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Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011)

Evaluation Report: Public Housing Authority Efficient Living Program

Presented to

The Illinois Department of Commerce and Economic Opportunity

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Presented by

Randy Gunn
Managing Director

Navigant Consulting
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606

phone 312.583.5700
fax 312.583.5701

www.navigant.com

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Michaels engineering

Submitted to:

DCEO
Illinois Department of Commerce and Economic Opportunity
620 East Adams Street
Springfield, IL 62701

Submitted by:

Navigant Consulting, Inc.
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606
Phone 312.583.5700
Fax 312.583.5701

Contact:

Randy Gunn, Managing Director
312.938.4242
Randy.Gunn@Navigant.Com

Jeff Erickson, Director
608.497.2322
Jeff.Erickson@Navigant.Com

Prepared by:

Damon Clark, Senior Consultant
802.526.5115
Damon.Clark@Navigant.Com

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Section E. Executive Summary

The Public Housing Authority Efficient Living Program implements cost-effective energy efficient measures in Public Housing Authority buildings. The Smart Energy Design Assistance Center (SEDAC) at the University of Illinois in partnership with the Illinois Department of Commerce and Economic Opportunity (DCEO) manages this program. SEDAC aids the managers of Public Housing Authority (PHA) buildings to incorporate cost-effective energy measures into their buildings. This program is authorized by the Energy Efficiency Section of the Public Utilities Act 20 ILCS 5/12-103 to administer a portion of the Illinois Energy Efficiency Portfolio Standards (EEPS).

This evaluation report focuses on the low income public housing units that have been part of the Efficient Living Program from the period June 1, 2010 to May 31, 2011. The program implements numerous measures to produce energy savings. The program has an extensive outreach component.

Eligibility for this program is limited to Public Housing Authority buildings that receive their electric services from ComEd or Ameren utilities. The populations residing in these buildings are all low income.

The program claims savings from the measures listed below, however, the list of eligible measures is longer.

- Energy Star® refrigerators
- CFLs
- Fluorescent Fixtures
- CEE TIER 3 clothes washers
- Energy Star® Window Air-conditioning units
- T8 Lamps with High-Efficiency Electronic Ballasts
- LED Exit Signs
- Replacing Packaged Terminal Air Conditioners (PTACs) with Packaged Terminal Heat Pumps (PTHPs)
- Occupancy Sensors
- Beverage Vending Misers

- Snack Vending Misers

In addition to measure installation the program also hauled and recycled refrigerators, window air conditioning units, and packaged terminal air conditioning units.

The measures listed above will be evaluated in this report.

E.1 Evaluation Objectives

The objective of this evaluation report is to provide verification of electric savings impacts during the program year, which covers June 1, 2010 through May 31, 2011.

For this report, we examined the program's impact calculations and tracking data to answer the impact evaluation questions:

1. What are the gross impacts from this program?

2. Did the program meet its energy goals? If not, why not?

The process evaluation interviewed SEDAC implementers and PHA partners to explore how effective the program is with regards to outreach, implementation, and satisfaction. The other process evaluation questions were:

1. Is the program outreach to program partners effective in increasing awareness of the program opportunities?
2. Are the program processes effective for smoothly providing incentives to partners and motivating the program partners to participate?
3. How effective was the program implementation?

E.2 Evaluation Methods

The evaluation methods for this year included an algorithm review to verify that reasonable assumptions and methods were used for assigning ex-ante gross kWh and kW savings per measure.

Navigant used several sources to verify the reasonableness of the DCEO savings estimates including:

- Pennsylvania Public Utility Commission TRM
- The most current California Database for Energy Efficiency Resources (DEER) reports
- Efficiency Vermont's Technical Reference User Manual (TRM) 2010
- Navigant's own measure studies.

The data collection for the process evaluation included in-depth interviews with program implementation staff and program partners and a review of numerous reports and presentations the implementers used to promote and inform partners about the program.

E.3 Key Findings and Recommendations

Impact Evaluation

Based on the review of the measure savings algorithm, Navigant adjusted gross savings estimates for all measures except for the window air conditioners and packaged terminal heat pumps.

Table E-1 presents the ex ante (DCEO reported) and ex post (evaluation verified) gross and net program impact results for the Public Housing Authority Efficient Living program. As is common for low income programs, both the program and the evaluation assumed the net-to-gross ratio is one.

Table E-1. Summary of Gross and Net Savings for the Efficient Living Program

Efficient Living Program PY3	MWh Savings	
	Ex Ante	Ex Post
Gross Savings	1,330	1,331
Net-to-Gross Ratio	1	1
Net Savings	1,330	1,331

Table E-2. ComEd and Ameren Net Savings for the Efficient Living Program

Efficient Living Program PY3	MWh Savings	
	Ex Ante	Ex Post
ComEd	767	776
Ameren	563	555
Net Savings	1,330	1,331

Process Evaluation

The process evaluation of the Public Housing Authority Efficient Living Program concluded that this program is effectively administering a focused Low Income Multi-Family program.

The partners are very satisfied with the application process and interactions with the program staff.

