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May 7, 2013

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 the original of Philadelphia Gas Works' ("PGW") Fourth Year Implementation Plan, Fiscal Year 2014, for its Demand Side Management ("DSM") Program.

Please contact me if you have any questions

Very truly yours,

Daniel Clearfield

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

FOURTH YEAR IMPLEMENTATION PLAN

FISCAL YEAR 2014

MAY, 2013

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I. PORTFOLIO IMPLEMENTATION PLAN

A. Introduction

This Fourth Year Implementation Plan ("Plan") describes the processes and steps that Philadelphia Gas Works (PGW or "the Company") will follow to implement its EnergySense[1] Fiscal Year 2014 Demand-Side Management Portfolio (DSM Portfolio) as approved by the Pennsylvania Public Utility Commission ("PUC") by order entered July 29, 2010.[2] This plan also updates progress to date in FY 2013 for the Company's DSM Portfolio. In addition, this plan provides preliminary information on remaining implementation activities during the last year of PGW's 5-year DSM Plan.

From its inception, PGW's DSM Portfolio has been implemented to achieve 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

B. Summary of Portfolio Performance

This report projects results from the final two and a half years of implementing PGW's five-year DSM Plan. The following tables provide details on costs, gas savings, and economic benefits realized to date, and on projected outcomes for FY 2014 and 2015. Unless stated otherwise, cost-effectiveness results are indicated as present values calculated at a real discount rate of 2.88 percent, expressed in 2009 dollars for direct comparison with the economic performance objectives contained in the original 5-year DSM investment plan approved by the PUC. All budget and spending amounts in this implementation plan are stated in nominal (current-year) dollars. Gas savings are stated incrementally in millions of British Thermal Units (MMBTU), both annually and over the expected lifetimes of efficiency measures installed as a result of the programs. Levelized costs of gas DSM savings and avoided gas costs and prices are stated in constant 2013 dollars.

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[1] The DSM program was originally branded as "EnergySense" in FY 2011 for customer marketing purposes. The EnergySense brand now covers additional PGW customer programming beyond DSM. Only approved DSM program activities are funded through the DSM surcharge.

[2] PGW's Fiscal Year 2014 begins September 1st, 2013 and runs through August 31st, 2014

Over the full five years of the DSM Plan, PGW now expects to spend approximately $50.4 million on its six programs. The programs are projected to save 539 BBtus of natural gas during the first five years of the portfolio, and 11,087 BBtus of natural gas over the lifetime of the measures installed. For the natural gas system, the present value of benefits, in 2009 dollars, is $55.1 million leading to a present value of net benefits of $14.0 million and a benefit-cost ratio (BCR) of 1.34. From a total resource perspective, the present value of benefits, in 2009 dollars, is $65.9 million yielding net benefits of $13.4 million and nearly $1.25 in benefits for every $1 dollar spent. The results of both cost-effectiveness tests show that the DSM Portfolio is still amply cost-effective.

All data presented in this plan on progress to date is through February 28, 2013. Data on funds spent and recovered can be found in Appendix □I.

To date, total portfolio spending and gas savings again fell short of annual goals, and are expected to do so on a cumulative basis by the end of the five-year period covered by PGW's DSM Plan. Nonetheless, PGW can now report that to date, projected lifetime benefits from measures installed through February 2013 exceed cumulative costs incurred by PGW and participating customers. Not only has PGW's DSM portfolio become cost-effective from a total resource perspective, it has continued to increase the value provided by each dollar spent, while simultaneously increasing spending. This combination of enhanced cost-effectiveness and growing spending leads to progressively larger gains in net economic benefits from each year of continued implementation of the DSM Plan.

Cost-effectiveness analysis in this 2014 Implementation Plan relies on an updated and expanded analysis of avoided gas costs. Conducted by Resource Insight, the updated analysis finds that long-run avoided gas supply costs are expected to stabilize at roughly the same levels as in the previous study for the 2013 IP. On a levelized basis over the next 20 years, avoided gas costs are now projected at $5.93 to $7.94 per MMBtu, an average increase of 1.7% percent from the equivalent value used in last year's implementation plan.

The avoided cost analysis presented in this Implementation Plan also includes an alternative scenario with sources of additional economic value that PGW has not previously used in its analyses of DSM investment cost-effectiveness. This expanded analysis examines market impacts of reduced gas prices and risk, and avoided societal costs of greenhouse gas emissions due to reduced consumption. Including these additional benefits allows PGW to calculate a more accurate picture of the portfolio's full effect by quantifying values for measurable results.

Section G below presents and describes the updated avoided cost estimates uses to calculate the benefits of gas DSM savings resulting from planned program implementation; Appendix B details and documents their derivation. See Appendix □F for additional five-year projections broken down by year, as well as for comparisons with projections from the Fiscal Year 2013 plan.

Additional energy and environmental impacts projected from the full five years of portfolio implementation include:

- Saving 5.5 MWh per year of electricity[3]
- Avoiding 1,283 kW per year of summer peak demand
- Saving 50.5 million gallons of water per year
- Creating new jobs in Pennsylvania
- Reducing the emissions of CO_2 by over 37 thousand tons per year

In FY 2014, PGW plans to spend approximately $14.2 million on total delivery of all six launched DSM programs. PGW's administration costs come to $840,000, or 6% of the fourth year's budget.

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

C. Portfolio Budgets, Savings, and Cost-Effectiveness

1. Budgets

Pursuant to the PUC Settlement Order, PGW will maintain compliance within total portfolio-wide annual spending caps, as shown below in *Table 1*. While these budgets represent current plans for spending within the individual programs to ensure compliance with that overall portfolio cap, there are no specific spending caps on individual programs. Additionally, incentive spending within the individual programs depends 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' relative effectiveness and market reception, while still maintaining the overall portfolio cap as set forth by the Settlement order.

Table 1 –Costs by Program from Inception through February, 2013 (Nominal)

Program	Inception to Feb 28, 2013
Enhanced Low Income Retrofit	$12,326,911
Residential Heating Equipment Rebates	$792,909
Comprehensive Residential Retrofit Incentives	$-
High Efficiency Construction Incentives (Residential)	$-
Residential Total	**$13,119,820**
Commercial and Industrial Retrofit Incentives	$62,364
Commercial and Industrial Equipment Rebates	$98,356
High Efficiency Construction Incentives (Nonresidential)	$42,420
Non-residential Total	**$203,139**
Portfolio-wide Costs	$1,466,134
UTILITY TOTAL	**$14,789,093**
Participant Costs	$732,971
Total	**$15,522,064**

Table 2 – Portfolio Costs by Category from Inception through February 2013 (Nominal)

Category	Inception to Feb 28, 2013
Customer Incentives	$9,827,730
Administration and Management	$1,501,860
Marketing and Business Development	$133,880
Contractor Costs	$3,239,346
Inspection and Verification	$64,477
On-site Technical Assessment	$-
Evaluation	$21,800
UTILITY TOTAL	**$14,789,093**
Participant Costs	$732,971
Total	**$15,522,064**

Table 3–Projected Budgets by Program for FY 2014 (Nominal)

PROGRAM	FY 2014
Enhanced Low Income Retrofit	$7,600,000
Residential Heating Equipment Rebates	$1,457,253
Comprehensive Residential Retrofit Incentives	$2,654,597
High Efficiency Construction Incentives – Residential	$189,554
Residential Total	**$11,901,404**
Commercial and Industrial Retrofit Incentives	$745,953
Commercial and Industrial Equipment Rebates	$567,539
High Efficiency Construction Incentives – Nonresidential	$189,554
Commercial & Industrial Total	**$1,503,047**
Portfolio Administration and Management	$788,924
Portfolio Marketing and Business Development	$50,000
Portfolio-Wide Costs Total	**$838,924**
Utility Costs	**$14,243,375**
Participant Costs	$6,079,635
Total	**$20,323,010**

Table 4 - Projected Portfolio Budget by Cost Category for FY 2014 (Nominal)

Category	FY 2014
Customer Incentives & Measure Installation Costs	$10,590,598
Administration and Management	$805,924
Marketing and Business Development	$452,937
Contractor Costs	$2,134,670
Inspection and Verification	$176,440
Evaluation	$82,806
Utility Costs	**$14,243,375**
Participant Costs	$6,079,635
Total	**$20,323,010**

Table 5 – Five-Year Budget and Spending Reconciliation[4] (Nominal)

Year	Budgets		Budget Caps	Difference	
	Source	Amount		$	%
FY 2011	*Actual*	$3,519,825	$7,980,380	$(4,460,555)	-56%
FY 2012	*Actual*	$7,117,170	$8,293,780	$(1,176,610)	-14%
FY 2013	*FY 14 IP*	$10,386,588	$14,048,020	$(3,661,432)	-26%
FY 2014	*FY14 IP*	$14,243,375	$16,102,544	$(1,859,169)	-12%
FY 2015	*FY14 IP*	$15,132,372	$17,282,496	$(2,150,124)	-12%
FY 2011 - 15		**$50,399,329**	**$63,707,220**	**$(13,307,891)**	**-21%**

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

Table 6- Projected FY 2011-2015 Budgets with Portfolio-Wide Costs Allocated to Programs[5] (Nominal)

PROGRAM	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Enhanced Low Income Retrofit	$3,419,901	$6,584,137	$8,274,413	$8,071,824	$8,045,998	$34,396,273
Residential Heating Equipment Rebates	$66,569	$436,155	$802,143	$1,548,159	$1,603,600	$4,456,625
Comprehensive Residential Retrofit Incentives	$19,725	$21,074	$638,921	$2,823,110	$3,330,834	$6,833,663
Commercial and Industrial Retrofit Incentives	*$5,493*	*$52,559*	*$231,551*	*$792,427*	*$816,913*	*$1,898,943*
Commercial and Industrial Equipment Rebates	$4,867	$19,750	$312,379	$603,838	$739,243	$1,680,078
High Efficiency Construction Incentives	$3,270	$3,494	$127,181	$404,018	$595,784	$1,133,746
TOTAL PORTFOLIO	**$3,519,825**	**$7,117,170**	**$10,386,588**	**$14,243,375**	**$15,132,372**	**$50,399,329**

[5]See Appendix □F for budgets in Constant 2009 $ for comparison

2. Savings

a) Gas savings

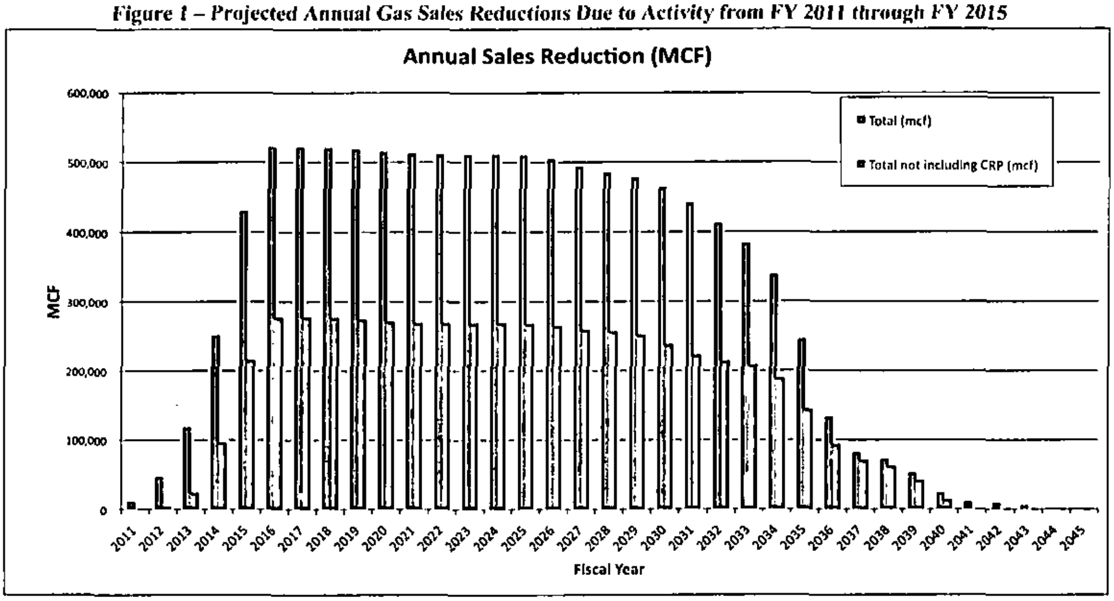
Table 7– Natural Gas Savings from Inception through February 2013

Program	Incremental Net Annual Gas Savings (MMBtus/yr)	Incremental Net Lifetime Gas Savings (MMBtus)
Enhanced Low Income Retrofit	92,005.2	1,929,811.3
Residential Heating Equipment Rebates	16,735.7	371,369.0
Comprehensive Residential Retrofit Incentives	-	-
High Efficiency Construction Incentives (Residential)	-	-
Residential Total	**108,740.9**	**2,301,180.3**
Commercial and Industrial Retrofit Incentives	-	-
Commercial and Industrial Equipment Rebates	3,868.2	96,704.4
High Efficiency Construction Incentives (Nonresidential)	-	-
Non-residential Total	**3,868.2**	**96,704.4**
PORTFOLIO TOTAL	**112,609.1**	**2,397,884.7**

Table 8 - Projected Natural Gas Savings for FY 2014

Program	Incremental Net Annual Gas Savings (MMBtus/yr)	Incremental Net Lifetime Gas Savings (MMBtus)
Enhanced Low Income Retrofit	63,564.1	1,334,846
Residential Heating Equipment Rebates	45,501.6	1,010,015
Comprehensive Residential Retrofit Incentives	35,582.7	747,237
High Efficiency Construction Incentives (Residential)	2,134.9	42,699
Residential Total	**146,783.3**	**3,134,797**
Commercial and Industrial Retrofit Incentives	11,700.0	187,200
Commercial and Industrial Equipment Rebates	19,904.9	316,144
High Efficiency Construction Incentives (Nonresidential)	2,134.9	42,699
Non-residential Total	**33,739.9**	**546,043**
PORTFOLIO TOTAL	**180,523.2**	**3,680,839**

Figure 1 – Projected Annual Gas Sales Reductions Due to Activity from FY 2011 through FY 2015



The projections in Figure 1 show the projected effect in a given year from DSM activity occurring in FYs 2011 through 2015. The reduction in sales increases as program activity ramps up, leveling off after FY 2015, and then gradually falling as measures reach the end of their lifetimes. These projections were developed using individual measure savings calculations and measure lifetimes (as documented in the attached PGW Technical Reference Manual) and penetrations for each measure during the FY 2011 through FY 2015. The gas sales reductions in Figure 1 account for the time difference between when the measure is installed and when a full year's worth of reductions are accrued. For the values in Figure 1 please see Appendix □G.

b) Non-Gas Savings

Table 9–Non-Gas Savings from Inception through February 2013

PROGRAM	Inception to February 28, 2013			
	Incremental Net Annual Electricity Savings (MWh)	Incremental Net Lifetime Electricity Savings (MWh)	Incremental Net Summer Peak Demand Savings (kW)	Incremental Net Annual Water Savings (Million Gallons)
Enhanced Low Income Retrofit	1,085.5	24,645.5	411.6	5.0
Residential Heating Equipment Rebates	93.8	1,876.0	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	**1,179.3**	**26,521.5**	**411.6**	**5.0**
Commercial and Industrial Retrofit Incentives	0.0	0.0	0.0	0.0
Commercial 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	**1,179.3**	**26,521.5**	**411.6**	**5.0**

Table 10–Projected Non-Gas Savings for FY 2014

PROGRAM	FY 2014			
	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	594.4	12,481.5	218.8	2.6
Residential Heating Equipment Rebates	233.3	4,666.7	0.0	0.0
Comprehensive Residential Retrofit Incentives	346.0	0.0	0.0	1.4
High Efficiency Construction Incentives - Residential	0.0	0.0	0.0	0.0
Residential Total	**1,173.7**	**17,148.2**	**218.8**	**4.0**
Commercial and Industrial Retrofit Incentives	650.0	10,400.0	0.0	6.5
Commercial and Industrial Equipment Rebates	0.0	0.0	0.0	8.1
High Efficiency Construction Incentives - Nonresidential	0.0	0.0	0.0	0.0
Commercial & Industrial Total	**650.0**	**10,400.0**	**0.0**	**14.6**
Total Portfolio	**1,823.7**	**27,548.2**	**218.8**	**18.6**

3. Cost-Effectiveness

a. Results to date

From inception through February 28th, 2013, the EnergySense portfolio shows a TRC Benefit-Cost Ratio (BCR) of 1.06, and a Present Value (PV) of Net Benefits of $752,850 (2009 dollars). The portfolio has had a slower than anticipated ramp-up period, but trends to date demonstrate steady improvement in terms of BCR and PV Net Benefits through the latest year of program activities.

The ELIRP program has been the lead program in PGW's DSM portfolio. It has now surmounted its prolonged ramp-up to achieve a cumulative BCR of 1.10. ELIRP is clearly trending towards planned cost-effectiveness.

The RHER program has also been cost-effective so far, with a BCR of 1.53; however, the program continues to experience lower than anticipated participation levels, which has resulted in relatively low PV Net Benefits to date. RHER participation is also trending upwards.

On the non-residential side, the CIER program has likewise shown strong cost-effectiveness accompanied by small net benefits due to low participation. Initial program participation has begun for commercial boiler rebates within the CIER program. The CIRI and HECI programs have incurred start-up and ongoing overhead costs; since no projects had closed by the end of this reporting period, there are no benefits to report for these programs in this Plan.

Overall EnergySense portfolio cost-effectiveness will continue to trend upwards towards targeted levels as ELIRP performance continues to improve and net benefits continue to grow with higher participation in other programs. These individual programs' cost-effectiveness will be discussed in greater detail in the respective sections below.

Table 11–Cost-Effectiveness Results from Inception through February 2013 (2009$)

Program	Total Resource Cost Test				% Of Total	
	PV of Benefits	PV of Costs	PV of Net Benefits	BCR	PV of Benefits	PV of Costs
:etrofit	$11,928,919	$10,870,594	$1,058,326	1.10	83%	80%
ipment Rebates	$1,999,333	$1,309,995	$689,338	1.53	14%	10%
tial Retrofit Incentives	$-	$-	$-		0%	0%
:tion Incentives (Residential)	$-	$-	$-		0%	0%
	$13,928,252	**$12,180,589**	**$1,747,663**	**1.14**	**97%**	**89%**
ial Retrofit Incentives	$-	$53,606	$(53,606)	-	0%	0%
ial Equipment Rebates	$483,044	$93,731	$389,314	5.15	3%	1%
:tion Incentives (Nonresidential)	$-	$36,517	$(36,517)	-	0%	0%
ıl	**$483,044**	**$183,853**	**$299,191**	**2.63**	**3%**	**1%**
	$-	$1,294,005	$(1,294,005)	-	0%	9%
PORTFOLIO TOTAL	**$14,411,296**	**$13,658,447**	**$752,850**	**1.06**	**100%**	**100%**

Program	Gas Administrator Test				% Of Total	
	PV of Benefits	PV of Costs	PV of Net Benefits	BCR	PV of Benefits	PV of Costs
:etrofit	$9,823,946	$10,870,594	$(1,046,648)	0.90	81%	83%
ipment Rebates	$1,889,455	$688,173	$1,201,283	2.75	15%	5%
tial Retrofit Incentives	$-	$-	$-		0%	0%
:tion Incentives (Residential)	$-	$-	$-		0%	0%
	$11,713,401	**$11,558,766**	**$154,635**	**1.01**	**96%**	**89%**
ial Retrofit Incentives	$-	$53,606	$(53,606)	-	0%	0%
ial Equipment Rebates	$483,044	$82,890	$400,154	5.83	4%	1%
:tion Incentives (Nonresidential)	$-	$36,517	$(36,517)	-	0%	0%
ıl	**$483,044**	**$173,013**	**$310,032**	**2.79**	**4%**	**1%**
	$-	$1,294,005	$(1,294,005)	-	0%	10%
PORTFOLIO TOTAL	**$12,196,445**	**$13,025,783**	**$(829,338)**	**0.94**	**100%**	**100%**

