

Evaluation of Energy Efficient Affordable Housing Construction Program

June 2012 through May 2013

Prepared for:
Illinois Department of Commerce Economic Opportunity

Prepared by:



ADM Associates, Inc.
3239 Ramos Circle
Sacramento, CA 95827
916.363.8383

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Contact:

Donald Dohrmann, Ph.D., Principal
775.825.7079
dohrmann@admenergy.com

Prepared by:

Steven Keates, P.E.
916.363.8383
steven@admenergy.com

Jeremy Offenstein, Ph.D.
916.363.8383
jeremy@admenergy.com

Matthew Jaoudi
510.371.0761
matthew@admenergy.com

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Executive Summary

This report presents the results of the impact and process evaluations of the Energy Efficient Affordable Housing Construction Program (Affordable Housing Construction Program) offered by the Illinois Department of Commerce and Economic Opportunity (DCEO). This report presents results for electric program year five and natural gas program year two (EPY5/GPY2), which is defined as the period June 2012 through May 2013.

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

- Data for the study were collected through review of program materials interviews with DCEO staff members and program participants.
- An engineering review was performed to verify gross savings of measures implemented under the program using the Illinois Statewide Technical Reference Manual (TRM) or other sources as appropriate.
- Interviews with program staff and participants informed the process evaluation.

The realized gross and net electric savings of the Affordable Housing Construction Program during the period June 2012 through May 2013 are summarized in Table ES-1. For EPY5/GPY2, realized annual gross electric savings total 3,049,817 kWh. The program gross realization rate for electric savings is 103%. The program net-to-gross ratio is 100% because the program targets low income residents. The realized net electric savings total 3,049,817 kWh annually.

Table ES-1 Summary of kWh Savings for Affordable Housing Construction Program

<i>Utility</i>	<i>Expected kWh Savings</i>	<i>Realized Gross kWh Savings</i>	<i>Gross Realization Rate</i>	<i>Realized Net kWh Savings</i>
Ameren	904,515	1,193,170	132%	1,193,170
ComEd	2,050,324	1,856,647	91%	1,856,647
Total	2,954,839	3,049,817	103%	3,049,817

**A net-to-gross ratio of 100% is applied because the Affordable Housing Construction Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.*

Natural gas savings are shown in Table ES-2. Gross realized natural gas savings total 80,482 therms annually. The gross realization rate is 71% for natural gas savings. Net therm savings total 80,482 annually.

Table ES-2 Summary of Therm Savings for Affordable Housing Construction Program

<i>Utility</i>	<i>Expected Therm Savings</i>	<i>Realized Gross Therm Savings</i>	<i>Gross Realization Rate</i>	<i>Realized Net Therm Savings</i>
Ameren	49,917	38,910	78%	38,910
Nicor	19,187	11,649	61%	11,649
North Shore	1,867	744	40%	744
Peoples	41,877	29,179	70%	29,179
Total	112,848	80,482	71%	80,482

**A net-to-gross ratio of 100% is applied because the Affordable Housing Construction Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.*

The realized gross and net peak kW reductions of the Affordable Housing Construction Program during the period June 2012 through May 2013 are summarized in Table ES-3. The achieved net peak demand savings are 465.76 kW.

Table ES-3 Summary of Peak kW Savings for Affordable Housing Construction Program

<i>Utility</i>	<i>Realized Gross kW Savings</i>	<i>Realized Net kW Savings</i>
Ameren	156.77	156.77
ComEd	308.99	308.99
Total	465.76	465.76

**A net-to-gross ratio of 100% is applied because the Affordable Housing Construction Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.*

The following presents a selection of key conclusions from EPY5/GPY2:

- **High Satisfaction with Program Offerings, but Room for Improving Communication and Support:** Overall, grant recipients were grateful for the Affordable Housing Construction Program and indicated that the program helped them overcome barriers to developing high performance low-income housing. The grant recipients indicated that the package of measures required by the program was adequate and did not suggest additional measures for inclusion. In addition, they noted that DCEO staff is flexible when it comes to approving custom measures. The DCEO consultant from Domus Plus was cited as an asset to the delivery of the program and participants valued his guidance.

However, grant recipients suggested that there was potential for better communication about the participation process. In particular, grant recipients noted a lack of clarity about the reporting requirements for the program and the grant timelines. The deficiencies in communication may stem from insufficient staff resources to administer the program, although improving the program documentation and other aspects of the infrastructure may compensate for the lack of staff resources. Additionally, these issues may be reduced as new staff members are fully trained and become acclimated to their roles.

- **DCEO Grant Dollars are Important to Project Financing Structures:** Interviews with program staff and participants indicated that in terms of total project funding, the DCEO

funds most often serve as ancillary capital to much larger project budgets. However, the Affordable Housing Construction Program funds are important for enabling developers to attract additional investments to support the design and development of high performance buildings.

- **Challenges to Maintaining Program Savings in Future Years:** The Affordable Housing Construction Program Incentives are designed to reduce the incremental cost of incorporating energy saving technologies and design features that exceed current code requirements. Illinois has adopted successive versions of the International Energy Conservation Code that require greater building efficiency. Each successive version requires the program to change the measure specifications so that they exceed the code requirements. However, with the increasing code requirements for building efficiency, the marginal efficiency gains achieved through the program diminish. Consequently, it is increasingly difficult for the program maintain the per project savings currently achieved.
- **Project Documentation is Inconsistent and Not Centralized:** The documentation supporting the purchase and installation of the energy efficiency measures submitted by grantees varies. Although some projects were better documented than others, overall, there is significant room to improve the documentation that is collected. Additionally, the documentation that is collected is stored in multiple locations. Centralizing storage so that the documentation is easily accessed by program staff should facilitate program administration and evaluation.
- **Additional Documentation would Better Support Savings Calculations:** EPY5/GPY2 was the first year that required the calculation of savings for all applicable measures using the procedures outlined in the TRM. The calculation procedures outlined in the TRM require measure specific information that is currently inconsistently reported by grant recipients. The supporting documentation submitted by program participants includes invoicing and contractor certifications that in many cases do not document the measure specifications needed to perform savings calculations, such as equipment make and model, operating efficiencies, wattages, and insulation R values. The evaluators obtained supporting documentation from grant recipients.

While the program has maintained participant satisfaction and continued to deliver energy efficiency improvements to low income residents, there are aspects of the program that could be improved. The following recommendations are offered for consideration.

- **Clarify Reporting Requirements:** Clarifying the reporting requirements for the program will improve the efficiency and effectiveness of the program administration. By providing reporting templates that outline what measure specification information is needed, grant recipients will have a better understanding of what to provide and program staff will be able to ensure that they are receiving the information they need to verify that equipment meets the program requirements and to calculate energy savings. Furthermore, the program guidelines

should provide a clear description of what constitutes proof of purchase for the rebated measures.

- **Consider Hosting a Program Kick-Off Webinar:** Once grant notification are sent to participants, program staff should consider hosting a webinar where staff discusses what is expected throughout the program year. This discussion should address the documentation that should be submitted and how to address other reporting requirements. Program kick-off webinars would also be a good way to introduce new staff, get questions answered, and improve the overall program experience for participants. If not all grantees are notified of their award at the same time, consider hosting these quarterly for participants that receive awards later in the program year.
- **Designate an Electronic Document Storage Solution for All Project Documentation:** Currently the program database does not have document storage capabilities. A central database with these capabilities will greatly enable both DCEO's staff and evaluation staff to review project files and download documents, as needed. Ideally, project documentation storage would be integrated into the project tracking database system.

1. Introduction

This report presents the results of the impact and process evaluations of the Illinois Department of Commerce and Economic Opportunity (DCEO) Affordable Housing Construction Program. This report presents evaluation results pertaining to program activity during electric program year five and natural gas program year two (EPY5/GPY2), the period June 2012 through May 2013.

1.1 Description of Program

The Affordable Housing Construction Program provides grants to non-profit and for-profit affordable housing developers to help offset the cost of incorporating energy efficient building practices in residential construction. The goal of the program is to promote the benefits of lower utility bills that can be achieved by low income households within energy efficient buildings. Eligible projects must be targeted at households that are at or below 80% of the Average Median Income (AMI) level.