The program's implementation strategy meets the industry best practices for low-income programs. The program is smoothly providing incentives to partners, providing a program that is easily understood by its targets, and providing timely responses to partner questions.

SEDAC retains all the invoices for the measure installations associated with the program. SEDAC has the information available to do a detailed and accurate impact evaluation. As this was the first year of the program there was some confusion over what information was needed to complete the impact evaluation.

- **Recommendation**. SEDAC and the evaluator collaborate to create a database that will provide the information needed to support a more thorough impact evaluation. This could be as simple as creating a spreadsheet with the required information or it could involve an on-line tracking system where the PHAs would be able to enter their information directly.

E.4 Cost Effectiveness Review

Cost effectiveness is assessed through the use of the Illinois Total Resource Cost (TRC) test. Table E-3 summarizes the unique inputs used to calculate the TRC ratio for the Public Housing Authority Efficient Living Program in PY3. Most of the unique inputs come directly from the evaluation results presented in this report. Measure life estimates were based on similar ComEd programs, third party sources including the California Public Utilities Commission (CPUC) developed Database of Energy Efficiency Resources (DEER) and previous Navigant evaluation experience with similar programs. Program costs data came directly from DCEO. Incremental costs were estimated from program, survey data and similar ComEd programs. Avoided cost data came from both ComEd and Ameren and are the same for all programs.

Table E-3. Inputs to TRC Model for Public Housing Authority Efficient Living Program

Item	Value Used
Measure Life	13 years
Annual Gross Energy Savings	1,331 MWh
Gross Coincident Peak Savings	0.72 MW
Net-to-Gross Ratio	100%
DCEO Administration and Implementation Costs	$250,782
DCEO Incentive Costs	$1,700,232
Net Participant Costs	$1,700,232

Based on these inputs, the Illinois societal TRC for this program is 0.40 and the program fails the Illinois TRC test. However the low income programs are not required to meet the TRC test.[1]

[1] ILCS 220 5/8-103(a) and 5/8-104(a), which states "The low income measures described in section (f)(4) of this Section shall not be required to meet the total resource cost test."

Section 1. Introduction to the Program

1.1 Program Description

The Public Housing Authority Efficient Living Program implements cost-effective energy efficient measures in Public Housing Authority buildings. The Smart Energy Design Assistance Center (SEDAC) at the University of Illinois in partnership with the Illinois Department of Commerce and Economic Opportunity (DCEO) manages this program. SEDAC aids the managers of Public Housing Authority buildings to incorporate cost-effective energy measures into their buildings. This program is authorized by the Energy Efficiency Section of the Public Utilities Act 20 ILCS 5/12-103 to administer a portion of the Illinois Energy Efficiency Portfolio Standards (EEPS).

This evaluation report focuses on the low income public housing units that have been part of the Efficient Living Program from the period June 1, 2010 to May 31, 2011. The residents in these buildings are all low income: Extremely Low-Income at or below 30% of the Average Median income, Very Low-Income at or below 50% of the Average Median income, or Low-Income at or below 80% of the Average Median income. The Average median income is calculated by the counties where the resident lives.

The program implements numerous measures to produce energy savings. The program also hauled and recycled refrigerators, window air conditioning units, and packaged terminal air conditioning units.

1.1.1 Measures and Incentives

Table 1-1 shows the electric efficiency measures and the associated incentive levels provided by the program.

Table 1-1. Energy Efficiency Measures and Incentives

	Measure	Incentive per Unit
1	Energy Star® refrigerator	$700
2	CFL Installation	$5
3	T8 replacement of T12	$13
4	LED Exit Signs	$25
5	Energy Star® Window Air-conditioning units	$400
6	PTHP unit replacement of PTAC units	$1,050
7	Occupancy Sensors	$30
8	Beverage Vending Miser	$150
9	Snack Vending Miser	$45
10	CEE TIER 3 clothes washers	$975
11	Fluorescent Fixtures	$65

Note: This table only includes the electric efficiency measures actually installed through the PHA program in PY3.

1.2 Evaluation Questions

The evaluation sought to answer the following key researchable questions:

Impact Questions

1. What are the gross annual energy (kWh) and peak demand (kW) savings achieved by the program?
2. Are the current engineering algorithms and tools for estimating gross energy savings accurate?
3. Do the documentation of measures installed through the program support those referred to in the program standards?

Process Questions

The process evaluation gathered information from in-depth interviews with the program implementers and housing managers.

Specifically, we focused the process evaluation to answer the following questions:

4. Is the program outreach to program partners effective in increasing awareness of the program opportunities?
    a. What is the format of the outreach?
    b. How often does the outreach occur?
    c. Are the messages within the outreach clear and actionable?

   d. What is the type of support that the program is giving the program partners and is it sufficient?

5. Are the program processes effective for smoothly providing incentives to partners and motivating the program partners to participate?

   a. Has the participation process and program requirements been clearly explained to program partners?

   b. How quickly does the program answer program partner questions?

   c. What is the expectation of the program partners and are they fulfilling that role?

   d. What suggestions do the program partners have about the current program elements and do they have any recommendations for improvement?

   e. Are program partners satisfied with the program processes in which they were involved?

   f. Is the application process onerous? Does the process present any barriers to program participation?