Figure 2 – Cumulative Monthly TRC Net Benefits by Program

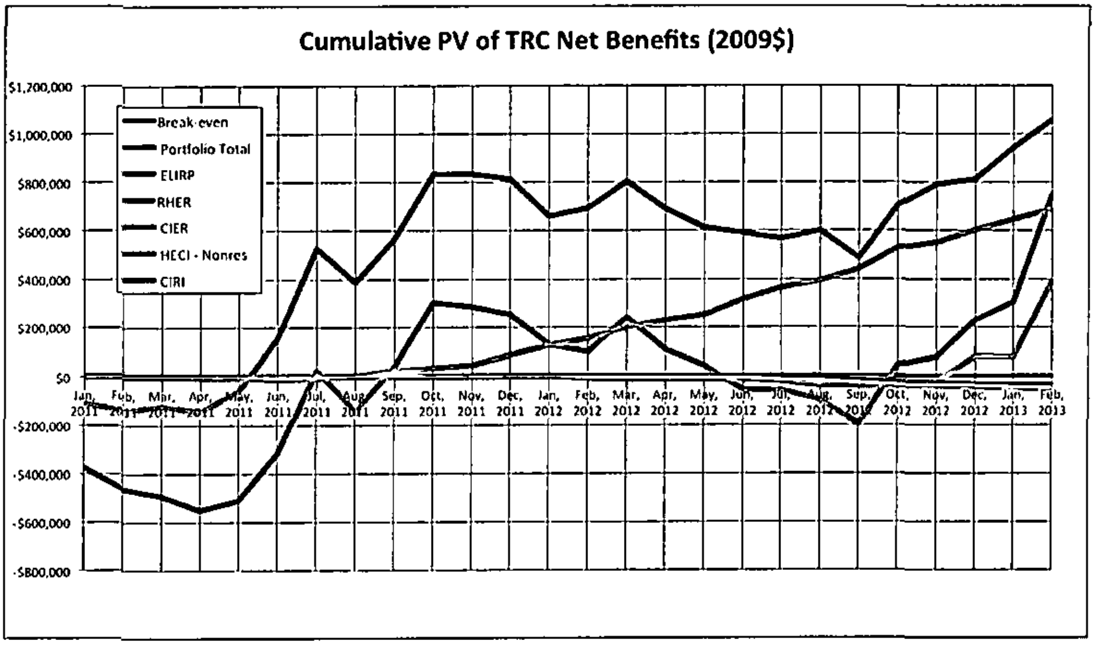
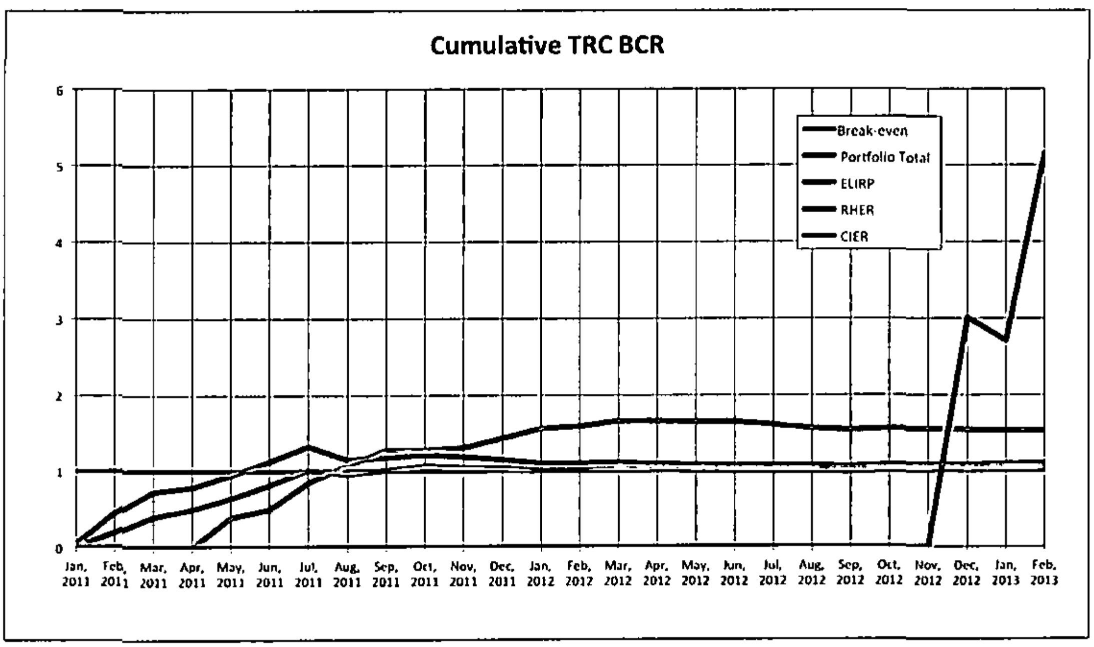


Figure 2 – Cumulative Monthly TRC BCR by Program



b. Projected Performance

Table 12–Projected Cost-Effectiveness Results FY 2011 – FY 2015 (2009$)

Program	Total Resource				% of Total	
	PV Benefits	PV Costs	PV Net Benefits	BCR	PV Benefits	PV Costs
Enhanced Low Income Retrofit	$31,829,889	$26,252,351	$5,577,538	1.21	48%	50%
Residential Heating Equipment Rebates	$13,513,044	$9,411,293	$4,101,751	1.44	21%	18%
Comprehensive Residential Retrofit Incentives	$10,136,069	$9,093,051	$1,043,018	1.11	15%	17%
High Efficiency Construction Incentives (Residential)	$510,637	$470,906	$39,731	1.08	1%	1%
Residential Total	**$55,989,638**	**$45,227,600**	**$10,762,038**	**1.24**	**85%**	**86%**
Commercial and Industrial Retrofit Incentives	$4,759,755	$2,251,004	$2,508,751	2.11	7%	4%
Commercial and Industrial Equipment Rebates	$4,604,400	$1,490,623	$3,113,777	3.09	7%	3%
High Efficiency Construction Incentives (Nonresidential)	$510,637	$470,906	$39,731	1.08	1%	1%
Commercial & Industrial Total	**$9,874,792**	**$4,212,533**	**$5,662,259**	**2.34**	**15%**	**8%**
Portfolio-wide Costs		$3,054,109	$(3,054,109)	n/a	0%	6%
Total Portfolio	**$65,864,430**	**$52,494,242**	**$13,370,188**	**1.25**	**100%**	**100%**

Program	Gas Administrator				% of Total	
	PV Benefits	PV Costs	PV Net Benefits	BCR	PV Benefits	PV Costs
Enhanced Low Income Retrofit	$26,750,060	$26,252,351	$497,710	1.02	49%	64%
Residential Heating Equipment Rebates	$12,809,993	$3,320,352	$9,489,641	3.86	23%	8%
Comprehensive Residential Retrofit Incentives	$8,576,210	$4,984,717	$3,591,493	1.72	16%	12%
High Efficiency Construction Incentives (Residential)	$510,637	$413,116	$97,521	1.24	1%	1%
Residential Total	**$48,646,900**	**$34,970,535**	**$13,676,365**	**1.39**	**88%**	**85%**
Commercial and Industrial Retrofit Incentives	$2,076,543	$1,392,094	$684,449	1.49	4%	3%
Commercial and Industrial Equipment Rebates	$3,880,725	$1,237,747	$2,642,978	3.14	7%	3%
High Efficiency Construction Incentives (Nonresidential)	$510,637	$413,116	$97,521	1.24	1%	1%
Commercial & Industrial Total	**$6,467,905**	**$3,042,958**	**$3,424,948**	**2.13**	**12%**	**7%**
Portfolio-wide Costs		$3,054,109	$(3,054,109)	n/a	0%	7%
Total Portfolio	**$55,114,805**	**$41,067,603**	**$14,047,203**	**1.34**	**100%**	**100%**

Table 13-Comparison of Current TRC Projections to FY 2013 Projections (2009$)

Program	FY 2013 IP - PV Net Benefits		FY 2014 IP - PV Net Benefits		Difference	
	Total Resource	Gas Energy System	Total Resource	Gas Energy System	Total Resource	Gas Energy System
Enhanced Low Income Retrofit	$5,883,025	$1,120,314	$5,577,538	$497,710	$(305,487)	$(622,604)
Residential Heating Equipment Rebates	$8,060,850	$14,133,763	$4,101,751	$9,489,641	$(3,959,100)	$(4,644,122)
Comprehensive Residential Retrofit Incentives	$2,130,230	$3,102,641	$1,043,018	$3,591,493	$(1,087,212)	$488,852
High Efficiency Construction Incentives (Residential)	$336,325	$406,754	$39,731	$97,521	$(296,594)	$(309,233)
Residential Total	**$16,410,431**	**$18,763,472**	**$10,762,038**	**$13,676,365**	**$(5,648,393)**	**$(5,087,107)**
Commercial and Industrial Retrofit Incentives	$1,300,841	$2,979,812	$2,508,751	$684,449	$1,207,910	$(2,295,363)
Commercial and Industrial Equipment Rebates	$7,270,397	$3,483,949	$3,113,777	$2,642,978	$(4,156,620)	$(840,971)
High Efficiency Construction Incentives (Nonresidential)	$336,325	$406,754	$39,731	$97,521	$(296,594)	$(309,233)
Commercial & Industrial Total	**$8,907,563**	**$6,870,514**	**$5,662,259**	**$3,424,948**	**$(3,245,303)**	**$(3,445,567)**
Portfolio-wide Costs	$(3,459,866)	$(3,459,866)	$(3,054,109)	$(3,054,109)	$405,757	$405,757
Total Portfolio	**$21,858,128**	**$22,174,120**	**$13,370,188**	**$14,047,203**	**$(8,487,940)**	**$(8,126,917)**

The cost-effectiveness projections reported here incorporate actual activity for FY 2011, FY 2012, and FY 2013 through February 28, 2013, as well as updated projections for the rest of FY 2013 and FY 2014 through FY 2015 from this plan. The main changes in net benefits are due to:

- Slower than expected ramp-up in program activity, which led to lower gas savings and under-spending budgets in FY 2011 and 2012
- Revised participation assumptions for RHER and CIER that significantly drop program participation levels, budgets, and gas savings.
- Updated assumptions for HECI, CIRI, and CRRI projects based on additional research and actual projects in the program pipelines.

Table 14 presents an alternative evaluation by expanding the cost-effectiveness analysis of projected portfolio performance to include the additional value estimated by Resource Insight for the combined effects of reduced gas prices, gas price risk, and carbon emissions. These results should be compared to Table 12, since, in addition to the standard benefit estimates generally used in Pennsylvania, PGW is also quantifying the value of three sources of real economic value to PGW and Pennsylvania utility ratepayers from gas DSM savings:

1. Reductions in future gas prices caused by DSM reductions in market demand.
2. Reductions in gas supply and price risk as a result of lower PGW system gas demand
3. Avoided societal costs of greenhouse gas emissions due to reduced gas consumption.

Taken together, these newly quantified sources of value amount to an additional $10 million in 2009 present worth.[6] Additional details on how values for demand-reduction-induced price effect (DRIPE) and CO2 were developed can be found in Appendix B.

Table 14 - Projected Cost-effectiveness Results for FY 2011 – 2015 (including value of DRIPE and CO2)

Program	Total Resource				% of Total	
	PV Benefits	PV Costs	PV Net Benefits	BCR	PV Benefits	PV Costs
Enhanced Low Income Retrofit	$36,519,197	$26,252,351	$10,266,847	1.39	48%	50%
Residential Heating Equipment Rebates	$15,973,024	$9,411,293	$6,561,731	1.70	21%	18%
Comprehensive Residential Retrofit Incentives	$11,766,331	$9,093,051	$2,673,280	1.29	16%	17%
High Efficiency Construction Incentives – Residential	$604,646	$470,906	$133,741	1.28	1%	1%
Residential Total	**$64,863,198**	**$45,227,600**	**$19,635,598**	**1.43**	**85%**	**86%**
Commercial and Industrial Retrofit Incentives	$5,111,453	$2,251,004	$2,860,449	2.27	7%	4%
Commercial and Industrial Equipment Rebates	$5,317,213	$1,490,623	$3,826,590	3.57	7%	3%
High Efficiency Construction Incentives - Nonresidential	$604,646	$470,906	$133,741	1.28	1%	1%
Commercial & Industrial Total	**$11,033,313**	**$4,212,533**	**$6,820,780**	**2.62**	**15%**	**8%**
Portfolio-wide Costs		$3,054,109	$(3,054,109)	n/a	0%	6%
Total Portfolio	**$75,896,511**	**$52,494,242**	**$23,402,269**	**1.45**	**100%**	**100%**

[6] Approximately $1.3 million of the $10 million in additional benefits comes from DRIPE. The remaining $8.7 million in benefits accrue from avoided CO2 emissions.

D. Plan Development

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 previous Implementation Plans, outlines progress that has been made to date in FY 2013, and provides details on projected program activities in FY 2013.

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

1. Portfolio-wide changes

- Avoided costs for natural gas were updated. Values in the next few years rise somewhat, but are offset by lower avoided costs in the future.
- Avoided costs for water savings were updated to more closely reflect water costs in the Philadelphia area. Updated water avoided costs are approximately 30% lower.
- The real discount rate used for cost-effectiveness analysis was updated to 4.94 percent from 5.32 percent in FY 2013 to reflect PGW's latest actual cost of capital.
- The Technical Reference Manual (TRM) was further developed to include calculations for the CRRI program. The updated TRM can be found in Appendix □J.

2. Program-specific changes

ELIRP

- 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

- On November 19, 2012, AHRI changed its testing requirements for modulating condensing residential boilers, which resulted in lower AFUE ratings making some products ineligible for PGW rebates that were previously available. PGW informed its contractor network of this change and instituted a grace period so that any down-rated boilers purchased before December 31, 2012 would be approved.
- Future targeted participation levels reduced based on actual activities to date.

CIRI

- The program is expanding beyond its initial focus on multi-family building retrofits to branch out to additional commercial and industrial retrofit opportunities.

- Marketing plans were updated to bolster program participation.

CIER

- Projections have been updated to reflect knowledge gained from current market activity.

- Rebate issuance protocols were updated to provide for commercial boilers that exceed the prescriptive rebate equipment sizes.

HECI

- Incentive designs were updated and finalized, resulting in a two-track system; a streamlined and prescriptive approach for single-family residential projects, and a more customized approach for commercial and industrial projects.

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

CRRI

- The detailed program design was finalized, including the establishment of a conservation service provider (CSP) administrator and a network of certified CSPs.

- The financial incentive design was finalized to offer customers a subsidized audit with performance-based incentives to both the customer and contractor for completed projects.

- PGW established a partnership with Keystone HELP to provide low-interest financing to participants.

E. Coordination Activities

PGW continually 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. In addition to the Keystone HELP partnership for CRRI, 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 21 local, unemployed entry-level workers through this partnership. PGW is finalizing a similar arrangement for the CRRI program.

- PGW has partnered with the Clean Air Council in applying for grants 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 was 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.
- Cross-promotional opportunities are being developed with other energy-efficiency programs, most notably EnergyWorks and Keystone HELP, 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.
- PGW is developing a partnership with Habitat for Humanity's Home Repair and Weatherization program, focusing on North Philadelphia neighborhoods. In situations where a home is a candidate for both Habitat and ELIRP services, the goal is for Habitat to focus on primarily health, safety and structural issues. Habitat's remediation of these issues, such as mold, knob and tube wiring and roof repairs, will open additional opportunities for PGW to further weatherize homes.

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 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 2014:

- RHER Impact evaluation was rescheduled for Fall, 2013 in order to capture a larger sample size of program activity aligned with the program's full 18 month long implementation period.

- CIRI Impact evaluation (start September, 2013)

G. Key Assumptions

i) Avoided Costs

PGW has updated its assumptions for the natural gas commodity portion of avoided costs as part of the detailed program design process in July 2010, March 2011, March 2012, and most recently March 2013.[7] The updated avoided costs were largely unchanged

[7] See Appendix B for table of updated avoided costs

compared to the previous year's estimates. Costs for 2013 through 2015 were slightly higher, while costs between 2016 and 2033 dropped slightly before going increasing. Table 15 shows the average annual drop in projected avoided cost over various time frames.

Table 15 - Average Annual Percentage Change in Avoided Costs

Year	Space Heating	Baseload	Water Heating
March 2012 to March 2013			
2013 - 2016	7.4%	3.2%	4.5%
2017 - 2021	0.2%	-4.5%	-3.1%
2022 - 2031	-1.0%	-4.3%	-3.3%
2013 - 2031	**0.9%**	**-2.9%**	**-1.8%**
March 2011 to March 2013			
2012 - 2016	-6.0%	-18.7%	-14.8%
2017 - 2021	-12.9%	-26.3%	-22.3%
2022 - 2031	-11.3%	-22.2%	-19.3%
2013 - 2031	**-10.4%**	**-22.3%**	**-18.9%**
September 2009 to March 2013			
2012 - 2016	-25.1%	-37.2%	-33.8%
2017 - 2021	-26.2%	-36.8%	-33.8%
2022 - 2031	-27.6%	-34.6%	-32.7%
2013 - 2031	**-26.7%**	**-35.7%**	**-33.2%**

PGW once again plans to update avoided costs next year for the FY 2015 Implementation Plan.

PGW has also provided an alternative, expanded scope of Resource Insight's analysis of avoided costs to estimate the economic value of wholesale price reduction caused by demand reductions resulting from energy-efficiency improvements. These demand reduction induced price effects (DRIPE) of natural gas DSM reflect the same market dynamics as the swings in gasoline prices that result from seasonal and secular variation in gasoline demand. Natural gas DRIPE varies over time and scope of the analysis. RII's estimate of gas DRIPE for Pennsylvania ranges from $0.13 to $0.37 per MMBtu (in 2013 dollars).

Resource Insight also provided current estimates of the long-run value of reduced greenhouse gas emissions resulting from gas DSM. Starting in 2020, on a levelized basis over 20 years, this value is projected at $2.36/MMBtu.

The avoided costs components of DRIPE and greenhouse gas emissions are not reflected in Table 15 above. However, the values are reflected in Table 14 in order to show the impact from these additional considerations.

In addition to updating avoided gas supply costs, PGW has updated assumptions for the avoided cost of water going forward. The new avoided costs for water are based on average delivery and wastewater treatment costs per gallon from the Philadelphia Water Department. The new costs are approximately 30% lower than older assumptions. While not a primary benefit, water savings play a part in the total resource cost perspective of cost-effectiveness. The following table shows the updated avoided costs of water supply.

Table 16 – Avoided Cost of Water

Calendar Year	Average Rate (2013$/Gallon)
2013	$0.0072
2014	$0.0075
2015+	$0.0077

ii) Benefit-Cost Analysis

The cost-effectiveness results reported in this plan were calculated using standard industry practice for conducting the Total Resource Cost (TRC) and Gas Program Administrator tests for cost-effectiveness. The Company employed the Microsoft Excel workbook- tool developed by GEEG to assess the cost-effectiveness of the DSM Portfolio.

The analysis used a real discount rate (RDR) of 2.88%. The RDR was calculated using assumptions of a nominal discount rate (NDR) of 4.935% and a future inflation rate of 2.0%. The inflation assumption has remained constant, while the nominal discount rate has been updated to reflect PGW's true average weighted cost of capital.

iii) Technical Reference Manual

PGW has prepared the *FY 2014 version of its Technical Reference Manual* (TRM), which is included as Appendix J. 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 will continue to be updated as technical information changes or new information becomes available.

II. Program Plans

This section provides details on completed and planned implementation activities in FY 2014 for all six DSM programs comprising PGW's EnergySense Portfolio:

- The Enhanced Low Income Retrofit Program (ELIRP)
- The Residential Heating Equipment Rebate Program (RHER)
- The Commercial and Industrial Retrofit Program (CIRI)
- The Commercial and Industrial Equipment Rebate Program (CEIR)T
- The High Efficiency Construction Incentive Program (HECI)
- The Comprehensive Residential Retrofit Incentive Program (CRRI)

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 efficient heating systems as feasible
- Providing comprehensive weatherization services as feasible
- 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, Savings and Benefits

As of February 28, 2013, ELIRP has been treating customer houses for slightly over two full years. A summary of results is presented in the tables below.

Table 17 - ELIRP Impacts from Inception to Date

	Actual Results (Inception to 2/28/2013)
PARTICIPATION	
Closed Cases – Full	2,352
Closed Cases - Partial/Rejected	1,097
Customers with Installations	3,449
COSTS	
Measure Installation Costs	$9,222,621
Administration and Management	$37,477
Marketing and Business Development	$-
Contractor Costs	$2,998,084
Inspection and Verification	$63,377
Evaluation	$5,353
Utility Costs	***$12,326,911***
Participant Costs	$-
Total	**$12,326,911**
BENEFITS	
Net Annual BBtu	92.0
Net Lifetime BBtu	2,204.5
Net Annual MMBtu / Customer	26.7
Weighted Lifetime (years)	24.0

<u>Program Costs</u>

$26,000 of the Low Income program budget remained unspent at the close of FY 2012 due to unspent inspections funding. As was the case for unspent FY 2011 program funding, all over-collections resulting from FY 2012 EnergySense activity are being refunded to the appropriate customer classes in FY 2013.

Approximately $3.1 million worth of the Low Income program budgets were left unspent from inception through close of FY 2011. 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 FY 2015 ELIRP budget, 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.