Grant amounts for projects are calculated on per living unit, per building, or per square footage of living space bases. To receive the grant funds, the new construction or rehab project must meet the program guidelines and accept the full set of measures specified. There are three sets of program guidelines applicable to different types of projects:

- New single-family and low-rise residential construction minimum energy standards;
- Single and multi-family building rehab minimum energy standards; and
- New multi-family building construction minimum energy standards.

These guidelines specify requirements for insulation, windows, air sealing, mechanical systems, ventilation, appliances, and lighting.

1.2 Overview of Evaluation Approach

The overall objective of the impact evaluation of the Affordable Housing Construction Program was to determine the net electric and natural gas energy savings and peak demand (kW) reductions resulting from program projects implemented during EPY5/GPY2.

The impact evaluation had the following main features:

- Available project documentation (e.g., invoices, savings calculation work papers, etc.) was reviewed, with particular attention given to the calculation methods and documentation of savings estimates.
- Gross savings were verified via analytical desk review.

The process evaluation involved the following:

- Review of program documentation and prior evaluation reports;

- In-depth interviews with a sample of program participants to gather information regarding program awareness, motivation for participation, program administration and delivery, overall impressions, and suggestions for improvement; and
- Interviews with program staff members to discuss program operations, successes, challenges, and future plans.

1.3 Organization of Report

The evaluation report for the Affordable Housing Construction Program is organized as follows:

- Chapter 2 presents and discusses the analytical methods and results of estimating program energy savings.
- Chapter 3 presents and discusses the analytical methods and results of the process evaluation of the program.
- Chapter 4 presents evaluation conclusions and recommendations resulting from the program evaluation.
- Appendix A provides a copy of the participant interview guide.

2. Impact Evaluation

This chapter presents the results of the impact evaluation of the Affordable Housing Construction Program offered by the Illinois Department of Commerce and Economic Opportunity (DCEO). The overall objective of the impact evaluation was to determine the electric and natural gas energy savings, as well as peak demand (kW) reductions resulting from program projects during the period June 2012 through May 2013. Section 2.1 describes the methodology used for estimating savings. Section 2.2 presents the results of the effort to estimate program savings.

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 Affordable Housing New Construction Program was to determine the net electric and natural gas savings, as well as peak demand (kW) reductions resulting from projects completed during EPY5/GPY2. When applicable, the measure-level algorithms from the Illinois Statewide Technical Reference Manual (TRM) were used to develop realized savings. Table 2-1 displays each program measure and the applicable section of the TRM and other resources used to develop savings.

Table 2-1 Illinois TRM Sections by Measure Type

<i>Measure</i>	<i>Section in Illinois TRM</i>	<i>Other Resources</i>
Air Sealing	5.6.1	WAPTAC Document*
Bathroom Exhaust Fan	5.3.7	-
Boiler	5.3.6, 4.4.10	Illinois Statewide Draft TRM Version 3.0
Building Envelope Improvements	5.6.4	-
Ceiling Fan	-	ES Calculator
Central Air Conditioner	5.3.1	-
Clothes Washer	5.1.2	-
Dishwasher	4.2.6, 5.1.4	-
Electric Chiller	4.4.6	-
Fluorescent and Common Area Lighting	4.5.2, 5.5.1	-
Furnace w/ Advanced Blower	5.3.5, 4.4.11	-
Heat Pump	4.4.9	-
Packaged Terminal Air Conditioner	4.4.13	-
Refrigerator	5.1.6	-
Water Heater	4.3.1, 5.4.2	PA TRM

* Weatherization Assistance Program Technical Assistance Center Document
http://www.waptac.org/data/files/Website_docs/Technical_Tools/Building%20Tightness%20Limits.pdf

2.1.1.1. Air Sealing

ADM applied the following savings algorithm for air sealing from the Illinois TRM, to determine ex post savings.

$$\Delta kWh = (\Delta kWh_{cooling} + \Delta kWh_{heating})$$

Where,

$$\Delta kWh_{cooling} = \text{If central cooling, the reduction in annual cooling requirement due to air sealing}$$

$$\Delta kWh_{cooling} = \frac{(((CFM50_{existing} - CFM50_{new})/N_{cool}) * 60 * 24 * CDD * DUA * 0.018) / (1000 * nCool)) * LM}$$

Where,

$$CFM50_{existing} = \text{Infiltration at 50 Pascals as measured by blower door before air sealing.}$$

$$CFM50_{new} = \text{Infiltration at 50 Pascals as measured by blower door after air sealing.}$$

$$N_{cool} = \text{Conversion factor from leakage at 50 Pascal to leakage at natural conditions}$$

$$60 * 24 = \text{Converts Cubic Feet per Minute to Cubic Feet per Day}$$

$$CDD = \text{Cooling Degree Days}$$

$$DUA = \text{Discretionary Use Adjustment (reflects the fact that people do not always operate their AC when conditions may call for it).}$$

$$0.018 = \text{Specific Heat Capacity of Air (BTU/ft}^3\text{*F)}$$

$$1,000 = \text{Converts Btu to kBtu}$$

$$nCool = \text{Efficiency (SEER) of Air Conditioning equipment}$$

$$LM = \text{Latent multiplier to account for latent cooling demand}$$

$$\Delta kWh_{heating} = \text{If electric heat (resistance or heat pump), reduction in annual electric heating.}$$

$$\Delta kWh_{heating} = \frac{((CFM50_{existing} - CFM50_{new})/N_{heat}) * 60 * 24 * HDD * 0.018}{(\eta_{Heat} * 3,412)}$$

Where,

N_{heat} = Conversion factor from leakage at 50 Pascal to leakage at natural conditions

HDD = Heating degree days.

η_{Heat} = Efficiency of the heating system.

For units with a natural gas furnace, the following algorithm was used to develop annual therm savings:

$$\Delta Therms = \frac{((CFM50_{existing} - CFM50_{new})/N_{heat}) * 60 * 24 * HDD * 0.018}{(\eta_{Heat} * 100,000)}$$

The Illinois TRM has N_{heat} values for buildings in zones 2 and 3, each at or below 3 stories high. An engineering review determined that a document from the Weatherization Assistance Program Technical Assistance Center that referenced a Lawrence Berkeley Laboratory study contained the appropriate N_{heat} values for zones 1 and 4. In order to find N_{heat} values for buildings with more than 3 stories, a linear regression was performed and N_{heat} was calculated for these cases.

2.1.1.2. Bathroom Exhaust Fan

ADM applied the following savings algorithm for bathroom exhaust fans from the Illinois TRM, to determine ex post savings.

$$\Delta kWh = (CFM * (1/\eta_{Baseline} - 1/\eta_{Efficient})/1000) * Hours$$

Where,

CFM = Nominal capacity of exhaust fan.

$\eta_{Baseline}$ = The efficiency of the baseline unit.

$\eta_{Efficient}$ = The efficiency of the efficient unit.

$Hours$ = Annual hours of operation.

2.1.1.3. Boiler

Ex post savings for boilers were developed using the following Illinois Draft TRM Version 3.0 algorithm because an error in Version 2.0 was corrected. The algorithm is as follows:

$$\Delta Therms = EFLH * Capacity * ((EfficiencyRating(actual) - EfficiencyRating(base))/EfficiencyRating(base)) / 100,000$$

Where,

<i>EFLH</i>	=	Equivalent Full Load Hours for boiler heating
<i>EfficiencyRating(base)</i>	=	Baseline Boiler Efficiency Rating
<i>EfficiencyRating(actual)</i>	=	Efficient Boiler Efficiency Rating (actual)
<i>Capacity</i>	=	Nominal Heating Input Capacity Boiler size (Btuh)

Documentation for the boilers installed through the program indicated that the commercial boiler Illinois TRM methodology should be used to estimate savings. This determination was based on the size of the boilers installed through the program.

