savings are calculated using the Illinois TRM are unlikely to have their first year savings impacts impacted by specific resident usage patterns.

with low income residents who trust them to provide services (Kushler, York, and Witte, 2005).

- **Collaborate with social service agencies and private market providers to deliver program services.** Partnering with other entities can improve the efficiency and effectiveness of program delivery (Kushler, York, and Witte, 2005). Additionally, private contractors can promote the services with prospective customers.

3.3.4.3. Multifamily Program Practices

A different program design and implementation approach is needed to effectively target multifamily projects. Multifamily programs typically provide incentives to cover a portion of the cost of retrofits for common areas and living quarters. These programs are commonly bundled with other services that help building owners identify efficiency improvements and prioritize them, secure other sources of funding, develop bid specifications, and perform quality assurance throughout the retrofit process.

3.3.4.3.1. Targeting Buildings

Targeting multifamily housing can be challenging. In particular, split incentives, where the building owner or operator funds the cost of efficiency improvements, but the utility costs are either paid directly by residents or indirectly through the rent, is an often cited barrier to program participation (Hynek, Smith, and Levy, 2011; Rambo and Detham, 2013). However, the presence of split incentives is not universal, but varies by how the building is metered (master metered vs. individually metered units) and whether or not it is conditioned using a central system. As discussed below, differences in building condition, size, and metering can impact program decisions about which buildings to target.

- **Target large buildings with larger energy savings potential.** Resources spent on developing relationships with building ownership may be most efficiently utilized if large buildings with corresponding large energy savings potential are targeted. (Energy Efficiency For All, 2015).
- **Target mastered metered buildings or buildings with central plant heating to avoid split incentives.** Ownership costs are affected by utility expenditures in master metered buildings and buildings that provide heating through a central plant (Brown and Syring, 2012). As such, owners may be more interested in efficiency improvements.
- **Target buildings with high energy use intensity to maximize energy savings potential.** Program cost effectiveness may be best achieved by targeting high use buildings based on energy use intensity (Brown and Syring, 2012). Building age may be an effective proxy to identify buildings with the greatest energy savings potential.
- **US Department of Agriculture housing programs are another potential means of generating program participation.** Another recommended approach to reach low income housing in rural locations is to target developments that participate in the US Department of

Agriculture housing programs may also represent an opportunity to for energy savings (Energy Efficiency For All, 2015).

3.3.4.3.2. Identifying Measures

Similarly to practices identified for single family homes, programs targeting multifamily housing improvements should target energy saving opportunities that can be achieved at a relatively lower cost.

- **Provide energy assessments to identify energy saving opportunities at multifamily properties and to ensure that cost effective savings opportunities are not overlooked.** Energy assessments should clearly convey information about opportunities for energy efficiency improvements and discuss efficiency in terms of return-on-investment and cash-flow impacts (Brown and Syring, 2012).
- **Provide incentives for cost effective measures or packages of measures.** Screen measures for cost effectiveness (Kushler, York, and Witte, 2005). Measures that are cost effective at one site may not be cost effective at another depending on baseline and operating conditions.
- **Provide standard packages of measures that are common in multifamily housing.** There is sufficient commonality among multifamily properties to provide incentives for some measure types without needing an audit or reducing the scale of the audit (Mckibbin, 2013).

3.3.4.3.3. Financial Incentive Types

There are multiple types of financial incentives provided through programs that target low-income multifamily housing. These include:

- Prescriptive incentives for specific types of measures or packages of measures.
- Performance based incentives paid based on energy savings. In these cases, packages of energy saving measures are typically developed based on a whole-building analysis.
- No cost, direct install measures. Direct install measures typically include low cost measures such as compact fluorescent light bulbs, low-flow shower heads, and low-flow faucet aerators. Providing these low cost measures at no cost to the customer also effectively negates split incentive issues while delivering cost effective energy savings.
- On-bill financing and low-cost loans are other incentive strategies that can generate cost effective energy savings and mitigate first-cost barriers to energy efficiency.

Effective programs can integrate these various incentive options to target different types of projects and maximize program savings. For example, performance based incentives based on whole building assessments may be effective at maximizing for energy savings for a specific site, while prescriptive incentives for measures provide predictability to owners not interested in assessing building energy performance and are also readily available to offset the cost of replacing failed

equipment with energy efficient equipment. Similarly, direct install measures can be effectively combined with incentives provided for more extensive retrofits.

Another practice identified as effective for one program is a “gap funding” approach. Through the gap funding approach, building finances are evaluated to determine what share of a project can be paid by property owners, and to bridge the gap with utility incentives, as well as local, state, and federal dollars that may be available (Kushler, York, and Witte, 2005).

- **Providing a variety of incentive types would best address the variety of multifamily efficiency needs.** Incentives based on a whole-building analysis are most effective at generating comprehensive energy saving projects but require greater investment by the participant to complete. Prescriptive incentives for single-measures are most effective at targeting projects initiated by equipment failures. Prescriptive incentives for a package of measures may be most effective at generating reasonably comprehensive projects with less investment by the participant and also provide greater certainty in the expected incentive payment. No cost direct install measures may be most effective at generating savings where owners may not be responsible for utility costs or are reluctant to participate for other reasons.

3.3.4.3.4. Program Delivery and Outreach

There are two primary types of delivery models for energy efficiency programs targeting multifamily housing: the “one-stop shop model” and the trade ally model (McKibbin, 2013).