<u>Program Savings</u>

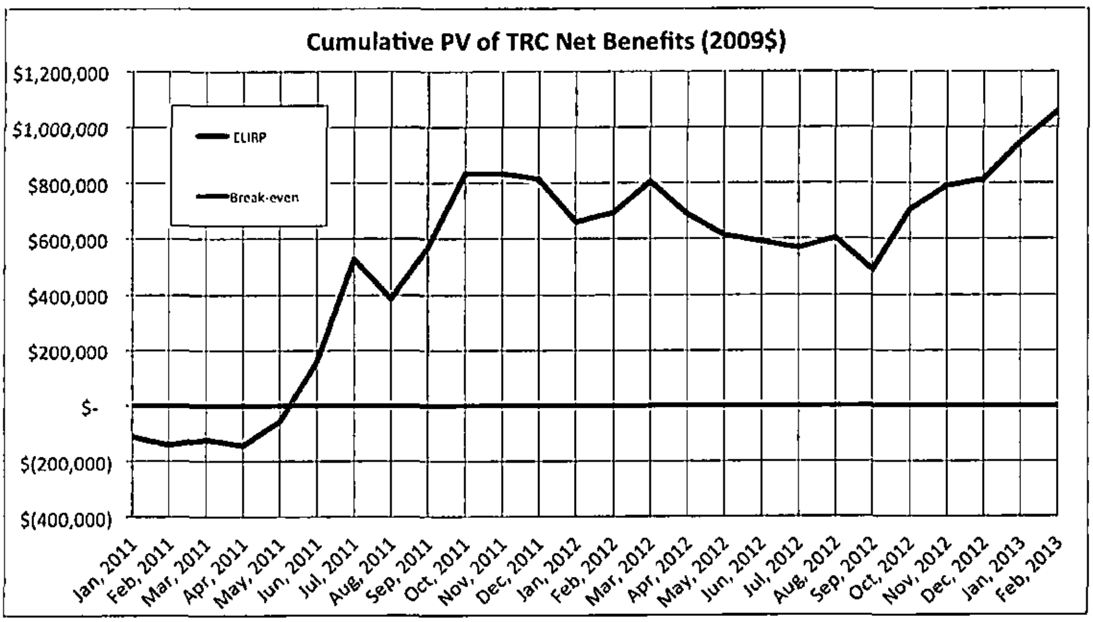
ELIRP continues to perform comprehensive weatherization projects on high users enrolled in PGW's Customer Responsibility Program. Contractor evaluations at the end of Fiscal Year 2013 resulted in a significant shifting of money between contractors and a focus on a more steady flow of program activity. On average, ELIRP projects are saving 24 MMBtus, an average of 12 percent savings per home. Homes that receive a more comprehensive treatment are achieving 31.5 MMBtus, 15.5 percent usage, while homes receiving a more limited treatment are seeing savings of 8.2 MMBtus, 4.4 percent of usage. Over two-thirds of participants are receiving comprehensive treatments.

Program Cost-Effectiveness to Date

ELIRP cost-effectiveness has continued to improve since inception. Currently, ELIRP has generated TRC benefits with a present value of $11.9 million (2009 dollars), against the present value costs PGW incurred of $10.9 million (2009 dollars), for a present value of net benefits of $1.0 million (2009 dollars) and a BCR of 1.10. Figure 3 shows how the cumulative net benefits have amassed since implementation inception.

By the end of the five-year program plan, PGW expects ELIRP to generate $5.6 million in PV net benefits, for a cumulative BCR of 1.21. This figure is approximately $300,000 less than goals established in the FY 2013 IP as shown previous in Table 13, due mainly to re-characterizing average project estimates going forward based on actual results achieved so far in FY 2013. Figure 3 shows the cumulative net TRC benefits for ELIRP since inception. The decreased effectiveness towards the latter half of FY2012 was due to specific performance issues with one of the program contractors. That issue was addressed through funding reallocations, as explained in section IV below, which resulted in significant performance improvement beginning with the start of FY 2013.

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 two and half years. Specifically, PGW has decreased the average savings and spending per project, while maintaining almost the same cost per MMBtu of gas savings. This has led to an increase in the number of participants required to meet savings and spending goals. Additionally, the portion of costs absorbed by contractor overhead has been increased from 15 percent to 20 percent based on the past two and half years of experience.

The ELIRP program aims to serve 2,155 customers in FY 2014, with associated annualized gas savings of 63.6 BBtus, or 29.3 MMbtu/customer. In FY 2014, the program is projected to cost $7.6 million. The following table shows a breakout of participation, costs, and savings.

Table 18 - Projected ELIRP Impacts for FY 2014

	Projected (FY 2014)
PARTICIPATION	
Open Cases	n/a
Closed Cases – Full	n/a
Closed Cases - Partial/Rejected	n/a
Customers with Installations	2,155
COSTS	
Measure Installation Costs	$6,006,400
Administration and Management	$17,000
Marketing and Business Development	$-
Contractor Costs	$1,501,600
Inspection and Verification	$75,000
Evaluation	$-
Utility Costs	**$7,600,000**
Participant Costs	$-
Total	**$7,600,000**
SAVINGS	
Net Annual BBtu	63.6
Net Lifetime BBtu	1,334.8
Net Annual MMBtu / Customer	29.3
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 has generated both immediate, short-term improvements by directing funding to those who have proven most capable of effectively implementing the program, and an ongoing incentive to drive longer-term performance improvements.

The competitive reallocation process 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.

Four rounds of CSP performance evaluations and resulting funding reallocations have been conducted to date, based on a semi-annual cycle of the first annual evaluation held immediately preceding the beginning of a new Fiscal Year, and the second annual evaluation held at the Fiscal Year's midway point. These four evaluations to date have resulted in the total reallocation of over $4 million amongst the three ELIRP CSPs, as compared to original contractor allocation figures. The pre-FY 2013 evaluation alone resulted in the reallocation of $2.7mm, or 41% of the total annual FY 2013 program funding.

The next round of performance evaluations is currently scheduled for the summer of 2013, to set CSP funding allocations for FY 2014, which begins September 1, 2013. PGW expects to continue the semi-annual evaluations and reallocations to motivate CSPs to continue improving performance. However, going forward, the mid-year reallocation may likely result in significantly less reallocation amounts, with the pre-FY reallocation serving as the primary tool for appropriately setting funding levels at the start of each program year.

v) *Target Market and Program Eligibility*

To be eligible for ELIRP customers must be currently enrolled in PGW's CAP, the Customer Responsibility Program (CRP). Additionally, PGW has targeted customers in the highest gas usage tiers.[8] PGW added two additional criteria for PGW's second pool of prospective participants, developed in August 2011:

- Customer cannot have current arrears older than two (2) months

[8] The definition of "high users" was expanded to the top quartile, from the top quintile, due to CSP feedback that some of the very highest users had health, safety, and structural issues, beyond the scope of this program, which made cost-effective weatherization impossible. PGW has developed a process so that ELIRP-eligible CRP high users who have had health and safety treatments performed by other programs but were not assigned to ELIRP through the random selection process, may be manually assigned to ELIRP CSPs.

- Customer cannot have been treated under PGW's recent CWP Pilot program or have received ELIRP services within last two years

The first criterion ensures that further PGW assistance, beyond CRP payment subsidization, 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 as well as some low cost measures such as low flow faucet aerators, low flow showerheads, and training on the use of programmable thermostats. Approximately 30 percent of comprehensively treated homes (20 percent of all closed cases) 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.

Program/Organization	Description of Coordination
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, 11 homes have been assigned to both programs and coordination efforts are currently underway. Ongoing efforts are being made to stream-line this partnership and improve the process. 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.
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 21 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.

Program/Organization	Description of Coordination
Habitat for Humanity	PGW is developing a partnership with Habitat for Humanity's Home Repair and Weatherization program, focusing on North Philadelphia neighborhoods. In situations where a home is a candidate for both Habitat and ELIRP services, the goal is for Habitat to focus on primarily health, safety and structural issues. Habitat's remediation of these issues, such as mold, knob and tube wiring and roof repairs, will open additional opportunities for PGW to further weatherize homes.

xi) Evaluation, Monitoring, and Verification

Inspections

PGW has continued performing and monitoring third-party quality assurance (QA) inspections of ELIRP homes, along with mentoring sessions for the CSP staff on specific issues. Additionally, PGW, along with program implementation consultants, occasionally shadows field inspections with each of the three CSPs to observe the QA inspector's performance and understanding of the PGW program design.

Recurring quality issues with one of the program CSPs were identified early in FY 2012, which led to an immediate doubling of inspection rates for that CSP until the issues were resolved. The following table shows the number of on-site inspections and hours of mentoring performed by PGW's third-party inspector for all CSPs. Overall, PGW inspected 7.5% of comprehensive closed cases. Inspection rates will be increased over the remainder of FY 2013 in order to achieve the targeted 10% inspection rate on closed cases.

Table 19 – ELIRP Inspections and On-site Mentoring (Inception-to-date)

Fiscal Year	Inspections	Hours of Mentoring
2011	44	22.5
2012	82	17
2013*	50	19.75
Inception-to-Date	**176**	**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. PGW has seen improvement in contractor inspections, with the inspection score rising from 84% in FY 2012 to 94% for the first half of FY 2013.

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 and reduce opportunities for error. Through regular meetings with the internal IT team and implementation consultants, PGW has improved data quality by additional field level validation, improving default values, and streamlining data entry screens. PGW develops reports based on CSP activity and regularly performs quality assurance to verify that energy savings calculations are accurate and based off CSP activity, and duplicate data is not present. PGW will continue to perform quality assurance to maintain the integrity of ELIRP program data.

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 currently underway, analyzing Calendar Year 2011 program activities, including analysis of usage data to determine actual gas reductions. Preliminary analysis has found that customers saved an average of 25.2 MMBtus per year, or 12 percent. The average savings are nearly double the 12.9 MMBtus per year found in 2010 as the program transitioned from the CWP pilot program to ELIRP. In ELIRP, 53 percent of customers experienced savings greater than 10 percent, while 28 percent of customers experienced savings over 20 percent. More than 50 customers saw their usage reduced by greater than 40%. In addition, preliminary results from the impact evaluation indicate that a comparison group experienced a small increase in gas use (1.2 MMBtus, 0.9 percent), implying that net program impacts are slightly larger than the gross savings indicate. The full evaluation is expected to be available later in FY 2013.

B. *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, Savings, and Benefits

As of February 28, 2013, RHER has issued rebates for over 590 high efficiency boilers and furnaces, totaling over $540,000 in incentives.

Table 20 - RHER Impacts from Inception to February 28, 2013[9]

	Actual Results (Inception to 2/28/2013)
Submission Activity	
Valid Applications[10]	591
Invalid Applications[11]	243
Total Applications Processed	834
COSTS	
Customer Incentives	$547,209
Administration and Management	$2,270
Marketing and Business Development	$126,608
Contractor Costs	$99,275
Inspection and Verification	$1,100
Evaluation	*$16,447*
Utility Costs	**$792,909**
Participant Costs[12]	$719,970
Total	**$ $1,512,879**
SAVINGS	
Net Annual BBtu	16.7
Net Lifetime BBtu	371.4
Net Annual MMBtu / Application	28.3
Weighted Lifetime (years)	22.2

Program Costs

Since inception, PGW spent slightly under $800,000 on RHER, with around $350,000 of the total coming from activity in the first six months of FY 2013. Together, fixed costs for Administration and Management as well as additional Contractor Costs were slightly under budget. While PGW did not meet its targets for FY 2011 and FY12, and is trending low in FY 2013 to date due to under-subscription, overall rebate activity has been increasing since the program launched. The difference between budgeted and actual costs can be attributed to three factors.

A. Under-subscription due to Communications & Marketing

PGW has continued to ramp-up and include additional communications and marketing efforts since low program participation trends first developed. HVAC contractor outreach activities, which are found to be the most effective vehicle for

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

10 Valid applications for landlords and multifamily buildings may cover more than one piece of equipment.

11 Invalid applications may be corrected and resubmitted.

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

marketing an HVAC equipment rebated program, have been increased. PGW has also continued to perform additional consumer marketing activities as well.

From program experience and marketing research, it is clear that costly natural gas efficiency upgrades are difficult to market for a combination of reasons. Customers in general know little about heating systems. There are often more immediate financial obligations and priorities that customers are focused on. Many customers focus on short term items, rather than an efficient heater that will cost more money initially but save customers money in the following years. Regardless, PGW will continue to identify and attempt all possible, aggressive outreach efforts so long as low program participation persists.

B. Rebate levels

Rebate amounts were doubled in FY 2012 to cover larger percentages of the incremental differences between standard and targeted equipment costs. These increases were seen as a temporary fix, and ideally would be reduced as soon as possible. The rebate levels will be continued at current rates so long as the program trends short of targeted activity levels, especially since targets are increased even higher in FY 2014. However, PGW will not increase the rebates any further at this point, as further increases could begin to negatively impact the program's cost-effectiveness.

C. Application Rejections

PGW has continually analyzed and attempted to address rejection rates since program inception, such as improving application instructions, eliminating previous causes for rejection, and contacting individual customers, contractors and landlords responsible for rejected applications.

Approximately 25% unique customer claims have been rejected. Of these rejected claims, 80% have been submitted multiple times, but the required information has not been corrected. The most common causes for rejection are related to purchase of incorrect equipment, lack of invoice or proof of payment, and incorrect account number or customer information.

Going forward, PGW seeks to better address this issue through its marketing and contractor outreach initiatives. Contractors will be encouraged to take a more active role in the application process so that they can ensure customers are provided all necessary documentation. Contractors whose customers have submitted the most invalid rebate applications will be prioritized for training and outreach.

As is the case with ELIRP, the RHER variance between budgets and actual expenditures 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 FY 2015 RHER budget, thereby allowing sufficient time to identify and address the issues that prevented PGW from realizing the originally planned pace of activity.

Program Cost-Effectiveness to Date

Despite low participation, RHER achieved positive TRC net benefits with a present value of $689,338 (in 2009 dollars), a TRC BCR of 1.53, in activity through February 28, 2013. The Gas Energy System test shows net benefits with a present value of $1,201,283), and a BCR of 2.75.

Projections

The program aims to serve 2,000 customers in FY 2014, with associated annualized gas savings of 45.5 BBtu, or 14.2 MMBtu/customer. The program is projected to cost $1,457,253. The following table shows a detailed breakout of participation, costs, and savings.

Table 21 - Projected RHER Impacts for FY 2014

	Projected (FY 2014)
PARTICIPATION	
Valid Applications	n/a
Invalid Applications	n/a
Total Applications	2,000
COSTS	
Customer Incentives	$1,286,000
Administration and Management	$-
Marketing and Business Development	$100,000
Contractor Costs	$48,100
Inspection and Verification	$23,153
Evaluation	$-
Utility Costs	**$1,457,253**
Participant Costs	$3,174,583
Total	**$4,631,835**
SAVINGS	
Net Annual BBtu	45.5
Net Lifetime BBtu	1,010.0
Net Annual MMBtu / Customer	14.2
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 from program inception through February 28, 2013:

- Selected a rebate vendor, Helgeson Enterprises, Inc., 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.
- In late 2011 and early 2012, PGW undertook additional market research and updated data on measure costs in an effort to understand and address program under subscription. This additional analysis lead to PGW increasing rebates for high-efficiency furnaces from $250 to $500, and rebates for high efficiency boilers from $1,000 to $2,000 in February of 2012.
- Launch of CIRI (September 2011) and HECI (September 2012) provided additional opportunities for RHER-eligible projects. Marketing materials were updated as a result.
- On November 19, 2012, AHRI changed its testing requirements for modulating condensing residential boilers, which resulted in lower AFUE ratings making products ineligible for PGW rebates. PGW informed its contractor network of this change and instituted a grace period so that any down-rated boilers purchased before December 31, 2012 would be approved. This product down-rating negatively affected the RHER program, as contractors who had preferences for specific boilers may have been hesitant to switch to new products. A local boiler manufacturer that offered a company rebate in conjunction with RHER, a major sales tool, became ineligible.
- Updated program policies to better serve multi-family properties, reflecting a slight shift from maximizing program customers to maximizing program impact. PGW began allowing for multiple rebates for individual units within a single master-metered multi-family property.

v) Target Market and Program Eligibility

There are no updates to program eligibility.

vi) Target End-use Measures

Through February 28, 2013, PGW has provided 225 boiler rebates and 382 furnace rebates. PGW also provided 346 thermostat rebates, which are only available with the purchase of a premium-efficiency furnace or boiler. The positive response to thermostats (57 % of valid applications) was better than anticipated. Figure 4 shows how Rebate activity has progressed over time.

Figure 4 – RHER Rebates Issued by Month (Inception through Feb 28, 2013)

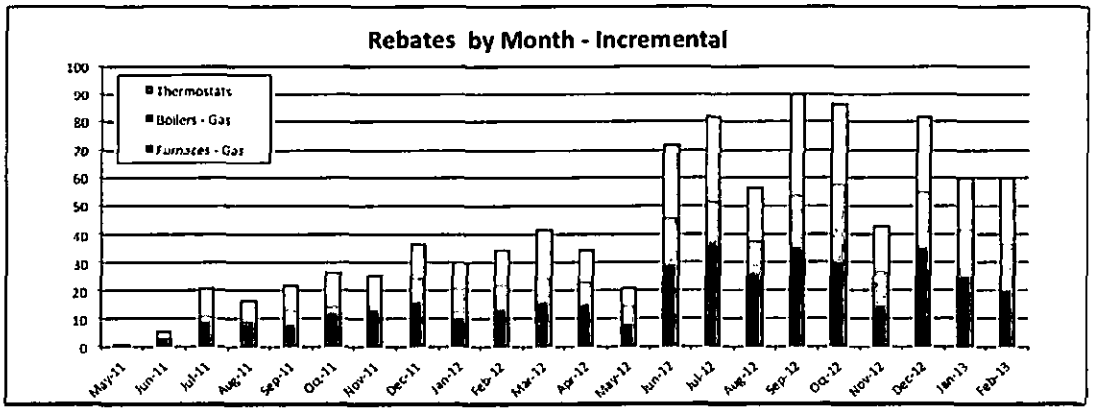

Figure 4 clearly shows an increasing trend in rebates issued, with spikes in activity during the heating season (generally October through April). The number of heating system rebates issued in the first six months of FY 2013 (September 1, 2012 through February 28, 2013) is now over twice the amount issued in the same period a year before, up 146%.[13] The percentage of rebates going to boilers has also been increasing steadily, going from 17% of rebates issued in FY 2011 to 41% so far in FY 2013.[14]

In FY 2014 PGW will explore the potential benefits of offering new prescriptive equipment rebates, such as standalone rebates for top-tier programmable thermostats and combi-boilers (which provide both space and domestic water heating) Additionally, in the coming months PGW plans to establish a process for providing incentives for custom measures that save natural gas but are currently not covered under the RHER program. Customers would need to prove to PGW that the custom measures save natural gas and pass PGW's cost-effectiveness tests, after which PGW would provide an incentive offer calculated in a similar way to the CIRI program. This custom track is a way to fill in the gaps left by single-measure applications to CIRI, as well as address the various ways in which residential and small commercial customers use natural gas.

[13] 273 rebates were issued so far in FY 2013, compared to 111 in the first six months of FY 2012.

[14] PGW had previously estimated a mix of 50% furnaces and 50% boilers.

Projections

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

Table 22 - Projected Rebates for FY 2013 to FY 2015 by Equipment Type

Fiscal Year	2013 (remaining)	2014	2015	2013 - 15
Natural Gas Furnace	117	667	667	1,450
Natural Gas Furnace w/ ECM	58	333	333	725
Natural Gas Boiler	175	1,000	1,000	2,175
Programmable Thermostat	210	1,200	1,200	2,610

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 23 - Residential Equipment Rebates

Measure	Amount
Natural Gas Furnace 94% AFUE	$500
Natural Gas Furnace 94% AFUE, BFM Fan[15]	$500
Natural Gas Water Boiler 94% AFUE (w/ electronic ignition)	$2,000
Programmable Thermostat [16]	$30

PGW anticipates maintaining this rebate schedule through FY 2014, 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 had issued a rule that would have raised the minimum efficiency standard of furnaces in the Northern U.S. region, including Pennsylvania, to 90% AFUE. PGW's rebate program is based on encouraging customers to move from the existing baseline equipment, which is currently 80%, to the targeted high-efficiency equipment. As such, if the equipment baseline did shift from 80% to 90%, PGW's rebates would have to be re-examined and restructured accordingly. However, the DOE has retracted the proposed rule as part of a settlement with the APGA. The DOE will reconsider and restate their proposal through a full review process to begin sometime in the future. PGW will continue to monitor these developments and update the RHER

[15] 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.

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

program accordingly. However, all current program designs will be maintained in current states for the time being.

viii) Roles and Responsibilities

There are no updates to roles and responsibilities

ix) Marketing Strategy

PGW, in coordination with the implementation consultant and the program contractor, has 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 consumer marketing activities will continue to be ramped up, as discussed above.

Additionally, as discussed in section XI below, PGW has engaged a third-party firm to perform an impact evaluation and market study related to the RHER program performance. This evaluator performed interviews with customers who received rebates and contractors who installed RHER equipment for customers. The survey results both helped PGW assess effective marketing activities and opportunities for improvement. Initial takeaways include:

- The program is very popular with both customers and contractors and was a major factor in the decision for customers to choose the highest efficiency equipment.

- Incentive levels were high enough to make a significant reduction in the incremental costs for the project.

- In a majority of cases, contractors were the primary source of information for PGW rebates. This affirms that our outreach to contractors and supply houses has been a good use of resources. PGW seeks to build upon these contractor relationships by offering trainings and sales tools for pitching high efficiency equipment and completing the application process.

- While contractors were the primary information source, they took a somewhat passive role regarding rebate submissions. Customers often filled out the application on their own. PGW feels that if contractors were more engaged and ensured customers had all of the documents and information required, there would be fewer rejections. PGW will be communicating with and training contractors for how to fill out applications.