2.1.1.4. Building Envelope Improvements

For the building envelope improvements measure, energy savings were developed using the following Illinois TRM algorithms:

$$\Delta kWh = (\Delta kWh_{cooling} + \Delta kWh_{heating}) * ADJ$$

Where,

$\Delta kWh_{cooling}$ = If central cooling, the reduction in annual cooling requirement due to insulation

$$\Delta kWh_{cooling} = \frac{[(1/R_{old} - 1/R_{wall}) * A_{wall} * (1-Framing_factor) + (1/R_{old} - 1/R_{attic}) * A_{attic} * (1-Framing_factor/2)] * 24 * CDD * DUA}{1000 * \eta_{Cool}}$$

Where,

R_{old}	=	Baseline R-value.
R_{wall}	=	R-value of implemented wall assembly and insulation.
A_{wall}	=	Total area of insulated wall (ft ²)
$Framing_factor$	=	An adjustment to account for area of framing.
R_{attic}	=	R-value of implemented attic assembly and insulation.
A_{attic}	=	Total area of insulated ceiling/attic (ft ²)
CDD	=	Cooling degree days.
DUA	=	A discretionary use adjustment to reflect the fact that people do not always operate their air conditioner when conditions may call for it.
η_{Cool}	=	Seasonal Energy Efficiency Ratio of the cooling system.

$\Delta kWh_{heating}$ = If electric heat (resistance or heat pump), reduction in annual electric heating.

$$\Delta kWh_{heating} = [(1/R_{old} - 1/R_{wall}) * A_{wall} * (1-Framing_factor) + (1/R_{old} - 1/R_{attic}) * A_{attic} * (1-Framing_factor/2)] * 24 * HDD / (\eta_{Heat} * 3412)$$

Where,

R_{old}	=	Baseline R-value.
R_{wall}	=	R-value of implemented wall assembly and insulation.
A_{wall}	=	Total area of insulated wall (ft ²)
$Framing_factor$	=	An adjustment to account for area of framing.
R_{attic}	=	R-value of implemented attic assembly and insulation.
A_{attic}	=	Total area of insulated ceiling/attic (ft ²)
HDD	=	Heating degree days.
η_{Heat}	=	Efficiency of the heating system.

For units with a natural gas furnace, the following algorithm was used to develop annual therm savings:

$$\Delta Therms = (((1/R_{old} - 1/R_{wall}) * A_{wall} * (1-Framing_factor) + (1/R_{old} - 1/R_{attic}) * A_{attic} * (1-Framing_factor/2)) * 24 * HDD) / (\eta_{Heat} * 100,067 \text{ Btu/therm}) * ADJ$$

Where,

R_{old}	=	Baseline R-value.
R_{wall}	=	R-value of implemented wall assembly and insulation.
A_{wall}	=	Total area of insulated wall (ft ²)
$Framing_factor$	=	An adjustment to account for area of framing.
R_{attic}	=	R-value of implemented attic assembly and insulation.
A_{attic}	=	Total area of insulated ceiling/attic (ft ²)
HDD	=	Heating degree days.
η_{Heat}	=	Efficiency of the heating system.

2.1.1.5. Ceiling Fan

The Illinois TRM does not provide an algorithm for estimating savings from ceiling fans. The most recent ENERGY STAR® calculator was used to develop the annual savings from energy efficient ceiling fans. Savings developed using the calculator was dependent on the total wattage of the baseline and efficient fan lights. Per unit savings of 115 kWh, 118 kWh, or 181 kWh were given depending on the specifications for installed fans. Per unit savings of 115 kWh was most commonly determined to be appropriate.

2.1.1.6. Central Air Conditioning

For the central air conditioning measure, the annual kWh savings are based on the following Illinois TRM algorithm:

$$\Delta kWh = (FLH_{cool} * BtuH * (1/SEER_{base} - 1/SEER_{ee}))/1000$$

Where,

FLH_{cool} = Full Load Hours for cooling.

BtuH = The size of the new unit.

SEER_{base} = Seasonal Energy Efficiency Ratio of the baseline equipment.

SEER_{ee} = Seasonal Energy Efficiency Ratio of the efficient equipment.

2.1.1.7. Clothes Washer

Ex post savings for clothes washers were developed using the following Illinois TRM algorithms. For electric savings,

$$\Delta kWh = [(Capacity * 1/MEF_{base} * Ncycles) * (\%CW_{base} + (\%DHW_{base} * \%Elect_DHW)) + (\%Dryer_{base} * \%Elect_Dryer)] - [(Capacity * 1/MEF_{eff} * Ncycles) * (\%CW_{eff} + (\%DHW_{eff} * \%Elect_DHW)) + (\%Dryer_{eff} * \%Elect_Dryer)]$$

For natural gas savings,

$$\Delta Therm = [(Capacity * 1/MEF_{base} * Ncycles) * ((\%DHW_{base} * \%NG_DHW * R_{eff}) + (\%Dryer_{base} * \%Gas_Dryer))] - [(Capacity * 1/MEF_{eff} * Ncycles) * ((\%DHW_{eff} * \%NG_DHW * R_{eff}) + (\%Dryer_{eff} * \%Gas_Dryer))] * Therm_{convt}$$

Where,

MEF_{base} = Modified Energy Factor of baseline unit

<i>MEF_{eff}</i>	=	Modified Energy Factor of efficient unit
<i>Ncycles</i>	=	Number of cycles per year
<i>Capacity</i>	=	Clothes Washer capacity of the new unit
<i>%CW</i>	=	Percentage of energy consumption for Clothes Washer
<i>%DHW</i>	=	Percentage of energy consumption for water heating
<i>%Dryer</i>	=	Percentage of energy consumption for dryer operation
<i>%Elect_DHW</i>	=	Percentage of DHW savings assume to be electric
<i>%Elect_Dryer</i>	=	Percentage of dryer savings assume to be electric
<i>%NG_DHW</i>	=	Percentage of DHW savings assume to be Natural Gas
<i>%Gas_Dryer</i>	=	Percentage of dryer savings assume to be Natural Gas
<i>R_{eff}</i>	=	Recovery efficiency factor
<i>Therm_conv_t</i>	=	Conversion factor from kWh to Therms

2.1.1.8. Dishwasher

The annual kWh savings for the ENERGY STAR® dishwasher measure are based on the following Illinois TRM algorithm:

$$\Delta kWh = (kWh_{base} - kWh_{estar}) * [\%kWh_{op} + (\%kWh_{heat} * \%Electric_{DWH})]$$

Where,

<i>kWh_{base}</i>	=	Baseline kWh consumption per year.
<i>kWh_{estar}</i>	=	ENERGY STAR® kWh annual consumption.
<i>%kWh_{op}</i>	=	Percentage of dishwasher energy consumption used for unit operation.
<i>%kWh_{heat}</i>	=	Percentage of dishwasher energy consumptions used for water heating.
<i>%Electric_{DHW}</i>	=	Percentage of DHW Savings assumed to be electric.

Using the aforementioned algorithm, the average annual savings for an ENERGY STAR® dishwasher is 60kWh per unit.

$$\Delta kWh = (355kWh - 295kWh) * [0.44 + (0.56 * 1.00)] = 60.0 kWh$$

Therm savings for ENERGY STAR® dishwashers supplied with water heated by natural gas are based on the following Illinois TRM algorithm:

$$\Delta Therms = (kWh_{base} - kWh_{estar}) * \%kWh_{heat} * \%Natural_Gas_DHW * Ref_{eff} * Conversion_Factor$$

Where,

<i>kWh_base</i>	=	Baseline kWh consumption per year
<i>kWh_estar</i>	=	ENERGY STAR® kWh annual consumption
<i>%kWh_heat</i>	=	Percentage of dishwasher energy consumptions used for water heating
<i>%Natural_Gas_DHW</i>	=	Percentage of DHW Savings assumed to be natural gas
<i>Reff</i>	=	recovery efficiency factor
<i>Conversion_Factor</i>	=	factor to convert from kWh to therms

Using the aforementioned algorithm, the average annual savings for an ENERGY STAR® dishwasher is 1.44 Therms per unit.

$$\Delta Therms = (355kWh - 295kWh) * 0.56 * 1.0 * 1.26 * 0.03413 Therms/kWh = 1.44 Therms$$

For this program year, one site was found to have installed a commercial sized dishwasher. Savings for the commercial dishwasher were estimated using the Illinois TRM methodology for commercial dishwashers. Three variables affected the savings from commercial dishwashers: the water heater fuel type, the booster water heating fuel type of the unit, whether the unit was low temperature or high temperature dishwasher, and the type of unit installed (under the counter, door type, single tank conventional, or multi-tank conventional).