The one-stop shop model is designed to centralize program resources into one point of contact.⁵ In this model, a participant works with a single project manager that leads him or her through the entire process including the initial energy assessment, hiring of contractors, applying for rebates, providing assistance in securing additional financing, and quality assurance and final verification of the work performed. The one-stop shop model allows for flexibility in support provided to participants that is dependent on their specific needs. This model may also be particularly suited to smaller owners who may be in need of greater assistance, for delivery of comprehensive whole-building projects, and to sell customers on completing projects by providing services that simplify the process (Brown and Syring, 2012; McKibbin, 2013). The trade ally delivery model works with a group of contractors that specialize in delivering services to multifamily properties. In this delivery model, program staff work closely with contractors to ensure that they understand the program processes, available incentives, and provide training on proper implementation of measures with which they may be less familiar. In this model, the contractor plays a key role in outreach efforts to potential participants. The contractor model may be particularly well suited to capturing projects that result from failed equipment replacements and for programs that deliver prescriptive incentives.

⁵ One of the Residential Retrofit Program grantees, Elevate Energy, functions as a one-stop-service provider. Assisting the owners and managers that they work with in receiving incentive dollars through the Residential Retrofit Program is one of the services they provide.

One-stop-shop and trade ally delivery models can be integrated to provide a comprehensive set of program options to appeal to varying customer and project types. For example, the New York State Energy Research and Development Authority's (NYSERDA) Multifamily Performance Program provides both comprehensive retrofits and new construction incentives through a one-stop model as well as offering prescriptive incentives for smaller buildings (Peters, Messer, and Wirtshafter, 2014). The one-stop services are provided through a network of program partners that assist with the development of measures to implement; benchmarking, energy auditing, and energy modeling; developing an energy reduction plan; executing contract documents and invoices; and conducting onsite inspections. Buildings with 5-49 units can opt to receive prescriptive incentives without performing an energy assessment.

A number of approaches have been identified as effective outreach practices to effectively target low income affordable housing projects.

- **Segment the market to refine program design and outreach strategies.** The low income multifamily housing market is comprised of varying building types and ownership structures (Energy Efficiency for All, 2015). Affordable housing falls into three general categories, HUD-assisted public housing, Low Income Housing Tax Credits (LIHTC), and market rate housing that is affordable. These types of buildings may require different outreach strategies or services to effectively develop energy saving projects. For example, LIHTC subsidies can be provided as vouchers to the renter or as subsidies that accrue to the rental unit. Subsidies that accrue to the rental unit may limit the owner's ability to finance additional retrofits, and consequently, program staff should determine what constraints owners face in this regard (McKibbin, 2013). Additional segmentation factors include building size and mastered vs. individual metering. As previously noted, targeting larger buildings may result in more efficient generation of energy savings because of the savings potential, and whether units are individually metered or the building is mastered metered has implications for owners motivations for improving the buildings energy efficiency.
- **Build relationships with key market actors.** Program implementers should build relationship with key market actors to effectively cultivate trust and generate energy efficiency projects. For example, attending property owner association functions and affordable housing conferences are methods the program can use to familiarize building owners with program services. Additionally, it is important to build relationships with state housing financing agencies, community development financial institutions, and multifamily lenders. These relationships can be useful for identifying buildings undergoing renovations that will enable them to cost effectively integrate energy efficiency improvements into projects.
- **Target events that make energy efficiency improvement projects more feasible and less costly.** Buildings that are undergoing refinancing, changing ownership, or planning building wide renovation projects provide opportunities where owners have access to capital and tenant living spaces and as such represent an opportunity to complete energy efficiency improvements (Brown and Syring, 2012).

- **Develop relationships with equipment supply houses and property managers to identify contractors that can provide program services.** Supply houses and contractors trusted by owners may be effective means of developing a network of contractors that specialize in multifamily properties (Elevate Energy and ACEEE, 2014).
- **Use direct install measures to develop relationships with building owners and create awareness of incentives and program services.** Providing direct install measures provides the program a means of developing relationships with building owners and a means to demonstrate energy efficiency to owners and tenants. (McKibbins, 2013). It also creates greater awareness of incentives available for larger whole-building retrofits or for replacement of specific equipment that fails.
- **Use energy assessments or benchmarking services to gain access to multifamily properties and engage owners.** Low-cost technical services can be effective means of creating awareness of energy saving opportunities with building owners.
- **Use completed projects as case studies to demonstrate successes and benefits.** Multifamily building owners may find case studies of owners of similar buildings to be particularly effective at communicating program benefits (Quantum Consulting, Inc., 2004b).

3.3.4.4. Low-Income Energy Efficiency Kits

Energy efficiency kit programs that target low-income customers are a less commonly implemented program type that may present an opportunity to deliver relatively low-cost savings to customers. Although reports of best practices were not identified for this program type, the following suggestions are made based on prior evaluations of kits programs targeting low-income customers as well as programs available to all residential customers.

- **Kits typically include compact fluorescent lights (CFLs), low-flow faucet aerators, and shower-heads.** Low-cost technical services can be effective means of creating awareness of energy saving opportunities with building owners.
- **Kits can be delivered through direct mailings, workshops, or through direct installation.** Recruitment can be done through direct mail or telephone calls.
- **Combine kits with energy education. To maximize the effectiveness of the kit, combine with energy education.** Education can be delivered in-person, through workshops and other events, or through energy saving tip materials supplied with the kit contents. Messaging should connect energy usage to home finances (Reeves, Drakos, and Khawaja, 2013). Education materials may generate additional savings that may be quantified through a billing analysis.
- **Use kits to promote available energy efficiency incentives.** Kits can be a means to promote participation in other low-income programs.

- **Install rates typically vary by measure type.** A review of low-income kit programs found that install rates are typically lower for low-flow devices than for CFLs (Winch and Swedenburg, 2012).

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