ECKERT SEAMANS
ATTORNEYS AT LAW

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

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

Daniel Clearfield
717.237.7173
dclearfield@eckertseamans.com

May 14, 2014

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") Fifth Year Implementation Plan Fiscal year 2015. Copies are being served in accordance with the attached Certificate of Service.

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

FIFTH YEAR IMPLEMENTATION PLAN

FISCAL YEAR 2015

MAY, 2014

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I. PORTFOLIO IMPLEMENTATION PLAN

A. Introduction

This Fifth 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 2015 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 2014 for the Company's DSM Portfolio. This FY2015 Implementation Plan addresses the final year of the Five-Year DSM period approved by the PUC. PGW is currently exploring a potential DSM Phase II extension filing, which would build on and enhance the current programs' staging and effectiveness to date.

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 for the final year of implementing PGW's initial five-year DSM Plan. The following tables provide details on costs, gas savings, and economic benefits realized through mid-FY 2014; estimated-actuals for the remainder of FY 2014; and projected outcomes for FY 2015. Unless stated otherwise, cost-effectiveness results are indicated as present values calculated at a real discount rate of 2.92 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.

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[1] The DSM program was originally branded as "EnergySense" in FY 2011 for customer marketing purposes. The DSM program is now referred to as conservation under EnergySense to reflect the fact that 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 2015 begins September 1st, 2014 and runs through August 31st, 2015

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 2014 dollars.

Over the full five years of the DSM Plan, PGW now expects to spend approximately $44.1 million on its six programs. The programs are projected to save 373 BBtus of natural gas during the first five years of the portfolio, and 7,802 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 $40 million leading to a present value of net benefits of $3.9 million and a benefit-cost ratio ("BCR") of 1.11. From a total resource perspective, the present value of benefits, in 2009 dollars, is $47.2 million yielding net benefits of $5.7 million and nearly $1.14 in benefits for every $1 dollar spent. The results of both cost-effectiveness tests show that the DSM Portfolio is cost-effective.

All data presented in this plan on progress to date is through February 28, 2014. 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 has achieved and continues to improve overall portfolio cost-effectiveness in that projected lifetime benefits from measures installed through February 2014 exceed cumulative costs incurred by PGW and participating customers. Not only is PGW's DSM portfolio 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 and could be expected to continue if the program is extended beyond FY15.

Cost-effectiveness analysis in this 2015 Implementation Plan includes 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 $6.73 to $8.98 per MMBtu, an average increase of 11.6 percent from the equivalent value used in last year's implementation plan.

The avoided cost analysis presented in this Implementation Plan also presents an alternative scenario showing 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 provides the updated avoided cost estimates for calculating DSM gas savings benefits resulting from planned program implementation; Appendices A and B detail and document their derivation. Appendix F provides additional five-year projections broken down by year, and comparisons with projections from the Fiscal Year 2014 plan.

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

- Saving 3.7 MWh per year of electricity[3]
- Avoiding 1,023 kW per year of summer peak demand
- Saving 20.3 million gallons of water per year
- Creating new jobs in Pennsylvania (see Appendix H)
- Reducing the emissions of CO_2 by over 25 thousand tons per year

[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 conservation programs, based on the programs' relative effectiveness and market reception, while still maintaining the overall portfolio cap as set forth by the Settlement order.

In FY 2015, PGW plans to spend approximately $12.7 million on total delivery of all six launched DSM programs. PGW's administration costs come to $1.4, or 10.9 percent of the fifth year's budget.

Table 1 –Costs by Program from Inception through February, 2014 (Nominal)

Program	Inception to Feb 28, 2014
Enhanced Low Income Retrofit	$20,454,045
Residential Heating Equipment Rebates	$1,472,776
Comprehensive Residential Retrofit Incentives	$483,227
High Efficiency Construction Incentives (Residential)	$127,088
Residential Total	**$22,537,135**
Commercial and Industrial Retrofit Incentives	$403,590
Commercial and Industrial Equipment Rebates	$191,547
High Efficiency Construction Incentives (Nonresidential)	$-
Non-residential Total	**$595,137**
Portfolio-wide Costs	$2,373,903
UTILITY TOTAL	**$25,506,174**
Participant Costs	$1,501,949
Total	**$27,008,123**

Table 2 – Portfolio Costs by Category from Inception through February 2014 (Nominal)

Category	Inception to Feb 28, 2014
Customer Incentives	$17,020,570
Administration and Management	$2,186,303
Marketing and Business Development	$354,686

Contractor Costs	$5,651,664
Inspection and Verification	$124,219
On-site Technical Assessment	$-
Evaluation	$168,732
UTILITY TOTAL	**$25,506,174**
Participant Costs	$1,501,949
Total	**$27,008,123**

Table 3–Projected Budgets by Program for FY 2015 (Nominal)

PROGRAM	FY 2015
Enhanced Low Income Retrofit	$7,600,000
Residential Heating Equipment Rebates	$1,145,520
Comprehensive Residential Retrofit Incentives	$1,400,000
High Efficiency Construction Incentives – Residential	$148,895
Residential Total	**$10,294,416**
Commercial and Industrial Retrofit Incentives	$536,558
Commercial and Industrial Equipment Rebates	$337,792
High Efficiency Construction Incentives – Nonresidential	$148,895
Commercial & Industrial Total	**$1,023,246**
Portfolio Administration and Management	$910,000
Portfolio Marketing and Business Development	$480,000
Portfolio-Wide Costs Total	**$1,390,000**
Utility Costs	**$12,707,662**
Participant Costs	$3,768,659
Total	**$16,476,321**

Table 4 - Projected Portfolio Budget by Cost Category for FY 2015 (Nominal)

Category	FY 2015
Customer Incentives & Measure Installation Costs	$8,890,090
Administration and Management	$940,000
Marketing and Business Development	$480,000
Contractor Costs	$1,911,978
Inspection and Verification	$175,593
Evaluation	$310,000
Utility Costs	**$12,707,662**
Participant Costs	$3,768,659
Total	**$16,476,321**

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

Year	Budgets		Budget Caps	Difference	
	Source	Amount		$	%
FY 2011	*Actual*	$3,543,577	$7,980,380	$(4,436,803)	-56%
FY 2012	*Actual*	$7,150,575	$8,293,780	$(1,143,205)	-14%
FY 2013	*Actual*	$9,769,640	$14,048,020	$(4,278,380)	-30%
FY 2014	*FY15 IP*	$10,912,059	$16,102,544	$(5,190,485)	-32%
FY 2015	*FY15 IP*	$12,707,662	$17,282,496	$(4,574,834)	-26%
FY 2011 - 15		**$44,083,513**	**$63,707,220**	**$(19,623,707)**	**-31%**

[4] Per Annual Budget Caps as set forth in the DSM Settlement: "The yearly DSM spending budget for the plan for the first two years (FY 2011 and FY 2012) shall not exceed 1% of PGW's total projected gross intrastate operating revenues…The annual budgets for the remaining years (FY 2013, FY 2014 and FY 2015) shall be determined in the annual reporting process described in paragraph 24(a) above, but in no event shall exceed the original level for that year proposed by the Company in this proceeding."