6. Effectiveness of program implementation

   a. Is implementation on track for meeting its goals?

Section 2. Evaluation Methods

2.1 *Analytical Methods*

2.1.1 Impact Evaluation Methods

The evaluation reviewed the energy savings algorithms to verify that the assumptions were reasonable and the algorithm was correct for assigning ex-ante gross kWh and kW savings per measure.

The first step was a verification of the mathematical soundness of the savings calculations for each measure. The measure algorithm's components were verified with the savings assumptions provided by SEDAC. The calculations were checked to ensure that the reported results could be replicated.

Once the calculation methods were verified, the reasonableness of the calculation was assessed. The assessment of reasonableness of the savings estimates was based on reputable measure savings evaluations from other sources and Navigant's own engineering calculations for similar measures.

2.1.2 Process Evaluation Methods

The process evaluation was primarily based on in-depth interviews with program staff and program partners. SEDAC program staff provided us with contact information for partners that received program funding in PY3. We were able to conduct in-depth interviews with partners. We also reviewed program materials including implementation plans, application materials, actual applications submitted to the program, program presentation material, and individual PHA case studies.

2.2 *Data Sources*

Program verification procedures, tracking systems and savings claims were evaluated based on program data and documents provided by program management and implementation staff, as well as interviews with program staff. Specifically, the following data were collected and analyzed in support of this evaluation:

- Program tracking data
- Program standards documents
- Program application details of project 'specifications'
- Relevant engineering algorithms and ex-ante savings calculations

- Secondary sources such as:
    - Pennsylvania Public Utility Commission TRM
    - The most current California Database for Energy Efficiency Resources (DEER) reports
    - Efficiency Vermont's Technical Reference User Manual (TRM) 2010
    - Navigant's own measure studies.
- Program staff interviews
- Program materials (Program presentations, individual PHA case studies)
- In-depth interviews with PHA participants
- SEDAC web-site

Section 3. Program Level Results

3.1 Impact Evaluation Results

The impact evaluation covered verification and due diligence issues, program tracking system review, and verification of gross and net savings for the program.

3.1.1 Verification and Due Diligence

The PHAs provide SEDAC with invoices to verify that the installations have occurred.

PHAs are responsible for ensuring that funded measures meet program requirements and are properly installed. The SEDAC program manager monitors PHAs compliance with the terms of the program.

Finding. The evaluation reviewed SEDAC's procedures and documentation and concluded that their verification procedures were adequate.

3.1.2 Tracking System Review

The tracking system was provided to Navigant by SEDAC. SEDAC created spreadsheets for each PHA that was involved in the program. The spreadsheets listed the number of measures installed for each PHA. Separate tracking spreadsheets by PHA and building is useful for analysis of measure savings by building type. The spreadsheets were populated from invoices provided by the PHAs.

Navigant suggests SEDAC create a formal database for next year. The database could be as simple as creating a spreadsheet with the required information or it could involve an on-line tracking system where the PHAs would be able to enter their information directly. The most essential information for the database is measure data from the measure they removed and measure data for the measure they installed. For the analysis we need the calculation equation and source/s of the equations.

3.1.3 Gross Program Impact Parameter Estimates

This section presents the results of the evaluation's technical review of the gross savings assumptions for each measure.

Energy Star Refrigerator

SEDAC assumes annual savings of 576 kWh per unit for their Energy Star Refrigerator measure based on energy use estimates of the replaced units subtracted from the Energy Star unit. SEDAC had model numbers for the units they replaced allowing for a specific estimate of the replaced units energy use.

Navigant's confirmed the energy saving estimate by model number for the replaced units from ASHRAE as well as the energy saving estimate for the Energy Star units. Navigant recommends SEDAC continue using 576 kWh per unit as long as the refrigerator stocks remain the same.

CFL Installation

SEDAC assumes annual savings of 49.2 kWh for their CFL Installation measure based on Energy Star calculator energy saving estimates. Navigant suggests adjusting this savings to 42.21 kWh for CFL Installation measure based on Navigant's evaluation of ComEd's residential lighting program. This suggestion is consistent with Navigant's evaluation of DCEO's Low Income Residential Retrofit program. There are several key assumptions to the calculation of savings for CFLs.

In-service Rate. In this program the bulbs are installed for the customer while other energy efficiency work is being done on the home. This justifies the use of the 100% in-service rate for this program. If the bulbs were distributed to the customer but not installed for them a lower in-service rate would be appropriate.

Hours of Use. SEDAC's estimate of 3 hours of use per day is based on the assumption that the demographic of the PHA multi-family buildings largely composed of the elderly which is different than standard residential buildings leading to different assumptions about run times of lighting. While SEDAC's reasoning is compelling, Navigant suggests considering a logger study to verify occupancy hours of use for future program years. Navigant's evaluation of the ComEd residential lighting program extensively explored hours of use with on-site verifications. The logger study estimated 2.57 hours of use per day for residential CFLs. Navigant recommends using 2.57 hours of use as it is the most justifiable estimate at this time.

