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Cost Effectiveness of 2015 IECC Compliance Using the HERS Index

Florida Solar Energy Center

Philip W. Fairey
Florida Solar Energy Center, pfairey@fsec.ucf.edu

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Residential Energy Services Network, Inc.
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Authors

Philip Fairey
Florida Solar Energy Center

Meg Waltner
David Goldstein
Natural Resources Defense Council

and

Eric Makela
Britt/Makela Group

1679 Clearlake Road
Cocoa, Florida 32922, USA
(321) 638-1000

www.floridaenergycenter.org

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Background

The Residential Energy Services Network (RESNET) contracted the Florida Solar Energy Center (FSEC) to conduct cost effectiveness analysis of new homes configured to comply with the Energy Rating Index (ERI) compliance provisions of the 2015 International Energy Conservation Code (IECC). The ERI compliance provisions of the 2015 IECC resulted from acceptance of code proposal RE 188-13. Simulation analysis of homes configured to comply with the 2012 IECC were used as the basis for the analysis and compared against homes meeting the ERI thresholds of the 2015 IECC for typical residences across representative U.S. climates. EnergyGauge® USA (v.3.1.02), a RESNET-accredited HERS software tool, was used to conduct the simulation analysis.

This study relies on previous simulation and analysis works used in the development of the ERI compliance values that were adopted by the 2015 IECC (Fairey 2013). This work extends the earlier work to include a set of cost effectiveness analysis of 2015 IECC compliance using the 2012 IECC *Standard Reference Design* as the basis of comparison and the HERS Index as the measure of ERI compliance.

Abstract

The EnergyGauge HERS software tool is used to examine the 2012 IECC *Standard Reference Design* (IECC SRD) configuration for three-bedroom, one-story 2000 ft^2 and three-bedroom, two-story 2,400 ft^2 single-family homes in sixteen representative U.S. cities. The energy use of the 2012 SRD homes is compared against the energy use of homes complying with the 2015 IECC using the ERI compliance method.

HERS simulations for each home are conducted for both a *best case* home orientation and a *worst case* home orientation. Improvements to the 2012 IECC SRD homes are made such that the HERS Index for the homes are at or below the ERI compliance scores prescribed by the 2015 IECC. The incremental improvement costs are estimated as the difference in cost between the SRD measure costs and the measure costs for the 2015 ERI compliant homes. Economic cost effectiveness calculations are performed in accordance with Section 4.6, ANSI/RESNET 301-2014.

The analysis show that the 2015 IECC ERI scores are cost effective in all of the 16 cities for all of the homes under all of the conditions studied. On a national basis, the climate

zone weighted average net present value (present value life-cycle savings minus present value life-cycle improvement costs) for the cohort of homes is $5,219. This is significant considering the fact that the weighted average first cost of making the energy efficiency improvements is $3,338.

Methodology

One-story, 2000 ft^2, 3-bedroom frame homes and two-story, 2400 ft^2, 3-bedroom frame homes were configured to simulate the 2012 IECC *Standard Reference Design* in sixteen representative cities across the eight IECC climate regions of the United States. Windows were configured such that 35% of the total window area was located on the front and rear faces of the home and 15% was located on the side faces. This allowed the simulations to examine a *best-case* orientation scenario with the front of the homes facing north and a *worst-case* scenario with the front facing east. The front of the homes also had a 20-foot adjoining garage wall. The foundation for the homes was varied by IECC climate zone with slab-on-grade foundations in zones 1 through 4 and with unconditioned basement foundations in zones 5 through 8.

Tables 1 through 5 present the 2012 IECC characteristics for the 64 different home configurations used as the baseline in the simulation analysis.

Table 1: *Best-Case* Home Characteristics

Component	1-story	2-Story
1st floor area (ft^2)	2,000	1,200
2nd floor area (ft^2)	0	1,200
Total above grade floor area (ft^2)	2,000	2,400
Total above grade volume (ft^3)	18,000	21,000
N-S wall length (ft)	50	40
E-W wall length (ft)	40	30
1st floor wall height (ft)	9	8
Height between floors (ft)	0	1.5
2nd floor wall height (ft)	0	8
Door area (ft^2)	40	40
Window/floor area ratio (%)	15%	15%
Total window area (ft^2)	300	360
N-S window fraction (%)	35%	35%
E-W window fraction (%)	15%	15%

Table 2: 2012 IECC Component Insulation Values

LOCATION	IECC CZ	Ceiling R-value	Wall R-value	Found. Type	Slab R-value	Floor R-value	Fen U-factor	Fen SHGC
Miami, FL	1A	30	13	SOG	none	n/a	0.50	0.25
Orlando, FL	2A	38	13	SOG	none	n/a	0.40	0.25
Houston, TX	2A	38	13	SOG	none	n/a	0.40	0.25
Phoenix, AZ	2B	38	13	SOG	none	n/a	0.40	0.25
Charleston, SC	3A	38	13+5	SOG	none	n/a	0.35	0.25
Charlotte, NC	3A	38	13+5	SOG	none	n/a	0.35	0.25
Ok. City, OK	3A	38	13+5	SOG	none	n/a	0.35	0.25
Las Vegas, NV	3B	38	13+5	SOG	none	n/a	0.35	0.25
Baltimore, MD	4A	49	13+5	SOG	10, 2ft	n/a	0.35	0.40
Kansas City, MO	4A	49	13+5	SOG	10, 2ft	n/a	0.35	0.40
Chicago, IL	5A	49	13+5	UCbsmt	n/a	30	0.32	0.40
Denver, CO	5B	49	13+5	UCbsmt	n/a	30	0.32	0.40

LOCATION	IECC CZ	Ceiling R-value	Wall R-value	Found. Type	Slab R-value	Floor R-value	Fen U-factor	Fen SHGC
Minneapolis, MN	6A	49	13+10	UCbsmt	n/a	30	0.32	0.40
Billings, MT	6B	49	13+10	UCbsmt	n/a	30	0.32	0.40
Fargo, ND	7A	49	13+10	UCbsmt	n/a	38	0.32	0.40
Fairbanks, AK	8	49	13+10	UCbsmt	n/a	38	0.32	0.40

Notes for Tables 2:

Wall R-value: 1st value is cavity fill and 2nd value is continuous insulation

SOG = slab on grade

Crawl = crawlspace

UCbsmt = unconditioned basement

Table 3: Additional 2012 IECC
Standard Reference Design Characteristics

Item	2012 IECC
Envelope Leakage	CZ 1-2: 5 ach50 CZ 3-8: 3 ach50
Air Distribution System Efficiency	See Table 4
Programmable Thermostat	Yes
High Efficiency Lighting	75%
Hot Water Pipe Insulation	Yes
Mechanical Ventilation (per 2012 IMC)	CZ 1-2: None CZ 3-8: 60 cfm
Sealed Air Handlers	Yes

Table 4: Air Distribution Systems (ADS) for 2012 *Standard Reference Designs*

Foundation Type	ADS location	Duct R-value	Duct leakage
Slab on grade	Attic	8	4 cfm25/100 ft^2
Basement	Basement	6	4 cfm25/100 ft2

Base thermostat set point temperatures for all simulations were maintained at the IECC 2006 values of 78 ^oF for cooling and 68 ^oF for heating. While the 2009 IECC and 2012 IECC use 75 F for cooling and 72 F for heating, use of these base thermostat set points for HERS Index compliance would not allow comparison.

