Executive Office

RIVERBAY CO-OP CITY

RIVERBAY CORPORATION, 2049 BARTOW AVENUE, BRONX, NEW YORK 10475

September 17, 2008

Jaclyn A. Brilling
Secretary
New York State
Public Service Commission
3 Empire State
Albany, New York 12223

Dear Ms. Brilling:

As the Public Service Commission seeks to achieve energy reductions of 15% by 2015, Co-op City's potential contribution to that goal could serve as beacon for others looking to construct tri-generation resources that will enhance reliability, reduce the transmission and distribution bottlenecks, reduce total load on the electric grid, enhance our national and local security through distribution of our generating resources, enhance efficiency of our asset base with lower heat rates and less fossil fuel use, and help to avoid the requirement to build large scale fossil-fuel plants and additional transmission.

We are considering operating our tri-generation combined heat and power facility, in a manner that reduces end-use load on the electric power grid. The financial benefits that we gain from operating in that manner are apt to be critical in that decision--we need to make certain that this community remains an economically solid citizen and provides affordable homes for 15,372 families.

As a result, we authorized ConsumerPowerline to act as our agent, with respect to assessing the manner in which our tri-generation plant might be operated, as we meet all further building and testing requirements and it is cleared to do so, given the economic opportunity the environmental assets from that operation may offer. ConsumerPowerline has been further authorized to represent our tri-generation plant asset, in registering, certifying and monetizing environmental assets in Independent System Operator and efficiency rehate/incentive programs, overseen by the Public Utilities Commission.

It is truly important that Co-op City is offered the chance to earn from its environmental assets, on an equal footing with others, throughout the state and city. A positive outcome from ConsumerPowerline's 9/22/08 submission to the Commission will afford us that opportunity.

We await the Commission's decision with a willingness to provide the support that the city and state need, as we together build a reliable and efficient electric infrastructure to assure our continued prosperity and security.

Sincerely,

Othelia Jones

Othelia Jones
President
Riverbay Board of Directors

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CFL LIGHT BULB (DIRECT INSTALL)

Description of Measure

A direct installed screw-based CFL bulb. "Direct installed" bulbs are either supplied to the builder for use in qualifying new homes or installed during the final inspection. Savings do not apply to bulbs that are placed in closets or non-living spaces (attics, unconditioned basements, etc.).

Method for Calculating Energy Savings

Annual Energy Savings = Δ Watts x Hours x 365/1000

Where:
Δ Watts = 2.4 x CFL wattage. This represents an "incandescent to CFL" wattage ratio of 3.4 to 1.

Hours = 2.6 Hours per day (See Note 1)

365 = days per year

For example, the annual savings for a 20 watt CFL:
Annual kWh = 2.4 x 20 watts x 2.6 hours/day x 365 days / 1000 = 45.5 kWh

Note that actual bulb wattage should be used to calculate energy savings – using a default average could lead to a large margin of error. The following chart can be used to calculate the savings for various size bulbs:

CFL Bulb Wattage	Annual kWh Savings	**CFL Bulb Wattage**	Annual kWh Savings
7	15.9	**19**	43.3
8	18.2	**20**	45.6
9	20.5	**21**	47.8
10	22.8	**22**	50.1
11	25.1	**23**	52.4
12	27.3	**24**	54.7
13	29.6	**25**	56.9
14	31.9	**26**	59.2
15	34.2	**27**	61.5
16	36.4	**28**	63.8
17	38.7	**29**	66.1
18	41	**30**	68.3

Method for Calculating Demand Savings

The demand savings is calculated by multiplying the annual kWh savings by the peak kW/kWh factor for residential lighting found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Baseline is assumed to be an incandescent light source with a wattage which is 3.4 times higher than the wattage of the CFL bulb. For instance, it's assumed that a 75 Watt incandescent is "equivalent" to a 22

Watt CFL (22 x 3.4 = 75). For dimmable or three-way CFL bulbs, assume the highest wattage/setting when calculating the baseline equivalent.

Compliance Efficiency from which incentives are calculated

Energy Star CFL Bulb.

Operating Hours

2.6 Hours per day from RLW 2003 Lighting Evaluation (Note 1).

Incremental Cost

$3.00

Non-Electric Benefits - Annual O&M Cost Adjustments

$4.00 per bulb one time benefit. Estimate based on current cost of incandescent bulbs that would be used in place of one CFL.

Notes & References

Note 1. *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation,* RLW Analytics, April 2003.

CFL FXTURES (NEW HOMES)

Description of Measure

An Energy Star hardwired fluorescent fixture with pin based bulbs. Fixtures with screw-based (CFL) bulbs are treated as CFL bulbs for savings calculations.

Method for Calculating Energy Savings

Annual Energy Savings = Δ Watts x Hours x 365/1000

Where:

Δ Watts = 2.4 x fixture wattage (a 3.4 wattage conversion factor).
Hours = 3.2 Hours per day (Note 1)
365 = days per year

For example, the annual savings for a 25 watt fixture:

Annual kWh = 2.4 x 25 watts x 3.2 hours/day x 365 days / 1000 = 70.1 kWh

Method for Calculating Demand Savings

The peak demand savings is calculated by multiplying the annual kWh by the peak demand factor for residential lighting found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Incandescent fixture with a wattage equal to 3.4 times the wattage of the efficient fluorescent fixture. For dimmable or three-way CFL bulbs, assume the highest wattage/setting when calculating the baseline equivalent.

Compliance Efficiency from which incentives are calculated

Energy Star hard-wired fixture with equivalent lumen output.

Operating Hours

3.2 hours per day from RLW 2003 Lighting Evaluation (Note 1).

Incremental Cost

$10

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

Non-Electric Benefits - Annual O&M Cost Adjustments

$14.00 (one-time benefit per fixture). Estimate based on added cost of using incandescent bulbs over the life of the measure.

Notes & References

Note 1. *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation,* RLW Analytics, April 2003.

SEER 14 MIN AC

Description of Measure

Central AC system with rated efficiency of 14 SEER or higher.

Method for Calculating Energy Savings

A. New Construction:

Annual Energy Savings = 500 x size (1/13 – 1/SEER) / 1000

Where:

500 = expected annual full-run hours (Note 1).
Size = size of system in Btu
13 = assumed SEER (efficiency) of baseline equipment.
SEER = rated SEER (efficiency) of efficient equipment

For example, for a 3 ton (36,000 Btu) 14 SEER system, the annual kWh savings would be = 500 x 36,000 x (1/13 – 1/14) / 1000 = 98.9 kWh.

The following chart can be used as a reference to look up the savings for new units:

Size	14 SEER	15 SEER	16 SEER	17 SEER
1 ton	33	61.5	86.5	108.6
2 ton	65.9	123.1	173.1	217.2
3 ton	98.9	184.6	259.6	325.8
4 ton	131.9	246.2	346.2	434.4
5 ton	164.8	307.7	432.7	543

Expected annual kWh cooling savings for various sizes and efficiency of units

Note 1: The above chart on energy savings also applies to the Ductless Mini Splits Heat Pump equipments.
Note 2: For multi-speed units, a weighted average of the high speed and low speed efficiencies should be used. Assume 70% on low speed and 30% on high speed.

B. Early Retirement:

If the contractor identifies an old central air unit still working and the customer agrees to replace it then a savings can be claimed for removing old unit and installing an Energy Star Unit. The following chart can be used as a reference to look up the savings for Early Retirement of old units:

Annual Energy Savings = 500 x size (1/Old SEER – 1/New SEER) / 1000

Where:

500 = expected annual full-run hours (Note 1).
Size = size of system in Btu
Old SEER = Rated SEER (efficiency) of the old unit being replaced.
New SEER = Rated SEER (efficiency) of efficient equipment.

Table: Annual Energy savings in kWh per ton

		Old Existing Equipment SEER						
		7.0	7.5	8.0	8.5	9.0	9.5	10.0
New Equipment SEER	13.0	395.60	338.46	288.46	244.34	205.13	170.04	138.46
	13.5	412.70	355.56	305.56	261.44	222.22	187.13	155.56
	14.0	428.57	371.43	321.43	277.31	238.10	203.01	171.43
	14.5	443.35	386.21	336.21	292.09	252.87	217.79	186.21
	15.0	457.14	400.00	350.00	305.88	266.67	231.58	200.00
	15.5	470.05	412.90	362.90	318.79	279.57	244.48	212.90
	16.0	482.14	425.00	375.00	330.88	291.67	256.58	225.00

For early retirement, the measure life is 18 years. However, the first five years savings are based on the old unit verses an energy star unit (assumes unit would have been installed for another 5 years) and the remaining 13 years savings are based on the new energy star unit verses the baseline. For example, if a 3 ton SEER 8.0 unit was retired and replaced with a new SEER 15 unit, the lifetime savings would be 5x(1050 kWh) + 13x(184.6kWh)=3450 kWh.

Note: Retirement savings may only be claimed if retirement is program induced.

Method for Calculating Demand Savings

Annual kW = size (1/11 – 1/New EER) / 1000

Where:

Size = size of system in Btu/hr
EER for a baseline SEER 13 unit = 11
New EER = Rated EER (Energy Efficiency Ratio) of efficient equipment.

Baseline Efficiencies from which savings are calculated

A 13 SEER (code minimum) system.

Compliance Efficiency from which incentives are calculated

14 SEER or higher (Note 1).

Operating Hours

500 hours per year.

Incremental Cost
$100 per SEER unit per ton above 13. For example, a 3 ton 15 SEER would have an assumed incremental cost of $600.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

Notes & References

Note 1. Estimated based on *Market Research for the Rhode Island, Massachusetts, and Connecticut Residential HVAC Market*, RLW Analytics, Deeember 2002, and supported by ASHRAE hours of use when corrected for oversizing.

HEAT PUMP

Description of Measure

A heat pump with a heating season performance factor (HSPF) of 8.5 or higher. Note only the heating savings is presented here; cooling savings from an efficient heat pump is the same as the cooling savings for an efficient air conditioner. Utilize methodology in measure 5.2.1 in this manual to determine cooling savings if unit is rated in SEER and 5.3.6 if unit is rated in EER.

