ECKERT SEAMANS
ATTORNEYS AT LAW

Eckert Seamans Cherin & Mellott, LLC
213 Market Street
8th Floor
Harrisburg, PA 17101

TEL 717 237 6000
FAX 717 237 6019
www.eckertseamans.com

Daniel Clearfield
717.237.7173
dclearfield@eckertseamans.com

May 3, 2012

Via Hand Delivery
Rosemary Chiavetta, Secretary
PA Public Utility Commission
PO Box 3265
Harrisburg, PA 17105-3265

Re: Pennsylvania Public Utility Commission v. Philadelphia Gas Works,
Docket Nos. R-2009-2139884; P-2009-2097639

Dear Secretary Chiavetta:

In accordance with Paragraph 24 of the Joint Petition For Settlement of the above proceeding, which was approved by the Commission by Order entered July 29, 2010, enclosed for filing please find an original and three copies of Philadelphia Gas Works' ("PGW") Third Year Implementation Plan, Fiscal Year 2013, for its Demand Side Management ("DSM") Program.

Please contact me if you have any questions

Very truly yours,

Daniel Clearfield

DC/lww
Enclosure

cc: Cert. of Service w/enc.

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PHILADELPHIA GAS WORKS

FIVE-YEAR ENERGYSENSE DEMAND SIDE MANAGEMENT PORTFOLIO

THIRD YEAR IMPLEMENTATION PLAN

FISCAL YEAR 2013

MAY 2, 2012

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I. PORTFOLIO IMPLEMENTATION PLAN

A. Introduction

The Third Year Implementation Plan ("Plan") describes the processes and steps that Philadelphia Gas Work (PGW or "Company") will take to implement the third year (FY 2013[1]) of its EnergySense Demand-Side Management Portfolio (DSM Portfolio) as approved by the Pennsylvania Public Utility Commission ("PUC") by order entered on July 29, 2010.

This plan also provides an update on the progress to date in FY 2012 for the Company's DSM Portfolio. In addition, this plan provides more limited information on the planned implementation activities during the remaining two years of PGW's DSM Portfolio.

PGW's DSM Portfolio has five broad goals:

- Reduce customer bills
- Maximize customer value
- Contribute to the fulfillment of the City's sustainability plan.
- Reduce PGW cash flow requirements
- Help the Commonwealth and the City of Philadelphia reduce greenhouse gas emissions

To achieve these goals, PGW will undertake the following activities during the third year of the DSM Portfolio:

- Continue to develop the infrastructure required to scale up the DSM portfolio
- Continue to ramp up the new Enhanced Low Income Retrofit Program (ELIRP) program and achieve aggressive savings targets by focusing on heating equipment replacements, when cost-effective, and diagnostically comprehensive work in every home treated.
- Continue to ramp up the new Residential Heating Equipment Rebate Program (RHER).

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[1] PGW's Fiscal Year 2013 begins September 1st, 2012 and goes until August 31st, 2013

- Ramp-up the Commercial and Industrial Retrofit Incentives Program (CIRI) from what had essentially been a pilot year, focusing on only 1-3 strictly multi-family buildings, to a larger fully implemented program.

- Launch the Commercial and Industrial Equipment Rebates Program (CIER), utilizing a structure similar to the RHER, but targeting high efficiency natural gas equipment used in the commercial and industrial markets.

- Launch the High Efficiency Construction Incentives Program (HECI) to deliver services similar to the CIRI, with a focus on new construction in the residential and commercial markets.

- Launch the Comprehensive Residential Retrofit Incentives Program (CRRI) in order to offer comprehensive natural gas energy efficiency retrofits to all PGW residential customers.

- Issue the second Annual Report for the DSM portfolio, covering FY 2012

B. Plan Development Process

Over the past year, PGW has continued to refine program details as the new DSM programs were developed and rolled out. The Plan updates information provided in the two previous Implementation Plans, outlines progress that has been made to date in FY 2012, and provides details on programs that are scheduled to begin in FY 2013.

The following material changes were made to PGW's DSM Plan to develop this Third Year Implementation Plan and to ensure compliance with the approved settlement. Additional details are provided in the relevant sections of the Plan.

General

- Avoided costs for natural gas were updated, reflecting a significant decrease in value from previous assumptions.

- The discount rate used for cost-effectiveness analysis was reduced to reflect PGW's true cost of capital.

- A Technical Reference Manual (TRM) was further developed to refine the methods used to calculate savings from the ELIRP and RHER, and to document the deemed savings approaches used for CIRI, CIER, HECI, and CRRI. The updated TRM can be found in Appendix I.

ELIRP

- The existing selection criteria for ELIRP homes was amended to include two additional criteria:
  - Customer cannot have current arrears older than 2 months
  - Customer cannot have been treated under PGW's recent CWP Pilot program

- Projections were updated to reflect that the current cost of savings and the weighted lifetimes were higher than initially assumed. In order to maintain budget levels, projected savings and participation amounts were lowered.

RHER

- Existing rebate incentive levels for the high efficiency furnaces and boilers were doubled from $250 and $1,000, respectively, to $500 and $2,000 to account for extremely low participation rates to date and a refined economic analysis of the local incremental measure and installation costs.

- Projections have been updated to reflect the changes in the heating market and updated rebate amounts.

CIRI

- PGW is in preliminary discussions with financial institutions for the purposes of structuring financing assistance products for CIRI projects.

- PGW continues to focus initial efforts on multi-family building retrofits, and will branch out to additional commercial and industrial retrofit opportunities in FY 2013.

CIER

- An initial list of measures and rebates has been established

- The original program design has been updated to reflect PGW's experience with the RHER program.

- Detailed projections have been added based on the new schedule of rebates and additional market research

HECI

- A detailed program design was created that updates PGW's plans to reflect recent research and design development work.

- Projections have also been updated to reflect the current conditions for the new construction and gut rehabilitation markets.

CRRI

- Significant revisions were made to program design and delivery including a more gradual ramp up and a drop in participation projections to reflect the difficulty in program delivery.
- Program overhead cost assumptions were updated to reflect higher anticipated setup and customer acquisition costs.
- Savings and incentive levels were adjusted to reflect PGW's experience with ELIRP, including raising the amount of incentives offered to customers and the incremental cost of those savings.

C. Summary of Costs, Benefits, and Impacts

The following tables present the projected FY 2013 impacts for the DSM Portfolio. The exception is the "Cost-Effectiveness of Planned Results", which reflects projected results for the entire five year period of the portfolio. Unless otherwise stated, all dollar amounts in the plan are shown in nominal dollars. Please see Appendix E for additional five-year projections broken down by year as well as a comparison to projections from the Fiscal Year 2012 plan.

Over the five years of the DSM Portfolio, PGW expects to spend approximately $56.8 million on six DSM programs. The programs are projected to save 754 BBtus of natural gas during the first five years of the portfolio, and 14,752 BBtus of natural gas over the lifetime of the measures installed. For the natural gas system, the present value of benefits is $68 million leading to a present value of net benefits of $22 million and a benefit-cost ratio (BCR) of 1.48. From a total resource perspective, the present value of benefits is $80 million leading to a present value of net benefits of $22 million and a benefit-cost ration (BCR) of 1.38. The cost-effectiveness results of both tests show that the DSM Portfolio is still cost-effective, creating nearly $1.40 in benefits for every $1 dollar spent. Data on funds spent and recovered to date can be found in Appendix H.

Additional benefits from the five years of the portfolio include:

- Saving 3,484 MWh of electricity[2]

[2] Electric savings are ancillary resulting from direct gas saving measures, such as air-conditioning savings from insulation treatments.

- Avoiding 1,817 kW of summer peak demand
- Saving 102 million gallons of water
- Creating new jobs in Pennsylvania
- Reducing the emissions of CO_2 by over 900 thousand tons

In FY 2013, PGW plans to spend approximately $12 million, which includes the continued delivery of the ELIRP, RHER, and CIRI programs as well as the launching of the HECI, CIER, and CRRI program.

PGW's administration costs come to $808,000, or 6.7% of the third year's budget.

All data presented in this plan on progress to date is through the end of February, 2012 in order to give PGW ample time to process data and prepare the Plan.

i) Cost-Effectiveness

From inception through February 29th, 2012, the EnergySense portfolio shows a TRC Benefit-Cost-Ratio (BCR) of 1.00 with Present Value (PV) of Net Benefits of -$20,204. The portfolio has had a slower than anticipated start, but trends to date demonstrate steady improvement in terms of BCR and PV Net Benefits through the first year of actual activities. This period included one-time start-up costs of approximately $760,000, as well as regular ongoing administrative costs at both the portfolio and program levels, while experiencing unexpectedly low initial production levels as the programs ramped-up.

Over this initial launch period, the ELIRP program has already overcome a prolonged ramp-up, to achieve a BCR of 1.09 and is clearly trending towards targeted cost-effectiveness levels. The RHER program, while also cost-effective with a BCR of 1.59, continues to demonstrate low participation levels, which has resulted in relatively low PV Net Benefits to date. Additionally, the CIRI program, launched in FY12 has absorbed the start-up and ongoing overhead costs in its first year; however, as no projects had been closed by the end of this reporting period there are no benefits to be claimed for this program in this Plan. Overall EnergySense portfolio cost-effectiveness will continue to trends upwards towards targeted levels as ELIRP BCR continues to improve and RHER and CIRI PV Net Benefits continue to grow with higher participation. These individual programs' cost-effectiveness will be discussed in greater detail in the respective sections below.

Table 1–Cost-Effectiveness Results from Inception through Feb 29, 2012 (2009$)

Program	PV of Benefits	PV of Costs	PV of Net Benefits	BCR
	Total Resource			
Enhanced Low Income Retrofit	$ 8,397,084	$ 7,722,758	$ 674,326	1.09
Residential Heating Equipment Rebates	$ 522,298	$ 329,026	$ 193,272	1.59
Commercial and Industrial Retrofit Incentives	$ -	$ 13,059	$ (13,059)	-
Portfolio-wide Costs	$ -	$ 874,743	$ (874,743)	-
Total Portfolio	**$ 8,919,382**	**$ 8,939,586**	**$ (20,204)**	**1.00**
	Gas Utility			
Enhanced Low Income Retrofit	$ 6,690,848	$ 7,722,758	$ (1,031,910)	0.87
Residential Heating Equipment Rebates	$ 492,065	$ 210,387	$ 281,677	2.34
Commercial and Industrial Retrofit Incentives	$ -	$ 13,059	$ (13,059)	-
Portfolio-wide Costs	$ -	$ 874,743	$ (874,743)	-
Total Portfolio	**$ 7,182,913**	**$ 8,820,948**	**$ (1,638,035)**	**0.81**

Figure 1 – Cumulative Monthly TRC BCR by Program

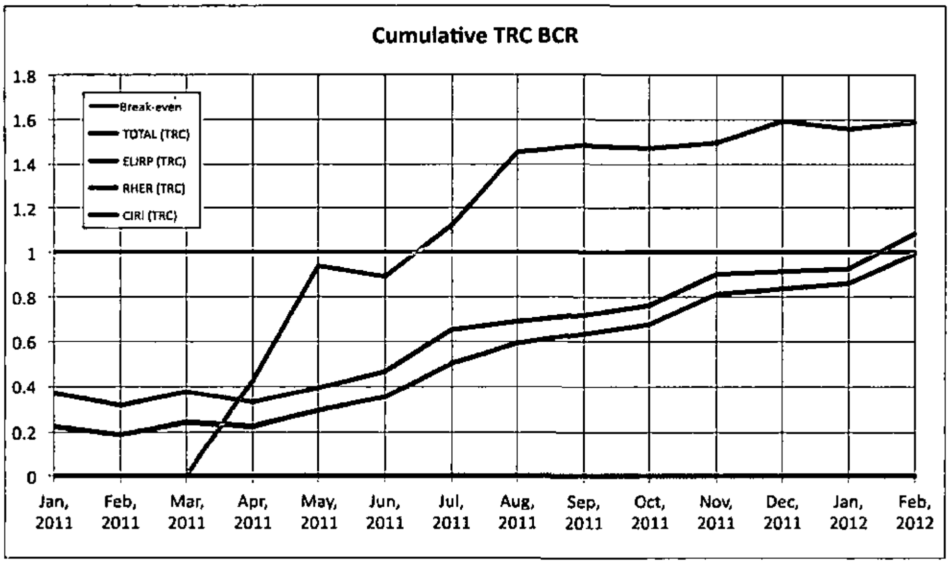


Figure 2 – Cumulative Monthly TRC Net Benefits by Program

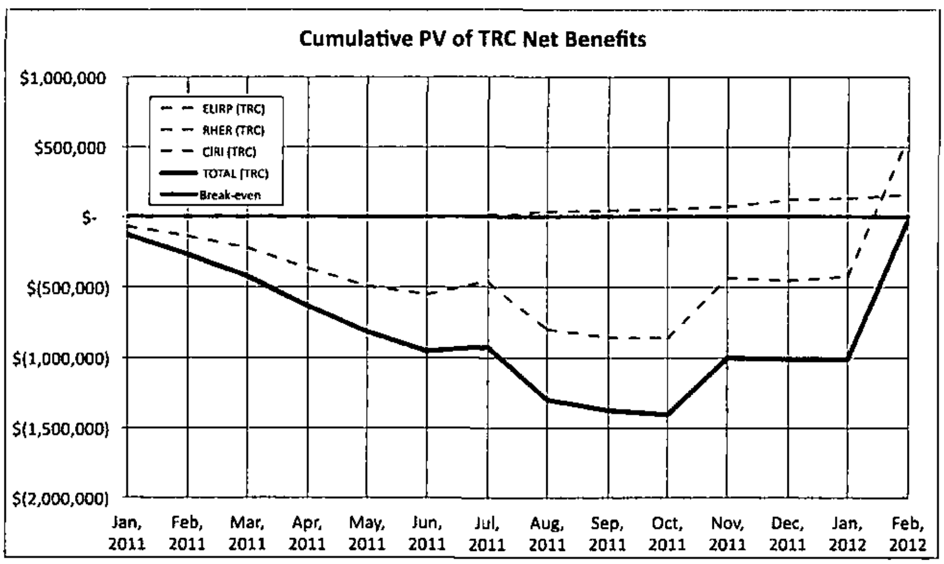


Table 2–Projected Cost-Effectiveness Results FY 2011 – FY 2015 (2009$)

Program	Total Resource		
	PV Costs	**PV Net Benefits**	**Benfit-Cost Ratio**
Enhanced Low Income Retrofit	$ 25,204,026	$ 5,883,025	1.23
Residential Heating Equipment Rebates	$ 15,912,220	$ 8,060,850	1.51
Comprehensive Residential Retrofit Incentives	$ 7,219,994	$ 2,130,230	1.30
High Efficiency Construction Incentives - Residential	$ 514,705	$ 336,325	1.65
Residential Total	**$ 48,850,945**	**$ 16,410,431**	**1.34**
Commercial and Industrial Retrofit Incentives	$ 3,226,551	$ 1,300,841	1.40
Commerical and Industrial Equipment Rebates	$ 1,956,625	$ 7,270,397	4.72
High Efficiency Construction Incentives - Nonresidential	$ 514,705	$ 336,325	1.65
Commercial & Industrial Total	**$ 5,697,882**	**$ 8,907,563**	**2.56**
Portfolio-wide Costs	$ 3,459,866	$ (3,459,866)	n/a
Total Portfolio	**$58,008,693**	**$ 21,858,128**	**1.38**
Program	**Gas Energy System**		
	PV Costs	**PV Net Benefits**	**Benfit-Cost Ratio**
Enhanced Low Income Retrofit	$ 25,204,026	$ 1,120,314	1.04
Residential Heating Equipment Rebates	$ 8,399,004	$ 14,133,763	2.68
Comprehensive Residential Retrofit Incentives	$ 4,874,919	$ 3,102,641	1.64
High Efficiency Construction Incentives - Residential	$ 444,277	$ 406,754	1.92
Residential Total	**$ 38,922,226**	**$ 18,763,472**	**1.48**
Commercial and Industrial Retrofit Incentives	$ 1,547,580	$ 2,979,812	2.93
Commerical and Industrial Equipment Rebates	$ 1,575,183	$ 3,483,949	3.21
High Efficiency Construction Incentives - Nonresidential	$ 444,277	$ 406,754	1.92
Commercial & Industrial Total	**$ 3,567,040**	**$ 6,870,514**	**2.93**
Portfolio-wide Costs	$ 3,459,866	$ (3,459,866)	n/a
Total Portfolio	**$45,949,132**	**$ 22,174,120**	**1.48**

Table 3–Comparison of Current TRC Projections to FY 2012 Projections (2009$)

Program	FY 2012 IP - PV Net Benefits		FY 2013 IP - PV Net Benefits		Difference	
	Total Resource	Gas Energy System	Total Resource	Gas Energy System	Total Resource	Gas Energy System
Enhanced Low Income Retrofit	$ 6,586,476	$ 4,870,604	$ 5,883,025	$ 1,120,314	$ (703,450)	$ (3,750,490)
Residential Heating Equipment Rebates	$ 22,772,727	$ 30,575,676	$ 8,060,850	$ 14,133,763	$ (14,711,876)	$ (16,441,913)
Comprehensive Residential Retrofit Incentives	$ 10,291,543	$ 16,898,461	$ 2,130,230	$ 3,102,641	$ (8,161,313)	$ (13,793,820)
High Efficiency Construction Incentives - Residential	$ 1,032,002	$ 1,304,745	$ 336,325	$ 406,754	$ (695,676)	$ (897,991)
Residential Total	**$ 40,682,747**	**$ 53,647,685**	**$ 16,410,431**	**$ 18,763,472**	**$ (24,272,316)**	**$ (34,884,213)**
			$ -	$ -	$ -	$ -
Commercial and Industrial Retrofit Incentives	$ 1,158,004	$ 2,654,851	$ 1,300,841	$ 2,979,812	$ 142,837	$ 324,961
Commerical and Industrial Equipment Rebates	$ 146,670	$ 290,873	$ 7,270,397	$ 3,483,949	$ 7,123,726	$ 3,193,076
High Efficiency Construction Incentives - Nonresidential	$ 257,361	$ 325,378	$ 336,325	$ 406,754	$ 78,964	$ 81,376
Commercial & Industrial Total	**$ 1,562,036**	**$ 3,271,102**	**$ 8,907,563**	**$ 6,870,514**	**$ 7,345,527**	**$ 3,599,413**
			$ -	$ -	$ -	$ -
Portfolio-wide Costs	$ (3,245,695)	$ (3,245,695)	$ (3,459,866)	$ (3,459,866)	$ (214,171)	$ (214,171)
Total Portfolio	**$38,999,088**	**$53,673,092**	**$ 21,858,128**	**$ 22,174,120**	**$ (17,140,960)**	**$ (31,498,972)**

The cost-effectiveness projections presented in Table 3 incorporate actual activity for FY 2011 and midway through FY 2012 (i.e. February 29, 2012), as well as updated projections for the rest of FY 2012 and FY 2013 – 15 from this plan (the FY 2013 Implementation Plan). The main changes in net benefits are due to:

- Slower than expected ramp-up which led to under spending budgets in FY 2011 and 2012
- Updated Avoided Costs, which reflect significantly decreased gas commodity costs.
- Changes in codes and standards for natural gas furnaces due to go into effect in May of 2013. Specifically, the baseline efficiency level for natural gas furnaces will rise from the current value of 80 AFUE to 90 AFUE.
- An increase in the incentives offered for residential heating equipment in RHER, which decreases the number of incentives in order to maintain budget levels.
- Revised assumptions for CRRI that significantly drop program participation levels and budgets.
- Increased budget projections and the inclusion of highly cost-effective commercial cooking equipment in the updated design for CIER.

ii) Gas Savings

Table 4– Natural Gas Savings from Inception through February 29, 2012 (BBtus)

PROGRAM	Inception through Feb 29, 2012 INCREMENTAL NET ANNUAL GAS SAVINGS (BBtu)	INCREMENTAL NET LIFETIME GAS SAVINGS (BBtu)
Enhanced Low Income Retrofit	57.4	1,196.2
Residential Heating Equipment Rebates	4.0	87.1
Comprehensive Residential Retrofit Incentives	0.0	0.0
High Efficiency Construction Incentives - Residential	0.0	0.0
Residential Total	**61.4**	**1,283.3**
Commercial and Industrial Retrofit Incentives	0.0	0.0
Commerical and Industrial Equipment Rebates	0.0	0.0
High Efficiency Construction Incentives - Nonresidential	0.0	0.0
Commercial & Industrial Total	**0.0**	**0.0**
Total Portfolio	**61.4**	**1,283.3**

Table 5 - Projected Natural Gas Savings for FY 2013 (BBtus)

PROGRAM	FY 2013 INCREMENTAL NET ANNUAL GAS SAVINGS (BBtu)	INCREMENTAL NET LIFETIME GAS SAVINGS (BBtu)
Enhanced Low Income Retrofit	69.8	1,466.5
Residential Heating Equipment Rebates	36.3	805.9
Comprehensive Residential Retrofit Incentives	4.7	98.3
High Efficiency Construction Incentives - Residential	1.6	32.7
Residential Total	**112.4**	**2,403.4**
Commercial and Industrial Retrofit Incentives	19.3	289.1
Commerical and Industrial Equipment Rebates	21.3	248.3
High Efficiency Construction Incentives - Nonresidential	1.6	32.7
Commercial & Industrial Total	**42.2**	**570.1**
Total Portfolio	**154.6**	**2,973.5**

iii) Budgets

Per the PUC Settlement Order, PGW will maintain compliance within total portfolio-wide spending caps. While these budgets below represent current plans for budgets within the individual program to ensure compliance with that overall portfolio cap, there are no specific caps on how much can or should be spent on an individual program. Additionally, incentive spending within the individual programs is dependent in part on market conditions over which PGW has no control; this is especially the case for the High Efficiency Construction Incentives program as described below in that program section. As such, PGW reserves the flexibility to shift funding across the EnergySense programs, based on the programs' effectiveness and market reception, while still maintaining the overall portfolio cap as set forth by the Settlement order.

Table 6 –Costs by Program for Inception through February 29, 2012 (Nominal)

PROGRAM	Inception to Feb 29, 2012
Enhanced Low Income Retrofit	$ 7,409,889
Residential Heating Equipment Rebates	$ 202,527
Comprehensive Residential Retrofit Incentives	$ -
High Efficiency Construction Incentives - Residential	$ -
Residential Total	**$ 7,612,416**
Commercial and Industrial Retrofit Incentives	$ 13,059
Commerical and Industrial Equipment Rebates	$ -
High Efficiency Construction Incentives - Nonresidential	$ -
Commercial & Industrial Total	**$ 13,059**
Portfolio Administration and Management	$ 834,720
Portfolio Marketing and Business Development	
Portfolio-Wide Costs Total	**$ 834,720**
Utility Costs	**$ 8,460,195**
Participant Costs	$ 114,234
Total	**$ 8,574,429**

Table 7 – Portfolio Costs by Cost Category for Inception through February 29, 2012 (Nominal)

Category	Inception to Feb 29, 2012
Customer Incentives & Measure Installation Costs	$ 5,483,478
Administration and Management	$ 834,720
Marketing and Business Development	$ 73,846
Contractor Costs	$ 1,997,902
Inspection and Verification	$ 70,250
Evaluation	$ -
Utility Costs	**$ 8,460,195**
Participant Costs	$ 114,234
Total	**$ 8,574,429**

Table 8–Projected Budgets by Program for FY 2013 (Nominal)

PROGRAM	FY 2013
Enhanced Low Income Retrofit	$ 7,704,110
Residential Heating Equipment Rebates	$ 1,775,476
Comprehensive Residential Retrofit Incentives	$ 566,197
High Efficiency Construction Incentives - Residential	$ 96,207
Residential Total	**$ 10,141,990**
Commercial and Industrial Retrofit Incentives	$ 502,390
Commerical and Industrial Equipment Rebates	$ 408,158
High Efficiency Construction Incentives - Nonresidential	$ 96,207
Commercial & Industrial Total	**$ 1,006,755**
Portfolio Administration and Management	$ 464,000
Portfolio Marketing and Business Development	$ 344,000
Portfolio-Wide Costs Total	**$ 808,000**
Utility Costs	**$ 11,956,745**
Participant Costs	$ 1,920,122
Total	**$ 13,876,867**

Table 9 - Projected Portfolio Budget by Cost Category for FY 2013 (Nominal)

Category	FY 2013
Customer Incentives & Measure Installation Costs	$ 8,981,247
Administration and Management	$ 664,000
Marketing and Business Development	$ 633,286
Contractor Costs	$ 1,494,833
Inspection and Verification	$ 102,196
Evaluation	$ 81,182
Utility Costs	**$ 11,956,745**
Participant Costs	$ 1,920,122
Total	**$ 13,876,867**

Table 10 - FY 2013 Budget Cap Basis[3] (Nominal)

Year	Budgets		Budget Caps	Difference	
	Source	Amount		$	%
FY 2011	*Actual*	$ 3,792,281	$ 7,980,380	$ (4,188,099)	-52%
FY 2012	*FY12 IP*	$ 7,873,179	$ 8,293,780	$ (420,601)	-5%
FY 2013	*FY13 IP*	$ 11,956,745	$ 14,048,020	$ (2,091,275)	-15%
FY 2014	*FY13 IP*	$ 16,021,851	$ 16,102,544	$ (80,693)	-1%
FY 2015	*FY13 IP*	$ 17,235,343	$ 17,282,496	$ (47,153)	0%
FY2011 - 15		**$ 56,879,399**	**$ 63,707,220**	**$ (6,827,821)**	**-11%**

[3] Per Annual Budget Caps as set forth in the DSM Settlement.

Table 11- Projected FY 2013-2015 Budgets with Portfolio-Wide Costs Allocated to Programs[4]

PROGRAM	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2013 - FY 2015
Enhanced Low Income Retrofit	$ 3,589,538.24	$ 6,641,522	$ 8,226,278	$ 7,543,472	$ 7,275,486	$ 33,276,297
Residential Heating Equipment Rebates	$ 104,297	$ 932,891	$ 1,918,365	$ 3,814,603	$ 4,666,433	$ 11,436,588
Comprehensive Residential Retrofit Incentives	$ 23,699	$ 25,191	$ 626,294	$ 2,796,877	$ 3,212,287	$ 6,684,347
Commercial and Industrial Retrofit Incentives	$ 62,840	$ 185,020	$ 537,793	$ 702,781	$ 564,790	$ 2,053,225
Commerical and Industrial Equipment Rebates	$ 7,610	$ 8,089	$ 439,789	$ 749,932	$ 936,550	$ 2,141,971
High Efficiency Construction Incentives	$ 4,297	$ 4,568	$ 208,225	$ 414,186	$ 579,797	$ 1,211,073
TOTAL PORTFOLIO	**$ 3,792,281**	**$ 7,797,281**	**$ 11,956,745**	**$ 16,021,851**	**$ 17,235,343**	**$ 56,803,501**

[4]See Appendix E for budgets in Constant 2009 $ for comparison

iv) Non-Gas Savings

Table 12–Non-Gas Savings for Inception through February 29, 2012

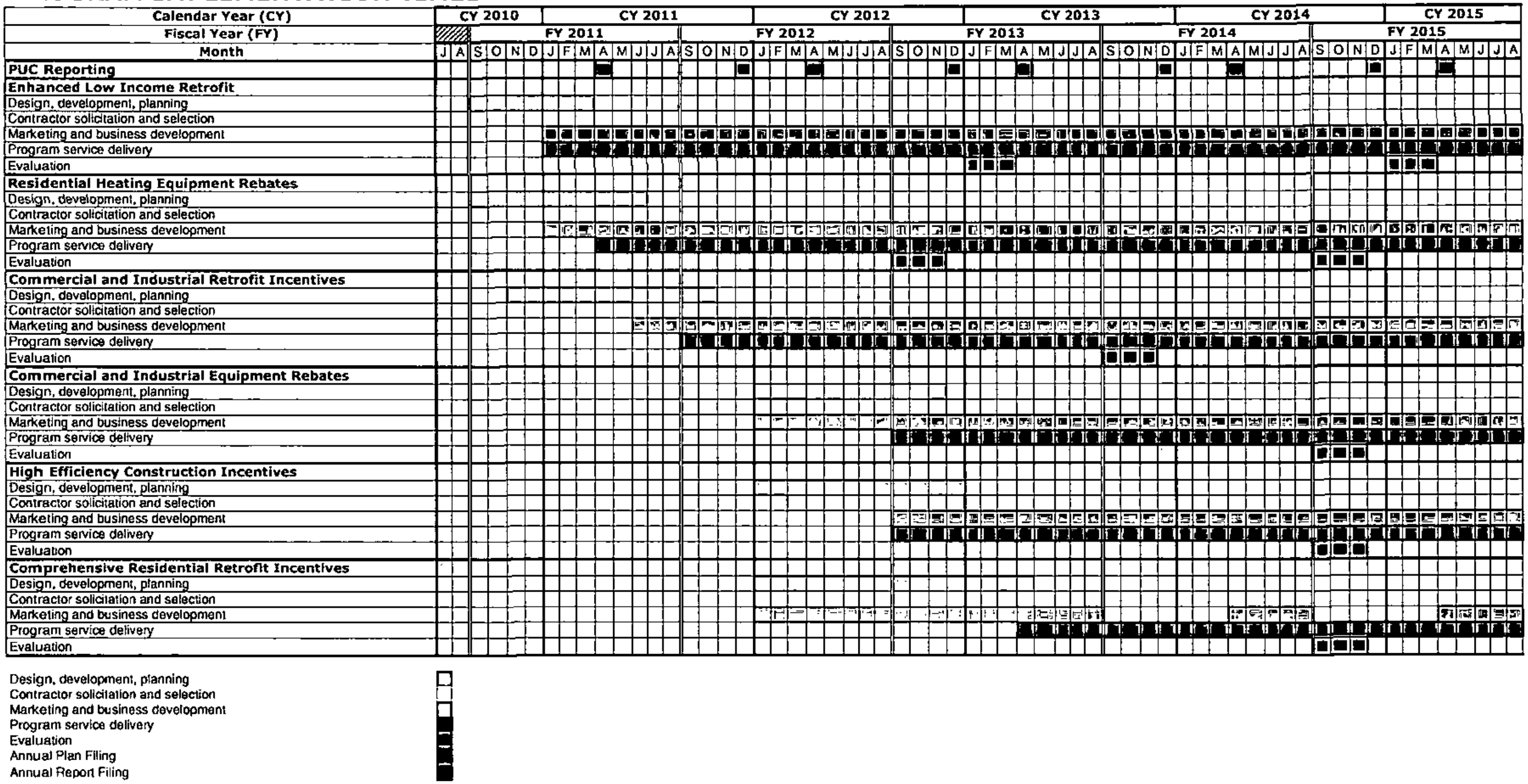
PROGRAM	Inception to February 29, 2012 INCREMENTAL NET ANNUAL ELECTRICITY SAVINGS (MWh)	INCREMENTAL NET LIFETIME ELECTRICITY SAVINGS (MWh)	INCREMENTAL NET ANNUAL SUMMER PEAK DEMAND SAVINGS (kW)	INCREMENTAL NET ANNUAL WATER SAVINGS (Million Gallons)
Enhanced Low Income Retrofit	764.4	16,924.5	288.9	3.6
Residential Heating Equipment Rebates	23.1	462.0	0.0	0.0
Comprehensive Residential Retrofit Incentives	0.0	0.0	0.0	0.0
High Efficiency Construction Incentives - Residential	0.0	0.0	0.0	0.0
Residential Total	**787.5**	**17,386.5**	**288.9**	**3.6**
Commercial and Industrial Retrofit Incentives	0.0	0.0	0.0	0.0
Commerical and Industrial Equipment Rebates	0.0	0.0	0.0	0.0
High Efficiency Construction Incentives - Nonresidential	0.0	0.0	0.0	0.0
Commercial & Industrial Total	**0.0**	**0.0**	**0.0**	**0.0**
Total Portfolio	**787.5**	**17,386.5**	**288.9**	**3.6**

Table 13–Projected Non-Gas Savings for FY 2013

PROGRAM	FY 2013 INCREMENTAL NET ANNUAL ELECTRICITY SAVINGS (MWh)	INCREMENTAL NET LIFETIME ELECTRICITY SAVINGS (MWh)	INCREMENTAL NET ANNUAL SUMMER PEAK DEMAND SAVINGS (kW)	INCREMENTAL NET ANNUAL WATER SAVINGS (Million Gallons)
Enhanced Low Income Retrofit	219.1	4,601.9	255.7	4.4
Residential Heating Equipment Rebates	149.3	2,986.7	0.0	0.0
Comprehensive Residential Retrofit Incentives	37.5	0.0	0.0	0.0
High Efficiency Construction Incentives - Residential	0.0	0.0	0.0	0.0
Residential Total	**406.0**	**7,588.6**	**255.7**	**4.4**
Commercial and Industrial Retrofit Incentives	0.0	0.0	0.0	0.0
Commerical and Industrial Equipment Rebates	0.0	0.0	0.0	17.3
High Efficiency Construction Incentives - Nonresidential	0.0	0.0	0.0	0.0
Commercial & Industrial Total	**0.0**	**0.0**	**0.0**	**17.3**
Total Portfolio	**406.0**	**7,588.6**	**255.7**	**21.8**

D. *Implementation Schedule*

PROGRAM IMPLEMENTATION TIMELINE



E. *Coordination Activities*

PGW seeks to coordinate DSM Portfolio efforts as much as possible with other organizations and programs in order to leverage existing resources and avoid lost opportunities and duplication of services. PGW is currently pursuing the following coordination activities:

- PGW has partnered with Philadelphia Workforce Investment Board and the Philadelphia Workforce Development Corporation through PA CareerLink Philadelphia to connect local unemployed workers with weatherization training programs and then onto employment with our ELIRP CSPs. To date, PGW CSPs have hired 17 local, unemployed entry-level workers through this partnership.
- PGW has partnered with the Clean Air Council in applying for a grant in order to ready certain housing stock in some of the poorest neighborhoods of Philadelphia for PGW's ELIRP weatherization services. The partnership sought external grants to fund the pre-treatment of existing structural, health, and safety issues that are preventing ELIRP work from proceeding. Additionally, the partnership sought to provide ongoing education services to ensure the lasting impact of PGW's weatherization services for Philadelphia's low income households. Unfortunately, no grant funding has been awarded to date, however PGW will continue seeking this partnership opportunity.
- PGW has partnered with the Philadelphia Health Department Green & Healthy Homes and Lead Poison Prevention Programs. In this initiative, PGW's ELIRP contractors refer customers to the Health Department for particular housing health and safety problems. The Health Department may then be able to correct these problems for residents, which allows PGW to provide cost-effective weatherization treatments to the customer under ELIRP.
- PGW is a partner on a State-wide Committee, chaired by the National Housing Trust, the Pennsylvania Utility Law Project, and the Pennsylvania Housing Finance Agency, on increasing Multi-Family Weatherization in Pennsylvania.
- PGW has held coordination discussions with the Pennsylvania Department of Community & Economic Development (DCED), the overseer of the State's Weatherization Assistance Program (WAP). The eligibility for participating in WAP is very similar to PGW's CRP, and by extension ELIRP, eligibility criteria. While PGW will continue sharing lists of potential customers to WAP, this opportunity for significant coordination benefits is greatly minimized as WAP had recently been primarily funded through ARRA with increased funding, which has now sunset. At a bare minimum, PGW will continue seeking to share information so as to avoid the duplication of efforts and allow both programs to work more efficiently together in the same service territory.
- In order to increase customer participation in its retrofit programs, the Company will aid customers in seeking and securing financing. PGW will target the

Keystone HELP and EnergyWorks programs as well as local banks and credit unions.