Saved Watts per Bulb. DCEO assumed that the average replaced light bulb was a 60 Watt bulb and it was replaced with a 15 Watt CFL bulb. It is known that all of the installed bulbs were 15 watt bulbs for this program, however, this is only half of the equation. The wattage of the replaced light would be needed to improve the estimate of saved watts per bulb.

The energy saving equation suggested by the evaluation team is listed below.

kWh = delta watts/1000 * HOU/day * days/year

kWh = 45/1000 * 2.57 * 365

kWh = 42.21

Table 3-1. CFL Installation saving estimates

	SEDAC Assumption	Evaluation Recommended
Change in watts	45	45
HOU/day	3	2.57
days/year	365	365
Annual kWh savings	49.28	42.21

Energy Star rated Room Air Conditioner

SEDAC assumes annual savings of 176 kWh per unit for their Energy Star rated Room Air Conditioner measure based on the Energy Star calculator saving estimates.

SEDAC assumes the conventional room AC unit has an EER rating of 8.8, while the Energy Star room AC has an EER rating of 11.5. Based on these values, the Energy Star calculator estimates an annual kWh usage of 750 for the conventional unit and 574 for the efficient unit. The total annual savings per unit from this calculation is 176 kWh.

Navigant examined Vermont's 2010 TRM and Pennsylvania's 2011 TRM and concluded DCEO's EER rating parameters provide a reasonable estimate of savings and Navigant recommends DCEO continue using 176 kWh per unit.

CEE TIER 3 clothes washers

SEDAC assumes annual savings of 880 kWh per unit for CEE TIER 3 clothes washers based on Energy Star calculator energy saving estimates. These are commercial clothes washers that are used in multi-family common spaces. Navigant suggests adjusting this savings to 1,359 kWh per unit. The adjustment is based on the most current data available on CEE TEIR 3 commercial clothes washers, which includes a higher number of washing cycles per year than SEDAC assumed. SEDAC assumes less frequent washing cycles annually due to the elderly population that reside in the multi-family units. SEDAC's estimate of 802 annual cycles per year equates to 2.2 cycles per day. Navigant's estimate of 1,241 equates to 3.4 cycles per day. Navigant believes that 3.4 cycles per day is the most justifiable number at this time. Navigant believes that 3.4 cycles per day is the most justifiable number at this time. The energy savings equation below is the equation used by the evaluation team and SEDAC. The only value that differs in the two equations is the number of cycles per unit.

kWh Savings per machine = Washer Volume* (1/BaseMEF - 1/EFFMEF) * Number of washing cycles annually

Washer Volume 3.23

Base MEF 1.26 Federal Standard

CEE TIER 3 MEF 2.2 CEE Tier 3 Standard

Number of Cycles annually per unit = 1,241[2]

Table 3-2. Clothes Washer saving estimates

	SEDAC Assumption	Evaluation Recommended
Washer Volume	3.23	3.23
Base MEF	1.26	1.26
CEE TIER 3 MEF	2.2	2.2
Number of Cycles annually	803	1,241
Annual kWh savings	880	1,359

The Energy Star calculator's input for number of cycles annually is from the Energy Information Administration's (EIA) 2005 document "Residential Energy Consumption Survey: Preliminary Housing Characteristics Tables". The evaluation team's number of cycles annually is based on the Energy Efficiency & Renewable Energy's (EERE) 2009 "Technical Support Document: Energy Efficiency Program For Consumer Products and Commercial and Industrial Equipment". The EERE document uses the EIA study as well as other studies to arrive at the 1,241 annual cycles. The evaluation team suggests using the EERE document's number of cycles as more update research was in the document the EERE. The EERE document also had a focus on multi-family building types that are similar to the building types of the PHAs.

Navigant recommends using 1,394 kWh per unit. A metering study to gauge the amount of annual washing cycles could be useful to obtain more accurate saving estimates.

PTHP unit replacement of PTAC units

SEDAC assumes annual savings of 296 kWh per unit for PTHP unit replacement of PTAC units based on the Energy Star calculator. Below are equations for energy savings. SEDAC had detailed information on all the PTAC units that were replaced. SEDAC used the equations below to calculate their energy savings. Navigant's research found the equation to be the most reputable and standard.

[2] Technical Support Document: Energy Efficiency Program For Consumer Products and Commercial and Industrial Equipment: Residential Dishwashers, Dehumidifiers, and Cooking Products, and Commercial Clothes Washers http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/ccw_snopr_chap6.pdf US Department of Energy: Energy Efficiency & Renewable Energy. October 2009

kWhc = kBTU/hr × [(1/SEERbase - 1/SEERee)] × FLHs

kWhh = kBTU/hr × [(1/HSPFbase - 1/HSPFee)] × FLHw

The equation used by SEDAC for PTHP replacements was found to be consistent with other resources. The data SEDAC entered into the equation was derived from pre and post installation invoices, which Navigant believes is accurate. Navigant suggests keeping the savings of 296 kWh per unit annually.

4 foot T8 replacement of 4 foot T12

SEDAC assumes annual savings of 71 kWh per unit for 4 foot T8 replacement of 4 foot T12 based on Energy Star calculator energy savings. Navigant suggests adjusting this savings to 82 kWh per unit by increasing the hours of operation to be consistent with Navigant's evaluation report Smart Ideas for Your Business Prescriptive Program[3] report that adjusted the DEER report to hours reflecting the ComEd territory. The calculation for this measure was based on 2005 DEER report adjusted for the ComEd territory.