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	$3.459,820	$6,632,506	$8,266,828	$8,399,808	$8,532,897	$35,291,859
Residential Heating Equipment Rebates	$66,181	$437,286	$676,814	$1,112,085	$1,285,861	$3,578,226
Commercial and Industrial Retrofit Incentives	$8,907	$9,791	$317,984	$749,375	$1,571,854	$2,657,912
Commercial and Industrial Equipment Rebates	$4,076	$51,342	$258,125	$286,285	$602,506	$1,202,333
High Efficiency Construction Incentives	$2,373	$17,210	$148,402	$151,138	$379,711	$698,834
Comprehensive Residential Retrofit Incentives	$2,221	$2,441	$101,486	$213,368	$334,832	$654,348
TOTAL PORTFOLIO	**$3,543,577**	**$7,150,575**	**$9,769,640**	**$10,912,059**	**$12,707,662**	**$44,083,513**

Table 7 – Projected FY 2011 – 2015 Budgets with Portfolio-Wide Costs Separate (Nominal)

PROGRAM	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Enhanced Low Income Retrofit	$2,885,303	$6,076,982	$7,538,827	$7,600,000	$7,600,000	$31,701,113
Residential Heating Equipment Rebates	$46,596	$395,897	$611,057	$1,004,753	$1,145,520	$3,203,823
Commercial and Industrial Retrofit Incentives	$-	$43,768	$233,363	$255,956	$536,558	$1,069,645
Commercial and Industrial Equipment Rebates	$-	$13,640	$133,998	$134,475	$337,792	$619,905
High Efficiency Construction Incentives	$-	$-	$90,475	$191,875	$297,791	$580,142
Comprehensive Residential Retrofit Incentives	$-	$-	$280,176	$670,000	$1,400,000	$2,350,176
Portfolio-wide Costs	$611,678	$620,288	$881,743	$1,055,000	$1,390,000	$4,558,709
TOTAL PORTFOLIO	**$3,543,577**	**$7,150,575**	**$9,769,640**	**$10,912,059**	**$12,707,662**	**$44,083,513**

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

2. Savings

a) Gas savings

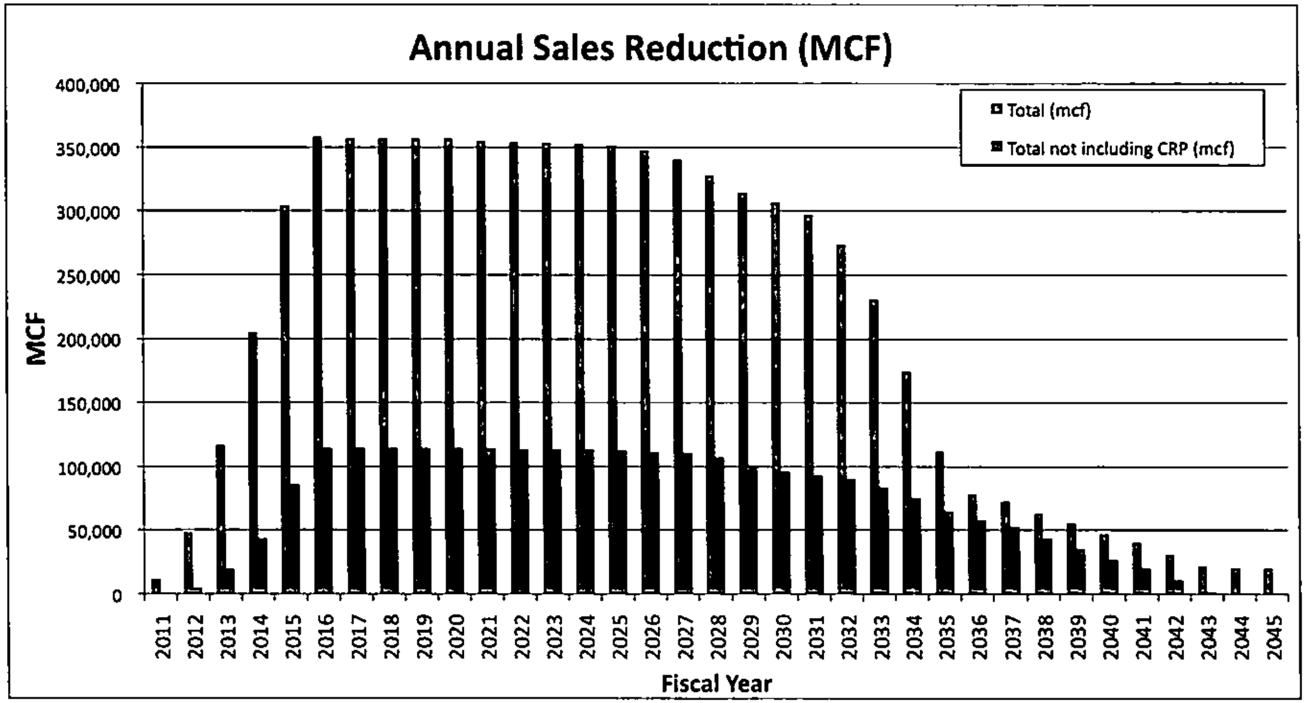
Table 8– Natural Gas Savings from Inception through February 2014

Program	Incremental Net Annual Gas Savings (MMBtus/yr)	Incremental Net Lifetime Gas Savings (MMBtus)
Enhanced Low Income Retrofit	171,468.2	5,003,817.8
Residential Heating Equipment Rebates	30,236.4	2,788,173.3
Comprehensive Residential Retrofit Incentives	1,544.7	467,012.1
High Efficiency Construction Incentives (Residential)	655.1	132,001.5
Residential Total	**203,904.4**	**8,391,004.7**
Commercial and Industrial Retrofit Incentives	5,320.8	552,233.8
Commercial and Industrial Equipment Rebates	4,931.6	472,308.3
High Efficiency Construction Incentives (Nonresidential)	-	-
Non-residential Total	**10,252.3**	**1,024,542.1**
PORTFOLIO TOTAL	**214,156.8**	**4,543,558.8**

Table 9 - Projected Natural Gas Savings for FY 2015

Program	Incremental Net Annual Gas Savings (MMBtus/yr)	Incremental Net Lifetime Gas Savings (MMBtus)
Enhanced Low Income Retrofit	55,315.7	1,106,314
Residential Heating Equipment Rebates	20,125.3	431,726
Comprehensive Residential Retrofit Incentives	17,665.1	453,687
High Efficiency Construction Incentives (Residential)	1,864.7	34,228
Residential Total	**94,970.8**	**2,025,955**
Commercial and Industrial Retrofit Incentives	8,169.2	150,986
Commercial and Industrial Equipment Rebates	10,055.6	156,424
High Efficiency Construction Incentives (Nonresidential)	1,864.7	34,228
Non-residential Total	**20,089.5**	**341,638**
PORTFOLIO TOTAL	**115,060.4**	**2,367,594**

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 portfolio's activity period 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 by shifting annual savings forward by six months. For the values in Figure 1 please see Appendix G.

b) Non-Gas Savings

Table 10–Non-Gas Savings from Inception through February 2014

PROGRAM	Inception through February 28, 2014			
	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	1,836.6	42,623.0	699.7	7.9
Residential Heating Equipment Rebates	138.6	2,772.0	0.0	0.0
Comprehensive Residential Retrofit Incentives	19.0	571.0	0.0	0.0
High Efficiency Construction Incentives - Residential	4.8	119.3	1.7	4.5
Residential Total	**1,999.1**	**46,085.3**	**701.3**	**12.4**
Commercial and Industrial Retrofit Incentives	72.2	1,454.3	6.7	2.4
Commerical and Industrial Equipment Rebates	0.0	0.0	0.0	0.0
High Efficiency Construction Incentives - Nonresidential	0.0	0.0	0.0	0.0
Commercial & Industrial Total	**72.2**	**1,454.3**	**6.7**	**2.4**
Total Portfolio	**2,071.3**	**47,539.7**	**708.1**	**14.9**

Table 11–Projected Non-Gas Savings for FY 2014

PROGRAM	FY 2015			
	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	673.3	13,466.0	211.2	2.3
Residential Heating Equipment Rebates	162.3	3,246.7	0.0	0.0
Comprehensive Residential Retrofit Incentives	208.6	0.0	0.0	0.2
High Efficiency Construction Incentives - Residential	5.0	144.1	0.0	0.0
Residential Total	**1,049.2**	**16,856.7**	**211.2**	**2.5**
Commercial and Industrial Retrofit Incentives	93.9	2,004.7	0.0	2.2
Commerical and Industrial Equipment Rebates	0.0	0.0	0.0	1.0
High Efficiency Construction Incentives - Nonresidential	5.0	144.1	0.0	0.0
Commercial & Industrial Total	**98.9**	**2,148.8**	**0.0**	**3.2**
Total Portfolio	**1,148.1**	**19,005.5**	**211.2**	**5.7**

3. Cost-Effectiveness

a. Results to date

From inception through February 28, 2014, the EnergySense portfolio shows a TRC BCR of 1.17, and a Present Value ("PV") of Net Benefits of $3.8 million (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. This year's results demonstrate an 8 percent improvement in BCR and 250 percent improvement in Net Benefits.