2.1.1.9. Electric Chiller

The annual kWh savings for electric chillers are based on the following Illinois TRM algorithm:

$$\Delta kWh = TONS * ((12/IPLV_{base} - (12/IPLV_{ee})) * EFLH$$

Where,

<i>TONS</i>	=	Chiller nominal cooling capacity in tons
<i>IPLV_base</i>	=	Integrated Part Load Value EER = Efficiency of baseline equipment, dependent on chiller type.
<i>IPLV_ee</i>	=	Efficiency of high efficiency equipment
<i>EFLH</i>	=	Equivalent full load hours dependent on geographic location

2.1.1.10. Fluorescent Lighting and Common Area Fluorescent Lighting

Ex post savings were developed using the following Illinois TRM algorithm:

$$\Delta kWh = ((WattsBase - WattsEE) / 1000) * ISR * Hours * WHFe$$

Where,

<i>WattsBase</i>	=	Watts for baseline fixture.
<i>WattsEE</i>	=	Watts for energy efficient fixture.
<i>ISR</i>	=	In-service rate.
<i>WHFe</i>	=	Waste heat factor.
<i>Hours</i>	=	Annual hours of operation

2.1.1.11. Furnace with Advanced Blower

Ex post savings were developed using the following Illinois TRM algorithm:

$$\Delta Therms = Gas_Furnace_Heating_Load * (1/AFUE(base) - 1/AFUE(eff))$$

2.1.1.12. Heat Pump

Ex post savings for heat pumps were developed using the following Illinois TRM algorithm:

$$\Delta kWh = Annual kWh Savings_cool + Annual kWh Savings_heat$$

Where,

<i>Annual kWh Savings_cool</i>	=	Annual savings from cooling.
<i>Annual kWh Savings_cool</i>	=	$(FLH_cool * BtuH * (1/SEER_base - 1/SEER_ee))/1000$

Where,

<i>FLH_cool</i>	=	Full Load Hours for cooling.
<i>SEER_base</i>	=	Seasonal Energy Efficiency Ratio of the baseline equipment.
<i>SEER_ee</i>	=	Seasonal Energy Efficiency Ratio of the efficient equipment.
<i>BtuH</i>	=	The capacity of the equipment.

And,

$$Annual kWh Savings_heat = Annual savings from heating.$$

$$Annual kWh Savings_heat = (kBtu/h_heat) * [(1/HSPF_base) - (1/HSPF_ee)] * EFLH_heat$$

Where,

$kBtu/h_{heat}$ = Capacity of the heating equipment in kBtu per hour (1 ton of heating capacity equals 12 kBtu/h).

$HSPF_{base}$ = Heating Seasonal Performance Factor of the baseline equipment.

$HSPF_{ee}$ = Heating Seasonal Performance Factor of the efficient equipment.

$EFLH_{heat}$ = Equivalent Full Load Hours for heating.

Or,

$$Annual\ kWh\ Savings_{heat} = (FLH_{cool} * Btu/H * (1/SEER_{base} - (1/(EER_{ee} * 1.02))/1000) + (FLH_{heat} * Btu/H * (1/HSPF_{base} - (1/COP_{ee} * 3.412))/1000)$$

Where,

FLH_{cool} = Full Load Hours for cooling.

EER_{ee} = Energy Efficiency Ratio of the energy efficient equipment.

FLH_{heat} = Full Load Hours for heating.

$HSPF_{base}$ = Heating Seasonal Performance Factor of the baseline equipment.

COP_{ee} = Coefficient of performance of the energy efficient equipment.

2.1.1.13. Packaged Terminal Air Conditioner

Ex post savings for packaged terminal air conditioners were developed using the following Illinois TRM algorithm:

$$\Delta kWh = Annual\ kWh\ Savings_{cool}$$

Where,

$$Annual\ kWh\ Savings_{cool} = (kBtu/h_{cool}) * (1/EER_{base} - 1/EER_{ee}) * EFLH_{cool}$$

Where,

$EFLH_{cool}$ = Full Load Hours for cooling.

EER_{base} = Energy Efficiency Ratio of the baseline equipment.

EER_{ee} = Energy Efficiency Ratio of the efficient equipment.

$kBtu/hcool$ = The capacity of the equipment.

2.1.1.1. Refrigerators

Ex post savings for refrigerators were developed using the Illinois TRM. Under this methodology,

$$\Delta kWh = UEC_{BASE} - UEC_{EE}$$

Where,

UEC_{BASE} = Annual Unit Energy Consumption of baseline unit, and

UEC_{EE} = Annual Unit Energy Consumption of ENERGY STAR unit

Unit energy consumption can be determined by using the algorithms specified in the following table:

Table 2-2 Unit Energy Consumption of Refrigerators

Product Category	NAECA as of July 1, 2001 Maximum Energy Usage in kWh/year	Current ENERGY STAR level Maximum Energy Usage in kWh/year
1. Refrigerators and Refrigerator-freezers with manual defrost	$8.82*AV+248.4$	$7.056*AV+198.72$
2. Refrigerator-Freezer--partial automatic defrost	$8.82*AV+248.4$	$7.056*AV+198.72$
3. Refrigerator-Freezers--automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerators--automatic defrost	$9.80*AV+276$	$7.84*AV+220.8$
4. Refrigerator-Freezers--automatic defrost with side-mounted freezer without through-the-door ice service	$4.91*AV+507.5$	$3.928*AV+406$
5. Refrigerator-Freezers--automatic defrost with bottom-mounted freezer without through-the-door ice service	$4.60*AV+459$	$3.68*AV+367.2$
6. Refrigerator-Freezers--automatic defrost with top-mounted freezer with through-the-door ice service	$10.20*AV+356$	$8.16*AV+284.8$
7. Refrigerator-Freezers--automatic defrost with side-mounted freezer with through-the-door ice service	$10.10*AV+406$	$8.08*AV+324.8$

Where,

$$AV = Adjusted_volume = Fresh_volume + (1.63 * Freezer_volume)$$

2.1.1.2. Water Heater

The Illinois TRM does not specify an algorithm for kWh savings for electric water heaters. The following algorithm from the Pennsylvania TRM was applied to calculate ex post electric savings:

$$\Delta kWh = ((1/EF_{base} - 1/EF_{proposed}) * (HW * 365 * 8.3lb/gal * (Thot - Tcold))) / 3413 BTU/kWh$$

Where,

EF_{base}	=	Energy factor of baseline water heater.
$EF_{proposed}$	=	Energy factor of proposed efficient water heater.
HW	=	How water used per day in gallons.
$Thot$	=	Temperature of hot water.
$Tcold$	=	Temperature of cold water supply.

Using these values, the ex post calculations result in 71.68 kWh savings per electric water heater.

Therm savings for residential natural gas water heaters were calculated using the following algorithm provided by the Illinois TRM:

$$\Delta Therms = (1/EF_{base} - 1/EF_{efficient}) * (GPD * 365.25 * \gamma_{Water} * (Tout - Tin) * 1.0) / 100,000$$

Where,

EF_{base}	=	Efficiency of the baseline equipment.
$EF_{efficient}$	=	Efficiency of the new equipment.
GPD	=	Gallons of water used per day.
γ_{Water}	=	Specific weight of water.
$Tout$	=	Tank temperature.
Tin	=	Temperature of the incoming supply water.

The Illinois TRM deemed savings of 119 therms per unit was applied to large central water heaters installed in multifamily buildings.

2.1.2 Program-Level Savings Results

This subsection presents the gross and net savings for the Affordable Housing Construction Program during the period of June 2012 through May 2013.

The realized gross and net electric savings of the Affordable Housing Construction Program during the period June 2012 through May 2013 are summarized by utility in Table 2-3 and by measure in Table 2-4. During this period, realized gross electrical savings totaled 3,049,817 kWh. The gross realization rate for the program is 103%. A net-to-gross factor of 100% was used because the Affordable Housing Construction Program targets low income residents. The realized net savings for the period are 3,049,817 kWh.