Table 5: 2012 Equipment Standards

LOCATION	IECC CZ	Heating System		Cooling System		Water Heater	
		Fuel	Eff	Fuel	SEER	Fuel	EF
Miami, FL	1A	elec	7.7	elec	13	elec (50)	0.90
Orlando, FL	2A	elec	7.7	elec	13	elec (50)	0.90
Houston, TX	2A	elec	7.7	elec	13	elec (50)	0.90
Phoenix, AZ	2B	elec	7.7	elec	13	elec (50)	0.90
Charleston, SC	3A	elec	7.7	elec	13	elec (50)	0.90
Charlotte, NC	3A	gas	78%	elec	13	gas (40)	0.59
Ok. City, OK	3A	gas	78%	elec	13	gas (40)	0.59
Las Vegas, NV	3B	gas	78%	elec	13	gas (40)	0.59
Baltimore, MD	4A	gas	78%	elec	13	gas (40)	0.59
Kansas City, MO	4A	gas	78%	elec	13	gas (40)	0.59
Chicago, IL	5A	gas	78%	elec	13	gas (40)	0.59
Denver, CO	5B	gas	78%	elec	13	gas (40)	0.59
Minneapolis, MN	6A	gas	78%	elec	13	gas (40)	0.59
Billings, MT	6B	gas	78%	elec	13	gas (40)	0.59

LOCATION	IECC CZ	Heating System		Cooling System		Water Heater	
		Fuel	Eff	Fuel	SEER	Fuel	EF
Fargo, ND	7A	gas	78%	elec	13	gas (40)	0.59
Fairbanks, AK	8	gas	78%	elec	13	gas (40)	0.59

Notes for Tables 5 and 7:

Eff = heating system efficiency where gas-fired furnace is given as AFUE (%) and electric heat pump is given as HSPF

An additional 64 home configurations were created to comply with the ERI compliance criteria of the 2015 IECC. These ERI compliance criteria are given in Table 6.

Table 6: 2015 IECC Criteria

Climate Zone	ERI
Zone 1	52
Zone 2	52
Zone 3	51
Zone 4	54
Zone 5	55
Zone 6	54
Zone 7	53
Zone 8	53

Martin (2014) reports that the RESNET National Building Registry contains 270,580 registered HERS ratings. Of these, 33,426 or 12.4% comply with the 2015 IECC ERI compliance criteria given in Table 6.

The most common efficiency improvements employed in the study comprised 100% high-efficiency lighting; higher efficiency heating, cooling and water heating equipment; interior, leak-free duct systems; enhanced envelope efficiencies; and energy star refrigerators, dishwashers and clothes washers.

Improvement Costs

Incremental cost of improving the 2012 IECC SRD prototypes to comply with the ERI compliance criteria of the 2015 IECC are determined using the methodology used to evaluate the cost effectiveness of retrofits for the Building America program (Fairey and Parker 2012). In most cases, improvement costs used in the investigation parallel those available from the National Renewable Energy Laboratory's (NREL) National Residential Efficiency Measure Database.[1]

For heating and air conditioning equipment costs, Fairey and Parker (2012) relied on a separate methodology whereby the costs are expressed in an equation as a function of the equipment capacity and efficiency along with an offset, derived using available retail data and estimated fixed costs. The data and analysis that underlie these heating and cooling equipment cost equations are presented in Appendix B of Fairey and Parker (2012). For certain other costs, the NREL cost data were reduced to equations based on component areas and incremental improvement changes. For example, examination of the NREL data on fibrous insulation reveals that the cost of fibrous insulation is approximately

[1] www.nrel.gov/ap/retrofits/index.cfm

$0.035/ft^2 per R-value. For these types of improvements these costs were cast in such terms. For most other costs, the costs contained in the NREL database were adopted.

For ENERGY STAR appliance costs, representative pricing from the internet is used to determine incremental costs. However, this is difficult because most new appliances are now ENERGY STAR compliant and it is often difficult to find appliances with similar features that are not rated as ENERGY STAR.

Attic radiant barrier systems (RBS) were employed to enhance efficiency in a number of the cooling dominated and mixed climate homes. The cost of the RBS is determined as $0.25 per square foot of roof area. For each of the improved homes, the forced air distribution systems is brought into the conditioned space and tested to be leak free. The cost of this improvement is taken as $0.50 per square foot of conditioned floor area.

For HVAC equipment, the following equations are used to calculate installed retrofit costs (see Appendix B of Fairey and Parker 2012 for derivations).

- Heat pumps: –5539 + 604*SEER + 699*tons
- Air conditioners (with strip heat): –1409 + 292*SEER + 520*tons
- Gas furnace/air conditioner: –6067 + 568*SEER + 517*tons + 4.04*kBtu + 1468*AFUE
- Gas furnace only: –3936 + 14.95*kBtu + 5865*AFUE

where:
tons = air conditioning capacity, which is limited to a minimum value of 1.5 tons
kBtu = gas furnace capacity, which is limited to a minimum value of 45 kBtu

The estimating equations are valid for heat pump and cooling system sizes of 1.5–5 tons and multiples thereof. Similarly, the costs of gas heating equipment are based on heating capacities of 40–120 kBtu/h.

For envelope measures, incremental costs are determined as the difference between the measure cost for the 2012 IECC component and the measure cost of the improved component. For example, if the ceiling insulation level requirement in the 2012 IECC home is R-30 and it is increased to R-38 in the improved home, the incremental cost would be the R-value difference (8) times $0.035/R per square foot of ceiling area.

For heating, cooling and hot water equipment, the basis for determining the cost difference is slightly different. In these cases, the cost of the 2015 NAECA minimum equipment are used as the baseline cost from which incremental costs are determined. When the 2015 IECC becomes effective, the NEACA standards will require the minimum heating, cooling and hot water equipment efficiencies to increase somewhat. Since these will be the new equipment baseline for the 2015 IECC, they are used as the basis for the incremental cost calculations in this study. These 2015 NAECA equipment standards are given in Table 7.