- Cross-Promotional opportunities are being developed with other energy-efficiency programs, most notably EnergyWorks, to provide information on complementary resources to existing networks.
- PGW will coordinate current marketing efforts with efforts by program CSPs. Examples of such cooperation include referencing recent program activity in "Good Gas News," PGW's monthly newsletter, providing information though bill inserts, and organizing joint training and education events.
- PGW directs CSPs to provide information on other relevant energy efficiency programs at the time of service delivery. This includes information about additional PGW programs as well as other local, state, and federal programs and resources.

F. Evaluation, Monitoring, and Verification

i) Planning and Reporting

PGW will continue to provide Annual Reports and Annual Implementation Plans in accordance with previous plans.

ii) Quality Control

PGW will continue to maintain and establish a DSM Portfolio team to provide overall program management, emphasize funding level requirements, and coordinate program delivery with other utilities and energy efficiency programs.

The Company will continuously monitor the program results, and, when necessary, program managers will modify the delivery of program services to meet changing customer and market conditions. Included in this oversight is the monitoring of vendor performance, customer satisfaction, and market responsiveness.

iii) Data Management

PGW initially launched the data tracking system in January, 2011 and continues to refine the system to maximize utility. As the Company develops implements the rest of the DSM portfolio, the database will be expanded to aid in data management and analysis for those programs.

iv) Evaluations

PGW is planning on performing the following impact evaluations in FY 2013:

- RHER Impact evaluation (start September 2012)

- ELIRP Impact evaluation (start January 2013)

G. *Key Assumptions*

i) Avoided Costs

PGW has updated its assumptions for avoided natural gas costs as part of the detailed program design process in July 2010, March 2011, and most recently March 2012.[5] The updated avoided costs were significantly lower than the previous projections from September of 2009. Table 14 shows the average annual drop in projected avoided cost over various time frames.

Table 14 - Average Annual Percentage Change in Avoided Costs

Year	Space Heating	Baseload	Water Heating
March 2011 to March 2012			
2012 - 2016	-12.0%	-22.3%	-19.4%
2017 - 2021	-16.7%	-24.4%	-22.2%
2022 - 2031	-14.8%	-19.9%	-18.5%
September 2009 to March 2012			
2012 - 2016	-29.3%	-38.7%	-36.1%
2017 - 2021	-26.4%	-33.8%	-31.7%
2022 - 2031	-26.7%	-31.8%	-30.4%

This significant reduction in avoided costs had a broad impact on the cost-effectiveness of the portfolio, reducing the value of benefits across the board. PGW plans to update avoided costs next year for the FY 2014 Implementation Plan.

ii) Benefit-Cost Analysis

The cost-effectiveness results reported in this plan followed standard industry practices for utilizing the Total Resource Cost (TRC) test for cost-effectiveness. The Company employed an Excel spreadsheet-based tool to calculate the cost-effectiveness of the DSM Portfolio.

The analysis used a real discount rate (RDR) of 3.25%. The RDR was calculated using an assumption of a nominal discount rate (NDR) of 5.32%f and inflation rate of 2.0%.The RDR used in previous plans was based on an NDR of 8.02%, in accordance with PGW's latest CWP evaluation. The value has been updated to reflect PGW's true weighted

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5 See Appendix A for table of updated avoided costs

average cost of capital (WECC), per PGW's calculated FY 2012 AFUDC[6] Rate. The reduction in the real discount rate offset most of the drop in avoided costs for the present value of measure savings, Appendix J has additional details on how the drop in avoided costs and its impacts on the value of savings.

iii) Technical Reference Manual

PGW has prepared the FY 2013 version of its Technical Reference Manual (TRM), which is included as Appendix I. The FY 2013 TRM includes details on calculating deemed savings for the ELIRP, RHER, CIRI, CIER, HECI, and CRRI.

The primary source of information for the TRM is other utilities' gas DSM programs, with regional adjustments where appropriate. In the future, the characterizations may also be based on PGW program experience and evaluations. Sources for all measure characteristics are documented in the TRM.

The TRM is a living document and is updated as technical information changes or new information becomes available.

[6] Allowance for Funds Used During Construction, a weighted average cost of capital of the company's long-term debt and commercial paper program.

II. Plans for Current Programs

This section contains the detailed completed and planned activities for programs that provided delivery of energy efficiency services in the second year of the DSM Portfolio, FY 2012. This includes three programs: ELIRP, RHER, and CIRI. ELIRP, which launched in January 2011, is an expansion of PGW's previous CWP, both in customers served and the depth of savings achieved. RHER, which launched April 2011, is a new program that provides prescriptive rebates for high efficiency, residential-sized gas heating equipment. CIRI, which launched September 2011, provides customized incentives to encourage commercial & industrial properties to proceed with comprehensive retrofit projects.

A. Enhanced Low Income Retrofit Program

i) Program Description

The Enhanced Low-Income Retrofit Program seeks to provide cost-effective energy savings to low-income customers who participate in PGW's Customer Responsibility Program (CRP). A secondary goal of the program is to reduce the overall long-term cost of the CRP as paid by all firm customers. The program seeks to achieve these goals and make customers' homes more energy efficient and comfortable by:

- Repairing or replacing older and less energy efficiency heating systems
- Providing comprehensive weatherization services
- Educating customers on ways to reduce their energy use along with basic health and safety information
- Raising awareness of energy conservation and encouraging the incorporation of energy saving behavior
- Targeting high-use customers to maximize impact and increase cost-effectiveness
- Streamlining the delivery mechanism through the use of implementation contractors

The program replaced the Conservation Works Program (CWP) as the Company's Low-Income Usage Reduction Program (LIURP) and was launched in January of 2011.

ii) Costs, Benefits, and Impacts

As of February 29, 2012, ELIRP has been treating customer houses for slightly over one full year. A summary of results is presented in the tables below.

Table 15 - ELIRP Impacts from Inception to Date

	Actual Results (Inception to 2/29/2012)
PARTICIPATION	
Open Cases	898
Closed Cases - Full	1,126
Closed Cases - Partial/Rejected	553
Customers with Installations	2,577
COSTS	
Measure Installation Costs	$5,406,598
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$1,933,042
Inspection and Verification	$70,250
Evaluation	$-
Utility Costs	**$7,409,889**
Participant Costs	$-
Total	**$7,409,889**
BENEFITS	
Net Annual BBtu	57.4
Net Lifetime BBtu	1,196.1
Net Annual MMBtu / Customer	22.3
Weighted Lifetime (years)	20.8

Program Costs

Approximately $3.1 million worth of the Low Income program budgets was left unspent at the close of FY 2011. All over-collections resulting from FY 2011 EnergySense activity are being refunded to the appropriate customer classes in FY 2012. However, this variance represents a significant portion of activity essential to achieving the overall energy usage reduction goals set forth in the Company's approved plans. Accordingly, PGW may seek approval to add this unspent funding to increase the final years' ELIRP budgets, thereby allowing sufficient time to identify and address the issues that prevented PGW from realizing the pace of activity originally planned for FY 2011. Any budgetary changes would be proposed and justified in future Annual Implementation Plans, per the Commission order.

Program Savings

Initially, ELIRP was designed to focus on the average savings per home treated, with a goal of 20% based on the results of the previous CWP pilot program. Through the end of this reporting period, ELIRP had achieved an average savings of 15.5% in homes that received a full treatment and an average of 4.7% savings per home for those that received only the partial treatment. The average across all completed homes was 12.0% savings as a percentage of weather-normalized usage. For comparison, PGW's 2008 evaluation found that the comprehensive CWP pilot achieved 9.7% savings. While the enhanced program design has resulted in substantially deeper average savings in comprehensive projects, the program is currently still short of the original goal of 20% on average.

It should be noted that previously a project was only identified for CWP pilot treatments after the site visit confirmed suitable conditions. In ELIRP, all projects are targeted for treatments, regardless of their initial on-site suitability for comprehensive treatments. This is an important point as pre-existing conditions preventing comprehensive treatments became a key issue due to the ELIRP's targeting of customers within the highest usage tiers.

When ELIRP launched with the focus on an average savings of 20% per home, the CSPs began entirely rejecting homes, even though there were savings opportunities, when they found they could not proceed with a comprehensive project due to pre-existing conditions. By providing some measures in this home, but not comprehensive treatments, the CSPs would be decreasing their average savings per home overall, which they understood to be the program's primary metric.

However, once a home has been selected, scheduled, screened and audited, all cost-effective work should be performed. In order to properly manage the program CSPs, two new evaluation metrics were introduced: 1) total overall savings and 2) cost-effectiveness of those savings. PGW will continue striving towards deeper savings on average while managing the CSPs in terms of total savings and total cost-effectiveness.

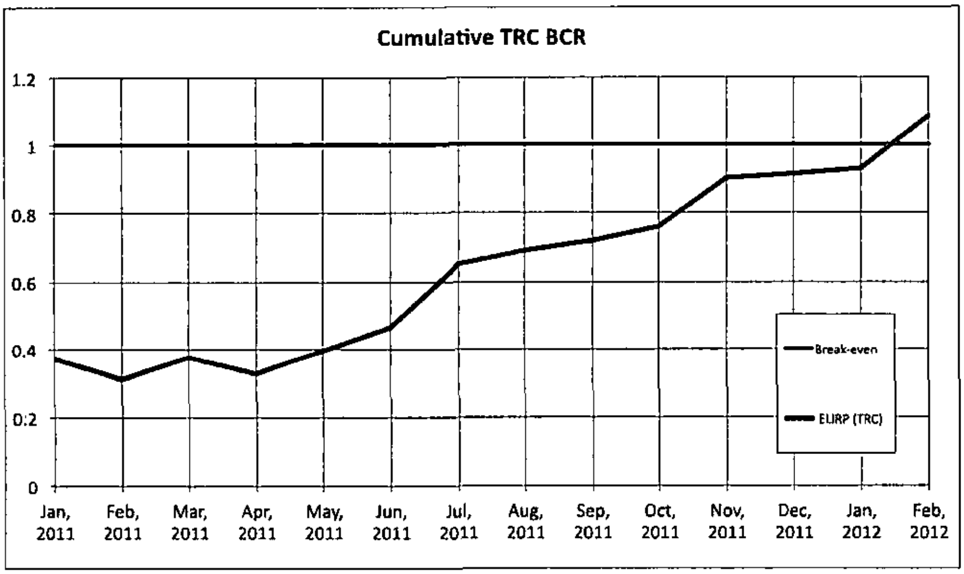
Program Cost-Effectiveness

As noted above, ELIRP experienced a prolonged ramp-up, which impacted the program's cost-effectiveness over this evaluation period. In FY 2011, the program absorbed one-time start-up costs of approximately $380,000 along with the regular, ongoing administrative costs during a time in which the program did not achieve full targeted production levels. Nonetheless, ELIRP did achieve cost-effectiveness by the end of this launch period.

Furthermore, the cost-effectiveness of ELIRP has continued to improve since inception. Currently, ELIRP has incurred TRC benefits with a present value of $8.4 million, against the present value costs of $7.7 million, for a present value of net benefits of $674,326 and a TRC BCR of 1.09. In FY 2012, the present value of net benefits is $1.6 million for a BCR of 1.34. Figure 3 shows how the cumulative BCR has improved since inception. By the end of the five-year program plan, PGW expects ELIRP to generate $5.9 million in PV net benefits, for a cumulative BCR of 1.23. This figure is approximately $700 thousand less than goals established in the FY 2012 IP as shown previous in Table 3, due mainly to the slow ramp up in FY 2011. Figure 3 shows the cumulative TRC BCR for ELIRP since inception. ELIRP has continued to improve its marginal cost-effectiveness and is now cost-effective since inception. For activity in FY 2012, ELIRP has achieved

$1.4 million in present value of net benefits with a BCR of 1.34, which is higher than the previous plan's long-term projection of 1.28.

Figure 3 – ELIRP Cost-effectiveness over Time



Projections

In order to more accurately project future savings, PGW has made updates to projections based on costs and savings achieved over the past one and half years. Specifically, PGW has increased the amount that it expects to pay per annual MMBtu of savings by 37%. In order to maintain projected budgets, this increase to the projected cost of energy savings means reductions to projected savings and customer participation.

PGW has also increased the projected weighted measure lifetime for each project from 15 years to 21 years. This reflects the weighted lifetime that PGW has been seeing in FY 2012 results to date.

The program aims to serve 1,641 customers in FY 2013, with associated annualized gas savings of 69.8 BBtus, or 42.6 MMbtu/customer. In FY 2013, the program is projected to cost $6.4 million. The following table shows a detailed breakout of participation, costs, and savings.

Table 16 - Projected ELIRP Impacts for FY 2013

	Projected (FY 2013)
PARTICIPATION	
Open Cases	n/a
Closed Cases - Full	n/a
Closed Cases - Partial/Rejected	n/a
Customers with Installations	1,641
COSTS	
Measure Installation Costs	$6,424,238
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$1,133,689
Inspection and Verification	$65,000
Evaluation	$81,182
Utility Costs	**$7,704,110**
Participant Costs	$-
Total	**$7,704,110**
BENEFITS	
Net Annual BBtu	69.8
Net Lifetime BBtu	1,466.5
Net Annual MMBtu / Customer	42.6
Weighted Lifetime (years)	21.0

iii) Workflow

There are no updates to the ELIRP workflow.

iv) History, Ramp-Up Strategy and Milestones

As part of its drive for continuous program improvement, PGW has incorporated competition to reward the best performing CSPs with additional funding reallocated from the other CSPs. This is expected to generate both immediate, short-term improvements by providing funding to those who have proven most capable of effectively implementing the program and an ongoing incentive to drive longer-term incremental improvements.

The reallocation begins with a formal performance evaluation of each contractor, which is based on two primary metrics: overall energy reductions and cost-effectiveness. These two metrics will drive each contractor towards the best balance of achieving the greatest overall savings as ambitiously as possible while at the best dollar value possible. Inspections report scores are also incorporated into the evaluation model along with other minor considerations. Funding is then reallocated amongst the three ELIRP CSPs based upon the results of these evaluations.

The first round of Conservation Service Providers (CSPs) performance evaluations and resulting funding reallocations were held in FY12. This has resulted in the total reallocation of $771,000 amongst the three ELIRP CSPs, based on objective performance metrics.

The next round of performance evaluations is currently scheduled for the summer of 2012, to set CSP funding allocations for FY 2013 beginning September 1, 2012.

Looking forward, PGW plans to provide its first evaluation of the new ELIRP program in early 2013.

v) Target Market and Program Eligibility

Initially, ELIRP eligibility comprised of two criteria: current enrollment in PGW's CAP, the Customer Responsibility Program (CRP), and usage within the top 20% tier of high CRP users. PGW added two additional criteria for PGW's second pool of prospective participants, developed in August 2011:

- Customer cannot have current arrears older than 2 months
- Customer cannot have been treated under PGW's recent CWP Pilot program

The first criterion ensures that further PGW assistance, beyond CRP payment assistance, is only provided to those who have been paying responsibly and are up to date on their affordable asked-to-pay-bills. The second criterion was added as an interim policy to ensure the initial treatment of those who have not yet received comprehensive weatherization services from PGW. PGW is currently collecting data on the needs for potential follow-up treatment for previously treated homes through ELIRP or the CWP pilot, which will inform the development of a permanent re-treatment policy.

vi) Target End-use Measures

The majority of installations include air sealing and/or insulation in the basement and attic. 19.5% of homes received a new furnace or boiler. In homes where comprehensive treatment is prohibited due to poor conditions (principally, health and safety and water issues) the CSPs install basic measures, such as a programmable thermostat, pipe insulation, or a carbon monoxide detector, as feasible.

vii) Incentive Strategy

There are no updates to the incentive strategy.

viii) Roles and Responsibilities

There are no updates to roles and responsibilities.

ix) Marketing Strategy

No marketing plan will be prepared for the ELIRP since services will be provided automatically based on the eligibility criteria.

x) Coordination with other Programs

Program/Organization	Description of Coordination
Pennsylvania Department of Community & Economic Development (DCED)	PGW will be coordinating with DCED, as the overseer of the State WAP program, in selecting and potentially treating low-income CRP households.
Philadelphia Department of Public Health Green & Healthy Homes and Lead Poison Prevention Programs	CSPs have begun referring homes with health and safety issues to the Philadelphia Department of Public Health (PDPH) for potential remediation services. Additionally, PGW is now accepting PDPH's lists of their clients to confirm against ELIRP program eligibilities. Coordinated treatments will then be pursued in homes that appear on both programs lists. To date, no such homes have been identified; however, both programs are now pursuing opportunities to assist their customers in potentially securing eligibility in the other's program. Additionally, through this Green and Healthy Home Initiative partnership, PDPH has offered to provide free trainings and certifications in identifying relevant health and safety issues to PGW's ELIRP CSPs. The hope is that this exposure to the relevant issues can be a potential first step in developing a more coordinated in-home partnership that can achieve significant programmatic savings for all.

Program/Organization	Description of Coordination
PA CareerLink Philadelphia	PGW has partnered with the Philadelphia Workforce Investment Board and the Philadelphia Workforce Development Corporation through PA CareerLink Philadelphia to connect local unemployed workers with weatherization training programs and then onto employment with our ELIRP CSPs. To date, PGW CSPs have hired 17 local, unemployed entry-level workers through this partnership.
Clean Air Council	PGW has partnered with the Clean Air Council in applying for a grant in order to ready certain housing stock in some of the poorest neighborhoods of Philadelphia for free weatherization services provided the Philadelphia Gas Works (PGW). The partnership sought external grants to fund the pre-treatment of existing structural, health, and safety issues in order to qualify households to participate in PGW's ELIRP program. Additionally, the partnership sought to provide ongoing education services to ensure the lasting impact of PGW's weatherization services for Philadelphia's low income households. Unfortunately, no grant funding has been awarded to date, however PGW will continue seeking this partnership opportunity.
PECO	PGW has engaged in discussions with PECO regarding CFL installation but a formal arrangement has not been established.

xi) Evaluation, Monitoring, and Verification

Inspections

The previously expanded inspection process was further increased to ensure the CSPs had improved in areas that were initially problematic and fully understood the program design. Additionally PGW, along with program implementation consultants, shadowed field inspections with each of the three CSPs to observe the QC inspector's performance and understanding of the PGW program design.

The following table shows the number of on-site inspections and hours of mentoring performed by PGW's third-party inspector. Overall, PGW inspected 11.3% of closed jobs.

Table 17 – ELIRP Audits and On-site Mentoring (Inception-to-date)

Fiscal Year	Audits	Hours of Mentoring
2011	44	22.5
2012*	83	17
Inception-to-Date	**127**	**39.5**

**First six months of fiscal year*

As part of the inspection process, PGW collected a scorecard for each inspection. These scorecards were used in the funding reallocation process, and to determine whether a contractor needed additional inspections and/or mentoring.

Data Collection

The CSPs provide PGW with field visit data by entering information in PGW's web-based tracking system. PGW systematically reviews the data and works with contractors to improve collection quality. As PGW gains more experience, it will continue to work on improving data quality by doing things such as adding additional field level validation, improving default values, and streamlining data entry screens.

Reporting

There are no updates to planned reporting for the ELIRP.

Evaluation

PGW has conducted extensive evaluation of its low-income program. PGW will continue to use the results of independent evaluation to update savings estimates and redirect program activities.

The first impact evaluation for the ELIRP is scheduled to cover calendar year 2011 and will be available in early 2013.

A. *Residential Heating Equipment Rebates Program*

i) Program Description

The Residential Heating Equipment Rebates program (RHER) issues prescriptive rebates on premium efficiency gas appliances and heating equipment to increase the penetration of these measures in the homes of PGW's customers. The program has the following objectives:

- Promote the selection of premium efficiency residential models at the time of purchase of residentially-sized gas heating equipment
- Increase consumers' awareness of the breadth of energy efficiency opportunities in their homes
- Strengthen PGW's relationship with customers as a partner in energy efficiency
- Encourage market actors throughout the supply chain to provide and promote high efficiency options
- Align incentives with other programs
- Aid in market transformation towards highest-efficiency options

Eligible customers use a contractor to install the premium efficiency equipment and receive cash rebates to offset most of the incremental cost of the higher efficiency equipment and installation. The program launched April, 2011.

ii) Costs, Benefits, and Impacts

As of February 29, 2012, RHER has received 149 valid rebates and 62 invalid rebates, totaling $76,880 in incentives.

Table 18 - RHER Impacts from Inception to February 29, 2012[7]

	Actual Results (Inception to 2/29/2012)
PARTICIPATION	
Valid Applications	149
Invalid Applications	62
Total Applications	211
COSTS	
Customer Incentives	$76,880
Administration and Management	$-
Marketing and Business Development	$73,846
Contractor Costs	$51,801
Inspection and Verification	$-
Evaluation	$-
Utility Costs	**$202,527**
Participant Costs[8]	$114,234
Total	**$316,761**
BENEFITS	
Net Annual BBtu	4.0
Net Lifetime BBtu	87.0
Net Annual MMBtu / Customer	18.8
Weighted Lifetime (years)	21.9

Program Costs

PGW spent slightly over $200,000 on RHER over this reporting period. Together, fixed costs for Administration and Management as well as additional Contractor Costs were slightly under budget. Variable costs for marketing and customer incentives were much lower than budgeted. The difference between budgeted and actual costs can be attributed to three factors

A. Under-subscription

PGW did not meet its targets for FY 2011 and is trending low in FY12 to date due to under-subscription. PGW believes this is primarily a result of the Company's marketing and outreach decisions prior to the program's launch. As market participation was unforeseeable at that time, PGW developed a multi-phase marketing plan for RHER based on three potential scenarios: 1) over-subscription, 2) moderate subscription, and 3) under-subscription. PGW decided to start

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7 Participation and incentives are based on actual program activity as recorded by the rebate processor over this period.

8 Incremental cost of equipment and installation not covered by PGW rebate.

conservatively by planning for potential over-subscription, and react as needed, based on data trends at set milestones.

PGW launched a more aggressive marketing campaign in the autumn of 2011, including increased consumer advertising, which consisted of:

- Outreach to neighborhood centers and district offices
- Advertisements on Philadelphia's subway and regional rail platforms
- Internet ads
- Radio ads
- HVAC equipment manufacturer, supplier and installer outreach
- Multiple mass mailings to contractors

This campaign will continue to urge customers to take advantage of PGW's rebate program to save money on the upfront costs now, so they can save even more on their annual heating bills over the lifetime of the new measures installed.

Additionally, PGW has increased existing HVAC contractor outreach activities, which are found to be the most effective vehicle for marketing an HVAC equipment rebated program. In addition to ongoing direct communications with HVAC contractors, PGW has hired an outreach vendor to provide tabling events at HVAC equipment suppliers throughout the region where contractors purchase the equipment. The outreach vendor is providing information at these events on the RHER program, and how HVAC contractors can take advantage of it to increase their sales numbers and values, as the high efficiency equipment is often more labor intensive to install.

B. Incremental Cost Economics

Originally, rebates were designed to be in-line with those offered by other jurisdictions in the region. However, PGW increased efficiency thresholds higher than most programs (94% AFUE for RHER vs. 90% AFUE for many programs). As participation levels in the program remained relatively low past the immediate launch, PGW undertook an updated incremental cost analysis to determine whether the initial rebate values were sufficiently high to compel action.

The updated analysis found that the incremental labor and material costs were 60% higher than original assumptions for furnaces without BFM fans.[9] The analysis also found that boilers had incremental labor and material costs that were 35% higher than previous estimates. Given these higher incremental costs and the low participation levels, the rebate amounts were increased to a value that would cover a greater percentage of the incremental costs while also still maintaining the overall cost-effectiveness of the program.

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[9] "BFM" stands for Brushless Fan Motor (also known as Electronically Commutated Motors "ECMs"), and is an optional feature that increases the electrical efficiency of a furnace. Furnaces with BFMs were found to have almost exactly the same incremental labor and material costs as previous estimates.

C. Application Rejections

In FY 2011, the RHER program had a rejection rate of 20%. PGW analyzed the rejections and identified missing AHRI information as the primary cause. In an effort to make the application process easier for customers, PGW representatives began researching and providing any missing AHRI information. PGW is continuing to examine potential methods for addressing other rejection causes.

PGW stated the intention to rollover unspent FY11 RHER funding, to account for the condensed launch period, into FY12, Table 19 below shows rollover funding as added to the FY12 RHER budget. As described above, RHER is currently projecting to under-spend in FY12 as well. As is the case with ELIRP, this RHER variance represents a significant portion of activity essential to achieving the overall energy usage reduction goals set forth in the Company's approved plans. Accordingly, PGW may seek approval to add this unspent funding to increase the final years' RHER budgets, thereby allowing sufficient time to identify and address the issues that prevented PGW from realizing the pace of activity originally planned for FY 2011 and FY 2012.

Table 19 – RHER Budget Rollover

	Customer Incentives	Contractor Admin	Marketing	Verifications
FY11 Budget	$229,000	$21,150	$100,000	$1,700
FY11 Actual	$14,060	$18,873	$18,394	$0
FY11 Rollover Funding	$214,940	$2,277	$81,606	$1,700
FY12 Budget	$678,370	$50,000	$100,000	$5,000
FY12 Total Budget (w/ rollover)	**$893,310**	**$52,277**	**$181,606**	**$6,700**

Program Cost-Effectiveness

Despite low participation, RHER achieved positive TRC net benefits with a present value of $193,272, a TRC BCR of 1.59, in activity through February 29, 2012. The Gas Energy System saw net benefits with a present value of $281,677, a BCR of 2.43.

Projections

The program aims to serve 1,280 customers in FY 2013, with associated annualized gas savings of 29.3 BBtu, or 22.9 MMBtu/customer. The program is projected to cost $1,775,476. Table 16 shows a detailed breakout of participation, costs, and savings.

Table 20 - Projected RHER Impacts for FY 2013

	Projected (FY 2013)
PARTICIPATION	
Valid Applications	n/a
Invalid Applications	n/a
Total Applications	1,280
COSTS	
Customer Incentives	$1,626,112
Administration and Management	$-
Marketing and Business Development	$100,000
Contractor Costs	$45,064
Inspection and Verification	$4,300
Evaluation	$-
Utility Costs	**$1,775,476**
Participant Costs	$1,068,270
Total	**$2,843,746**
BENEFITS	
Net Annual BBtu	29.3
Net Lifetime BBtu	648.7
Net Annual MMBtu / Customer	22.9
Weighted Lifetime (years)	22.2

iii) Workflow

There are no updates to the workflow for RHER.

iv) History, Ramp-Up Strategy and Milestones

The following qualitative RHER Developments have occurred in FY11 through February 29, 2012:

- Selected a rebate vendor, Helgeson Enterprises, to implement the rebate processing.
- Began marketing and outreach efforts to provide information to HVAC contractors allowing them to educate their customers about our rebates.
- Contacted suppliers in the region to gather information on the existing local market and to provide information on our rebate program and the expected impact on their sales
- Launched RHER on April 1, 2011.
- Launched a general consumer outreach campaign
- Expanded the HVAC contractor outreach efforts to provide tabling sessions at HVAC equipment suppliers throughout the region.

PGW anticipates the following remaining milestones

Task	Time Period
Select evaluator and contract for services	May 15, 2013 – July 15, 2013
Submit first RHER impact evaluation study	Early 2013

v) Target Market and Program Eligibility

There are no updates to program eligibility.

vi) Target End-use Measures

Through February 29, 2012, PGW has provided 49 boiler rebates and 100 furnace rebates. PGW also provided 96 thermostat rebates, which are only available with the purchase of a premium-efficiency furnace or boiler. The positive response to thermostats (64% of valid applications) was better than anticipated.

Projections

PGW updated projections for rebates based on new incentive levels and market acceptance. Updated projections can be found in the table below

Table 21 - Projected Rebates for FY 2013 to FY 2015 by Equipment Type

Fiscal Year	2013	2014	2015	2013 - 15
Natural Gas Furnace	427	1,330	1,738	3,495
Natural Gas Furnace w/ ECM	213	665	869	1,747
Natural Gas Boiler	640	1,995	2,607	5,242
Programmable Thermostat	870	2,632	3,546	7,048

vii) Incentive Strategy

Existing rebate incentive levels for the high efficiency furnaces and boilers were doubled from $250 and $1,000, respectively, to $500 and $2,000 to account for extremely low participation rates to date and a refined economic analysis of the local incremental measure and installation costs. The following table shows the current rebate schedule.

Table 22 - Residential Equipment Rebates

Measure	Amount
Natural Gas Furnace 94% AFUE	$500
Natural Gas Furnace 94% AFUE, BFM Fan[10]	$500
Natural Gas Water Boiler 94% AFUE (w/ electronic ignition)	$2,000
Programmable Thermostat [11]	$30

PGW anticipates maintaining this rebate schedule through FY 2013, PGW will continue to perform periodic reviews of the rebates being offered and may change the types of measures covered, the minimum efficiency level required, and/or the rebate amount based on changing market conditions.

The Federal Department of Energy has issued a rule that raises the minimum efficiency standard of furnaces in the Northern U.S. region, including Pennsylvania, to 90% AFUE. PGW's rebate program is based on compelling customers to move from the existing baseline equipment, which is currently 80%, to the targeted high-efficiency equipment. As such, assuming the equipment baseline shifts from 80% to 90%, PGW's rebates would have to be re-examined and restructured accordingly. This rule is scheduled to go into effect May 1, 2013, though the DOE has not yet issued implementing regulations. PGW will continue to monitor these developments and update the RHER program accordingly.

viii) Roles and Responsibilities

There are no updates to roles and responsibilities

ix) Marketing Strategy

The CSP and its subcontractor, in coordination with PGW, have crafted a marketing plan that targets equipment manufacturers, distributors, installation contractors and retailers/vendors to make the high-efficiency equipment available for purchase. Engineers and contractors have been encouraged to recommend or specify the choice of high-efficiency equipment to customers making purchases of gas appliances and heating equipment. Based on the experience of other gas utility rebate programs, contractor outreach is the most effective strategy for increasing customer demand for high efficiency gas equipment via rebates. PGW will utilize this strategy as the primary tool to promote awareness of the RHER. However, additional marketing activities, including direct to consumer activities, will be ramped up, as discussed above.

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[10] Furnaces that have fans driven by Brushless Fan Motors (BFMs) provide significant electricity savings. However, as a natural gas utility, PGW is unable to provide any additional incentives for measures that purely save electricity.

[11] May only be claimed with an accompanying furnace or boiler rebate

x) Coordination with other Programs

Program/Organization	Description of Coordination
EnergyWorks Residential	Through the EnergyWorks program, the City of Philadelphia and the five surrounding counties offer low-interest financing products specifically for weatherization work. The residential program offers rebates for the home energy audit, financing as low as .99%, and a free final inspection to ensure high-quality installations. There could be a good fit between the EnergySense programs, which offer up-front incentives to buy-down the costs and shorten payback terms of projects, and EnergyWorks programming, which offers low-interest financing. Any actual funding partnerships would be based on an individual project basis. However, at a minimum, there is currently cross-promotion between the two programs. Both cite the others' resources as additional assistance available to eligible projects.
PGW Oil-to-gas Rebate Program	The existing oil-to-gas program identifies a niche market of customers currently considering a natural gas heating equipment purchase, without any regards to efficiency. By allowing the rebate programs to be used in conjunction, PGW is able to effectively and efficiently serve the EnergySense RHER primary purpose: to convince customers currently in the market for natural gas heating equipment to purchase the most energy-efficient models possible, rather than the inefficient and cheaper models they may otherwise select.

xi) Evaluation, Monitoring, and Verification

<u>Quality Assurance</u>

PGW has hired an inspector to visit the homes of 3% of the customers that received a rebate incentive to ensure the equipment installed matched the equipment listed on the rebate application. No verifications had yet been performed by the end of the evaluation period of this Implementation Plan.

Data Collection

PGW's rebate processor maintains a real-time database of rebate activity. PGW collects program activity from its rebate processor and reviews it for accuracy.

Reporting

There are no updates to reporting for the RHER.

Evaluation

The first impact evaluation for the program is scheduled for FY 2013, during the end of calendar year 2012 and early 2013.

B. Commercial and Industrial Retrofit Incentives Program

v) Program Description

The Commercial and Industrial Retrofit Incentives Program (CIRI) promotes natural gas energy efficiency retrofit investments by PGW's multi-family residential, commercial, and industrial customers. The program provides technical assistance and customized financial incentives for cost-effective gas-saving investments including high-efficiency heating system replacements, improved system controls, and building thermal performance enhancements. The program also assists participants in arranging financing for the balance of project costs through partnerships with third-party lenders. The program has the following objectives:

- Save natural gas through cost-effective energy efficiency retrofit projects.
- Make comprehensive energy-efficiency retrofit affordable by combining customized financial incentives with third-party financing to provide participating customers with immediate positive cash flow.
- Promote a better understanding of energy efficiency options available to PGW's nonresidential customers.