Table 2-3 Summary of kWh Savings by Utility

Utility	Expected kWh Savings	Realized Gross kWh Savings	Gross Realization Rate	Realized Net kWh Savings
Ameren	904,515	1,193,170	132%	1,193,170
ComEd	2,050,324	1,856,647	91%	1,856,647
Total	2,954,839	3,049,817	103%	3,049,817

*A net-to-gross ratio of 100% is applied because the Affordable Housing Construction Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.

Table 2-4 Summary of kWh Savings by Measure

Measure	Expected kWh Savings	Realized Gross kWh Savings	Gross Realization Rate	Realized Net kWh Savings
Air Sealing	14,797	14,797	100%	14,797
Bath Fan	125,075	125,075	100%	125,075
Ceiling Fan	47,889	90,351	189%	90,351
Clothes Washer (Electric Hot Water)	5,962	11,509	193%	11,509
Commercial Dishwasher (Electric Booster)	5,269	5,269	100%	5,269
Common Area Fluorescent Lighting - Exterior	135,128	422,549	313%	422,549
Common Area Fluorescent Lighting - Interior	1,146,210	1,172,131	102%	1,172,131
Dishwasher (Electric Hot Water)	6,840	2,520	37%	2,520
Efficient AC	53,964	57,388	106%	57,388
Efficient Chiller	140,499	140,499	100%	140,499
Efficient Heat Pump	407,662	273,383	67%	273,383
Efficient Packaged Terminal Air Conditioner	4,215	4,215	100%	4,215
Fluorescent Lighting	411,643	338,422	82%	338,422
Furnace w/ Advanced Blower	60,460	245,575	406%	245,575
Individual Electric Water Heater	6,433	3,871	60%	3,871
Refrigerator	145,020	100,135	69%	100,135
Thermal Envelope Improvements w/ AC	150,661	18,001	12%	18,001
Thermal Envelope Improvements w/ Heat Pump	87,114	24,129	28%	24,129
Total	2,954,839	3,049,817	103%	3,049,817

The realized gross and net peak kW reductions of the Affordable Housing Construction Program during the period June 2012 through May 2013 are summarized in Table 2-5. The achieved net peak demand savings for the program total 465.76 kW.

Table 2-5 Summary of Peak kW Savings by Utility

<i>Utility</i>	<i>Realized Gross kW Savings</i>	<i>Realized Net kW Savings</i>
Ameren	156.77	156.77
ComEd	308.99	308.99
Total	465.76	465.76

**A net-to-gross ratio of 100% is applied because the Affordable Housing Construction Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.*

The realized gross and net natural gas savings of the Affordable Housing Construction Program during the period June 2012 through May 2013 are summarized by utility in Table 2-6 and by measure in Table 2-7. During this period, realized gross natural gas savings totaled 80,482 therms. The gross realization rate for the program is 71%. A net-to-gross factor of 100% was used because the Affordable Housing Construction Program targets low income residents. The realized net savings for the period are 80,482 therms.

Table 2-6 Summary of Therm Savings by Utility

<i>Utility</i>	<i>Expected Therm Savings</i>	<i>Realized Gross Therm Savings</i>	<i>Gross Realization Rate</i>	<i>Realized Net Therm Savings</i>
Ameren	49,917	38,910	78%	38,910
Nicor	19,187	11,649	61%	11,649
North Shore	1,867	744	40%	744
Peoples	41,877	29,179	70%	29,179
Total	112,848	80,482	71%	80,482

**A net-to-gross ratio of 100% is applied because the Affordable Housing Construction Program targets low income residents who would not have funded new energy efficiency measures in the absence of the program.*

Table 2-7 Summary of Therm Savings by Measure

<i>Measure</i>	<i>Expected Therm Savings</i>	<i>Realized Gross Therm Savings</i>	<i>Gross Realization Rate</i>	<i>Realized Net Therm Savings</i>
Air Sealing	1,231	1,231	100%	1,231
Central Water Heater	992	3,570	360%	3,570
Clothes Washer (Gas Hot Water)	1,269	2,520	199%	2,520
Dishwasher (Gas Hot Water)	876	731	84%	731
Efficient Boiler	26,331	26,331	100%	26,331
Furnace w/ Advanced Blower	44,741	38,921	87%	38,921
Individual Gas Water Heater	3,218	4,027	125%	4,027
Thermal Envelope Improvements w/ AC	34,191	3,150	9%	3,150
Total	112,848	80,482	71%	80,482

3. Process Evaluation

This chapter presents the results of the process evaluation of the DCEO Energy Efficient Affordable Housing Construction Program (Affordable Housing Construction Program). The EPY5/GPY2 program year was a year of transition for the Affordable Housing Construction Program, during which new staff assumed responsibility for the administration of the program. In many respects, this process evaluation builds on the process evaluation of the EPY4/GPY1 program year. The process evaluation focuses on the effectiveness of program policies and organization, as well as the program delivery framework. The purpose of the process evaluation is to assess the design and recent results of the program in order to determine how effectively the program is being delivered.

The chapter begins with an overview of the process evaluation methodology, related objectives, and a summary of key findings. The overview is followed by a description of the program, detailed review of the participant interview findings and an in-depth look at program mechanics and staff perspectives. The process analysis is meant to provide a qualitative understanding of how the program is progressing and what is working well and what needs to be improved upon. The process findings provide insight into participant decision-making behavior and the effectiveness of the program from the participant's perspective. In addition, it can identify issues that are critical to the future success of the program. Conclusions, recommendations, and other findings from the process evaluation may be useful in conducting planning efforts for future program years.

3.1 Evaluation Objectives

The purpose of the process evaluation is to examine program operations and results throughout the program operating year. The evaluation also seeks to identify potential program improvements that may prospectively increase program efficiency in terms of levels of participation and program satisfaction.

Key research questions to be addressed by this evaluation of EPY5/GPY2:

Was the Affordable Housing Construction Program delivery effective and successful?

Did the Affordable Housing Construction Program reduce barriers to increased energy efficiency project implementation?

What motivates grantees to participate in the program?

Are grantees satisfied with the participation process?

During the evaluation, data and information from multiple sources was analyzed to achieve the stated research objectives. Insight into the participant experience with the Affordable Housing Construction Program was developed from in-depth interviews with participants. The program operations perspective was developed through in-depth interviews with program staff.

3.2 Summary of Primary Data Collection

- **Participant Interviews:** Participant interviews were a primary data source for the process evaluation and served as the foundation for understanding the grant recipients' perspective. Respondents commented on their satisfaction with the program, their motivations and the factors affecting their decision-making process.
- **Program Staff Interviews:** At various times during the evaluation effort, program staff was interviewed about the program operations. Interviews with program staff covered topics such as program administration, operations, data collection, and the participation process.

3.3 Summary of Conclusions and Recommendations

Interviews were conducted with grant recipients to better understand the effectiveness of program delivery. Participants were generally satisfied with the program. A review of program documentation and in-depth interviews with program staff indicate that there are aspects of the program that could be changed to increase awareness, and improve program administration and project tracking. In addition, findings from the evaluation provide insight into how to better align reporting requirements with the informational needs for assessing savings.

The following presents a selection of key conclusions from EPY5/GPY2:

- **High Satisfaction with Program Offerings, but Room for Improving Communication and Support:** Overall, grant recipients were grateful for the Affordable Housing Construction Program and indicated that the program helped them overcome barriers to developing high performance low-income housing. The grant recipients indicated that the package of measures required by the program was adequate and did not suggest additional measures for inclusion. In addition, they noted that DCEO staff is flexible when it comes to approving custom measures. The DCEO consultant from Domus Plus was cited as an asset to the delivery of the program and participants valued his guidance.

However, grant recipients suggested that there was potential for better communication about the participation process. In particular, grant recipients noted a lack of clarity about the reporting requirements for the program and the grant timelines. The deficiencies in communication may stem from insufficient staff resources to administer the program, although improving the program documentation and other aspects of the infrastructure may compensate for the lack of staff resources. Additionally, these issues may be reduced as new staff members are fully trained and become acclimated to their roles.