Table 7: 2015 NAECA Minimum Equipment Standards

LOCATION	IECC CZ	Heating System		Cooling System		Water Heater	
		Fuel	Eff	Fuel	SEER	Fuel	EF
Miami, FL	1A	elec	8.2	elec	14	elec (50)	0.95
Orlando, FL	2A	elec	8.2	elec	14	elec (50)	0.95
Houston, TX	2A	elec	8.2	elec	14	elec (50)	0.95

LOCATION	IECC CZ	Heating System		Cooling System		Water Heater	
		Fuel	Eff	Fuel	SEER	Fuel	EF
Phoenix, AZ	2B	elec	8.2	elec	14	elec (50)	0.95
Charleston, SC	3A	elec	8.2	elec	14	elec (50)	0.95
Charlotte, NC	3A	gas	80%	elec	14	gas (40)	0.62
Ok. City, OK	3A	gas	80%	elec	14	gas (40)	0.62
Las Vegas, NV	3B	gas	80%	elec	14	gas (40)	0.62
Baltimore, MD	4A	gas	80%	elec	14	gas (40)	0.62
Kansas City, MO	4A	gas	80%	elec	13	gas (40)	0.62
Chicago, IL	5A	gas	80%	elec	13	gas (40)	0.62
Denver, CO	5B	gas	80%	elec	13	gas (40)	0.62
Minneapolis, MN	6A	gas	80%	elec	13	gas (40)	0.62
Billings, MT	6B	gas	80%	elec	13	gas (40)	0.62
Fargo, ND	7A	gas	80%	elec	13	gas (40)	0.62
Fairbanks, AK	8	gas	80%	elec	13	gas (40)	0.62

Economic Analysis

Economic analysis is based on a 30-year life-cycle-cost analysis using the methodology specified by Section 4.6, ANSI/RESNET 301-2014, which is based on the P1, P2 method of determining present worth values derived by Duffie and Beckman (1980). The equations used to determine P1 and P2 are given in Appendix A. The economic parameter values published on the RESNET web site for 2014[2] as augmented by an effective income tax rate of 25%, a property tax rate of 4% and a property assessment ratio of 80% were used in the analysis. These economic parameter values are given in Table 8.

Table 8: Economic Parameter Values

General Inflation Rate (GR)	2.53%
Discount Rate (DR)	4.53%
Mortgage Interest Rate (MR)	5.42%
Down payment Rate (DnPmt)	10.00%
Energy Inflation Rate (ER)	4.18%
Effective Income Tax Rate (iTR)	25.0%
Property Tax Rate (pTR)	4.0%
Assessment/Appraisal Ratio	80%

The life-cycle-cost analysis includes replacement costs (escalated at the general inflation rate) for measures lasting less than the full analysis period (standard residential mortgage period of 30 years in this case). For example, HVAC equipment, with an assumed service life of 15 years, would be replaced in year 16 and high efficiency CFL lighting, with an assumed service life of 5 years, would be replaced five times during the analysis period. Where incremental maintenance is required, a maintenance fraction is also included in the analysis.

Energy prices used in the analysis are the most recently published (2012) average annual U.S. prices for residential electricity and residential natural gas as provided by the U.S.

[2] http://www.resnet.us/professional/standards/mortgage

Energy Information Administration.[3] The prices used are $0.1177/kWh of electricity consumption and $1.045/therm of natural gas consumption. Energy prices are not varied in the analysis by location.

Findings

For the purposes of this study 'cost effective' is defined as the case in which the present value of the life-cycle energy cost reductions (the savings) exceeds the present value of the life-cycle improvement costs (the investment). The ratio of these two present values (Savings / Investment) is referred to as the savings-to-investment ratio or SIR. If the SIR is greater than unity, there is a net financial benefit derived from making the investment. The net present value (NPV) of the improvements is also calculated, where NPV equals the present value of the life-cycle energy cost reductions minus the present value of the life-cycle improvement costs.

The study finds that in all 64 cases, compliance with the ERI criteria of the 2015 IECC is cost-effective, including homes in *worst case* configurations. The detailed data for each home in each of the 16 TMY cities evaluated are given in Appendix B. The four set of results (1-story, 2-story, *best-case*, and *worst-case*) are averaged to determine the average data for each of the 16 TMY cities evaluated. The average values for each of the 8 climate zones are then taken as the averages of the cities in that climate zone. Once climate zone values are determined, it is possible to weight the results based on the fraction of new home starts in each climate zone (Drumheller 2012). Table 9 presents the summary of findings calculated in this manner.

Table 9: Summary of Life-Cycle-Cost Analysis Results

Climate Zone	IECC ERI	Avg. HERS	Avg. 1st cost	Avg. LC Cost	Avg. Savings	Avg. LC Save	SIR	NPV	CZ Weights
1	52	50	$3,435	$7,725	$532	$14,543	1.88	$6,818	0.96%
2	52	51	$4,009	$9,181	$498	$13,606	1.48	$4,425	21.43%
3	51	50	$3,302	$7,423	$465	$12,707	1.71	$5,284	25.77%
4	54	53	$2,951	$6,647	$460	$12,569	1.89	$5,922	22.76%
5	55	54	$3,356	$7,617	$442	$12,072	1.58	$4,455	21.03%
6	54	53	$2,695	$6,134	$461	$12,602	2.05	$6,467	6.79%
7	53	51	$2,813	$6,417	$503	$13,734	2.14	$7,317	0.75%
8	53	52	$2,727	$6,211	$700	$19,143	3.08	$12,931	0.50%
Averages		**52**	**$3,263**	**$7,399**	**$488**	**$13,347**	**1.80**	**$5,948**	
Weighted averages		**52**	**$3,338**	**$7,565**	**$468**	**$12,784**	**1.69**	**$5,219**	

Table 9 shows that climate zone 2 has the smallest SIR and climate zone 8 has the largest. The simple averages tend to over predict the weighted life-cycle savings due to the large savings in climate zone 8, which makes up only on half of one percent of new starts. It is also interesting to note that the NPV of improvements is greater than the 1st cost of improvements in all climate zones.

[3] http://www.eia.gov/

Appendix B provides detailed energy use, energy cost, improvement costs and economic cost effectiveness results for each building configuration for each of the 16 TMY sites evaluated by this study.

Conclusions

This study evaluates the cost effectiveness of meeting a stringent future-year code level of home energy efficiency using equipment widely enough available that its current costs can be determined. However, this equipment is not prevalent enough to state with certainty that the estimated incremental cost estimated by this study will not decline significantly as the market develops. Homes that currently meet this level of energy efficiency may be estimated at about 6% of the market by assuming that the 12.4% reported by the RESNET National Building Registry (Martin 2014) constitute less than half of the new home sales and that the remainder do not have a significant number of homes at this level of energy efficiency, otherwise they likely also would have been energy rated.