Method for Calculating Energy Savings

A. New Construction:

Annual Energy (heating) Savings = 1,500 x Size (1/7.7 – 1/HSPF) / 1000

Where:

1,500 = estimated annual full-run hours
Size = size of system in Btu
7.7 = assumed efficiency of baseline equipment (HSPF Baseline)
HSPF = rated Heating Season Performance Factor of efficient equipment

For example, for a 3 ton (36,000 Btu) 9 HSPF system, the annual kWh savings would be = 1,500 x 36,000 x (1/7.7 – 1/9) / 1000 = 1,013 kWh.

The following chart can be used as a reference to look up the savings for various sizes and efficiencies:

Size	8.5	9.0	9.5
1 ton	220	338	443
2 ton	440	675	886
3 ton	660	1,013	1,329
4 ton	880	1,351	1,772
5 ton	1,100	1,688	2,215

Expected annual kWh heating savings for various sizes and efficiency of units
Note 1: The above chart on energy savings also applies to Ductless Mini Splits Heat Pump equipments.
Note 2: For multi-speed units, a weighted average of the high speed and low speed efficiencies should be used. Assume 70% on low speed and 30% on high speed.

B. Early Retirement:

The following Table shows the annual energy savings from the installation of old existing equipments with new Energy Star rated heat pumps.

Where:

1,500 = Estimated annual full-run hours
Size = Size of system in Btu
Old HSPF = Heating Season Performance Factor of old existing equipment
New HSPF = Heating Season Performance Factor of new Energy Star equipment

If unit heating efficiency is a COP then multiply COP by 3.41 to get HSPF

Annual Energy (heating) Savings = 1,500 x Size (1/Old HSPF – 1/New HSPF) / 1000

Table: Annual energy savings in kWh per ton

		Old Existing Equipment HSPF										
		5.0	**5.2**	**5.4**	**5.6**	**5.8**	**6.0**	**6.2**	**6.4**	**6.6**	**6.8**	**7.0**
New Equipment HSPF	**8.0**	1350.0	1211.5	1083.3	964.3	853.4	750.0	653.2	562.5	477.3	397.1	321.4
	8.2	1404.9	1266.4	1138.2	1019.2	908.3	804.9	708.1	617.4	532.2	451.9	376.3
	8.4	1457.1	1318.7	1190.5	1071.4	960.6	857.1	760.4	669.6	584.4	504.2	428.6
	8.6	1507.0	1368.5	1240.3	1121.3	1010.4	907.0	810.2	719.5	634.2	554.0	478.4
	8.8	1554.5	1416.1	1287.9	1168.8	1058.0	954.5	857.8	767.0	681.8	601.6	526.0
	9.0	1600.0	1461.5	1333.3	1214.3	1103.4	1000.0	903.2	812.5	727.3	647.1	571.4

For early retirement, the measure life is 18 years. However, the first five years savings are based on the old unit verses an energy star unit (assumes unit would have been installed for another 5 years) and the remaining 13 years savings are based on the new energy star unit verses the baseline. For example, if a 3 ton HSPF 6.0 unit was retired and replaced with a new HSPF 9.0 unit, the lifetime savings would be 5x(3000 kWh) + 13x(1013kWh)=3450 kWh.
Note: Retirement savings may only be claimed if retirement is program induced.

C. Electric Resistance to Air Source Heat Pump Energy Savings:

Table: Annual energy savings in kWh per ton replacing Electric Resistance HP to Energy Star rated Heat Pump.

		Old Electric Resistance Unit COP = 1 (HSPF = 3.4)
New Heat Pump HSPF	**8**	3028.6
	8.2	3083.5
	8.4	3135.7
	8.6	3185.6
	8.8	3233.1
	9	3278.6

Method for Calculating Demand Savings

The peak demand savings is calculated by multiplying the annual kWh savings by the peak kW/kWh factor for winter heating or summer cooling found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated
7.7 HSPF (code minimum) heat pump. In case of Retrofit the baseline for energy savings calculation is the HSPF rating of the old existing heat pump.

Compliance Efficiency from which incentives are calculated

8.5 or higher HSPF heat pump (Note 1)

Operating Hours

1500 hours per year

Incremental Cost

$400 per ton.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

GEOTHERMAL HEAT PUMP

Description of Measure

Groumd source heat pump (GSHP) systems. GSHP systems (or "geothermal"), supply heating, cooling, and in some cases water heating (desuperheater or full hot water capability). The savings from those three end-uses are presented separately

Method for Calculating Energy Savings

The following table was developed from the results of "HVAC Systems in an Energy Star Home: Owning & Operating Costs", Johnson Research, LLC. The values in the table are given in units per ton of installed cooling capacity.

Heating Consumption			
Heating System	**Consumption**	**Engineering Units**	**Efficieneies**
Electric Resistance	5,971	kWh/Ton	100%
Air Source Heat Pump	2,504	kWh/Ton	7.7 HSPF
Oil Furnace	265	Gallons/Ton	80% AFUE
	195	kWh/Ton	
Gas Furnaee	344	Therms/Ton	78% AFUE
	240	kWh/Ton	
GSHP	1,660	kWh/Ton	4 COP
Note: Tonnage based on cooling capacity of Geothermal Unit			

Cooling Consumption and Summer Demand			
System	**Cooling (kWh/Ton)**	**Efficiency**	**Summer Demand (kW/Ton)**
Eleetric Resistance	807	13 SEER	1.05
Air Source Heat Pump	807	13 SEER	1.05
Oil Furnace	807	13 SEER	1.05
Gas Furnace	807	13 SEER	1.05
GSHP	541	19.4 EER	0.65
Note: Tonnage based on cooling capacity			

Water Heating Consumption		
System	**Consumption**	**Units**
Electric Resistance	4,305	kWh
Oil	154	Gallons
Gas	215	Therms

Annual kWh savings = annual kWh Heating savings + annual kWh Cooling savings +annual kWh water heating savings

The non-commissioning savings calculations below are shown for information only. Savings claimed by this measure will only be the commissioning savings calculated below. It is assumed that customers would have installed geothermal without program intervention.

1) Natural Gas Baseline.

a) Heating (kWh) Savings = INCCAP*(240 – (1,660)*(4 /INCOP))

b) Cooling (kWh) Savings = INCCAP*(807 – (541)*(19.4 /INEER))

c) Water Heating (kWh) Savings = 0 – (4,305/INWHCOP)

2) Oil Baseline:

a) Heating (kWh) Savings = INCCAP*(195 – (1,660)*(4 /INCOP))

b) Cooling (kWh) Savings = INCCAP*(807 – (541)*(19.4 /INEER))

c) Water Heating (kWh) Savings = 0 – (4,305/INWHCOP)

3) Electric Resistance Baseline:

a) Heating (kWh) Savings = INCCAP*(5,971 – (1,660)*(4 /INCOP))

b) Cooling (kWh) Savings = INCCAP*(807 – (541)*(19.4 /INEER))

c) Water Heating (kWh) Savings = 4,304 – (4,305/INWHCOP)

4) Air Source Heat Pump Baseline:

a) Heating (kWh) Savings = INCCAP*(2,504 – (1,660)*(4 /INCOP))

b) Cooling (kWh) Savings = INCCAP*(807 – (541)*(19.4 /INEER))

c) Water Heating (kWh) Savings = 4,304 – (4,305/INWHCOP)

INCCAP = installed nominal cooling capacity in tons

INCOP = GSHP's rated heating efficiency in COP. System must be tested to verify unit is operating at rated efficiency.

INEER = GSHP's rated Cooling efficiency in EER. System must be tested to verify unit is operating at rated efficiency.

INWHCOP = GSHP's rated water heating efficiency in COP
Use 1 for electric resistance, use 1.2 for desuperheater

The baseline is assumed to be GSHP. Therefore the only claimed savings from this measure would be from the commissioning requirement (and perhaps shell savings).

Commissioning savings are assumed to be 10% of the theoretical usage:

Heating kWh savings = (166 kWh/ton)(ICCAP)(4)/(INCOP)

Cooling kWh savings = (54.1 kWh/ton)(ICCAP)(19.4)/(INEER)

Method for Calculating Demand Savings

The savings calculations below are shown for information only. Savings claimed by this measure will only be the commissioning savings calculated above. It is assumed that customers would have installed geothermal without program intervention.

For retrofit Projects:

Summer Demand savings = Cooling (kW) savings + Water heating (kW) savings

a) Cooling (kW) savings = CF*INCCAP*(1.05 – 0.62*19.4/INEER)

b) Water Heating (kW) savings = (Water heating (kWh) savings) / 8,760

For New construction projects:

a) Cooling (kW) demand savings = CF*INCCAP*0.062*19.4/INEER

CF = Residential central cooling coincidence factor

Baseline Efficiencies from which savings are calculated

It is assumed that the home would have a ground source heat pump without program intervention. However, it is assumed that the system would not be commissioned. Therefore, the baseline is an uncommissioned ground source heat pump, and savings is based on the commissioning (10%) savings (in addition to any shell savings through the Residential New Construction Program).

System Replacement: The existing system will determine the heating and water heating baseline. Central air with a 13 SEER is the assuming cooling baseline.

Incremental Cost

Typically, incremental cost will range from $8,000 to $20,000 based on system size and system baseline. A rough estimate of incremental cost would be about $3,000 per ton.

Non-Electric Benefits - Annual Fossil Fuel Savings

Fossil Fuel savings = fossil fuel heating savings + Fossil fuel water heating savings

Natural Gas Baseline:
Fossil fuel savings (therms) = INCCAP*344 + 215

Oil Baseline:
Fossil Fuel savings (gallons) = INCCAP*298 + 154

AC SYS TUNE-UP

Description of Measure

This measure applies to diagnostic tune-up using the Service Assistant and is based on the measured changes in the efficiency index (EI) as measured with the Service Assistant Tool.

This savings estimate was developed by UI and CL&P in April, 2006.

Method for Calculating Energy Savings

$$\text{Annual Energy Savings (kWh)} = \frac{12 \times \text{Capacity} \times \text{EFLH} \times (1/\text{EIb} - 1/\text{EIa})}{\text{SEER}}$$

Capacity - Air conditioning units rated capacity in tons
12 - Conversion from tons to kBTU's
SEER - Seasonal energy efficiency ratio (nameplate)
EIb – Efficiency index before (output from tool)
EIa – Efficiency index after (output from tool)
EFLH – Equivalent Full Load Hours (assumed to be 500)

IMPORTANT – The following recommendations must be followed in order for savings from a tuneup to be valid.