- Customers would like to hear from an objective source about how much money efficient heating equipment would save compared with standard models based on their housing type. PGW is exploring providing these estimates or linking to other organizations like ENERGY STAR® that have provided this analysis.

- Customer awareness of the program from non-contractor sources was low, and PGW is determining ways in which to raise general awareness of the program. By raising the general awareness of the program, PGW believes that it is possible to significantly ramp up rebate levels and capitalize upon the foundation that has been laid down so far.

- Additional recommendations were given for making the application and rebate process more customer-friendly, which PGW is working on addressing.

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.

Program/Organization	Description of Coordination
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

Quality Assurance
PGW has hired a firm to perform on-site verifications of 3% of the customers that received a rebate incentive to ensure the equipment installed matched the equipment listed on the rebate application. Eleven (11) verifications were performed during the evaluation period. PGW is also currently undertaking a second round of equipment verifications beginning in April, 2013. In addition to random selections, PGW may request on-site verifications in circumstances where a landlord has submitted multiple claims for a multi-family property.

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. All program data will be then stored at PGW for long-term purposes.

Reporting
There are no updates to reporting for the RHER.

Evaluation
The first impact evaluation is currently being performed and should be completed by the end of calendar year 2014. The start date for this program evaluation had been pushed back from initial plans in order to capture a larger, more useful sample size of program activity. Accounts that received rebates between April 1, 2011 and August 31, 2012 will be evaluated, and their usage history for one year after the heater installation will be measured. Section IX above provides preliminary results already under consideration for immediate program improvements.

C. *Commercial and Industrial Retrofit Incentives Program*

i) 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 specifically targeted energy efficiency opportunities in multi-family buildings. As the program ramped-up additional commercial and industrial customer classes have been targeted.

ii) Costs, Savings, and Benefits

While no CIRI projects have been completed as of February 28, 2013, there are currently two multifamily projects underway, two additional incentives offers awaiting customer acceptance, and three forthcoming application projects under analysis. Variances between program targets and actuals are addressed below.

The following table provides the costs incurred since program launch.

Table 24 - CIRI Impacts from Inception to February 28, 2013

	Actual Results (Inception to 2/28/2013)
PARTICIPATION	
Applications	14
Analyses/Audits	6
Customers with Installations	-
COSTS	
Measure Installation Costs	$-
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$62,364
On-site Technical Assessment	
Evaluation	$-
Utility Costs	**$62,364**
Participant Costs	$-
Total	**$62,364**
SAVINGS	
Net Annual BBtu	-
Net Lifetime BBtu	-
Net Annual MMBtu / Customer	n/a
Weighted Lifetime (years)	n/a

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. Additionally, PGW has found that projects may take one year or longer from the time the owner expresses interest in CIRI to the time when they submit an application or begin the project.

As is the case with other PGW DSM programs, variance between budgets and actual spends 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 FY 2015 CIRI budget, thereby allowing sufficient time to identify and address the issues that prevented PGW from realizing the originally planned pace of activity.

Projections

The program aims to serve 27 customers in FY 2014, with associated annualized gas savings of 11.7 BBtu, or 433.3 MMBtu/customer. The program is projected to cost $745,953 in FY 2014.

Table 25 - Projected CIRI Impacts for FY 2014

	Projected (FY 2014)
PARTICIPATION	
Applications	n/a
Analysis/Audits	
Customers with Installations	27
COSTS	
Measure Installation Costs	$513,333
Administration and Management	$-
Marketing and Business Development	$50,000
Contractor Costs	$85,555
On-site Technical Assessment	$-
Evaluation	$82,806
Utility Costs	**$745,953**
Participant Costs	$456,296
Total	**$1,202,249**
SAVINGS	
Net Annual BBtu	11.7
Net Lifetime BBtu	187.2
Net Annual MMBtu / Customer	433.3
Weighted Lifetime (years)	16.0

iii) Workflow

There is no update to the workflow for CIRI.

iv) History, Ramp-Up Strategy and Milestones

When CIRI launched in FY 2012, PGW specifically targeted customers who were most likely to propose multi-family projects. This customer base was reached primarily through organizations that service the multi-family building owners. The first step of which was identifying multi-family property owners in Philadelphia, and the potential projects that are already in development. To that end, PGW worked directly with the Pennsylvania Housing Finance Agency (PHFA).

In FY 2013, PGW has continued its collaboration with PHFA to identify multi-family building owners with potential projects, and has expanded the program marketing to include all eligible customer classes. PGW's marketing and partnerships in FY 2013 focused on identifying projects through building service providers, business and trade associations, and direct communications with property owners.

PGW continued to experience difficulty in identifying eligible projects with committed property owners. The reasons included property ownership arrangement and funding availability. PGW has found that often 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, many owners are either unwilling or unable to assume loans or have loans in place preventing them from assuming additional debt.

To date, PGW has received fourteen applications, including nine from multi-family facilities building owners, four from commercial building owners, and one from an industrial building owner. Among these applications, only five were moved to the final stages of analysis. The remaining applications were not advanced for several reasons. The most common reason was that applicants were only interested in installing a single measure, and were unwilling or unable to expand their project scopes. In these cases the applicants were ruled ineligible due to the CIRI comprehensive retrofit project requirement.[17] In three other cases, the applications were rejected because the customer's rate class was DSM ineligible.

Table 26 – Current CIRI Project Activity

Current CIRI Project Activity (Inception to February 28, 2013)	
Committed Projects	
Committed Projects	2
Committed Incentives	$126,300
Projects Awaiting Customer Commitment	
Expected Projects	2
Expected Incentives	$25,600

To date, PGW has received signed incentive agreements from two building owners for projects that are currently underway, and has offered incentives to two additional multi-family building owners. The incentive agreement is a contract between PGW and the building owner that commits CIRI funds to a project based on a mutually agreed upon project scope. The two projects that PGW has executed incentive agreements with are multi-family buildings; one affordable housing and one market rate. As of February 28, 2013, PGW has two outstanding incentive agreements awaiting final customer approval. Both of the outstanding agreements are for projects in multi-family, affordable housing buildings.

[17] For instances of single measure projects, PGW is working on expanding the CIER program to handle custom measure applications.

To overcome the challenges above, PGW plans to pursue paths to drive higher participation in FY 2014. First, it will conduct broad awareness campaigns to high-usage building owners and service companies that work with building owners to reduce energy usage. Second, PGW will conduct narrowly targeted outreach to promising leads for retrofit projects that are already planned and partially or wholly funded. In these cases, PGW will seek to act as bridge funding, or seek to push building owners to invest in additional measures for planned retrofit projects. This targeted approach led to one of the expected CIRI projects, and is expected to net additional projects from the same customer. PGW expects these combined approaches to drive participation in FY 2014.

v) *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.

vi) Target End-use Measures

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

vii) Incentive Strategy

PGW has revised its incentive payment structure to allow customers to assign the incentive award over to their contractor who performed the work. This design was added as a sales tool for contractors to use, allowing them to reduce the up-front costs to customers by deducting the amount of the incentive from the project quote. This change was made after hearing of the success of the practice in other DSM programs.

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.

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

viii) Roles and Responsibilities

There are no updates to roles.

ix) Marketing Strategy

Per the FY 2011 and FY 2012 Implementation Plans, PGW actively sought to identify, assist, and accept eligible multi-family retrofit projects; however this effort faced the aforementioned challenges.

Through its partnerships with EnergyWorks, and PHFA, PGW will seek to continue to identify affordable housing, multi-family facilities that could be ideal candidates for efficiency retrofits. Many of these properties had audits conducted through funding from the American Recovery and Reinvestment Act, paid for by PHFA. PGW conducted direct outreach to the owners of many of these properties.

For ongoing program marketing, PGW has crafted a marketing plan similar to the RHER program that targets equipment manufacturers, distributors, retailers, architects, engineers, and installation contractors. The decision to market primarily to these groups is based on the experience of other gas utility rebate programs which found that contractor outreach is the most effective strategy for increasing customer demand for high efficiency gas equipment via rebates.

From the program's inception, PGW has conducted direct outreach to building and business owners that might be interested in CIRI. This occurred through targeted emails and calls, and also through presentations to membership-based trade organizations and business associations. Examples of such organizations include the PennDel Affordable Housing Management Association, the Building Industry Association, and the West Parkside Business Association. PGW plans to continue conducting outreach to contractors through these and similar organizations by scheduling co-sponsored events and presenting at membership meetings.

x) 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. PHFA also administers federal funding through the Low Income Housing Tax Credit program. Many affordable housing facilities use this funding for building upgrades, including energy efficiency measures.

Program/Organization	Description of Coordination
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

xi) 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

D. *Commercial and Industrial Equipment Rebates Program*

i) Program Description

The Commercial and Industrial Equipment Rebates Program (CIER) issues prescriptive rebates on premium efficiency gas appliances and heating equipment to increase the penetration of these measures in the facilities of PGW's commercial, industrial, and multi-family customers. The CIER program launched September 1, 2012 at the start of FY 2013. 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, Savings, and Benefits

As of February 28, 2013, CIER has received 6 valid applications and 2 invalid applications, and issued incentives totaling $57,900.

Table 27 - CIER Impacts from Inception to February 28, 2013[18]

	Actual Results (Inception to 2/28/2013)
PARTICIPATION	
Valid Equipment Applications[19]	6
Invalid Equipment Applications	2
Total Equipment Applications	2
COSTS	
Customer Incentives	$ 57,900
Administration and Management	$ 0
Marketing and Business Development	$ 3,252
Contractor Costs	$ 37,204
Inspection and Verification	$ 0
Evaluation	$ 0
Utility Costs	**$98,356**
Participant Costs[20]	$13,001
Total	**$111,357**
SAVINGS	
Net Annual BBtu	3.9
Net Lifetime BBtu	96.7
Net Annual MMBtu / Customer	351.7
Weighted Lifetime (years)	25

Program Costs

PGW spent slightly over $37,000 on fixed contractor costs for CIER over this reporting period, slightly under budget. Variable costs for marketing and customer incentives were much lower than budgeted.

Program Cost-Effectiveness to Date

As of February 28, 2013, CIER achieved positive TRC net benefits with a present value of $363,878 (in 2009 dollars), a TRC BCR of 4.93. The Gas Energy System saw net benefits with a present value of $374,570 (in 2009 dollars), a BCR of 5.58.

Projections

The program aims to serve 250 customers in FY 2014, with associated annualized gas savings of 19.9 BBtu, or 76.6 MMBtu/customer. The program is projected to cost $567,539. The following table shows a detailed breakout of participation, costs, and savings.

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

[19] Applications may cover more than one piece of equipment.

[20] Incremental cost of equipment and installation not covered by PGW rebate.

Table 28 - Projected CIER Impacts for FY 2014

	Projected (FY 2014)
PARTICIPATION	
Valid Applications	250
Invalid Applications	n/a
Total Applications	n/a
COSTS	
Customer Incentives	$365,588
Administration and Management	$-
Marketing and Business Development	$82,265
Contractor Costs	$109,686
Inspection and Verification	$10,000
Evaluation	$-
Utility Costs	**$567,539**
Participant Costs	$132,607
Total	**$700,146**
SAVINGS	
Net Annual BBtu	19.9
Net Lifetime BBtu	316.1
Net Annual MMBtu / Customer	76.6
Weighted Lifetime (years)	15.9

iii) Workflow

There are no updates to the workflow for CIER.

iv) History, Ramp-Up Strategy and Milestones

The following qualitative CIER Developments have occurred from program inception through February 28, 2013:

- Selected a rebate vendor, Helgeson Enterprises, Inc., to implement the rebate processing.
- Began marketing and outreach efforts to provide information to HVAC contractors, energy management consultants, and commercial kitchen designers, allowing them to educate their customers about PGW's 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 CIER on September 1, 2012.
- Expanded the HVAC contractor outreach vendor's scope of services to also address CIER equipment rebates.

v) Target Market and Program Eligibility

There are no updates to program eligibility.

vi) Target End-use Measures

The CIER is primarily designed to provide incentives for high efficiency, commercial-sized natural gas boilers and high efficiency, natural gas powered commercial kitchen appliances. Through February 28, 2013, PGW has provided 11 high efficiency boiler rebates and no commercial food service rebates. The boilers for which rebates were issued all had a thermal efficiency greater than 90%, and had an average capacity over 1,000 kBtus/hr.

In the coming months, PGW plans to establish a process for providing incentives for custom measures that save natural gas and are currently not covered under the CIER. Customers would fill out an application detailing the equipment characteristics, costs, and savings potential. PGW will review the savings calculations and work with the customer to make sure a realistic savings estimate is reached, similar to the way in which CIRI projects are handled. After establishing the measure characteristics, PGW will screen the measure for cost-effectiveness, and will only move forward with measures that pass the Total Resource Cost test. For measures that are deemed cost-effective, a custom incentive will be offered to the customer, which will be less than the value of gas benefits and equal to the lesser of fifty percent (50%) of the incremental costs, or buying the payback of the project to two years.

After the customer installs the equipment, and PGW verifies the installation, the customer would receive a rebate from the CIER program. This custom track is a way to fill in the gaps left by single-measure applications to CIRI, as well as develop new potential prescriptive rebates. Examples of custom projects include complex controls, combined-heat and power (CHP), industrial gas applications, or any other application that uses natural gas and is not covered by prescriptive rebates.

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. Due to the complex nature of commercial and industrial equipment installations, PGW will allow customers to apply for up to three rebates per-equipment type per-account on the rebate form, and will manually approve accounts for additional equipment rebates when necessary.

Under the rebate schedule that was devised for the program launch, only high-efficiency boilers and commercial food service equipment measures will be incentivized. The following table shows the current list of eligible efficiency measures and their incentives.

Table 29 –Current Measures in CIER

Measure Name	Minimum Efficiency	Rebate Amount
Boiler, Hot Water (300 ≤ MBH ≤ 2,500)	90% Thermal Efficiency (Et)	$2,900 - $8,400
Boiler, Hot Water (300 ≤ MBH ≤ 2,500)	85% Thermal Efficiency (Et)	$800-$6,300
Commercial Gas Fryer (Large Vat)	ENERGY STAR®	$1,200
Commercial Gas Fryer	ENERGY STAR®	$1,000
Commercial Gas Convection Oven	ENERGY STAR®	$500
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

In order to encourage wider participation in the program, PGW will also offer customers with efficient commercial-sized boilers that are larger than the prescribed scope to apply to for a rebate. Customers that installed equipment larger than 2,500 MBH, will be provided with two options: 1) receive a rebate equal to the amount provided for a 2,500 MBH piece of equipment; or 2) complete a worksheet providing usage and cost information for the efficient boiler, and a standard-efficiency model of the same size. As discussed in the previous section, PGW also anticipates the creation of a custom measure track that will calculate incentives in the same manner as the CIRI program.

PGW plans to maintain this rebate schedule through FY 2014. PGW will continue to perform periodic reviews and may change the types of measures covered, the minimum efficiency level required, and/or the rebate amount based on changing market conditions.

viii) Roles and Responsibilities

There are no updates to roles and responsibilities.

ix) Marketing Strategy

PGW has crafted a marketing plan similar to the RHER program that targets equipment manufacturers, distributors, retailers, architects, engineers, and installation contractors. The decision to market primarily to these groups is based on the experience of other gas utility rebate programs which found that contractor outreach is the most effective strategy for increasing customer demand for high efficiency gas equipment via rebates.

PGW engaged these markets by individual outreach through email, mail and calls, and through relevant member organizations and associations. Examples of such organizations include the Mechanical Sheet Contractor Association, the Plumbing Heating and Cooling Contractors Association, and the American Society of Heating, Refrigeration and Air-

Conditioning Engineers (ASHRAE). PGW plans to conducting outreach to contractors through the organizations by scheduling co-sponsored events and presenting at membership meetings.

In addition to outreach through trade associations, PGW has also contracted with a communications outreach vendor to reach contractors through supply houses. For the remainder of FY 2013 and in FY 2014, this firm will ramp-up outreach to contractors at supply houses that sell measures included under CIER.

Although it is not proven to be as effective as outreach to contractors, PGW will also conduct direct outreach to commercial property owners and facility engineers. This outreach will be conducted through direct mail and email communications, participation in expos such as the Greater Philadelphia Facility Maintenance expo, and networking through trade associations.

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
ENERGY STAR®	In an effort to promote the CIER commercial food service rebates for ENERGY STAR rated equipment, PGW became an ENERGY STAR Energy Efficiency Program Sponsor in FY 2012. This partnership has allowed PGW to stay up-to-date with ENERGY STAR activities, and will allow it to be included in its national registries of rebates and incentives.
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.

PGW is engaging an inspector to conduct on-site verifications for 25% of the commercial boiler installations, and 10% of the commercial food service installations. PGW expects to perform onsite verification for all custom applications. Different verification levels were established because the commercial boiler installations are frequently more complicated, and result in significantly higher rebates. The inspector will check to ensure that the equipment that the customer included on the rebate application matches what was installed in the building. As of February 28, 2013, no verifications were performed.

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. All program data will be then stored at PGW for long-term purposes.

Reporting

There are no updates to reporting for the CIER program.

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. As part of the initial program development, PGW will work with the selected third-party 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 impact evaluation for the CIER program is scheduled for FY 2015.

E. 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. For commercial projects, 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 seeks 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 operates on a "first-come, first-serve" basis, providing technical assistance and incentives for reaching a certain level of efficiency. PGW has hired 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 provides the financial incentive to the customer upon the completion of the project.

ii) Program Staging

Like the rest of the country, activity in the construction market in Philadelphia has been severely slowed by the lingering 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's slow recovery gathers strength, the new construction and building rehabilitation market will most likely follow. Due to the uncertainty for this market in the coming years, PGW is approaching the start of HECI with a "pilot program" mentality. PGW believes 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 in advance of higher activity levels later. Looking forward, PGW believes it will be important to have the ability to quickly ramp up if and when the Philadelphia construction market resurges.

iii) Costs, Savings, and Benefits

At the end of February, HECI had received 10 applications, had three applications withdrawn or rejected, and has committed to providing an incentive totaling $27,210 for one project.

Table 30 - HECI Impacts from Inception to February 28, 2013[21]

	Actual Results (Inception to 2/28/2013)
PARTICIPATION	
Applications Received	10
Applications Withdrawn or Rejected	3
Approved Projects	1
COSTS	
Customer Incentives	$0
Administration and Management	$ 0
Marketing and Business Development	$ 0
Contractor Costs	$ 42,420
Inspection and Verification	$ 0
Evaluation	$0
Utility Costs	$ 42,420
Participant Costs[22]	$ 0
Total	$ 42,420
SAVINGS	
Net Annual BBtu	0
Net Lifetime BBtu	0
Net Annual MMBtu / Customer	0
Weighted Lifetime (years)	n/a

Program Costs

PGW spent slightly over $42,000 on HECI over this reporting period, and has commitments for $27,210 of incentives for projects not yet completed. Together, fixed costs for Administration and Management as well as additional Contractor Costs were higher than expected due to program ramp up. Variable costs for marketing and customer incentives were much lower than budgeted. Overall, non-incentive costs still remain below levels budgeted for in the FY 2013 Implementation Plan.

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

[22] Incremental cost of equipment and installation not covered by PGW rebate.

Program Cost-Effectiveness to Date

As of February 28, 2013, HECI has not yet issued any rebates, and is claiming no savings.

Projections

The program aims to serve 180 residential units and 12 commercial new construction projects in FY 2014, with associated annualized gas savings of 4.3 BBtu, or 22.2 MMBtu/customer. The program is projected to cost $379,108.

Table 31 - Projected HECI Impacts for FY 2014

	Projected (FY 2014)
PARTICIPATION	
Valid Applications	192
Invalid Applications	n/a
Total Applications	n/a
COSTS	
Customer Incentives	$244,680
Administration and Management	$-
Marketing and Business Development	$20,672
Contractor Costs	$109,728
Inspection and Verification	$4,028
Evaluation	$-
Utility Costs	**$379,108**
Participant Costs	$61,170
Total	**$440,278**
SAVINGS	
Net Annual BBtu	4.3
Net Lifetime BBtu	85.4
Net Annual MMBtu / Customer	22.2
Weighted Lifetime (years)	20

iv) Workflow

There are no updates to the workflow for HECI.

v) History, Ramp-Up Strategy and Milestones

The following qualitative HECI Developments have occurred from program inception through February 28, 2013:

- Selected a technical assessment contractor, ICF Resources, LLC, to provide services including but not limited to: verifying customers' project savings claims, identifying further savings opportunities, and estimating project measures' costs and savings.

- Began marketing and outreach efforts to provide information about HECI to architects, engineers, and residential and commercial building developers.
- Developed a commercial building measure guide that suggests combinations of measures that may achieve adequate savings to participate in HECI. An interactive residential developer measure guide was developed, to provide savings, incremental costs, and incentive estimates based on measure inputs.
- Launched HECI on September 1, 2012.
- Expanded the HVAC contractor outreach vendor's scope of services to also address HECI incentives.

vi) Target Market and Program Eligibility

There are no updates to program eligibility.

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.).