The Enhanced Low Income Retrofit ("ELIRP") program has been the lead program in PGW's DSM portfolio, representing 80 percent of all portfolio spending to date. The ELIRP program now demonstrates a cumulative BCR of 1.23, with a trend of continued improvement.

The Residential Heating Equipment Rebate ("RHER") program has also been cost-effective so far, with a BCR of 1.71; 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, although not as quickly as past predictions.

On the non-residential side, the Commercial and Industrial Equipment Rebates ("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. Near the end of the reporting period PGW has begun to see a few rebates for efficient kitchen equipment.

The Commercial and Industrial Retrofit Incentive ("CIRI") has provided incentives for seven projects with incentives totaling over $230,000. PGW continues to cultivate the development of non-residential retrofit projects.

The High Efficiency Construction Incentives ("HECI") program has provided its first incentive for a multifamily property and is working with a number of other projects that are anticipated to close by the end of FY 2014.

The Comprehensive Residential Retrofit Program ("CRRP"), now rebranded as Home Rebates, has continued its ramp-up process, and is now working with five contractors to deliver market-rate retrofits to non-low income residential customers. As of February 28, 2014, there have been over 200 audits and nearly 60 completed jobs. FY 2015 will build on this ramp-up period in further increasing program capacity through the use of expanded marketing tactics and inclusion of additional program contractors. A DSM Phase II extension would then be based on and benefit from this projected momentum, in developing a full-scale retail residential retrofit market.

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 12–Cost-Effectiveness Results from Inception through February 2014 (2009S)[6]

Program	Total Resource Cost Test				% Of Total	
	PV of Benefits	PV of Costs	PV of Net Benefits	BCR	PV of Benefits	PV of Costs
Enhanced Low Income Retrofit	$21,637,066	$17,523,808	$4,113,258	1.23	81%	76%
Residential Heating Equipment Rebates	$3,626,059	$2,114,643	$1,511,416	1.71	13%	9%
Comprehensive Residential Retrofit Incentives	$235,902	$530,600	$(294,698)	0.44	1%	2%
High Efficiency Construction Incentives (Residential)	$88,413	$125,916	$(37,502)	0.70	0%	1%
Residential Total	**$25,587,441**	**$20,294,968**	**$5,292,473**	**1.26**	**95%**	**88%**
Commercial and Industrial Retrofit Incentives	$691,713	$525,383	$166,330	1.32	3%	2%
Commercial and Industrial Equipment Rebates	$593,238	$189,128	$404,110	3.14	2%	1%
High Efficiency Construction Incentives (Nonresidential)	$-	$-	$-		0%	0%
Non-residential Total	**$1,284,951**	**$714,511**	**$570,440**	**1.80**	**5%**	**3%**
Portfolio-wide Costs	$-	$2,037,720	$(2,037,720)	-	0%	9%
PORTFOLIO TOTAL	**$26,872,392**	**$23,047,199**	**$3,825,193**	**1.17**	**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
Enhanced Low Income Retrofit	$18,087,140	$17,523,808	$563,332	1.03	79%	80%
Residential Heating Equipment Rebates	$3,463,749	$1,243,815	$2,219,934	2.78	15%	6%
Comprehensive Residential Retrofit Incentives	$198,006	$394,745	$(196,740)	0.50	1%	2%
High Efficiency Construction Incentives (Residential)	$60,659	$106,123	$(45,464)	0.57	0%	0%
Residential Total	**$21,809,553**	**$19,268,491**	**$2,541,063**	**1.13**	**95%**	**88%**
Commercial and Industrial Retrofit Incentives	$435,313	$333,111	$102,202	1.31	2%	2%
Commercial and Industrial Equipment Rebates	$593,238	$158,988	$434,250	3.73	3%	1%
High Efficiency Construction Incentives (Nonresidential)	$-	$-	$-		0%	0%

6 As described in PGW's FY20111 DSM Implementation Plan, the TRC cost-effectiveness test is the primary test used in determining DSM programs' cost-effectiveness. However, PGW also includes the Gas Administrator cost-effectiveness test to provide another perspective on program cost-effectiveness based on utility system costs and benefits.

Non-residential Total	**$1,028,551**	**$492,099**	**$536,452**	**2.09**	**5%**	**2%**
Portfolio-wide Costs	$-	$2,037,720	$(2,037,720)	-	0%	9%
PORTFOLIO TOTAL	**$22,838,105**	**$21,798,310**	**$1,039,795**	**1.05**	**100%**	**100%**

Figure 2 – Cumulative Monthly TRC Net Benefits by Program

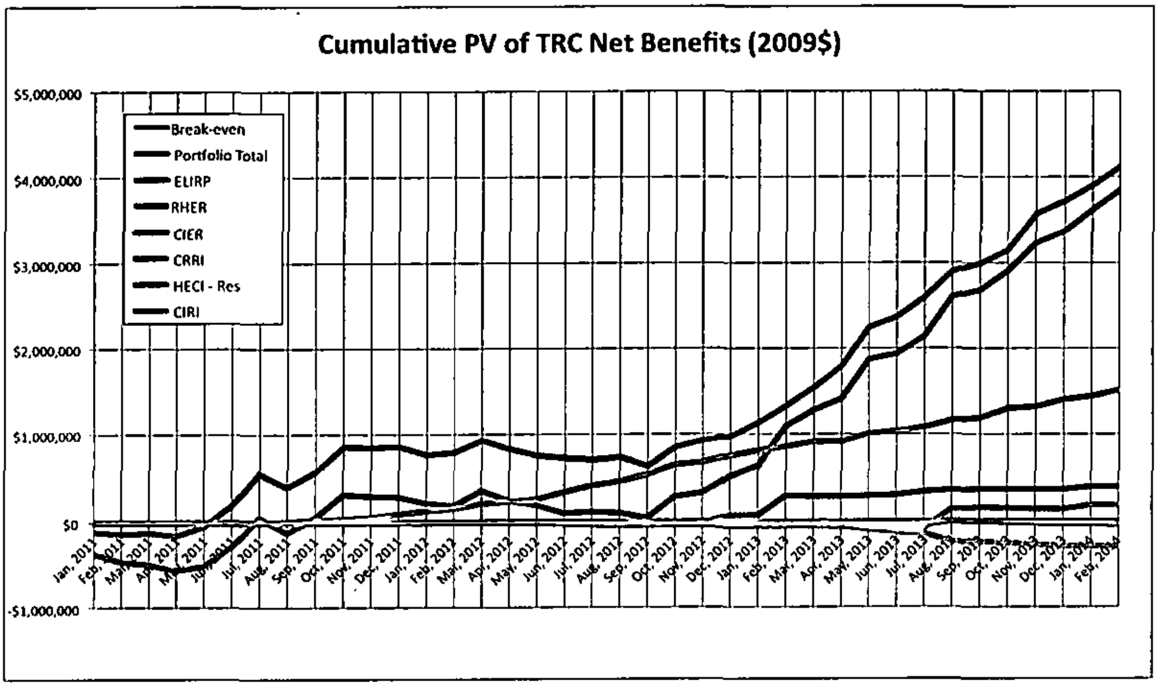
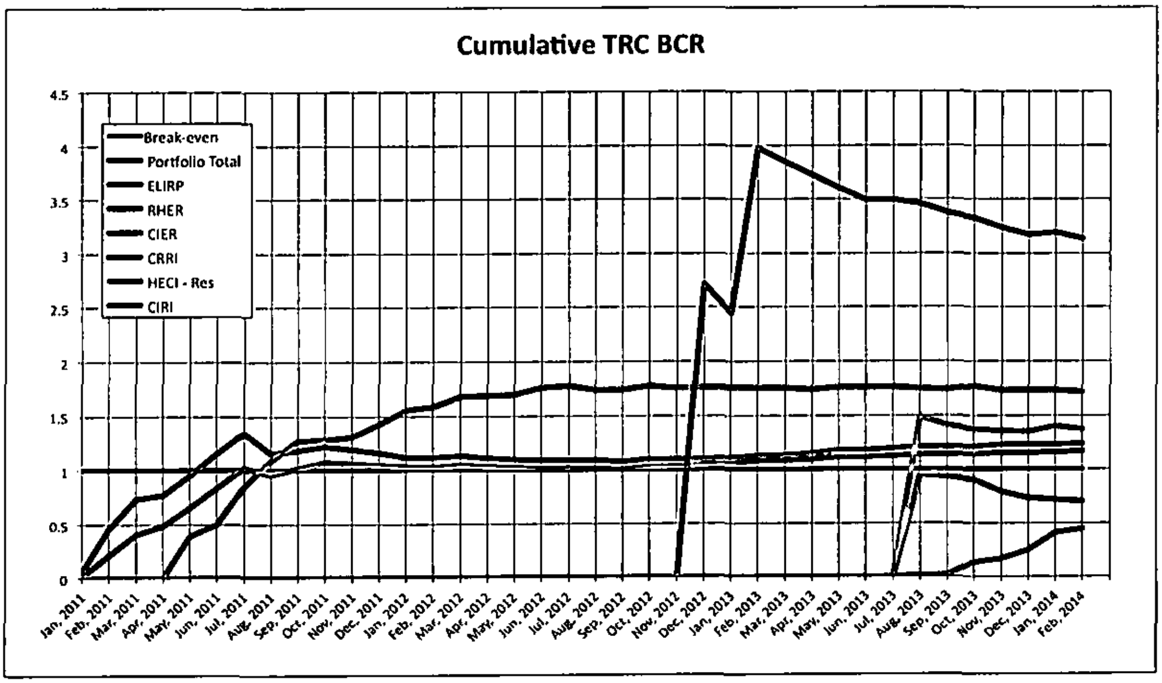