1) On the occasion that only one reading is taken or EIa < EIb, the savings defaults to 0 and "deemed" savings is not claimed.
2) Minimum outdoor temperature must be 55 Degrees F and 65 Degrees F for a TXV System. "Tents" should not be used to increase the ambient temperature around the condensing unit.
3) System must be running for 10 – 15 minutes prior to taking the first (initial) reading.
4) Compressor must be fully loaded (high speed for multi-speed units) and running at steady state efficiency.
5) A reasonable indoor load must be maintained throughout the test or the results. Therefore, return air must be at least 65 degrees F wet bulb and/or 80 degrees F dry bulb temperature.
6) Units that have been tuned-up within measure life time period specified in Table 1.4 can not claim additional (double-counted) savings since the savings has already been.

Method for Calculating Demand Savings

$$\text{Demand Savings (kW)} = \frac{12 \times \text{Capacity} \times \text{DF} \times (1/\text{EIb} - 1/\text{EIa})}{\text{SEER} \times 0.875}$$

DF – diversity factor
0.875 – Conversion from SEER to EER.

Baseline Efficiencies from which savings are calculated

The baseline efficiency is the nameplate SEER multiplied by the EIb.

Compliance Efficiency from which incentives are calculated

An HVAC system that has documented performance testing using the Service Assistant.

Operating Hours

The full load operating hours for CT are assumed to be 500 hours / year.

Total Cost

The cost to the contractor for each tune-up is assumed to be $125, but costs may vary based on the contractor and geographic location. Also, $125 is assumed to be the minimum cost and is expected to only cover the diagnostic portion of the test in most situations. If significant problems are uncovered during the diagnostic portion of the test, the cost is expected to rise.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

DUCT SEALING

Description of Measure

Ducts sealed to reduce outside infiltration. Duct improvements (sealing) should be verified with duct blaster test at 25 Pa using an approved test method. Alternative test methods (subtraction method, flow hood method, delta Q, etc) will generally yield inconsistent results and are not permitted.

Note that REM savings (5.4.1) and BOP savings (5.4.2) includes duct sealing savings. Therefore, this measure does NOT apply to homes that are already claiming savings as one of these measures. This is a stand-alone measure and is not intended to be applied to homes that fall into one of these tracks.

Method for Calculating Energy Savings

A) **New Construction:** The results below are engineering estimates of expected savings from verified duct scaling for new construction. This savings does NOT apply to Energy Star Homes. For those homes, savings should be calculated using the UDRH (see 5.4.1 REM Savings).

	Savings per 1000 Square Feet Conditioned Space			
Duct Blaster Results (outside leakage per 100 sq ft conditioned space at 25 Pa)	Heating (MBtu)	Geothermal kWh Savings	Heating (kWh Fan Savings)	kWh (Cooling)
8	3.1	227	25	101
7	3.9	286	31	127
6	4.7	344	38	152
5	5.5	403	44	177
4	6.3	461	50	203
3	7.0	513	56	228
2	7.8	571	62	253
1	8.6	630	69	279
0	9.4	689	75	304

B) **Retrofit**

Savings for existing ducts that are sealed. Savings must be verified by measuring outside duct leakage at 25 Pascals using standard duct blaster testing procedures.

Duct Blaster Savings at 25 Pa

	Heating (MBtu)	Heating (Resistance)	Heating (Heat Pumps)	Heating (Geothermal)	kWh Fan Heating Savings	**kWh (Cooling)**
Average Basement Leakage	5.2	1523	762	507	44	159
Average Attic Leakage	8.1	2373	1187	791	65	234
Average (basement and attic)	6.7	1948	974	649	55	197
Savings for 100 CFM at 25 Pa duct leakage reduction						

Method for Calculating Demand Savings

The demand savings is calculated using peak factors found in Table 1.1.3 in the Appendix.

Baseline Efficiencies from which savings are calculated

Ducts that have not been sealed.

Compliance Efficiency from which incentives are calculated

Duct sealed to reduce outside leakage.

Incremental Cost

Actual cost or $100 per 1000 square feet.

Non-Electric Benefits - Annual Fossil Fuel Savings

A) New Construction:

The heating savings (above) can be converted to appropriate fossil fuel units of measure
Savings per 1000 Square feet Conditioned Space

	Savings per 1000 Square Feet Conditioned Space			
Duct Blaster Results (outside leakage per 100 sq ft conditioned space at 25 Pa)	Heating (MBtu)	Gallons Oil	Therms Gas	Gallons Propane
8	3.1	29.5	41.7	46.3
7	3.9	37.1	52.2	57.9
6	4.7	44.8	62.5	69.4
5	5.5	52.4	73.0	81.1
4	6.3	60.0	83.3	92.7
3	7.0	66.7	93.9	104.3
2	7.8	74.3	104.3	115.8
1	8.6	81.9	114.7	127.5
0	9.4	89.5	125.1	139.0

Estimated savings values are take into account average expected system efficiency of 75%.
In addition, there may be some non-electric benefits due to better comfort and small system size. However, due to their indeterminate nature, it is difficult to rigorously quantify their value with reasonable certainty.

B) Retrofit

Duct Blaster Savings at 25 Pa

	Heating (MBtu)	Gallons Oil	Therms Gas	Gallons Propane
Average Basement Leakage	5.2	50.0	70.0	77.8
Average Attic Leakage	8.1	76.9	107.6	119.6
Average (basement and attic)	6.7	63.5	88.9	98.7
Savings for 100 CFM at 25 Pa duct leakage reduction				

Estimated savings values are take into account average expected system efficiency of 75%.

HEAT PUMP - DUCTLESS

Description of Measure

Ductless heat pumps.

Method for Calculating Energy Savings

Heating Savings is calculated using the lesser of the heating capacity of the unit(s) OR the load of the house, the region IV HSPF, and 1500 full load hours. Estimated heating savings should be compared with bill data for reasonableness.

Annual Energy (heating) Savings = 1,500 x Size (1/HSPF(baseline) – 1/HSPF(new)) / 1000

Where:

1,500 = estimated annual full-run hours
Size = size of system in Btu
HSPF = Heating Season Performance Factor

Cooling savings is calculated using the rated SEER and 500 full load hours.

Annual Energy (cooling) Savings = 500 x size (1/SEER(baseline) – 1/SEER(new)) / 1000

Where:

500 = expected annual full-run hours.
Size = size of system in Btu
SEER = Seasonal Energy Efficiency Ratio

Method for Calculating Demand Savings

Demand Savings is calculated using the peak factors in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

For retrofit, baseline efficiency is the actual existing efficiency for both heating and cooling. In situations where the actual baseline efficiency us unknown, use the following table:

Technology	Baseline Retrofit Efficiency	Baseline New Construction
Electric Resistance Heating	3.41 HSPF	N/A
Heat Pump (heating)	5.0 HSPF	7.7 HSPF
Window AC	7.5 EER/SEER	13 SEER
Central AC (or heat pump) Cooling	10 SEER	13 SEER
NO AC Present	0 (negative cooling savings)	13 SEER

Operating Hours

1500 hours heating

500 hours cooling

Incremental Cost

For retrofit, the incremental cost is assumed to be $4,000 + $2,000*(# of zones-1).

i.e. one zone costs $4,000, two zones cost $6,000 etc. A "zone" is a separate air handler regardless of the number of condensing units.

For new construction, the incremental cost is $500

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

CFL BULBS (RETAIL)

Description of Measure

A screw-based (integrated ballast) compact fluorescent light bulb. Typical CFL wattage is between 9 and 23 watts.

Method for Calculating Energy Savings

Gross Annual Energy Savings = Δ Watts x Hours x 365/1000

Where:

Δ Watts = 2.4 x CFL wattage based on a 3.4 wattage ratio (Note 1).
Hours = 2.6 Hours per day (Note 2).
365 = days per year

For example, the annual savings for a 20 watt CFL:
Annual kWh = 2.4 x 20 watts x 2.6 hours/day x 365 days / 1000 = 45.6 kWh

Note that actual bulb wattage should be used to calculate energy savings. See the chart below for gross and net savings for bulbs of various wattages.

The overall realization rate is 76% and includes the effects of spillover, free-ridership and installation rates (Note 2)

The following chart can be used to look up gross (without impact factors) and net (with impact factors) savings for various size bulbs. The gross savings numbers were generated using the savings algorithm above and the net savings numbers were generated by applying the realization rate above to the gross savings:

CFL Bulb Wattage	Gross Annual kWh Savings	Net Annual kWh Savings	CFL Bulb Wattage	Gross Annual kWh Savings	Net Annual kWh Savings
7	15.9	12.1	19	43.3	32.9
8	18.2	13.8	20	45.6	34.6
9	20.5	15.6	21	47.8	36.4
10	22.8	17.3	22	50.1	38.1
11	25.1	19.0	23	52.4	39.8
12	27.3	20.8	24	54.7	41.5
13	29.6	22.5	25	56.9	43.3
14	31.9	24.2	26	59.2	45.0
15	34.2	26.0	27	61.5	46.7
16	36.4	27.7	28	63.8	48.5
17	38.7	29.4	29	66.1	50.2
18	41.0	31.2	30	68.3	51.9

Gross and Net Annual Savings for bulbs.
Note that the net savings in this chart assumes that sales data is available for the bulb.

Method for Calculating Demand Savings

The demand savings is calculated by multiplying the annual kWh savings by the appropriate peak factors found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Baseline is assumed to be an incandescent light source with a wattage which is 3.4 times higher than the wattage of the CFL bulb. For instance, it's assumed that a 75 Watt incandescent is "equivalent" to a 22 Watt CFL (22 x 3.4 = 75). For dimmable or three-way CFL bulbs, assume the highest wattage/setting when calculating the baseline equivalent.

Compliance Efficiency from which incentives are calculated

Energy Star screw-based bulb with equivalent lumen output.

Operating Hours

2.6 Hours per day estimate (Note 1).

Incremental Cost

$2.00 assumed average. Range is between $1 and $10, however most bulbs currently in the lighting program are towards the lower end of this price spectrum.