Energy savings are calculated by applying the annual operating hours according to the following formula:

kWh = Delta watts/1000 * Annual Operating Hours

Table 3-3. T8 replacement saving estimates

	SEDAC Assumption	Evaluation Recommendation
Delta watts	34	34
Annual Operating Hours	2088	2403
Annual kWh savings	71	82

[3] Evaluation Report: Smart Ideas for Your Business Business Prescriptive Program. Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011). Navigant Consulting. May 2012.

LED Exit Signs

SEDAC assumes annual savings of 324 kWh per unit for LED exit signs based on the assumption that the replaced exit sign used a 40 watt incandescent bulb and the LED sign used a 3 watt LED bulb.

Navigant's research of the Pennsylvania's 2011 TRM found SEDAC's assumptions to be reasonable for dual-sided LED exit signs replacing Incandescent exit signs. Navigant recommends SEDAC continue using 324 kWh per unit.

Occupancy Sensors

DCEO assumes annual savings of 397 kWh per unit for common space occupancy sensors based on the estimated number of fixtures connected to the occupancy sensor with the assumption that the occupancy sensor will reduced use of these fixtures by 30%.

Navigant finds the 397 kWh estimate to be reasonable based on Navigant's evaluation report Smart Ideas for Your Business Prescriptive Program.[4] The report uses DEER estimates and adjusts the Annual Operating Hours to ComEd territory appropriate hours. Navigant recommends SEDAC continue using 397 kWh per unit.

Beverage Vending Machine Misers

DCEO assumes annual savings of 1,612 kWh per unit for Vending Misers based on the replaced conventional vending machines estimated use subtracted from the vending miser's estimated use.

Navigant's research suggests that SEDAC savings is reasonable based on the 2010 Energy Star calculator using Lawrence Berkley National Lab study of Vending Misers. Navigant recommends SEDAC continue using 1,612 kWh per unit.

Snack Vending Machine Miser

SEDAC assumes annual savings of 387 kWh per unit for Vending Misers based on the replaced conventional vending machines estimated use subtracted from the vending miser's estimated use. Navigant's research concluded that 387 kWh per unit is an accurate estimate based on the Database for Energy-Efficient Resources (DEER). The DEER resource is an update of the Energy

[4] Evaluation Report: Smart Ideas for Your Business Business Prescriptive Program. Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011). Navigant Consulting May 2012.

Star calculator with more accurate occupancy sensor information which affects the vending machines hours of use. Navigant recommends SEDAC continue using 387 kWh per unit.

Fluorescent Fixtures

SEDAC assumes annual savings of 123.5 kWh per unit for Fluorescent Fixtures in residential units. SEDAC's calculations are based upon a mixture of 2-lamp and 3-lamp fixtures where 60 watt incandescent bulbs were replaced with 15 watt CFL bulbs. Navigant suggests adjusting this to 105.8 kWh per unit based on Navigant's evaluation report Smart Ideas for Your Business Prescriptive Program.[5] The report uses DEER estimates and adjusts the Annual Operating Hours to ComEd territory appropriate hours.

Energy savings are calculated according to the following formula:

kWh = Delta watts/1000 * Hours of use/day * days/year

Table 3-4. Fluorescent Fixture saving estimates

	SEDAC Assumption	Evaluation Recommendation
Delta W	112.8	112.8
Hours of use/day	3	2.57
Days/year	365	365
Annual kWh Savings	123.5	105.8

Summary of Energy Savings Assessment

Table 3- compares the original estimates of ex ante gross savings per unit to the final recommended verified values for each program measure.

Most of the measure-specific ex ante gross savings estimates were reasonable when compared to other authoritative sources.

[5] Evaluation Report: Smart Ideas for Your Business Business Prescriptive Program. Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011). Navigant Consulting May 2012.

Table 3-5. Summary of PY3 Verified Gross Energy Savings per Unit

	Measure	Ex Ante kWh per unit	Verified kWh per unit	Difference
1	Energy Star® refrigerator	576	576	0
2	CFL Installation	49.28	42.21	-7
3	T8 replacement of T12	71	82	11
4	LED Exit Signs	324	324	0
5	Energy Star® Window Air-conditioning units	176	176	0
6	PTHP unit replacement of PTAC units	296	296	0
7	Occupancy Sensors	397	397	0
8	Beverage Vending Miser	1,612	1,612	0
9	Snack Vending Miser	387	387	0
10	CEE TIER 3 clothes washers	880	1,359	479
11	Fluorescent Fixtures	123.5	105.8	-17.7

3.1.4 Gross Program Impact Results

The verified gross savings per unit for energy and demand savings can be used with the actual number of installations for each measure to show the overall gross program impact results for PY3.

The evaluation team recommends that SEDAC and the EM&V team continue to monitor measure saving estimate studies to continue to improve the programs saving estimates.