Through February 28, 2013, PGW has committed to issuing incentives to a single project in the amount of $27,210.

viii) Incentive Strategy

The HECI program consists of two types of incentives based on gas conservation achieved beyond baseline building code: a more prescriptive rebate design for single-family residential buildings, and a customized incentive design for commercial and industrial buildings. Both types of incentives will be calculated to cover most of the incremental costs of the efficiency measures, and to offset additional design costs incurred to add the efficiency measures to the building plan. Individual incentive amounts will be calculated based on projected savings for the buildings, as modeled by PGW's technical assessment provider.

Single-family homes will be eligible for incentives up to $2,750, depending on the heating system, for building projected to conserve 20% or more gas beyond the consumption level resulting from building code. The incentive amount was designed to address over 50% of the incremental costs for residential new construction projects in coordination with heating system rebates offered through RHER. This design is intended to provide a prescriptive rebate for developers building multiple houses on the same model. The table below provides the incentives based on heating system.

Table 32 - Residential HECI Incentives

Proposed HECI Incentive – Single-Family Residential	Incentives to Builder (Per-Home)
≥ 20% more efficient, and includes a 94% AFUE Boiler	$2,750
≥ 20% more efficient, and includes a 94% AFUE Furnace	$1,250
≥ 20% more efficient, and includes any other heating source	$750

Commercial, industrial and multi-family facilities will be eligible for a customized, sliding-scale incentive based on the level of savings, with a maximum per-project incentive of $60,000. This design is intended to incentivize building developers to go beyond standard energy conservation measures, and seek creative solutions for their facilities to achieve a high level of energy conservation. If efficient equipment that is incentivized under PGW's CIER or RHER programs is included in the design, PGW will include the total rebate for this equipment in its HECI incentive. The savings attributed to these measures will be excluded from the HECI incentive calculation. Incentives by savings tier are shown below.

Table 33 - Commercial & Industrial HECI Incentives

Proposed HECI Incentive - Commercial and Industrial	Incentives to Builder (Per-First Year MMBtu Saved)
≥ 5% to **< 10%** more efficient than code	$ 5.00
≥ 10% to **< 20%** more efficient than code	$ 13.00
≥ 20% to **< 30%** more efficient than code	$ 24.00
≥ 30% more efficient than code	$ 40.00

ix) Roles and Responsibilities

There are no updates to roles and responsibilities

x) Marketing Strategy

In the HECI program, unlike the CIER or CIRI programs, the property's end-user is often not the individual developing the building. As a result, PGW has experienced an even greater challenge in marketing the program because some developers may not be able to easily justify the additional investment in high-efficiency measures even when incentives are available. As a result, PGW has focused its marketing on influencers that can help to educate developers about the benefits of investing in additional energy efficiency measures.

The chief influencers in this process are the project architects and engineers. PGW's marketing plans emphasize outreach to architects and engineers, through direct communications, presentations at firms, and outreach through organizations. Through the end of FY 2013 and into FY 2014, PGW plans to conduct expanded outreach to these groups through organizations like the Architects Institute of America (AIA), Philadelphia Chapter, and the American Society of Heating, Refrigeration and Air Conditioning Engineers.

In addition to outreach to service providers, PGW also began targeting residential and commercial developers. This outreach included targeted, direct outreach based on projects identified through PGW's partnership with PHFA, or through news articles. Additional outreach was conducted through real estate associations and organizations devoted to green building. PGW presented its program to members of the Building Industry Association (BIA) and the Delaware Valley Green Building Council (DVGBC). Among these trade organizations, conducting outreach to members of DVGBC will yield the greatest return, as developers that are members are already aware of the benefits of energy efficient building, so PGW's communications can focus on the incentive program.

Through the end of FY 2013 and in FY 2014, PGW will expand its targeted outreach to developers through knowledge of approved developments. PGW will also deepen its relationships with the trade organizations listed above, and seek out new organizations and associations with members involved in the construction of single family, multifamily, commercial, and industrial buildings.

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
Pennsylvania Housing Finance Authority (PHFA)	PHFA also administers federal funding through the Low Income Housing Tax Credit program, which is awarded twice a year. Many affordable housing organizations use this funding to develop new facilities. PGW will conduct outreach to the recipients, from a list provided by PHFA, to offer additional funding to the recipients' projects.
Delaware Valley Green Building Council	PGW will collaborate with the DVGBC to participate in the national's recognized Greenbuild 2013 conference, which will be held in Philadelphia.

Program/Organization	Description of Coordination
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

On-site inspections will be performed on a subset of projects. The inspection will occur after PGW receives notice that the facility has received its Certificate of Occupancy (CO), or if no CO was required, then the facility development must be completed with gas service turned on. The inspections will be based on a list of efficiency measures provided to PGW's technical assessment provider, to confirm that the measures were installed and consistent with the pre-construction application.

Post-construction inspections will occur in all commercial, industrial and multi-family properties, and 10% of all single-family residential properties. This differential is a result of the higher incentives and more sophisticated installations in commercial, industrial and multi-family facilities. The inspections will 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 the planned efficiency improvement measures, building plans and schedules including mechanical and plumbing, cut sheets for all natural gas equipment, performance reports (for commercial projects, if available).
- Building energy usage model (HERS rating file for residential projects or eQuest for commercial, industrial and multi-family), detailed input/output report from building energy model showing base and efficient cases, and an unmet load hours report. If the facility does not have an energy model, the developer must complete a comprehensive worksheet providing all necessary inputs to create a model.

PGW will work with ICF 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. ICF 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 an on-site verification. The data collected during this inspection and stored by PGW will include:

- Documentation of the project's costs in the form of final invoices;
- Specifics on the installed measures, including the data required by the project economic and financial analysis tool;
- Copy of the property's Certificate of Occupancy;
- Information on the quality of the installation and the viability of achieving projected savings;
- Results from interviews with customers and contractors.

<u>Reporting</u>
There are no updates to reporting for the HECI program.

<u>Evaluation</u>
In accordance with the general evaluation plans for the DSM Portfolio, a third-party contractor will perform in-depth evaluations every two years.

The first HECI evaluation is scheduled for FY 2015.

F. *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 an average reduction of at least 20% in annual gas heating consumption 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 difficulty of launching voluntary retrofit programs, PGW will gradually ramp up the participation in CRRI. PGW plans to integrate a highly trained contractor network with financial incentives, streamlined access to financing, and a rigorous QA/QC process. PGW has already initiated program implementation through the selection of a Program Administrator and the selection of five participating Conservation Service Providers (CSPs) to start the contractor network. The program will begin with a soft-launch in Spring, 2013, in which the most market-ready CSPs will start offering CRRI program services to targeted customers. The remainder of FY 2013 will be dedicated to identifying initial program delivery issues with smaller participant volume, training additional CSPs, and preparing communication and marketing initiatives for the hard-launch, which is currently planned for September, 2013. PGW expects to continue to add contractors and will build up participation through the lifetime of the program.

iii) Costs, Savings, and Benefits

No costs or savings have been allocated to the CRRI program through February 28, 2013.

Over FY 2013 to FY 2015, the program is expected to provide lifetime net present benefits of $1.04 million with a benefit-cost ratio (BCR) of 1.11. The program aims to serve 1,384 projects in FY 2014, with associated annualized gas savings of 35.6 BBtu, or 25.7 MMBtu/customer. The program is projected to cost $2,654,597 in FY 2014. The following table shows a detailed breakout of participation, costs, and savings.

Table 34 - Projected CRRI Impacts for FY 2014

	Projected (FY 2014)
PARTICIPATION	
Analyses/Audits	3,955
Customers with Installations	1,384
COSTS	
Measure Installation Costs	$2,174,597
Administration and Management	$-
Marketing and Business Development	$150,000
Contractor Costs	$280,000
Inspection and Verification	$50,000
Evaluation	$-
Utility Costs	**$2,654,597**
Participant Costs	$2,254,980
Total	**$4,909,577**
SAVINGS	
Net Annual BBtu	35.6
Net Lifetime BBtu	747.2
Net Annual MMBtu / Customer	25.7
Weighted Lifetime (years)	21.0

iv) Workflow

The following steps outline how a customer will participate in CRRI.

- A customer enters CRRI either by a contractor signing up a customer directly, or through a central program hub to be established and managed by the Program Administrator.

- The CSP then contacts the customer to schedule and perform the initial energy audit; enter data into the in-home Contractor Tool; and provide the customer with the recommended job scope, costs, projects savings, PGW CRRI incentive, and any financing options available. PGW is currently working with the program CSPs in developing an audit subsidy model in which PGW, the CSP, and the customer will all absorb some of the upfront audit costs so as to lower the customer's initial barrier to entry while still requiring a manageable level of program buy-in.

- The CSP will then install all measures approved by the customer, bill the customer, complete the PGW CRRI application, and submit it with supporting information to the Program Administrator.

- When 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 incentives to the customer and the contractor.

Additionally, CRRI will be cross-marketed to RHER participants. 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

The following qualitative CRRI developments have occurred as of February 28, 2013:

- Issued an RFP for a Program Administrator
- Issues an RFP for CSPs
- Selected a Program Administrator
- Finalized a financing referral relationship with the Keystone HELP program.

PGW anticipates the following remaining milestones:

Task	Time Period
Pre-launch planning, training, and infrastructure development between PGW, CSP(s), and market actors. Includes signing up initial group of certified contractors.	February, 2013 to June, 2013
"Soft Launch" Program	***June, 2013***
Train additional certified contractors for ramp-up period. Address initial program delivery issues identified.	June, 2013 to August, 2013
"Full Launch" of Program in preparation for 2013 heating season.	***September, 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, including those who previously participated for single-measure projects, or did not follow through on applications.

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 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".

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:

- Instrument-guided air and duct sealing, particularly when combined with furnace upgrades;
- Roof and cavity Insulation;
- Early-retirement of existing inefficient heating systems;
- Replacement of natural gas water heaters;
- Low flow showerheads and faucet aerators;
- Programmable thermostat installation and education; and
- Any other measures which would save natural gas and meet PGW's program requirements for cost-effectiveness.

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.

Audits

PGW seeks to obtain a consistent and affordable audit cost for all participating customers. This cost should result in a modest fee to the customer in order to require a manageable level of buy-in (and thereby avoid "tire-kickers"), while also reducing full market-rate audit costs (and thereby avoid "sticker-shock"). The average market-rate audit cost is approximately $450, and PGW has targeted a flat customer fee of $150.

In order to achieve that $150 level, PGW will require participating CSPs to provide subsidized, flat audit rates through the RFP-selection and contracting processes. PGW will then further subsidize audits by a fixed amount per completed audit.

Incentives

PGW is still finalizing the program's incentive designs. As of the time of this report, they are expected to be calculated on a per MMBtu saved basis, based on the properties' weather normalized pre-usage and the program's deemed savings calculations, both of which will be built into an in-home Contractor Tool. This incentive design is structured so as to encourage contractors to pro-actively close sales and to reward both contractors and customers for proceeding with projects that save as much energy as possible.

Customer communications on the incentives and their potential dollar values are also still being finalized, but may involve describing the programs in terms of typical project scales and incentive levels. PGW will maintain control on the depth and cost-effectiveness of the gas savings through the CSPs and their use of the Contractor Tool.

Financing

To augment this strategy, and to reduce program costs, PGW has also finalized a direct referral relationship with the Keystone HELP program for low-interest energy-efficiency financing in order to address the potential hurdle of upfront funding.

ix) Roles and Responsibilities

PGW

PGW will oversee and coordinate program activity with the Program Administrator 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, financing terms, 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.

Program Administrator
PGW has selected Performance Systems Development (PSD) as the CRRI Program Administrator to train, mentor, and oversee the activity of certified CSPs. This includes running initial training sessions, reviewing data gathered by certified CSPs (including applications), performing on-site inspections and mentoring, and processing all project applications and rebates.

Certified CSPs
Certified CSPs will be responsible for selling projects, performing audits, 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 XII below as well provide timely and accurate reporting of job data.

Evaluator
APPRISE has been selected as program evaluator and 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 of certified CSPs, 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.

CSPs will utilize the PGW Contractor Tool to guide their audits, set recommended job scopes, determine PGW CRRI Incentives, and provide a sales report to the customer. CSPs 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.
EnergyWorks/ Keystone HELP	As a start, all programs will cross-promote all available energy-efficiency resources. Keystone HELP, through EnergyWorks funding, will continue to offer low-interest financing products specifically for weatherization work. These subsidized interest-rate products will be available to PGW customers who are interested in financing and meet program eligibility criteria.
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 CRRI CSPs. This builds upon the partnership PGW has developed for ELIRP.
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

<u>Quality Assurance</u>

The primary quality assurance tool that PGW will use is that customers must have work performed by certified CSPs in order to receive the PGW incentive. CSPs will be required to maintain standard certification levels, and will be trained and continually vetted by the Program Administrator using PGW's CRRI program protocols. The Program Administrator will perform 3rd-party inspections of a certain percentage of

CRRI homes, and CSPs will be evaluated on an ongoing basis, with increased assignment activity directed to superior performance.

Data Collection

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

- Initial Leads
    - 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

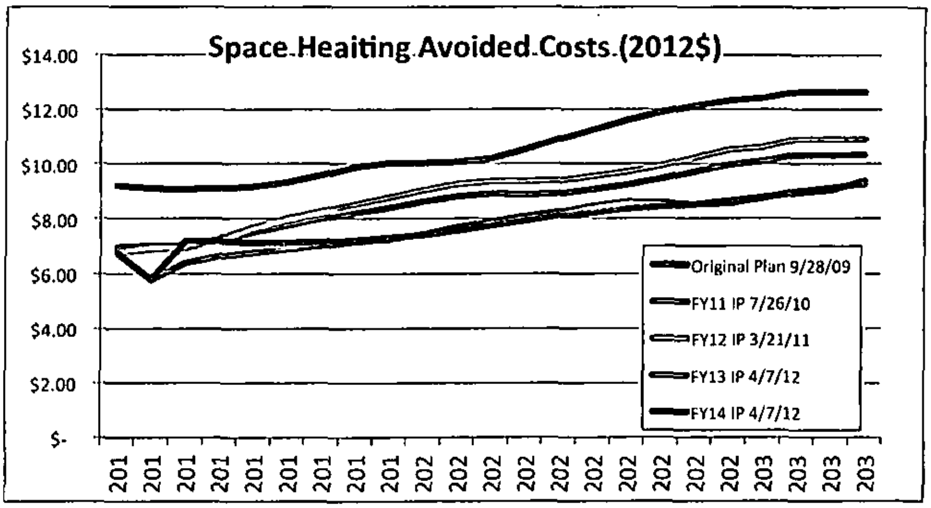
In accordance with the general evaluation plans for the Demand Side Management (DSM) Portfolio, a third-party contractor will perform in-depth evaluations every two years. The first evaluation for the CRRI is scheduled for FY 2015.

III.Appendices

A. PGW Avoided Costs and Value of Savings

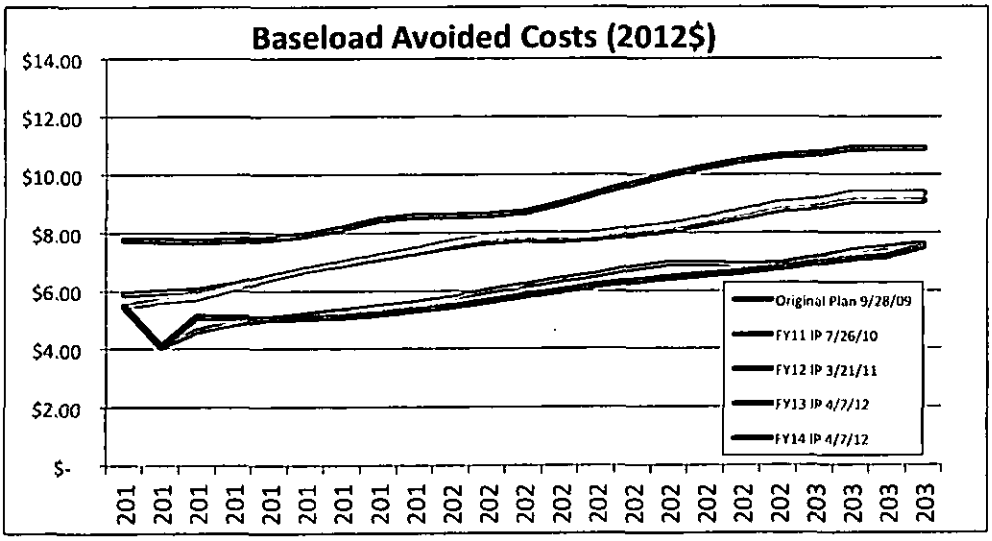
Comparison of Space Heating Avoided Costs (2012$)

Year	Original Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12	FY14 IP 4/7/12
2011	$9.20	$6.96	$6.77	$6.77	$6.77
2012	$9.11	$7.00	$6.91	$5.75	$5.75
2013	$9.06	$7.02	$6.93	$6.36	$7.19
2014	$9.10	$7.21	$7.28	$6.62	$7.17
2015	$9.19	$7.50	$7.68	$6.76	$7.10
2016	$9.34	$7.77	$8.00	$6.88	$7.10
2017	$9.58	$8.01	$8.27	$7.03	$7.14
2018	$9.89	$8.21	$8.52	$7.16	$7.21
2019	$10.05	$8.42	$8.78	$7.25	$7.30
2020	$10.04	$8.62	$9.05	$7.43	$7.41
2021	$10.08	$8.81	$9.28	$7.69	$7.58
2022	$10.20	$8.90	$9.37	$7.90	$7.75
2023	$10.53	$8.88	$9.35	$8.09	$7.93
2024	$10.91	$8.92	$9.40	$8.24	$8.10
2025	$11.27	$9.07	$9.55	$8.45	$8.21
2026	$11.62	$9.23	$9.72	$8.63	$8.36
2027	$11.92	$9.45	$9.95	$8.60	$8.43
2028	$12.15	$9.71	$10.23	$8.52	$8.54
2029	$12.34	$9.99	$10.53	$8.56	$8.66
2030	$12.41	$10.10	$10.63	$8.77	$8.79
2031	$12.64	$10.32	$10.91	$9.00	$8.96
2032	$12.64	$10.32	$10.91	$9.13	$9.06
2033	$12.64	$10.32	$10.91	$9.27	$9.40



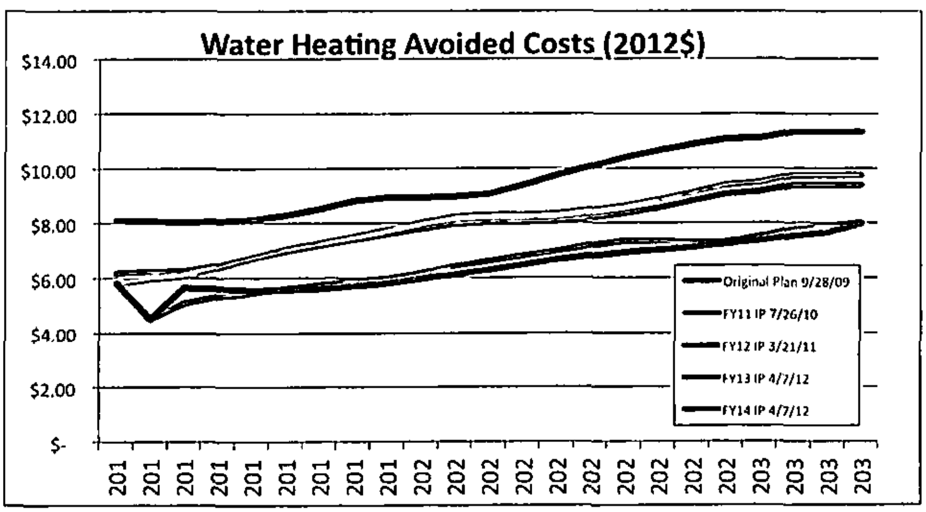
Comparison of Baseload Avoided Costs (2012$)

Year	Original Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12	FY14 IP 4/7/12
2011	$7.75	$5.90	$5.48	$5.48	$5.48
2012	$7.71	$5.95	$5.66	$4.07	$4.07
2013	$7.68	$6.01	$5.76	$4.64	$5.11
2014	$7.71	$6.20	$6.07	$4.89	$5.09
2015	$7.80	$6.46	$6.43	$5.03	$5.05
2016	$7.94	$6.71	$6.72	$5.17	$5.07
2017	$8.15	$6.93	$6.96	$5.32	$5.12
2018	$8.43	$7.12	$7.18	$5.45	$5.21
2019	$8.57	$7.31	$7.42	$5.55	$5.33
2020	$8.56	$7.49	$7.66	$5.73	$5.47
2021	$8.60	$7.68	$7.86	$5.98	$5.63
2022	$8.70	$7.76	$7.95	$6.19	$5.81
2023	$9.00	$7.74	$7.93	$6.38	$6.00
2024	$9.35	$7.78	$7.97	$6.53	$6.18
2025	$9.67	$7.91	$8.11	$6.75	$6.30
2026	$9.98	$8.06	$8.26	$6.92	$6.45
2027	$10.26	$8.27	$8.47	$6.91	$6.53
2028	$10.46	$8.51	$8.71	$6.84	$6.64
2029	$10.64	$8.77	$8.98	$6.89	$6.77
2030	$10.69	$8.87	$9.08	$7.09	$6.91
2031	$10.91	$9.07	$9.33	$7.33	$7.08
2032	$10.91	$9.07	$9.33	$7.46	$7.18
2033	$10.91	$9.07	$9.33	$7.60	$7.52



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	FY14 IP 4/7/12
2011	$8.12	$6.16	$5.80	$5.80	$5.80
2012	$8.06	$6.21	$5.97	$4.49	$4.49
2013	$8.03	$6.26	$6.05	$5.07	$5.63
2014	$8.06	$6.45	$6.37	$5.32	$5.61
2015	$8.14	$6.72	$6.74	$5.46	$5.57
2016	$8.29	$6.98	$7.04	$5.60	$5.58
2017	$8.51	$7.20	$7.29	$5.74	$5.63
2018	$8.79	$7.39	$7.51	$5.88	$5.71
2019	$8.94	$7.59	$7.76	$5.98	$5.82
2020	$8.93	$7.77	$8.01	$6.15	$5.95
2021	$8.97	$7.96	$8.22	$6.41	$6.12
2022	$9.08	$8.05	$8.31	$6.62	$6.29
2023	$9.38	$8.03	$8.29	$6.81	$6.48
2024	$9.74	$8.07	$8.33	$6.96	$6.66
2025	$10.07	$8.20	$8.47	$7.17	$6.78
2026	$10.39	$8.35	$8.62	$7.35	$6.93
2027	$10.67	$8.56	$8.84	$7.33	$7.01
2028	$10.88	$8.81	$9.09	$7.26	$7.12
2029	$11.06	$9.08	$9.37	$7.31	$7.25
2030	$11.12	$9.17	$9.47	$7.51	$7.38
2031	$11.34	$9.38	$9.72	$7.75	$7.55
2032	$11.34	$9.38	$9.72	$7.88	$7.65
2033	$11.34	$9.38	$9.72	$8.01	$7.99



B. Additional Avoided Costs for PGW

Paul Chernick
Resource Insight, Inc.
April 11, 2013

Wholesale Gas Market Effects

Supply Market Effects on PGW Gas Bills

Reducing gas usage reduces the price of natural gas on a continental basis. Table B-1 summarizes the results of a number of analyses in the period 1998–2007 that estimated the effect on continental gas prices of reducing gas use with gas or electric energy-efficiency programs and/or renewable energy.[23] Most of these studies used EIA's National Energy Modeling System (NEMS), which is also used in the Annual Energy Outlook.[24] Table B-1 shows results for 2020, except for the ACEEE study, which estimated results in 2008.