Figure 3 – Cumulative Monthly TRC BCR by Program



b. Projected Performance

Table 13–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	$32,660,547	$26,134,841	$6,525,706	1.25	69%	63%
Residential Heating Equipment Rebates	$7,008,786	$4,486,599	$2,522,187	1.56	15%	11%
Comprehensive Residential Retrofit Incentives	$3,363,126	$4,585,344	$(1,222,219)	0.73	7%	11%
High Efficiency Construction Incentives (Residential)	$368,732	$307,823	$60,909	1.20	1%	1%
Residential Total	**$43,401,191**	**$35,514,607**	**$7,886,584**	**1.22**	**92%**	**86%**
Commercial and Industrial Retrofit Incentives	$1,858,114	$1,275,619	$582,495	1.46	4%	3%
Commercial and Industrial Equipment Rebates	$1,543,498	$602,901	$940,597	2.56	3%	1%
High Efficiency Construction Incentives (Nonresidential)	$368,732	$307,823	$60,909	1.20	1%	1%
Commercial & Industrial Total	**$3,770,344**	**$2,186,343**	**$1,584,001**	**1.72**	**8%**	**5%**
Portfolio-wide Costs		$3,724,098	$(3,724,098)	n/a	0%	9%
Total Portfolio	**$47,171,535**	**$41,425,048**	**$5,746,487**	**1.14**	**100%**	**100%**

Program	Gas Administrator				% of Total	
	PV Benefits	PV Costs	PV Net Benefits	BCR	PV Benefits	PV Costs
Enhanced Low Income Retrofit	$27,136,602	$26,134,841	$1,001,761	1.04	68%	72%
Residential Heating Equipment Rebates	$6,566,094	$2,567,277	$3,998,817	2.56	16%	7%
Comprehensive Residential Retrofit Incentives	$2,932,127	$1,825,828	$1,106,299	1.61	7%	5%
High Efficiency Construction Incentives (Residential)	$264,483	$230,852	$33,632	1.15	1%	1%
Residential Total	**$36,899,307**	**$30,758,798**	**$6,140,508**	**1.20**	**92%**	**85%**
Commercial and Industrial Retrofit Incentives	$1,330,115	$842,006	$488,109	1.58	3%	2%
Commercial and Industrial Equipment Rebates	$1,492,661	$493,275	$999,387	3.03	4%	1%
High Efficiency Construction Incentives (Nonresidential)	$264,483	$230,852	$33,632	1.15	1%	1%
Commercial & Industrial Total	**$3,087,260**	**$1,566,132**	**$1,521,128**	**1.97**	**8%**	**4%**
Portfolio-wide Costs		$3,724,098	$(3,724,098)	n/a	0%	10%
Total Portfolio	**$39,986,567**	**$36,049,029**	**$3,937,538**	**1.11**	**100%**	**100%**

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

- Slower than expected ramp-up in program activity for market rate programs.
- Revised participation assumptions for RHER and CIER that significantly drop program participation levels, budgets, and gas savings.
- Revised program savings from inception to-date for CIER due to a corrected calculation error that resulted in underestimated savings for commercial-sized boilers.
- Updates to deemed savings values for RHER and CIER based on evaluated savings for RHER.
- 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 13, 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.

These additional sources of value amount to an additional $16 million in 2009 present worth.[7] Additional details on how values for demand-reduction-induced price effect ("DRIPE") and CO_2 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	$43,492,149	$26,134,841	$17,357,308	1.66	69%	63%
Residential Heating Equipment Rebates	$9,505,545	$4,486,599	$5,018,946	2.12	15%	11%
Comprehensive Residential Retrofit Incentives	$4,646,474	$4,585,344	$61,130	1.01	7%	11%
High Efficiency Construction Incentives – Residential	$477,051	$307,823	$169,228	1.55	1%	1%
Residential Total	**$58,121,219**	**$35,514,607**	**$22,606,612**	**1.64**	**92%**	**86%**
Commercial and Industrial Retrofit Incentives	$2,457,064	$1,275,619	$1,181,445	1.93	4%	3%
Commercial and Industrial Equipment Rebates	$2,094,844	$602,901	$1,491,943	3.47	3%	1%
High Efficiency Construction Incentives - Nonresidential	$477,051	$307,823	$169,228	1.55	1%	1%
Commercial & Industrial Total	**$5,028,958**	**$2,186,343**	**$2,842,616**	**2.30**	**8%**	**5%**
Portfolio-wide Costs		$3,724,098	$(3,724,098)	n/a	0%	9%
Total Portfolio	**$63,150,177**	**$41,425,048**	**$21,725,129**	**1.52**	**100%**	**100%**

[7] 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

This Plan updates information provided in previous Implementation Plans, outlines progress that has been made to date in FY 2014, and provides details on projected program activities in FY 2015.

The following material changes were made to PGW's DSM Plan to develop this Fifth 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 based on latest available data. Avoided costs were higher for the near future but dropped slightly in after 2031.

- Avoided costs for electric energy and capacity were updated based on values from relevant Act 129 Plan electric energy and capacity projections.[8]

- The nominal discount rate used for cost-effectiveness analysis was updated to 4.98 percent from 4.94 percent in FY 2014 to reflect PGW's latest actual cost of capital.