CIRI seeks to convince facility managers, department heads, and financial officers to conduct audits of their facilities and identify cost-effective energy saving retrofit opportunities. PGW then provides an incentive for completing the installation of the identified savings measures. The initial phase of the program will specifically target energy efficiency opportunities in multi-family buildings. As the program ramps, up additional commercial and industrial customer classes will be targeted.

vi) Costs, Benefits, and Impacts

As of February 29, 2012, PGW has not completed any projects under CIRI, for reasons described below.

The following table provides the current costs incurred since program launch.

Table 23 - CIRI Impacts from Inception to February 29, 2012

	Actual Results (Inception to 2/29/2012)
PARTICIPATION	
Applications	7
Analyses/Audits	4
Customers with Installations	-
COSTS	
Measure Installation Costs	$-
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$13,059
On-site Technical Assessment	
Evaluation	$-
Utility Costs	**$13,059**
Participant Costs	$-
Total	**$13,059**
BENEFITS	
Net Annual BBtu	-
Net Lifetime BBtu	-
Net Annual MMBtu / Customer	n/a
Weighted Lifetime (years)	n/a

<u>Combined Funding Years</u>

A primary purpose of the CIRI program is to identify Commercial & Industrial property owners who are considering upgrading their building's energy performance and to encourage them to install a comprehensive array of measures that will result in the greatest, most cost-effective reduction of natural gas usage.

Much of the development of this pipeline of projects is outside of PGW's control. PGW will actively pursue all communication and marketing opportunities to engage the sector, however it is incumbent upon the property owners themselves to determine, at their own timing, the scope of their potential projects and whether or not to proceed.
PGW cannot control when projects will progress; instead the Company aims to capture viable projects at the appropriate points in their development timelines to enhance maximum program success.

In order to more effectively manage the program's subscription rates and provide continuous service, PGW is proposing in this FY13 Implementation Plan to allow "rollover" funds not expended in the FY 2012 pilot year to be used for incentives in FY 2013. In the meantime, PGW will continue to make all possible outreach efforts to identify and close eligible CIRI projects.

Projections

The program aims to serve 10 customers in FY 2012, with associated annualized gas savings of 19.3 BBtu, or 1,927 MMBtu/customer. The program is projected to cost $502,390 in FY 2013.

Table 24 - Projected CIRI Impacts for FY 2013

	Projected (FY 2013)
PARTICIPATION	
Applications	n/a
Analysis/Audits	
Customers with Installations	10
COSTS	
Measure Installation Costs	$274,216
Administration and Management	$-
Marketing and Business Development	$50,000
Contractor Costs	$167,420
On-site Technical Assessment	$-
Evaluation	$-
Utility Costs	**$502,390**
Participant Costs	$548,432
Total	**$1,050,822**
BENEFITS	
Net Annual BBtu	19.3
Net Lifetime BBtu	289.1
Net Annual MMBtu / Customer	1,927.6
Weighted Lifetime (years)	15.0

vii) Workflow

There is no update to the workflow for CIRI.

viii) History, Ramp-Up Strategy and Milestones

While general CIRI program materials have been developed and are being distributed to the PGW customer base, PGW specifically outreached to those most likely to propose multi-family projects. The first step of which was identifying multi-family property owners in Philadelphia, and the potential projects that are already in development. PGW worked directly with the Pennsylvania Housing Finance Agency (PHFA) in achieving these ends. From there, the Company took steps to identify which projects present the best comprehensive gas savings opportunities and are the most realistic in terms of property owner engagement and existing financing.

To date, PGW has received seven applications, but has not yet been able to approve a single project. As described in the FY12 Implementation Plan, PGW committed to focusing on multifamily retrofits in the first year of CIRI, and then expanding the scope to all Commercial and Industrial properties in FY13 when the program ramps up beyond the current year's $75,000 incentive budget.

For several reasons, including property ownership arrangement and funding availability, many multi-family property owners are reluctant or unable to proceed with comprehensive retrofits, even if incentives are available to buy down project costs. The primary hurdle is the high upfront costs. Even though the incentives can make an impact and the projects will ultimately result in significant savings over the long term, securing the funding to cover or greatly reduce the total upfront costs has been problematic.

PGW has sought assistance from various lending alternatives that could hopefully assist in providing funding for the participant's share of retrofit upfront costs. Some programs, such as EnergyWorks, target energy-efficiency financing specifically and offer loans that can be as low as .99%. However, customer demand for this financing has not materialized due to the nature of the multi-family properties involved, in which there is limited interest in providing additional owner funding for discretionary improvement projects, and limited interest and ability in acquiring financing to fund such improvements. Many are either unwilling or unable to assume loans or have loans in place preventing them from assuming additional debt.

It is PGW's role, through CIRI, to provide incremental incentives to encourage properties to pursue comprehensive retrofit projects. However, PGW has found that incentives alone are not sufficient to close projects in the absence of funding to assist with the majority of the upfront costs.

In addition, the multifamily project applications that have been received and analyzed in FY12 focus on single, high-efficiency equipment purchases. While these stand-alone high efficiency purchases certainly make sense for some property owners, particularly in the case of end-of-life replacements, these transactions are a better fit within the forthcoming CIER program. As CIRI seeks to promote comprehensive, whole-building retrofits including an array of natural gas saving measures, standalone efficiency replacements are not being considered for the customized incentives.

For now, PGW is continuing to work with the existing pool of applicants to convince them to pursue more comprehensive projects involving a wider array of natural gas end-uses. PGW is also seeking to generate additional multi-family project applications. Opening CIRI to all Commercial & Industrial properties in FY13 will result in a greater pool of candidate projects, for which comprehensive retrofits will be more viable.

While additional projects types will now be pursued, PGW will continue attempting to identify and fund eligible multi-family projects through CIRI and all other future, relevant EnergySense programs (namely, Commercial & Industrial Equipment Rebates and High Efficiency Construction Incentives).

ix) Target Market and Program Eligibility

Multi-family, commercial, industrial customers of PGW will be eligible for the program. This includes both firm heating and firm non-heating customers.

x) Target End-use Measures

The measures will be customized for each project. Typical examples include heating system retrofits and shell improvements.

xi) Incentive Strategy

The CIRI will provide custom incentives for the natural gas portion of the retrofit projects and may connect projects to other available financing and incentives for the electric portion of the project. There are no updates to the upfront incentive that PGW plans to offer.

Financing

PGW will continue to explore all possible options for securing financing assistance through EnergyWorks low-interest loan programs.

xii) Roles and Responsibilities

There are no updates to roles.

xiii) Marketing Strategy

PGW will continue to recruit participants through targeted outreach and will begin to branch out beyond multifamily buildings in FY 2013.

xiv) Coordination with other Programs

Program/Organization	Description of Coordination
EnergyWorks	The Philadelphia regional EnergyWorks program currently provides low-interest financing for both residential and commercial/industrial sized energy-efficiency projects. PGW will continue discussions with EnergyWorks representatives regarding a potential partnership in which PGW's EnergySense would provide up-front financial assistance to make projects viable and EnergyWorks would provide low-interest financing to initially fund the projects.
Pennsylvania Housing Finance Authority (PHFA)	PHFA currently provides funding assistance for multifamily residential energy-efficiency projects through their Smart Rehab program. The overlap between PHFA's Smart Rehab and PGW's CIRI presents a significant coordination opportunity.
The City of Philadelphia	The City of Philadelphia currently provides several small business funding assistance programs, including for energy-efficiency projects. PGW will attempt to identify opportunities for partnership with the City's existing programs.
Federal Tax Deductions and Credits	Currently, a federal tax deduction is available to certain owners or designers of new or existing commercial buildings See below link for further details: http://www1.eere.energy.gov/buildings/tax_commercial.html

xv) Evaluation, Monitoring, and Verification

Quality Assurance

An on-site inspection will be performed on every project. The inspection may be performed both during and after the installation, since some larger projects may require oversight at different stages of the project. Inspections allow PGW to validate that the correct equipment was installed and that it is in working order.

Data Collection

There is no update to data collection for CIRI.

Reporting

There is no update to reporting for CIRI.

Evaluation

In accordance with the general evaluation plans for the Demand Side Management (DSM) Portfolio, a third-party contractor will perform in-depth evaluations every two years. The first evaluation for the CIRI is scheduled for FY 2014

III. Plans for Programs Launching in FY 2013

A. Commercial and Industrial Equipment Rebates Program

i) Program Description

The Commercial and Industrial Equipment Rebates Program (CIER) will issue prescriptive rebates on premium efficiency gas appliances and heating equipment to increase the penetration of these measures in the homes of PGW's customers. The program has the following objectives:

- Promote the selection of premium efficiency residential models at the time of purchase of commercial and industrial sized gas heating equipment
- Increase consumers' awareness of the breadth of energy efficiency opportunities in their homes
- Strengthen PGW's relationship with customers as a partner in energy efficiency
- Encourage market actors throughout the supply chain to provide and promote high efficiency options
- Align incentives with other programs
- Aid in market transformation towards highest-efficiency options

Eligible customers will use a certified contractor to install the premium efficiency equipment and receive cash rebates to offset most of the incremental cost of the higher efficiency equipment.

ii) Costs, Benefits, and Impacts

Over FY 2013 to FY 2015, the program is expected to provide net present benefits of $7.3 million with a benefit-cost ratio (BCR) of 4.72. The program aims to serve 471 customers in FY 2013, with associated annualized gas savings of 21.3 BBtus, or 45.1 MMBtu/customer. The program is projected to cost $408,158. The following table shows a detailed breakout of participation, costs, and savings.

Table 25 - Projected CIER Impacts for FY 2013

	Projected (FY 2013)
PARTICIPATION	
Analyses/Audits	n/a
Customers with Installations	471
COSTS	
Measure Installation Costs	$270,004
Administration and Management	$-
Marketing and Business Development	$53,768
Contractor Costs	$71,690
Inspection and Verification	$12,696
On-site Technical Assessment	$-
Evaluation	$-
Utility Costs	**$408,158**
Participant Costs	$98,371
Total	**$506,530**
BENEFITS	
Net Annual BBtu	21.3
Net Lifetime BBtu	248.3
Net Annual MMBtu / Customer	45.1
Weighted Lifetime (years)	11.7

iii) Workflow

The following steps describe the delivery of services for the CIER:

- Customers are made aware of the program through various marketing channels, including efforts by the CSP, the Company, equipment dealers, and contractors.

- The customer obtains information pertaining to eligibility and measures covered by the program from the CSP, the Company, retailers, or contractors. This information includes a document describing eligible measures as well as a copy of the application form, both of which will be available in physical and electronic formats and details the exact rebate that they may receive.

- Customers work with contractors and retailers to purchase and install the eligible equipment. They then fill out the rebate application and submit the form, along with proof of purchase and the contractor's certification that the measure was installed, to the program's CSP.

- The CSP processes the application, checking customer and measure eligibility. If the application meets program guidelines, a check is mailed to the customer.

Otherwise, the customer is notified that the rebate application was not accepted and the reason for rejection.

- A randomly selected group of applications will be selected for a post-installation inspection. Please see the Evaluation, Monitoring, and Verification section of this program for additional details.

iv) Ramp-Up Strategy and Milestones

The program will begin accepting rebate application in September of 2012, giving program participants time to prepare for the 2012-heating season. The amount of rebates offered in the first year will be smaller than those offered in future years, as customers gain awareness of the program and the CSP(s) work out any issues with service delivery.

Task	Time Period
Issue RFP for implementation CSP(s)	March, 2012 to April, 2012
Secure implementation CSP(s)	May, 2012
Pre-launch planning, training, and infrastructure development between PGW, CSP(s), and market actors	January, 2012 to September, 2012
Launch Program	***September 2012***
Select evaluator and contract for services	October, 2012 to December, 2012
Submit first CIER impact evaluation study	Late 2014

v) Target Market and Program Eligibility

The program's target market is a PGW customer purchasing non-residential sized, high efficiency space heating and cooking equipment. As was the case for the RHER program, PGW will not limit eligibility by Customer Class. All PGW customers that are interested in purchasing the targeted CIER equipment and are paying PGW's Energy-Efficiency surcharge are eligible. Owners and renters, with the approval of the owner, are both eligible. Only equipment installed after the start date of the program in September of 2012 will be eligible for a rebate.

vi) Target End-use Measures

Initially, measures in the program include high-efficiency boilers and cooking equipment. Market research found that commercial sized natural gas water heating equipment would not be cost-effective in FY 2013. Other measures that PGW will continue examine and may provide incentives for at some point in the future include unit heaters, HVAC controls, and natural gas equipment with industrial end-usage. The following table shows a preliminary list of efficient measures and their incentives.

Table 26 – Initial Measures in CIER

Measure Name	Minimum Efficiency	Rebate Amount
Boiler, Hot Water (300 ≤ MBH ≤ 2,500)	85% Thermal Efficiency (Et)	\$800-\$6,300
Boiler, Hot Water (300 ≤ MBH ≤ 2,500)	90% Thermal Efficiency (Et)	\$2,900 - \$8,400
Commercial Gas Convection Oven	ENERGY STAR®	\$500
Commercial Gas Fryer	ENERGY STAR®	\$1000
Commercial Gas Fryer (Large Vat)	ENERGY STAR®	\$1200
Commercial Gas Steam Cooker	ENERGY STAR®	\$500
Commercial Gas Griddle	ENERGY STAR®	\$500
High-Efficiency Pre-Rinse Spray Valve	1.6 Gallons per Minute (GPM)	\$25

PGW does not anticipate modifying rebate amounts or measures covered after the plan launches in September of 2012. However, the Company will do a periodic review of the rebates being offered and may change the types of measures covered, the minimum efficiency level required, and/or the rebate amount based on changing market conditions.

vii) Incentive Strategy

Fixed rebates will be used to streamline program delivery and increase customer participation. Rebates covering approximately 80% of the incremental cost of premium-efficiency equipment will be offered to customers to help offset the barriers that the higher costs of the more efficient equipment often pose.

viii) Roles and Responsibilities

Pursuant to an RFP process, PGW will seek an implementation CSP to setup and manage the system for providing rebates to customers. The CSP will be responsible for the processing of rebate applications from start to finish, including collecting applications, checking eligibility, and either sending a rebate check or notifying the applicant with the reason for rejection. The implementation CSP will also monitor program performance and market acceptance, reporting results to the programs administrators.

Marketing and communication activities will mainly be carried out by a CSP, though not necessarily the same CSP that processes rebates. The marketing CSP will be responsible for outreach, training, and support with retailers, equipment suppliers, contractors, and customers. The Company will work with the marketing CSP to coordinate efforts with other programs and across the DSM Portfolio.

As the program administrator, PGW will oversee the service delivery through regular communications with CSPs and by tracking program data. Additionally, the Company will seek an independent inspector to perform on-site verifications for a random selection of completed applications.

ix) Marketing Strategy

Pursuant to an RFP process, PGW will seek a CSP with experience marketing rebate programs. The CSP, in coordination with the Company, will craft a marketing plan that works with equipment manufacturers, distributors, and retailers/vendors to make the high-efficiency equipment available for purchase. Engineers and contractors will be encouraged to recommend or specify the choice of high-efficiency equipment to customers making purchases of gas appliances and heating equipment. Additional marketing activities may include:

- Promotional materials and program information provided at the point-of-sale
- Inclusion in PGW customer communications (i.e. bill inserts, newsletters, etc.)
- An online presence, through the Company's website, and/or a stand-alone site
- Advertising in newspapers, on the radio, and other mass media outlets
- Outreach and coordination with trade groups, community organizations, and other market partners

x) Coordination with other Programs

Program/Organization	Description of Coordination
EnergyWorks	PGW will seek to coordinate with the existing EnergyWorks Commercial & Industrial energy-efficiency programming, as administered by the Philadelphia Industrial Development Corporation and The Reinvestment Fund

Program/Organization	Description of Coordination
Other EnergySense Programs	PGW will work to refer customers to any other programs under EnergySense that the customer may be eligible for or interested in.
Other existing energy-efficiency programs	PGW will also seek to identify and coordinate with any other existing energy-efficiency programs in Philadelphia serving over-lapping markets.

xi) Evaluation, Monitoring, and Verification

Quality Assurance

PGW will monitor the ongoing progress of the program and work closely with CSPs to provide the highest possible service to its customers. PGW will track rebate application data and provide regular impact evaluations that will be supplemented by more in-depth, biennial process evaluations performed by a third-party evaluator. To insure that measures are installed correctly, rebates must be signed by certified contractors. A third-party firm will perform on-site verifications on a random selection of projects.

Data Collection

Implementation CSPs will provide PGW with program activity data for populating the DSM Tracking System. Program data will be collected from rebate application forms, site visits, and surveys of participants and non-participants. PGW's tracking system supports program evaluation through the collection of all relevant data pertaining to customer rebates and installed equipment. Application data and status, customer details and installation contractor information will be captured by the system as well as measure level data.

Reporting

As part of the Annual Reporting process, PGW will provide regular reports of the programs impacts. Deemed savings will be calculated using the values established in the TRM, and formulas will be updated as the TRM changes. Only rebates for which payment has been issued will impact saving amounts. Figures showing the pipeline of applications as well as the number of rejected applications will be provided along with realized costs. PGW may also report additional information on characteristics of customers, contractors, and efficiency measure details. Findings from on-site inspections may be presented in impact evaluations although the results will be primarily used in the program's process evaluations.

Evaluation

In line with evaluation activities performed in the past for the CWP and planned for the ELIRP, the program will undergo an in depth process evaluation every two years.

Pursuant to an RFP process, PGW will seek an independent evaluator to perform the biennial process evaluation. As part of the initial program development, PGW will work with the evaluator to establish the methodology and goals of the process evaluation. Initial objectives include:

- Verifying energy savings and associated costs
- Assessing market attitudes towards the program, including contractors, customers, and efficient equipment suppliers
- Measuring the effectiveness of current program design, marketing, and service delivery

The first process evaluation for the program is scheduled for FY 2015.

B. High Efficiency Construction Incentives Program

i) Program Description

The High Efficiency Construction Incentives Program (HECI) promotes natural gas energy efficiency in the new construction and gut rehab markets, both for residential and non-residential new construction projects. The program provides technical assistance and prescriptive financial incentives for projects that go beyond building code. Incentives increase for projects the more a project saves natural gas compared to the code baseline. The program has the following objectives:

- Save natural gas through cost-effective energy efficiency new construction and gut rehabilitation projects.
- Promote a better understanding of energy efficiency options available in the new construction and gut rehabilitation markets.

HECI will seek to convince homebuilders, building owners, engineers, architects, and contractors to incorporate natural gas energy efficiency into the design of their projects and go beyond standards dictated by the building code. The program will operate on a "first-come, first-serve" basis, providing technical assistance and incentives for reaching a certain level of efficiency. PGW will hire a CSP to assess the project plans and verify that the project meets program eligibility requirements, helping the customer along the way to reaching the program requirements and go further if possible. PGW will provide the financial incentive to the customer upon the completion of the project.

ii) Program Staging

Like the rest of the country, the new construction market in Philadelphia has been severely hampered by the recent economic recession. New construction activity across all sectors has stayed well below pre-recession highs, and is still well below levels seen when the original projections for this program were made. However, as the economy begins to slowly recover, the new construction market will most likely follow. Due to the uncertainty for this market in the coming years, PGW feels that it is important to approach the start of HECI with a "pilot program" mentality. PGW believe that the initial budget proposed in this plan will be sufficient to meet needs for the current market, and that important groundwork can be laid down with major market actors. Looking forward, PGW believes it will be important to have the ability to quickly ramp up if and when the new construction market begins to take off.

iii) Costs, Benefits, and Impacts

Over FY 2013 to FY 2015, the program is expected to provide lifetime net present benefits of approximately $580,000 with a benefit-cost ratio (BCR) of 1.52. The program aims to serve 101 residential projects and 24 non-residential projects in FY 2013, with associated annualized gas savings of 3.3 BBtu, or 26.1 MMBtu/customer. The program is projected to cost $206,395 FY 2013. The following table shows a detailed breakout of participation, costs, and savings.

Table 27 - Projected HECI Impacts for FY 2013

	Projected (FY 2013)
PARTICIPATION	
Analyses/Audits	n/a
Customers with Installations	125
COSTS	
Measure Installation Costs	$140,547
Administration and Management	$-
Marketing and Business Development	$35,845
Contractor Costs	$26,635
Inspection and Verification	$3,368
On-site Technical Assessment	$-
Evaluation	$-
Utility Costs	**$206,395**
Participant Costs	$35,137
Total	**$241,532**
BENEFITS	
Net Annual BBtu	3.3
Net Lifetime BBtu	65.3
Net Annual MMBtu / Customer	26.1
Weighted Lifetime (years)	20.0

iv) Workflow

The following steps describe the delivery of services for the HECI:

- A customer finds out about HECI through marketing and outreach efforts and completes a HECI application.
- The HECI Technical Assistance Provider (TAP) will review the application and work with the customer to obtain detailed plans and building models, including information on project costs and projected energy usage.
- The TAP will review all the materials to verify that the project meets the program's criteria and identify any deficiencies in the data provided. The TAP will also be able to provide design assistance by identifying additional or alternative options and communicating them to the customer.
- Once the customer has finalized building plans, and the TAP has verified that the project is eligible, a rebate will be set aside for the project and the customer will complete the project.
- Once the project is complete, PGW will pay the rebate to the customer.
- The TAP will inspect a subset of projects identified by PGW before paying the incentive. If any deficiencies are found, the customer will be notified and the issue must be fixed before the rebate will be paid.

v) History, Ramp-Up Strategy and Milestones

Contractors will be selected and services launched at the same time as the CIER to ensure that customers will have a larger menu of prescriptive rebates to complement the other incentives offered by HECI.

Task	Time Period
Issue RFP and select TAP CSP	April, 2012 to June, 2012
Pre-launch planning, training, and infrastructure development between PGW, CSP(s), and market actors	May 2012 to September 2012
Launch Program	***September 2012***
Select evaluator and contract for services	September 15, 2012 to October 20, 2012
Submit first HECI impact evaluation study	Late 2014

vi) Target Market and Program Eligibility

The program's target market is a new construction or gut rehabilitation ("gut rehab") project that will use natural gas provided by PGW. A gut rehab is generally understood to be a project where the interior space of the building is "taken down to the studs" and/or all the mechanical systems are being replaced. All PGW residential and commercial customers that pay the Energy-Efficiency surcharge and are pursuing these targeted project types are eligible for participation.

The project must meet the savings criteria outlined in the Target End-Use Measures section below. As long as a project meets the savings criteria and has not completed construction by the time the program launches, it will be eligible to receive a rebate.

vii) Target End-use Measures

HECI takes a "performance-based", whole-building approach. Projects must save a certain amount of gas compared to similar project that merely meets building code. There will be no specific measures required, but most measures are expected to be either part of the HVAC system (new equipment, tighter ducts, controls, etc.) or the building envelope (insulation, air sealing, high-efficiency windows, etc.).

viii) Incentive Strategy

Fixed rebates will be used to streamline program delivery and increase customer participation. Rebates covering approximately 80% of the incremental cost of the efficient project will be offered to customers to help offset the barriers that the higher costs of the more efficient equipment often pose.

ix) Roles and Responsibilities

<u>PGW</u>
The company will be responsible for the general administration of the program including coordinating efforts with the CSPs as well as overseeing marketing, outreach, and evaluations. PGW will also be responsible for providing incentive payments to customers.

<u>Program Development Consultants</u>
Program Development Consultants will assist PGW in providing market research and economic analysis of projects.

<u>Technical Assistance Provider(s)</u>
Local and regional firms will be solicited to provide technical assistance on projects. The selected provider(s) will be responsible for collecting project information through

applications and communication with the customer and his or her contractors, analyzing energy efficiency opportunities, and providing PGW with the results of their analysis, as well as provide design assistance to applicants.

The TAP will also be responsible for verifying that the project meets PGW's program eligibility guidelines.

Finally the TAP will perform on-site inspections for a subset of projects to verify application materials, conducting brief interviews with customers and, if possible, contractors, checking that installation followed state and local codes and informing clients of any violations, and reporting findings and issues to program administrators.

Third-Party Lending Institutions
Third-party lending institutions will be responsible for funding, processing, and servicing any loans assumed by property owners in closing the high efficiency new constructions.

Evaluator
The evaluator will be responsible for analyzing pre and post usage data of participants, analyzing program tracking data, conducting follow-up interviews with customers, if necessary, and reporting findings to program administrators

x) Marketing Strategy

PGW will recruit participants through targeted outreach. Externally, PGW could solicit applications through organizations and associations that are involved with the new construction of single family, multifamily, commercial, and industrial buildings. PGW will document and publicize case studies from each year to build future demand, posting results on its website and hopefully generating media coverage.

xi) Coordination with other Programs

Program/Organization	Description of Coordination
EnergyWorks	PGW will seek to coordinate with the existing EnergyWorks Commercial & Industrial energy-efficiency programming, as administered by the Philadelphia Industrial Development Corporation and The Reinvestment Fund
Other EnergySense Programs	PGW will work to refer customers to any other programs under EnergySense that the customer may be eligible for or interested in.
Other existing energy-efficiency programs	PGW will also seek to identify and coordinate with any other existing energy-efficiency programs in Philadelphia serving over-lapping markets.

xii) Evaluation, Monitoring, and Verification

Quality Assurance

An on-site inspection will be performed on a subset of project. The inspection may be performed both during and after the installation, since some larger projects may require oversight at different stages of the project. Inspections allow PGW to validate that the correct equipment was installed.

Data Collection

PGW will collect and store information provided by potential customers on applications. Information that will be collected through applications and stored in the DSM database includes:

- Customer information such as name, organization, and contact information.

- An overview of the potential project including floor plans, cross-sections, occupancy levels, HERs ratings (for residential projects), mechanical and plumbing plans, and quotes for services.

PGW will work with the TAP to collect additional details on the premise and potential measures that make up the project in order to confirm and expand on the information submitted by applicants. The TAP will use this information to estimate the amount energy the finished building will use compared to a baseline building.

After a project is completed, an inspector may perform on-site verification of every project. The data collected during this inspection and stored by PGW will include

- Documentation of the projects costs

- Specifics on the installed measures, including the data required by the project economic and financial analysis tool

- Information on the quality of the installation and the viability of achieving projected savings

- Results from interviews with customers and contractors

Reporting

As part of the Annual Reporting process, PGW will provide regular reports of the programs impacts. Deemed savings will be calculated using the values established in the TRM, and formulas will be updated as the TRM changes. Figures showing the pipeline of projects as well as the number of rejected projects will be provided along with realized costs. Findings from on-site inspections will be primarily used in the program's impact evaluations.

Evaluation

In accordance with the general evaluation plans for the Demand Side Management (DSM) Portfolio, a third-party contractor will perform in-depth evaluations every two years. The first evaluation for the HECI is scheduled for FY 2015

C. Comprehensive Residential Retrofit Incentives Program

i) Program Description

The Comprehensive Residential Retrofit Incentives (CRRI) program will provide incentives to customers and contractors that perform comprehensive natural gas energy efficiency retrofits. The CRRI program has the following goals:

- Save natural gas through cost-effective residential retrofits.
- Achieve reductions of 20% or more in annual gas heating consumption on average among all participants.

The CRRI program builds on the lessons learned from implementing the ELIRP, which promotes similar energy efficiency packages among Philadelphia's low-income population at no cost through use of approved CSPs.

ii) Program Staging

Due to the complications in launching voluntary retrofit programs, PGW will gradually ramp up the participation in CRRI. PGW plans to integrate contractors with financial incentives, streamlined access to financing, and a rigorous QA/QC. To get all of these pieces to work together, PGW will focus on recruiting and training partners to integrate all of these services over the first half of FY 2013.

Contractors selling customers on retrofit projects will be the primary driver of program participation. The program will begin offering services to customers in the spring of 2013 with two to three contractors. This "soft launch" will allow partners to iron out issues with smaller participant volume before adding additional contractors and building up participant volume in the fall. PGW expects to continue to add contractors and will build up participation through the lifetime of the program.

iii) Costs, Benefits, and Impacts

Over FY 2013 to FY 2015, the program is expected to provide lifetime net present benefits of $2.1 million with a benefit-cost ratio (BCR) of 1.30. The program aims to serve 225 projects in FY 2013, with associated annualized gas savings of 4.7 BBtu, or 20.8 MMBtu/customer. The program is projected to cost $566,197 in FY 2013. The following table shows a detailed breakout of participation, costs, and savings.

Table 28 - Projected CRRI Impacts for FY 2013

	Projected (FY 2013)
PARTICIPATION	
Analyses/Audits	n/a
Customers with Installations	225
COSTS	
Measure Installation Costs	$260,110
Administration and Management	$200,000
Marketing and Business Development	$49,673
Contractor Costs	$50,334
Inspection and Verification	$6,079
On-site Technical Assessment	$-
Evaluation	$-
Utility Costs	**$566,197**
Participant Costs	$173,407
Total	**$739,603**
BENEFITS	
Net Annual BBtu	4.7
Net Lifetime BBtu	98.3
Net Annual MMBtu / Customer	20.8
Weighted Lifetime (years)	21.0

iv) Workflow

A customer enters CRRI either by a contractor signing up a customer directly, or through PGW intake methods such as targeted mailings or an online self-audit tool. The contractor then makes contact with the customer to assess the opportunities in the home (via an audit) and sell CRRI to the customer. If the customer agrees to a project that meets PGW's gas savings and cost-effectiveness criteria, then an application is sent to PGW. PGW will also attempt to develop relationships with lenders to provide a simple financing application process for the customer as well. The contractor then performs the work and bills the customer. In the case where an applicant is seeking financing, the lending institution will process the loan. Once the work has been completed, the contractor sends the test-out results to the implementation contractor, who does a bench review and, in some instances, an onsite inspection. As soon as all the proper post-installation documentation has been completed satisfactorily, PGW will pay out the incentive to the customer and the contractor.

Additionally, CRRI will be cross-marketed to RHER participants. When a customer gets a rebate for a new piece of residential heating equipment, they will be allowed to count the savings from that new piece of equipment towards the savings requirements for CRRI. However, PGW will only pay an incentive based on the additional measures, and the equipment savings will only be counted in one of the programs to avoid double-counting of savings.

v) History, Ramp-Up Strategy and Milestones

Program services will launch in April of 2013 for an initial ramp-up period to allow positioning for full-scale operation in the fall.

Task	Time Period
Issue RFP for lending partners	June, 2012
Issue RFP for implementation CSP(s)	August, 2012
Select lending partners and CSPs and contract for services	August 2012 – November 2012
Pre-launch planning, training, and infrastructure development between PGW, CSP(s), and market actors. Includes signing up initial group of certified contractors.	November, 2012 to April, 2013
"Soft Launch" Program	***April, 2013***
Recruit and train additional certified contractors for ramp-up period. Work out issues with program delivery.	April, 2013 to August, 2013
"Full Launch" of Program in preparation for 2013 heating season.	***August, 2013***
Submit first CRRI impact evaluation study	early 2015

vi) Target Market, Program Eligibility and Process

The target market segments among PGW's eligible population of residential heating customers includes:

1. Customer annual gas usage in the top quintile of all PGW heating customers;

2. Customers already in the market for end-of-life heating system replacement and thus eligible to participate in PGW's high-efficiency heating equipment rebate program.

3. Customers who independently participate in the Pennsylvania Keystone HELP and EnergyWorks programs.

CRRI will also accept applications directly from customers registering through PGW and choosing to work with an approved CRRI CSP outside of the other Pennsylvania energy-efficiency financing programs. PGW will need to manage customer-driven program intake to keep pace with contractor and program infrastructure capacities as well as available program budget. PGW will develop a mechanism for controlling intake; e.g., announce a certain amount in incentives available through some date, first come first serve to reserve based on an updated estimate of average project cost for both participation tracks. By closely monitoring participation rates, it also will be possible to adjust the rate at which approved contractors are given "hot leads".

Any project done under CRRI must be estimated to save at least 20% of a customer's weather-normalized natural gas usage. All PGW residential customers that are pursuing these targeted project types and are paying the Energy-Efficiency surcharge are eligible for participation.

vii) Target End-use Measures

The targeted efficiency measures include:

- Instrumented air and duct sealing, particularly when combined with furnace upgrades;
- Insulation; and
- Early-retirement of existing inefficient heating systems.

To reach the 20% savings goal, participating customers will typically need to install at least two out of three of these options.

viii) Incentive Strategy

The core of the CRRI conceptual program design has been to offer participants a combination of incentives and financing opportunities for the customer portion of the investment to leverage as much customer investment in cost-effective gas savings with the available program budget. To augment this strategy, and to reduce program costs, PGW is investigating financing options in order to provide necessary financial assistance to as many interested customers as possible.

Incentives

PGW will establish a simple set of incentives tied to magnitude of savings for the installed measure package, assuming a qualifying minimum of 20% gas savings through projections from the Contractor Tool already in use for ELIRP. Based on Tool use and typical conditions of high use customers, it is anticipated that 20% cost-effective savings can be typically achieved through a package of air sealing and attic insulation measures, combined with hot water conservation measures. Furnace sites can be expected to achieve additional savings through duct sealing. Homes that do not practice set-back thermostat usage will benefit from programmable thermostat savings.

The actual customer incentives will be likely in the range of $50/MMBtu 1st year savings, depending on the results of screening using the newly developed avoided costs and with the adjusted discount rate. From the customer's perspective, the messaging of the CRRI incentives may likely be tied to spending amounts (spending $X to receive $Y in incentives) for the sake of clarity and simplicity, with education about the cost-effectiveness of the improvements, while PGW maintains control on the depth and cost-effectiveness of the gas savings through the contractor relationships.

In addition to customer incentives for participating, contractors may receive incentives for selling a comprehensive work scope and for complete documentation/reporting; i.e., the greater the savings, the greater the contractor incentive to parallel the customer incentive structure, perhaps on the order of $10/MMBtu 1st year savings. Both the customer and the contractor incentive structures are designed to encourage deep savings. The PGW incentive structure and process also could encourage those leery of loan application hassles.

For those directly participating in CRRI, any incentives due, either to contractors or customers, will be paid within 30 days upon satisfactory job completion.

Financing

PGW will explore existing energy-efficiency financing programs.

ix) Roles and Responsibilities

PGW

PGW will oversee and coordinate program activity with the Implementation CSP(s), and other partners. PGW will provide approved CSPs with the same Contractor cost-effectiveness tool initially developed for the ELIRP program, modified for application to the housing stock targeted by the CRRI program and provide training in its use. The tool will have additional features for selling the project to the customer, including an incentive calculator, customer economics, and a report that can be co-branded with a contractor and left with a customer. PGW will also assist with marketing the program, as well as paying incentives.