Non-Electric Benefits - Annual O&M Cost Adjustments

$4.00 per bulb one time benefit. Estimate based on current cost of incandescent bulbs that would be used in plaee of one CFL.

Notes & References

Note 1. Hours of use is an estimate based on various recent evaluation work including: *CFL Metering Study*, (California), KEMA Inc. 2005.

Note 2. *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation*, RLW Analytics, April 2003.

Note 3. In cases where sales data is not available, a 35% installation rate should be used (half of the current installation rate of 70%) based on an assumption that half of the bulbs with no sales data make it into the marketplace and produce savings.

PORTABLE LAMPS

Description of Measure

An Energy Star portable (plug type) light fixture with pin-based bulbs (i.e. table lamp, desk lamp, etc.). Note that torchieres are not included here; rather they are handled as a separate measure.

Method for Calculating Energy Savings

Annual Energy Savings = Δ Watts x Hours x 365/1000

Where:

Δ Watts = 2.4 x fixture wattage (3.4 wattage conversion factor).
Hours = 3.2 Hours per day (Note 1)
365 = days per year

For example, the annual savings for a 25 watt fixture:

Annual kWh = 2.4 x 25 watts x 3.2 hours/day x 365 days / 1000 = 70.1 kWh

Method for Calculating Demand Savings

The peak demand savings is calculated by multiplying the annual kWh savings by the peak kW/kWh factor for residential lighting found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Incandescent portable fixture with a wattage equal to 3.4 times the wattage of the efficient fluorescent fixture. For dimmable or three-way products, assume the highest wattage/setting when calculating the baseline equivalent.

Compliance Efficiency from which incentives are calculated

Energy Star lamp with equivalent lumen output.

Operating Hours

3.2 hours per day from RLW 2003 Lighting Evaluation. Note 1.

Incremental Cost

$10

Non-Electric Benefits - Annual O&M Cost Adjustments

$6.00 one-time benefit per fixture.

Notes & References

Note 1. *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation*, RLW Analytics, April 2003.

TORCHIERE

Description of Measure

Energy Star torchiere (fixture).

Method for Calculating Energy Savings

Annual Energy Savings = Δ Watts x Hours x 365/1000 (Note 1)

Where:

Δ Watts = the lesser of 2.4 x fixture wattage (3.4 wattage conversion factor).
or 190 – fixture Wattage (Note 2).

Hours = 3.2 Hours per day
365 = days per year

For example, the annual savings for a 55 watt torchiere fixture:

Δ Watts = the lesser of 2.4 x 55 = 132 OR 190 – 55 = 135.
Therefore, Δ Watts = 132 Watts (lesser of the two).

Annual kWh = 132 Watts x 3.2 hours/day x 365 days / 1000 = 154.2 kWh

The overall realization rate is 72.1% and includes free-ridership, spillover and installation rate (Note 1).

The following chart displays gross and net savings for torchieres of various wattages. Linear interpolation can be used to predict savings for wattages that fall between these categories.

Fluorescent Torchiere Wattage	Delta Watts	Gross Annual kWh Savings	Net Annual kWh Savings (with 72.1% Realization Rate)
25	60	70.1	50.5
30	72	84.1	60.6
35	84	98.1	70.7
40	96	112.1	80.8
45	108	126.1	90.9
50	120	140.2	101.1
55	132	154.2	111.2
60	130	151.8	109.5
65	125	146.0	105.3
70	120	140.2	101.1
75	115	134.3	96.8

Torchiere Net and Gross Savings by Wattage.

Method for Calculating Demand Savings

The demand savings can be calculated by multiplying the annual savings in kWh by the appropriate peak factors found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Incandescent or halogen torchiere with a wattage equal to 3.4 times the wattage of the efficient fluorescent fixture. For dimmable or three-way products, assume the highest wattage/setting when calculating the baseline equivalent.

Compliance Efficiency from which incentives are calculated

Energy Star torchiere with equivalent lumen output.

Operating Hours

3.2 hours per day.

Incremental Cost

$10

Non-Electric Benefits - Annual O&M Cost Adjustments

$5.00 (one-time benefit per fixture). Estimate based on increased cost of incandescent bulbs that would be used in the baseline case.

Notes & References
Note 1. Savings assumptions including impact factors are from the following: *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation*, RLW Analytics, April 2003.
Note 2. Public Act 04-85, An Act Concerning Energy Efficiency Standards, July 2004, limits torchiere wattage to 190 Watts. Therefore, the baseline is capped at 190 watts and the Δ Wattage is limited by this cap.

FIXTURE (HARD WIRED)

Description of Measure

An Energy Star hardwired fluorescent fixture with pin based bulbs. Note that fixtures with screw-based (CFL) bulbs are treated as CFL bulbs for savings calculations.

Method for Calculating Energy Savings

Annual Energy Savings = Δ Watts x Hours x 365/1000 (Note 1).

Where:

Δ Watts = 2.4 x fixture wattage (a 3.4 wattage conversion factor).
Hours = 3.2 Hours per day
365 = days per year

For example, the annual savings for a 25 watt fixture:

Annual kWh = 2.4 x 25 watts x 3.2 hours/day x 365 days / 1000 = 70.1 kWh

For fixtures with multiple bulbs, the wattage is the total wattage of all bulbs (not the wattage of one bulb).

Method for Calculating Demand Savings

The demand savings can be calculated by multiplying the annual savings in kWh by the appropriate peak factors found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Incandescent fixture with a wattage equal to 3.4 times the wattage of the efficient fluorescent fixture. For dimmable or three-way CFL bulbs, assume the highest wattage/setting when calculating the baseline equivalent.

Compliance Efficiency from which incentives are calculated

Energy Star hard-wired fixture with equivalent lumen output.

Operating Hours

3.2 hours per day from RLW 2003 Lighting Evaluation (Note 1).

Incremental Cost

$10

Non-Electric Benefits - Annual O&M Cost Adjustments

$14.00 (one-time benefit per fixture). Estimate based added cost of using incandescent bulbs over the life of the measure.

Notes & References

Note 1. Savings assumptions including impact factors are from the following: *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation*, RLW Analytics, April 2003.

CEILING FAN & LIGHTS

Description of Measure

Energy Star ceiling fan/light combination.

Method for Calculating Energy Savings
Note that only the energy savings from the light is considered. Therefore, savings for this measure is based on the light wattage and is identical to the savings for a light fixture. Fan motor savings is negligible, and cooling savings has not been determined.

Annual Energy Savings = Δ Watts x Hours x 365/1000 (Note 1).
Where:

Δ Watts = 2.4 x fixture wattage (a 3.4 wattage conversion factor).
Hours = 3.2 Hours per day
365 = days per year

For example, the annual savings for a qualifying fan/light with a 25 watt light source:
Annual kWh = 2.4 x 25 watts x 3.2 hours/day x 365 days / 1000 = 70.1 kWh

For fans with multiple bulbs, the wattage is the total wattage of all bulbs. For instance, if a ceiling fan has four 20 watt bulbs, the savings would be based on an 80 Watt light source.

Method for Calculating Demand Savings

The demand savings can be calculated by multiplying the annual savings in kWh by the appropriate peak factors found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

Fan/light combination with an incandescent light source wattage equal to 3.4 times the light source wattage of the Energy Star fan/light combination.

Compliance Efficiency from which incentives are calculated

Energy Star fan/light combination with fluorescent light source.

Operating Hours

3.2 hours per day from RLW 2003 Lighting Evaluation (Note 1).

Incremental Cost

$10

Non-Electric Benefits - Annual O&M Cost Adjustments
$14.00 (one-time benefit per fixture). Estimate based added cost of using incandescent bulbs over the life of the measure.

Notes & References
Note 1. Savings assumptions including impact factors are from the following: *Northeast Utilities and United Illuminating Retail/Point of Purchase Lighting Program Impact Evaluation*, RLW Analytics, April 2003.

ROOM WINDOW AIR CONDITIONER

Description of Measure

Room air conditioners meeting the minimum qualifying efficiencies established by the Energy Star Program that are purchased from vendors participating in negotiated cooperative promotions.

Method for Calculating Energy Savings

The savings is the difference in consumption between the new Energy Star unit and the base unit (minimum federal efficiency standard).

Annual kWh Savings = 500 hours * BTU/h Rating * (1/Fed Std EER - 1/Actual EER)/1000W/ kW

EER Rating >	**9.7**	**10**	**10.7**	**11**	**11.5**	**12**
	Fed Std		**E-Star min**			
BTU/h Rating						
5,000	0.0	7.7	24.1	30.5	40.3	49.4
6,000	0.0	9.3	28.9	36.6	48.4	59.3
EER Rating >	**9.8**	**10**	**10.8**	**11**	**11.5**	**12**
	Fed Std		**E-Star min**			
8,000	0.0	8.2	37.8	44.5	60.3	74.8
10,000	0.0	10.2	47.2	55.7	75.4	93.5
11,000	0.0	11.2	52.0	61.2	83.0	102.9
12,000	0.0	12.2	56.7	66.8	90.5	112.2
13,000	0.0	13.3	61.4	72.4	98.0	121.6
EER Rating >	**9.7**	**10**	**10.7**	**11**	**11.5**	**12**
	Fed Std		**E-Star min**			
14,000	0.0	21.6	67.4	85.3	113.0	138.3
15,000	0.0	23.2	72.3	91.4	121.0	148.2
16,000	0.0	24.7	77.1	97.5	129.1	158.1
17,000	0.0	26.3	81.9	103.6	137.2	168.0
18,000	0.0	27.8	86.7	109.7	145.2	177.8

Method for Calculating Demand Savings

The demand saving is calculated by multiplying the annual savings by the summer peak demand factor for residential cooling found in Table 1.1.3 in the Appendix.

Baseline Efficiencies from which savings are calculated

The baseline efficiencies are the Federal Standards shown in the table above.

Compliance Efficiency from which incentives are calculated

The compliance efficiencies are the Energy Star Efficiencies shown in the table above.

Operating Hours

The full load operating hours for CT are assumed to be 500 hours per year.

Incremental Cost

The incremental cost of a new Energy Star unit is assumed to be $50.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

Non-Electric Benefits - Annual Water Savings

Non-electric benefits have not been identified for this measure.

Non-Electric Benefits - Annual O&M Cost Adjustments

Non-electric benefits have not been identified for this measure.