Table 3-6. Efficient Living Ex Ante and Ex Post Gross MWh Savings

	Ex Ante			Ex Post		
Measure	kWh/Unit	Units	Total MWh	kWh/Unit	Units	Total MWh
Energy Star® refrigerator	576	1,428	823	576	1,428	823
CFL Installation	49.28	1,276	63	42.21	1,276	54
T8 replacement of T12	71	648	46	82	648	53
LED Exit Signs	324	198	64	324	198	64
Energy Star® Window Air-conditioning units	176	854	150	176	854	150
PTHP unit replacement of PTAC units	296	185	55	296	185	55
Occupancy Sensors	397	84	33	397	84	33
Beverage Vending Miser	1,612	5	8	1,612	5	8
Snack Vending Miser	387	4	2	387	4	2
CEE TIER 3 clothes	880	25	22	1,359	25	34

Measure	Ex Ante			Ex Post		
	kWh/Unit	Units	Total MWh	kWh/Unit	Units	Total MWh
washers						
Fluorescent Fixtures	123.5	520	64	105.8	520	55
TOTAL		5,227	1,330		5,227	1,331

3.1.5 Net Program Impact Results

Since these programs specifically target organizations with limited means it is likely that the customers would not have funded new energy efficiency measures on their own. As a result, the EM&V team believes the Net-to-Gross factor should be 100%.

3.1.6 Net Program Impact Results

Table 3- presents the final gross and net program impact results for the Efficient Living program.

Table 3-7. Summary of Gross and Net Savings for the Efficient Living Program

Efficient Living Program PY3	MWh Savings	
	DCEO Claimed	Evaluation Verified
Gross Savings	1,330	1,331
Net-to-Gross Ratio	1	1
Net Savings	1,330	1,331

3.2 *Process Evaluation Results*

3.2.1 Process Themes

Marketing and Outreach Effectiveness

Initial Outreach

SEDAC conducted lunch-and-learn sessions to inform involved parties of the Efficient Living program. The attendants at these meetings were PHA Executive Directors and their staff; staff from the HUD, IL State Office of Public Housing; and the DCEO Energy Office.

Two separate lunch-and-learn sessions were held in January, 2011 that had a total of 39 attendees including 17 PHA representatives.

SEDAC also presented the Efficient Living program at the Illinois Association of Housing Authorities Maintenance and Management Clinic, and the Illinois Association of Housing and Redevelopment Officials Summer Conference.

Documentation

During the lunch-and-learn sessions and throughout the program year SEDAC presented updated documentation on the Efficient Living program. An extensive slide show presentation discussing the reason for creating the program, background of the energy efficiency program with a focus on the program specific needs, the program procedure, and common measures that are installed. SEDAC also produces case studies on specific PHA program results. These case studies provide a detailed description of the individual PHA projects that helped solicit participation from PHAs who have not been in the Efficient Living program.

SEDAC has an excellent web-site that provides all the needed documentation to participate in the program. The site also gives detailed information on the organization, past Efficient Living projects, news relating to the program, and an extensive resource section. The resource section has so much information regarding funding information, links to other energy efficiency organizations, energy and environmental links, and legislation links that it would be beneficial to create several pages within the resource tab for easier searching.

SEDAC retains all the invoices for the measure installations associated with the program. SEDAC has the information available to do a detailed and accurate impact evaluation. As this was the first year of the program there was some confusion over what information was needed to complete the impact evaluation.

In the future it could be beneficial if SEDAC and the evaluator collaborate to create a database that will provide the information needed for a more thorough impact evaluation. This could be as simple as creating a spreadsheet with the required information or it could involve an on-line tracking system where the PHAs would be able to enter their information directly.

Creating an Effective Program

SEDAC staff was involved in conferences and training sessions informing others of the Efficient Living program and discussing possible energy efficient measures, the potential for energy savings opportunities, and the program's application and administrative procedures.

Program Implementation Effectiveness

Below, we summarize the partners' satisfaction with the program in several key areas.

Designing a program that is easily understood by its intended targets

Best practices suggest that a program should be designed in such a way that its intended targets easily understand it. Interviews with the PHA organizations staff suggest that the program is easily understood by its targets. PHA staff found the initial lunch-and-learns to be informative which provided a strong foundation for the program running smoothly.

PHA staff found the application process to be clear.

Smoothly providing grants to partners to encourage participation

Smoothly providing grants to partners contributes to program satisfaction and motivates PHA organizations to participate. Interviews of PHA staff revealed they were satisfied with the time period with which the grants were received. PHA staff said SEDAC provided them with accurate time estimates for receiving the grants.

Providing timely responses to partner questions

Providing timely responses to PHA organization's questions contributes to program satisfaction and motivates partners to participate. SEDAC provided timely responses to PHA questions.

SEDAC has provided timely responses to PHA organization's questions. PHA staff were comfortable contacting SEDAC. Some PHA staff required more technical information regarding the requirements for replacement measures and administrative questions regarding invoices were all answered in a timely manner by SEDAC.

Communication

Partners were extremely satisfied with the level of communication with SEDAC. Partners expressed gratitude for being able to participate in the program. Partners were happy with the suggestion the implementers made for upgrades. The partners said all their questions were answered in a timely manner. The partners also said that the initial explanation of the program and informative feedback at every step kept the needed communication to a minimum.