Implementation CSP(s)

PGW will select one or more implementation CSP(s) to train, mentor, and oversee the activity of certified contractors. This includes running initial training sessions, reviewing data gathered by certified contractors (including applications), and doing on-site inspections and mentoring.

The inspection contractor chosen will be required to have all CRRI inspections conducted by those holding BPI QC Inspector certification. They also will be expected to provide any needed mentoring of CRRI CSPs and reports of all inspections through use of the PGW inspection form and templates provided.

PGW will also use the implementation CSP(s) to process rebates that will be paid to customers and certified contractors.

Certified Contractors

Certified contractors will be responsible for selling projects and installing measures. Approved CRRI contractors will be required to have BPI Energy Auditor certification for those developing and selling work scopes, and Retrofit Installer certification for those implementing work scopes. Preference will be given to contractors who also possess BPI Crew Leader certification for the lead member of site crews. They also will be required to abide by the conditions set forth in section xi below as well provide timely and accurate reporting of job data.

Evaluator

The chosen program evaluator will be required to conduct an impact evaluation of all work submitted involving PGW incentives.

x) Marketing Strategy

PGW believes that the best strategy will be to provide as few barriers as possible for customers to participate in the program. Customers will mainly come through marketing efforts done by certified contractors, and PGW will increase intake through activities such as targeted mailers or maintaining a website where a customer can do an initial assessment on their own.

On the contractor's side, after conducting their own initial screening using PGW-approved cost-effectiveness protocols, participating contractors will conduct a comprehensive assessment and will be encouraged to sell as comprehensive a package of improvements as possible. Contractors will emphasize the many benefits of these retrofit projects, including:

- Payback period and positive cash-flow
- Ease of access to lending with less stringent requirements
- Robust QA/QC process to ensure quality work
- Increased comfort from air sealing and insulation

Initially, the program should have a limited "footprint" while the infrastructure of approved contractors and program management is developed. PGW also may develop a project reserve list if initial program intake exceeds expectations.

xi) Coordination with other Programs

Program/Organization	Description of Coordination
Other EnergySense Programs	The CRRI program will be linked directly as an optional upgrade to PGW's existing RHER program promoting premium gas space heating equipment replacement. CRRI program incentives will be structured to supplement those all PGW residential customers are eligible for when they replace their existing furnaces and boilers at the end of their useful lives. Incentives will be offered on a sliding scale, providing higher incentives for deeper energy savings. For example, to qualify for CRRI incentives beyond the RHER program, the RHER participant effectively would at least need to perform air and duct-sealing in addition to installing the high-efficiency furnace, given the 20% minimum savings requirement and may need to engage in further thermal and hot water measures. Since the incentives are for MMBtu savings, the greater the savings, the greater the incentives, thereby encouraging cross-coordination with other energy-efficiency programs.
Other existing energy-efficiency programs	PGW will also seek to identify and coordinate with any other existing energy-efficiency programs in Philadelphia serving over-lapping markets.

xii) Evaluation, Monitoring, and Verification

QA

The primary quality assurance tool that PGW will use is that customers must have work done by a certified contractor in order to receive the PGW incentive. Contractors will be selected either directly by PGW through an open RFP process, or by an Implementation CSP selected by PGW. Contractors will be evaluated on an ongoing basis, with increased activity directed to superior performance.

Data Collection

PGW will maintain a database of program activity related to each step of the process in CRRI, including:

- Initial Lead
  - Data on where and when the customer came to the program
- Audit/Application
  - Information relating to potential energy savings
  - Proposed costs for the project
  - Detailed customer data, including what would be required for the loan application
- Loan Information
  - Date and status of loan
  - Amount
  - Interest rate
  - Term
- Post-completion Verification
  - Completion date and contractor
  - Final costs for measures
  - Final savings
- Inspections
  - Date, customer, and contractor
  - Results of inspection check-list

Reporting

As part of the Annual Reporting process, PGW will provide regular reports of the programs impacts. Deemed savings will be calculated using the values established in the TRM, and formulas will be updated as the TRM changes. Figures showing the pipeline of projects as well as the number of rejected projects will be provided along with realized costs. Findings from on-site inspections will be primarily used in the program's impact evaluations.

Evaluation

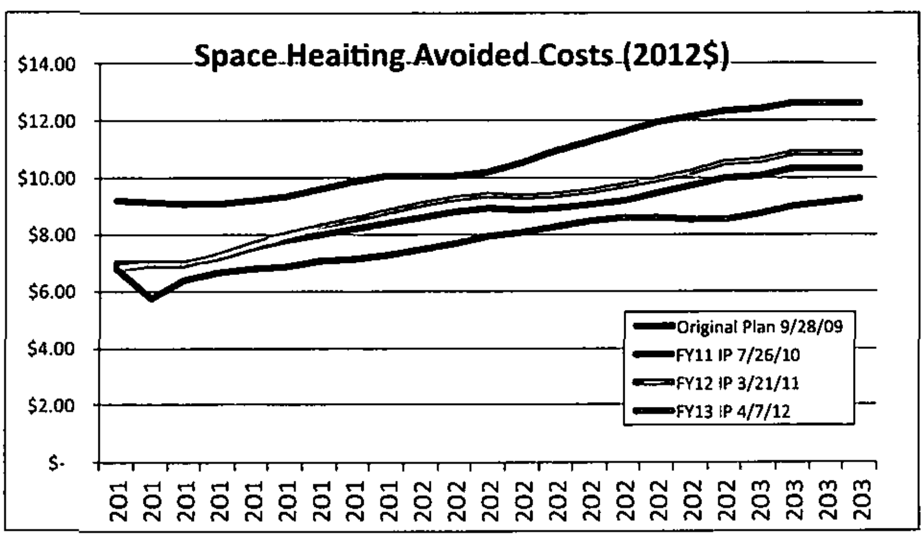
In accordance with the general evaluation plans for the Demand Side Management (DSM) Portfolio, a third-party contractor will perform in-depth evaluations every two years. The first evaluation for the CRRI is scheduled for FY 2015.

IV. Appendices

A. PGW Avoided Costs and Value of Savings

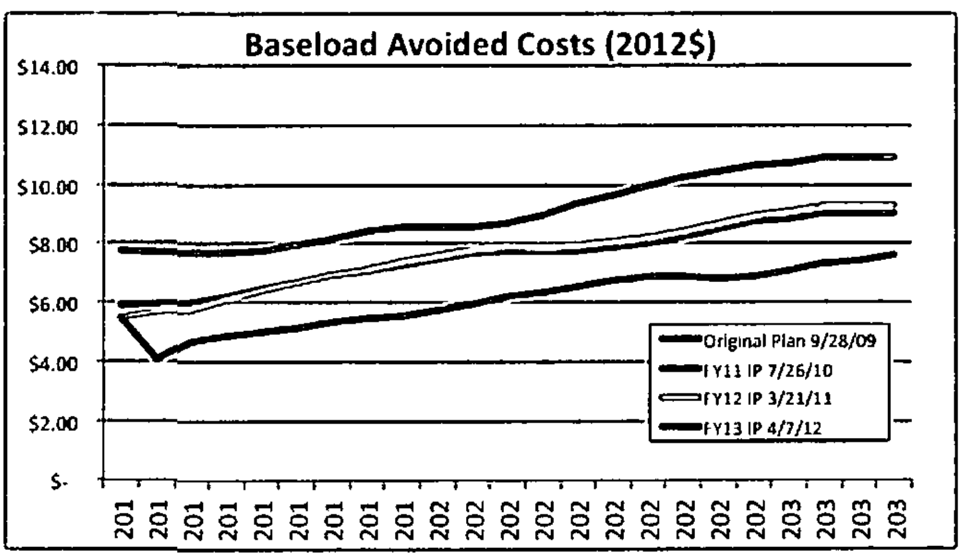
Comparison of Space Heating Avoided Costs (2012$)

Year	Original Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12
2011	$9.20	$6.96	$6.77	$6.77
2012	$9.11	$7.00	$6.91	$5.75
2013	$9.06	$7.02	$6.93	$6.36
2014	$9.10	$7.21	$7.28	$6.62
2015	$9.19	$7.50	$7.68	$6.76
2016	$9.34	$7.77	$8.00	$6.88
2017	$9.58	$8.01	$8.27	$7.03
2018	$9.89	$8.21	$8.52	$7.16
2019	$10.05	$8.42	$8.78	$7.25
2020	$10.04	$8.62	$9.05	$7.43
2021	$10.08	$8.81	$9.28	$7.69
2022	$10.20	$8.90	$9.37	$7.90
2023	$10.53	$8.88	$9.35	$8.09
2024	$10.91	$8.92	$9.40	$8.24
2025	$11.27	$9.07	$9.55	$8.45
2026	$11.62	$9.23	$9.72	$8.63
2027	$11.92	$9.45	$9.95	$8.60
2028	$12.15	$9.71	$10.23	$8.52
2029	$12.34	$9.99	$10.53	$8.56
2030	$12.41	$10.10	$10.63	$8.77
2031	$12.64	$10.32	$10.91	$9.00
2032	$12.64	$10.32	$10.91	$9.13
2033	$12.64	$10.32	$10.91	$9.27



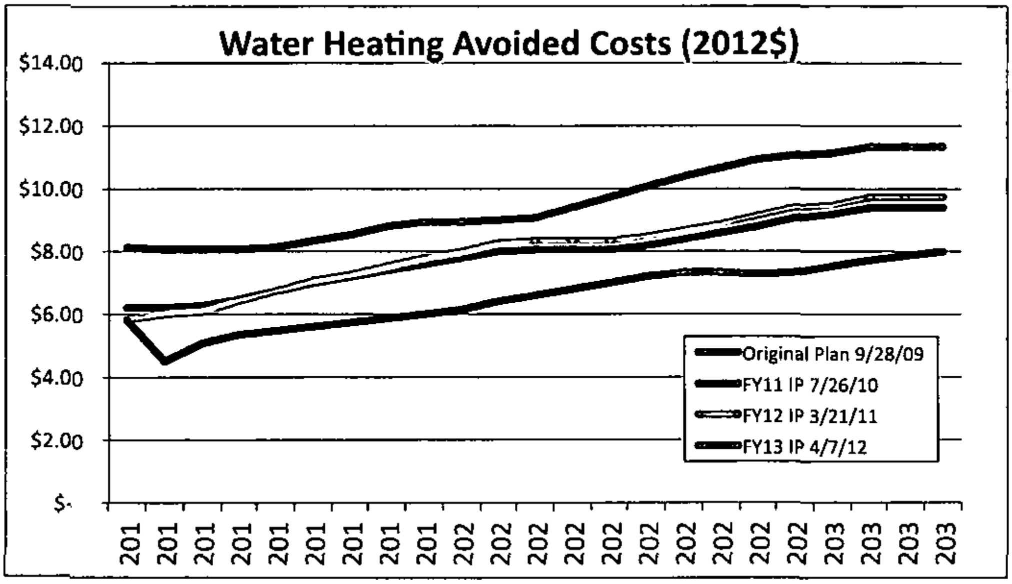
Comparison of Baseload Avoided Costs (2012$)

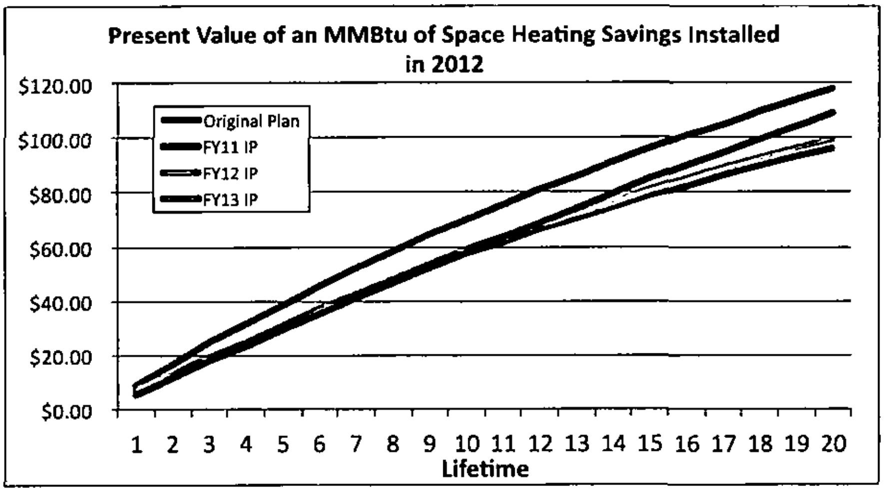
Year	Original Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12
2011	$7.75	$5.90	$5.48	$5.48
2012	$7.71	$5.95	$5.66	$4.07
2013	$7.68	$6.01	$5.76	$4.64
2014	$7.71	$6.20	$6.07	$4.89
2015	$7.80	$6.46	$6.43	$5.03
2016	$7.94	$6.71	$6.72	$5.17
2017	$8.15	$6.93	$6.96	$5.32
2018	$8.43	$7.12	$7.18	$5.45
2019	$8.57	$7.31	$7.42	$5.55
2020	$8.56	$7.49	$7.66	$5.73
2021	$8.60	$7.68	$7.86	$5.98
2022	$8.70	$7.76	$7.95	$6.19
2023	$9.00	$7.74	$7.93	$6.38
2024	$9.35	$7.78	$7.97	$6.53
2025	$9.67	$7.91	$8.11	$6.75
2026	$9.98	$8.06	$8.26	$6.92
2027	$10.26	$8.27	$8.47	$6.91
2028	$10.46	$8.51	$8.71	$6.84
2029	$10.64	$8.77	$8.98	$6.89
2030	$10.69	$8.87	$9.08	$7.09
2031	$10.91	$9.07	$9.33	$7.33
2032	$10.91	$9.07	$9.33	$7.46
2033	$10.91	$9.07	$9.33	$7.60



Comparison of Water Heating Avoided Costs (2012$)

Year	Original Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12
2011	$8.12	$6.16	$5.80	$5.80
2012	$8.06	$6.21	$5.97	$4.49
2013	$8.03	$6.26	$6.05	$5.07
2014	$8.06	$6.45	$6.37	$5.32
2015	$8.14	$6.72	$6.74	$5.46
2016	$8.29	$6.98	$7.04	$5.60
2017	$8.51	$7.20	$7.29	$5.74
2018	$8.79	$7.39	$7.51	$5.88
2019	$8.94	$7.59	$7.76	$5.98
2020	$8.93	$7.77	$8.01	$6.15
2021	$8.97	$7.96	$8.22	$6.41
2022	$9.08	$8.05	$8.31	$6.62
2023	$9.38	$8.03	$8.29	$6.81
2024	$9.74	$8.07	$8.33	$6.96
2025	$10.07	$8.20	$8.47	$7.17
2026	$10.39	$8.35	$8.62	$7.35
2027	$10.67	$8.56	$8.84	$7.33
2028	$10.88	$8.81	$9.09	$7.26
2029	$11.06	$9.08	$9.37	$7.31
2030	$11.12	$9.17	$9.47	$7.51
2031	$11.34	$9.38	$9.72	$7.75
2032	$11.34	$9.38	$9.72	$7.88
2033	$11.34	$9.38	$9.72	$8.01




Present Value of an MMBtu of Space Heating Savings Installed in 2012
$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00
Original Plan
FY11 IP
FY12 IP
FY13 IP
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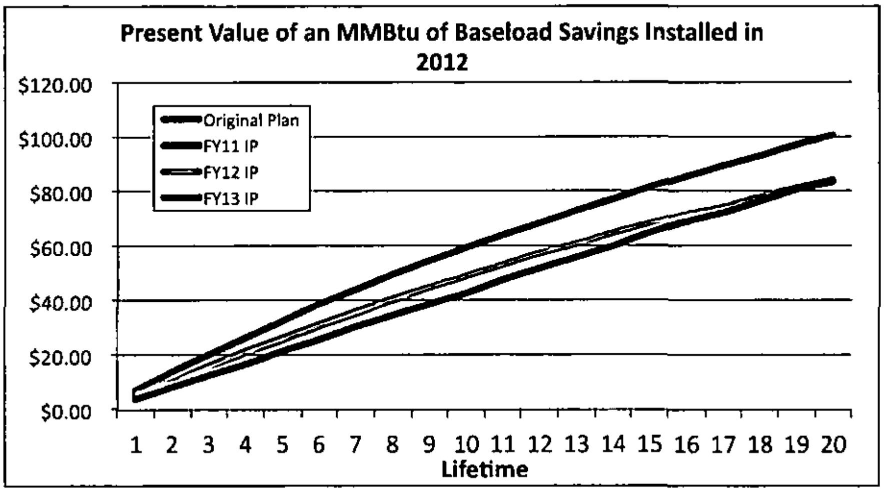
Lifetime


Present Value of an MMBtu of Baseload Savings Installed in 2012
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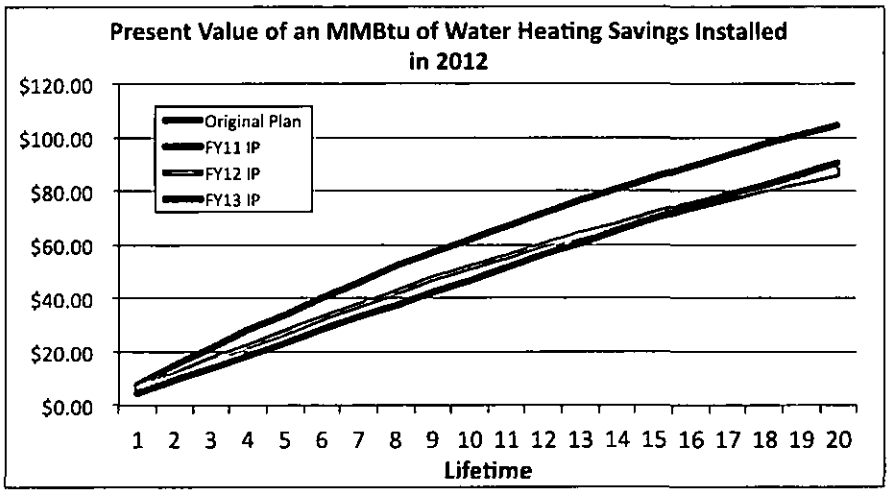
$80.00
$60.00
$40.00
$20.00
$0.00
Original Plan
FY11 IP
FY12 IP
FY13 IP
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Lifetime


Present Value of an MMBtu of Water Heating Savings Installed in 2012
$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00
Original Plan
FY11 IP
FY12 IP
FY13 IP
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Lifetime

B. List of Acronyms

Acronym	Meaning
ACEEE	American Council for an Energy Efficient Economy
ARRA	American Recovery and Reinvestment Act
BCR	Benefit-cost ratio
BSRP	Basic System Repair Program
CEE	Consortium for Energy Efficiency
CIRI	Commercial and Industrial Retrofit Program
CRRI	Comprehensive Residential Heating Retrofit Program
CRP	Customer Responsibility Program
CSP	Conservation Service Provider
CWP	Conservation Works Program
CY	Calendar Year
DEP	Department of Environmental Protection
DSM	Demand-Side Management
ECA	Energy Coordinating Agency
ECRS	Efficiency Cost Recovery Surcharge
ELIRP	Enhanced Low Income Program
FY	Fiscal Year (PGW's fiscal year goes from September 1 to August 31)
GEEG	Green Energy Economics Group, Inc.
HECI	High Efficiency Construction Program
Keystone HELP	Keystone Home Energy Loan Program
NAECP	National Appliance Energy Conservation Act
NDR	Nominal Discount Rate
PA	Pennsylvania
PECIEP	Commercial and Industrial Equipment Rebates Program
RHER	Premium Efficiency Heating Equipment Program
PGW	Philadelphia Gas Works
PHDC	Philadelphia Housing Development Corp.
RDR	Real Discount Rate
TRC	Total Resource Cost
TRM	Technical Reference Manual
USC	Universal Services Charge
WAP	Weatherization Assistance Program

C. Units

Dth = 10 therms
MDth = 10,000 therms
MMDth = 10,000,000 therms

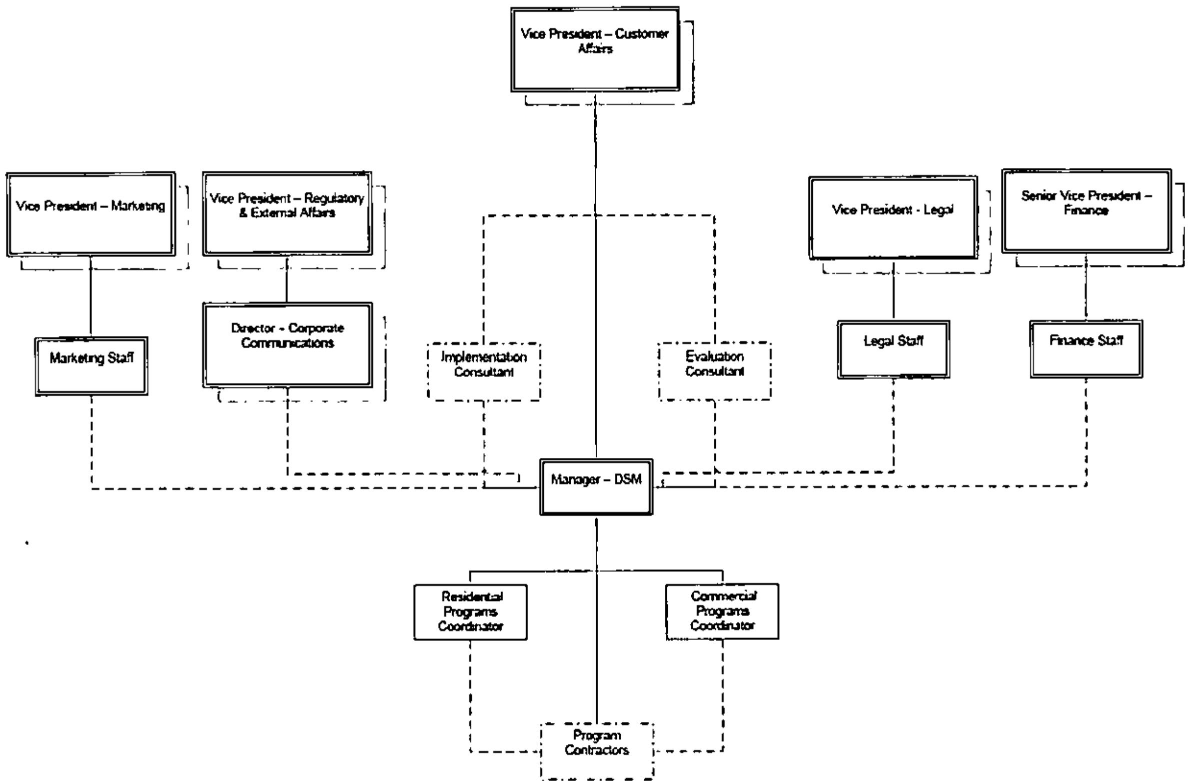
Ccf = 100 cubic feet
Mcf = 1,000 cubic feet
MMcf = 1,000,000 cubic feet
Bcf = 1,000,000,000 cubic feet

MMBtu = 1,000,000 Btu
BBtu = 1,000,000,000 Btu

kW = 1,000 watts
MW = 1,000,000 watts
GW = 1,000,000,000 watts

1 MMBtu = 1 Dth
1 therm = 1 ccf

D. Organization Chart



E. Five-Year Portfolio Projection Tables

PHILADELPHIA GAS WORKS
Five Year Gas Demand-Side Management Plan
FISCAL YEAR BUDGETS (Real 2009 Dollars)

Real 2009 dollars

Portfolio

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives & Measure Installation Costs	$ 1,732,757	$ 5,309,867	$ 8,349,705	$ 11,485,700	$ 12,220,850	$ 39,098,878
Administration and Management	$ 484,977	$ 440,152	$ 616,291	$ 515,445	$ 460,052	$ 2,516,918
Marketing and Business Development	$ 369,803	$ 483,503	$ 588,948	$ 711,274	$ 699,778	$ 2,853,305
Contractor Costs	$ 1,051,587	$ 1,124,279	$ 1,389,766	$ 1,670,942	$ 1,636,056	$ 6,872,630
Inspection and Verification	$ 11,371	$ 54,245	$ 94,971	$ 149,390	$ 162,981	$ 472,958
Evaluation	$ -	$ -	$ 75,000	$ 75,000	$ 225,000	$ 375,000
TOTAL:	$ 3,650,495	$ 7,412,046	$ 11,114,681	$ 14,607,750	$ 15,404,717	$ 52,189,689

Enhanced Low Income Retrofit

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Measure Installation Costs	$ 1,717,744	$ 4,615,821	$ 5,973,906	$ 5,504,293	$ 5,154,814	$ 22,966,578
Administration and Management	$ 36,021	$ -	$ -	$ -	$ -	$ 36,021
Marketing and Business Development	$ -	$ -	$ -	$ -	$ -	$ -
Contractor Costs	$ 1,008,127	$ 1,050,644	$ 1,054,219	$ 971,346	$ 909,673	$ 4,994,009
Inspection and Verification	$ 11,371	$ 50,354	$ 60,445	$ 59,260	$ 58,098	$ 239,528
Evaluation	$ -	$ -	$ 75,000	$ -	$ 75,000	$ 150,000
TOTAL:	$ 2,773,263	$ 5,716,820	$ 7,163,570	$ 6,534,899	$ 6,197,586	$ 28,386,136

Residential Heating Equipment Rebates

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ 15,013	$ 620,712	$ 1,512,291	$ 3,158,781	$ 3,823,678	$ 9,130,476
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ 7,930	$ 109,752	$ 93,000	$ 91,177	$ 89,389	$ 391,249
Contractor Costs	$ 27,890	$ 42,495	$ 41,910	$ 41,274	$ 51,233	$ 204,802
Inspection and Verification	$ -	$ 890	$ 3,999	$ 8,444	$ 11,409	$ 24,742
Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL:	*$ 50,833*	*$ 773,850*	*$ 1,651,200*	*$ 3,299,676*	*$ 3,975,709*	*$ 9,751,268*

Commercial and Industrial Retrofit Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ 73,333	$ 255,000	$ 321,667	$ 321,667	$ 971,667
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ 29,027	$ 47,430	$ 46,500	$ 45,588	$ 44,695	$ 213,241
Contractor Costs	$ 15,570	$ 31,140	$ 155,702	$ 155,702	$ 103,801	$ 461,915
Inspection and Verification	$ -	$ 3,000	$ 10,000	$ 11,000	$ 11,000	$ 35,000
Evaluation	$ -	$ -	$ -	$ 75,000	$ -	$ 75,000
TOTAL:	$ 44,597	$ 154,904	$ 467,202	$ 608,957	$ 481,162	$ 1,756,822

Commerical and Industrial Equipment Rebates

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 250,510	$ 452,007	$ 522,804	$ 1,225,321
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ 50,000	$ 75,000	$ 75,000	$ 200,000
Contractor Costs	$ -	$ -	$ 66,667	$ 100,000	$ 100,000	$ 266,667
Inspection and Verification	$ -	$ -	$ 11,779	$ 21,254	$ 24,583	$ 57,615
Evaluation	$ -	$ -	$ -	$ -	$ 75,000	$ 75,000
TOTAL:	$ -	$ -	$ 378,956	$ 648,261	$ 797,386	$ 1,824,603

High Efficiency Construction Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 117,697	$ 246,692	$ 295,250	$ 659,639
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ 33,333	$ 50,000	$ 50,000	$ 133,333
Contractor Costs	$ -	$ -	$ 24,768	$ 53,861	$ 64,463	$ 143,091
Inspection and Verification	$ -	$ -	$ 3,132	$ 7,312	$ 8,752	$ 19,196
Evaluation	$ -	$ -	$ -	$ -	$ 75,000	$ 75,000
TOTAL:	$ -	$ -	$ 178,930	$ 357,865	$ 493,464	$ 1,030,259

Comprehensive Residential Retrofit Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 240,301	$ 1,802,260	$ 2,102,636	$ 4,145,198
Administratson and Management	$ -	$ -	$ 184,769	$ 92,385	$ 45,287	$ 322,440
Marketing and Business Development	$ -	$ -	$ 46,192	$ 135,860	$ 133,196	$ 315,248
Contractor Costs	$ -	$ -	$ 46,501	$ 348,760	$ 406,886	$ 802,147
Inspection and Verification	$ -	$ -	$ 5,616	$ 42,121	$ 49,141	$ 96,878
Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL:	$ -	$ -	$ 523,380	$ 2,421,384	$ 2,737,146	$ 5,681,910

Portfolio-wide Costs

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ -	$ -	$ -	$ -
Administration and Management	$ 448,956	$ 440,152	$ 431,522	$ 423,061	$ 414,766	$ 2,158,456
Marketing and Business Development	$ 332,846	$ 326,320	$ 319,922	$ 313,649	$ 307,499	$ 1,600,235
Contractor Costs	$ -	$ -	$ -	$ -	$ -	$ -
Inspection and Verification	$ -	$ -	$ -	$ -	$ -	$ -
On-site Potential Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL:	$ 781,802	$ 766,472	$ 751,444	$ 736,709	$ 722,264	$ 3,758,691

Comparison of Budget Projections

Real 2009$

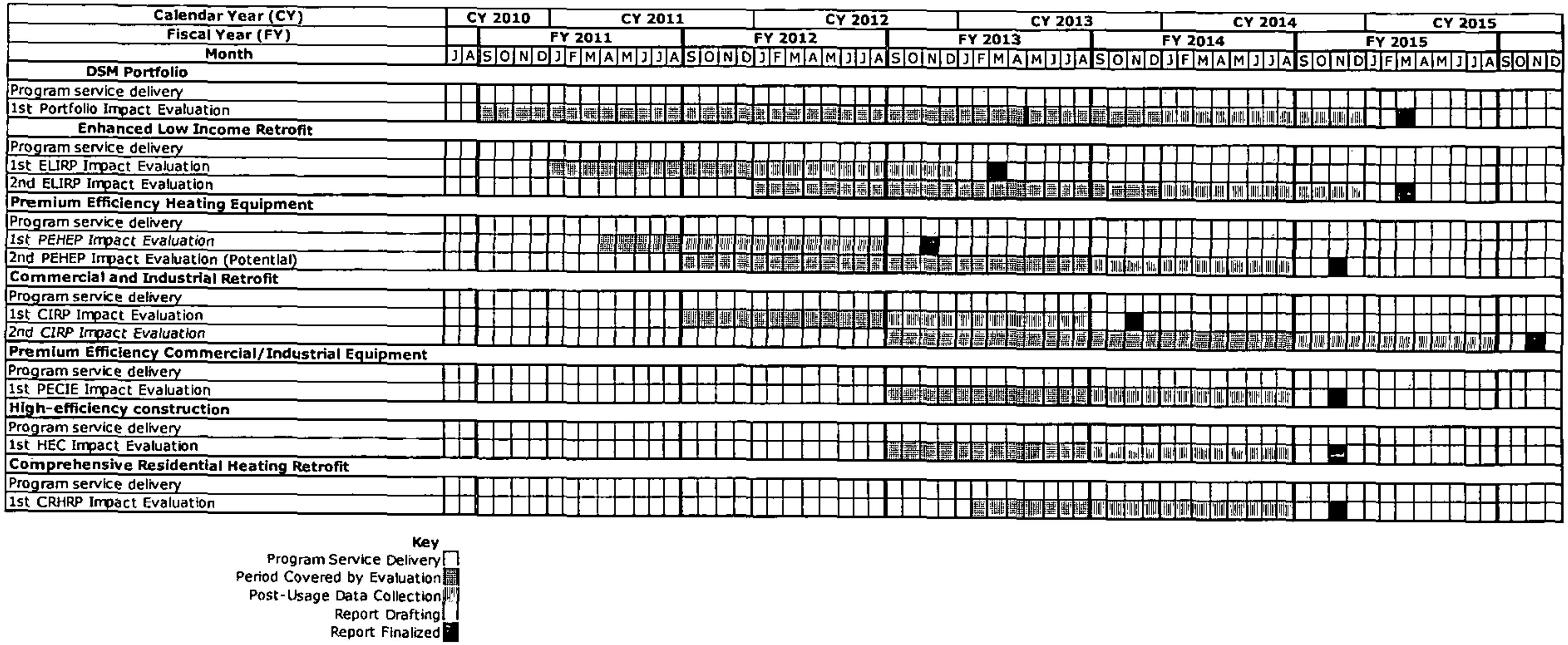
Program	FY 2011 (ACTUAL)	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - 15
FY 2013 IP (New)						
PORTFOLIO TOTAL	$ 3,650,495	$ 7,412,046	$ 11,114,681	$ 14,607,750	$ 15,404,717	$ 52,189,689
ELIRP	$ 2,773,263	$ 5,716,820	$ 7,163,570	$ 6,534,899	$ 6,197,586	$ 28,386,136
RHER	$ 50,833	$ 773,850	$ 1,651,200	$ 3,299,676	$ 3,975,709	$ 9,751,268
CIRI	$ 44,597	$ 154,904	$ 467,202	$ 608,957	$ 481,162	$ 1,756,822
CIER	$ -	$ -	$ 378,956	$ 648,261	$ 797,386	$ 1,824,603
HECI	$ -	$ -	$ 178,930	$ 357,865	$ 493,464	$ 1,030,259
CRRI	$ -	$ -	$ 523,380	$ 2,421,384	$ 2,737,146	$ 5,681,910
Portfolio-wide	$ 781,802	$ 766,472	$ 751,444	$ 736,709	$ 722,264	$ 3,758,691
FY 2012 IP (Old)						
PORTFOLIO TOTAL	$ 6,913,368	$ 7,468,521	$ 11,036,706	$ 16,558,672	$ 18,170,885	$ 60,148,151
ELIRP	$ 5,748,782	$ 5,764,241	$ 5,358,140	$ 5,993,659	$ 6,067,497	$ 28,932,319
RHER	$ 338,187	$ 782,904	$ 1,654,884	$ 3,264,713	$ 3,922,850	$ 9,963,537
CIRI	$ 44,597	$ 154,904	$ 467,202	$ 608,957	$ 481,162	$ 1,756,822
CIER	$ -	$ -	$ 204,930	$ 484,305	$ 648,305	$ 1,337,539
HECI	$ -	$ -	$ 384,303	$ 924,345	$ 1,171,450	$ 2,480,098
CRRI	$ -	$ -	$ 2,215,805	$ 4,545,984	$ 5,157,356	$ 11,919,145
Portfolio-wide	$ 781,802	$ 766,472	$ 751,444	$ 736,709	$ 722,264	$ 3,758,691
Difference ($)						
PORTFOLIO TOTAL	$ (3,262,873)	$ (56,475)	$ 77,975	$ (1,950,921)	$ (2,766,168)	$ (7,958,462)
ELIRP	$ (2,975,519)	$ (47,421)	$ 1,805,430	$ 541,240	$ 130,088	$ (546,182)
RHER	$ (287,354)	$ (9,054)	$ (3,684)	$ 34,963	$ 52,858	$ (212,270)
CIRI	$ -	$ -	$ -	$ -	$ -	$ -
CIER	$ -	$ -	$ 174,026	$ 163,956	$ 149,081	$ 487,064
HECI	$ -	$ -	$ (205,372)	$ (566,480)	$ (677,986)	$ (1,449,839)
CRRI	$ -	$ -	$ (1,692,425)	$ (2,124,600)	$ (2,420,210)	$ (6,237,235)
Portfolio-wide	$ -	$ -	$ -	$ -	$ -	$ -
Difference (%)						
PORTFOLIO TOTAL	-47.2%	-0.8%	0.7%	-11.8%	-15.2%	-13.2%
ELIRP	-51.8%	-0.8%	33.7%	9.0%	2.1%	-1.9%
RHER	-85.0%	-1.2%	-0.2%	1.1%	1.3%	-2.1%
CIRI	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CIER			84.9%	33.9%	23.0%	36.4%
HECI			-53.4%	-61.3%	-57.9%	-58.5%
CRRI			-76.4%	-46.7%	-46.9%	-52.3%
Portfolio-wide	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

F. Projected Job Creation

The following table presents the range of employment-impact projects for the proposed PGW programs, using a range of jobs created per trillion BTU saved. The job figures presented here do not include the additional jobs created from the electric savings resulting from PGW's programs. Please see PGW's Five Year Demand Side Management Plan for a discussion of the research that lead to the assumptions of jobs created per TBtu.