CLOTHES WASHER

Description of Measure

Residential clothes washers meeting the minimum qualifying efficiency standards establishes under the Energy Star Program.

Method for Calculating Energy Savings

The savings shown below for program planning purposes is the average for washers based on an expected fuel mix.

Table1: Annual Energy Savings

Clothes Washers	MEF	Incremental Cost	Electric Water Heater Savings		Fossil Fuel Water Heater Savings		Annual Water Savings	20% Mix	80%	24%	48%	8%
			Electric (kWh)	Fossil Fuel (BTU)	Electric (kWh)	Fossil Fuel (BTU)	(gallons)	Electric (kWh)	Fossil Fuel (BTU)	Natural Gas (CCF)	Oil (Gal)	Other (BTU)
Savings - New Units												
Baseline	1.26	0	0	0	0	0	0	0	0	0	0	0
Energy Star	1.72	290	254	0	15.0	900,000	6,993	62.8	720,000	2.16	3.09	72,000
Tier 3	2.20		609	0	22.4	1,680,531	7,397	139.7	1,344,425	4.03	5.76	134,442
Early Retirement												
Typical Washer	-	0	0	0	0	0	0	0	0	0	0	0
Energy Star	1.72		565	0	50.0	3,900,000	9,932	153.0	3,120,000	9.36	13.37	312,000
Tier 3	2.20		920	0	57.4	4,680,531	10,336	229.9	3,744,425	11.23	16.05	374,442

For new units, the weighted average savings for tier 3 washers and all fuel types is 139.7 kWh compared to the federal minimum baseline.

For early retirement, the measure life is 14 years. However, the first four years savings (229.9 kWh weighted all fuels) are based on the old washer (typical) verses a tier 3 washer (assumes old washer would have been used another 4 years) and the remaining 10 years savings (139.7 kWh weighted all fuels) are based on the new Tier 3 washer verses the baseline. This assumes that the customer replaces the existing unit with a Tier 3 model.

Note: Retirement savings may only be claimed if retirement is program induced.

Method for Calculating Demand Savings

The peak demand savings is calculated by multiplying the annual kWh savings by the peak kW/kWh factor for winter or summer domestic water heating found in Appendix Table 1.1.3.

Baseline Efficiencies from which savings are calculated

The baseline efficiency is the efficiency of a washer meeting the federal minimum std.

Compliance Efficiency from which incentives are calculated

The compliance efficiency to receive an incentive is that of an Energy Star Washer.

Operating Hours

The number of wash cycles per year is used instead of the operating hours for the washing machine. The number of cycles per year is 392.

Incremental Cost

Clothes Washers	MEF	Incremental Cost ($)
Baseline	1.26	0
Energy Star	1.72	250
Tier 3	2.2	450

Source: Survey conducted by Applied Proactive Technologies (APT), Springfield, MA.

Non-Electric Benefits - Annual Fossil Fuel Savings

Annual Fossil Fuel savings is shown in table above.

Non-Electric Benefits - Annual Water Savings

The annual water savings is shown in the table above.

Notes & References

Savings were based on minimum federal standard MEF = 1.26, Energy Star MEF = 1.72 And Tier 3 MEF = 2.20 Clothes Washers and an analysis using Energy Star clothes washer savings calculator.
Source: Energy Star Website

DISHWASHER

Description of Measure

Energy Star Dishwasher

Method for Calculating Energy Savings

Table1: Annual Energy

Dishwashers	EF	Incremental Cost	Electric Water Heater Savings		Fossil Fuel Water Heater Savings		Annual Water Savings	20%	80%	24%	48%	8%
								Mix				
			Electric (kWh)	Fossil Fuel (BTU)	Electric (kWh)	Fossil Fuel (BTU)	(gallons)	Electric (kWh)	Fossil Fuel (BTU)	Natural Gas (CCF)	Oil (Gal)	Other (BTU)
Savings - New Units												
Baseline	6	0	0	0	0	0	0	0	0	0	0	0
Energy Star	7	50	51 0	0	23 0	250,000	430	28.6	200,000	0.60	1.20	20,000
Early Retirement												
Typical Dishwasher	-	0	0	0	0	0	0	0	0	0	0	0
Energy Star	0 7	500	125 9	0	55 4	287,000	559	69 5	229,600	0.6888	0 98	22,960

For early retirement, the measure life is 12 years. However, the first three years savings (69.5 weighted all fuels) are based on the old dishwasher (typical) verses the new Energy star dishwasher (assumes old dishwasher would have been used another 3 years) and the remaining 9 years savings (28.6 weighted all fuels) are based on the new energy star dishwasher verses the baseline.

Note: Retirement savings may only be claimed if retirement is program induced.

Method for Calculating Demand Savings

The demand savings for the summer or winter peak period is calculated by multiplying the annual kWh savings by a summer or winter peak coincidence factor for domestic water heating found in Appendix Table 1.1.3.

Baseline Efficiencies from which savings are calculated

The baseline efficiencies are the Federal Standard values shown in the table above.

Operating Hours

Operating hours do not apply since the Federal Standards are written in units of cycles/kWh.

Incremental Cost

The Energy Star web site uses $50 as the incremental cost between an Energy Star model and a Federal Standard model.
Source: Survey conducted by APT

Non-Electric Benefits - Annual Fossil Fuel Savings

Annual Fossil Fuel savings is shown in table above.

Non-Electric Benefits - Annual Water Savings

The annual water savings is shown in the table above.
Source: Energy Star Website

Notes & References

www.energystar.gov

REFRIGERATOR

Method for Calculating Energy Savings

Refrigerators qualifying as Energy Star refrigerators must consume 15% less electricity than that required by current Federal Standards. These standards can be found in the Federal Register mentioned above for all types and configurations up to a total refrigerated volume of 30 cubic feet.

Refrigerator Savings Assumptions													
Type	**Refrigerator Size (Adjusted Volume)**												
	10	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**20**	**21**	**22**	**24**	**25**
Manual Defrost	53	56	58	59	61	63	64	66	69	71	72	76	79
Partial Auto Defrost	53	56	58	59	61	63	64	66	69	71	72	76	79
Top Freezer no Ice Door	59	63	64	66	68	70	71	73	76	79	80	84	87
Side Freezer no Ice Door	85	87	88	88	89	90	91	92	94	95	96	98	99
Bottom Freezer no Ice Door	77	79	80	80	81	82	83	84	85	86	87	88	89
Top Freezer with Ice Door	72	76	77	79	81	83	84	87	90	92	94	98	101
Side Freezer with Ice Door	79	83	84	86	88	90	91	94	97	99	101	105	108

Method for Calculating Demand Savings

The demand savings during the summer or winter peak period is calculated by multiplying the annual kWh savings by the appropriate peak kW/kWh factor for residential refrigeration found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

The baseline efficiency is that of a refrigerator which meets the Federal Standard as described above.

For early retirement, the baseline is the rated usage of the existing unit based on AHAM refrigerator data.

Compliance Efficiency from which incentives are calculated

The compliance efficiency is that of a refrigerator which meets the Energy Star standard and uses a minimum of 15% less electricity than a refrigerator meeting the Federal Standard.

Operating Hours

Operating hours are included in the Federal Standards and are not separated from the Federal Standard calculations.

Incremental Cost

The incremental cost of a refrigerator meeting Energy Star standards is estimated to be $75.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

Notes & References

Note 1: Based on Nexus Market Research Evaluation of the 2005 Appliance Retirement Program offered by CL&P and UI.

ROOM AC RETIREMENT

Description of Measure

This measure applies to old room air conditioners which are in working condition, but are turned in to a demanufacturing facility where they are properly disassembled, with all materials recycled where possible.

Method for Calculating Energy Savings

For early retirement, the measure life is 12 years. However, the first 3 years savings are based on the old air conditioner (assumes old unit would have been used another 3 years) and the remaining 9 years savings are based on the new energy star air conditioner.

The savings are estimated to be 191kWh per year for the first three years and 58 kWh for the remaining 9 years. A realization factor of 20.7% should be applied for the first 3 years and 26.0% for the remaining 9 years.

Note: Retirement savings may only be claimed if retirement is program induced.

Energy Savings and Realization rate base on Impact, Process, and Market study of CT Appliance retirement Program, Nexus Market Research, Inc., December 2005, Table 2.13, page 25

Method for Calculating Demand Savings

Demand savings in kW is calculated by multiplying the annual savings in kWh by the summer system peak kW/kWh factor found in Appendix Table1.1.3.

Baseline Efficiencies from which savings are calculated

The Federal Standard baseline efficiency is 9.7BTU/W.

Compliance Efficiency from which incentives are calculated

The unit retired must be in working condition when retired.

Operating Hours

The full load operating hours for CT is assumed to be 500 hours per year.

Total Cost

The cost to pick up and demanufacture an AC unit is $65.00 plus any customer incentive.

REFRIGERATOR RETIREMENT

Description of Measure

This measure is for the retirement and demanufacturing of refrigerators. Refrigerators are picked up at the customer's premises, and removed to a central facility operated by a contractor where they are disassembled, with all material recycled where practical. The refrigerators are required to be in working order, preferably having been in operation as a second or third refrigerator.

Method for Calculating Energy Savings

It is assumed that the refrigerators would continue in daily operation for another 5 years without the retirement program. It is assumed that the refrigerators are not replaced by the owners. The energy savings is calculated as the average consumption for the average refrigerator retired times 5 years. The average consumption is estimated at 1,383 kWh per year. A realization factor of 29.9% should be applied to the savings. The result is 414 kWh/y.

Energy Savings and Realization rate base on Impact, Process, and Market study of CT Appliance retirement Program, Nexus Market Research, Inc., December 2005, Table 2.13, page 25

Note: Retirement savings may only be claimed if retirement is program induced.

Method for Calculating Demand Savings

The annual kWh savings is multiplied by the peak kW/kWh factor for summer and winter residential refrigeration found in Appendix Table 1.1.3.

Baseline Efficiencies from which savings are calculated

Since the refrigerators are removed from service and not replaced, no baseline efficiency is involved in the savings calculation.

Compliance Efficiency from which incentives are calculated

There is no compliance efficiency involved in the savings calculation

Operating Hours

Operating hours are included in the annual energy consumption estimated for the refrigerators and are not broken out of the annual estimates of kWh.