Costs are virtually certain to come down as the code encourages more builders to buy components that reach lower ERI scores. This is the case because when implemented, appliance efficiency standards (including those for heating, cooling and water heating equipment) actually end up costing much less than predicted using methodologies similar to those used in this study – so much less that a simple arithmetic average shows negative first costs overall (Nadel and deLaski 2012). This likely cost reduction applies to the heating, cooling and water heating equipment cost estimates used for this study.

In summary, the study shows that the ERI scores given by the 2015 IECC are cost effective even when worst-case pricing scenarios are used.

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Appendix A
Economic Cost Effectiveness

If analyses are conducted to evaluate energy saving improvements to the home, indicators of economic cost effectiveness shall use present value life-cycle costs and benefits, which shall be calculated as follows:

$$\mathbf{LCC_E = P1 * (1^{st}\ Year\ Energy\ Costs)} \qquad \textbf{Eq. [1]}$$

$$\mathbf{LCC_I = P2 * (1^{st}\ Cost\ of\ Improvements)} \qquad \textbf{Eq. [2]}$$

where:
- LCC_E = Present Value Life-Cycle Cost of Energy
- LCC_I = Present Value Life-Cycle Cost of Improvements
- P1 = Ratio of Life-Cycle energy costs to the 1^{st} year energy costs
- P2 = Ratio of Life-Cycle Improvement costs to the first cost of improvements

Present value life-cycle energy cost savings shall be calculated as follows:

$$\mathbf{LCC_S = LCC_{E,b} - LCC_{E,i}} \qquad \textbf{Eq. [3]}$$

where:
- LCC_S = Present Value Life Cycle Energy Cost Savings
- $LCC_{E,b}$ = Present Value LCC of energy for **baseline** home configuration
- $LCC_{E,i}$ = Present Value LCC of energy for **improved** home configuration

Standard economic cost effectiveness indicators shall be calculated as follows:

$$\mathbf{SIR = LCC_S / LCC_I} \qquad \textbf{Eq. [4]}$$

$$\mathbf{NPV = LCC_S - LCC_I} \qquad \textbf{Eq. [5]}$$

where:
- SIR = Present Value Savings to Investment Ratio
- NPV = Net Present Value of Improvements

Calculation of P1 and P2. The ratios represented by P1 and P2 shall be calculated in accordance with the following methodology[4]:

$$\mathbf{P1 = 1 / (DR - ER) * (1 - ((1 + ER) / (1 + DR))\wedge nAP)} \qquad \textbf{Eq. [6a]}$$

or if DR = ER then

$$\mathbf{P1 = nAP / (1+DR)} \qquad \textbf{Eq. [6b]}$$

where:
- P1 = Ratio of Present Value Life Cycle Energy Costs to the 1^{st} year Energy Costs
- DR = Discount Rate
- ER = Energy Inflation Rate
- nAP = number of years in Analysis Period

$$\mathbf{P2 = DnPmt + P2_A - P2_B + P2_C + P2_D - P2_E + P2_F} \qquad \textbf{Eq. [7]}$$

where:

[4] Duffie, J.A. and W.A. Beckman, 1980. *Solar Engineering of Thermal Processes*, pp. 398-406, John Wylie & Sons, Inc., New York, NY.

$P2$ = Ratio of Life Cycle Improvement costs to the first cost of improvements
DnPmt = Mortgage down payment rate
$P2_A$ = Mortgage cost parameter
$P2_B$ = Income Tax cost parameter
$P2_C$ = Operation & Maintenance cost parameter
$P2_D$ = Property tax cost parameter
$P2_E$ = Salvage value cost parameter
$P2_F$ = Replacement cost parameter

$P2_A$ = (1 - DnPmt) * (PWFd / PWFi) **Eq. [8a]**

where:
PWFd = Present Worth Factor for the discount rate = 1/DR*(1-(1/(1+DR)^nAP))
PWFi = Present Worth Factor for the mortgage rate = 1/MR*(1-(1/(1+MR)^nMP))
DR = Discount Rate
MR = Mortgage interest Rate
nAP = number of years of the Analysis Period
nMP = number of years of the Mortgage Period

$P2_B$ = (1 - DnPmt) * iTR * (PWdiff *(MR – 1 / PWFi) + PWFd / PWFi) **Eq. [8b]**

where:
iTR = effective income Tax Rate
PWdiff = ratio of the present worth discount rate to present worth mortgage rate
= 1 / (DR - MR) * (1- (((1 + MR) / (1 + DR))^nMP))

or if DR = MR then
= nMP/(1+MR)

$P2_C$ = MFrac*PWinf **Eq. [8c]**

where:
MFrac = annual O&M costs as a fraction of first cost of improvements
PWinf = ratio of present worth discount rate to present worth general inflation rate
= 1/(DR-GR)*(1-(((1+GR)/(1+DR))^nAP))

or if DR = GR then
= nAP/(1+DR)

GR = General Inflation Rate

$P2_D$ = pTR*AssessRatio*PWinf **Eq. [8d]**

where:
pTR = effective property Tax Rate
AssessRatio = Fraction of assessed property value against which pTR is applied (typically 0.80)

$P2_E$ = RLF / ((1 + DR)^nAP) **Eq. [8e]**

where:
RLF = Remaining Life Fraction following the end of the analysis period
and
RLF = (nAP/Life) – (Integer (nAP/Life))

or if Life > nAP
RLF = (Life-nAP) / nAP
where:
Life = useful service life of the improvement(s)

$P2_F$ = Sum {1 / ((1 + (DR - GR))^(Life*i))} for i=1, n **Eq. [8f]**

where:
i = the i^{th} replacement of the improvement
Life = the expected service life of the improvement

Determination of Economic Parameters. Economic parameter values used in the cost effectiveness calculations shall be determined as follows:

General Inflation Rate (GR) shall be the greater of the 5-year and the 10-year Annual Compound Rate (ACR) of change in the Consumer Price Index for Urban Dwellers (CPI-U) as reported by the U.S. Bureau of Labor Statistics, where ACR shall be calculated in accordance with equation [9].

ACR = ((endVal)/(startVal))^(1.0/((endYr)-(startYr)))-1.0 **Eq. [9]**

where:
ACR = Annual Compound Rate of change
endVal = Value of parameter at end of period
startVal = Value of parameter at start of period
endYr = Year number at end of period
startYr = Year number at start of period

Discount Rate (DR) shall be equal to the General Inflation Rate plus 2%.

Mortgage Interest Rate (MR) shall be the greater of the 5-year and the 10-year average of simple interest rate for fixed rate, 30-year mortgages computed from the Primary Mortgage Market Survey (PMMS) as reported by Freddie Mac.

Down Payment Rate (DnPmt) shall be 10% of 1st cost of improvements.