3.3 Cost Effectiveness Review

This section addresses the cost effectiveness of the Public Housing Authority Efficient Living Program. Cost effectiveness is assessed through the use of the Illinois Total Resource Cost (TRC) test. The Illinois TRC test is defined in the Illinois Power Agency Act SB1592 as follows:

> *'Total resource cost test' or 'TRC test' means a standard that is met if, for an investment in energy efficiency or demand-response measures, the benefit-cost ratio is greater than one. The benefit-cost ratio is the ratio of the net present value of the total benefits of the program to the net*

> *present value of the total costs as calculated over the lifetime of the measures. A total resource cost test compares the sum of avoided electric utility costs, representing the benefits that accrue to the system and the participant in the delivery of those efficiency measures, to the sum of all incremental costs of end-use measures that are implemented due to the program (including both utility and participant contributions), plus costs to administer, deliver, and evaluate each demand-side program, to quantify the net savings obtained by substituting the demand-side program for supply resources. In calculating avoided costs of power and energy that an electric utility would otherwise have had to acquire, reasonable estimates shall be included of financial costs likely to be imposed by future regulations and legislation on emissions of greenhouse gases.*[6]

Navigant developed an Excel based TRC model that incorporates all relevant program level data including avoided costs, line losses, gross savings, free ridership, program costs and CO_2 reductions. It then calculates a TRC that meets the requirements of the Illinois Power Agency Act SB1592. The two electric distribution companies (EDCs) that pass funds to DCEO's programs, ComEd and Ameren, utilize different avoided costs in calculating the benefits that accrue from energy efficiency programs; therefore Navigant employed each utility's specific avoided costs to their corresponding energy and demand savings from each program.

Results

Table 3-8 summarizes the unique inputs used to calculate the TRC ratio for the Public Housing Authority Efficient Living Program in PY3. Most of the unique inputs come directly from the evaluation results presented previously in this report. Measure life estimates were based on similar ComEd programs, third party sources including the California Public Utilities Commission (CPUC) developed Database of Energy Efficiency Resources (DEER) and previous Navigant evaluation experience with similar programs. Program costs data came directly from DCEO. Incremental costs were estimated from program, survey data and similar ComEd programs. Avoided cost data came from both ComEd and Ameren and are the same for all programs.

[6] Illinois Power Agency Act SB1592, pages 7-8.

Table 3-8. Inputs to TRC Model for Public Housing Authority Efficient Living Program

Item	Value Used
Measure Life	13 years
Annual Gross Energy Savings	1,331 MWh
Gross Coincident Peak Savings	0.72 MW
Net-to-Gross Ratio	100%
DCEO Administration and Implementation Costs	$250,782
DCEO Incentive Costs	$1,700,232
Net Participant Costs	$1,700,232

Based on these inputs, the Illinois societal TRC for this program is 0.40 and the program fails the Illinois TRC test. However the low income programs are not required to meet the TRC test.[7]

[7] ILCS 220 5/8-103(a) and 5/8-104(a), which states "The low income measures described in section (f)(4) of this Section shall not be required to meet the total resource cost test."

Section 4. Conclusions and Recommendations

This section highlights the conclusions and recommendations from the PY3 evaluation of the Efficient Living program.

4.1 Key Impact Conclusions and Recommendations

Tracking System Finding: The tracking system kept individual spreadsheets for each PHA.

Recommendation: It would be beneficial to have one uniform spreadsheet to be used for the entire program. A uniform tracking sheet would aid in data collection and analysis. SEDAC and the evaluator should collaborate to create a database that will provide the information needed for an impact evaluation. This could be as simple as creating a spreadsheet with the required information or it could involve an on-line tracking system where the PHAs would be able to enter their information directly.

CFLs Finding: SEDAC based their CFL ex ante savings on Energy Star calculator saving estimates. EM&V staff examined Navigant's evaluation of the ComEd residential lighting program that adjusted hours of use and concluded that it represents a more accurate estimate of likely energy savings. Navigant conducted a lighting logger study for ComEd that estimated the hours of use (HOU) and peak coincidence factor for CFL installations. The logger study estimated the HOU at 2.57 hours per day. The HOU adjustment changes the kWh savings from 49.28 to 42.21. This study is more representative of the HOU in the DCEO area than the California study that was previously used for HOU.

Recommendation: Navigant recommends adjusting the savings for CFL installations to 42.21 kWh per CFL from the current 49.28 kWh.

Clothes Washer Finding: SEDAC based their clothes washer ex ante savings on Energy Star calculator saving estimates. EM&V staff examined the DOE's 2009 "Technical Support Document: Energy Efficiency Program For Consumer Products and Commercial and Industrial Equipment"[8] and concluded that it represents a more accurate estimate of likely energy savings. Navigant's research of best savings estimates concluded that 1,395 kWh was the best saving estimate for CEE TIER 3 clothes washers. The Energy Information Administration had the most reputable data on CEE TIER 3 clothes washers and the annual washing cycles per unit. One of the most important factors in the annual energy savings is the amount of washing cycles the

[8] U.S. Department of Energy-Office of Energy Efficiency and Renewable Energy. Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Dishwashers, Dehumidifiers, Cooking Products, and Commercial Clothes Washers, October, 2009. Washington, DC. http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/ccw_finalrule_ch6.pdf

machine performs in a year. The evaluation research reported the most reputable number for number of washing cycles that our research could find.