Total Cost

The current cost to pick up a refrigerator at the customer's home and to demanufacture it is $85 plus any customer incentive.

FREEZER

Description of Measure

This measure is for the retirement and demanufacture of working freezers that are generally more than 10 years old. The freezers are picked up at the customer's premises by a contractor, and taken to the contractor's facility where they are demanufactured with materials recycled where possible.

Method for Calculating Energy Savings

It is assumed that the freezers would continue in daily operation for another 5 years without the retirement program. It is assumed that the freezers are not replaced by the owners. The energy savings is calculated from the average consumption for the average freezer is estimated at 1,181 kWh/y. After applying a realization rate of 38.1% on a program wide basis the average savings in consumption is assumed to be 450 kWh per year.

Energy Savings and Realization rate base on Impact, Process, and Market study of CT Appliance retirement Program, Nexus Market Research, Inc., December 2005, Table 2.13, page 25

Note: Retirement savings may only be claimed if retirement is program induced.

Method for Calculating Demand Savings

The peak demand savings is calculated from the peak kW per kWh factors for residential freezers found in Appendix Table 1.1.3.

Baseline Efficiencies from which savings are calculated

Since the freezers are removed from service and not replaced, no baseline efficiency is involved in the savings calculation.

Compliance Efficiency from which incentives are calculated

There is no compliance efficiency involved in the savings calculation.

Operating Hours

Operating hours are included in the annual energy consumption estimated for the freezers and are not broken out of the annual estimates of kWh.

Total Cost

The current cost to pick up a freezer at the customer's home and to demanufacture it is $85 plus any customer incentive.

DEHUMIDIFIER RETIREMENT

Description of Measure

This measure applies to old dehumidifiers which are in working condition, but are turned in to a demanufacturing facility where they are properly disassembled, with all materials recycled where possible.

Method for Calculating Energy Savings

Early Retirement			
Dehumidifiers	EF	Incremental Cost	Electric
pints/day	(L/kWh)		kWh
based on 40-pint			
Typical Dehumidifier	1.28	0	1,239.35
ES 1 to 25	1.2	150	643
ES 25 to 35	1.4	150	555
ES 35 to 45	1.5	150	388
ES 45 to 54	1.6	150	252
ES 54 to 75	1.6	150	95
ES 75 to 185	2.5	150	54

For early retirement, the measure life is 12 years. However, the first 3 years savings (table above) are based on the old dehumidifier (typical) verses the new Energy Star unit (assumes old unit would have been used another 3 years) and the remaining 9 years of savings (see measure 5.3.14) are based on the new energy star air dehumidifier verses the baseline.

Note: Retirement savings may only be claimed if retirement is program induced.

Method for Calculating Demand Savings

Demand savings is calculated by multiplying the expected annual savings in kWh by (1/1900) * (74%) where 1900 represents the expected annual operating hours and (74%) is the estimated coincidence of the operation of each unit with the system peak.

Baseline Efficiencies from which savings are calculated

Conventional			Electric Consumption	
	EF (L/kWh)	L/day	kWh/day	kWh
1 to 25	1.1	10.6	9.63	650
25 to 35	1.35	14.19	10.51	710
35 to 45	1.36	18.92	13.91	939
45 to 54	1.47	23.41	15.93	1075
54 to 75	1.53	30.51	19.94	1346
75 to 185	2.38	43.89	18.44	1245

Operating Hours

The annual operating hours are estimated to be 67.5 days per year X .66 duty factor = 44.55 hours/year

Total Cost

The total cost to pick up a dehumidifier and to demanufacture it is $65.00 plus any customer incentive.

DEHUMIDIFIER

Description of Measure

Energy Star Dehumidifier through a negotiated cooperative promotion.

Method for Calculating Energy Savings

Table1: Annual Energy Savings

Dehumidifiers	EF	Incremental Cost	Electric
pints/day	(L/kWh)		kWh
Savings - New Units			
1 to 25	1.20	0	54
25 to 35	1.40	0	25
35 to 45	1.50	0	88
45 to 54	1.60	0	87
54 to 75	1.80	0	59
75 to 185	2.50	0	60

Method for Calculating Demand Savings

Demand savings is calculated by multiplying the expected annual savings in kWh (115kWh) by (1/1900) * (74%) where 1900 represents the expected annual operating hours and (74%) is the estimated coincidence of the operation of each unit with the system peak. The demand savings as described above would be 0.03 kW

Baseline Efficiencies from which savings are calculated

Conventional	
	EF
	(L/kWh)
1 to 25	1.10
25 to 35	1.35
35 to 45	1.36
45 to 54	1.47
54 to 75	1.53
75 to 185	2.38

Compliance Efficiency from which incentives are calculated

The compliance efficiency is the Energy Star efficiency of 1.3L/kWh.

Operating Hours

The annual operating hours are estimated to be 67.5 days per year X .66 duty factor = 44.55 hours/year

Total Cost

The total cost to pick up a dehumidifier and to demanufacture it is $65.00 plus any customer incentive

Notes & References

Savings and baseline efficiency factors are from the energy star website.

HIGH PERFORMANCE WALL INSULATION

Description of Measure

High performance insulation. The following are examples of high performance insulation. In order to be considered as high performance, the whole wall R-value (including framing) must be better than an R-15 and have proven ability to substantially retard infiltration relative to standard fiberglass insulation. The following are examples of high performance insulation:

- Cellulose, 2 x 6 framing
- Blown-in fiberglass, 2 x 6 framing
- Icynene, 2 x 6 framing
- SIPs panels (3.5 inches or better)
- Insulated concrete forms
- 2 x 4 wall (fiberglass cavity) with 1 inch of rigid (R-5) insulation.
- Any wall assembly which can be demonstrated to thermally perform as well as any of these options.

Note that thermal mass does NOT equate to R-value. Solid wood walls (log cabins) are NOT considered high performance walls and do NOT qualify (they do not meet the R-value or infiltration requirement).

Since the savings calculation includes the effects of decreased infiltration, homes that qualify for this measure do NOT qualify for any incentive for blower door reduction, nor should savings for both measures be counted. Also, if a home is HERS rated, the UDRH savings takes precedent over the savings presented here and additional wall insulation savings should not be claimed. Homes that meet ENERGY STAR standards or meet the federal tax credit standards should calculate the savings based on measure 5.4.7 and should not claim additional wall insulation savings.

This measure applies to new construction only. For retrofit savings, refer to measure 6.4.13.

Method for Calculating Energy Savings

Parallel flow method was used to calculate savings (Note 1) based on a standard 2 x 6 wall with fiberglass.

Heating Savings = (1/Rexisting – 1/RNew) x Degree Days x 24 x Adjustment x Area + infiltration saving

where:
- Rexisting is the effective R-value of the existing wall assumed to be 12
- RNew is the upgraded effective R-value assumed to be 15
- Degree days = 6200 assumed state average
- Adjustment = 0.64 ASHRAE adjustment factor (Note 2)
- Area = 100 square feet .
- Infiltration savings estimate = 50,000 Btu per 100 sq feet.

Note: infiltration savings is backed out for homes that are blower door tested (savings is multiplied by 76% to account for the infiltration component) and measure 5.4.4 is used to calculate the savings from infiltration reduction to account for reduced infiltration.

Annual Btu saving = 208,720 per 100 square feet of wall = 0.209 MBtu for non-blower door tested homes or 0.209 MBtu x 76% = 0.159 MBtu + 5.4.4 Blower Door Savings.

Therefore, Annual Savings (for homes with electric heat):

- Electric resistance savings = 61 kWh per 100 square feet
- Heat Pump savings = 30.5 kWh per 100 square feet
- Fan savings (furnace fan or air handler) is estimated to be 20 kwh per MBtu or 4.2 kwh per 100 square feet.

Cooling Savings = estimated at 5 kWh per 100 square feet of wall. 76% of this value is used for blower door tested homes and the savings is supplemented by measure 5.4.4.

Method for Calculating Demand Savings

The demand savings is calculated using peak factors found in Table 1.1.3 in the Appendix.

Incremental Cost

50 cents per square foot.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-Electric savings would occur for homes that have a non-electric source of heating.

MBtu savings = .28 per 100 square feet.

Therefore,

annual gas savings = 2.8 Therms/year pcr 100 sq ft.
annual oil savings = 2.0 Gallons/year per 100 sq ft.
annual propane = 3.1Gallons/year per 100 sq ft.

Notes & References

Note 1. Joe Swift, Northeast Utilities, 2005.

Note 2. ASHRAE degree-day correction. 1989 ASHRAE Handbook Fundamentals 28.2, Fig 1

HIGH PERFORMANCE CEILING INSULATION

Description of Measure

High performance insulation: In order to be considered as high performance ceiling insulation, the whole component R-value (including framing) must be better than an R-35 and have proven ability to substantially retard infiltration relative to standard fiberglass insulation. The following are examples of high performance insulation:

Cellulose
Icynene (spray foam)
SIPs panels (3.5 inches or better)
Spray foam loose fill combination (loose fill fiberglass by itself does NOT qualify)
Hybrid systems (rigid foam with fiberglass)

Any wall ceiling assembly which can be demonstrated to thermally perform as well as any of these options. Thermal mass should not be used to make adjustments to R-values.

Since the savings calculation includes the effects of decreased infiltration, homes that qualify for this measure that are blower door tested should use the blower door results to calculate the savings. Also, if a home is HERS rated, the UDRH savings takes precedent over the savings presented here and additional wall insulation savings should not be claimed. Homes that meet ENERGY STAR standards or meet the federal tax credit standards should calculate the savings based on measure 5.4.7 and should not claim additional ceiling insulation savings.

This measure is for new construction only. For retrofit savings, refer to measure 6.4.12.

Method for Calculating Energy Savings

New Construction (for new homes, uses fiberglass code-minimum as baseline)

Heating Savings = (1/Rexisting – 1/RNew) x Degree Days x 24 x Adjustment x Area + infiltration saving

Where: Rexisting is the effective R-value of the existing ceiling assumed to be 25
RNew is the upgraded effective R-value assumed to be 35
Degree days = 6200 assumed state average
Adjustment = 0.64 ASHRAE adjustment factor (Note 2)
Area = 100 square feet .
Infiltration savings estimate = 100,000 Btu per 100 sq feet. **Infiltration savings should be subtracted out if blower door savings is claimed.** Above savings should be multiplied by 52% for homes that are blower door tested, and measure 5.4.4 Blower Door Test should be used to calculate the impact reduced infiltration.