- The Technical Reference Manual ("TRM") was further developed and updated to address findings from recent evaluations and new measures that will be included in FY 2015. The updated TRM can be found in Appendix J. PGW plans on implementing this updated TRM beginning on June 1, 2014 in order to begin utilizing new savings formulas informed by the RHER Impact Evaluation as soon as possible. This implementation will take effect for all new applications received after June 1, 2014, with the exception of CIER commercial food service equipment measure modifications, removals and additions, which will go into effect beginning in FY 2015.

- Marketing budgets for individual programs were combined into one portfolio-wide line item to represent the portfolio centered marketing campaign launched in FY 2014.

2. Program-specific changes

ELIRP

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[8] PECO Program Years 2013-2015 ACT 129 – Revised Phase II Energy Efficiency and Conservation Plan. January 24, 2013. Exhibit No. 2

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

- The TRM entry for residential heating pipe insulation was updated into to properly cap the amount of achievable savings based on the limited effectiveness of the measure beyond certain lengths.

RHER

- Future targeted participation levels were reduced based on actual activities to date. This resulted in lower participation than the previous plans.

- Incentives for boilers will be lowered to $1,500 and new incentives of $1,700 will be added for combi-boilers.

- Savings and incremental costs were updated for residential sized heating units based on evaluation results that found lower than predicted savings.

CIRI

- The initial findings of the evaluation market study have informed new tactics that will increase participation through simplified processes and additional program resources.

- Project, costs, savings, and participation were updated based on current program experience and the program's current pipeline of projects.

- Marketing plans were updated to bolster program participation.

CIER

- A new incremental cost study has resulted in a modified incentive strategy for commercial food service equipment; commercial ovens and griddles were removed from the program due to revised cost-effectiveness results.

- PGW will add two new rebates for Commercial & Industrial Domestic Hot Water heater and Steam Traps

- Savings for FY 2013 were updated to reflect a calculation error that resulted in undercounted savings.

HECI

- New, simplified, applications were launched for single family homes and small multi-family buildings to increase program participation and program cost-effectiveness.

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

CRRI

- Project costs, savings, and participation were modified to be based on past activity. Participation projections were scaled back, while individual project cost-effectiveness and conversion rates remained relatively similar to plans from FY 2014.

- Marketing budgets were rolled up to portfolio-wide costs, however much of the marketing activity planned for FY 2015 is aimed at increasing awareness of the Home Rebates program and getting customers to have energy audits performed.

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. Coordination activities to date include:

- 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 to employment with PGW's ELIRP CSPs. To date, PGW CSPs have hired 21 local, unemployed entry-level workers through this partnership. PGW has established a similar partnership for the CRRI program.
- PGW has partnered with the Philadelphia Health Department's ("PDPH") Green & Healthy Homes and Lead Poison Prevention Programs. The PDPH programs treat health, safety and structural issues, similar to those that frequently prevent ELIRP weatherization work. Through this partnership, PDPH and PGW share program information to identify project coordination opportunities. In total, five homes have been treated through both programs, resulting in a savings of 3,945 mmbtu. Healthy Homes spent over $25,000 in these homes remediating issues including moisture and mold, lead, carbon monoxide, which then allowed PGW to spend a total of $17,200 in weatherization. Early barriers impeding initial coordination efforts have been identified; increased project coordination activities are expected as a result.
- PGW established a partnership with Habitat for Humanity's Home Repair and Weatherization program in February, 2014. Habitat's program focuses on individual neighborhoods and provides weatherization and structural repairs to support housing revitalization. Under this arrangement, PGW and Habitat will coordinate to identify customers enrolled or eligible for both Habitat's Home Repair and Weatherization Program and ELIRP. These projects will allow Habitat to perform primarily health, safety and structural issues, which will allow additional opportunities for PGW to further weatherize homes.

- PGW has worked with Pennsylvania Housing Finance Agency ("PHFA") in targeting multifamily weatherization projects specifically. PHFA provides funding assistance for multifamily energy-efficiency projects through their Smart Rehab program, which can be combined with PGW's EnergySense rebates to further encourage these projects. 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.
- The City of Philadelphia enacted the Philadelphia Benchmarking Ordinance in FY 2014. PGW partnered with the Mayor's Office of Sustainability and the Energy Efficiency Green Buildings Hub in FY 2013-2014 to conduct outreach to commercial property owners impacted by the legislation. PGW expects to expand its outreach to these building owners to in FY2015 when the building benchmarking data is made public.
- PGW has established a partnership with the Keystone HELP program, which offers low-interest loans for qualified residential energy efficiency projects. PGW and Keystone HELP have also developed co-branded marketing materials to advertise the benefits of both HELP loans and PGW's EnergySense rebates.
- In an effort to promote the PGW 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.
- PGW has partnered with the Green Stormwater Initiative ("GSI") to collaborate on outreach to large facility owners that are impacted by the City of Philadelphia's storm water management regulations. Storm water management projects may be combined with energy efficiency retrofits to address multiple needs and provide positive cash flow for projects that would otherwise just address one issue. PGW plans to collaborate with the GSI on outreach activities, including a combined event for commercial property owners.
- Cross-promotional opportunities and project coordination activities have taken place with other energy-efficiency programs, most notably EnergyWorks.
- 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 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.

- PGW directs CSPs to provide information on other relevant energy efficiency programs at the time of service delivery to occupants or property owners. This includes information about additional PGW programs as well as other local, state, and federal programs and resources.

F. *Evaluation, Monitoring, and Verification*

i) Planning and Reporting

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

ii) Quality Control

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

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

iii) Data Management

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

iv) Evaluations

In the past year, PGW has completed third-party Impact Evaluations on the following programs:

- The ELIRP Impact Evaluation was completed on the calendar year 2011 evaluation period, finding that the program achieved actual gas savings greater than initially projected by PGW; and attained cost-effectiveness in this launch year with a BCR of 1.08. Further findings and next steps are discussed in the ELIRP program section below.

- The RHER Impact Evaluation was completed on the launch year evaluation period, running from April, 2011 through August, 2012, finding that the gas savings were not as great as initially projected, demonstrating a need for updating calculation assumptions. Further findings and next steps are discussed in the RHER program section below.

PGW is planning on performing the following impact evaluations in FY 2015:

- The CIRI Impact Evaluation is currently underway, and is scheduled to be completed by the end of FY 2014.
- The CIER & HECI Impact Evaluations are scheduled to take place in FY 2015 based on FY 2013 activity.
- The CRRI Impact Evaluation is scheduled to take place in FY 2016 based on FY 2014 activity.

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, and has provided updated studies annually as part of all Implementation Plans to date.[9] The updated avoided costs went up approximately 6.8 percent in real terms compared to the previous year's estimates. Costs for all periods analyzed went up approximately 6 to 7 percent. Table 15 shows the average change in projected avoided cost over various time frames.

Table 15 – Percentage Change in Avoided Costs between Plans

Year	Space Heating	Baseload	Water Heating
March 2013 to March 2014			
2013 - 2016	7.0%	7.7%	7.5%
2017 - 2021	6.1%	6.6%	6.5%
2022 - 2031	7.0%	6.4%	6.6%
2013 - 2031	**6.8%**	**6.7%**	**6.7%**
March 2012 to March 2014			
2013 - 2016	14.9%	11.2%	12.4%
2017 - 2021	6.3%	1.9%	3.2%
2022 - 2031	5.7%	1.4%	2.7%
2013 - 2031	**7.8%**	**3.6%**	**4.9%**
March 2011 to March 2014			
2013 - 2016	2.6%	-11.9%	-7.7%
2017 - 2021	-11.4%	-23.0%	-19.7%
2022 - 2031	-10.0%	-18.9%	-16.4%
2013 - 2031	**-7.7%**	**-18.5%**	**-15.4%**
March 2010 to March 2014			
2012 - 2016	3.8%	-16.0%	-11.3%
2017 - 2021	-7.6%	-22.2%	-18.0%
2022 - 2031	-5.2%	-17.3%	-14.0%
2013 - 2031	**-3.9%**	**-18.3%**	**-14.5%**
September 2009 to March 2014			
2012 - 2016	-16.7%	-29.6%	-26.0%
2017 - 2021	-21.7%	-32.6%	-29.5%
2022 - 2031	-22.6%	-30.9%	-28.6%
2013 - 2031	**-21.1%**	**-31.1%**	**-28.3%**

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

Resource Insight also updated PGW's avoided costs for electric energy used in the TRC test. Updated avoided electric cost values were derived from PECO's Revised Phase II energy Efficiency Conservation Plan. Average electric energy avoided costs went up 38%, while average avoided capacity costs went up 2 percent.