Energy Inflation Rate (ER) shall be the greater of the 5-year and the 10-year Annual Compound Rate (ACR) of change in the Bureau of Labor Statistics, Table 3A, Housing, Fuels and Utilities, Household Energy Index[5] as calculated using Equation [9].

Mortgage Period (nMP) shall be defaulted to 30 years unless a mortgage finance period is specified by a program or mortgage lender, in which case the specified mortgage period shall be used. The mortgage period used in the cost effectiveness calculation shall be disclosed in reporting results.

[5] Table 3A from detailed reports listed at http://www.bls.gov/cpi/cpi_dr.htm

Table B-1: Detailed results for Miami, FL, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	13,048	0	$1,536	80	8,779	0	$1,033	50
1-sty Wrst Case	13,149	0	$1,548	81	8,868	0	$1,044	51
2-sty Best Case	14,444	0	$1,700	78	9,679	0	$1,139	49
2-sty Wrst Case	14,557	0	$1,713	79	9,787	0	$1,152	50
Averages	**13,800**	**0**	**$1,624**	**80**	**9,278**	**0**	**$1,092**	**50**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	4,269	0	$502	30	$3,494	$7,835	$13,731	1.75
1-sty Wrst Case	4,281	0	$504	30	$3,494	$7,835	$13,770	1.76
2-sty Best Case	4,765	0	$561	29	$3,375	$7,615	$15,327	2.01
2-sty Wrst Case	4,770	0	$561	29	$3,375	$7,615	$15,343	2.01
Averages	**4,521**	**0**	**$532**	**30**	**$3,435**	**$7,725**	**$14,543**	**1.88**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16HP*	$4,280	$5,307	$1,027	15		2.396	$2,462
Capacity (kBtu)	23.4	20.3					
SEER	14	16					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100% FL	$200	$300	$100	5		5.056	$506
Attic RBS	$0	$542	$542	30		1.653	$896
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,494**				**$7,835**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16HP*	$4,525	$5,430	$905	15		2.396	$2,169
Capacity (kBtu)	27.6	22.4					
SEER	14	16					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100% FL	$240	$360	$120	5		5.056	$607
Attic RBS	$0	$325	$325	30		1.653	$537
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,375**				**$7,615**

* Heat pump cost calculations based on capacity, SEER and HSPF values

Table B-2: Detailed results for Orlando, FL, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	**Th/y**	**$/yr**	**HERS**	**kWh/y**	**Th/y**	**$/yr**	**HERS**
1-sty Best Case	11,713	0	$1,379	79	8,031	0	$945	51
1-sty Wrst Case	11,812	0	$1,390	80	8,094	0	$953	52
2-sty Best Case	13,077	0	$1,539	76	8,974	0	$1,056	50
2-sty Wrst Case	13,205	0	$1,554	78	9,064	0	$1,067	51
Averages	**12,452**	**0**	**$1,466**	**78**	**8,541**	**0**	**$1,005**	**51**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	**Δ Th/y**	**Δ $/yr**	**Δ HERS**	**1stCost**	**LC Cost**	**LC Save**	**SIR**
1-sty Best Case	3,682	0	$433	28	$4,232	$9,603	$11,843	1.23
1-sty Wrst Case	3,718	0	$438	28	$4,232	$9,603	$11,959	1.25
2-sty Best Case	4,103	0	$483	26	$3,973	$9,048	$13,197	1.46
2-sty Wrst Case	4,141	0	$487	27	$3,973	$9,048	$13,320	1.47
Averages	**3,911**	**0**	**$460**	**27**	**$4,103**	**$9,326**	**$12,580**	**1.35**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER17HP*	$4,257	$6,022	$1,765	15		2.396	$4,230
Capacity (kBtu)	23.0	22.2					
SEER	14	17					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$4,232**				**$9,603**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER17HP*	$4,519	$6,022	$1,503	15		2.396	$3,602
Capacity (kBtu)	27.5	22.2					
SEER	14	17					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$240	$360	$120	5		5.056	$607
RBS	$0	$325	$325	30		1.653	$537
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,973**				**$9,048**

* Heat pump cost calculations based on capacity, SEER and HSPF values

Table B-3: Detailed results for Houston, TX, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	12,695	0	$1,494	78	8,684	0	$1,022	51
1-sty Wrst Case	12,808	0	$1,508	79	8,761	0	$1,031	52
2-sty Best Case	14,149	0	$1,665	76	9,721	0	$1,144	50
2-sty Wrst Case	14,320	0	$1,685	77	9,829	0	$1,157	51
Averages	**13,493**	**0**	**$1,588**	**78**	**9,249**	**0**	**$1,089**	**51**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	4,011	0	$472	27	$4,708	$10,743	$12,901	1.20
1-sty Wrst Case	4,047	0	$476	27	$4,708	$10,743	$13,017	1.21
2-sty Best Case	4,428	0	$521	26	$4,345	$10,181	$14,243	1.40
2-sty Wrst Case	4,491	0	$529	26	$4,345	$10,181	$14,445	1.42
Averages	**4,244**	**0**	**$500**	**27**	**$4,527**	**$10,462**	**$13,652**	**1.30**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER18HP*	$4,501	$6,743	$2,241	15		2.396	$5,370
Capacity (kBtu)	27.2	24.2					
SEER	14	18					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$4,708**				**$10,743**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER18HP*	$4,723	$6,923	$2,200	15		2.396	$5,272
Capacity (kBtu)	31.0	27.3					
SEER	14	18					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$240	$360	$120	5		5.056	$607
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$4,345**				**$10,181**

* Heat pump cost calculations based on capacity, SEER and HSPF values

Table B-4: Detailed results for Phoenix, AZ, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	13,857	0	$1,631	74	9,654	0	$1,136	50
1-sty Wrst Case	14,077	0	$1,657	76	9,609	0	$1,131	51
2-sty Best Case	15,486	0	$1,823	73	10,792	0	$1,270	50
2-sty Wrst Case	15,759	0	$1,855	75	10,985	0	$1,293	51
Averages	**14,795**	**0**	**$1,741**	**75**	**10,260**	**0**	**$1,208**	**51**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	4,203	0	$495	24	$3,425	$7,667	$13,519	1.76
1-sty Wrst Case	4,468	0	$526	25	$3,425	$7,667	$14,371	1.87
2-sty Best Case	4,694	0	$552	23	$3,369	$7,842	$15,098	1.93
2-sty Wrst Case	4,774	0	$562	24	$3,369	$7,842	$15,356	1.96
Averages	**4,535**	**0**	**$534**	**24**	**$3,397**	**$7,755**	**$14,586**	**1.88**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16HP*	$4,373	$5,331	$958	15		2.396	$2,294
Capacity (kBtu)	25.0	20.7					
SEER	14	16					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,425**				**$7,667**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16HP*	$4,665	$5,564	$899	15		2.396	$2,155
Capacity (kBtu)	30.0	24.7					
SEER	14	16					
HSPF	8.2	9.2					
HPWH (EF = 2.5)	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$240	$360	$120	5		5.056	$607
RBS	$0	$325	$325	15		2.396	$779
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,369**				**$7,842**