	JOB CREATION IMPACTS OF GAS EFFICIENCY PORTFOLIO		
	30 Jobs/TBtu	**40 Jobs/TBtu**	**50 Jobs/TBtu**
RESIDENTIAL PROGRAMS			
FY 2011	45	61	76
FY 2012	59	79	99
FY 2013	55	74	92
FY 2014	114	152	190
FY 2015	119	159	199
TOTAL	**393**	**525**	**656**
NON-RESIDENTIAL PROGRAMS			
FY 2011	0	0	0
FY 2012	3	4	5
FY 2013	18	23	29
FY 2014	28	37	46
FY 2015	30	40	50
TOTAL	**78**	**105**	**131**
TOTAL PORTFOLIO			
FY 2011	46	61	76
FY 2012	62	83	104
FY 2013	73	97	122
FY 2014	142	189	236
FY 2015	149	199	249
TOTAL	**472**	**629**	**786**

G. Impact Evaluation Schedule



H. Cost Recovery Schedules

The Enhanced Low Income Retrofit Program costs are recovered through the Universal Services Surcharge, beginning at ELIRP program launch on January 1, 2011.

The five other EnergySense program costs are recovered through the Efficiency Cost Recovery Surcharge in accordance with each program's launch date and funding activities.

STATEMENT OF RECONCILIATION

UNIVERSAL SERVICES & ENERGY CONSERVATION SURCHARGE

SEPTEMBER 2010 THROUGH AUGUST 2011

Month		Applicable Volumes	USC Charge	USC Revenue Billed	USC Expenses	Monthly Over/(Under) Recovery	Cumulative Over/(Under) Recovery
FY 10 Reconciliation							($19,939,314)
September 2010	Actual	1,109,653	$ 2.2855	$ 2,536,111	$ (2,118,782)	$ 4,654,893	($15,284,421)
October	Actual	1,573,678	$ 2.3678	$ 3,726,155	$ (374,819)	$ 4,100,973	($11,183,448)
November	Actual	3,244,696	$ 2.3678	$ 7,682,791	$ 7,224,051	$ 458,739	($10,724,709)
December	Actual	6,848,148	$ 2.1703	$ 14,862,536	$ 17,190,745	$ (2,328,209)	($13,052,918)
January 2011	Actual	10,697,049	$ 1.9728	$ 21,103,137	$ 28,669,860	$ (7,566,723)	($20,619,641)
February	Actual	9,291,679	$ 1.9728	$ 18,330,623	$ 25,370,341	$ (7,039,717)	($27,659,358)
March	Actual	6,780,663	$ 2.3098	$ 15,661,974	$ 20,422,074	$ (4,760,100)	($32,419,458)
April	Actual	4,708,175	$ 2.6468	$ 12,461,598	$ 12,927,927	$ (466,329)	($32,885,786)
May	Actual	2,278,994	$ 2.6468	$ 6,032,041	$ 4,525,304	$ 1,506,738	($31,379,049)
June	Actual	1,383,215	$ 2.7215	$ 3,764,351	$ 177,376	$ 3,586,975	($27,792,074)
July	Actual	1,159,585	$ 2.7961	$ 3,242,316	$ (1,685,909)	$ 4,928,225	($22,863,849)
August	Actual	1,065,364	$ 2.7961	$ 2,978,864	$ (428,152)	$ 3,407,016	($19,456,833)

USC Expenses	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11
Conservation Works	$ 4,565	$ 13,656	$ 179,959	$ 198,424	$ 5,494	$ 221,064	$ 5,718	$ 9,054	$ 50,169	$ 14,339	$ 9,744	$ 104,674
ELIRP**	$ -	$ -	$ 55,192	$ 59,685	$ 100,422	$ 18,679	$ 161,301	$ 134,495	$ 356,232	$ 385,612	$ 277,718	$ 1,829,436
CRP Discount	$ (3,188,434)	$ (1,488,133)	$ 5,532,786	$ 14,965,360	$ 25,990,955	$ 22,798,212	$ 18,046,143	$ 11,052,977	$ 2,739,453	$ (1,416,837)	$ (3,028,412)	$ (3,315,405)
CRP Forgiveness	$ 851,310	$ 794,420	$ 762,875	$ 744,519	$ 764,345	$ 769,414	$ 981,477	$ 881,749	$ 925,968	$ 938,061	$ 846,067	$ 767,337
Senior Citizen Discount	$ 213,777	$ 305,238	$ 693,239	$ 1,222,757	$ 1,808,644	$ 1,572,397	$ 1,258,279	$ 873,722	$ 459,214	$ 253,530	$ 207,616	$ 185,807
Bad Debt Expense Offset*	$ -	$ -	$ -	$ -	$ -	$ (9,426)	$ (30,844)	$ (24,070)	$ (5,752)	$ 2,672	$ 1,358	$ -
Total	$ (2,118,782)	$ (374,819)	$ 7,224,051	$ 17,190,745	$ 28,669,860	$ 25,370,341	$ 20,422,074	$ 12,927,927	$ 4,525,304	$ 177,376	$ (1,685,909)	$ (428,152)

		Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11
CRP Participation													
Rate Case Participation Rate		84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000
Actual Participation Rate*		81,292	79,732	81,855	82,544	83,198	84,492	86,072	86,658	86,560	86,292	84,534	83,535
CRP Under(Over) Participation		2,708	4,268	2,145	1,456	802	(492)	(2,072)	(2,658)	(2,560)	(2,292)	(534)	465
Average Shortfall Per CRP Participant													
CRP Discount		$ (3,188,434)	$ (1,488,133)	$ 5,532,786	$ 14,965,360	$ 25,990,955	$ 22,798,212	$ 18,046,143	$ 11,052,977	$ 2,739,453	$ (1,416,837)	$ (3,028,412)	(3,315,405)
Actual Participation Rate		81,292	79,732	81,855	82,544	83,198	84,492	86,072	86,658	86,560	86,292	84,534	83,535
Average Shortfall per CRP Participant		$ (39)	$ (19)	$ 68	$ 181	$ 312	$ 270	$ 210	$ 128	$ 32	$ (16)	$ (36)	(40)
Shortfall*		$ -	$ -	$ -	$ -	$ -	$ (132,755)	$ (434,422)	$ (339,020)	$ (81,019)	$ 37,633	$ 19,130	-
Bad Debt Expense Offset*	7.1%	$ -	$ -	$ -	$ -	$ -	$ (9,426)	$ (30,844)	$ (24,070)	$ (5,752)	$ 2,672	$ 1,358	$ -

*Bad Debt Expense Offset Applicable When Actual CRP Participation Exceeds 84,000

** Revised

STATEMENT OF RECONCILIATION

UNIVERSAL SERVICES & ENERGY CONSERVATION SURCHARGE

SEPTEMBER 2011 THROUGH AUGUST 2012

Month		Applicable Volumes	USC Charge	USC Revenue Billed	USC Expenses	Monthly Over/(Under) Recovery	Cumulative Over/(Under) Recovery
FY 11 Reconciliation							($19,456,833)
September 2011	Actual	1,243,318	$ 2.6303	$ 3,270,298	$ (1,776,432)	$ 5,046,730	($14,410,103)
October	Actual	1,499,912	$ 2.4645	$ 3,696,534	$ (479,527)	$ 4,176,061	($10,234,042)
November	Actual	3,467,643	$ 2.4645	$ 8,546,006	$ 7,859,442	$ 686,565	($9,547,477)
December	Actual	4,807,618	$ 2.3581	$ 11,336,845	$ 12,360,614	$ (1,023,769)	($10,571,247)
January 2012	Actual	7,635,779	$ 2.2517	$ 17,193,483	$ 23,480,623	$ (6,287,140)	($16,858,387)
February	Actual	7,349,262	$ 2.2517	$ 16,548,332	$ 21,967,215	$ (5,418,882)	($22,277,269)
March	Estimated	5,588,651	$ 2.2341	$ 12,485,605	$ 14,418,722	$ (1,933,118)	($24,210,387)
April	Estimated	3,667,636	$ 2.2165	$ 8,129,316	$ 6,708,301	$ 1,421,015	($22,789,372)
May	Estimated	2,325,464	$ 2.2165	$ 5,154,390	$ 2,207,737	$ 2,946,653	($19,842,718)
June	Estimated	1,324,944	$ 2.2165	$ 2,936,738	$ (1,522,034)	$ 4,458,772	($15,383,946)
July	Estimated	1,197,076	$ 2.2165	$ 2,653,318	$ (1,902,544)	$ 4,555,862	($10,828,084)
August	Estimated	1,065,884	$ 2.2165	$ 2,362,533	$ (2,186,594)	$ 4,549,126	($6,278,958)

USC Expenses	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12
CWP/ELIRP Expense	$ 3,921	$ 4,084	$ 1,142,166	$ 35,823	$ 1,870,894	$ 1,131,932	$ 394,805	$ 394,805	$ 394,805	$ 394,805	$ 394,805
CWP/ELIRP Labor	$ 10,394	$ 6,916	$ 6,313	$ 8,765	$ 10,114	$ 6,312	$ 13,808	$ 13,808	$ 13,808	$ 13,808	$ 13,808
CRP Discount	$ (2,800,522)	$ (1,491,658)	$ 5,408,379	$ 10,821,473	$ 19,679,942	$ 18,919,974	$ 12,133,917	$ 4,770,370	$ 470,778	$ (3,075,719)	$ (3,431,814)
CRP Forgiveness	$ 803,980	$ 742,602	$ 684,391	$ 613,413	$ 609,441	$ 638,500	$ 967,960	$ 967,960	$ 967,960	$ 951,174	$ 945,579
Senior Citizen Discount	$ 205,795	$ 258,529	$ 618,193	$ 881,140	$ 1,310,232	$ 1,270,496	$ 908,232	$ 561,357	$ 360,385	$ 193,897	$ 175,077
Bad Debt Expense Offset*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ (1,776,432)	$ (479,527)	$ 7,859,442	$ 12,360,614	$ 23,480,623	$ 21,967,215	$ 14,418,722	$ 6,708,301	$ 2,207,737	$ (1,522,034)	$ (1,902,544)

CRP Participation							
Rate Case Participation Rate		84,000	84,000	84,000	84,000	84,000	84,000
Actual Participation Rate*		82,679	82,023	80,752	80,298	80,686	81,921
CRP Under(Over) Participation		1,321	1,977	3,248	3,702	3,314	2079
Average Shortfall Per CRP Participant							
CRP Discount		$ (2,800,522)	$ (1,491,658)	$ 5,408,379	$ 10,821,473	$ 19,679,942	18,919,974
Actual Participation Rate		82679	82023	80752	80298	80686	81,921
Average Shorfall per CRP Participant		$ (34)	$ (18)	$ 67	$ 135	$ 244	$ 231
*Shortfall**		$ -	$ -	$ -	$ -	$ -	$ -
Bad Debt Expense Offset*	7.1%	$ -	$ -	$ -	$ -	$ -	$ -

*Bad Debt Expense Offset Applicable When Actual CRP Participation Exceeds 84,000

EFFICIENCY COST RECOVERY (ECR) SURCHARGE

STATEMENT OF RECONCILIATION

SEPTEMBER 2010 THRU AUGUST 2011

RESIDENTIAL & PHA GS

		Volumes	ECR Surcharge	Revenue Billed	RHER Expenses	CIRI Expenses	CIER Expenses	HECI Expenses	CRRI Expenses	Total Expenses	Monthly Over/(Under)	Cumulative Over/(Under)
September 2010	Actual	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
October	Actual	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
November	Actual	-	$ -	$ -	$ 4,888	$ -	$ -	$ 384	$ 3,549	$ 8,821	$ (8,821)	$ (8,821)
December *	Actual	2,560,740	$ 0.0168	$ 43,020	$ 5,286	$ -	$ -	$ 415	$ 3,838	$ 9,539	$ 33,481	$ 24,660
January 2011	Actual	8,464,623	$ 0.0168	$ 142,206	$ 8,779	$ -	$ -	$ 689	$ 6,374	$ 15,843	$ 126,363	$ 151,023
February	Actual	7,264,385	$ 0.0168	$ 122,042	$ 1,654	$ -	$ -	$ 130	$ 1,201	$ 2,985	$ 119,056	$ 270,079
March	Actual	5,213,151	$ 0.0168	$ 87,581	$ 6,908	$ -	$ -	$ 543	$ 5,015	$ 12,466	$ 75,115	$ 345,195
April	Actual	3,652,600	$ 0.0168	$ 61,364	$ 2,332	$ -	$ -	$ 183	$ 1,693	$ 4,207	$ 57,156	$ 402,351
May	Actual	1,700,158	$ 0.0168	$ 28,563	$ 13,184	$ -	$ -	$ 353	$ 3,264	$ 16,801	$ 11,762	$ 414,112
June	Actual	952,920	$ 0.0179	$ 17,057	$ 15,548	$ -	$ -	$ 160	$ 1,481	$ 17,189	$ (131)	$ 413,981
July	Actual	790,139	$ 0.0190	$ 15,013	$ 17,111	$ -	$ -	$ 235	$ 2,172	$ 19,518	$ (4,505)	$ 409,476
August	Actual	694,249	$ 0.0190	$ 13,191	$ 14,144	$ -	$ -	$ 340	$ 3,144	$ 17,629	$ (4,438)	$ 405,038
Total		31,292,965		$ 530,036	$ 89,835	$ -	$ -	$ 3,432	$ 31,730	$ 124,998	$ 405,038	

COMMERCIAL & PHA

		Volumes	ECR Surcharge	Revenue Billed	RHER Expenses	CIRI Expenses	CIER Expenses	HECI Expenses	CRRI Expenses	Total Expenses	Monthly Over/(Under)	Cumulative Over/(Under)
September 2010	Actual	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
October	Actual	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
November	Actual	-	$ -	$ -	$ 49	$ 448	$ 207	$ 384	$ -	$ 1,088	$ (1,088)	$ (1,088)
December *	Actual	741,937	$ 0.0053	$ 3,932	$ 53	$ 484	$ 224	$ 415	$ -	$ 1,177	$ 2,755	$ 1,667
January 2011	Actual	1,922,977	$ 0.0053	$ 10,192	$ 89	$ 804	$ 372	$ 689	$ -	$ 1,955	$ 8,237	$ 9,904
February	Actual	1,762,507	$ 0.0053	$ 9,341	$ 17	$ 152	$ 70	$ 130	$ -	$ 368	$ 8,973	$ 18,877
March	Actual	1,366,040	$ 0.0053	$ 7,240	$ 70	$ 633	$ 293	$ 543	$ -	$ 1,538	$ 5,702	$ 24,579
April	Actual	913,073	$ 0.0053	$ 4,839	$ 24	$ 214	$ 99	$ 183	$ -	$ 519	$ 4,320	$ 28,899
May	Actual	520,222	$ 0.0053	$ 2,757	$ 133	$ 412	$ 191	$ 353	$ -	$ 1,089	$ 1,668	$ 30,567
June	Actual	379,348	$ 0.0095	$ 3,604	$ 157	$ 187	$ 86	$ 160	$ -	$ 591	$ 3,013	$ 33,580
July	Actual	332,000	$ 0.0137	$ 4,548	$ 173	$ 274	$ 127	$ 235	$ -	$ 809	$ 3,740	$ 37,320
August	Actual	327,111	$ 0.0137	$ 4,481	$ 143	$ 397	$ 184	$ 340	$ -	$ 1,063	$ 3,418	$ 40,738
Total		8,265,215		$ 50,935	$ 907	$ 4,004	$ 1,854	$ 3,432	$ -	$ 10,197	$ 40,738	

INDUSTRIAL

		Volumes	ECR Surcharge	Revenue Billed	RHER Expenses	CIRI Expenses	CIER Expenses	HECI Expenses	CRRI Expenses	Total Expenses	Monthly Over/(Under)	Cumulative Over/(Under)
September 2010	Actual	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
October	Actual	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
November	Actual	-	$ -	$ -	$ -	$ 448	$ 207	$ -	$ -	$ 655	$ (655)	$ (655)
December *	Actual	68,578	$ 0.0532	$ 3,648	$ -	$ 484	$ 224	$ -	$ -	$ 708	$ 2,940	$ 2,285
January 2011	Actual	162,829	$ 0.0532	$ 8,663	$ -	$ 804	$ 372	$ -	$ -	$ 1,177	$ 7,486	$ 9,771
February	Actual	124,083	$ 0.0532	$ 6,601	$ -	$ 152	$ 70	$ -	$ -	$ 222	$ 6,379	$ 16,150
March	Actual	110,521	$ 0.0532	$ 5,880	$ -	$ 633	$ 293	$ -	$ -	$ 926	$ 4,954	$ 21,104
April	Actual	71,746	$ 0.0532	$ 3,817	$ -	$ 214	$ 99	$ -	$ -	$ 312	$ 3,504	$ 24,608
May	Actual	47,639	$ 0.0532	$ 2,534	$ -	$ 412	$ 191	$ -	$ -	$ 603	$ 1,932	$ 26,540
June	Actual	42,903	$ 0.0301	$ 1,289	$ -	$ 187	$ 86	$ -	$ -	$ 273	$ 1,016	$ 27,556
July	Actual	32,240	$ 0.0069	$ 222	$ -	$ 274	$ 127	$ -	$ -	$ 401	$ (178)	$ 27,378
August	Actual	38,682	$ 0.0069	$ 267	$ -	$ 397	$ 184	$ -	$ -	$ 580	$ (314)	$ 27,064
Total		699,221		$ 32,922	$ -	$ 4,004	$ 1,854	$ -	$ -	$ 5,858	$ 27,064	

* Volumes include 50% of Dec 2010 billed sales

EFFICIENCY COST RECOVERY (ECR) SURCHARGE

STATEMENT OF RECONCILIATION

FISCAL YEAR 2012

		Actual Sep-11	Actual Oct-11	Actual Nov-11	Actual Dec-11	Actual Jan-12	Actual Feb-12	Estimated Mar-12	Estimated Apr-12	Estimated May-12	Estimated Jun-12	Estimated Jul-12	Estimated Aug-12	
RESIDENTIAL & PHA GS														
FY 2011 Over-Collection														$ 405,038
Volume Billed		815,328	1,000,881	2,519,255	3,580,810	5,873,552	5,663,270	4,352,256	2,748,257	1,721,910	882,982	780,910	693,736	
ECR Surcharge		$ 0.0174	$ 0.0158	$ 0.0158	$ 0.0290	$ 0.0421	$ 0.0421	$ 0.0491	$ 0.0560	$ 0.0560	$ 0.0560	$ 0.0560	$ 0.0560	
Revenue Billed		$ 14,187	$ 15,814	$ 39,804	$ 103,664	$ 247,277	$ 238,424	$ 213,478	$ 153,902	$ 96,427	$ 49,447	$ 43,731	$ 38,849	
RHER	Expense	$ 19,403	$ 14,453	$ 38,570	$ 20,187	$ 25,197	$ 29,162	$ 126,353	$ 126,353	$ 126,353	$ 126,353	$ 126,353	$ 126,353	
RHER	Labor	$ 1,833	$ 1,220	$ 1,113	$ 1,546	$ 1,784	$ 1,113	$ 2,435	$ 2,435	$ 2,435	$ 2,435	$ 2,435	$ 2,435	
HECI	Expense	$ 32	$ 33	$ 170	$ 249	$ 32	$ 523	$ 441	$ 441	$ 441	$ 441	$ 441	$ 441	
HECI	Labor	$ 84	$ 56	$ 51	$ 71	$ 82	$ 51	$ 112	$ 112	$ 112	$ 112	$ 112	$ 112	
CRRI	Expense	$ 306	$ 319	$ 1,630	$ 2,396	$ 307	$ 5,026	$ 4,239	$ 4,239	$ 4,239	$ 4,239	$ 4,239	$ 4,239	
CRRI	Labor	$ 811	$ 540	$ 492	$ 684	$ 789	$ 492	$ 1,077	$ 1,077	$ 1,077	$ 1,077	$ 1,077	$ 1,077	
Total		$ 22,469	$ 16,620	$ 42,027	$ 25,133	$ 28,190	$ 36,368	$ 134,658	$ 134,658	$ 134,658	$ 134,658	$ 134,658	$ 134,658	
Monthly Over/(Under)		$ (8,282)	$ (806)	$ (2,222)	$ 78,531	$ 219,066	$ 202,056	$ 78,821	$ 19,245	$ (38,231)	$ (85,211)	$ (90,927)	$ (95,808)	
Cumulative Over/(Under)		$ 396,756	$ 395,950	$ 393,728	$ 472,259	$ 691,345	$ 893,401	$ 972,221	$ 991,466	$ 953,236	$ 868,025	$ 777,099	$ 681,290	
COMMERCIAL & PHA														
FY 2011 Over-Collection														$ 40,738
Volume Billed		$ 379,865	$ 439,026	$ 830,817	$ 1,064,342	$ 1,529,860	$ 1,465,433	$ 1,076,882	$ 808,642	$ 542,719	$ 404,790	$ 379,953	$ 339,733	
ECR Surcharge		$ 0.0141	$ 0.0144	$ 0.0144	$ 0.0201	$ 0.0257	$ 0.0257	$ 0.0280	$ 0.0302	$ 0.0302	$ 0.0302	$ 0.0302	$ 0.0302	
Revenue Billed		$ 5,337	$ 6,322	$ 11,964	$ 21,340	$ 39,317	$ 37,662	$ 30,099	$ 24,421	$ 16,390	$ 12,225	$ 11,475	$ 10,260	
RHER	Expense	$ 196	$ 146	$ 390	$ 204	$ 255	$ 295	$ 1,276	$ 1,276	$ 1,276	$ 1,276	$ 1,276	$ 1,276	
RHER	Labor	$ 19	$ 12	$ 11	$ 16	$ 18	$ 11	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	
CIRI	Expense	$ 121	$ 126	$ 644	$ 946	$ 121	$ 11,819	$ 27,252	$ 27,252	$ 27,252	$ 27,252	$ 27,252	$ 27,252	
CIRI	Labor	$ 320	$ 213	$ 195	$ 270	$ 312	$ 195	$ 426	$ 426	$ 426	$ 426	$ 426	$ 426	
CIER	Expense	$ 17	$ 18	$ 91	$ 134	$ 17	$ 282	$ 238	$ 238	$ 238	$ 238	$ 238	$ 238	
CIER	Labor	$ 46	$ 30	$ 28	$ 38	$ 44	$ 28	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	
HECI	Expense	$ 32	$ 33	$ 170	$ 249	$ 32	$ 523	$ 441	$ 441	$ 441	$ 441	$ 441	$ 441	
HECI	Labor	$ 84	$ 56	$ 51	$ 71	$ 82	$ 51	$ 112	$ 112	$ 112	$ 112	$ 112	$ 112	
Total		$ 834	$ 635	$ 1,579	$ 1,929	$ 881	$ 13,203	$ 29,830	$ 29,830	$ 29,830	$ 29,830	$ 29,830	$ 29,830	
Monthly Over/(Under)		$ 4,503	$ 5,687	$ 10,385	$ 19,411	$ 38,437	$ 24,458	$ 269	$ (5,409)	$ (13,440)	$ (17,606)	$ (18,356)	$ (19,570)	
Cumulative Over/(Under)		$ 45,241	$ 50,928	$ 61,313	$ 80,723	$ 119,160	$ 143,618	$ 143,887	$ 138,478	$ 125,038	$ 107,432	$ 89,077	$ 69,507	
INDUSTRIAL														
FY 2011 Over-Collection														$ 27,064
Volume Billed		42,818	43,580	72,363	91,294	124,564	119,367	80,132	64,817	40,893	31,321	29,677	26,512	
ECR Surcharge		$ (0.0077)	$ (0.0222)	$ (0.0222)	$ 0.0293	$ 0.0807	$ 0.0807	$ 0.1224	$ 0.1641	$ 0.1641	$ 0.1641	$ 0.1641	$ 0.1641	
Revenue Billed		$ (328)	$ (967)	$ (1,606)	$ 2,670	$ 10,052	$ 9,633	$ 9,808	$ 10,636	$ 6,711	$ 5,140	$ 4,870	$ 4,351	
CIRI	Expense	$ 12	$ 13	$ 67	$ 98	$ 13	$ 205	$ 173	$ 173	$ 173	$ 173	$ 173	$ 173	
CIRI	Labor	$ 33	$ 22	$ 20	$ 28	$ 32	$ 20	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	
CIER	Expense	$ 17	$ 18	$ 91	$ 134	$ 17	$ 282	$ 238	$ 238	$ 238	$ 238	$ 238	$ 238	
CIER	Labor	$ 46	$ 30	$ 28	$ 38	$ 44	$ 28	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	
Total		$ 108	$ 83	$ 206	$ 299	$ 106	$ 535	$ 515	$ 515	$ 515	$ 515	$ 515	$ 515	
Monthly Over/(Under)		$ (436)	$ (1,051)	$ (1,812)	$ 2,372	$ 9,946	$ 9,098	$ 9,293	$ 10,121	$ 6,195	$ 4,624	$ 4,355	$ 3,835	
Cumulative Over/(Under)		$ 26,628	$ 25,577	$ 23,765	$ 26,137	$ 36,083	$ 45,181	$ 54,473	$ 64,594	$ 70,789	$ 75,414	$ 79,768	$ 83,603	

I. Technical Reference Manual

The technical reference manual for FY 2013 has been provided as a separate document.

Appendix I

Technical Reference Manual

Measure Savings Algorithms and Cost Assumptions

EnergySense

Your building, your savings.

PGW

May 1, 2012

Table of Contents

Prepared by: GreenEnergy EconomicsGroup

I. Residential Time of Replacement Market

A. Space Heating End Use

1) Efficient Space Heating System

Unique Measure Code(s): TBD
Draft date: 2/17/11
Effective date: TBD
End date: TBD

Measure Description
This measure applies to residential-sized gas furnaces and boilers purchased at the time of natural replacement. A qualifying furnace or boiler must meet minimum efficiency requirements (AFUE).

Definition of Baseline Condition
The efficiency levels of the gas-fired furnaces or boilers that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Baseline AFUE
Gas Furnace	80%
Gas Boiler	80%

Definition of Efficient Condition
The installed gas furnace or boiler must have an AFUE greater than that shown in the table below. Efficient model minimum AFUE requirements are detailed below.

Equipment Type	Minimum AFUE
Gas Furnace	94%
Gas Furnace with ECM Fan	94%
Gas Boiler	94%

Gas Savings Algorithms
MMBtu savings are realized due to the increase in AFUE of the new equipment. MMBtu savings vary by equipment type due to differences in model specific baseline AFUE and high efficiency AFUE percentages. Savings are calculated from the baseline new unit to the installed efficient unit.

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{Capacity_{Out}}{1{,}000} \times \left(\frac{1}{AFUE_{Base}} - \frac{1}{AFUE_{Eff}}\right) \times EFLH_{Heat}$$

$$EFLH_{Heat} = \frac{HDD \times 24}{Dt} = \frac{4{,}033 \times 24}{70} = 1{,}383$$

Where:

$Capacity_{Out}$ = Output capacity of equipment to be installed (kBtu/hr)

1,000	= Conversion from kBtu to MMBtu
$AFUE_{Base}$	= Efficiency of new baseline equipment (Annual Fuel Utilization Efficiency)
$AFUE_{Eff}$	= Efficiency of new equipment
$EFLH_{Heat}$	= Equivalent Full Load Heating Hours
HDD	= Base 63° F Heating Degree Days for Philadelphia = 4,033[1]
Dt	= Design temperature difference (assume from 0° F to 70° F)

Electric Savings Algorithms

Electric energy savings result from efficient furnace fans (ECM) that may be included with efficient furnaces. Electrical savings from fan motor efficiency does not apply to boilers.

Energy Savings

$\Delta kWh = 700\ kWh$

Demand Savings

$\Delta kW = 0\ kW$

Where:

ΔkWh	=	Gross customer annual kWh savings for the measure. Based on 500 kWh heating season plus 200 kWh cooling season.
ΔkW	=	Gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Gas Furnace	0%	0%
Gas Furnace with ECM Fan	0%	0%
Gas Boiler	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Furnaces	20
Gas Boilers	25

Source: Lifetime estimates used by Efficiency Vermont.

Measure Cost

The measure cost is the incremental cost of the efficient equipment compared to the baseline equipment. An additional $500 is assumed for the installation of direct venting required for condensing furnaces and boilers.

[1] Based on NCDC ASOS temperature data for PHL from 2002 through 2009.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

2) Programmable Thermostat

Unique Measure Code(s): TBD
Draft date: 2/17/11
Effective date: TBD
End date: TBD

Measure Description
This is a programmable thermostat controlling a residential-sized gas furnace or boiler.

Definition of Baseline Condition
The baseline is a manual thermostat where each temperature setting change requires human intervention.

Definition of Efficient Condition
The efficient thermostat is one that can be programmed to automatically increase or lower the temperature setting at different times of the day and week.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = SH_{pre} \times 5.3\% = (81 - 30) \times 5.3\% = 1.53\ MMBtu$$

Where:

SH_{pre} = Space Heat MMBtu gas usage with manual thermostat
5.3% = Percentage savings from programmable thermostat compared to manual thermostat[2]
81 = Typical PGW residential heating customer total gas usage in MMBtu.
30 = Non-space-heat gas usage in typical residence.[3]

Electric Savings Algorithms

If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[4]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons, but these auxiliary savings are not accounted for in the following algorithms.

Energy Savings
$\Delta kWh = \Delta kWh_{Aux} + \Delta kWh_{Cool}$

[2] Percent savings from CWP evaluations of ECA thermostat installations.
[3] Non-space-heat usage assumption in New Jersey Clean Energy Program Protocols (December 2009).
[4] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

ΔkWh_{Aux} = $Annual\ Gas\ Savings\ (MMBtu) \times Auxiliary$

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= 0 if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = CAP_{COOL} \times \left(\frac{12{,}000 \frac{Btu}{ton} \times \frac{1}{1{,}000} \frac{kWh}{Wh}}{EER_{COOL} \times Eff_{duct}} \right) \times EFLH \times ESF_{COOL}$$

Deemed Savings:
$\Delta kWh = \Delta kWh_{aux} + \Delta kWh_{CAC}\ (missing) = 7.7 + 77.1 = 84.8\ kWh$

$\Delta kWh_{aux} = 1.53 \times 5.02 = 7.7$

$$\Delta kWh_{CAC}\ (missing) = 83\% \times \Delta kWh_{CAC} = 83\% \times 3 \times \left(\frac{12}{10 \times 0.8}\right) \times 1032 \times 0.02 = 77.1$$

Demand Savings
ΔkW = 0 kW

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.
CAP_{COOL} = *capacity of the air conditioning unit in tons, based on nameplate capacity (see table below)*

EER_{COOL} = *Seasonally averaged efficiency rating of the baseline unit . (see table below)*

Eff_{duct} = *duct system efficiency (see table below)*

ESF_{COOL} = *energy savings factor for cooling and heating, respectively (see table below)*

$EFLH$ = *equivalent full load hours*

Residential Electric HVAC Calculation Assumptions

Component	Type	Value	Sources
CAP_{COOL}	Variable	Nameplate data	Contractor Data Gathering
		Default: 3 tons	1
EER_{COOL}	Variable	Nameplate data	Contractor Data Gathering
		Default: Cooling = 10 SEER Default: Heating = 1.0 (electric furnace COP)	2
Eff_{duct}	Fixed	0.8	3
ESF_{COOL}	Fixed	2%	4
EFLH	Fixed	Philadelphia Cooling = 1,032 Hours	5

Sources:

1. Average size of residential air conditioner.
2. Minimum Federal Standard for new Central Air Conditioners/Heat Pumps between 1990 and 2006.
3. New York Standard Approach for Estimating Energy Savings from Energy Efficiency Measures in Commercial and Industrial Programs, September 1, 2009.
4. DEER 2005 cooling savings for climate zone 16, assumes a variety of thermostat usage patterns.
5. US Department of Energy, ENERGY STAR Calculator. Accessed 3/16/2009.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Programmable Thermostat	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Programmable Thermostat	15

Source: New Jersey Clean Energy Program Protocols (December 2009).

Measure Cost

The measure cost is the cost of the programmable thermostat.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

B. Water Heating End Use

1) Tankless Water Heater

Unique Measure Code(s): TBD
Draft date: 1/12/11
Effective date: TBD
End date: TBD

Measure Description
This measure is an on-demand gas water heater.