Recommendation: Navigant recommends adjusting the savings for CEE Tier 3 clothes washers to 1,359 kWh per unit. A metering study to determine the number of annual washing cycles would be useful.

4 foot T8 replacement of 4 foot T12 Finding: SEDAC based their T8 replacement ex ante savings on Energy Star calculator saving estimates. EM&V staff examined Navigant's evaluation report Smart Ideas for Your Business Prescriptive Program[9] that adjusted the DEER report to hours reflecting the ComEd territory and concluded that it represents a more accurate estimate of likely energy savings. Navigant's research of best savings estimates concluded that 82 kWh per unit was the best saving estimate for 4 foot T8 replacement of 4 foot T12. Energy savings are calculated by applying the annual operating hours and the energy interactive effect.

Recommendation: Navigant recommends adjusting this savings to 82 kWh per unit.

Fluorescent Fixtures Finding: SEDAC assumes annual savings of 123.5 kWh per unit for Fluorescent Fixtures in residential units. SEDAC's calculations are based upon a mixture of 2-lamp and 3-lamp fixtures where 60 watt incandescent bulbs were replaced with 15 watt CFL bulbs. Navigant suggests adjusting this to 105.8 kWh per unit based on Navigant's evaluation report Smart Ideas for Your Business Prescriptive Program.[10] The report uses DEER estimates and adjusts the Annual Operating Hours to ComEd territory appropriate hours.

Recommendation: Navigant recommends adjusting this savings to 105.8 kWh per unit.

Efficient Living Program

Table 4-1 presents the ex ante and ex post gross MWh savings for the Efficient Living program. The ex post energy savings for the Efficient Living program are higher than the ex ante energy savings due to the adjustments in the measure savings estimates.

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[9] Evaluation Report: Smart Ideas for Your Business Business Prescriptive Program. Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011). Navigant Consulting. May 2012

[10] Evaluation Report: Smart Ideas for Your Business Business Prescriptive Program. Energy Efficiency / Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011). Navigant Consulting May 2012

Table 4-1. Efficient Living Program Ex Ante and Ex Post Gross MWh Savings

Measure	Ex Ante			Ex Post		
	kWh/Unit	Units	Total MWh	kWh/Unit	Units	Total MWh
Energy Star® refrigerator	576	1,428	823	576	1,428	823
CFL Installation	49.28	1,276	63	42.21	1,276	54
T8 replacement of T12	71	648	46	82	648	53
LED Exit Signs	324	198	64	324	198	64
Energy Star® Window Air-conditioning units	176	854	150	176	854	150
PTHP unit replacement of PTAC units	296	185	55	296	185	55
Occupancy Sensors	397	84	33	397	84	33
Beverage Vending Miser	1,612	5	8	1,612	5	8
Snack Vending Miser	387	4	2	387	4	2
CEE TIER 3 clothes washers	880	25	22	1,359	25	34
Fluorescent Fixtures	123.5	520	64	105.8	520	55
TOTAL		5,227	1,330		5,227	1,331

Note: These tables only include the electric efficiency measures actually installed through the Efficient Living program in PY3.

Table 4-2 presents the net savings impact contributions of ComEd and Ameren for the Efficient Living program.

Table 4-2. ComEd and Ameren Net Savings for the Efficient Living Program

Efficient Living Program PY3	MWh Savings	
	Ex Ante	Ex Post
ComEd	767	776
Ameren	563	555
Net Savings	1,330	1,331

4.2 Key Process Conclusions and Recommendations

Findings: The evaluation team concluded that DCEO and SEDAC are effectively administering this program. SEDAC's outreach is effective in recruiting PHAs as well as providing a comprehensive description of the program that helps the program run smoothly. SEDAC provides numerous types of program documentation, slide show presentations, case studies of

individual PHA projects, a web-site with access to the program applications and all the presentation material as well as an extensive resource page, applications, invoices, saving spreadsheets, and the year-end report. These documents provided a clear picture of the program goals and the program's progress. The PHA staff are very satisfied with the application process and interactions with the program staff. The program's implementation strategy meets many of the industry best practices for low-income programs. The program staff are smoothly providing incentives to partners, providing a program that is easily understood, providing timely responses to PHA staff. SEDAC attended numerous affordable housing/ low-income housing conferences and training sessions to inform others of the Efficient Living program as well as learn ways to improve the program.

SEDAC retains all the invoices for the measure installations associated with the program. SEDAC has the information available to do a detailed and accurate impact evaluation. As this was the first year of the program there was some confusion over what information was needed to complete the impact evaluation.

Recommendation: In the future it could be beneficial if SEDAC and the evaluator collaborate to create a database that will provide the information needed to support a more thorough impact evaluation. This could be as simple as creating a spreadsheet with the required information or it could involve an on-line tracking system where the PHAs would be able to enter their information directly.