- **DCEO Grant Dollars are Important to Project Financing Structures:** Interviews with program staff and participants indicated that in terms of total project funding, the DCEO funds most often serve as ancillary capital to much larger project budgets. However, the Affordable Housing Construction Program funds are important for enabling developers to attract additional investments to support the design and development of high performance buildings.
- **Challenges to Maintaining Program Savings in Future Years:** The Affordable Housing Construction Program Incentives are designed to reduce the incremental cost of incorporating energy saving technologies and design features that exceed current code requirements. Illinois has adopted successive versions of the International Energy Conservation Code that require greater building efficiency. Each successive version requires the program to change the measure specifications so that they exceed the code requirements. However, with the increasing code requirements for building efficiency, the marginal efficiency gains achieved through the program diminish. Consequently, it is increasingly difficult for the program maintain the per project savings currently achieved.
- **Project Documentation is Inconsistent and Not Centralized:** The documentation supporting the purchase and installation of the energy efficiency measures submitted by grantees varies. Although some projects were better documented than others, overall, there is significant room to improve the documentation that is collected. Additionally, the documentation that is collected is stored in multiple locations. Centralizing storage so that the documentation is easily accessed by program staff should facilitate program administration and evaluation.
- **Additional Documentation would Better Support Savings Calculations:** EPY5/GPY2 was the first year that required the calculation of savings for all applicable measures using the procedures outlined in the TRM. The calculation procedures outlined in the TRM require measure specific information that is currently inconsistently reported by grant recipients. The supporting documentation submitted by program participants includes invoicing and contractor certifications that in many cases do not document the measure specifications needed to perform savings calculations, such as equipment make and model, operating efficiencies, wattages, and insulation R values. The evaluators obtained supporting documentation from grant recipients.

While the program has maintained participant satisfaction and continued to deliver energy efficiency improvements to low income residents, there are aspects of the program that could be improved. The following recommendations are offered for consideration.

- **Clarify Reporting Requirements:** Clarifying the reporting requirements for the program will improve the efficiency and effectiveness of the program administration. By providing reporting templates that outline what measure specification information is needed, grant recipients will have a better understanding of what to provide and program staff will be able to ensure that they are receiving the information they need to verify that equipment meets the

program requirements and to calculate energy savings. Furthermore, the program guidelines should provide a clear description of what constitutes proof of purchase for the rebated measures.

- **Consider Hosting a Program Kick-Off Webinar:** Once grant notification are sent to participants, program staff should consider hosting a webinar where staff discusses what is expected throughout the program year. This discussion should address the documentation that should be submitted and how to address other reporting requirements. Program kick-off webinars would also be a good way to introduce new staff, get questions answered, and improve the overall program experience for participants. If not all grantees are notified of their award at the same time, consider hosting these quarterly for participants that receive awards later in the program year.
- **Designate an Electronic Document Storage Solution for All Project Documentation:** Currently the program database does not have document storage capabilities. A central database with these capabilities will greatly enable both DCEO's staff and evaluation staff to review project files and download documents, as needed. Ideally, project documentation storage would be integrated into the project tracking database system.

3.4 Energy Efficient Affordable Housing Construction Program Description

The Affordable Housing Construction Program is designed to help improve the energy efficiency of low-income housing in Illinois. Applicants requesting grant funds for electricity conservation measures must do so for sites serviced by Ameren Illinois or ComEd. Grant funds are available for natural gas conservation measures for sites serviced by Ameren Illinois, Nicor, Peoples, or North Shore.

3.4.1 Participant and Measure Eligibility Requirements

The Affordable Housing Construction Program provides grants to non-profit and for-profit affordable housing developers to offset the cost of incorporating energy efficient building practices in residential construction. The goal of the program is to promote the benefits of lower utility bills on low-income households as a result of living in energy efficient buildings. Eligible projects must be targeted at households that are at or below 80% of the Average Median Income (AMI) level.

To receive the grant funds, the new construction or rehabilitation project must meet the program guidelines and implement the full set of measures. There are three sets of measures for different types of projects:

- New single-family and low-rise residential construction minimum energy standards;
- Single and multi-family building rehab minimum energy standards; and
- New multi-family building construction minimum energy standards.

These guidelines specify requirements for insulation, windows, air sealing, mechanical systems, ventilation, appliances, and lighting.

3.4.2 Program Incentives

Grant amounts for projects are based per living unit, building, or square footage of living space. Rehab grant amounts are described below and reflect combined natural and electric incentives:

- Up to \$4,500 per living unit for single-family homes;
- Up to \$4.50/ft² of gross living space or \$4,500, whichever is less, for multi-family buildings with fewer than 80 units; and
- Up to \$4.25/ft² of gross living space or \$4,250, whichever is less, for multi-family buildings with 80 or more units.

Grant amounts for new construction projects are described below and reflect combined natural and electric incentives:

- Up to \$4,000 per living unit for new single-family homes;
- Up to \$6,500 per building for new duplex construction;
- Up to \$7,500 per building for new “3-flat” construction;
- Up to \$8,500 per building for new “4-flat” construction;
- Up to \$11,000 per building for new “6-flat” construction;
- Up to \$4.25/ft² of gross living space in new multi-family buildings with fewer than 80 units; and
- Up to \$4.00/ft² of gross living space in new multi-family buildings with 80 or more units.

3.4.3 Program Participation Process

Interested parties apply to the program by submitting an application. The program strongly recommends a pre-application meeting with the program manager to discuss the proposed project before construction documents have been completed. Applications are reviewed by program staff for completeness and adherence to program requirements. Applicants are selected if they demonstrate their ability to integrate efficiency measures into the project at a reasonable cost. Prior to awarding of the grant, the applicant submits construction documents and DCEO staff develops the project statement of work and energy savings estimations.

Approximately 50% of the grant funds are awarded at the initiation of construction at the building site. Interim payments may be negotiated, but the expectation is that the remaining grant payment will be issued upon substantial completion of efficiency measure implementation. The process for participating and completing an Affordable Housing Construction grant project is illustrated in Figure 3-1.