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 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). This analysis was provided in the FY 2014 Implementation Plan and has been included again. The analysis was reexamined recently by Resource Insight, and no updates were found to be required

Resource Insight also provided current estimates of the long-run value of reduced greenhouse gas emissions resulting from gas DSM as detailed in Appendix B.

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.

ii) Benefit-Cost Analysis

The cost-effectiveness results reported in this plan were calculated using standard industry practice for conducting the TRC and Gas Program Administrator tests for cost-effectiveness.

The analysis used a real discount rate ("RDR") of 2.92 percent. The RDR was calculated using assumptions of a nominal discount rate ("NDR") of 4.98 percent and a future inflation rate of 2.0 percent. 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 2015 version of its 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. Additionally, PGW is beginning to incorporate revisions based on the actual gas savings determined through the program third-party Impact Evaluations. Sources for all measure characteristics are documented in the TRM.

The TRM filed with this FY 2015 Implementation Plan also includes the following updates:

- Water heating pipe insulation, within the ELIRP and CRRI programs, has been limited to vertical piping of both cold/hot feeds directly above tank, limited at a maximum length of to six feet.
- Equivalent full load heating hour (EFLH) assumptions have been adjusted downwards to reflect evaluation results and variations in building types in both the RHER and CIER programs.
- Heat loss tables were expanded for heating pipe insulation measure in ELIRP and CRRI to handle cases where insulation is going on hot water distribution as well as steam distribution space heating systems.
- Updates were made to commercial kitchen equipment based on the latest ENERGY STAR® requirements.
- New entries have been added for the following measures
    - Residential combination space and domestic hot water heating boilers
    - High efficiency windows
    - Steam traps
    - Commercial domestic hot water heating

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 2015 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 ("CIER")
- 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, 2014, ELIRP has been treating customer houses for slightly over three full years. A summary of results is presented in the tables below.

Table 16 - ELIRP Impacts from Inception to February 14, 2014

	Actual Results (Inception to 2/28/2014)
PARTICIPATION	
Closed Cases – Full	4,040
Closed Cases - Limited	1,866
Customers with Installations	5,906
COSTS	
Measure Installation Costs	$15,414,789
Administration and Management	$37,477
Marketing and Business Development	$-
Contractor Costs	$4,826,499
Inspection and Verification	$103,192
Evaluation	$72,088
Utility Costs	**$20,454,045**
Participant Costs	$-
Total	**$20,454,045**
BENEFITS	
Net Annual BBtu	171.5
Net Lifetime BBtu	3,589.2
Net Annual MMBtu / Customer	29.03
Weighted Lifetime (years)	20.9

Program Costs

PGW spent 98 percent of its budget for FY 2013, and PGW believes that ELIRP is now operating at expected levels

Program Savings

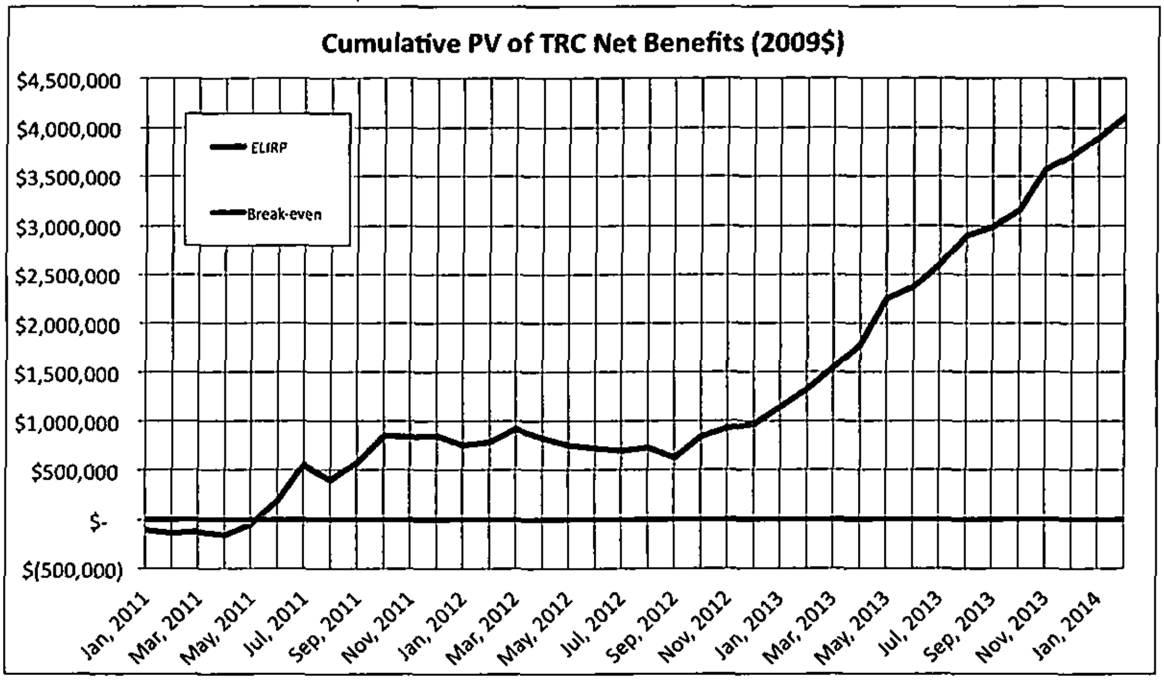
ELIRP continues to perform comprehensive weatherization projects on high users enrolled in PGW's Customer Responsibility Program. On average, ELIRP projects are saving 29 MMBtus, an average of 14 percent savings per home. Homes that receive a more comprehensive treatment are achieving 34 MMBtus, 18 percent of usage. The "core measures" treatment (programmable thermostats, pipe-wrap, and low-flow device measures), which are provided in homes with pre-existing issues preventing comprehensive weatherization projects, results in average savings of 9 MMBtus and 5 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 $21.6 million (2009 dollars), against the present value costs PGW incurred of $17.5 million (2009 dollars), for a present value of net benefits of $4.1 million (2009 dollars) and a BCR of 1.23. Figure 4 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 $6.9 million in PV net benefits, for a cumulative BCR of 1.26. This figure is approximately $1.3 more than goals established in the FY 2014 IP, due mainly to re-characterizing average project estimates going forward based on actual results achieved so far in FY 2014. Figure 4 shows the cumulative net TRC benefits for ELIRP since inception.

Figure 4 – ELIRP Cost-effectiveness over Time



PGW has targeted two primary plans for further improving ELIRP cost-effectiveness:

A. Addressing Pre-treatment Issues

Health, safety and structural issues, like damaged roofs, mold, asbestos, pests and other issues have continued to prevent comprehensive home weatherization. Contractors are unable to remediate these issues due to their costs, which would make job scopes cost-ineffective. In these instances, contractors are installing the measures that they can cost-effectively and safely install as part of Close Limited jobs. PGW has made modest progress in treating these homes through partnerships with Healthy Homes and Habitat for Humanity, described fully below, which allow partners to treat health and safety issues so that PGW can focus on weatherization. Since these programs have unique registration processes and serve a limited number of homes a year, these partnerships on their own cannot provide a large scale solution to the issues facing Philadelphia housing stock, though PGW has developed a coordination model that can be expanded upon with these organizations and replicated with others.