Definition of Baseline Condition
The efficiency levels of the gas-fired furnaces or boilers that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Baseline EF
Gas Stand-alone Storage Water Heater	0.60

Source: Getting Into Hot Water, by Cindy Baldhoff.

Definition of Efficient Condition
The installed tankless water heater must have an EF greater than that shown in the table below. Efficient model minimum EF requirements are detailed below.

Equipment Type	Minimum EF
Gas Tankless Water Heater	0.82

Gas Savings Algorithms
The following formula for gas savings is based on the DOE test procedure for water heaters.

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{\left(\frac{1}{EF_{Base}} - \frac{1}{EF_{Eff}}\right) \times 41{,}045 \times 365}{1{,}000{,}000}$$

Where:

EF_{Base} = Energy Factor of baseline water heater = 0.60
EF_{Eff} = Energy Factor of efficient water heater

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
ΔkWh = 0 kWh

Demand Savings
ΔkW = 0 kW

Where:

ΔkWh	= gross customer annual kWh savings for the measure.
ΔkW	= gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Tankless Water Heater	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Tankless Water Heater	20

Source: Energy Star Residential Water Heaters: Final Criteria Analysis, April 1, 2008, p. 10.

Measure Cost

The measure cost is the incremental cost of the efficient equipment compared to the baseline equipment. The cost for tankless water heater is expected to decline in the future, so the cost should be revisited each year.[5] The cost is currently estimated at $1,779.[6] The baseline cost for a stand-alone storage water heater is estimated as $900.[7] The incremental cost is therefore currently $879.

O&M Cost Adjustments

It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings

There are no water savings for this measure.

[5] Tankless Gas Water Heaters: Oregon Market Status, December 6, 2005

[6] Federal Register, Part III, Department of Energy, 10 CFR Part 430, Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters; Final Rule, April 16, 2010. p. 20114

[7] Energy Star Residential Water Heaters: Final Criteria Analysis, April 1, 2008, p. 10. Average of cost for EF 0.575 and EF 0.62.

II. Residential New Construction

A. All End Uses

1) Custom Measures

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure applies to all custom measures, not otherwise specified in this TRM.

Definition of Baseline Condition
The baseline represents the typical equipment that is installed without a DSM program. The efficiency level is based on the current Federal standards, or state and local building codes that are applicable.

Definition of Efficient Condition
The efficient measure is any equipment that uses less energy than the baseline equipment.

Gas Savings Algorithms
The generalized equation for a custom measure compares the baseline usage to the efficient usage.

$$Annual\ Gas\ Savings\ (MMBtu) = BaselineUse - EfficientUse$$

Where:

BaselineUse = The gas usage of baseline equipment or building.

EfficientUse = The gas usage of efficient equipment or building.

Electric Savings Algorithms

Energy Savings
$\Delta kWh = BaselinekWh - EfficientkWh$

Demand Savings
$\Delta kW = BaselinekW - EfficientkW$

Where:

ΔkWh = Gross customer annual kWh savings for the measure.

ΔkW = Gross customer summer load kW savings for the measure.

BaselinekWh = The electric kWh usage of baseline equipment or building.

EfficientkWh = The electric kWh usage of efficient equipment or building.

BaselinekW	=	The electric kW usage of baseline equipment or building.
EfficientkW	=	The electric kW usage of efficient equipment or building.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Custom Measure	0%	0%

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
Where available, custom measure lifetimes should be based on similar measures defined elsewhere in this TRM.

Measure Cost
The measure cost is the incremental cost of the efficient equipment compared to the baseline equipment.

O&M Cost Adjustments
Any O&M cost differences between the new efficient and baseline equipment should be accounted for.

Water Savings
The water savings are the difference between the baseline and efficient equipment annual water usage in gallons.

III. Residential Retrofit Market (Non-Low Income)

A. Space Heating End Use

1) Efficient Space Heating System

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure applies to residential-sized high-efficiency gas furnaces and boilers replacing an existing and functioning furnace or boiler of lower efficiency.

Definition of Baseline Condition
The efficiency levels (AFUE) of existing and functioning gas-fired furnaces or boilers. If the manufacturer's rated AFUE is available use it in the savings calculations. If the manufacturer's rated AFUE is not available, then calculate the existing heating system AFUE by multiplying the measured Steady State Efficiency by the appropriate multipliers in the following table:

Distribution Type	System Type	Default Multiplier
Air	Forced Air	1.0
	Gravity Feed	0.8
	Freestanding Heater	0.95
	Floor Furnace	0.9
	Wall Furnace	0.85
Water	Force Circulation (high mass)	0.85
	Force Circulation (low mass)	0.9
	Gravity Feed	0.85
	Steam	0.75

Source: Building Performance Institute, Technical Standards for the Heating Professional, Revision 11/20/07, p.6.

Definition of Efficient Condition
The installed gas furnace or boiler must have an AFUE greater than the baseline condition.

Gas Savings Algorithms
MMBtu savings are realized due to the increase in AFUE of the new equipment. MMBtu savings vary by equipment type due to differences in model-specific baseline AFUE and high efficiency AFUE percentages. Savings are calculated from the baseline existing unit to the installed efficient unit.

$$Annual\ Gas\ Savings\ (MMBtu) = HeatingUse \times \left(1 - \frac{AFUE_{Base}}{AFUE_{Eff}}\right)$$

Where:

HeatingUse	=	Annual heating use (MMBtu/yr) from weather normalized usage analysis of customer billing data from pre-treatment period. See description below.
$AFUE_{Base}$	=	Efficiency of existing baseline equipment (Annual Fuel Utilization Efficiency)
$AFUE_{Eff}$	=	Efficiency of new efficient equipment

Heating Use weather normalization methods (HeatingUse):

Method 1: Use a linear regression model of use/day as a function of HDD63[8]/day to estimate heating slope (MMbtu/HDD63) and baseload daily use (MMBtu/day) with an annual HDD63 of 4033[9] to calculate annual heating load.

Method 2: Calculate baseload (MMBtu/day) as the third lowest MMBtu/day bill for the analysis year. Then calculate raw heating use as the sum of monthly billed use minus the – baseload * sum(monthly bill elapsed days), then calculate weather adjusted heating use as raw heating use * (4033/HDD63actual).

Electric Savings Algorithms

Electric energy savings result from efficient furnace fans (ECM) that may be included with efficient furnaces. Electrical savings from fan motor efficiency does not apply to boilers.

Energy Savings
$\Delta kWh = 700\ kWh$

Demand Savings
$\Delta kW = 0\ kW$

Where:

ΔkWh	=	Gross customer annual kWh savings for the measure. Based on 500 kWh heating season plus 200 kWh cooling season.
ΔkW	=	Gross customer summer load kW savings for the measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Gas Furnace	0%	0%
Gas Furnace with ECM Fan	0%	0%
Gas Boiler	0%	0%

[8] Heating degree days are calculated using base 63°F, which was selected, based on variable-base degree day regressions of billing data from CWP participants over the past several years. This value is higher than found for many non-low income populations in similar climates and likely reflects the low efficiency of the low income housing stock and also the targeting of high users by CWP. The use of this HDD base eliminates the need for the degree day correction factor found in some similar calculations that use HDD65.
[9] This value of 4033 HDD63 is the average from NWS data for PHL for the years 2002 through 2009.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Furnaces	20
Gas Boilers	25

Source: Lifetime estimates used by Efficiency Vermont.

Measure Cost
The measure cost is the full cost of installing the efficient equipment, including labor and for the installation of direct venting required for condensing furnaces and boilers.

O&M Cost Adjustments
Any O&M cost differences between the new efficient and existing baseline equipment should be accounted for.

Water Savings
There are no water savings for this measure.

2) Infiltration Reduction

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This involves decreasing the amount of air exchange between the inside and outside of the house by sealing the sources of leaks, while maintaining minimum air exchange for air quality.

Definition of Baseline Condition
The baseline is the house in its pre-treatment condition, with opportunities for infiltration reductions.

Definition of Efficient Condition
Any decrease in infiltration will reduce energy consumption compared to the pre-treated house.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{HDD_t \times 24 \times (CFM50_{pre} - CFM50_{post})}{(21.5 \times AFUE \times 1{,}000{,}000)}$$

Where:

HDD_t = Heating degree days at temperature t, where t=63°F if no programmable thermostat has been installed and t=62°F if a programmable thermostat has been installed. From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820.

24 = hours/day

$CFM50_{pre}$ = CFM50 of building shell leakage as measured by a blower door test before treatment.

$CFM50_{post}$ = CFM50 of building shell leakage as measured by a blower door test after treatment.

21.5 = factor to convert CFM50 value to Btu/hrF heat loss rate, calculated from hourly infiltration modeling[10]

AFUE = rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the air sealing work.

Electric Savings Algorithms

If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[11]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons.

Energy Savings

$\Delta kWh = \Delta kWh_{Aux} - \Delta kWh_{Cool}$

$\Delta kWh_{Aux} = \mathit{Annual\ Gas\ Savings\ (MMBtu)} \times \mathit{Auxiliary}$

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} *if house has central air conditioning*
= ΔkWh_{RAC} if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = \frac{CDD \times 24 \times DUA \times (CFM50_{pre} - CFM50_{post})}{\left(21.5 \times SEER_{CAC} \times 1000 \frac{W}{kW}\right)}$$

$$\Delta kWh_{RAC} = \frac{CDD \times 24 \times DUA \times F_{Room\,AC} \times (CFM50_{pre} - CFM50_{post})}{\left(21.5 \times \overline{EER}_{RAC} \times 1000 \frac{W}{kW}\right)}$$

Demand Savings

ΔkW = 0 kW if house has no air conditioning
= ΔkW_{CAC} if house has central air conditioning
= ΔkW_{RAC} if house has room air conditioning

$$\Delta kW_{CAC} = \frac{\Delta kWh_{CAC}}{EFLH_{cool}} \times CF_{CAC}$$

$$\Delta kW_{RAC} = \frac{\Delta kWh_{RAC}}{EFLH_{cool\,RAC}} \times CF_{RAC}$$

Where:

[10] An hourly infiltration was calculated using a modified version of the LBL (a.k.a. Sherman-Grimsrud) infiltration model with a wind effect modification (EPRI RP 2034-40, Palmiter and Bond 1991) using Philadelphia TMY2 hourly weather data. This analysis result was then adjusted to account for an assumed party wall leakage fraction of 12% and an estimated 10% thermal regain from infiltration/exfiltratiom. The resulting value of 21.5 is consistent with statistical analyses of empirical data using CFM50 values and actual gas use and savings from CWP evaluations.

[11] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.

Auxiliary = *Heating system auxiliary usage per MMBTU consumption (5.02 From Vermont Technical Reference Manual)*

CDD = *Cooling Degree Days (Degrees F * Days)HDD*

DUA = *Discretionary Use Adjustment to account for the fact that people do not always operate their air conditioning system when the outside temperature is greater than 65F.*

$SEER_{CAC}$ = *Seasonal Energy Efficiency Ratio of existing home central air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

$\overline{EER}_{RAC}$ = *Average Energy Efficiency Ratio of existing room air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

CF_{CAC} = *Demand Coincidence Factor for central AC systems (See table below)*

CF_{RAC} = *Demand Coincidence Factor for Room AC systems (See table below)*

$EFLH_{cool}$ = *Equivalent Full Load Cooling hours for Central AC and ASHP (See table below)*

$EFLH_{cool\ RAC}$ = *Equivalent Full Load Cooling hours for Room AC (See table below)*

$F_{Room\ AC}$ = *Adjustment factor to relate insulated area to area served by Room AC units*

The default values for each term are shown in the table below.

Default values for algorithm terms, Ceiling/Attic and Wall Insulation

Term	Type	Value	Source
DUA	Fixed	0.75	OH TRM[12]
$SEER_{CAC}$	Variable	Default values: Early Replacement = 10 Replace on Burnout = 13	PUC Technical Reference Manual
		Nameplate	Contractor Data Gathering
$\overline{EER}_{RAC}$	Variable	*Default = 9.8*	*DOE Federal Test Procedure 10 CFR 430,* Appendix F (Used in ES Calculator for baseline)
		Nameplate	Contractor Data Gathering
CF_{CAC}	Fixed	0.70	PUC Technical Reference Manual

[12] "State of Ohio Energy Efficiency Technical Reference Manual," prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation. August 6, 2010.

Term	Type	Value	Source
CF_{RAC}	Fixed	0.58	PUC Technical Reference Manual
$F_{Room,AC}$	Fixed	0.38	Calculated[13]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[14]	$EFLH_{cool\ RAC}$ (Hours)[15]	CDD (Base 65)[16]	HDD (Base 65)[17]
Philadelphia	1032	320	1235	4759

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Measure	Free Ridership	Spillover
Infiltration Reduction	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Measure	Measure Lifetime
Infiltration Reduction	20

Source: NYSERDA Home Performance with Energy Star.

Measure Cost

The measure cost is the material and labor cost for reducing air leakage.

O&M Cost Adjustments

It is assumed that there are no O&M cost differences between the efficient and baseline condition, other than energy usage.

Water Savings

There are no water savings for this measure.

3) Roof and Cavity Insulation

[13] From PECO baseline study, average home size = 2323 ft^2, average number of room AC units per home = 2.1. Average Room AC capacity = 10,000 BtuH per ENERGY STAR Room AC Calculator, which serves 425 ft^2 (average between 400 and 450 ft^2 for 10,000 BtuH unit per ENERGY STAR Room AC sizing chart). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$

[14] PA 2010 TRM Table 2-1.

[15] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement

[16] Climatography of the United States No. 81. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000, 36 Pennsylvania. NOAA. http://cdo.ncdc.noaa.gov/climatenormals/clim81/PAnorm.pdf

[17] Ibid.

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This involves increasing the insulation levels in either the roof or cavities.

Definition of Baseline Condition
The baseline is amount of insulation in the house in its pre-treatment condition.

Definition of Efficient Condition
Any increase in insulation will reduce energy consumption compared to the pre-treated house.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{HDD_t \times 24 \times AREA \times \left({}^{1}/_{R_{pre}} - {}^{1}/_{R_{post}} \right)}{(AFUE \times 1{,}000{,}000)}$$

Where:

HDD_t	=	Heating degree days at temperature t, where t=63°F if no programmable thermostat has been installed and t=62°F if a programmable thermostat has been installed[18].
24	=	Hours per day
AREA	=	Net insulated area in square feet. Estimated at 85% of gross area for cavities.
R_{pre}	=	R value of roof/cavity pre-treatment. R_{pre} = 5 unless there is existing insulation.
R_{post}	=	R value of roof/ cavity after insulation is installed.
AFUE	=	Rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the air sealing work.

Electric Savings Algorithms
If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[19]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons.

Energy Savings
$\Delta kWh = \Delta kWh_{Aux} + \Delta kWh_{Cool}$

$\Delta kWh_{Aux} = Annual\ Gas\ Savings\ (MMBtu) \times Auxiliary$

[18] From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820
[19] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= ΔkWh_{RAC} if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = \frac{CDD \times 24\frac{hr}{day} \times DUA}{SEER_{CAC} \times 1000\frac{W}{kW}} \times \left[AREA \times \left(\frac{1}{R_{pre}} - \frac{1}{R_{post}}\right)\right]$$

$$\Delta kWh_{RAC} = \frac{CDD \times 24\frac{hr}{day} \times DUA \times F_{Room\ AC}}{\overline{EER}_{RAC} \times 1000\frac{W}{kW}} \times \left[AREA \times \left(\frac{1}{R_{pre}} - \frac{1}{R_{post}}\right)\right]$$

Demand Savings

ΔkW = 0 kW if house has no air conditioning
= ΔkW_{CAC} if house has central air conditioning
= ΔkW_{RAC} if house has room air conditioning

$$\Delta kW_{CAC} = \frac{\Delta kWh_{CAC}}{EFLH_{cool}} \times CF_{CAC}$$

$$\Delta kW_{RAC} = \frac{\Delta kWh_{RAC}}{EFLH_{cool\ RAC}} \times CF_{RAC}$$

Where:

ΔkWh = gross customer annual kWh savings for the measure.

ΔkW = gross customer summer load kW savings for the measure.

Auxiliary = *Heating system auxiliary usage per MMBTU consumption (5.02 From Vermont Technical Reference Manual)*

CDD = *Cooling Degree Days (Degrees F * Days)HDD*

DUA = *Discretionary Use Adjustment to account for the fact that people do not always operate their air conditioning system when the outside temperature is greater than 65F.*

$SEER_{CAC}$ = *Seasonal Energy Efficiency Ratio of existing home central air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

$\overline{EER}_{RAC}$ = *Average Energy Efficiency Ratio of existing room air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

CF_{CAC} = *Demand Coincidence Factor for central AC systems (See table below)*

CF_{RAC} = *Demand Coincidence Factor for Room AC systems (See table below)*

$EFLH_{cool}$ = *Equivalent Full Load Cooling hours for Central AC and ASHP (See table below)*

$EFLH_{cool\ RAC}$ = *Equivalent Full Load Cooling hours for Room AC (See table below)*

$F_{Room\ AC}$ = *Adjustment factor to relate insulated area to area served by Room AC units*

The default values for each term are shown in the table below.

Default values for algorithm terms, Ceiling/Attic and Wall Insulation

Term	Type	Value	Source
DUA	Fixed	0.75	OH TRM[20]
$SEER_{CAC}$	Variable	Default values: Early Replacement = 10 Replace on Burnout = 13	PUC Technical Reference Manual
		Nameplate	Contractor Data Gathering
$\overline{EER}_{RAC}$	Variable	Default = 9.8	DOE Federal Test Procedure 10 CFR 430, Appendix F (Used in ES Calculator for baseline)
		Nameplate	Contractor Data Gathering
CF_{CAC}	Fixed	0.70	PUC Technical Reference Manual
CF_{RAC}	Fixed	0.58	PUC Technical Reference Manual
$F_{Room,AC}$	Fixed	0.38	Calculated[21]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[22]	$EFLH_{cool\ RAC}$ (Hours)[23]	CDD (Base 65)[24]	HDD (Base 65)[25]
Philadelphia	1032	320	1235	4759

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Measure	Free Ridership	Spillover
Insulation	0%	0%

Persistence

The persistence factor is assumed to be one.

[20] "State of Ohio Energy Efficiency Technical Reference Manual," prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation. August 6, 2010.

[21] From PECO baseline study, average home size = 2323 ft^2, average number of room AC units per home = 2.1. Average Room AC capacity = 10,000 BtuH per ENERGY STAR Room AC Calculator, which serves 425 ft^2 (average between 400 and 450 ft^2 for 10,000 BtuH unit per ENERGY STAR Room AC sizing chart). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$

[22] PA 2010 TRM Table 2-1.

[23] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement

[24] Climatography of the United States No. 81. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000, 36 Pennsylvania. NOAA. http://cdo.ncdc.noaa.gov/climatenormals/clim81/PAnorm.pdf

[25] Ibid.

Measure Lifetimes

Measure	Measure Lifetime
Roof Insulation	40
Cavity Insulation	40

Source: NYSERDA Home Performance with Energy Star.

Measure Cost
The measure cost is the material and labor cost adding insulation.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline condition, other than energy usage.

Water Savings
There are no water savings for this measure.

4) Programmable Thermostat

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This is a programmable thermostat controlling a residential-sized gas furnace or boiler.

Definition of Baseline Condition
The baseline is a manual thermostat where each temperature setting change requires human intervention.

Definition of Efficient Condition
The efficient thermostat is one that can be programmed to automatically increase or lower the temperature setting at different times of the day and week.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = HeatingUse \times \left(1 - {HDD_{62}}/{HDD_{63}}\right) = HeatingUse \times 0.053$$
$$= 1.53\ MMBtu$$

Where:

HeatingUse = Annual heating use (MMBtu/yr) from weather normalized usage analysis of customer billing data from pre-treatment period (see description under heating system replacement). If thermostat measure is performed after shell measures of insulation or air sealing, then subtract the projected savings from those measures from the pre retrofit heating use.

HDD_{62} = 3820

The annual heating degree days based on 62°F, representing the estimated balance point temperature of the home with the programmable thermostat.

HDD_{63} = 4033

The annual heating degree days based on 63°F, representing the estimated balance point temperature of the home with the programmable thermostat.

An analysis of variable base degree day billing data from the CWP has found an average net reduction in balance point temperature of about 1.0°F for thermostat installations. Multiple impact evaluations have also found heating savings averaging about 5%-6% from thermostat installations. These two findings are consistent with each other and indicate an estimated average impact based on employing the approach from past CWP contractors to targeting customers and selecting homes to receive thermostats and the savings opportunities and compliance rates achieved. The savings may not be accurate when applied to different populations in different ways.

Electric Savings Algorithms

If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[26]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons, but these auxiliary savings are not accounted for in the following algorithms.

Energy Savings

$\Delta kWh = \Delta kWh_{Aux} + \Delta kWh_{Cool}$

$\Delta kWh_{Aux} = Annual\ Gas\ Savings\ (MMBtu) \times Auxiliary$

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= 0 if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = CAP_{COOL} \times \left(\frac{12{,}000 \frac{Btu}{ton} \times \frac{1}{1{,}000} \frac{kWh}{Wh}}{EER_{COOL} \times Eff_{duct}} \right) \times EFLH \times ESF_{COOL}$$

Demand Savings

$\Delta kW = 0\ kW$

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.
CAP_{COOL} = *capacity of the air conditioning unit in tons, based on nameplate capacity (see table below)*

[26] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doc.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

EER_{COOL} = *Seasonally averaged efficiency rating of the baseline unit . (see table below)*

Eff_{duct} = *duct system efficiency (see table below)*

ESF_{COOL} = *energy savings factor for cooling and heating, respectively (see table below)*

EFLH = *equivalent full load hours*

Residential Electric HVAC Calculation Assumptions

Component	Type	Value	Sources
CAP_{COOL}	Variable	Nameplate data	Contractor Data Gathering
		Default: 3 tons	1
EER_{COOL}	Variable	Nameplate data	Contractor Data Gathering
		Default: Cooling = 10 SEER Default: Heating = 1.0 (electric furnace COP)	2
Eff_{duct}	Fixed	0.8	3
ESF_{COOL}	Fixed	2%	4
EFLH	Fixed	Philadelphia Cooling = 1,032 Hours	5

Sources:

6. Average size of residential air conditioner.
7. Minimum Federal Standard for new Central Air Conditioners/Heat Pumps between 1990 and 2006.
8. New York Standard Approach for Estimating Energy Savings from Energy Efficiency Measures in Commercial and Industrial Programs, September 1, 2009.
9. DEER 2005 cooling savings for climate zone 16, assumes a variety of thermostat usage patterns.
10. US Department of Energy, ENERGY STAR Calculator. Accessed 3/16/2009.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Programmable Thermostat	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Programmable Thermostat	15

Source: New Jersey Clean Energy Program Protocols (December 2009).

Measure Cost
The measure cost is the cost of the programmable thermostat.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

5) Duct Work Insulation

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to installing insulation on ducts in unconditioned spaces.

Definition of Baseline Condition
The baseline condition is assumed to be a bare steel duct.

Definition of Efficient Condition
The efficient condition is the duct with insulation installed.

Water Savings Algorithms
This measure has no water savings associated with it.

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{AFUE \times 1{,}000{,}000}$$

Where:

Length = Number of linear feet of duct work insulated

Th_{base} = Thickness of base condition insulation (inches)

Th_{eff} = Thickness of efficient condition insulation (inches)

HeatLoss(x) = Heat loss through duct work as a function of insulation thickness x (Btu/ft /yr)

AFUE = Rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the duct work insulation.

"HeatLoss(x)" can be found using the following lookup table.

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr
Bare	1,120,000
0.25	339,500
0.5	205,300
0.75	190,700
1	128,300
1.5	93,970
2	74,370
2.5	61,620
3	52,650
3.5	45,990
4	40,830

This table was calculated using the North American Insulation Manufacturers Association's (NAIMA) 3E Plus 4.0 Insulation Thickness Computer Program. The following assumptions were used.

Item Description	=	bare duct
Calculation Type	=	Heat Loss Per Year Report
Geometry Description	=	Steel Duct - Rectangular Horz.
System Units	=	ASTM C585
Bare Surface Emittance	=	0.8
Process Temperature	=	140 °F
Ave. Ambient Temperature	=	41.8 °F[27]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Condensation Control Thickness	=	N/A
Hours Per Year	=	2000[28]
Outer Jacket Material	=	Aluminum, oxidized, in service
Outer Surface Emittance	=	0.1
Insulation Layer 1	=	Duct Wrap, 1.0 pound per cubic foot, C1290,
Duct Horiz Dimension	=	12 in.
Duct Vert Dimension	=	8 in.

Electric Savings Algorithms

No electric savings are currently claimed for this measure.

[27] Average winter temperature for Philadelphia from "Cost Savings and Comfort for Existing Buildings", 3rd Edition, by John Krigger, Saturn Resource Management. Page 255.

[28] Low end of 2,000 – 2,500 winter heating load hours from Air-conditioning and Refrigeration Institute. http://www.waterfurnace.ca/Engineer/Misc%20References/ARI%20Cooling%20&%20Heating%20Load%20Hours%20Map.pdf

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to 18 years[29].

Measure Cost
The measure cost is the actual cost of installing the insulation, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

6) Heating Pipe Insulation

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to installing insulation on steam pipes used for space heating.

Definition of Baseline Condition
The baseline condition is the current insulation thickness on a space heating hot water or steam pipe.

Definition of Efficient Condition
The efficient condition is any insulation thicker than that already on the pipe.

Water Savings Algorithms
This measure has no water savings associated with it.

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{AFUE \times 1{,}000{,}000}$$

Where:

Length	=	Number of linear feet of steam pipe insulated
Th_{base}	=	Thickness of base condition insulation (inches)
Th_{eff}	=	Thickness of efficient condition insulation (inches)
HeatLoss(x)	=	Heat loss through steam pipe as a function of insulation thickness x (Btu/ft /yr)
AFUE	=	Rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the duct work insulation.

[29] NYSERDA Home Performance with Energy Star

"HeatLoss(x)" can be found using the following lookup table.

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr
Bare	2,006,040
1	413,822
1.25	370,898
1.5	327,974
1.75	307,564
2	279,882
2.5	250,098
3	228,724
3.5	212,430
4	198,151

This table was calculated using the North American Insulation Manufacturers Association's (NAIMA) 3E Plus 4.0 Insulation Thickness Computer Program. The following assumptions were used.

Item Description	=	steam pipe insulation
Calculation Type	=	Personnel Protection Report
Geometry Description	=	Steel Pipe - Horizontal
System Units	=	ASTM C585
Bare Surface Emittance	=	0.8
Nominal Pipe Size	=	2 in.
Process Temperature	=	212 °F
Ave. Ambient Temperature	=	60 °F[30]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Personnel Protection Thickness	=	Bare
Outer Jacket Material	=	Iron or Steel
Outer Surface Emittance	=	0.8
Insulation Layer 1	=	High Temp Fiber Blanket, Gr 6, C892-05, Varied

Electric Savings Algorithms
There are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to be 20 years[31].

[30] Temperature of unconditioned basement.
[31] NYSERDA Home Performance with Energy Star

Measure Cost
The measure cost is the actual cost of installing the insulation, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

B. Domestic Hot Water End Use

1) Low Flow Showerhead

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to the installation of a low flow showerhead in a home. This is a retrofit direct install measure.

Definition of Baseline Condition
The baseline is the flow rate of the showerhead being replaced. If this is not available a baseline value of 2.5 GPM will be used.

Definition of Efficient Condition
The flow rate of the efficient showerhead should be greater than the flow rate of the baseline condition. If this value is not available it is assumed to be 1.5 GPM[32].

Water Savings Algorithms
The water savings for low flow showerheads are due to the reduced amount of water being used per shower.

$$\Delta Gallons = \frac{\left(\frac{GPM_{base} - GPM_{eff}}{GPM_{base}}\right) \times 2.48 \times 11.6 \times 365}{1.6}$$

Where:

$\Delta Gallons$	=	Gallons of water saved
GPM_{base}	=	Maximum gallons per minute of baseline showerhead. Default = 2.5 GPM if measured rate is not available[33]
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[34]
11.6	=	Average gallons of water per person per day used for showering[35]
365	=	Days per year
1.6	=	Average number of showers per home[36]

Natural Gas Savings Algorithms

[32] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[33] The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)
[34] Pennsylvania, Census of Population, 2000.
[35] Most commonly quoted value of gallons of water used per person per day (including in U.S. Environmental Protection Agency's "water sense" documents; http://www.epa.gov/watersense/docs/home_suppstat508.pdf)
[36] Estimate based on review of a number of studies:

a) Pacific Northwest Laboratory; "Energy Savings from Energy-Efficient Showerheads: REMP Case Study Results, Proposed Evaluation Algorithm, and Program Design Implications" http://www.osti.gov/bridge/purl.cover.jsp;jsessionid=80456EF00AAB94DB204E848BAE65F199?purl=/10185385-CEkZMk/native/
b) East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf

Gas energy savings result from avoiding having to heat the saved water due to the efficient showerhead.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times (105 - 55)] / 1{,}000{,}000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs.)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
105	=	Assumed temperature of water coming out of showerhead (degrees Fahrenheit)
55	=	Assumed temperature of water entering house (degrees Fahrenheit)[37]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[38]

Electric Savings Algorithms
It is assumed that all low flow showerheads installed under PGW's ELIRP program are installed in homes that heat water using natural gas. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a low flow showerhead is assumed to be 9 years[39].

Measure Cost
The measure cost is the actual cost of installing the new showerhead, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

2) Low Flow Faucet Aerators

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to the installation of a low flow faucet aerator in either a kitchen or bathroom.

[37] A good approximation of annual average water main temperature is the average annual ambient air temperature. Average water main temperature = 55° F based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[38] Review of AHRI Directory suggests range of recovery efficiency ratings for new Gas DHW units of 70-87%. The average of existing units is estimated at 75% by the Northeast Energy Efficiency Partnerships' Mid-Atlantic Technical Reference Manual Version 1.1 (October 2010).
[39] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

Definition of Baseline Condition
The baseline is the flow rate of the existing faucet. If this is not available, it is generally assumed that a faucet will already have a standard faucet aerator using 2.2 GPM.

Definition of Efficient Condition
The efficient condition is a faucet aerator that has a flow rate lower than the baseline condition. If this value is not available than the flow rate is assumed to be 1.5 GPM[40].

Water Savings Algorithms
The water savings for low flow faucet aerators are due to the reduced amount of water being used per minute that flows down the drain (instead of being collected in the sink).

$$\Delta Gallons = \frac{\left(\frac{GPM_{base} - GPM_{eff}}{GPM_{base}}\right) \times 2.48 \times 10.9 \times 365 \times 50\%}{3.5}$$

Where:

$\Delta Gallons$	=	Gallons of water saved
GPM_{base}	=	Gallons per minute of baseline showerhead = 2.2 GMP[41]
GPM_{eff}	=	Gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[42]
10.9	=	Average gallons per day used by faucet[43]
365	=	Days per year
50%	=	Drain rate, the percentage of water flowing down the drain[44]
3.5	=	Average Number of Faucets per home[45]

Natural Gas Savings Algorithms
Gas energy savings result from avoiding having to heat the saved water due to the efficient showerhead.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times 25] / 1{,}000{,}000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs.)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
25	=	The difference between the temperature of the water entering the house and the temperature leaving the faucet (degrees Fahrenheit).[46]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[47]

[40] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[41] Public Service Commission of Wisconsin Focus on Energy Evaluation Default Deemed Savings Review, June 2008. http://www.focusonenergy.com/files/Document_Management_System/Evaluation/acesdeemedsavingsreview_evaluationreport.pdf
[42] Pennsylvania, Census of Population, 2000.
[43] Most commonly quoted value of gallons of water used per person per day (including in U.S. Environmental Protection Agency's "water sense" documents; http://www.epa.gov/watersense/docs/home_suppstat508.pdf)
[44] Estimate consistent with Ontario Energy Board. "Measures and Assumptions for Demand Side Management Planning."
[45] East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf
[46] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[47] See assumption for low flow shower head.

Electric Savings Algorithms
It is assumed that all faucet aerators installed under PGW's ELIRP program are installed in homes that heat water using natural gas. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a faucet aerator is assumed to be 12 years[48].

Measure Cost
The measure cost is the actual cost of installing the new faucet aerator, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

3) Efficient Natural Gas Water Heater

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to an efficient natural gas water heater.

Definition of Baseline Condition
The baseline is the energy factor (EF) of the existing water heater. If possible, the EF of the existing water heater should be used. If the EF of the existing water heater is unknown, 0.575 should be used[49].

Definition of Efficient Condition
The efficient condition is a natural gas water heater that is more energy efficient than the existing water heater.

Water Savings Algorithms
No water savings have been defined for this measure.

Natural Gas Savings Algorithms
MMBtu savings are realized due to the increase in efficiency factor (EF) of the new equipment. MMBtu savings vary by equipment type due to differences in model specific baseline EF and high efficiency EF percentages. Savings are calculated from the baseline new unit to the installed efficient unit. The following formula for gas savings is based on the DOE test procedure for water heaters.

$$\Delta MMBtu = \frac{\left(\frac{1}{EF_{base}} - \frac{1}{EF_{eff}}\right) \times 41{,}045 \times 365}{1{,}000{,}000}$$

[48] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[49] From Mass Save "Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures: 2011 Program Year – Plan Version." October 2010. Page 242.

Where:

EF_{base}	=	Energy Factor of baseline water heater
EF_{eff}	=	Energy Factor of efficient water heater
41,045	=	Factor used in DOE test procedure algorithm
365	=	Days in the year

Electric Savings Algorithms
It is assumed that all faucet aerators installed under PGW's ELIRP program are installed in homes that heat water using natural gas water. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a natural gas water heater is assumed to be 15 years[50].

Measure Cost
In a natural replacement scenario, the cost is the incremental cost of the efficient equipment over the baseline equipment. In a retrofit scenario, the measure cost is full equipment and labor costs.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

4) Hot Water Heater Tank Temperature Turn-down

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to lowering the thermostat setting on a natural gas hot water heater to 120° F, if the temperature is set higher.

Definition of Baseline Condition
The baseline is the temperature setting of the existing water heater. usually above 135° F

Definition of Efficient Condition
The efficient condition is the new setting point for the hot water heater, 120° F.

Water Savings Algorithms
No water savings have been defined for this measure.

Natural Gas Savings Algorithms
MMBtu savings arise from lower temperature setting that reduces the standby heat losses required to maintain the tanks temperature setting.