* Heat pump cost calculations based on capacity, SEER and HSPF values

Table B-5: Detailed results for Charleston, SC, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	**Th/y**	**$/yr**	**HERS**	**kWh/y**	**Th/y**	**$/yr**	**HERS**
1-sty Best Case	13,281	0	$1,563	80	8,707	0	$1,025	51
1-sty Wrst Case	13,440	0	$1,582	82	8,814	0	$1,037	53
2-sty Best Case	14,515	0	$1,708	77	9,554	0	$1,125	50
2-sty Wrst Case	14,715	0	$1,732	79	9,683	0	$1,140	51
Averages	**13,988**	**0**	**$1,646**	**80**	**9,190**	**0**	**$1,082**	**51**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	**Δ Th/y**	**Δ $/yr**	**Δ HERS**	**1stCost**	**LC Cost**	**LC Save**	**SIR**
1-sty Best Case	4,574	0	$538	29	$4,208	$9,544	$14,712	1.54
1-sty Wrst Case	4,626	0	$544	29	$4,208	$9,544	$14,880	1.56
2-sty Best Case	4,961	0	$584	27	$3,560	$8,300	$15,957	1.92
2-sty Wrst Case	5,032	0	$592	28	$3,560	$8,300	$16,186	1.95
Averages	**4,798**	**0**	**$565**	**28**	**$3,884**	**$8,922**	**$15,434**	**1.73**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16HP*	$4,635	$6,226	$1,591	15		2.396	$3,811
Capacity (kBtu)	29.5	25.7					
SEER	14	17					
HSPF	8.2	9.2					
HPWH	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$4,208**				**$9,544**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16HP*	$4,793	$5,733	$940	15		2.396	$2,252
Capacity (kBtu)	32.2	27.6					
SEER	14	16					
HSPF	8.2	9.2					
HPWH	$300	$1,000	$700	15	2.22%	2.884	$2,019
100%FL	$240	$360	$120	5		5.056	$607
RBS	$0	$325	$325	15		2.396	$779
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,560**				**$8,300**