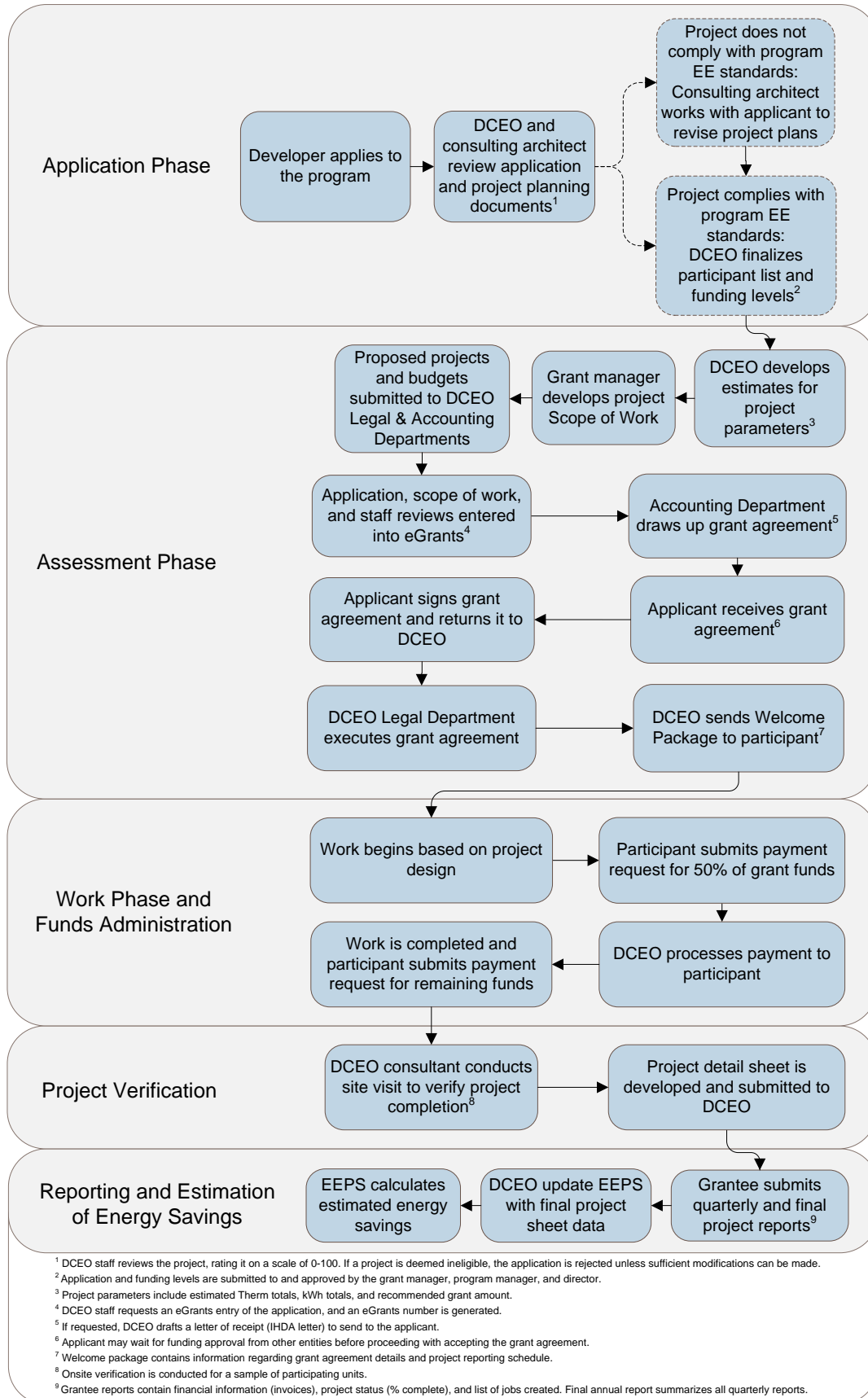


Figure 3-1 Affordable Housing Construction Program Grant Process

3.4.4 Reporting and Verification

Grantees submit quarterly progress reports to DCEO. Upon acceptance of the grant, the recipient agrees to assist with an analysis of energy consumption for up to three years following the occupancy of the buildings. Verification is based on materials submitted by the applicants such as project invoices and reports of project activity. Additionally, program staff performs site verification visits for each of the funded projects.

3.5 Energy Efficient Affordable Housing Construction

Table 3-1 presents a summary of the total number of residential units constructed or rehabilitated by project type. In total, 1,411 units were constructed or rehabilitated through 26 program projects. The majority of units were new multi-family construction, followed by multi-family building rehab.

Table 3-1 Number of Residential Units Receiving Efficiency Improvements

<i>Type of Project</i>	<i>EPY5/GPY2 Number of Residential Units</i>
New Multi-Family Building Construction	1,135
Multi-Family Building Rehab	201
New Single Family Construction	62
Single Family Rehab	13
Total	1,411

3.6 Participant In-Depth Interviews

Telephone interviews were conducted with approximately one-quarter of the developers who participated in DCEO's Affordable Housing Construction Program. The interview questions addressed participants' experiences with the program and DCEO staff. Interview topics included:

- How participants became aware of the program;
- Motivations for participation;
- Experience with the program administration and delivery; and
- Overall impressions and suggestions for improvement.

Key trends and issues addressed by developers include:

- **Participants Learned of the Program through Various Sources:** This program year was the first year of participation for many of the grant recipients. The interviewed grant recipients reported learning of the program through various sources including the City of Springfield staff, the AmeriCorp Vista program, the DCEO website, conferences, and

architects. Some developers noted that they had interaction with key DCEO staff members prior to program participation and that this was crucial to their decision to participate.

Program participants reported becoming aware of the program during different phases of the construction process. Some reported that they learned of the program during the planning phase of the project, while others reported learning of it during construction.

- **Lower Operating Costs and Environmental Concerns were Primary Motivations for Participation:** The primary motivation for participation in the Affordable Housing Construction Program was to create lower operating costs through reduced taxes, insurance, and utility costs. In addition to minimizing expenses, several of the developers noted that their participation in the Affordable Housing Construction Program helps to reduce their carbon footprint and ultimately make them a greener organization.
- **Diversity of Funding Sources:** The housing developers typically seek out funding from various additional non-program sources to fund the low-income development projects. The participants most commonly received grants from the Illinois Housing Development Authority (IHDA) and the U.S. Department of Housing and Urban Development's (HUD) Community Development Block Grant (CDBG) Program and Neighborhood Stabilization Grant Program. Other sources of funding include tax equity investors, home funds from the city, and bungalow trust funds. Some of the organizations try to rely less on grants and more on donations from corporations such as U.S. Bank, Wells Fargo, and Walmart. In terms of the comparative amounts of funding provided from these various sources, some of the developers noted that the DCEO funds were relatively small while others characterized them as somewhere in the middle. It is not surprising that other sources of funding are comparatively larger since the DCEO funds are used for energy efficiency improvements. Although the DCEO funds were not the primary source of funding for any of the organizations, these funds were described as being the most straightforward to acquire.
- **Timely Receipt of Grant Payments:** The majority of the developers felt that they received the DCEO funds in a timely manner. Typically, the organization received half of the funds prior to the construction of the housing projects and the remaining half after or during construction, once all invoices were submitted. However, one respondent noted that they did not receive any grant payments until long after the construction was completed.
- **Mixed Experiences Working with Program Staff:** Some developers described positive experiences working with DCEO staff. They described DCEO staff members as helpful and easy to work with. Interview respondents noted that program staff provided assistance when issues arose until they were resolved. However, other developers felt that some staff members were not quite as knowledgeable as others. One respondent described an experience in which there was a failure to submit the required documentation on time because a staff member was unclear with instructions. These delinquent items led to a delay in the processing of the grant payment.
- **Funding Not Enough to Cover Costs of Energy Efficiency Improvements:** Although all of the developers agreed that the funding was extremely helpful, they often felt it was not

enough to cover the entire cost of the energy efficiency improvements. It was difficult to install all of the recommended items because the funds simply do not stretch that far. In fact, for many of the organizations, it was only enough to cover a portion of a few things. The developers explained that the DCEO funds could potentially be sufficient for projects that are considered new construction, but are less adequate for rehabilitation projects.

The perceived insufficiency of the funds may stem from a misunderstanding of the purpose of the DCEO grant funds. The intent of the funds is not to cover the full cost of the measure, but the marginal cost associated with installing more efficient equipment or implementing design features than would otherwise be implemented by participants.

- **Overall Impressions:** Overall, the developers of low-income housing were pleased with how easy and streamlined the participation process was. However, they did offer some suggestions for areas that they felt needed improvement. One participant noted that after applying to the program, there was no confirmation or status as to whether the application was done correctly. Other participants felt that they did not know what was needed because some instructions were unclear. The developers felt that more guidance and oversight would have been helpful in terms understanding how the money was to be used, what documentation to send to DCEO, and how to complete the reports. One participant felt that some type of training, webinar or presentation would be helpful.

3.7 Program Operations Perspective

This section summarizes the core findings from interviews that were conducted with the Affordable Housing Construction Program staff and data collection activities that occurred over the past four months. Interviews were completed with the new primary grant manager for the program. Additionally, an interview was completed with a part-time support staff member.

The interview and data collection process provided insights into program design, staffing, partnerships, and the participation process. Several key findings are described below.

- **External Consultant Provides Technical Expertise:** A Chicago-based consulting firm, Domus Plus, is responsible for the majority of the technical support and project verification. By contracting with this company DCEO is able to outsource critical program administration functions. Domus Plus works closely with DCEO and participants to collect and review documentation, suggest appropriate funding levels for projects, visit project sites to support developers, verify measure installation, and to ensure project completion prior to payment approval.
- **New Staff Hired:** The Affordable Housing Construction Program has struggled with insufficient staff resources, but steps have been taken to remedy the issue. Two new staff members have been transferred from DCEO's recycling programs to the Affordable Housing Construction Program; one as a full time grant manager and the other will split his time between Affordable Housing Construction and Residential Retrofit. The program also employs a part-time intern who provides additional administrative and project management support to all three DCEO low income programs.