B. Addressing Customer Refusals

As a condition of CRP, customers are required to accept the energy audit if they are contacted by a CSP, though they have the opportunity to refuse individual measures. Customers who refuse audits and ignore multiple CSP contact attempts are not only violating their CRP, but are negatively impacting cost-effectiveness by requiring CSPs to spend more effort on scheduling and wasted trips. PGW has designed a protocol based on other Pennsylvania weatherization programs, in which formal letters are sent from PGW informing customers that they may be taken off CRP if they do not accept the audit.

PGW has not yet implemented this protocol, but is currently collecting monthly lists from CSPs of all audit refusals. PGW plans to implement this process in 2015, recognizing that it will take considerable time and coordination among departments to properly automate letters to customers and ensure that customers are not removed from CRP by error.

PGW believes that these activities, in addition to ongoing program improvement initiatives such as CSP evaluations and funding reallocations, will help further improve the program's effectiveness.

Projections

In order to more accurately project future savings, PGW has made updates to projections based on actual activities to date. Specifically, PGW has increased the average savings and spending per project, while slightly lowering the cost per MMBtu of gas savings. This has led to a decrease in the number of participants required to meet savings and spending goals and an increase in projected benefits. .

The ELIRP program aims to serve 1,781 customers in FY 2015, with associated annualized gas savings of 55.3 BBtus, or 30.8 MMbtu/customer. In FY 2015, the program is projected to cost $7.6 million. The following table shows a breakout of participation, costs, and savings.

Table 17 - Projected ELIRP Impacts for FY 2015

	Projected (FY 2015)
PARTICIPATION	
Open Cases	n/a
Closed Cases - Full	n/a
Closed Cases - Partial/Rejected	n/a
Customers with Installations	1,795
COSTS	
Measure Installation Costs	$5,928,000
Administration and Management	$30,000
Marketing and Business Development	$-
Contractor Costs	$1,482,000
Inspection and Verification	$75,000
Evaluation	*$85,000*
Utility Costs	**$7,600,000**
Participant Costs	$-
Total	**$7,600,000**
BENEFITS	
Net Annual BBtu	55.3
Net Lifetime BBtu	1,106.3
Net Annual MMBtu / Customer	30.8
Weighted Lifetime (years)	20.0

iii) Workflow

There are no updates to the ELIRP workflow.

iv) History, Ramp-Up Strategy and Milestones

PGW has maintained a semi-annual contractor performance evaluation and funding reallocation cycle since FY 2011. Through six cycles, over $5.2 million has been reallocated across the programs CSP's or awarded as mid-year funding increases based on their relative performance based on two primary metrics: overall energy reductions and cost-effectiveness. Over time, this program design aspect, along with ongoing inspections and mentoring, is credited as increasing program cost-effectiveness on average from $6.06 spent per lifetime MMbtu saved to $5.69.

Current contracts for all three ELIRP CSPs expire at the end of FY2014. As such, PGW has released an RFP for CSPs who will begin services in September 2014. PGW also intends to re-release an RFP for ELIRP inspection and verification services within the year.

Further planned program updates resulting from the CY2011 ELIRP Impact Evaluation are discussed in the Evaluation section below.

v) Target Market and Program Eligibility

To be eligible for ELIRP customers must be currently enrolled in PGW's CRP. Additionally, PGW has targeted customers in the highest gas usage tiers.[10] 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
- 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 one third of comprehensively treated homes (68 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.

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[10] 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.

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	Through this partnership, PGW and Healthy Homes share data about customers who are assigned in both programs. Healthy Homes is able to treat many health, safety and structural issues, which then allows ELIRP CSPs to comprehensively treat homes they may not otherwise have been able to. In total, five homes have been treated through both programs, resulting in a savings of 3,945 mmbtu. PGW spent a total of $17,200 in these properties and Healthy Homes spent over $25,000 to remediate issues including damp and mold growth, lead, carbon monoxide and other issues. PGW identified 22 additional matching cases that are either in assigned or open status. These are in various stages of progress, though PGW plans to have a portion of these homes treated by the end of the year. PGW initially found difficulty in coordinating cases with Healthy Homes due to different procedures for case intake and project work. A more "bottom-up" approach was developed to facilitate coordinated scheduling between the respective schedulers and in-home contractors of both programs, with ELIRP CSPs taking the lead based on when they could actually schedule audits. 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.

Program/Organization	Description of Coordination
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 PGW's free weatherization services. 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.
Habitat for Humanity	Habitat for Humanity: PGW signed an agreement with Habitat for Humanity in February 2014 to coordinate services through their Home Repair and Weatherization Program. Habitat's program focuses on individual neighborhoods and provides weatherization and structural repairs to support housing revitalization. Under this arrangement, PGW and Habitat will share data as appropriate and identify customers who are enrolled or eligible for both Habitat's Home Repair and Weatherization Program and ELIRP. Habitat and PGW contractors will identify pre-treatment and structural issues for Habitat to address, and PGW contractors will focus on weatherization. Although no coordinated projects have been completed to date, there are currently four homes identified as assigned in both programs that offer potential for coordination.

xi) Evaluation, Monitoring, and Verification

Inspections

PGW has continued performing and monitoring third-party 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.

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 percent of comprehensive closed cases. Going forward, PGW intends to continue targeting a 10 percent inspection rate of all Comprehensive Closed cases. PGW had directed the program inspector to inspect a set percentage of Closed Limited cases as well; however these inspections have offered a lack of useful data-points due to the verified presence of pre-existing conditions limiting the amount of weatherization work able to be performed. PGW will continue to perform random inspections of Closed Limited cases to confirm findings to date, but at a reduced rate than previously performed.

Table 18 – ELIRP Inspections and On-site Mentoring (Inception-to-date)

Fiscal Year	Inspections	Hours of Mentoring
2011	44	22.5
2012	82	28.5
2013	131	23
2014*	66	4.75
Inception-to-Date	323	78.75

**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 96 percent in FY 2013 to 97 percent for the first half of FY 2014. Points are deducted occasionally for missed savings opportunities or applications without benefit, though no CSPs present cause for concern or poor work patterns. PGW also stresses the importance of identifying and properly addressing or reporting health and safety issues as warranted, and has directed the ELIRP inspector to report any that are missed. CSPs have shown considerable improvement in identifying these issues (such as CO readings), as point deductions in 2014 for health and safety deficiencies were issued at less than half the rate they were in 2013.

In the past year, PGW has re-focused inspections in a more targeted manner to gather specific data and identify trends in CSP work. In addition to randomly selected cases, CSG now performs inspections on cases that are classified by certain criteria (though still selected at random). These include cases with: high and low blower door percentage reductions; high and low energy savings; cases that receive air sealing but have a high post blower door reading; cases that receive heater replacements but no air sealing and insulation; and other measure combinations. PGW has not yet received enough data on these cases to make any conclusions.

PGW is also evaluating opportunities to improve the ELIRP program through enhanced QA and mentoring. One limitation of the current post-project-completion inspection model is that it offers little insight into how work scopes were developed. PGW is considering opportunities for inspectors to shadow CSPs during the initial audit, and offer mentoring and analysis of the CSPs work scope to identify missed opportunities and other issues at that stage. PGW also intends to provide another formal CSP training event this summer, similar to the one held at the program outset, for all contractors selected through the current RFP process to build on lessons learned and to optimize contractor performance.

Finally, PGW is also considering revising the inspection scoring process in the coming year. The inspection score is a metric used in the scorecard to evaluate CSPs and decide funding allocations. The bi-annual scorecard awards a maximum of 25 points calculated by averaging their scores (based on 0-100) and dividing it by four. Since all CSPs have greatly improved their scores since program launch, they regularly score over 20 points and there is little distinction between CSPs, as demonstrated by the average inspection score of 97 percent provided above. PGW is considering updating these metrics to create greater distinction and reward CSPs who perform the highest quality and safest work.