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[50] DEER values, updated October 10, 2008
http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

$$\Delta MMBtu = \frac{\frac{Area \times (T_{base} - T_{eff})}{R_{DHW}} \times \frac{8,760}{1,000,000}}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved gas per year
$Area$	=	Surface area of hot water heater (ft^2)
T_{base}	=	*Original temperature inside the tank (°F) = Assume 135 °F if no other* information provided
T_{eff}	=	New temperature inside the tank (°F) = Assume 120° F if no other information provided
R_{DHW}	=	R-value of the hot water heater (h °F ft^2/Btu) = 5.0[51]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[52]
1,000,000	=	Btu to MMBtu

The following table provides surface areas based on the number of gallons the water tank can hold, along with deemed savings values using the assumptions above.

Water Heater Size (Gal)	Height (Inches)*	Diameter (Inches)*	Total Surface Area (ft^2)	Annual Savings (MMBtu)
30	60	16	29.7	1.04
40	61	16.5	31.3	1.10
50	53	18	31.9	1.12
66	58	20	39.0	1.37
80	58	22	44.4	1.56

** From New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (October 15, 2010). Page 98*

Electric Savings Algorithms
There are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a natural gas water heater is assumed to be 2 years[53].

Measure Cost
In a natural replacement scenario, the cost is the incremental cost of the efficient equipment over the baseline equipment. In a retrofit scenario, the measure cost is full equipment and labor costs.

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[51] Calculated using the base conductive heat loss co-efficient and surface areas from: *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* (October 15, 2010). Page 98
[52] See assumption for low flow showerhead.
[53] Page 410. Vermont Technical Reference Manual and New Jersey Clean Energy Program Protocols

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

5) Repair Hot Water Leaks/Plumbing Repairs

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to repairing any leaks from hot water pipes.

Definition of Baseline Condition
The baseline condition is the amount of water leaking from the hot water pipe per minute.

Definition of Efficient Condition
The efficient condition is no hot water leaking from the hot water pipe.

Water Savings Algorithms
The water saved is the amount of water that is lost due to the leak. The following table provides the deemed water savings values for the most common types of leaks.

Leak Type	Amount per Minute	Gallons per Day
Slow Steady Drip	100 drips	14.4*
Fast Drip	200 drips	28.8*
Small Stream	1 cup (8 fl oz)	89.28

** A drip is assumed to be 0.0001 gallons*[54]

Natural Gas Savings Algorithms
Gas savings result from the avoided energy used to heat the water wasted from the leak.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times (120 - 55)] / 1{,}000{,}000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
120	=	Assumed temperature of hot water as it leaves the water heater and travels through the pipes.
55	=	Assumed temperature of water entering house (degrees Fahrenheit)[55]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[56]

[54] Figures provided to North Carolina's Dare County Water Department by the North Carolina Rural Water Association: http://www.darenc.com/water/Othsts/WtrLoss.htm (accessed June 23, 2011)
[55] A good approximation of annual average water main temperature is the average annual ambient air temperature. Average water main temperature = 55° F based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[56] See assumption for low flow showerhead.

The following table provides deemed gas savings values based on the deemed water savings, the algorithm outlined above, and the measure lives from below.

Leak Type	Savings (MMBtu)
Slow Steady Drip	0.87
Fast Drip	0.87
Small Stream	1.35

Electric Savings Algorithms
It is assumed that all leaks repaired are for homes that heat water using natural gas water. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The savings for repairing hot water leaks persist as long as the leak would not have otherwise been fixed. PGW assumes that a smaller leak will persist longer than a larger and more noticeable leak and has adjusted the following measure lifetimes to account for this.

Leak Type	Lifetime
Slow Steady Drip	12 weeks
Fast Drip	6 weeks
Small Stream	3 week

Measure Cost
The measure cost is the actual cost of repairing the leak, including parts and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

6) DHW Pipe Insulation

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure relates to installing insulation on hot water pipes.

Definition of Baseline Condition
The baseline condition is the current insulation thickness on the hot water pipe.

Definition of Efficient Condition
The efficient condition is any insulation thicker than that already on the hot water pipe.

Water Savings Algorithms
This measure has no water savings associated with it.

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{RE_{DHW} \times 1{,}000{,}000}$$

Where:

Length	=	Number of linear feet of steam pipe insulated
Th_{base}	=	Thickness of base condition insulation (inches)
Th_{eff}	=	Thickness of efficient condition insulation (inches)
HeatLoss(x)	=	Heat loss through hot water pipe as a function of insulation thickness x (Btu/ft /yr)
RE_{DHW}	=	Recovery efficiency of the hot water heater = 75%[57]

"HeatLoss(x)" can be found using the following lookup table.

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr
Bare	267,881
3/8"	99,076
1/2"	86,636
5/8"	75,073
3/4"	71,482
7/8"	66,488
1"	62,722
1 1/2"	51,509
2"	45,815
2 1/2"	40,208
3"	37,843

This table was calculated using the North American Insulation Manufacturers Association's (NAIMA) 3E Plus 4.0 Insulation Thickness Computer Program. The following assumptions were used.

Item Description	=	DHW pipe insulation
Calculation Type	=	Personnel Protection Report
Geometry Description	=	Copper Pipe - Horizontal
System Units	=	ASTM C585
Bare Surface Emittance	=	0.6
Nominal Pipe Size	=	0.5 in.
Process Temperature	=	130 °F

[57] See assumption for low flow showerhead.

Ave. Ambient Temperature	=	60 °F
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Personnel Protection Thickness	=	Bare
Outer Jacket Material	=	Copper
Outer Surface Emittance	=	0.6
Insulation Layer 1	=	Polystyrene PIPE, Type XIII, C578-07, Varied

Electric Savings Algorithms
There are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to be 20 years[58].

Measure Cost
The measure cost is the actual cost of installing the insulation, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

7) Hot Water Storage Tank Wrap

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure refers to an insulating "blanket" that is wrapped around the outside of a hot water tank to reduce stand-by losses. The tank wrap must follow BPI technical standards:

> "Water heater insulation wraps shall not cover the top of oil or gas systems, and shall not obstruct the pressure relief valve, thermostats, hi-limit switch, plumbing pipes, or access plates. A minimum 2-inch clearance is required from the access door for gas burners.
>
> Water heater insulation wraps shall not be installed where forbidden by the manufacturer's instructions found on the nameplate."[59]

Definition of Baseline Condition
The baseline is the hot water heater tank without the insulating blanket.

[58] NYSERDA Home Performance with Energy Star
[59] Building Performance Institute, Inc. *Technical Standards for the Heating Professional.* Revised 11/20/07. Page 12.

Definition of Efficient Condition
The efficient condition is the hot water heater tank with the insulating blanket.

Water Savings Algorithms
There are no water savings due to this measure.

Natural Gas Savings Algorithms
Gas energy savings result from the reduction in standby losses.

$$\Delta MMBtu = \frac{\left(\frac{1}{R_{base}} - \frac{1}{R_{eff}}\right) \times Area \times (T_{tank} - T_{amb}) \times \frac{8,760}{1,000,000}}{RE_{DHW}}$$

Where:

$\Delta MMBtu$ = MMBtu of saved gas per year
R_{eff} = R-value of the hot water heater with the insulating blanket (h °F ft²/Btu)
R_{base} = Original R-value of the hot water heater (h °F ft²/Btu) = 5.0[60] unless *other information provided*
Area = Surface area of the hot water heater covered by the insulating blanket (ft²)
T_{tank} = Temperature inside the tank (°F) = Assume 120 °F if no other *information provided*
T_{amb} = Temperature outside the tank (°F) = 55 °F[61]
8,760 = Number of hours in a year
RE_{DHW} = Recovery efficiency of the domestic hot water heater = 75%[62]
1,000,000 = Btu to MMBtu

The following table provides assumed insulated surface areas and corresponding deemed savings values for standard tank insulation blankest

Water Heater Size (Gal)	Height (Inches)*	Diameter (Inches)*	Surface Area of Cylinder (ft²)	Surface Area of Accessed Areas (ft²)**	Surface are of Cylinder minus Accessed Areas (ft²)	R-10 Wrap Annual Savings (MMBtu)	R-19 Wrap Annual Savings (MMBtu)
30	60	16	20.9	0.4	20.5	1.6	2.3
40	61	16.5	22.0	0.4	21.5	1.6	2.4
50	53	18	20.8	0.4	20.4	1.5	2.3
66	58	20	25.3	0.4	24.9	1.9	2.8
80	58	22	27.8	0.4	27.4	2.1	3.1

** From New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (October 15, 2010). Page 98*
*** Assuming square access area with 4" square and 2" clearance on each side*

Electric Savings Algorithms

[60] Calculated using the base conductive heat loss co-efficient and surface areas from: *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* (October 15, 2010). Page 98
[61] Assumed to be in unconditioned space, ambient temperature assumption based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[62] See assumption for low flow showerhead.

This measure is assumed to be installed only on a natural gas fired hot water heating systems, so there are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to be 5 years[63].

Measure Cost
The measure cost is the actual cost of installing the hot water tank-wrap, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

[63] Northeast Energy Efficiency Partnerships. *Mid-Atlantic Technical Reference Manual (Version 1.1)*. October 2010

IV. Low Income Retrofit Market

A. Space Heating End Use

1) Efficient Space Heating System

Unique Measure Code(s): TBD
Draft date: 4/13/11
Effective date: TBD
End date: TBD

Measure Description
This measure applies to residential-sized high-efficiency gas furnaces and boilers replacing an existing and functioning furnace or boiler of lower efficiency.

Definition of Baseline Condition
The efficiency levels (AFUE) of existing and functioning gas-fired furnaces or boilers. If the manufacturer's rated AFUE is available use it in the savings calculations. If the manufacturer's rated AFUE is not available, then calculate the existing heating system AFUE by multiplying the measured Steady State Efficiency by the appropriate multipliers in the following table:

Distribution Type	System Type	Default Multiplier
Air	Forced Air	1.0
	Gravity Feed	0.8
	Freestanding Heater	0.95
	Floor Furnace	0.9
	Wall Furnace	0.85
Water	Force Circulation (high mass)	0.85
	Force Circulation (low mass)	0.9
	Gravity Feed	0.85
	Steam	0.75

Source: Building Performance Institute, Technical Standards for the Heating Professional, Revision 11/20/07, p.6.

Definition of Efficient Condition
The installed gas furnace or boiler must have an AFUE greater than the baseline condition.

Gas Savings Algorithms
MMBtu savings are realized due to the increase in AFUE of the new equipment. MMBtu savings vary by equipment type due to differences in model-specific baseline AFUE and high efficiency AFUE percentages. Savings are calculated from the baseline existing unit to the installed efficient unit.

$$Annual\ Gas\ Savings\ (MMBtu) = HeatingUse \times \left(1 - \frac{AFUE_{Base}}{AFUE_{Eff}}\right)$$

Where:

HeatingUse	=	Annual heating use (MMBtu/yr) from weather normalized usage analysis of customer billing data from pre-treatment period. See description below.
$AFUE_{Base}$	=	Efficiency of existing baseline equipment (Annual Fuel Utilization Efficiency)
$AFUE_{Eff}$	=	Efficiency of new efficient equipment

Heating Use weather normalization methods (HeatingUse):

Method 1: Use a linear regression model of use/day as a function of HDD63[64]/day to estimate heating slope (MMbtu/HDD63) and baseload daily use (MMBtu/day) with an annual HDD63 of 4033[65] to calculate annual heating load.

Method 2: Calculate baseload (MMBtu/day) as the third lowest MMBtu/day bill for the analysis year. Then calculate raw heating use as the sum of monthly billed use minus the – baseload * sum(monthly bill elapsed days), then calculate weather adjusted heating use as raw heating use * (4033/HDD63actual).

Electric Savings Algorithms

Electric energy savings result from efficient furnace fans (ECM) that may be included with efficient furnaces. Electrical savings from fan motor efficiency does not apply to boilers.

Energy Savings
$\Delta kWh = 700\ kWh$

Demand Savings
$\Delta kW = 0\ kW$

Where:

ΔkWh	=	Gross customer annual kWh savings for the measure. Based on 500 kWh heating season plus 200 kWh cooling season.
ΔkW	=	Gross customer summer load kW savings for the measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Gas Furnace	0%	0%
Gas Furnace with ECM Fan	0%	0%
Gas Boiler	0%	0%

[64] Heating degree days are calculated using base 63°F which was selected based on variable-base degree day regressions of billing data from CWP participants over the past several years. This value is higher than found for many non-low income populations in similar climates and likely reflects the low efficiency of the low income housing stock and also the targeting of high users by CWP. The use of this HDD base eliminates the need for the degree day correction factor found in some similar calculations that use HDD65.
[65] This value of 4033 HDD63 is the average from NWS data for PHL for the years 2002 through 2009.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Furnaces	20
Gas Boilers	25

Source: Lifetime estimates used by Efficiency Vermont.

Measure Cost
The measure cost is the full cost of installing the efficient equipment, including labor and for the installation of direct venting required for condensing furnaces and boilers.

O&M Cost Adjustments
Any O&M cost differences between the new efficient and existing baseline equipment should be accounted for.

Water Savings
There are no water savings for this measure.

2) Infiltration Reduction

Unique Measure Code(s): TBD
Draft date: 4/13/11
Effective date: TBD
End date: TBD

Measure Description
This involves decreasing the amount of air exchange between the inside and outside of the house by sealing the sources of leaks, while maintaining minimum air exchange for air quality.

Definition of Baseline Condition
The baseline is the house in its pre-treatment condition, with opportunities for infiltration reductions.

Definition of Efficient Condition
Any decrease in infiltration will reduce energy consumption compared to the pre-treated house.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{HDD_t \times 24 \times (CFM50_{pre} - CFM50_{post})}{(21.5 \times AFUE \times 1{,}000{,}000)}$$

Where:

HDD_t = Heating degree days at temperature t, where t=63°F if no programmable thermostat has been installed and t=62°F if a programmable thermostat has been installed. From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820.

24 = hours/day

$CFM50_{pre}$ = CFM50 of building shell leakage as measured by a blower door test before treatment.

$CFM50_{post}$ = CFM50 of building shell leakage as measured by a blower door test after treatment.

21.5 = factor to convert CFM50 value to Btu/hrF heat loss rate, calculated from hourly infiltration modeling[66]

AFUE = rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the air sealing work.

Electric Savings Algorithms

If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[67]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons.

Energy Savings

$\Delta kWh = \Delta kWh_{Aux} + \Delta kWh_{Cool}$

ΔkWh_{Aux} = $\textit{Annual Gas Savings (MMBtu)} \times \textit{Auxiliary}$

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= ΔkWh_{RAC} if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = \frac{CDD \times 24 \times DUA \times (CFM50_{pre} - CFM50_{post})}{\left(21.5 \times SEER_{CAC} \times 1000 \frac{W}{kW}\right)}$$

$$\Delta kWh_{RAC} = \frac{CDD \times 24 \times DUA \times F_{Room\,AC} \times (CFM50_{pre} - CFM50_{post})}{\left(21.5 \times \overline{EER}_{RAC} \times 1000 \frac{W}{kW}\right)}$$

Demand Savings

ΔkW = 0 kW if house has no air conditioning
= ΔkW_{CAC} if house has central air conditioning
= ΔkW_{RAC} if house has room air conditioning

$$\Delta kW_{CAC} = \frac{\Delta kWh_{CAC}}{EFLH_{cool}} \times CF_{CAC}$$

$$\Delta kW_{RAC} = \frac{\Delta kWh_{RAC}}{EFLH_{cool\,RAC}} \times CF_{RAC}$$

Where:

[66] An hourly infiltration was calculated using a modified version of the LBL (a.k.a. Sherman-Grimsrud) infiltration model with a wind effect modification (EPRI RP 2034-40, Palmiter and Bond 1991) using Philadelphia TMY2 hourly weather data. This analysis result was then adjusted to account for an assumed party wall leakage fraction of 12% and an estimated 10% thermal regain from infiltration/exfiltratiom. The resulting value of 21.5 is consistent with statistical analyses of empirical data using CFM50 values and actual gas use and savings from CWP evaluations.

[67] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

ΔkWh = gross customer annual kWh savings for the measure.

ΔkW = gross customer summer load kW savings for the measure.

Auxiliary = *Heating system auxiliary usage per MMBTU consumption (5.02 From Vermont Technical Reference Manual)*

CDD = *Cooling Degree Days (Degrees F * Days)HDD*

DUA = *Discretionary Use Adjustment to account for the fact that people do not always operate their air conditioning system when the outside temperature is greater than 65F.*

$SEER_{CAC}$ = *Seasonal Energy Efficiency Ratio of existing home central air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

$\overline{EER}_{RAC}$ = *Average Energy Efficiency Ratio of existing room air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

CF_{CAC} = *Demand Coincidence Factor for central AC systems (See table below)*

CF_{RAC} = *Demand Coincidence Factor for Room AC systems (See table below)*

$EFLH_{cool}$ = *Equivalent Full Load Cooling hours for Central AC and ASHP (See table below)*

$EFLH_{cool\ RAC}$ = *Equivalent Full Load Cooling hours for Room AC (See table below)*

$F_{Room\ AC}$ = *Adjustment factor to relate insulated area to area served by Room AC units*

The default values for each term are shown in the table below.

Default values for algorithm terms, Ceiling/Attic and Wall Insulation

Term	Type	Value	Source
DUA	Fixed	0.75	OH TRM[68]
$SEER_{CAC}$	Variable	Default values: Early Replacement = 10 Replace on Burnout = 13	PUC Technical Reference Manual
		Nameplate	Contractor Data Gathering
$\overline{EER}_{RAC}$	Variable	Default = 9.8	DOE Federal Test Procedure 10 CFR 430, Appendix F (Used in ES Calculator for baseline)
		Nameplate	Contractor Data Gathering
CF_{CAC}	Fixed	0.70	PUC Technical Reference Manual

[68] "State of Ohio Energy Efficiency Technical Reference Manual," prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation. August 6, 2010.

Term	Type	Value	Source
CF_{RAC}	Fixed	0.58	PUC Technical Reference Manual
$F_{Room,AC}$	Fixed	0.38	Calculated[69]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[70]	$EFLH_{cool\ RAC}$ (Hours)[71]	CDD (Base 65)[72]	HDD (Base 65)[73]
Philadelphia	1032	320	1235	4759

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Measure	Free Ridership	Spillover
Infiltration Reduction	0%	0%

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Measure	Measure Lifetime
Infiltration Reduction	20

Source: NYSERDA Home Performance with Energy Star.

Measure Cost
The measure cost is the material and labor cost for reducing air leakage.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline condition, other than energy usage.

Water Savings
There are no water savings for this measure.

3) Roof and Cavity Insulation

[69] From PECO baseline study, average home size = 2323 ft^2, average number of room AC units per home = 2.1. Average Room AC capacity = 10,000 BtuH per ENERGY STAR Room AC Calculator, which serves 425 ft^2 (average between 400 and 450 ft^2 for 10,000 BtuH unit per ENERGY STAR Room AC sizing chart). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$
[70] PA 2010 TRM Table 2-1.
[71] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement
[72] Climatography of the United States No. 81. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000, 36 Pennsylvania. NOAA. http://cdo.ncdc.noaa.gov/climatenormals/clim81/PAnorm.pdf
[73] Ibid.

Unique Measure Code(s): TBD
Draft date: 4/13/11
Effective date: TBD
End date: TBD

Measure Description
This involves increasing the insulation levels in either the roof or cavities.

Definition of Baseline Condition
The baseline is amount of insulation in the house in its pre-treatment condition.

Definition of Efficient Condition
Any increase in insulation will reduce energy consumption compared to the pre-treated house.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{HDD_t \times 24 \times AREA \times \left({}^{1}/_{R_{pre}} - {}^{1}/_{R_{post}} \right)}{(AFUE \times 1{,}000{,}000)}$$

Where:

HDD_t	=	Heating degree days at temperature t, where t=63°F if no programmable thermostat has been installed and t=62°F if a programmable thermostat has been installed[74].
24	=	Hours per day
AREA	=	Net insulated area in square feet. Estimated at 85% of gross area for cavities.
R_{pre}	=	R value of roof/cavity pre-treatment. R_{pre} = 5 unless there is existing insulation.
R_{post}	=	R value of roof/ cavity after insulation is installed.
AFUE	=	Rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the air sealing work.

Electric Savings Algorithms
If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[75]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons.

Energy Savings
$\Delta kWh = \Delta kWh_{Aux} + \Delta kWh_{Cool}$

$\Delta kWh_{Aux} = Annual\ Gas\ Savings\ (MMBtu) \times Auxiliary$

[74] From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820
[75] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= ΔkWh_{RAC} if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = \frac{CDD \times 24\frac{hr}{day} \times DUA}{SEER_{CAC} \times 1000\frac{W}{kW}} \times \left[AREA \times \left(\frac{1}{R_{pre}} - \frac{1}{R_{post}}\right)\right]$$

$$\Delta kWh_{RAC} = \frac{CDD \times 24\frac{hr}{day} \times DUA \times F_{Room\,AC}}{\overline{EER}_{RAC} \times 1000\frac{W}{kW}} \times \left[AREA \times \left(\frac{1}{R_{pre}} - \frac{1}{R_{post}}\right)\right]$$

Demand Savings

ΔkW = 0 kW if house has no air conditioning
= ΔkW_{CAC} if house has central air conditioning
= ΔkW_{RAC} if house has room air conditioning

$$\Delta kW_{CAC} = \frac{\Delta kWh_{CAC}}{EFLH_{cool}} \times CF_{CAC}$$

$$\Delta kW_{RAC} = \frac{\Delta kWh_{RAC}}{EFLH_{cool\,RAC}} \times CF_{RAC}$$

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.

Auxiliary = *Heating system auxiliary usage per MMBTU consumption (5.02 From Vermont Technical Reference Manual)*

CDD = *Cooling Degree Days (Degrees F * Days)HDD*

DUA = *Discretionary Use Adjustment to account for the fact that people do not always operate their air conditioning system when the outside temperature is greater than 65F.*

$SEER_{CAC}$ = *Seasonal Energy Efficiency Ratio of existing home central air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

$\overline{EER}_{RAC}$ = *Average Energy Efficiency Ratio of existing room air conditioner (Btu/W•hr) (See table below for default values if actual values are not available)*

CF_{CAC} = *Demand Coincidence Factor for central AC systems (See table below)*

CF_{RAC} = *Demand Coincidence Factor for Room AC systems (See table below)*

$EFLH_{cool}$ = *Equivalent Full Load Cooling hours for Central AC and ASHP (See table below)*

$EFLH_{cool\,RAC}$ = *Equivalent.Full Load Cooling hours for Room AC (See table below)*

$F_{Room\,AC}$ = *Adjustment factor to relate insulated area to area served by Room AC units*

The default values for each term are shown in the table below.

Default values for algorithm terms, Ceiling/Attic and Wall Insulation

Term	Type	Value	Source
DUA	Fixed	0.75	OH TRM[76]
$SEER_{CAC}$	Variable	Default values: Early Replacement = 10 Replace on Burnout = 13	PUC Technical Reference Manual
		Nameplate	Contractor Data Gathering
$\overline{EER}_{RAC}$	Variable	Default = 9.8	DOE Federal Test Procedure 10 CFR 430, Appendix F (Used in ES Calculator for baseline)
		Nameplate	Contractor Data Gathering
CF_{CAC}	Fixed	0.70	PUC Technical Reference Manual
CF_{RAC}	Fixed	0.58	PUC Technical Reference Manual
$F_{Room,AC}$	Fixed	0.38	*Calculated*[77]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[78]	$EFLH_{cool\,RAC}$ (Hours)[79]	CDD (Base 65)[80]	HDD (Base 65)[81]
Philadelphia	1032	320	1235	4759

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Measure	Free Ridership	Spillover
Insulation	0%	0%

Persistence

The persistence factor is assumed to be one.

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[76] "State of Ohio Energy Efficiency Technical Reference Manual," prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation. August 6, 2010.

[77] From PECO baseline study, average home size = 2323 ft^2, average number of room AC units per home = 2.1. Average Room AC capacity = 10,000 BtuH per ENERGY STAR Room AC Calculator, which serves 425 ft^2 (average between 400 and 450 ft^2 for 10,000 BtuH unit per ENERGY STAR Room AC sizing chart). $F_{Room,AC}$ = (425 ft^2 * 2.1)/(2323 ft^2) = 0.38

[78] PA 2010 TRM Table 2-1.

[79] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement

[80] Climatography of the United States No. 81. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000, 36 Pennsylvania. NOAA. http://cdo.ncdc.noaa.gov/climatenormals/clim81/PAnorm.pdf

[81] Ibid.

Measure Lifetimes

Measure	Measure Lifetime
Roof Insulation	40
Cavity Insulation	40

Source: NYSERDA Home Performance with Energy Star.

Measure Cost
The measure cost is the material and labor cost adding insulation.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline condition, other than energy usage.

Water Savings
There are no water savings for this measure.

4) Programmable Thermostat

Unique Measure Code(s): TBD
Draft date: 4/13/11
Effective date: TBD
End date: TBD

Measure Description
This is a programmable thermostat controlling a residential-sized gas furnace or boiler.

Definition of Baseline Condition
The baseline is a manual thermostat where each temperature setting change requires human intervention.

Definition of Efficient Condition
The efficient thermostat is one that can be programmed to automatically increase or lower the temperature setting at different times of the day and week.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = HeatingUse \times \left(1 - {HDD_{62}}/{HDD_{63}}\right) = HeatingUse \times 0.053 = 1.53\ MMBtu$$

Where:

HeatingUse = Annual heating use (MMBtu/yr) from weather normalized usage analysis of customer billing data from pre-treatment period (see description under heating system replacement). If thermostat measure is performed after shell measures of insulation or air sealing, then subtract the projected savings from those measures from the pre retrofit heating use.

HDD_{62} = 3820

The annual heating degree days based on 62°F, representing the estimated balance *point temperature of the home with the programmable thermostat.*

HDD_{63} = 4033

The annual heating degree days based on 63°F, representing the estimated balance point temperature of the home with the programmable thermostat.

An analysis of variable base degree day billing data from the CWP has found an average net reduction in balance point temperature of about 1.0°F for thermostat installations. Multiple impact evaluations have also found heating savings averaging about 5%-6% from thermostat installations. These two findings are consistent with each other and indicate an estimated average impact based on employing the approach from past CWP contractors to targeting customers and selecting homes to receive thermostats and the savings opportunities and compliance rates achieved. The savings may not be accurate when applied to different populations in different ways.

Electric Savings Algorithms

If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[82]

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons, but these auxiliary savings are not accounted for in the following algorithms.

Energy Savings

$\Delta kWh = \Delta kWh_{Aux} + \Delta kWh_{Cool}$

ΔkWh_{Aux} $= Annual\ Gas\ Savings\ (MMBtu) \times Auxiliary$

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= 0 if house has room air conditioning
= 83% × ΔkWh_{CAC} if no information about air conditioner

$$\Delta kWh_{CAC} = CAP_{COOL} \times \left(\frac{12{,}000 \frac{Btu}{ton} \times \frac{1}{1{,}000} \frac{kWh}{Wh}}{EER_{COOL} \times Eff_{duct}} \right) \times EFLH \times ESF_{COOL}$$

Demand Savings

$\Delta kW = 0$ kW

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.
CAP_{COOL} = *capacity of the air conditioning unit in tons, based on nameplate capacity (see table below)*

[82] Percentage of houses with air-conditioning from EIA Table AC1.xls for Middle Atlantic region (PA, NY, NJ). From: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

EER_{COOL} = *Seasonally averaged efficiency rating of the baseline unit . (see table below)*

Eff_{duct} = *duct system efficiency (see table below)*

ESF_{COOL} = *energy savings factor for cooling and heating, respectively (see table below)*

EFLH = *equivalent full load hours*

Residential Electric HVAC Calculation Assumptions

Component	Type	Value	Sources
CAP_{COOL}	Variable	Nameplate data	Contractor Data Gathering
		Default: 3 tons	1
EER_{COOL}	Variable	Nameplate data	Contractor Data Gathering
		Default: Cooling = 10 SEER Default: Heating = 1.0 (electric furnace COP)	2
Eff_{duct}	Fixed	0.8	3
ESF_{COOL}	Fixed	2%	4
EFLH	Fixed	Philadelphia Cooling = 1,032 Hours	5

Sources:

11. Average size of residential air conditioner.
12. Minimum Federal Standard for new Central Air Conditioners/Heat Pumps between 1990 and 2006.
13. New York Standard Approach for Estimating Energy Savings from Energy Efficiency Measures in Commercial and Industrial Programs, September 1, 2009.
14. DEER 2005 cooling savings for climate zone 16, assumes a variety of thermostat usage patterns.
15. US Department of Energy, ENERGY STAR Calculator. Accessed 3/16/2009.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Programmable Thermostat	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Programmable Thermostat	15

Source: New Jersey Clean Energy Program Protocols (December 2009).

Measure Cost
The measure cost is the cost of the programmable thermostat.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

5) Duct Work Insulation

Unique Measure Code(s): TBD
Draft date: 7/28/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to installing insulation on ducts in unconditioned spaces.

Definition of Baseline Condition
The baseline condition is assumed to be a bare steel duct.

Definition of Efficient Condition
The efficient condition is the duct with insulation installed.

Water Savings Algorithms
This measure has no water savings associated with it.

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{AFUE \times 1{,}000{,}000}$$

Where:

Length	=	Number of linear feet of duct work insulated
Th_{base}	=	Thickness of base condition insulation (inches)
Th_{eff}	=	Thickness of efficient condition insulation (inches)
HeatLoss(x)	=	Heat loss through duct work as a function of insulation thickness x (Btu/ft /yr)
AFUE	=	Rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the duct work insulation.

"HeatLoss(x)" can be found using the following lookup table.

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr
Bare	1,120,000
0.25	339,500
0.5	205,300
0.75	190,700
1	128,300
1.5	93,970
2	74,370
2.5	61,620
3	52,650
3.5	45,990
4	40,830

This table was calculated using the North American Insulation Manufacturers Association's (NAIMA) 3E Plus 4.0 Insulation Thickness Computer Program. The following assumptions were used.

Item Description	=	bare duct
Calculation Type	=	Heat Loss Per Year Report
Geometry Description	=	Steel Duct - Rectangular Horz.
System Units	=	ASTM C585
Bare Surface Emittance	=	0.8
Process Temperature	=	140 °F
Ave. Ambient Temperature	=	41.8 °F[83]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Condensation Control Thickness	=	N/A
Hours Per Year	=	2000[84]
Outer Jacket Material	=	Aluminum, oxidized, in service
Outer Surface Emittance	=	0.1
Insulation Layer 1	=	Duct Wrap, 1.0 pound per cubic foot, C1290,
Duct Horiz Dimension	=	12 in.
Duct Vert Dimension	=	8 in.

Electric Savings Algorithms
No electric savings are currently claimed for this measure.

[83] Average winter temperature for Philadelphia from "Cost Savings and Comfort for Existing Buildings", 3rd Edition, by John Krigger, Saturn Resource Management. Page 255.
[84] Low end of 2,000 – 2,500 winter heating load hours from Air-conditioning and Refrigeration Institute.
http://www.waterfurnace.ca/Engineer/Misc%20References/ARI%20Cooling%20&%20Heating%20Load%20Hours%20Map.pdf

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to 18 years[85].

Measure Cost
The measure cost is the actual cost of installing the insulation, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

6) Heating Pipe Insulation

Unique Measure Code(s): TBD
Draft date: 7/28/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to installing insulation on steam pipes used for space heating.

Definition of Baseline Condition
The baseline condition is the current insulation thickness on a space heating hot water or steam pipe.

Definition of Efficient Condition
The efficient condition is any insulation thicker than that already on the pipe.

Water Savings Algorithms
This measure has no water savings associated with it.

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{AFUE \times 1{,}000{,}000}$$

Where:

Length	=	Number of linear feet of steam pipe insulated
Th_{base}	=	Thickness of base condition insulation (inches)
Th_{eff}	=	Thickness of efficient condition insulation (inches)
HeatLoss(x)	=	Heat loss through steam pipe as a function of insulation thickness x (Btu/ft /yr)
AFUE	=	Rated AFUE of heating system. If no rating is available then use the method described in the Efficient Space Heating System section for calculating the AFUE. The AFUE of replacement equipment should be used if the heating system replacement precedes the duct work insulation.

[85] NYSERDA Home Performance with Energy Star

"HeatLoss(x)" can be found using the following lookup table.

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr
Bare	2,006,040
1	413,822
1.25	370,898
1.5	327,974
1.75	307,564
2	279,882
2.5	250,098
3	228,724
3.5	212,430
4	198,151

This table was calculated using the North American Insulation Manufacturers Association's (NAIMA) 3E Plus 4.0 Insulation Thickness Computer Program. The following assumptions were used.

Item Description	=	steam pipe insulation
Calculation Type	=	Personnel Protection Report
Geometry Description	=	Steel Pipe - Horizontal
System Units	=	ASTM C585
Bare Surface Emittance	=	0.8
Nominal Pipe Size	=	2 in.
Process Temperature	=	212 °F
Ave. Ambient Temperature	=	60 °F[86]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Personnel Protection Thickness	=	Bare
Outer Jacket Material	=	Iron or Steel
Outer Surface Emittance	=	0.8
Insulation Layer 1	=	High Temp Fiber Blanket, Gr 6, C892-05, Varied

Electric Savings Algorithms
There are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to be 20 years[87].

[86] Temperature of unconditioned basement.
[87] NYSERDA Home Performance with Energy Star

Measure Cost
The measure cost is the actual cost of installing the insulation, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

B. Domestic Hot Water End Use

7) Low Flow Showerhead

Unique Measure Code(s): TBD
Draft date: 6/8/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to the installation of a low flow showerhead in a home. This is a retrofit direct install measure.

Definition of Baseline Condition
The baseline is the flow rate of the showerhead being replaced. If this is not available a baseline value of 2.5 GPM will be used.

Definition of Efficient Condition
The flow rate of the efficient showerhead should be greater than the flow rate of the baseline condition. If this value is not available it is assumed to be 1.5 GPM[88].