- **Multiple Year Program Cycles:** New construction and gut rehab projects, unlike small scale energy efficiency improvements, take years to plan and complete. DCEO staff indicated that even after participants are approved and funds are allocated, construction may not begin for 18 to 24 months. Participants are often waiting for other funding sources before beginning construction. When this occurs, applications are kept active and rolled into the following program year so that participants do not need to reapply for previously approved projects. The majority of the projects completed during EPY5/GPY2 were begun during prior program years.
- **Data Captured in the EEPS Database:** Currently, most of the Affordable Housing Construction activity is tracked in the Energy Efficiency Portfolio Standard (EEPS) database. However, the database measure fields are limited to broad descriptions of the measures and do not provide information on the technical specifications. Consequently, information about measures that exceed the efficiency standards for the program is not captured. Because measure specific information is not captured by the EEPS database, as it is currently designed, it is not a particularly useful tool for recording and reporting on project information and expected savings. As an alternative, staff record measure specific information in various other documents.
- **Project Documents are Stored in Multiple Locations:** DCEO staff and partners store project documentation in various locations and formats. The project documentation that is retained includes drawings, lighting schedules, floor plans, measure specifications, invoices, and grantee progress and final reports. These documents are primarily stored in two locations, namely, the Illinois egrants system, and by the independent consultant, Domus Plus. The egrant system archives all grantee reporting and Domus Plus staff maintains documentation associated with project specifications. These distributed systems make it difficult for any one person to have a comprehensive understanding of program activity.
- **Site Visits are Conducted for All Completed Project:** Site visits were conducted for all completed Affordable Housing Construction projects. Most participants indicated that a site visit was conducted at two points during the project work phase. The first visit occurs early in the construction process. During this initial visit, program staff documents the progress of the project and offer technical support if necessary. Upon project completion, program staff performed site visits to verify the installation of the energy efficient equipment funded through the program and to perform blower door testing.

3.8 Documentation Review

ADM staff reviewed available project documentation to better understand the participation process, DCEO grant administration procedures, and how energy efficiency measure specifications are being documented. The program documentation is critical for program administration and evaluation as it provides information on the technical specifics of the measures installed and substantiates the proper use of the grant funds. ADM staff identified several key types of project documentation collected during the participation process. Specifically, the documentation that was reviewed included the following:

- Participant applications;
- Statements of work;
- Project drawings;
- Proofs of purchase for the measures (invoices and receipts);
- Quarterly status reports and final reports; and
- Project sheets documenting counts of measures and specifications.

The review of the documentation found variability in the drawings and proofs of purchase submitted for each project. Different types of drawings (e.g., architectural, mechanical) were collected for each project. Additionally, the documentation submitted as proofs of purchase for the measures installed varied significantly in terms of the level of detail provided and in many cases additional supporting documentation needed to be collected from the grant recipients. This variability highlights a need for providing greater clarity to grantees about the information that needs to be submitted as part of the grant agreement.

4. Conclusions and Recommendations

The preceding chapters provide insight into how the program is being administered, received, and evaluated. Key conclusions developed from the evaluation are presented below, followed by a list of recommendations for consideration by program staff.

4.1 Key Conclusions

The following presents a selection of key conclusions from EPY5/GPY2:

- **High Satisfaction with Program Offerings, but Room for Improving Communication and Support:** Overall, grant recipients were grateful for the Affordable Housing Construction Program and indicated that the program helped them overcome barriers to developing high performance low-income housing. The grant recipients indicated that the package of measures required by the program was adequate and did not suggest additional measures for inclusion. In addition, they noted that DCEO staff is flexible when it comes to approving custom measures. The DCEO consultant from Domus Plus was cited as an asset to the delivery of the program and participants valued his guidance.

However, grant recipients suggested that there was potential for better communication about the participation process. In particular, grant recipients noted a lack of clarity about the reporting requirements for the program and the grant timelines. The deficiencies in communication may stem from insufficient staff resources to administer the program, although improving the program documentation and other aspects of the infrastructure may compensate for the lack of staff resources. Additionally, these issues may be reduced as new staff members are fully trained and become acclimated to their roles.

- **DCEO Grant Dollars are Important to Project Financing Structures:** Interviews with program staff and participants indicated that in terms of total project funding, the DCEO funds most often serve as ancillary capital to much larger project budgets. However, the Affordable Housing Construction Program funds are important for enabling developers to attract additional investments to support the design and development of high performance buildings.
- **Challenges to Maintaining Program Savings in Future Years:** The Affordable Housing Construction Program Incentives are designed to reduce the incremental cost of incorporating energy saving technologies and design features that exceed current code requirements. Illinois has adopted successive versions of the International Energy Conservation Code that require greater building efficiency. Each successive version requires the program to change the measure specifications so that they exceed the code requirements. However, with the increasing code requirements for building efficiency, the marginal efficiency gains achieved through the program diminish. Consequently, it is increasingly difficult for the program to maintain the per project savings currently achieved.

- **Project Documentation is Inconsistent and Not Centralized:** The documentation supporting the purchase and installation of the energy efficiency measures submitted by grantees varies. Although some projects were better documented than others, overall, there is significant room to improve the documentation that is collected. Additionally, the documentation that is collected is stored in multiple locations. Centralizing storage so that the documentation is easily accessed by program staff should facilitate program administration and evaluation.
- **Additional Documentation would Better Support Savings Calculations:** EPY5/GPY2 was the first year that required the calculation of savings for all applicable measures using the procedures outlined in the TRM. The calculation procedures outlined in the TRM require measure specific information that is currently inconsistently reported by grant recipients. The supporting documentation submitted by program participants includes invoicing and contractor certifications that in many cases do not document the measure specifications needed to perform savings calculations, such as equipment make and model, operating efficiencies, wattages, and insulation R values. The evaluators obtained supporting documentation from grant recipients.

4.2 Program Recommendations

While the program has maintained participant satisfaction and continued to deliver energy efficiency improvements to low-income residents, there are aspects of the program that could be improved. The following recommendations are offered for consideration.

- **Clarify Reporting Requirements:** Clarifying the reporting requirements for the program will improve the efficiency and effectiveness of the program administration. By providing reporting templates that outline what measure specification information is needed, grant recipients will have a better understanding of what to provide and program staff will be able to ensure that they are receiving the information they need to verify that equipment meets the program requirements and to calculate energy savings. Furthermore, the program guidelines should provide a clear description of what constitutes proof of purchase for the rebated measures.
- **Consider Hosting a Program Kick-Off Webinar:** Once grant notification are sent to participants, program staff should consider hosting a webinar where staff discusses what is expected throughout the program year. This discussion should address the documentation that should be submitted and how to address other reporting requirements. Program kick-off webinars would also be a good way to introduce new staff, get questions answered, and improve the overall program experience for participants. If not all grantees are notified of their award at the same time, consider hosting these quarterly for participants that receive awards later in the program year.
- **Designate an Electronic Document Storage Solution for All Project Documentation:** Currently the program database does not have document storage capabilities. A central

database with these capabilities will greatly enable both DCEO's staff and evaluation staff to review project files and download documents, as needed. Ideally, project documentation storage would be integrated into the project tracking database system.

Appendix A: Participant Interview Guide

Research Objectives: To better understand the participants experience with participating in the Low Income Affordable Housing Program. The objectives of the interview are to understand:

- How participants became aware of the program;
- What motivated participation in the program;
- How participants implement projects through the program;
- Participants understanding of reporting requirements;
- Other sources of funding for the projects; and
- Perceived strengths and weaknesses of the program.

Interview Topics

Background Questions

- Is your organization a private-for-profit or a non-profit? What is your organization's mission?
- How large is your organization?
- Do you own the buildings that are built/restored/renovated?

Program Awareness

- For how long have you participated in the program?
- How did you initially hear about the program?
- When did you find out about the program? Was it before you began planning, while planning, after plans were completed, during construction, or after construction was finished?

Motivation for Participation

- Why did you decide to participate in the program?

Program Administration and Delivery

- What is your role in the implementation of the program?

- How are projects managed and implemented? Do you hire contractors or sub-contractors? What are their roles?
- What invoicing do you require from contractors?

Reporting

- What are your reporting requirements?
- Have you tried to obtain info such as invoicing and detailed equipment specifications?

Funding & Grant Payments

- Do you typically seek additional funding for development projects?
- What aspects of the projects do you seek funding for?

Overall Impressions and Suggestions for Improvement

- Do you feel the incentivized measures are comprehensive enough? Are there other measures that should be part of the package?
- What do you think works well with the program?
- What areas of the program could be improved?