Most of these analyses estimated that a 1% reduction in US gas consumption would reduce gas prices by about 1%–3%. For the gas supply prices that we are projecting for 2014–2020, a price reduction of 1%–3% would be about $0.05–$0.20/MMBtu. For that same time period, EIA forecasts that total US consumption of natural gas will be about 25 quads (or billion MMBtu). In more practical terms, the reduction of PGW gas consumption by 1% (about 780,000 MMBtu) would reduce continental gas prices by about $0.0002–$0.0006/MMBtu.

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23 While there are regional differences in gas prices due to pipeline congestion, most of the natural-gas price in most locations at most times is determined by the total balance of load and supply across the US and Canada.

24 The ACEEE study used the proprietary model of Energy and Environmental Analysis, Inc.

Table B-1: Estimates of Gas Price Suppression from Reduced Usage

Author	Reduction in U.S. Gas Consumption quads	Gas Wellhead Price Reduction $/MMBtu (2000$)	$/MMBtu per quad (2000$)
EIA (1998)	1.12	$0.34	$0.30
EIA (1999)	0.41	$0.19	$0.46
EIA (2001)	1.45	$0.27	$0.19
EIA (2001)	3.89	$0.56	$0.14
EIA (2002a)	0.72	$0.12	$0.17
EIA (2002a)	1.32	$0.22	$0.17
EIA (2003)	0.48	$0.00	$0.00
UCS (2001)	10.54	$1.58	$0.15
UCS (2002a)	1.28	$0.32	$0.25
UCS (2002a)	3.21	$0.55	$0.17
UCS (2002b)	0.72	$0.05	$0.07
UCS (2003)	0.10	$0.14	$1.40
UCS (2004a)	0.49	$0.12	$0.24
UCS (2004a)	1.80	$0.07	$0.04
UCS (2004b)	0.62	$0.11	$0.18
UCS (2004b)	1.45	$0.27	$0.19
Tellus (2002)	0.13	$0.00	$0.00
Tellus (2002)	0.23	$0.01	$0.04
Tellus (2002)	0.28	$0.02	$0.07
ACEEE (2003)	1.35	$0.76	$0.56

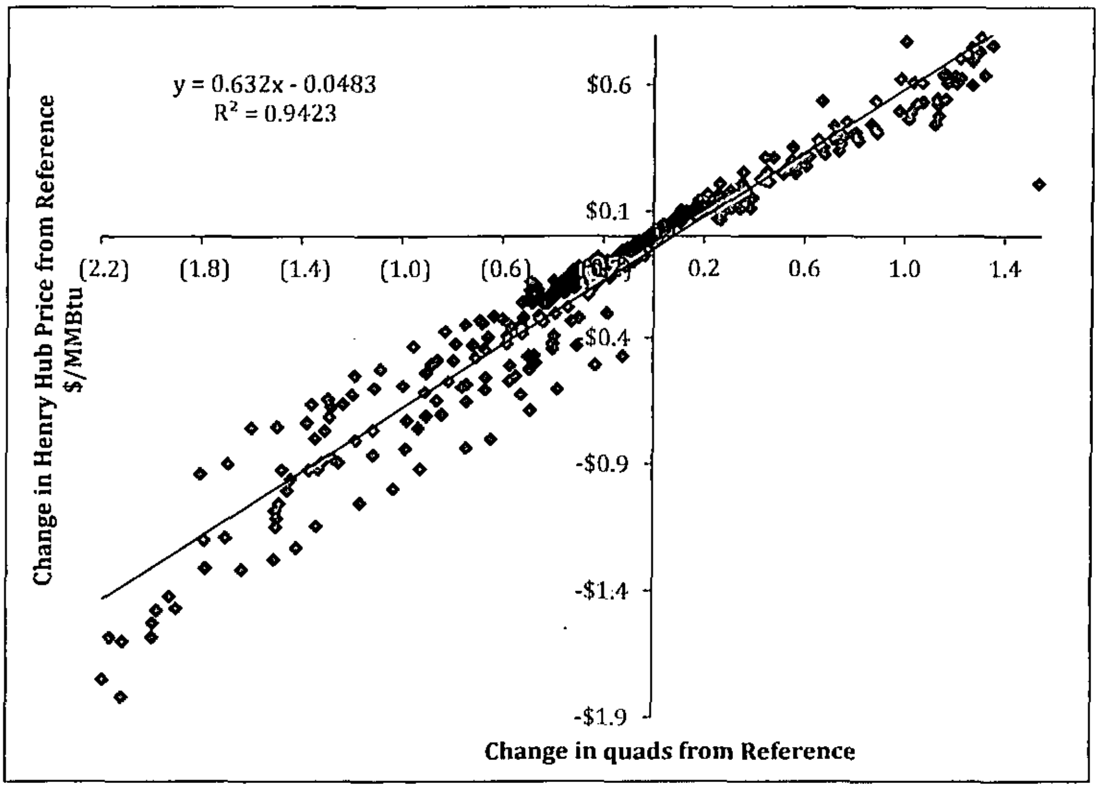
The structure of natural gas supply has changed considerably since 2007, with the growing importance of shale gas and the transition from forecasts of large LNG imports to forecasts of significant LNG exports. As a result, we have not used these older analyses to estimate gas-supply DRIPE. Instead, we have used EIA's most recent set of sensitivity analyses, from the 2012 AEO. Exhibit 1 lists the cases we identified as changing natural gas demand without affecting the gas supply curve, along with EIA's projection of the changes in gas consumption (in quads or billion Btu or trillion cubic feet), and Henry Hub price (in 2010$/MMBtu) from the AEO reference case in 2020.

Exhibit 1: AEO 2012 Gas-Demand Sensitivity Cases

	Change from 2020 Reference Case	
Forecast Case	**Consumption (quads)**	**Henry Hub Price (2010$/MMBtu)**
High economic growth	0.48	0.31
Low economic growth	(0.53)	(0.35)
Low nuclear uprates, lives and additions	0.07	0.05
High nuclear uprates, lives and additions	0.00	0.01
Low coal cost	(0.32)	(0.20)
High coal cost	0.45	0.26
2011 residential & commercial demand technology	0.37	0.17
High residential & commercial demand technology	(0.49)	(0.47)
Best residential & commercial demand technology	(0.74)	(0.83)
High coal retirement (Reference 05 case)	0.36	0.17
Low demand and supply technology	0.35	0.18
High demand and supply technology	(0.55)	(0.55)
Low renewable technology cost	(0.08)	(0.10)
Extended taxes and standards for efficiency & renewables	(0.15)	(0.08)
No sunset on tax policies for efficiency & renewables	(0.06)	(0.02)

Exhibit 2 plots those changes from the reference case, over all the years reported in AEO 2012. The results are remarkably linear, with the small changes in the early years clustered near the origin and the large changes in later years closer to the ends of the trend line.

Exhibit 2: Gas Demand and Price Changes, AEO 2012



We will use the linear trend line in Exhibit 2, which implies a $0.632/MMBtu decrease in Henry Hub gas price for every billion MMBtu decrease in annual gas consumption. To convert this slope of the supply curve to cents of gas-bill reduction per MMBtu saved, we multiply the coefficient times PGW's end-use gas consumption of about 78 million MMBtu. The potential effect on PGW gas end users' gas supply bill of one MMBtu reduction in gas consumption is

$$(\$0.632 \times 10^{-9}/MMBtu) \times (0.078 \times 10^{9}\ MMBtu) = \$0.05.$$

We do not expect to see any significant decay in these price-reduction values. The AEO gas prices (at least after the first few years) reflect the full long-term costs of gas development, not just the operation of existing wells. In addition, gas supply price reduction measures the effect of demand on the marginal cost of extraction for a finite resource.[25] If anything, lower gas usage in 2014 will leave more low-cost gas in the ground to meet demand in 2015, causing the effect to accumulate over time. A program that saves 100 MMBtu annually from 2015 onward would have kept another 500 BBtu in the ground by 2020, in addition to reducing 2020 demand by 100 BBtu. The shape of the

[25] As technology changes, the size of the resource changes, but once gas is removed from the ground, it is gone forever. Less gas will be available from that play in the future, forcing the marginal supply to more expensive plays.

scatter plot in Exhibit 2 does not suggest strong effects of either decay (which would produce an S curve, with the out years leveling off) or accumulation (which would result in rising effects in the out years, more extreme than the trend line).

Effect of Supply Gas Prices on Electric Prices

Natural gas set the market price in PJM about 33% of the time in the last twelve months.[26] That number is likely to rise over the next several years, as coal plants retire. The PJM data on marginal fuels reflect the generators that are at the margin in various zones of the sprawling PJM footprint, which stretches from Virginia to Chicago. In some hours, different fuels set the prices in different zones. Considering the large amount of coal-fired generation in the western parts of PJM, the percent of hours in which gas sets PECo's price is likely to be higher than the average.

When gas sets the market electric price, every $1/MMBtu change in gas price would change the market price by $7/MWh for the most efficient combined-cycle plants, $10/MWh for modern combustion turbines and older steam plants, and up to $15/MWh for older peakers. In 2012, PECo delivered about 39.7 million MWh. Assuming the average heat rate for the marginal gas generators is 9.5 MMBtu/MWh, the savings to PECo customers (many of which are also PGW customers and Philadelphia residents or businesses) from a MMBtu reduction in gas use would be

$$(\$0.632\times10^{-9}/\text{MMBtu}) \times (9.5\ \text{MMBtu/MWh}) \times 39.7\times10^{6}\ \text{MWh} \times 33\% = \$0.08$$

Effect of Gas Conservation on Pipeline Charges

Just as reducing gas consumption reduces gas prices at the wellhead and Henry Hub, reducing gas consumption also reduces the difference (or basis) between the market prices at Henry Hub and the Philadelphia citygate. This reduction in market price has no effect on the costs to PGW gas customers, because PGW purchases its gas transportation services under long-term contracts at tariff rates. For third-party marketers setting prices for their customers, and for power plants setting their bid prices, the market prices represent the cost of acquiring capacity or the opportunity cost of not selling the capacity into the market.

Exhibit 3 plots the basis from Henry Hub to Texas Eastern Zone M-3 against monthly gas consumption in the Northeast (Pennsylvania, New Jersey, New York, Massachusetts, Rhode Island, Connecticut and New Hampshire) for each month from January 2008 through June 2012, the last month for which EIA has reported complete state consumption data.[27] The solid markers identify the data for November through March for each of the indicated winters.

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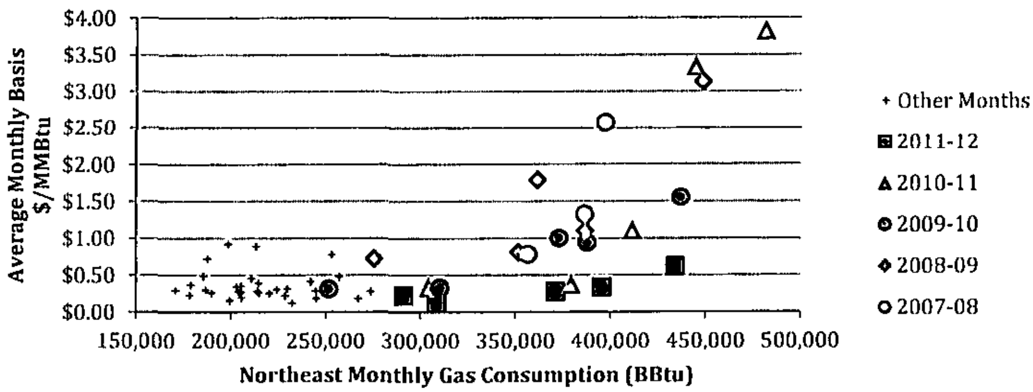
[26] Data from http://www.monitoringanalytics.com/data/marginal_fuel.shtml.

[27] Vermont and Maine have been served entirely or primarily from Canada, and are not included in this analysis.

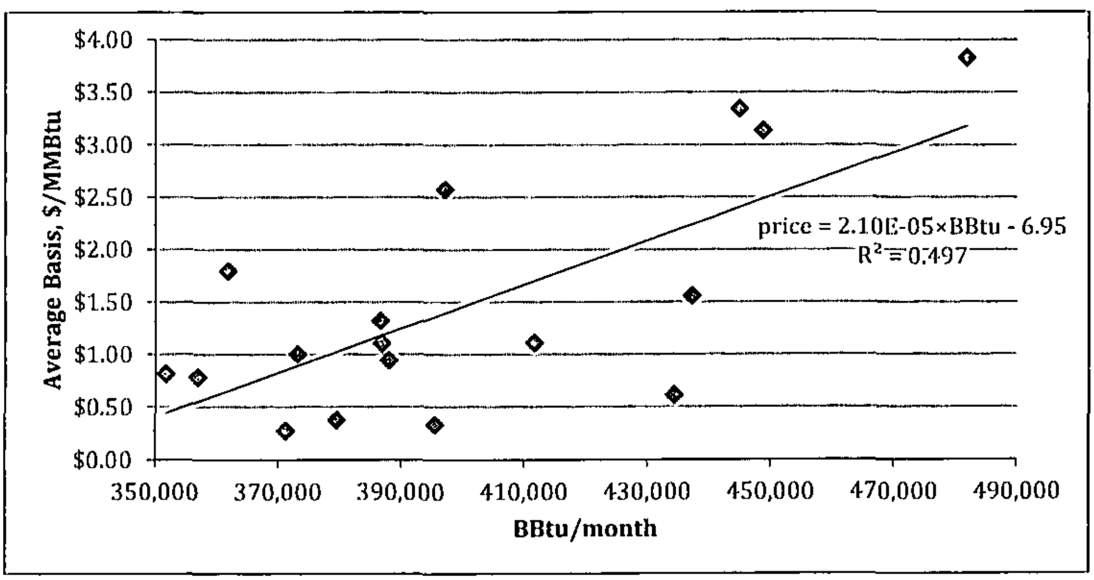
Basis has mostly been under $0.50/MMBtu (reflecting pipeline commodity and fuel charges) for consumption under 350,000 BBtu/month. The four non-winter months with basis over $0.50/MMBtu were April–July 2008, when gas prices were in the range of $12–$13/MMBtu, which would have substantially increased the fuel charges and hence the total variable pipeline charge. Over 350,000 BBtu/month, basis has risen fairly steadily for higher consumption levels, with lower prices in the unusually mild winter of 2011/12.

Exhibit 3: TETCo M-3 Basis versus Northeast Gas Consumption



As shown in Exhibit 4, every BBtu of monthly consumption over 350,000 has increased the monthly basis by an average of $0.021/TBtu. The load range includes every December, January and February in our data, three of the five Marchs, and no other months.

Exhibit 4: TETCo M-3 Basis versus Northeast Gas Consumption, >350,000 BBtu/month



Multiplying the $0.021/TBtu price-suppression by PGW's transportation deliveries forecast for December 2013 to February 2014, plus 60% of March 2014 (reflecting the probability of March being a high-demand month), weighted by the fraction of an annual space-heating MMBtu used the various months (58% in December–February and 14% in March) gives a price-suppression benefit of about $0.042/MMBtu of saved gas. Assuming that contract durations average three years, the price effect passed on to PGW customers would be about $0.014/MMBtu in the first year (e.g., 2014 for 2013/14 installation), $0.028/MMBtu in the second year, and $0.042/MMBtu thereafter. A MMBtu reduction in baseload gas usage would reduce winter load less than half as much, about $0.006/MMBtu in the first year, $0.013/MMBtu in the second year, and $0.019/MMBtu thereafter.

Similarly, the price effect on electricity prices for PECo customers would be $0.021/TBtu, times the percentage of hours with gas at the margin (about 40%), times a 9.5 heat rate, times PECo monthly sales in the winter (averaging about 3,600 GWh), weighted by the percentage of the heating load in each month, would result in total electric price effects of about $0.20/MMBtu for space-heating savings and $0.09/MMBtu for baseload savings. Since both PECo BGS and competitive marketers lock in prices for a year or so, the price effect would be delayed by a year.

Since the lower winter prices in the mid-Atlantic would tend to discourage construction of new pipeline supply, the price benefit is likely to decline after several years. In addition, the addition of shale gas in the mid-Atlantic is likely to reduce the TETCo M-3 basis over time. It seems reasonable to phase out the price effects from 2017 through 2020 or so.

Summary of Gas Price Effects

Each MMBtu of gas conservation would be expected to save PGW and PECo customers about $0.13 in reduced gas and electric prices due to wellhead gas prices, with up to $0.39 of additional savings from reduced basis for space-heating load reductions B-2 summarizes the results discussed above.

Table B-2: Summary of Price Effects per MMBTU of Savings (2013$)

Year	Wellhead Price Effect		Basis Effect for deliveries by				Total Effect	
			Space Heat		Baseload		Heating	Base
starting	PGW	PECo	PGW	PECo	PGW	PECo		
2013	$0.05	$0.08	$0.01		$0.01		$0.14	$0.14
2014	$0.05	$0.08	$0.03	$0.20	$0.01	$0.09	$0.36	$0.23
2015	$0.05	$0.08	$0.04	$0.20	$0.02	$0.09	$0.37	$0.24
2016	$0.05	$0.08	$0.04	$0.20	$0.02	$0.09	$0.37	$0.24
2017	$0.05	$0.08	$0.04	$0.20	$0.02	$0.09	$0.37	$0.24
2018	$0.05	$0.08	$0.03	$0.15	$0.01	$0.07	$0.31	$0.21
2019	$0.05	$0.08	$0.02	$0.10	$0.01	$0.05	$0.25	$0.18
2020	$0.05	$0.08	$0.01	$0.05	$0.00	$0.02	$0.19	$0.16
2021+	$0.05	$0.08	-	-	-	-	$0.13	$0.13

If the perspective were broadened to include all Pennsylvania energy consumers (which would be a reasonable perspective for the Pennsylvania PUC), the price-suppression benefits would be much larger. Pennsylvania end-use consumers use about 600 million MMBtu (about eight times PGW's use) and electric customers use about 162 million MWh (four times PECo's). The benefit of wellhead gas price suppression for all Pennsylvania customers would be about $0.68/MMBtu of gas consumption, not counting the basis price effect, which varies by year (and by location).

Carbon Allowance Price

We based our estimate on the latest allowance price forecast of Synapse Energy Economics. The Synapse externality values have been widely used by utilities and other entities.