Annual Btu saving = 208,837 per 100 square feet of ceiling = 0.208 MBtu per 100 square feet (or 108,837 MBtu plus 5.4.4. Blower Door savings for homes that are blower door tested).
Therefore, Annual Savings (for homes with electric heat):

Electric resistance savings = 61 kWh per 100 square feet
Heat Pump savings = 30.5 kWh per 100 square feet
Heating Fan (air handler) savings = 4.2 kWh per 100 square feet.

Cooling Savings = estimated at 5 kWh per 100 square feet of ceiling. For cooling, the infiltration adjustment factor is assumed to be 80%. Therefore, for homes that are blower door tested, 4 kWh per 100 square feet are used plus savings from 5.4.4 Blower Door Test.

Method for Calculating Demand Savings

The demand savings is calculated using peak factors found in Table 1.1.3 in the Appendix.

Incremental Cost

50 cents per square foot.

Non-Electric Benefits - Annual Fossil Fuel Savings

See above for MBtu fossil fuel savings.

Notes & References

Note 1. Joe Swift, Northeast Utilities, 2005.

Note 2. ASHRAE degree-day correction. 1989 ASHRAE Handbook Fundamentals 28.2, Fig 1

WATER HEATER THERMOSTAT SETTING

Description of Measure

This measure is for lowering of the hot water temperature in an electric domestic hot water heater.

Method for Calculating Energy Savings

Please see the table below: Savings will occur only when the lower temperature of the hot water does not require the use of more hot water. Savings will not occur in an application such as a shower where the user demands a certain water temperature and will increase the hot water flow to make up for the lower temperature. A realization rate of 50 % has been applied to the faucet since savings will result only when the hot water is being wasted, and not when the user requires a certain temperature and increases the water flow to compensate for the reduced temperature.

Lower Electric Water Heater Temp from 140 to 125F

	Faucet	Clothes Washer	Totals
Water Consumption			
Best available efficient aerator GPM	1.5		
Duration of use, minutes	0.5		
No of uses / day	30		
Days/year	260		
Gallons of hot water used / year	**5,850**	**2,080**	**7,930**
Consumption / cycle gallons hot water		10	
Cycles/week		4	
Energy Savings			
Btu			
Temp water to house in degrees F	55	55	
Original hot water temp in degrees F	140	140	
Reset water temp in degrees F	125	120	
Temp savings in degrees F	15	15	
Weight of water pounds/gal	8.3	8.3	
Btu savings /gal	124.5	124.5	
Btu saved /year	728,325	258,960	
MBtu saved/year	0.728	0.259	
kWh Electricity			
kWh/Mbtu	293	293	
Elect saved/year in kWh	**213**	**76**	
Efficiency of electric hot water	0.9	0.9	
Total Elect saved/year kWh at water heater	**237**	**84**	
Apply realization rate of 50% to faucet savings	**118.5**	**84**	**202.5**
Natural Gas			
Gas saved/ year in MBtu	0.728	0.259	

Lower Electric Water Heater Temp from 140 to 125F

	Faucet	Clothes Washer	Totals
Efficiency of gas water heater	0.6	0.6	
Gas Saved/year in MBtu at water heater (1,000 Cu ft)	**1.213**	**0.43**	
Apply realization rate of 50% to faucet savings	**0.61**	**0.43**	**1.04**

	Faucet	Clothes Washer	Totals
No.2 Oil			
No 2 Oil, Btu/gal			140,000
Gallons of No. 2 oil saved / year	5.2	1.8	
Efficiency of oil fired heater	0.5	0.5	
Gallons of No 2 oil saved at heater	**10.4**	**3.6**	
			8.8
Apply realization rate of 50% to faucet savings	**5.2**	**3.6**	

Method for Calculating Demand Savings

There is no demand savings associated with this measure.

Baseline Efficiencies from which savings are calculated

The base line efficiency is considered to be the 140F water heater outlet temperature.

Compliance Efficiency from which incentives are calculated

The compliance efficiency is considered to be the 125F water heater outlet temperature.

Operating Hours

The operating hours are included in the water consumption values in the table.

Total Cost

Since this is a low income measure, it is commonly done by a contractor and has a total cost of $5.

Non-Electric Benefits - Annual Fossil Fuel Savings

See Method for Calculating Energy Savings.

Non-Electric Benefits - Annual Water Savings

See Method for Calculating Energy Savings.

WATER HEATER WRAP

Description of Measure

Electric Hot water heaters with fiberglass insulation are wrapped with an insulating blanket to reduce standby heat loss through the skin. This measure is not necessary for newer units which are insulated with foam.

Method for Calculating Energy Savings

The reference used for this measure is "Meeting the Challenge: The Prospect of Achieving 30 percent Energy Savings Through the Weatherization Assistance Program" by the Oak Ridge National Laboratory - May 2002.

The home studied in the Northeast had a gas fired water heater, and was not applicable, since only electric water heaters are wrapped in the Low Income programs. The southern home in the study did have an electric water heater. The difference in the actual heating and storage of hot water may be a little different in the South versus the Northeast, but the southern home can still be used as a good approximation.

The temperature of the water entering the heater may be warmer in the South versus the Northeast, especially in the Winter, but this would not affect standby losses which the wrapping seeks to reduce. The other difference is that the heat loss from the tank to the environment may be greater in the Northeast than the South because of the more mild Southern winters and the warmer southern summers. Therefore the Southern house can be used as a good approximation to a house in the Northeast with a possible slight upward bias.

The Oak Ridge study predicted that wrapping a 40 gallon water heater would result in an increase in the energy factor form 0.86 to 0.88 with a resulting savings of 0.20 MBTU. The electric equivalent of 0.20 MBtu is 0.2 X 293 kWh/MBtu = 58.6 kWh. Adjusting upward for a house in Connecticut, the estimated annual savings is approximately 70 kWh.

Method for Calculating Demand Savings

The demand saving is calculate by multiplying the annual kWh savings by the summer or winter peak factor for domestic hot water found in Appendix Table 1.1.3

Baseline Efficiencies from which savings are calculated

The base line efficiency used is that of a foam-insulated electric water heater with an energy factor of 0.86.

Compliance Efficiency from which incentives are calculated

The tank must have fiberglass insulation.

Operating Hours

Operating hours are used in the heat loss calculations, but only the result of those calculations is used here.

Total Cost

Since this is a low income program, the entire cost is borne by the program. The estimated cost is $16.00 for the material and $8.00 for the labor.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-electric benefits have not been identified for this measure.

Notes & References

The reference used for this measure is "Meeting the Challenge: The Prospect of Achieving 30 percent Energy Savings Through the Weatherization Assistance Program" by the Oak Ridge National Laboratory - May 2002.

LOW FLOW SHOWERHEAD

Description of Measure

This measure is for the installation of 2.2 GPM low flow showerheads

Method for Calculating Energy Savings

The savings are estimated as shown in the table below.

Water Savings = ((Act.GPM - 2.2 GPM) X (min/shr) X (shr /day) X (days/y)) Gal/y					
Actual shower flow in GPM as found	3	3.5	4	4.5	5
Federal standard for new construction	2.2	2.2	2.2	2.2	2.2
Savings in Gal/min	0.8	1.3	1.8	2.3	2.8
Duration of use, minutes	2.5	2.5	2.5	2.5	2.5
No. of showers/day	2	2	2	2	2
Days/year	365	365	365	365	365
Gallons of Water Saved/year	**1,460**	**2,373**	**3,285**	**4,198**	**5,110**
Energy Sav =((Water sav X (Temp to shr-temp to htr) X (8.3) / (1,000,000)) Mbtu/y					
BTU					
Temp water to house in degrees F	55	55	55	55	55
Temperature water to shower in degree F	105	105	105	105	105
Delta temp in degrees F	50	50	50	50	50
Weight of water pounds/gal	8.3	8.3	8.3	8.3	8.3
BTU required/gal	415	415	415	415	415
MBtu saved /year	**0.606**	**0.985**	**1.363**	**1.742**	**2.121**
Elect. Sav = ((Sav at shower in Mbtu/y) X (293) / (0.9 assumed efficiency)) kWh/y					
kWh/Mbtu	293	293	293	293	293
Elect. saved/year in kWh at showerhead	177.5	288.5	399	4 510	4 621.4
Efficiency of electric hot water heater	0.9	0.9	0.9	0.9	0.9
Total elect. saved/year kWh at water heater	**197.3**	**320.5**	**443.8**	**567.1**	**690.4**
Nat Gas Sav = ((Sav at shr in Mbtu/y) / (0.6 assumed efficiency) / (1000,000))Mbtu/y					
Gas saved/year in MBTU at showerhead	0.606	0.985	1.363	1.742	2.121
Estimated efficiency of gas water heater	0.6	0.6	0.6	0.6	0.6
Gas in MBTU at water heater	**1.010**	**1.640**	**2.270**	**2.900**	**3.530**
No. 2 Oil Sav = ((Sav at shr in Mbtu) / (140,000) / (0.5 assumed efficiency)) Gal/y					
No 2 Oil, BTU/gal	140,000	140,000	140,000	140,000	140,000
Gallons of No. 2 oil saved/year at faucet	4.33	7.04	9.74	12.44	15.15
Estimated efficiency of oil fired hot water heater	0.5	0.5	0.5	0.5	0.5
Gallons of No 2 oil saved at water heater	**8.66**	**14.08**	**19.48**	**24.88**	**30.30**

Method for Calculating Demand Savings

There is no demand savings associated with this measure.

Baseline Efficiencies from which savings are calculated

The baseline efficiency is the Federal Standard showerhead with a flow rate of 2.5 gpm at 80 psi.

Compliance Efficiency from which incentives are calculated

The compliance efficiency is 2.2gpm

Operating Hours

The operating hours can be calculated from the use time in the table above.

Total Cost

Since this measure is used in the Low Income Program, there is no cost to the resident. The total cost for material and installation is $8.10.

Non-Electric Benefits - Annual Fossil Fuel Savings

The equivalent fossil fuel savings for this measure is shown above in MBtu of gas and gallons of No. 2 oil.