* Heat pump cost calculations based on capacity, SEER and HSPF values

Table B-6: Detailed results for Charlotte, NC, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	7,914	474	$1,427	78	6,498	274	$1,051	50
1-sty Wrst Case	8,012	480	$1,445	79	6,597	279	$1,068	51
2-sty Best Case	8,962	488	$1,565	75	7,280	315	$1,186	50
2-sty Wrst Case	9,112	495	$1,590	77	7,373	320	$1,202	51
Averages	**8,500**	**484**	**$1,506**	**77**	**6,937**	**297**	**$1,127**	**51**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,416	200	$376	28	$3,524	$7,766	$10,266	1.32
1-sty Wrst Case	1,415	201	$377	28	$3,524	$7,766	$10,292	1.33
2-sty Best Case	1,682	173	$379	25	$3,155	$7,188	$10,351	1.44
2-sty Wrst Case	1,739	175	$388	26	$3,155	$7,188	$10,591	1.47
Averages	**1,563**	**187**	**$380**	**27**	**$3,339**	**$7,477**	**$10,375**	**1.39**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16GF96*	$4,160	$5,367	$1,207	15		2.396	$2,892
Cooling Cap (kBtu)	21.8	18.0					
SEER	14	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tankless gas WH	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,524**				**$7,766**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16GF96*	$4,277	$5,436	$1,160	15		2.396	$2,779
Cooling Cap (kBtu)	24.5	19.6					
SEER	14	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tankless gas WH	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,155**				**$7,188**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-7: Detailed results for Oklahoma City, OK, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	**Th/y**	**$/yr**	**HERS**	**kWh/y**	**Th/y**	**$/yr**	**HERS**
1-sty Best Case	9,328	609	$1,734	75	6,588	408	$1,202	49
1-sty Wrst Case	9,466	610	$1,752	76	6,681	411	$1,216	50
2-sty Best Case	9,676	640	$1,808	73	7,848	429	$1,372	49
2-sty Wrst Case	9,852	645	$1,834	74	7,971	433	$1,391	50
Averages	**9,581**	**626**	**$1,782**	**75**	**7,272**	**420**	**$1,295**	**50**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	**Δ Th/y**	**Δ $/yr**	**Δ HERS**	**1stCost**	**LC Cost**	**LC Save**	**SIR**
1-sty Best Case	2,740	201	$533	26	$2,706	$5,806	$14,553	2.51
1-sty Wrst Case	2,785	199	$536	26	$2,706	$5,806	$14,641	2.52
2-sty Best Case	1,828	211	$436	24	$2,828	$6,406	$11,906	1.86
2-sty Wrst Case	1,881	212	$443	24	$2,828	$6,406	$12,105	1.89
Averages	**2,309**	**206**	**$487**	**25**	**$2,767**	**$6,106**	**$13,301**	**2.18**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER15GF96*	$4,501	$4,890	$389	15		2.396	$933
Cooling Cap (kBtu)	29.7	20.1					
SEER	14	15					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,706**				**$5,806**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER15GF96*	$4,400	$5,058	$658	15		2.396	$1,577
Cooling Cap (kBtu)	26.7	24.0					
SEER	14	15					
Heating Cap (kBtu)	47	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
RBS	$0	$325	$325	15		2.396	$779
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,828**				**$6,406**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-8: Detailed results for Las Vegas, NV, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	10,188	315	$1,528	73	7,572	209	$1,110	50
1-sty Wrst Case	10,388	322	$1,559	75	7,693	214	$1,129	52
2-sty Best Case	11,162	316	$1,644	70	8,426	214	$1,215	49
2-sty Wrst Case	11,406	322	$1,679	72	8,592	220	$1,241	50
Averages	**10,786**	**319**	**$1,603**	**73**	**8,071**	**214**	**$1,174**	**50**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	2,616	106	$419	23	$3,215	$7,025	$11,442	1.63
1-sty Wrst Case	2,695	108	$430	23	$3,215	$7,025	$11,753	1.67
2-sty Best Case	2,736	102	$429	21	$3,222	$7,349	$11,713	1.59
2-sty Wrst Case	2,814	102	$438	22	$3,222	$7,349	$11,964	1.63
Averages	**2,715**	**105**	**$429**	**22**	**$3,218**	**$7,187**	**$11,718**	**1.63**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16GF96*	$4,397	$5,445	$1,048	15		2.396	$2,510
Cooling Cap (kBtu)	27.3	19.8					
SEER	14	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,215**				**$7,025**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16GF96*	$4,505	$5,557	$1,052	15		2.396	$2,521
Cooling Cap (kBtu)	29.8	22.4					
SEER	14	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
RBS	$0	$325	$325	15		2.396	$779
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,222**				**$7,349**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-9: Detailed results for Baltimore, MD, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	7,800	602	$1,547	82	6,102	392	$1,128	52
1-sty Wrst Case	7,952	614	$1,578	85	6,219	399	$1,149	54
2-sty Best Case	8,822	650	$1,718	80	6,941	414	$1,250	51
2-sty Wrst Case	9,006	658	$1,748	82	7,069	422	$1,273	53
Averages	**8,395**	**631**	**$1,647**	**82**	**6,583**	**407**	**$1,200**	**53**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,698	210	$419	30	$3,507	$7,725	$11,459	1.48
1-sty Wrst Case	1,733	215	$429	31	$3,507	$7,725	$11,714	1.52
2-sty Best Case	1,881	236	$468	29	$3,480	$7,967	$12,790	1.61
2-sty Wrst Case	1,937	236	$475	29	$3,480	$7,967	$12,970	1.63
Averages	**1,812**	**224**	**$448**	**30**	**$3,493**	**$7,846**	**$12,233**	**1.56**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16GF96*	$4,177	$5,367	$1,190	15		2.396	$2,851
Cooling Cap (kBtu)	22.2	18.0					
SEER	14	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,507**				**$7,725**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16GF96*	$4,311	$5,471	$1,160	15		2.396	$2,779
Cooling Cap (kBtu)	25.3	20.4					
SEER	14	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
RBS	$0	$325	$325	15		2.396	$779
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$3,480**				**$7,967**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-10: Detailed results for Kansas City, KS, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	**Th/y**	**$/yr**	**HERS**	**kWh/y**	**Th/y**	**$/yr**	**HERS**
1-sty Best Case	8,038	734	$1,713	82	6,406	468	$1,243	53
1-sty Wrst Case	8,214	746	$1,746	85	6,542	476	$1,267	54
2-sty Best Case	9,108	789	$1,897	79	7,635	509	$1,431	53
2-sty Wrst Case	9,332	801	$1,935	81	7,809	519	$1,461	54
Averages	**8,673**	**768**	**$1,823**	**82**	**7,098**	**493**	**$1,351**	**54**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	**Δ Th/y**	**Δ $/yr**	**Δ HERS**	**1stCost**	**LC Cost**	**LC Save**	**SIR**
1-sty Best Case	1,632	266	$470	29	$2,401	$5,478	$12,846	2.34
1-sty Wrst Case	1,672	270	$479	31	$2,401	$5,478	$13,089	2.39
2-sty Best Case	1,473	280	$466	26	$2,416	$5,419	$12,734	2.35
2-sty Wrst Case	1,523	282	$474	27	$2,416	$5,419	$12,952	2.39
Averages	**1,575**	**275**	**$472**	**28**	**$2,409**	**$5,448**	**$12,905**	**2.37**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER14GF96*	$3,661	$4,287	$626	15		2.396	$1,501
Cooling Cap (kBtu)	23.4	19.3					
SEER	13	14					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,401**				**$5,478**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER14GF96*	$3,828	$4,399	$571	15		2.396	$1,369
Cooling Cap (kBtu)	26.9	21.9					
SEER	13	14					
Heating Cap (kBtu)	44	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_cWash	$450	$500	$50	15		2.396	$120
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
		Totals	**$2,416**				**$5,419**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-11: Detailed results for Chicago, IL, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	8,629	765	$1,815	78	6,998	537	$1,385	54
1-sty Wrst Case	8,746	775	$1,839	80	7,090	543	$1,402	55
2-sty Best Case	9,705	845	$2,025	77	7,834	581	$1,529	53
2-sty Wrst Case	9,828	857	$2,052	79	7,968	589	$1,553	54
Averages	**9,227**	**811**	**$1,933**	**79**	**7,473**	**563**	**$1,467**	**54**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,631	228	$430	24	$2,578	$5,901	$11,757	1.99
1-sty Wrst Case	1,656	232	$437	25	$2,578	$5,901	$11,952	2.03
2-sty Best Case	1,871	264	$496	24	$2,656	$5,992	$13,557	2.26
2-sty Wrst Case	1,860	268	$499	25	$2,656	$5,992	$13,636	2.28
Averages	**1,755**	**248**	**$466**	**25**	**$2,617**	**$5,947**	**$12,726**	**2.14**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER14GF96*	$3,429	$4,231	$803	15		2.396	$1,924
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	14					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
		Totals	**$2,578**				**$5,901**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER14GF96*	$3,588	$4,249	$661	15		2.396	$1,583
Cooling Cap (kBtu)	21.7	18.4					
SEER	13	14					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
		Totals	**$2,656**				**$5,992**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-12: Detailed results for Denver, CO, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	**Th/y**	**$/yr**	**HERS**	**kWh/y**	**Th/y**	**$/yr**	**HERS**
1-sty Best Case	8,370	604	$1,616	79	6,715	423	$1,232	54
1-sty Wrst Case	8,476	616	$1,641	81	6,796	433	$1,252	55
2-sty Best Case	9,408	664	$1,801	77	7,540	451	$1,359	52
2-sty Wrst Case	9,579	679	$1,837	79	7,642	461	$1,381	53
Averages	**8,958**	**641**	**$1,724**	**79**	**7,173**	**442**	**$1,306**	**54**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	**Δ Th/y**	**Δ $/yr**	**Δ HERS**	**1stCost**	**LC Cost**	**LC Save**	**SIR**
1-sty Best Case	1,655	181	$384	25	$4,256	$9,519	$10,492	1.10
1-sty Wrst Case	1,680	183	$389	26	$4,256	$9,519	$10,630	1.12
2-sty Best Case	1,868	213	$442	25	$3,934	$9,055	$12,091	1.34
2-sty Wrst Case	1,937	218	$456	26	$3,934	$9,055	$12,456	1.38
Averages	**1,785**	**199**	**$418**	**26**	**$4,095**	**$9,287**	**$11,417**	**1.23**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER16GF96*	$3,429	$5,367	$1,939	15		2.396	$4,646
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
RBS	$0	$542	$542	30		1.653	$896
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
		Totals	**$4,256**				**$9,519**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER16GF96*	$3,429	$5,367	$1,939	15		2.396	$4,646
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	16					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_dWash	$450	$500	$50	15		2.396	$120
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
		Totals	**$3,934**				**$9,055**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-13: Detailed results for Minneapolis, MN, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	8,563	896	$1,944	78	6,929	628	$1,472	53
1-sty Wrst Case	8,676	908	$1,970	80	7,011	637	$1,491	54
2-sty Best Case	9,528	964	$2,129	75	7,736	662	$1,602	51
2-sty Wrst Case	9,691	980	$2,165	77	7,864	673	$1,629	52
Averages	**9,115**	**937**	**$2,052**	**78**	**7,385**	**650**	**$1,548**	**53**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,634	268	$472	25	$2,578	$5,901	$12,909	2.19
1-sty Wrst Case	1,665	271	$479	26	$2,578	$5,901	$13,095	2.22
2-sty Best Case	1,792	302	$527	24	$2,827	$6,402	$14,388	2.25
2-sty Wrst Case	1,827	307	$536	25	$2,827	$6,402	$14,644	2.29
Averages	**1,730**	**287**	**$503**	**25**	**$2,702**	**$6,152**	**$13,759**	**2.24**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER14GF96*	$3,429	$4,231	$803	15		2.396	$1,924
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	14					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
		Totals	**$2,578**				**$5,901**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER14GF96*	$3,450	$4,231	$782	15		2.396	$1,873
Cooling Cap (kBtu)	18.2	18.0					
SEER	13	14					
Heating Cap (kBtu)	43.1	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_Fridge	$1,200	$1,300	$100	15		2.396	$240
ES_dWash	$400	$475	$75	15		2.396	$180
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
		Totals	**$2,827**				**$6,402**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-14: Detailed results for Billings, MT, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	8,332	748	$1,762	78	6,747	527	$1,345	54
1-sty Wrst Case	8,400	761	$1,784	80	6,802	536	$1,361	55
2-sty Best Case	9,250	740	$1,862	71	7,530	537	$1,447	50
2-sty Wrst Case	9,344	753	$1,887	73	7,606	547	$1,467	51
Averages	**8,832**	**751**	**$1,824**	**76**	**7,171**	**537**	**$1,405**	**53**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,585	221	$417	24	$2,578	$5,901	$11,409	1.93
1-sty Wrst Case	1,598	225	$423	25	$2,578	$5,901	$11,566	1.96
2-sty Best Case	1,720	203	$415	21	$2,798	$6,333	$11,330	1.79
2-sty Wrst Case	1,738	206	$420	22	$2,798	$6,333	$11,473	1.81
Averages	**1,660**	**214**	**$419**	**23**	**$2,688**	**$6,117**	**$11,444**	**1.87**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER14GF96*	$3,429	$4,231	$803	15		2.396	$1,924
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	14					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,578**				**$5,901**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER14GF96*	$3,429	$4,231	$803	15		2.396	$1,924
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	14					
Heating Cap (kBtu)	40	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,798**				**$6,333**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-15: Detailed results for Fargo, ND, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	8,485	976	$2,019	73	7,048	752	$1,615	52
1-sty Wrst Case	8,592	990	$2,046	74	7,135	763	$1,637	53
2-sty Best Case	9,439	1,166	$2,329	75	7,826	778	$1,734	49
2-sty Wrst Case	9,564	1,185	$2,364	76	7,948	790	$1,761	50
Averages	**9,020**	**1,079**	**$2,189**	**75**	**7,489**	**771**	**$1,687**	**51**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,437	224	$403	21	$2,705	$6,206	$11,019	1.78
1-sty Wrst Case	1,457	227	$409	21	$2,705	$6,206	$11,169	1.80
2-sty Best Case	1,613	388	$595	26	$2,921	$6,628	$16,269	2.45
2-sty Wrst Case	1,616	395	$603	26	$2,921	$6,628	$16,478	2.49
Averages	**1,531**	**309**	**$503**	**24**	**$2,813**	**$6,417**	**$13,734**	**2.14**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER13GF96*	$3,433	$4,363	$930	15		2.396	$2,228
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	13					
Heating Cap (kBtu)	41.2	40					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,705**				**$6,206**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER13GF96*	$3,461	$4,387	$926	15		2.396	$2,219
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	13					
Heating Cap (kBtu)	48	45.8					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,921**				**$6,628**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values