Table B-3: Synapse 2012 CO_2 Allowance Price Projections (Mid Case)

	2012$/ton CO_2	2013$/MMBtu
2020	$20.00	$1.20
2021	$22.25	$1.34
2022	$24.50	$1.47
2023	$26.75	$1.61
2024	$29.00	$1.75
2025	$31.25	$1.88
2026	$33.50	$2.02
2027	$35.75	$2.15
2028	$38.00	$2.29
2029	$40.25	$2.42
2030	$42.50	$2.56
2031	$44.75	$2.69
2032	$47.00	$2.83
2033	$49.25	$2.96
2034	$51.50	$3.10
2035	$53.75	$3.23
2036	$56.00	$3.37
2037	$58.25	$3.51
2038	$60.50	$3.64
2039	$62.75	$3.78
2040	$65.00	$3.91

Sources:

"2012 Carbon Dioxide Price Forecast," R. Wilson, P. Luckow, B. Biewald, F. Ackerman, and E. Hausman, 10/4/2012, Table 1

118 lb CO_2/MMBtu

C. 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

D. Units

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

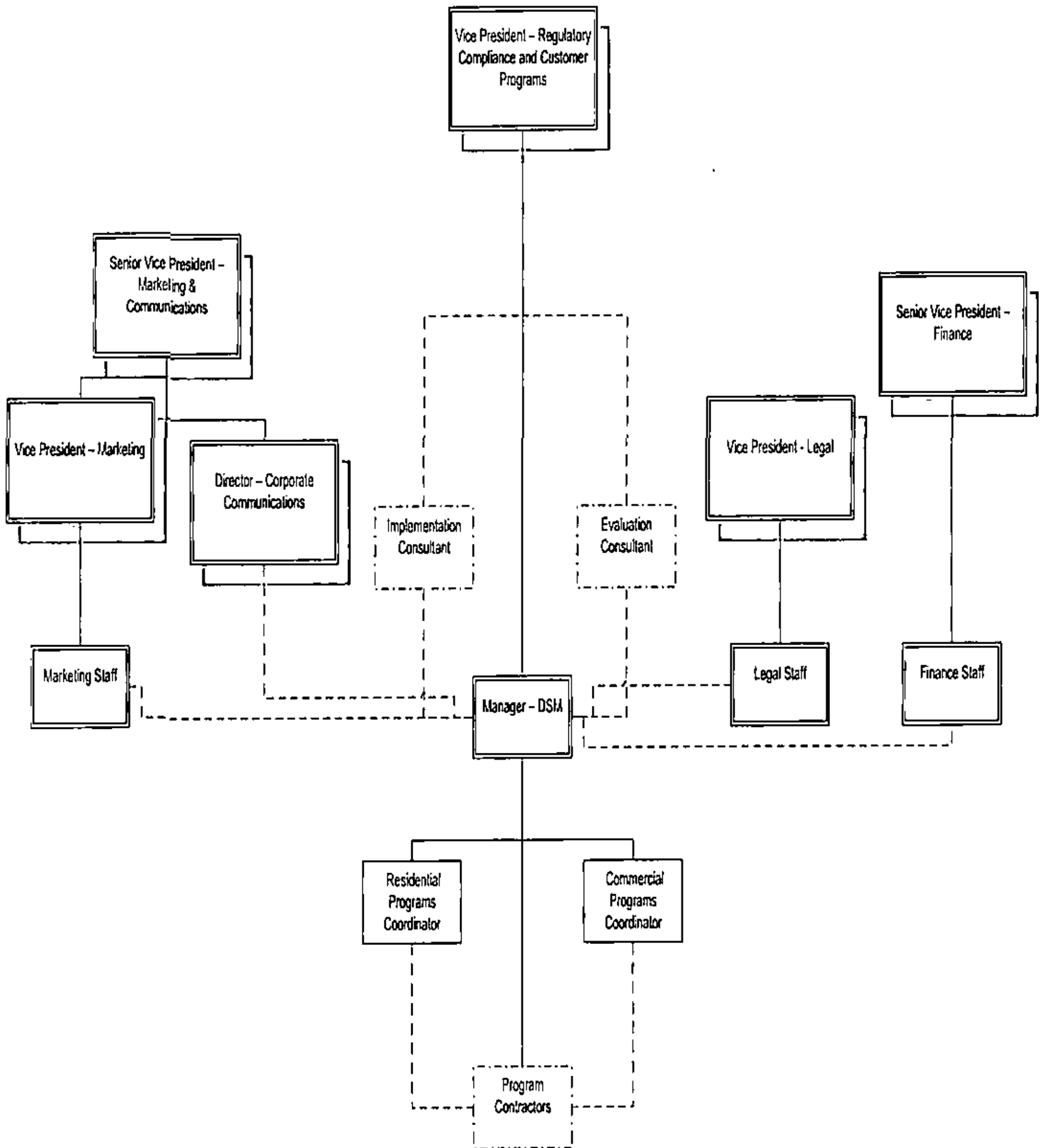
Ccf = 100 cubic feet
Mcf = 1,000 cubic feet
MMcf = 1,000,000 cubic feet
Bcf = 1,000,000,000 cubic feet

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

E. Organization Chart



F. 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	$ 1,726,711	$ 4,709,162	$ 6,525,725	$ 9,656,749	$ 9,940,749	$ 32,649,096
Administration and Management	$ 601,117	$ 557,453	$ 731,390	$ 734,817	$ 705,212	$ 3,329,988
Marketing and Business Development	$ 7,930	$ 109,364	$ 276,881	$ 412,966	$ 406,708	$ 1,213,848
Contractor Costs	$ 1,036,017	$ 1,263,901	$ 1,889,212	$ 1,946,183	$ 1,960,808	$ 8,096,121
Inspection and Verification	$ 11,371	$ 37,561	$ 95,037	$ 160,992	$ 170,208	$ 475,169
Evaluation	$ -	$ -	$ 126,540	$ 75,000	$ 342,930	$ 544,470
TOTAL:	$ 3,383,145	$ 6,767,441	$ 9,644,786	$ 12,986,706	$ 13,526,616	$ 46,308,693

Enhanced Low Income Retrofit

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Measure Installation Costs	$ 1,717,744	$ 4,579,144	$ 5,512,322	$ 5,475,972	$ 5,320,361	$ 22,605,544
Administration and Management	$ 36,022	$ -	$ -	$ 15,500	$ -	$ 51,522
Marketing and Business Development	$ -	$ -	$ -	$ -	$ -	$ -
Contractor Costs	$ 1,008,127	$ 1,167,369	$ 1,441,679	$ 1,368,993	$ 1,330,000	$ 6,316,258
Inspection and Verification	$ 11,371	$ 36,525	$ 69,421	$ 68,381	$ 67,042	$ 252,741
Evaluation	$ -	$ -	$ 76,540	$ -	$ 75,000	$ 151,540
TOTAL:	$ 2,773,264	$ 5,783,038	$ 7,099,962	$ 6,928,848	$ 6,792,494	$ 29,377,605

Residential Heating Equipment Rebates

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ 8,967	$ 220,018	$ 493,697	$ 1,172,535	$ 1,149,544	$ 3,044,761
Administration and Management	$ -	$ 2,139	$ -	$ -	$ -	$ 2,139
Marketing and Business Development	$ 7,930	$ 106,299	$ 92,507	$ 91,177	$ 89,389	$ 387,302
Contractor Costs	$ 27,890	$ 45,500	$ 41,867	$ 43,856	$ 42,996	$ 202,109
Inspection and Verification	$ -	$ 1,037	$ 3,565	$ 21,110	$ 21,731	$ 47,442
Evaluation	$ -	$ -	$ 50,000	$ -	$ 50,000	$ 100,000
TOTAL:	$ 44,786	$ 374,993	$ 681,637	$ 1,328,678	$ 1,353,660	$ 3,783,753

Commercial and Industrial Retrofit Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 108,000	$ 468,000	$ 540,000	$ 1,116,000
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ 46,192	$ 45,588	$ 44,695	$ 136,475
Contractor Costs	$ -	$ 41,244	$ 35,357	$ 78,000	$ 90,000	$ 244,600
Inspection and Verification	$ -	$ -	$ 3,000	$ 13,000	$ 15,000	$ 31,000
Evaluation	$ -	$ -	$ -	$ 75,000	$ -	$ 75,000
TOTAL:	$ -	$ 41,244	$ 192,549	$ 679,588	$ 689,695	$ 1,603,076

Commerical and Industrial Equipment Rebates

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 137,905	$ 334,440	$ 362,471	$ 834,816
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ 3,064	$ 50,000	$ 75,000	$ 75,000	$ 203,064
Contractor Costs	$ -	$ 9,788	$ 66,667	$ 100,000	$ 100,000	$ 276,455
Inspection and Verification	$ -	$ -	$ 9,238	$ 9,238	$ 12,680	$ 31,157
Evaluation	$ -	$ -	$ -	$ -	$ 75,000	$ 75,000
TOTAL:	$ -	$ 12,853	$ 263,810	$ 518,678	$ 625,151	$ 1,420,492

High Efficiency Construction Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 32,496	$ 223,072	$ 279,011	$ 534,579
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ 18,846	$ 18,846	$ 18,846	$ 56,539
Contractor Costs	$ -	$ -	$ 54,204	$ 100,038	$ 125,085	$ 279,327
Inspection and Verification	$ -	$ -	$ 575	$ 3,672	$ 4,592	$ 8,839
Evaluation	$ -	$ -	$ -	$ -	$ 75,000	$ 75,000
TOTAL:	$ -	$ -	$ 106,121	$ 345,629	$ 502,534	$ 954,284

Comprehensive Residential Retrofit Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 241,305	$ 1,982,730	$ 2,289,362	$ 4,513,398
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ 23,096	$ 136,765	$ 134,084	$ 293,945
Contractor Costs	$ -	$ -	$ 249,438	$ 255,295	$ 272,637	$ 777,370
Inspection and Verification	$ -	$ -	$ 9,238	$ 45,588	$ 49,164	$ 103,991
Evaluation	$ -	$ -	$ -	$ -	$ 67,930	$ 67,930
TOTAL:	$ -	$ -	$ 523,078	$ 2,420,380	$ 2,813,176	$ 5,756,634

Portfolio-wide Costs

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ -	$ -	$ -	$ -
Administration and Management	$ 565,095	$ 555,314	$ 731,390	$ 719,316	$ 705,212	$ 3,276,328
Marketing and Business Development	$ -	$ -	$ 46,239	$ 45,588	$ 44,695	$ 136,522
Contractor Costs	$ -	$ -	$ -	$ -	$ -	$ -
Inspection and Verification	$ -	$ -	$ -	$ -	$ -	$ -
On-site Potential Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL:	$ 565,095	$ 555,314	$ 777,629	$ 764,905	$ 749,907	$ 3,412,849

Comparison of Budget Projections

Real 2009$

Program	FY 2013	FY 2014	FY 2015	FY 2013 - 15
FY 2014 IP (New)				
PORTFOLIO TOTAL	$9,644,786	$12,986,706	$13,526,616	**$36,158,107**
ELIRP	$7,099,962	$6,928,848	$6,792,494	**$20,821,303**
RHER	$681,637	$1,328,678	$1,353,660	**$3,363,974**
CIRI	$192,549	$679,588	$689,695	**$1,561,832**
CIER	$263,810	$518,678	$625,151	**$1,407,640**
HECI	$106,121	$345,629	$502,534	**$954,284**
CRRI	$523,078	$2,420,380	$2,813,176	**$5,756,634**
Portfolio-wide	$777,629	$764,905	$749,907	**$2,292,440**
FY 2013 IP (Old)				
PORTFOLIO TOTAL	$11,114,681	$14,607,750	$15,404,717	**$41,127,148**
ELIRP	$7,163,570	$6,534,899	$6,197,586	**$19,896,054**
RHER	$1,651,200	$3,299,676	$3,975,709	**$8,926,585**
CIRI	$467,202	$608,957	$481,162	**$1,557,321**
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	$751,444	$736,709	$722,264	**$2,210,417**
Difference ($)				
PORTFOLIO TOTAL	$(1,469,896)	$(1,621,045)	$(1,878,101)	**$(4,969,041)**
ELIRP	$(63,608)	$393,949	$594,908	**$925,250**
RHER	$(969,564)	$(1,970,998)	$(2,622,049)	**$(5,562,610)**
CIRI	$(274,653)	$70,632	$208,532	**$4,511**
CIER	$(115,146)	$(129,583)	$(172,235)	**$(416,963)**
HECI	$(72,809)	$(12,236)	$9,069	**$(75,975)**
CRRI	$(302)	$(1,005)	$76,031	**$74,724**
Portfolio-wide	$26,185	$28,196	$27,643	**$82,023**
Difference (%)				
PORTFOLIO TOTAL	-13.2%	-11.1%	-12.2%	**-12.1%**
ELIRP	-0.9%	6.0%	9.6%	**4.7%**
RHER	-58.7%	-59.7%	-66.0%	**-62.3%**
CIRI	-58.8%	11.6%	43.3%	**0.3%**
CIER	-30.4%	-20.0%	-21.6%	**-22.9%**
HECI	-40.7%	-3.4%	1.8%	**-7.4%**
CRRI	-0.1%	0.0%	2.8%	**1.3%**
Portfolio-wide	3.5%	3.8%	3.8%	**3.7%**

G. Sales Reduction Projections

Gas Sales Reduction Projections from Activity in FY 2011 through FY 2015 (MCF)

FY	Total	Total (excluding CRP)
2011	11,414	267
2012	47,443	4,710
2013	118,089	24,631
2014	251,515	97,151
2015	430,722	216,040
2016	522,533	278,152
2017	522,533	278,152
2018	521,895	277,513
2019	519,589	275,208
2020	515,736	271,671
2021	513,137	269,802
2022	512,520	269,802
2023	512,261	269,802
2024	512,113	269,802
2025	511,075	268,900
2026	504,849	265,629
2027	493,522	260,491
2028	485,144	257,454
2029	478,167	252,569
2030	464,533	238,963
2031	442,092	223,229
2032	412,793	214,327
2033	384,120	208,341
2034	339,313	189,763
2035	246,011	144,552
2036	134,310	93,686
2037	82,037	71,394
2038	73,426	62,782
2039	52,882	42,238
2040	24,851	14,207
2041	10,644	0
2042	9,526	0
2043	5,687	0
2044	1,482	0
2045	0	0
TOTAL	**10,667,963**	**5,611,228**

H. 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	14	19	24
FY 2012	33	43	54
FY 2013	52	70	87
FY 2014	93	124	155
FY 2015	96	129	161
TOTAL	**289**	**385**	**481**
NON-RESIDENTIAL PROGRAMS			
FY 2011	0	0	0
FY 2012	0	0	0
FY 2013	7	10	12
FY 2014	17	23	29
FY 2015	19	26	32
TOTAL	**44**	**58**	**73**
TOTAL PORTFOLIO			
FY 2011	14	19	24
FY 2012	33	44	55
FY 2013	59	79	99
FY 2014	110	147	184
FY 2015	116	154	193
TOTAL	**333**	**443**	**554**

covery Schedules

come Retrofit Program costs are recovered through the Universal Services Surcharge, beginning at ELIRP nuary 1, 2011.

Sense program costs are recovered through the Efficiency Cost Recovery Surcharge in accordance with each 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 2853	$ 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	$ 14 862,538	$ 17,110,745	$ (2,328,209)	($13,052,918)
January 2011	Actual	10 607,049	$ 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	4,706,176	$ 2 6468	$ 12,461,598	$ 12,027,927	$ (466,329)	($32 885,786)
May	Actual	2,278 994	$ 2 6468	$ 6,032,041	$ 4,525,304	$ 1,506,736	($31,379,049)
June	Actual	1,383,215	$ 2 7215	$ 3,764,351	$ 177,376	$ 3,586,975	($27,792 074)
July	Actual	1,150,585	$ 2 7001	$ 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	$ 50,189	$ 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	$ 2,730,453	$ (1,416 837)	$ (3 028,412)	$ (3,315,405)
CRP Forgiveness	$ 851,310	$ 794,420	$ 762 875	$ 744,519	$ 764,345	$ 760,414	$ 961 477	$ 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	$ 1,258 270	$ 873,722	$ 459 214	$ 253,530	$ 207 616	$ 185,807
*Bad Debt Expense Offset**	$ -	$ -	$ -	$ -	$ -	$ *(9,426)*	$ *(30 844)*	$ *(24,070)*	$ *(5,752)*	$ *2 872*	$ *1,358*	$ -
Total	$ (2,118,782)	$ (374 819)	$ 7,224 051	$ 17,100 745	$ 28 669 860	$ 25,370,341	$ 20,422,074	$ 12,027,927	$ 4,525,304	$ 177,376	$ (1 685,909)	$ (428,152)
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	$ 2,730,453	$ (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)	$ (434 472)	$ (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	$ 3 270,296	$ (1,778,432)	$ 5,048,730	($14,410,103)
October	Actual	1,499 912	$ 2 4645	$ 3,696,534	$ (479 527)	$ 4,176 001	($10 234,042)
November	Actual	3,467,043	$ 2 4645	$ 8,546,006	$ 7,859,442	$ 686,565	($9,547,477)
December	Actual	4,807,018	$ 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	$ 12,485,606	$ 14,418,722	$ (1,933,116)	($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)	$ 4,549,128	($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	$ 3,021	$ 4,084	$ 1,142,168	$ 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	$ 8,312	$ 13 808	$ 13,808	$ 13,808	$ 13,808	$ 13 808
CRP Discount	$ (2 800,522)	$ (1,401,058)	$ 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	$ 967,060	$ 967,900	$ 967,900	$ 951,174	$ 945 579
Senior Citizen Discount	$ 205,795	$ 258,529	$ 618,193	$ 881,140	$ 1,310.232	$ 1,270,498	$ 908 232	$ 561,357	$ 360,385	$ 193,897	$ 175 077
Bad Debt Expense Offset*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ (1,778,432)	$ (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		Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12
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)	$ (1,401 058)	$ 5,408,379	$ 10,821,473	$ 19 679 942	18 919,974
Actual Participation Rate		82679	82023	80752	80298	80686	81,921
Average Shortfall 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

STATEMENT OF RECONCILIATION
UNIVERSAL SERVICES & ENERGY CONSERVATION SURCHARGE
SEPTEMBER 2012 THROUGH AUGUST 2013

Month FY 12 Reconciliation		Applicable Volumes	USC Charge	USC Revenue Billed	USC Expenses	Monthly Over/(Under) Recovery	Cumulative Over/(Under) Recovery
							($12,100,405)
September 2012	Actual	1,169,843	$ 2.0080	$ 2,420,289	$ (2,095,896)	$ 4,516,185	($7,584,280)
October	*Actual*	*1,609,480*	*$ 2.0307*	*$ 3,268,371*	*$ (87,330)*	*$ 3,355,700*	*($4,228,580)*
November	Actual	3,948,947	$ 2.0307	$ 8,019,127	$ 6,832,776	$ 1,186,351	($3,042,229)
December	Actual	6,013,512	$ 2.0260	$ 12,249,595	$ 13,512,866	$ (1,263,271)	($4,305,500)
January 2013	Actual	8,011,005	$ 2.0231	$ 16,207,185	$ 20,806,263	$ (4,599,079)	($8,904,579)
February	Actual	8,733,933	$ 2.0231	$ 17,669,619	$ 21,468,788	$ (3,799,170)	($12,703,748)
March	Estimated	7,102,097	$ 2.0735	$ 14,726,199	$ 18,251,732	$ (3,525,533)	($16,229,282)
April	Estimated	5,201,750	$ 2.1239	$ 11,047,996	$ 12,715,201	$ (1,667,205)	($17,896,487)
May	Estimated	2,401,006	$ 2.1239	$ 5,099,502	$ 2,913,031	$ 2,186,471	($15,710,016)
June	Estimated	1,347,031	$ 2.1239	$ 2,862,233	$ (977,457)	$ 3,839,690	($11,870,326)
July	*Estimated*	*1,187,255*	*$ 2.1239*	*$ 2,521,610*	*$ (1,411,693)*	*$ 3,933,303*	*($7,937,023)*
August	Estimated	1,086,834	$ 2.1239	$ 2,308,327	$ (1,584,642)	$ 3,892,969	($4,044,054)

USC Expenses	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13
ELIRP Expense	$ 3,438	$ 457,807	$ 499,011	$ 3,347	$ 1,076,076	$ 672,125
ELIRP Labor	$ 5,331	$ 5,489	$ 8,190	$ 7,826	$ 7,834	$ 7,951
CRP Discount	$ (2,956,703)	$ (1,446,565)	$ 5,210,746	$ 12,093,600	$ 17,968,024	$ 18,835,842
CRP Forgiveness	$ 681,304	$ 658,753	$ 533,301	$ 472,750	$ 547,865	$ 497,360
Senior Citizen Discount	$ 170,704	$ 237,187	$ 580,528	$ 935,334	$ 1,207,464	$ 1,255,510
Bad Debt Expense Offset*	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ (2,095,896)	$ (87,330)	$ 6,832,776	$ 13,512,866	$ 20,806,263	$ 21,468,788