Non-Electric Benefits - Annual Water Savings

The annual water savings is shown in the table above in gallons/year.

INSTALL CEILING INSULATION

Description of Measure

Installation of ceiling insulation in a residential living unit. The type of insulation installed is assumed to be either loose fill or batt-type insulation. Insulation must be installed between conditioned area and ambient (attic or outside) space. Insulation that is installed between two living spaces (i.e. between floors on a two family unit) does not qualify.

Method for Calculating Energy Savings

A parallel flow analysis was conducted (Note 1) and the following charts were generated. The R-value refers to the rated R-value of the insulation. The effective ceiling R-value and heat transfer was calculated to generate these charts. Note that the savings is based on 100 square feet of ceiling area.

		Total Post-Installed R-Value (including pre-existing)						
		19	**21**	**27**	**30**	**33**	**39**	**45**
Pre-Existing Insulation R-value	**0**	1,390	1,405	1,435	1,445	1,454	1,467	1,476
	3	424	439	469	479	488	501	510
	6	214	229	259	269	277	290	300
	9	122	136	167	177	185	198	208
	12	70	85	115	125	134	147	156
	15	37	52	82	92	101	114	123
	19		15	45	55	64	77	86
	21			30	41	49	62	71
	27				10	19	32	41

Annual kWh Savings for Electric Resistance Heat (per 100 sq. ft.)

		Total Post-Installed R-Value (including pre-existing)						
		19	21	27	30	33	39	45
Pre-Existing Insulation R-value	0	695	702	718	723	727	733	738
	3	212	219	235	240	244	250	255
	6	107	117	129	135	139	145	150
	9	61	68	83	88	93	99	104
	12	35	42	57	63	67	73	78
	15	18	29	41	46	50	57	61
	19		7.47	23	28	32	38	43
	21			15	20	24	31	36
	27				5	9	16	21

Annual kWh Savings for Electric Heat Pump (per 100 sq. ft.)

For example, suppose a house with electric resistance heat currently has 2 inches (assumed R-6) insulation in the attic. Insulation is installed to bring the total R-value up to R-30. The savings would be calculated by locating the R-6 on the left-hand column (pre-existing condition) and following across the row to R-30 (Total Post-installed R-value). For electric heat, the savings would be 269 kWh per 100 square feet of ceiling area.

In cases where the exact R-value (either pre or post) falls between the values on these tables, linear extrapolation can be used to approximate the savings.

Method for Calculating Demand Savings

The peak demand savings is calculated by multiplying the annual kWh savings by the peak kW/kWh factor for residential winter heating found in Appendix Table 1.1.3.

Cooling savings is not defined for this measure.

Total Cost

Actual cost or $1 per square foot as a default.

Non-Electric Benefits - Annual Fossil Fuel Savings

The following charts can be used to calculate fossil fuel savings for ceiling insulation. These charts are similar in nature to the charts above.

		Total Post-Installed R-Value (including pre-existing)						
		19	**21**	**27**	**30**	**33**	**39**	**45**
Pre-Existing Insulation R-value	**0**	45.2	45.7	46.6	47.0	47.3	47.7	48.0
	3	13.8	14.3	15.2	15.6	15.9	16.3	16.6
	6	6.9	7.4	8.4	8.7	9.0	9.4	9.7
	9	4.0	4.4	5.4	5.8	6.0	6.4	6.8
	12	2.3	2.8	3.7	4.1	4.3	4.8	5.1
	15	1.2	1.7	2.7	3.0	3.3	3.7	4.0
	19		0.5	1.5	1.8	2.1	2.5	2.8
	21			1.0	1.3	1.6	2.0	2.3
	27				0.3	0.6	1.0	1.3

Annual Gallons of Oil Saved (per 100 sq. ft.)

		Total Post-Installed R-Value (including pre-existing)						
		19	**21**	**27**	**30**	**33**	**39**	**45**
Pre-Existing Insulation R-value	**0**	63.3	63.9	65.3	65.8	66.2	66.7	67.2
	3	19.3	20.0	21.3	21.8	22.2	22.8	23.2
	6	9.7	10.4	11.8	12.2	12.6	13.2	13.6
	9	5.5	6.2	7.6	8.1	8.4	9.0	9.5
	12	3.2	3.9	5.2	5.7	6.1	6.7	7.1
	15	1.7	2.4	3.7	4.2	4.6	5.2	5.6
	19		0.7	2.1	2.5	2.9	3.5	3.9
	21			1.4	1.8	2.2	2.8	3.2
	27				0.5	0.9	1.4	1.9

Annual Therms of Gas Saved (per 100 sq. ft.)

		Total Post-Installed R-Value (including pre-existing)						
		19	21	27	30	33	39	45
Pre-Existing Insulation R-value	0	70.3	71.0	72.6	73.1	73.5	74.2	74.6
	3	21.4	22.2	23.7	24.2	24.7	25.3	25.8
	6	10.8	11.6	13.1	13.6	14.0	14.7	15.2
	9	6.1	6.9	8.4	8.9	9.4	10.0	10.5
	12	3.5	4.3	5.8	6.3	6.8	7.4	79.0
	15	1.9	2.6	4.1	4.7	5.1	5.7	6.2
	19		0.8	2.3	2.8	3.2	3.9	4.4
	21			1.5	2.0	2.5	3.1	3.6
	27				0.5	0.9	1.6	2.1

Annual Gallons of Propane Saved (per 100 sq. ft.)

Notes & References

Note 1. Joe Swift, Northeast Utilities, 2002. Reviewed and updated in April, 2005.

INSTALL WALL INSULATION

Description of Measure

Insulation installed (either bat or blown-in) in a wall. Assuming that there is no insulation installed previously.

Method for Calculating Energy Savings

Parallel flow method was used to calculate savings (Note 1) based on a typical 2 x 4 wall. Savings is based on 100 square feet of wall area (net of window and doors).

Savings = (1/Rexisting – 1/RNew) x Degree Days x 24 x Adjustment x Area

where: Rexisting is the effective R-value of the existing wall assumed to be 3
RNew is the upgraded effective R-value assumed to be 10
Degree days = 6200 assumed state average
Adjustment = 0.64 ASHRAE adjustment factor (note 2)
Area = 100 square feet .
Annual Btu conductive saving = 2,220,000

Therefore, Annual Savings (for homes with electric heat):
Electric resistance savings = 651 kWh
Heat Pump savings = 326 kWh

Method for Calculating Demand Savings

The peak demand savings is calculated by multiplying the annual kWh savings by the peak kW/kWh factor for residential winter heating found in Appendix Table 1.1.3. Summer demand savings is zero.

Total Cost

Actual cost or $0.75 per square foot as default.

Non-Electric Benefits - Annual Fossil Fuel Savings

Non-Electric savings would occur for homes that have a non-electric source of heating.

Annual fossil fuel savings = MBtu savings / system efficiency

where: MBtu savings = 2.22
75% is the assumed system efficiency including distribution loss.

Therefore,
annual gas savings = 22.2 Therms/year (for gas heated homes)
annual oil savings = 15.9 Gallons/year (for oil heated homes)
annual propane = 24.7 Gallons/year (for propane heated homes)

Notes & References
Note 1. Joe Swift, Northeast Utilities, 2002. Reviewed and updated in April, 2005.
Note 2. ASHRAE degree-day correction. 1989 ASHRAE Handbook Fundamentals 28.2, Fig 1

MWh achieved	2009	2010
residential electronics	1,324.9475	942.2558
residential buildings - lighting	7,452.8297	5,300.1889
residential buildings - new shell improvements	6,031.5911	4,387.7396
residential water heaters	100,861.6282	71,729.2232
residential buildings - shell retrofits	60,247.4094	43,827.5644
residential buildings - HVAC equipment efficiency	74,081.5942	173,813.0281
total	250,000.0000	300,000.0000

$/MWh	2009	2010
residential appliances	$ 197.42	$ 197.86
residential buildings - lighting	$ 98.77	$ 95.87
residential buildings - new shell improvements	$ 847.01	$ 835.61
residential water heaters	$ 321.02	$ 331.75
residential buildings - shell retrofits	$ 835.61	$ 840.34
residential buildings - HVAC equipment efficiency	$ 134.07	$ 136.87

total value per measure	2009	2010
residential appliances	$ 261,576.63	$ 186,438.08
residential buildings - lighting	$ 736,082.99	$ 508,133.03
residential buildings - new shell improvements	$ 5,108,800.95	$ 3,666,457.71
residential water heaters	$ 32,378,864.40	$ 23,796,035.08
residential buildings - shell retrofits	$ 50,343,592.95	$ 36,829,964.42
residential buildings - HVAC equipment efficiency	$ 9,932,097.10	$ 23,789,411.11
total	$ 98,761,015.02	$ 88,776,439.44

divided by TRC	2009	2010
residential appliances	$ 74,736.18	$ 53,268.02
residential buildings - lighting	$ 210,309.43	$ 145,180.87
residential buildings - new shell improvements	$ 1,459,657.41	$ 1,047,559.35
residential water heaters	$ 9,251,104.11	$ 6,798,867.17
residential buildings - shell retrofits	$ 14,383,883.70	$ 10,522,846.98
residential buildings - HVAC equipment efficiency	$ 2,837,742.03	$ 6,796,974.60

price cap	2009	2010
residential appliances	$ 56.41	$ 56.53
residential buildings - lighting	$ 28.22	$ 27.39
residential buildings - new shell improvements	$ 242.00	$ 238.75
residential water heaters	$ 91.72	$ 94.79
residential buildings - shell retrofits	$ 238.75	$ 240.10
residential buildings - HVAC equipment efficiency	$ 38.31	$ 39.11

budget	2009	2010
residential appliances	$ 74,736.18	$ 53,268.02
residential buildings - lighting	$ 210,309.43	$ 145,180.87
residential buildings - new shell improvements	$ 1,459,657.41	$ 1,047,559.35
residential water heaters	$ 9,251,104.11	$ 6,798,867.17
residential buildings - shell retrofits	$ 14,383,883.70	$ 10,522,846.98
residential buildings - HVAC equipment efficiency	$ 2,837,742.03	$ 6,796,974.60
total	$ 28,217,432.86	$ 25,364,696.98