Table B-16: Detailed results for Fairbanks, AK, homes

Case	2012 Code Homes				2015 ERI Homes			
	kWh/y	Th/y	$/yr	HERS	kWh/y	Th/y	$/yr	HERS
1-sty Best Case	8,619	1,585	$2,671	80	7,179	1,106	$2,001	53
1-sty Wrst Case	8,623	1,593	$2,680	81	7,184	1,112	$2,008	53
2-sty Best Case	9,455	1,696	$2,885	77	7,892	1,175	$2,157	51
2-sty Wrst Case	9,460	1,706	$2,896	77	7,898	1,182	$2,165	51
Averages	**9,039**	**1,645**	**$2,783**	**79**	**7,538**	**1,144**	**$2,082**	**52**

Case	Savings				Costs Effectiveness		P1 =	27.328
	Δ kWh/y	Δ Th/y	Δ $/yr	Δ HERS	1stCost	LC Cost	LC Save	SIR
1-sty Best Case	1,440	479	$670	27	$2,698	$6,189	$18,311	2.96
1-sty Wrst Case	1,439	481	$672	28	$2,698	$6,189	$18,365	2.97
2-sty Best Case	1,563	521	$728	26	$2,756	$6,233	$19,906	3.19
2-sty Wrst Case	1,562	524	$731	26	$2,756	$6,233	$19,989	3.21
Averages	**1,501**	**501**	**$700**	**27**	**$2,727**	**$6,211**	**$19,143**	**3.08**

1sty 2015 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,000	$1,000	30		1.653	$1,653
SEER13GF96*	$3,461	$4,384	$923	15		2.396	$2,212
Cooling Cap (kBtu)	18.0	18.0					
SEER	13	13					
Heating Cap (kBtu)	48.0	45.1					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$200	$300	$100	5		5.056	$506
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,698**				**$6,189**

2sty 2105 ERI home incremental costs

Measure	Base$	Improv$	Incr$	svc life	Maint	P2	LC Cost
Interior Ducts	$0	$1,200	$1,200	30		1.653	$1,984
SEER13GF96*	$3,659	$4,421	$761	15		2.396	$1,824
Cooling Cap (kBtu)	21.7	18.0					
SEER	13	13					
Heating Cap (kBtu)	57.7	54.2					
AFUE	80%	96%					
Tnkless gasWH (EF=0.83)	$600	$1,000	$400	15	2.29%	2.900	$1,160
100%FL	$240	$360	$120	5		5.056	$607
ES_cWash/dry	$1,200	$1,350	$150	15		2.396	$359
ES_Fridge	$1,200	$1,275	$75	15		2.396	$180
ES_dWash	$450	$500	$50	15		2.396	$120
		Totals	**$2,756**				**$6,233**

* Gas furnace/air conditioner combo cost calculations based on capacity, SEER and AFUE values