Water Savings Algorithms
The water savings for low flow showerheads are due to the reduced amount of water being used per shower.

$$\Delta Gallons = \frac{\left(\frac{GPM_{base} - GPM_{eff}}{GPM_{base}}\right) \times 2.48 \times 11.6 \times 365}{1.6}$$

Where:

$\Delta Gallons$	=	Gallons of water saved
GPM_{base}	=	Maximum gallons per minute of baseline showerhead. Default = 2.5 GPM if measured rate is not available[89]
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[90]
11.6	=	Average gallons of water per person per day used for showering[91]
365	=	Days per year
1.6	=	Average number of showers per home[92]

Natural Gas Savings Algorithms

88 Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
89 The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)
90 Pennsylvania, Census of Population, 2000.
91 Most commonly quoted value of gallons of water used per person per day (including in U.S. Environmental Protection Agency's "water sense" documents; http://www.epa.gov/watersense/docs/home_suppstat508.pdf)
92 Estimate based on review of a number of studies:

c) Pacific Northwest Laboratory; "Energy Savings from Energy-Efficient Showerheads: REMP Case Study Results, Proposed Evaluation Algorithm, and Program Design Implications" http://www.osti.gov/bridge/purl.cover.jsp;jsessionid=80456EF00AAB94DB204E848BAE65F199?purl=/10185385-CEkZMk/native/
d) East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf

Gas energy savings result from avoiding having to heat the saved water due to the efficient showerhead.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times (105 - 55)] / 1{,}000{,}000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
105	=	Assumed temperature of water coming out of showerhead (degrees Fahrenheit)
55	=	Assumed temperature of water entering house (degrees Fahrenheit)[93]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[94]

Electric Savings Algorithms
It is assumed that all low flow showerheads installed under PGW's ELIRP program are installed in homes that heat water using natural gas. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a low flow showerhead is assumed to be 9 years[95].

Measure Cost
The measure cost is the actual cost of installing the new showerhead, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

8) Low Flow Faucet Aerators

Unique Measure Code(s): TBD
Draft date: 6/8/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to the installation of a low flow faucet aerator in either a kitchen or bathroom.

[93] A good approximation of annual average water main temperature is the average annual ambient air temperature. Average water main temperature = 55° F based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[94] Review of AHRI Directory suggests range of recovery efficiency ratings for new Gas DHW units of 70-87%. The average of existing units is estimated at 75% by the Northeast Energy Efficiency Partnerships' Mid-Atlantic Technical Reference Manual Version 1.1 (October 2010).
[95] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

Definition of Baseline Condition

The baseline is the flow rate of the existing faucet. If this is not available, it is generally assumed that a faucet will already have a standard faucet aerator using 2.2 GPM.

Definition of Efficient Condition

The efficient condition is a faucet aerator that has a flow rate lower than the baseline condition. If this value is not available than the flow rate is assumed to be 1.5 GPM[96].

Water Savings Algorithms

The water savings for low flow faucet aerators are due to the reduced amount of water being used per minute that flows down the drain (instead of being collected in the sink).

$$\Delta Gallons = \frac{\left(\frac{GPM_{base} - GPM_{eff}}{GPM_{base}}\right) \times 2.48 \times 10.9 \times 365 \times 50\%}{3.5}$$

Where:

$\Delta Gallons$	=	Gallons of water saved
GPM_{base}	=	Gallons per minute of baseline showerhead = 2.2 GMP[97]
GPM_{eff}	=	Gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[98]
10.9	=	Average gallons per day used by faucet[99]
365	=	Days per year
50%	=	Drain rate, the percentage of water flowing down the drain[100]
3.5	=	Average Number of Faucets per home[101]

Natural Gas Savings Algorithms

Gas energy savings result from avoiding having to heat the saved water due to the efficient showerhead.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times 25] / 1{,}000{,}000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
25	=	The difference between the temperature of the water entering the house and the temperature leaving the faucet (degrees Fahrenheit).[102]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[103]

[96] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[97] Public Service Commission of Wisconsin Focus on Energy Evaluation Default Deemed Savings Review, June 2008. http://www.focusonenergy.com/files/Document_Management_System/Evaluation/acesdeemedsavingsreview_evaluationreport.pdf
[98] Pennsylvania, Census of Population, 2000.
[99] Most commonly quoted value of gallons of water used per person per day (including in U.S. Environmental Protection Agency's "water sense" documents; http://www.epa.gov/watersense/docs/home_suppstat508.pdf)
[100] Estimate consistent with Ontario Energy Board, "Measures and Assumptions for Demand Side Management Planning."
[101] East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf
[102] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[103] See assumption for low flow shower head.

Electric Savings Algorithms
It is assumed that all faucet aerators installed under PGW's ELIRP program are installed in homes that heat water using natural gas. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a faucet aerator is assumed to be 12 years[104].

Measure Cost
The measure cost is the actual cost of installing the new faucet aerator, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

9) Efficient Natural Gas Water Heater

Unique Measure Code(s): TBD
Draft date: 6/21/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to an efficient natural gas water heater.

Definition of Baseline Condition
The baseline is the energy factor (EF) of the existing water heater. If possible, the EF of the existing water heater should be used. If the EF of the existing water heater is unknown, 0.575 should be used[105].

Definition of Efficient Condition
The efficient condition is a natural gas water heater that is more energy efficient than the existing water heater.

Water Savings Algorithms
No water savings have been defined for this measure.

Natural Gas Savings Algorithms
MMBtu savings are realized due to the increase in efficiency factor (EF) of the new equipment. MMBtu savings vary by equipment type due to differences in model specific baseline EF and high efficiency EF percentages. Savings are calculated from the baseline new unit to the installed efficient unit. The following formula for gas savings is based on the DOE test procedure for water heaters.

$$\Delta MMBtu = \frac{\left(\frac{1}{EF_{base}} - \frac{1}{EF_{eff}}\right) \times 41{,}045 \times 365}{1{,}000{,}000}$$

[104] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[105] From Mass Save "Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures: 2011 Program Year – Plan Version." October 2010. Page 242.

Where:

EF_{base}	=	Energy Factor of baseline water heater
EF_{eff}	=	Energy Factor of efficient water heater
41,045	=	Factor used in DOE test procedure algorithm
365	=	Days in the year

Electric Savings Algorithms
It is assumed that all faucet aerators installed under PGW's ELIRP program are installed in homes that heat water using natural gas water. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a natural gas water heater is assumed to be 15 years[106].

Measure Cost
In a natural replacement scenario, the cost is the incremental cost of the efficient equipment over the baseline equipment. In a retrofit scenario, the measure cost is full equipment and labor costs.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

10) Hot Water Heater Tank Temperature Turn-down

Unique Measure Code(s): TBD
Draft date: 6/21/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to lowering the thermostat setting on a natural gas hot water heater to 120° F, if the temperature is set higher.

Definition of Baseline Condition
The baseline is the temperature setting of the existing water heater. usually above 135° F

Definition of Efficient Condition
The efficient condition is the new setting point for the hot water heater, 120° F.

Water Savings Algorithms
No water savings have been defined for this measure.

Natural Gas Savings Algorithms
MMBtu savings arise from lower temperature setting that reduces the standby heat losses required to maintain the tanks temperature setting.

[106] DEER values, updated October 10, 2008
http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

$$\Delta MMBtu = \frac{\frac{Area \times (T_{base} - T_{eff})}{R_{DHW}} \times \frac{8{,}760}{1{,}000{,}000}}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved gas per year
$Area$	=	Surface area of hot water heater (ft^2)
T_{base}	=	Original temperature inside the tank (°F) = Assume 135 °F if no other information provided
T_{eff}	=	New temperature inside the tank (°F) = Assume 120° F if no other information provided
R_{DHW}	=	R-value of the hot water heater (h °F ft^2/Btu) = 5.0[107]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[108]
1,000,000	=	Btu to MMBtu

The following table provides surface areas based on the number of gallons the water tank can hold, along with deemed savings values using the assumptions above.

Water Heater Size (Gal)	Height (Inches)*	Diameter (Inches)*	Total Surface Area (ft^2)	Annual Savings (MMBtu)
30	60	16	29.7	1.04
40	61	16.5	31.3	1.10
50	53	18	31.9	1.12
66	58	20	39.0	1.37
80	58	22	44.4	1.56

** From New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (October 15, 2010). Page 98*

Electric Savings Algorithms
There are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a natural gas water heater is assumed to be 2 years[109].

Measure Cost
In a natural replacement scenario, the cost is the incremental cost of the efficient equipment over the baseline equipment. In a retrofit scenario, the measure cost is full equipment and labor costs.

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[107] Calculated using the base conductive heat loss co-efficient and surface areas from: *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* (October 15, 2010). Page 98

[108] See assumption for low flow showerhead.

[109] Page 410. Vermont Technical Reference Manual and New Jersey Clean Energy Program Protocols

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

11) Repair Hot Water Leaks/Plumbing Repairs

Unique Measure Code(s): TBD
Draft date: 6/8/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to repairing any leaks from hot water pipes.

Definition of Baseline Condition
The baseline condition is the amount of water leaking from the hot water pipe per minute.

Definition of Efficient Condition
The efficient condition is no hot water leaking from the hot water pipe.

Water Savings Algorithms
The water saved is the amount of water that is lost due to the leak. The following table provides the deemed water savings values for the most common types of leaks.

Leak Type	Amount per Minute	Gallons per Day
Slow Steady Drip	100 drips	14.4*
Fast Drip	200 drips	28.8*
Small Stream	1 cup (8 fl oz)	89.28

* *A drip is assumed to be 0.0001 gallons*[110]

Natural Gas Savings Algorithms
Gas savings result from the avoided energy used to heat the water wasted from the leak.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times (120 - 55)] / 1{,}000{,}000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
120	=	Assumed temperature of hot water as it leaves the water heater and travels through the pipes.
55	=	Assumed temperature of water entering house (degrees Fahrenheit)[111]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[112]

[110] Figures provided to North Carolina's Dare County Water Department by the North Carolina Rural Water Association: http://www.darenc.com/water/Othsts/WtrLoss.htm (accessed June 23, 2011)
[111] A good approximation of annual average water main temperature is the average annual ambient air temperature. Average water main temperature = 55° F based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[112] See assumption for low flow showerhead.

The following table provides deemed gas savings values based on the deemed water savings, the algorithm outlined above, and the measure lives from below.

Leak Type	Savings (MMBtu)
Slow Steady Drip	0.87
Fast Drip	0.87
Small Stream	1.35

Electric Savings Algorithms
It is assumed that all leaks repaired are for homes that heat water using natural gas water. There are no additional electric savings claimed.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The savings for repairing hot water leaks persist as long as the leak would not have otherwise been fixed. PGW assumes that a smaller leak will persist longer than a larger and more noticeable leak and has adjusted the following measure lifetimes to account for this.

Leak Type	Lifetime
Slow Steady Drip	12 weeks
Fast Drip	6 weeks
Small Stream	3 week

Measure Cost
The measure cost is the actual cost of repairing the leak, including parts and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

12) DHW Pipe Insulation

Unique Measure Code(s): TBD
Draft date: 7/28/11
Effective date: TBD
End date: TBD

Measure Description
This measure relates to installing insulation on hot water pipes.

Definition of Baseline Condition
The baseline condition is the current insulation thickness on the hot water pipe.

Definition of Efficient Condition
The efficient condition is any insulation thicker than that already on the hot water pipe.

Water Savings Algorithms
This measure has no water savings associated with it.

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{RE_{DHW} \times 1{,}000{,}000}$$

Where:

Length = Number of linear feet of steam pipe insulated

Th_{base} = Thickness of base condition insulation (inches)

Th_{eff} = Thickness of efficient condition insulation (inches)

HeatLoss(x) = Heat loss through hot water pipe as a function of insulation thickness x (Btu/ft /yr)

RE_{DHW} = Recovery efficiency of the hot water heater = 75%[113]

"HeatLoss(x)" can be found using the following lookup table.

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr
Bare	267,881
3/8"	99,076
1/2"	86,636
5/8"	75,073
3/4"	71,482
7/8"	66,488
1"	62,722
1 1/2"	51,509
2"	45,815
2 1/2"	40,208
3"	37,843

This table was calculated using the North American Insulation Manufacturers Association's (NAIMA) 3E'Plus 4.0 Insulation Thickness Computer Program. The following assumptions were used.

Item Description = DHW pipe insulation

Calculation Type = Personnel Protection Report

Geometry Description = Copper Pipe - Horizontal

System Units = ASTM C585

Bare Surface Emittance = 0.6

Nominal Pipe Size = 0.5 in.

Process Temperature = 130 °F

[113] See assumption for low flow showerhead.

Ave. Ambient Temperature	=	60 °F
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Personnel Protection Thickness	=	Bare
Outer Jacket Material	=	Copper
Outer Surface Emittance	=	0.6
Insulation Layer 1	=	Polystyrene PIPE, Type XIII, C578-07, Varied

Electric Savings Algorithms
There are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to be 20 years[114].

Measure Cost
The measure cost is the actual cost of installing the insulation, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

13) Hot Water Storage Tank Wrap

Unique Measure Code(s): TBD
Draft date: 6/8/11
Effective date: TBD
End date: TBD

Measure Description
This measure refers to an insulating "blanket" that is wrapped around the outside of a hot water tank to reduce stand-by losses. The tank wrap must follow BPI technical standards:

> "Water heater insulation wraps shall not cover the top of oil or gas systems, and shall not obstruct the pressure relief valve, thermostats, hi-limit switch, plumbing pipes, or access plates. A minimum 2-inch clearance is required from the access door for gas burners.
>
> Water heater insulation wraps shall not be installed where forbidden by the manufacturer's instructions found on the nameplate."[115]

Definition of Baseline Condition
The baseline is the hot water heater tank without the insulating blanket.

[114] NYSERDA Home Performance with Energy Star
[115] Building Performance Institute, Inc. *Technical Standards for the Heating Professional*. Revised 11/20/07. Page 12.

Definition of Efficient Condition
The efficient condition is the hot water heater tank with the insulating blanket.

Water Savings Algorithms
There are no water savings due to this measure.

Natural Gas Savings Algorithms
Gas energy savings result from the reduction in standby losses.

$$\Delta MMBtu = \frac{\left(\frac{1}{R_{base}} - \frac{1}{R_{eff}}\right) \times Area \times (T_{tank} - T_{amb}) \times \frac{8,760}{1,000,000}}{RE_{DHW}}$$

Where:

$\Delta MMBtu$ = MMBtu of saved gas per year
R_{eff} = R-value of the hot water heater with the insulating blanket (h °F ft²/Btu)
R_{base} = Original R-value of the hot water heater (h °F ft²/Btu) = 5.0[116] unless other information provided
Area = Surface area of the hot water heater covered by the insulating blanket (ft²)
T_{tank} = Temperature inside the tank (°F) = Assume 120 °F if no other information provided
T_{amb} = Temperature outside the tank (°F) = 55 °F[117]
8,760 = Number of hours in a year
RE_{DHW} = Recovery efficiency of the domestic hot water heater = 75%[118]
1,000,000 = Btu to MMBtu

The following table provides assumed insulated surface areas and corresponding deemed savings values for standard tank insulation blankest

Water Heater Size (Gal)	Height (Inches)*	Diameter (Inches)*	Surface Area of Cylinder (ft²)	Surface Area of Accessed Areas (ft²)**	Surface arc of Cylinder minus Accessed Areas (ft²)	R-10 Wrap Annual Savings (MMBtu)	R-19 Wrap Annual Savings (MMBtu)
30	60	16	20.9	0.4	20.5	1.6	2.3
40	61	16.5	22.0	0.4	21.5	1.6	2.4
50	53	18	20.8	0.4	20.4	1.5	2.3
66	58	20	25.3	0.4	24.9	1.9	2.8
80	58	22	27.8	0.4	27.4	2.1	3.1

** From New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (October 15, 2010). Page 98*
*** Assuming square access area with 4" square and 2" clearance on each side*

Electric Savings Algorithms

[116] Calculated using the base conductive heat loss co-efficient and surface areas from: *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* (October 15, 2010). Page 98
[117] Assumed to be in unconditioned space, ambient temperature assumption based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[118] See assumption for low flow showerhead.

This measure is assumed to be installed only on a natural gas fired hot water heating systems, so there are no electric savings associated with this measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to be 5 years[119].

Measure Cost
The measure cost is the actual cost of installing the hot water tank-wrap, both materials and labor.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

[119] Northeast Energy Efficiency Partnerships. *Mid-Atlantic Technical Reference Manual (Version 1.1)*. October 2010

V. Non-Residential Time of Replacement Market

A. Space Heating End Use

1) Efficient Space Heating System

Unique Measure Code(s): TBD
Draft date: 4/27/12
Effective date: TBD
End date: TBD

Measure Description
This measure applies to non-residential-sized (≥300MBH) gas boilers purchased at the time of natural replacement. A qualifying boiler must meet minimum efficiency requirements (Thermal Efficiency).

Definition of Baseline Condition
The efficiency levels of the gas-fired boilers that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Baseline Thermal Efficiency
Gas Boiler	80%

Definition of Efficient Condition
The installed gas boiler must have a Thermal Efficiency greater than that shown in the table below. Efficient model minimum Thermal Efficiency requirements are detailed below.

Equipment Type	Minimum Thermal Efficiency
Gas Boiler Tier 1	90%
Gas Boiler Tier 2	85%

Gas Savings Algorithms
MMBtu savings are realized due to the increase in Thermal Efficiency of the new equipment. MMBtu savings vary by equipment type due to differences in model capacity and Thermal Efficiency percentages. Savings are calculated from the baseline new unit to the installed efficient unit.

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{Capacity_{Out}}{1{,}000} \times \left(\frac{1}{TE_{Base}} - \frac{1}{TE_{Eff}}\right) \times EFLH_{Heat}$$

$$EFLH_{Heat} = \frac{HDD \times 24}{Dt} = \frac{4{,}033 \times 24}{70} = 1{,}383$$

Where:

$Capacity_{Out}$ = Output capacity of equipment to be installed (kBtu/hr)

1,000	= Conversion from kBtu to MMBtu
TE_{Base}	= Thermal Efficiency of new baseline equipment
TE_{Eff}	= Thermal Efficiency of new equipment
$EFLH_{Heat}$	= Equivalent Full Load Heating Hours
HDD	= Base 63° F Heating Degree Days for Philadelphia = 4,033[120]
Dt	= Design temperature difference (assume from 0° F to 70° F)

Electric Savings Algorithms

Not applicable.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Gas Boiler	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	*Measure Lifetime*
Gas Boilers	25

Source: Consortium for Energy Efficiency, High Efficiency Commercial Boiler Systems Initiative Description, May 16, 2011, p. 17. Lifetimes range from 24-35 years.

Measure Cost

The measure cost is the incremental cost of the efficient equipment compared to the baseline equipment. The table below shows the incremental cost for 85% and 90% Thermal Efficiency (TE) boilers compared to baseline 80% TE boilers. The 90% TE boiler costs include the additional installation costs of direct venting required for condensing boilers.

	Incremental Cost	
Size (kBtu/h)	85% TE	90% TE
300-500	$1,005	$3,685
500-700	$1,765	$4,444
700-900	$2,524	$5,203
900-1100	$3,283	$5,962
1100-1300	$4,042	$6,722
1300-1500	$4,801	$7,481
1500-1700	$5,561	$8,240
1700-2000	$6,510	$9,189
2000-2200	$7,459	$10,138

[120] Based on NCDC ASOS temperature data for PHL from 2002 through 2009.

2200-2500	$7,838	$10,517

Source: INCREMENTAL COST STUDY REPORT FINAL, A Report on 12 Energy Efficiency Measure Incremental Costs in Six Northeast and Mid-Atlantic Markets, Prepared for the Evaluation, Measurement and Verification Forum, Chaired by the Northeast Energy Efficiency Partnerships, By Navigant Consulting, Inc., September 23, 2011, Table 5-16.

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

B.Commercial Kitchen End Uses

2) Commercial Convection Ovens

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
A general-purpose chamber designed for heating, roasting, or baking food by forcing hot dry air over the surface of the food product. The rapidly moving hot air strips away the layer of cooler air next to the food and enables the food to absorb the heat energy. For the purposes of this specification, convection ovens do not include ovens that have the ability to heat the cooking cavity with saturated or superheated steam. Maximum water consumption within the oven cavity must not exceed 0.25 gallons/hour. Ovens that include a hold feature are eligible under this specification as long as convection is the only method used to fully cook the food.

- Full-Size Convection Oven: A convection oven that is able to accept a minimum of five standard full-size sheet pans measuring 18 x 26 x 1-inch.

This does not cover ovens designed for residential or laboratory applications; hybrid ovens, such as those incorporating steam and/or microwave settings in addition to convection; other oven types, as defined in Section 1, including combination, conventional or standard, conveyor, slow cook-and-hold, deck, mini-rack, rack, range, rapid cook, and rotisserie ovens.

Definition of Baseline Condition
Cooking energy efficiency of 30% and Idle Energy Rate of 18,000 Btu/h[121].

Definition of Efficient Condition
Cooking energy efficiency greater than or equal to 44%[122] and an Idle Energy Rate less than or equal to 13,000 Btu/h
Additional criteria:

1) Must be full-size (for gas)
2) Have been installed in compliance with manufacturer instructions and meeting all applicable local, State, and Federal codes and standards;
3) Are third-party certified to:
    a. NSF/ANSI Standard 4, Commercial Cooking, Rethermalization and Powered Hot Food Holding and Transport Equipment
    b. ANSI/UL 197, Commercial Electrical Cooking Appliances (electric ovens only)
    c. ANSI Z83.11, Gas Food Service Equipment (gas ovens only)

All criteria are the same as the ENERGY STAR label.

Gas Savings Algorithms
The following shows the expected gas savings from a full-size commercial convection oven meeting the above specifications. These savings come from the Energy Star calculator.[123]

$$Annual\ Gas\ Savings\ (MMBtu) = 30.60\ MMBtu$$

[121] ENERGY STAR calculator default input.
[122] Using ASTM Standard F1496-99 (Reapproved 2005) based on heavy load (potato) cooking test.
[123] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
ΔkWh = 0 kWh

Demand Savings
ΔkW = 0 kW

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Commercial Convection Oven	0%	0%

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Commercial Convection Oven	12

Sources: CA DEER, MA 2011 TRM, ENERGY STAR.

Measure Cost
The measure cost is the incremental cost of the efficient equipment compared to new baseline equipment. The incremental cost is $600.[124]

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

[124] Focus On Energy 2009 Incremental Cost Study.

3) Commercial Gas Fryer

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
An appliance, including a cooking vessel, in which oil is placed to such a depth that the cooking food is essentially supported by displacement of the cooking fluid rather than by the bottom of the vessel. Heat is delivered to the cooking fluid by heat transfer from gas burners through either the walls of the fryer or through tubes passing through the cooking fluid.

- Standard Fryer: A fryer with a vat that measures >12 inches and < 18 inches wide, and a shortening capacity > 25 pounds and ≤ 65 pounds.
- Large Vat Fryer: A fryer with a vat that measures > 18 inches and < 24 inches wide, and a shortening capacity > 50 pounds.

Definition of Baseline Condition
Heavy Load (French Fry) Cooking Energy Efficiency of 35%.

Definition of Efficient Condition
Heavy Load (French Fry) Cooking Energy Efficiency greater than or equal to 50%.
Idle energy rate less than or equal to:

- 9,000 Btu/h for Standard Fryer
- 12,000 Btu/h for Large Vat Fryer

All criteria are the same as the ENERGY STAR label.

Gas Savings Algorithms
The following shows the expected gas savings from Energy Star commercial fryers meeting the above specifications. These savings come from the Energy Star calculator.[125]

Standard Fryer:

$$Annual\ Gas\ Savings\ (MMBtu) = 50.50\ MMBtu$$

Large Vat Fryer:

$$Annual\ Gas\ Savings\ (MMBtu) = 79.50\ MMBtu$$

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
$\Delta kWh = 0\ kWh$

Demand Savings
$\Delta kW = 0\ kW$

[125] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO

Where:

	ΔkWh	= gross customer annual kWh savings for the measure.
	ΔkW	= gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Commercial Convection Oven	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Commercial Fryer	12

Sources: CA DEER, MA 2011 TRM, ENERGY STAR.

Measure Cost

The measure cost is the incremental cost of the efficient equipment compared to new baseline equipment. The incremental cost is $1,351 for standard fryers and $2,000 for large vat fryers.[126]

O&M Cost Adjustments

It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings

There are no water savings for this measure.

[126] Focus On Energy 2009 Incremental Cost Study.

4) Commercial Gas Steamers (Cooking)

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
Also referred to as a "compartment steamer," a device with one or more food steaming compartments in which the energy in the steam is transferred to the food by direct contact. Models may include countertop models, wall-mounted models and floor-models mounted on a stand, pedestal or cabinet-style base.

Definition of Baseline Condition
Cooking energy efficiency of 15% and Idle Energy Rate of 3,666.67 Btu/h per pan[127].

Definition of Efficient Condition
Cooking energy efficiency greater than or equal to 38% and an Idle Energy Rates less than the maximum values in the table below.

# of Pans	Cooking Efficiency	Idle Rate (Btu/hr)
3 pans	38%	6,250
4 pans	38%	8,350
5 pans	38%	10,400
6 + pans	38%	12,500

All criteria are the same as the ENERGY STAR label.

Gas Savings Algorithms
The following shows the expected gas savings from a commercial steam cooker meeting the above specifications. These savings come from the Energy Star calculator.[128]

# of Pans	Annual Gas Savings (MMBtu)
3 pans	78.4
4 pans	88.2
5 pans	97.6
6 pans	106.6
7 + pans	106.6 + 13.9 per pan > 6 pans

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
ΔkWh = 0 kWh

Demand Savings
ΔkW = 0 kW

[127] The baseline comes from PG&E's online calculator at http://www.fishnick.com/saveenergy/tools/calculators/gsteamercalc.php

[128] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Commercial Steam Cooker	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Commercial Steam Cooker	12

Sources: CA DEER, MA 2011 TRM, ENERGY STAR.

Measure Cost

The measure cost is the incremental cost of the efficient equipment compared to new baseline equipment. The incremental cost is $710.[129]

O&M Cost Adjustments

It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings

According to the Energy Star calculator the water savings would be 162,060 gallons per year for an Energy Star steamer compared to a baseline steamer.

[129] Based on an average of the cost from the Energy Star calculator ($420) and $1,000 within the range of $0-$2500 from a National Grid presentation by Michael Pace.

5) Commercial Gas Griddle

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
Single or double sided gas griddle.

Definition of Baseline Condition
Cooking energy efficiency of 32% and Normalized Idle Energy Rate of 3,500 Btu/h per square foot[130].

Definition of Efficient Condition
Cooking energy efficiency greater than or equal to 38% and a Normalized Idle Energy Rate less than or equal to 2,650 Btu/h per square foot.

All criteria are the same as the ENERGY STAR label.

Gas Savings Algorithms
The following shows the expected gas savings from a commercial gas griddle meeting the above specifications. These savings come from the Energy Star calculator.[131]

$$Annual\ Gas\ Savings\ (MMBtu) = 14.90\ MMBtu$$

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
$\Delta kWh = 0\ kWh$

Demand Savings
$\Delta kW = 0\ kW$

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Commercial Gas Griddle	0%	0%

[130] From the Energy Star calculator

[131] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Commercial Gas Griddle	12

Sources: CA DEER, MA 2011 TRM, ENERGY STAR.

Measure Cost
The measure cost is the incremental cost of the efficient equipment compared to new baseline equipment. The incremental cost is $700.[132]

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
There are no water savings for this measure.

[132] Based on the range of costs from an Energy Star sales training presentation.

6) Pre-rinse Spray Valve

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
Commercial dishwasher pre-rinse spray valves use hot water under pressure to clean food items off plates, flatware, and other kitchen items before they are placed into a commercial dishwasher. Pre-rinse valves are handheld devices, consisting of a spray nozzle, a squeeze lever that controls the water flow, and a dish guard bumper. Often they include a spray handle clip, allowing the user to lock the lever in the full spray position for continual use. The pre-rinse valve is part of the pre-rinse unit assembly that typically includes an insulated handle, a spring supported metal hose, a wall bracket, and dual faucet valves. Pre-rinse valves are inexpensive and frequently interchangeable within different manufacturers' hose assemblies. They are usually placed at the entrance to a dishwasher and can also be located over a sink, used in conjunction with a faucet fixture.

Definition of Baseline Condition
The baseline is a standard pre-rinse spray valve using approximately 3 gpm.

Definition of Efficient Condition
An efficient pre-rinse spray valve uses an average of 1.6 gpm.

Gas Savings Algorithms
The following shows the expected gas savings from an energy efficient pre-rinse spray valve meeting the above specifications.[133]

$$Annual\ Gas\ Savings\ (MMBtu) = 33.6\ MMBtu$$

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
$\Delta kWh = 0\ kWh$

Demand Savings
$\Delta kW = 0\ kW$

Where:

ΔkWh = gross customer annual kWh savings for the measure.
ΔkW = gross customer summer load kW savings for the measure.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Pre-rinse Spray Valve	0%	0%

[133] Massachusetts 2011 Technical Reference Manual.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Pre-rinse Spray Valve	5[134]

Measure Cost
The incremental cost is $5.[135]

O&M Cost Adjustments
It is assumed that there are no O&M cost differences between the efficient and baseline equipment.

Water Savings
Expected water savings would be 62,305 gallons per year.[136]

[134] Massachusetts 2011 Technical Reference Manual.
[135] Based on a PG&E 2004 study.
[136] Massachusetts 2011 Technical Reference Manual.

VI. Non-Residential New Construction

A. All End Uses

1) Custom Measures

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure applies to all custom measures, not otherwise specified in this TRM.

Definition of Baseline Condition
The baseline represents the typical equipment that is installed without a DSM program. The efficiency level is based on the current Federal standards, or state and local building codes that are applicable.

Definition of Efficient Condition
The efficient measure is any equipment that uses less energy than the baseline equipment.

Gas Savings Algorithms
The generalized equation for a custom measure compares the baseline usage to the efficient usage.

$$Annual\ Gas\ Savings\ (MMBtu) = BaselineUse - EfficientUse$$

Where:

BaselineUse	=	The gas usage of baseline equipment or building.
EfficientUse	=	The gas usage of efficient equipment or building.

Electric Savings Algorithms

Energy Savings
$\Delta kWh = BaselinekWh - EfficientkWh$

Demand Savings
$\Delta kW = BaselinekW - EfficientkW$

Where:

ΔkWh	=	Gross customer annual kWh savings for the measure.
ΔkW	=	Gross customer summer load kW savings for the measure.
BaselinekWh	=	The electric kWh usage of baseline equipment or building.
EfficientkWh	=	The electric kWh usage of efficient equipment or building.

BaselinekW = The electric kW usage of baseline equipment or building.

EfficientkW = The electric kW usage of efficient equipment or building.

Freeridership/Spillover
Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Custom Measure	0%	0%

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
Where available, custom measure lifetimes should be based on similar measures defined elsewhere in this TRM.

Measure Cost
The measure cost is the incremental cost of the efficient equipment compared to the baseline equipment.

O&M Cost Adjustments
Any O&M cost differences between the new efficient and baseline equipment should be accounted for.

Water Savings
The water savings are the difference between the baseline and efficient equipment annual water usage in gallons.

VII. Non-Residential Retrofit

A. All End Uses

1) Custom Measures

Unique Measure Code(s): TBD
Draft date: 4/30/12
Effective date: TBD
End date: TBD

Measure Description
This measure applies to all custom retrofit measures, not otherwise specified in this TRM.

Definition of Baseline Condition
The baseline represents the existing equipment that is currently installed. The efficiency level is based on measurements or nameplate information.

Definition of Efficient Condition
The efficient measure is any equipment that uses less energy than the baseline equipment.

Gas Savings Algorithms
The generalized equation for a custom measure compares the baseline usage to the efficient usage.

$$Annual\ Gas\ Savings\ (MMBtu) = BaselineUse - EfficientUse$$

Where:

BaselineUse = The gas usage of baseline equipment or building.

EfficientUse = The gas usage of efficient equipment or building.

Electric Savings Algorithms

Energy Savings
$\Delta kWh = BaselinekWh - EfficientkWh$

Demand Savings
$\Delta kW = BaselinekW - EfficientkW$

Where:

ΔkWh = Gross customer annual kWh savings for the measure.

ΔkW = Gross customer summer load kW savings for the measure.

BaselinekWh = The electric kWh usage of baseline equipment or building.

EfficientkWh = The electric kWh usage of efficient equipment or building.

BaselinekW = The electric kW usage of baseline equipment or building.

EfficientkW = The electric kW usage of efficient equipment or building.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Custom Measure	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Where available, custom measure lifetimes should be based on similar measures defined elsewhere in this TRM.

Measure Cost

The measure cost is the full installed cost of the efficient equipment, including materials and installation labor.

O&M Cost Adjustments

Any O&M cost differences between the new efficient and existing baseline equipment should be accounted for.

Water Savings

The water savings are the difference between the baseline and efficient equipment annual water usage in gallons.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of PGW's DSM Implementation Plan FY 2013 upon the participants listed below in accordance with the requirements of § 1.54 (relating to service by a participant).

VIA EMAIL AND FIRST CLASS MAIL

Darryl Lawrence, Esq.
Christy Appleby, Esq.
Office of Consumer Advocate
5th Floor, Forum Place Bldg.
555 Walnut Street
Harrisburg, PA 17101-1921
dlawrence@paoca.org
cabbelby@paoca.org

Charis Mincavage, Esq.
McNEES, WALLACE, NURICK
100 Pine Street
P.O. Box 1166
Harrisburg, PA 17108-1166
cmincava@mwn.com

Sharon Webb, Esq.
Office of Small Business Advocate
Commerce Building, Suite 1102
300 North 2nd Street
Harrisburg, PA 17101
swebb@state.pa.us

Philip L. Hinerman, Esq.
Fox Rothschild LP
2000 Market St., 10th Fl.
Philadelphia, PA 19103-3291
phinerman@foxrothschild.com

Richard A. Kanaskie, Esq.
Bureau of Investigation and Enforcement
PA Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor
Harrisburg, PA 17120
rkanaskie@state.pa.us

Public Interest Law Center of Philadelphia
1709 Benjamin Franklin Parkway, 2nd Fl.
Philadelphia, PA 19103

Phillip Bertocci, Esq.
Thu B. Tran, Esquire
Community Legal Services
1424 Chestnut Street
Philadelphia, PA 19102
pbertocci@clsphila.org
ttran@clsphila.org

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Daniel Clearfield, Esq.