USC Expenses	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13
ELIRP Expense	$ 854,845	$ 854,845	$ 854,845	$ 854,845	$ 854,845	$ 854,845
ELIRP Labor	$ 11,643	$ 11,643	$ 11,643	$ 11,643	$ 11,643	$ 11,643
CRP Discount	$ 15,728,250	$ 10,441,689	$ 1,088,110	$ (2,820,749)	$ (3,025,194)	$ (3,180,000)
CRP Forgiveness	$ 587,261	$ 588,750	$ 588,750	$ 585,000	$ 577,500	$ 570,000
Senior Citizen Discount	$ 1,069,728	$ 818,275	$ 369,684	$ 191,804	$ 169,513	$ 158,930
Bad Debt Expense Offset*						
Total	$ 18,251,732	$ 12,715,201	$ 2,913,031	$ (977,457)	$ (1,411,693)	$ (1,584,642)

		Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13
CRP Participation							
Rate Case Participation Rate		84,000	84,000	84,000	84,000	84,000	84,000
Actual Participation Rate*		78,732	77,790	76,177	75,224	75,387	75,671
CRP Under(Over) Participation		5,268	6,210	7,823	8,776	8,613	8,329
Average Shortfall Per CRP Participant							
CRP Discount		$ (2,956,763)	$ (1,446,565)	$ 5,210,746	$ 12,093,600	$ 17,968,024	$ 18,835,842
Actual Participation Rate		78,732	77,790	76,177	75,224	75,387	75,871
Average Shortfall per CRP Participant		$ (38)	$ (19)	$ 68	$ 161	$ 238	$ 249
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	$ 119,058	$ 270,079
March	Actual	5,213,151	$ 0.0168	$ 87,581	$ 5,908	$ -	$ -	$ 543	$ 6,015	$ 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	852,020	$ 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		31,202,965		$ 530,036	$ 69,835	$ -	$ -	$ 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	1,368,040	$ 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		8,205,215		$ 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	$ 1,280	$ -	$ 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	$ -	$ -	$ 5,658	$ 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	882,082	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	$ 153,002	$ 96,427	$ 49,447	$ 43,731	$ 38,849	
RIIIR	Expense	$ 10,403	$ 14,453	$ 38,570	$ 20,187	$ 25,197	$ 29,102	$ 126,353	$ 126,353	$ 126,353	$ 126,353	$ 126,353	$ 126,353	
RIIIR	Labor	$ 1,833	$ 1,220	$ 1,113	$ 1,548	$ 1,784	$ 1,113	$ 2,435	$ 2,435	$ 2,435	$ 2,435	$ 2,435	$ 2,435	
HFCT	Expense	$ 32	$ 33	$ 170	$ 240	$ 32	$ 523	$ 441	$ 441	$ 441	$ 441	$ 441	$ 441	
HFCT	Labor	$ 84	$ 56	$ 51	$ 71	$ 82	$ 51	$ 112	$ 112	$ 112	$ 112	$ 112	$ 112	
CRRI	Expense	$ 306	$ 319	$ 1,630	$ 2,398	$ 307	$ 5,026	$ 4,239	$ 4,239	$ 4,239	$ 4,239	$ 4,239	$ 4,239	
CRRI	Labor	$ 811	$ 540	$ 492	$ 684	$ 769	$ 492	$ 1,077	$ 1,077	$ 1,077	$ 1,077	$ 1,077	$ 1,077	
Total		$ 22,469	$ 16,620	$ 42,027	$ 25,133	$ 28,170	$ 36,368	$ 134,658	$ 134,658	$ 134,658	$ 134,658	$ 134,658	$ 134,658	
Monthly Over/(Under)		$ (8,282)	$ (806)	$ (2,222)	$ 78,531	$ 219,086	$ 202,066	$ 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		$ 5,317	$ 6,322	$ 11,964	$ 21,340	$ 39,317	$ 37,662	$ 30,099	$ 24,421	$ 16,300	$ 12,225	$ 11,476	$ 10,260	
RIIIR	Expense	$ 196	$ 146	$ 390	$ 204	$ 255	$ 205	$ 1,276	$ 1,276	$ 1,276	$ 1,276	$ 1,276	$ 1,276	
RIIIR	Labor	$ 19	$ 12	$ 11	$ 18	$ 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	
CIFR	Expense	$ 17	$ 18	$ 91	$ 134	$ 17	$ 282	$ 238	$ 238	$ 238	$ 238	$ 238	$ 238	
CIFR	Labor	$ 40	$ 30	$ 28	$ 38	$ 44	$ 28	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	
HECT	Expense	$ 32	$ 33	$ 170	$ 240	$ 32	$ 523	$ 441	$ 441	$ 441	$ 441	$ 441	$ 441	
HECT	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		42,816	43,560	72,303	91,204	124,504	119,307	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	$ 72	$ 20	$ 28	$ 32	$ 20	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	
CIFR	Expense	$ 17	$ 18	$ 91	$ 134	$ 17	$ 282	$ 238	$ 238	$ 238	$ 238	$ 238	$ 238	
CIFR	Labor	$ 45	$ 30	$ 28	$ 38	$ 44	$ 28	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	
Total		$ 108	$ 83	$ 206	$ 293	$ 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	

EFFICIENCY COST RECOVERY (ECR) SURCHARGE

STATEMENT OF RECONCILIATION

FISCAL YEAR 2013

		Actual Sep-12	Actual Oct-12	Actual Nov-12	Actual Dec-12	Actual Jan-13	Actual Feb-13	Estimated Mar-13	Estimated Apr-13	Estimated May-13	Estimated Jun-13	Estimated Jul-13	Estimated Aug-13
RESIDENTIAL & PHA GS													
FY 2012 Over-Collection													
Volume Billed		778,071	1,060,326	2,860,862	4,639,892	6,128,404	6,752,192	5,431,965	4,047,054	1,771,513	887,841	784,200	697,871
ECR Surcharge		$ 0.0399	$ 0.0411	$ 0.0411	$ 0.0588	$ 0.0765	$ 0.0765	$ 0.0920	$ 0.0875	$ 0.0875	$ 0.0875	$ 0.0875	$ 0.0875
Revenue Billed		$ 30,927	$ 43,579	$ 117,581	$ 272,826	$ 468,823	$ 516,543	$ 445,421	$ 354,196	$ 155,007	$ 77,686	$ 68,667	$ 61,064
RRFR	Expense	$ 21,577	$ 48,918	$ 97,127	$ 903	$ 117,724	$ 57,524	$ 252,347	$ 252,347	$ 252,347	$ 252,347	$ 252,347	$ 252,347
RRFR	Labor	$ 1,438	$ 1,481	$ 2,470	$ 2,112	$ 2,114	$ 2,145	$ 1,141	$ 3,141	$ 3,141	$ 3,141	$ 1,141	$ 3,141
RECT	Expense	$ 52	$ 500	$ 11,279	$ 4,314	$ 926	$ 5,988	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194
RECT	Labor	$ 81	$ 84	$ 140	$ 119	$ 119	$ 121	$ 178	$ 178	$ 178	$ 178	$ 178	$ 178
CRRT	Expense	$ 401	$ 3,828	$ 4,501	$ 391	$ 7,089	$ 499	$ 99,320	$ 99,320	$ 99,320	$ 99,320	$ 99,320	$ 99,320
CRRT	Labor	$ 822	$ 841	$ 1,073	$ 913	$ 914	$ 928	$ 1,359	$ 1,359	$ 1,359	$ 1,359	$ 1,359	$ 1,359
Total		$ 24,172	$ 51,452	$ 116,799	$ 8,751	$ 128,886	$ 67,205	$ 369,538	$ 369,538	$ 369,538	$ 369,538	$ 369,538	$ 369,538
Monthly Over/(Under)		$ 6,755	$ (9,872)	$ 783	$ 264,074	$ 339,937	$ 449,338	$ 75,883	$ (15,342)	$ (214,531)	$ (291,852)	$ (302,671)	$ (308,475)
Cumulative Over/(Under)		$ *1,111,115*	$ *1,101,243*	$ *1,102,026*	$ *1,366,100*	$ *1,706,037*	$ *2,155,375*	$ *2,231,258*	$ *2,215,915*	$ *2,001,385*	$ *1,709,532*	$ *1,406,862*	$ *1,098,387*
COMMERCIAL & PHA													
FY 2012 Over-Collection													
Volume Billed		357,003	481,850	970,072	1,243,320	1,653,469	1,693,783	1,528,904	1,000,055	579,878	421,504	386,634	355,438
ECR Surcharge		$ 0.0421	$ 0.0457	$ 0.0457	$ 0.0539	$ 0.0618	$ 0.0618	$ 0.0780	$ 0.0941	$ 0.0941	$ 0.0941	$ 0.0941	$ 0.0941
Revenue Billed		$ 15,030	$ 22,021	$ 44,332	$ 66,828	$ 102,184	$ 104,676	$ 119,178	$ 99,808	$ 54,567	$ 39,664	$ 36,382	$ 33,447
RRFR	Expense	$ 1,055	$ 2,295	$ 4,760	$ 44	$ 5,758	$ 2,814	$ 12,342	$ 12,342	$ 12,342	$ 12,342	$ 12,342	$ 12,342
RRFR	Labor	$ 70	$ 72	$ 121	$ 103	$ 103	$ 105	$ 154	$ 154	$ 154	$ 154	$ 154	$ 154
CIRT	Expense	$ 200	$ 5,609	$ 2,246	$ 195	$ 4,231	$ 8,770	$ 71,751	$ 71,751	$ 71,751	$ 71,751	$ 71,751	$ 71,751
CIRT	Labor	$ 311	$ 320	$ 535	$ 456	$ 458	$ 483	$ 678	$ 678	$ 678	$ 678	$ 678	$ 678
CIFR	Expense	$ 197	$ 5,924	$ 6,267	$ 192	$ 19,658	$ 9,247	$ 60,836	$ 60,836	$ 60,836	$ 60,836	$ 60,836	$ 60,836
CIFR	Labor	$ 308	$ 315	$ 527	$ 449	$ 450	$ 450	$ 668	$ 668	$ 668	$ 668	$ 668	$ 668
RECT	Expense	$ 52	$ 500	$ 11,279	$ 4,314	$ 926	$ 5,988	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194
RECT	Labor	$ 81	$ 84	$ 140	$ 119	$ 119	$ 121	$ 178	$ 178	$ 178	$ 178	$ 178	$ 178
Total		$ 2,273	$ 15,119	$ 25,877	$ 5,872	$ 31,700	$ 27,964	$ 159,800	$ 159,800	$ 159,800	$ 159,800	$ 159,800	$ 159,800
Monthly Over/(Under)		$ 12,756	$ 6,902	$ 18,456	$ 60,956	$ 70,485	$ 76,712	$ (40,622)	$ (59,993)	$ (105,234)	$ (120,137)	$ (123,418)	$ (126,354)
Cumulative Over/(Under)		$ 191,490	$ 198,393	$ 216,848	$ 277,804	$ 348,289	$ 425,001	$ 384,379	$ 324,386	$ 219,152	$ 99,015	$ (24,403)	$ (150,757)
INDUSTRIAL													
FY 2012 Over-Collection													
Volume Billed		28,544	45,781	67,683	89,048	129,969	132,282	114,315	75,568	46,705	38,486	35,708	32,798
ECR Surcharge		$ 0.3432	$ 0.4264	$ 0.4264	$ 0.4954	$ 0.5644	$ 0.5644	$ 0.3536	$ 0.1427	$ 0.1427	$ 0.1427	$ 0.1427	$ 0.1427
Revenue Billed		$ 9,796	$ 19,521	$ 28,860	$ 44,114	$ 73,355	$ 74,660	$ 40,416	$ 10,784	$ 6,665	$ 5,492	$ 5,096	$ 4,680
CIRT	Expense	$ 35	$ 990	$ 396	$ 34	$ 747	$ 1,548	$ 12,662	$ 12,662	$ 12,662	$ 12,662	$ 12,662	$ 12,662
CIRT	Labor	$ 55	$ 56	$ 94	$ 80	$ 81	$ 82	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120
CIFR	Expense	$ 13	$ 378	$ 400	$ 12	$ 1,255	$ 590	$ 3,883	$ 3,883	$ 3,883	$ 3,883	$ 3,883	$ 3,883
CIFR	Labor	$ 20	$ 20	$ 34	$ 29	$ 29	$ 29	$ 41	$ 43	$ 43	$ 43	$ 43	$ 43
Total		$ 122	$ 1,444	$ 925	$ 158	$ 2,110	$ 2,249	$ 16,707	$ 16,707	$ 16,707	$ 16,707	$ 16,707	$ 16,707
Monthly Over/(Under)		$ 9,674	$ 18,077	$ 27,935	$ 43,959	$ 71,244	$ 72,411	$ 23,709	$ (5,924)	$ (10,043)	$ (11,215)	$ (11,612)	$ (12,027)
Cumulative Over/(Under)		$ 100,628	$ 118,705	$ 146,640	$ 190,599	$ 261,843	$ 334,254	$ 357,963	$ 352,039	$ 341,996	$ 330,781	$ 319,169	$ 307,142

J. Technical Reference Manual

The technical reference manual for FY 2014 has been provided as a separate document.

Appendix J

Technical Reference Manual

Measure Savings Algorithms and Cost Assumptions

ENERGYSENSE
Your building, your savings.

PGW

May, 2013

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

ΔkWh = 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

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

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

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:

[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.

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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

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

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)*

[26] 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:

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.

7) Duct Work Sealing

Unique Measure Code(s): TBD
Draft date: 4/30/2013
Effective date: TBD
End date: TBD

Measure Description
This measure provides estimates for stand-along savings from sealing ducts in a retrofit project and preventing heated air from leaking in to unconditioned spaces. In order to verify savings, a duct-blaster test must be used to calculate a reduction in CFM-25 readings.

Definition of Baseline Condition
The baseline condition is assumed to be a duct that has not been sealed.

Definition of Efficient Condition
The efficient condition is a duct that has been sealed to reduce outside leakage.

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

Natural Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = (CFMpre - CFMpost) \times DSFgas$$

Where:

CFMpre	=	Reading from duct-blaster test at 25 pascals, before sealing performed
CFMpost	=	Reading from duct-blaster test at 25 pascals, after sealing performed
DSFgas	=	Duct sealing factor for gas systems, 0.035 MMBtus/CFM-25[32]

Electric Savings Algorithms
Electric savings per 100 CFM-25 reduction:[33]

- 110.0 kWh in heating fan savings
- If a central air conditioner is present
  - 105.9 kWh from cooling
  - 0.23 kW summer peak demand savings

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

[32] Based on 3.5 MMBtus savings per 100 CFM reduction for duct sealing from UI/CL&P Program Savings Documentation – 2011, page 131
[33] UI/CL&P Program Savigns Documentation, 2011, page 131

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to 18 years[34].

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.

[34] California DEER estimage.

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[35].

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[36]
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[37]
11.6	=	Average gallons of water per person per day used for showering[38]
365	=	Days per year
1.6	=	Average number of showers per home[39]

Natural Gas Savings Algorithms

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[35] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[36] The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)
[37] Pennsylvania, Census of Population, 2000.
[38] 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)
[39] 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)[40]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[41]

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[42].

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.

[40] 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
[41] 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).
[42] 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[43].

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[44]
GPM_{eff}	=	Gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[45]
10.9	=	Average gallons per day used by faucet[46]
365	=	Days per year
50%	=	Drain rate, the percentage of water flowing down the drain[47]
3.5	=	Average Number of Faucets per home[48]

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

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

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).[49]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[50]

[43] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[44] 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
[45] Pennsylvania, Census of Population, 2000.
[46] 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)
[47] Estimate consistent with Ontario Energy Board, "Measures and Assumptions for Demand Side Management Planning."
[48] East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf
[49] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[50] 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[51].

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[52].

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.

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

[51] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[52] 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[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.

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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[53] 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[54]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[55]
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[56].

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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[54] 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

[55] See assumption for low flow showerhead.

[56] 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*[57]

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

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

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)[58]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[59]

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[57] 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)
[58] 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
[59] 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%[60]

"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

[60] 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[61].

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."[62]

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

[61] NYSERDA Home Performance with Energy Star
[62] 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[63] 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[64]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[65]
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

[63] 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
[64] Assumed to be in unconditioned space, ambient temperature assumption based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg
[65] 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[66].

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.

[66] 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[67]/day to estimate heating slope (MMbtu/HDD63) and baseload daily use (MMBtu/day) with an annual HDD63 of 4033[68] 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%

[67] 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.
[68] 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[69]

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.[70]

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:

[69] 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.

[70] 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[71]
$SEER_{CAC}$	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

[71] "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[72]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[73]	$EFLH_{cool\ RAC}$ (Hours)[74]	CDD (Base 65)[75]	HDD (Base 65)[76]
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

[72] 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). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$

[73] PA 2010 TRM Table 2-1.

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

[75] 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

[76] 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[77].
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.[78]

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

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

[77] From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820
[78] 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[79]
$SEER_{CAC}$	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[80]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[81]	$EFLH_{cool\ RAC}$ (Hours)[82]	CDD (Base 65)[83]	HDD (Base 65)[84]
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.

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

[80] 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). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$

[81] PA 2010 TRM Table 2-1.

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

[83] 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

[84] 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.[85]

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)*

[85] 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[86]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Condensation Control Thickness	=	N/A
Hours Per Year	=	2000[87]
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.

[86] Average winter temperature for Philadelphia from "Cost Savings and Comfort for Existing Buildings", 3rd Edition, by John Krigger, Saturn Resource Management. Page 255.
[87] 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[88].

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.

[88] 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[89]
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[90].

[89] Temperature of unconditioned basement.
[90] 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[91].

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[92]
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[93]
11.6	=	Average gallons of water per person per day used for showering[94]
365	=	Days per year
1.6	=	Average number of showers per home[95]

Natural Gas Savings Algorithms

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[91] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[92] The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)
[93] Pennsylvania, Census of Population, 2000.
[94] 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)
[95] 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)[96]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[97]

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[98].

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.

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[96] 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

[97] 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).

[98] 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[99].

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[100]
GPM_{eff}	=	Gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[101]
10.9	=	Average gallons per day used by faucet[102]
365	=	Days per year
50%	=	Drain rate, the percentage of water flowing down the drain[103]
3.5	=	Average Number of Faucets per home[104]

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).[105]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[106]

[99] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

[100] 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

[101] Pennsylvania, Census of Population, 2000.

[102] 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)

[103] Estimate consistent with Ontario Energy Board, "Measures and Assumptions for Demand Side Management Planning."

[104] East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf

[105] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

[106] 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[107].

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[108].

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.

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

107 Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
108 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[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.

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.

[109] 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[110]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[111]
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[112].

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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[110] 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

[111] See assumption for low flow showerhead.

[112] 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*[113]

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)[114]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[115]

[113] 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)
[114] 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
[115] 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%[116]

"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

[116] 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[117].

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."[118]

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

117 NYSERDA Home Performance with Energy Star
118 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 ft^2/Btu)
R_{base}	=	Original R-value of the hot water heater (h °F ft^2/Btu) = 5.0[119] unless other information provided
Area	=	Surface area of the hot water heater covered by the insulating blanket (ft^2)
T_{tank}	=	Temperature inside the tank (°F) = Assume 120 °F if no other information provided
T_{amb}	=	Temperature outside the tank (°F) = 55 °F[120]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[121]
1,000,000	=	Btu to MMBtu

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

Water Heater Size (Gal)	Height (Inches)*	Diameter (Inches)*	Surface Area of Cylinder (ft^2)	Surface Area of Accessed Areas (ft^2)**	Surface are of Cylinder minus Accessed Areas (ft^2)	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

[119] 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

[120] Assumed to be in unconditioned space, ambient temperature assumption based on: http://lwf.ncdc.noaa.gov/img/documentlibrary/clim81supp3/tempnormal_hires.jpg

[121] 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[122].

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.

[122] 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[123]
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

[123] 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.

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Definition of Baseline Condition
Cooking energy efficiency of 30% and Idle Energy Rate of 18,000 Btu/h[124].

Definition of Efficient Condition
Cooking energy efficiency greater than or equal to 44%[125] 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.[126]

$$Annual\ Gas\ Savings\ (MMBtu) = \ 30.60\ MMBtu$$

[124] ENERGY STAR calculator default input.
[125] Using ASTM Standard F1496-99 (Reapproved 2005) based on heavy load (potato) cooking test.
[126] 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.[127]

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.

[127] 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.[128]

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
$\Delta kW = 0\ kW$

[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 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.[129]

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.

[129] 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[130].

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.[131]

# 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
$\Delta kWh = 0\ kWh$

Demand Savings
$\Delta kW = 0\ kW$

[130] The baseline comes from PG&E's online calculator at
http://www.fishnick.com/saveenergy/tools/calculators/gsteamercalc.php

[131] 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.[132]

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.

[132] 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[133].

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.[134]

$$Annual\ Gas\ Savings\ (MMBtu) = \ 14.90\ MMBtu$$

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%

[133] From the Energy Star calculator

[134] 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.[135]

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.

[135] 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.[136]

$$Annual\ Gas\ Savings\ (MMBtu) = 33.6\ MMBtu$$

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%

[136] 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[137]

Measure Cost
The incremental cost is $5.[138]

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.*[139]

[137] Massachusetts 2011 Technical Reference Manual.
[138] Based on a PG&E 2004 study.
[139] 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 Fourth Year Implementation Plan, Fiscal year 2014 for its Demand Side Management upon the participants listed below in accordance with the requirements of § 1.54 (relating to service by a participant).

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