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.

As discussed in the coordination section, PGW has spoken with multiple nonprofits and community development corporations about partnership opportunities to address health and safety issues. As PGW develops new partnerships, it is identifying updates to its database that will allow CSPs and partner organizations to better share case data.

Reporting

There are no updates to planned reporting for the ELIRP.

Evaluation

PGW has completed the third-party ELIRP Impact Evaluation on Calendar Year 2011 program activities, including analysis of actual gas usage reductions. This evaluation found that the program achieved actual gas savings greater than initially projected by PGW; and attained cost-effectiveness in this launch year with a BCR of 1.08.

On average, the program achieved annual savings of 26.2 mcf per home treated, or 12.7 percent compared to pre-usage, across all closed cases. These savings are 30 percent larger than the 20.2 mcf savings initially projected by PGW. Additionally, these ELIRP savings represent a 37 percent increase over the 19.1 mcf average annual savings achieved in the 2008 CWP Pilot program year. Analysis focusing only on the comprehensive closed cases demonstrated actual annual gas savings of 32.6 mcf on average, or 15.6 percent as compared to pre-usage.

The evaluation further found the present value of the average actual lifetime gas savings to be $2,627 per home across all closed cases, about $197 and 8 percent greater than the average program cost of $2,430 per home. Further evaluation findings and conclusions are discussed in greater detail below.

A. Measures

The Impact Evaluation involved statistically disaggregated savings for the major program measures, resulting in the ability to reasonably conclude average savings per measure category across the program contractors. These statistically-derived savings results, based on actual usage, are useful in comparison against PGW's original calculated projections. Any significant differences, across different measures or different contractors, sheds light on opportunities to improve program effectiveness and better align projected savings with actual results. Where performance or projections vary, PGW intends to determine cause as best as possible and proposed solutions. Initial diagnoses include issues with data entry, installation performance, and PGW's TRM; all will be carefully examined as they interact with each measure's actual results.

The thermostat measure was one of the largest sources of savings discrepancies, ranging from 38 ccf for one contractor up to 113 ccf for the highest achieving contractor. Based on the Impact Evaluation and contractor interviews, PGW believes these results are impacted by contractor installation and energy education protocols. PGW intends to further explore and attempt to replicate successful practices across all three program contractors. Immediate next steps include reviewing and revising customer thermostat education protocols, and updating the QA inspection process to gain more information from customers on their use of the new thermostats.

Similarly, HVAC installations resulted in significant actual gas savings discrepancies across the three contractors. The top performing contractor appears to have been most successful by specifically installing the highest-efficiency new equipment and by performing installations at homes with higher pre-heating usage, on average. These results have been shared and discussed with all three contractors. For the immediate future, PGW intends to maintain the current program protocols allowing contractors to determine the efficiency of new equipment installations based on their costs and PGW's savings calculations. PGW will continue analyses and contractor discussions regarding HVAC replacements.

The roof insulation measure also provides an opportunity to examine and apply best practices across the contractors. Contractor actual savings results for this measure ranged from 64 ccf to 169 ccf. The Impact Evaluation identifies contractor installation issues as a primary cause worth investigating further. PGW concurs, and has directed the program inspector to begin immediately performing infra-red inspections of these installations to identify causes of lower savings as compared to PGW calculations. These infra-red inspections will be ongoing, within the targeted inspections tactics as discussed in the Inspections section above.

All three contractors demonstrated more consistent blower-door-guided air sealing savings; unfortunately, these actual results were lower than PGW's initial projections. In this regard, the Impact Evaluation recommends examination of the program TRM due to the consistently lower actual results as compared to PGW's projections. However, PGW has determined that these realization rates are likely not caused by inaccurate TRM formulas, but rather by the improper use of blower door projections and data-entry for test-in readings.

The lack of a cap on blower-door test-in readings allowed CSPs to enter data above the limits of accurate formula extrapolation. The application of the formula in these instances resulted in greater projected energy savings than could be accurately assumed. PGW placed a cap on extrapolated values in early FY 2012, which prevented these over-estimations. These installation protocols and data control updates, along with targeted CSP mentoring and trainings, are expected to provide a greater impact and a more appropriate response in addressing projected gas savings for this measure.

PGW also notes that 2011 was the first year of the program, during which time CSPs were learning and growing with the newly redesigned program. CSPs also made changes to their subcontractor arrangements and protocols. These two factors may account for performance issues listed for the measures above.

B. Reporting

The Impact Evaluation identifies several potential areas for further improving ELIRP data and reporting protocols. The nature of specific measures' installations, TRM input fields, and realization rates suggest the need for additional data controls to ensure data entry accuracy. Blower-door-guided air sealing, as discussed above, offers an example of an already implemented corrective action. PGW will continue to perform retroactive data queries to identify inaccurate historical data and introduce new controls to prevent accepting bad data in the future.

Several findings suggest the need for tighter definitions to allow for data consistency and effective comparisons across the contractors. Database reporting of health and safety issues differed drastically, with one contractor reporting the presence of problems in 12 percent of homes while another found issues in 75 percent of homes. PGW has since instructed all contractors to report all major issues found in homes, regardless of whether the contractor was able to perform weatherization work.

The ELIRP inspector will also be tasked with identifying the presence or absence of these problems (and whether they were contractor-reported) in their inspections. This data is critical in developing the pre-treatment partnerships, and therefore definition consistency is essential. Database updates are planned that will allow CSPs to enter more useful data about health and safety issues, noting estimated remediation costs and the work that was prevented by their presence. PGW seeks to better incorporate identifying, reporting and addressing health and safety issues in its contractor trainings. PGW recognizes however that CSPs may have different policies at the company level and staff may make different legitimate judgment calls on issues.

Similarly, differing contractor applications of the Closed Limited case status has limited the effectiveness of comparing these cases across the program. As with the health and safety problems, PGW has provided a consistent definition for all contractors to observe going forward. Closed Limiteds have now clearly been defined as any case in which work was limited to the core measures performed during the test-in audit (such as programmable thermostats, pipe-wrapping, and low-flow devices), with no further weatherization work performed in any follow-up visits. Comprehensive Closed cases are defined as any cases where any amount of follow-up work was performed, regardless of the extent. Additionally, PGW will ensure revisited protocols and controls to requiring explanations justifying the Closed Limiteds and the specific issues preventing a case from being Comprehensively Closed.

The evaluation findings, and CSP activities to date, will be used to inform the previously mentioned training event, tentatively scheduled for this summer. In particular, we intend to reinforce lessons learned to optimize the number and of Comprehensive Closed and the magnitude of their savings.

C. Project Savings and Cost-Effectiveness

As presented above, the ELIRP program attained cost-effectiveness in the calendar year 2011 launch period, with a BCR of 1.08, and actual gas savings 30 percent larger than PGW's initial projections.

Average savings for the comprehensive closed projects were even greater than the total program results. Unfortunately, these projects did not achieve cost-effectiveness overall, with a BCR of 0.92. PGW attributes this to early program performance issues related to the contractors' transitions from a prescriptive measure mind-set to a diagnostic project approach. PGW spent much of the first-year and beyond focusing on training, inspections, mentoring, and evaluation on this issue, particularly as it related to air-sealing. The other notable development in this regard has been the steady improvement in contractor's cost-effectiveness since the launch year, which PGW credits as a result to both contractor operations and the ELIRP program's contractor evaluation and reallocation model.

However, as the Impact Evaluation notes, even the best performing HVAC replacements still did not achieve cost-effectiveness in this evaluation period. That may be in part attributable to launch and ramp-up period, however initial results suggest that on average HVAC replacements within the ELIRP program may not be cost-effective measures by themselves. PGW has met with each of the contractors to discuss these points, and will continue to analyze the HVAC replacements and all other program measures' cost-effectiveness and savings results through ongoing real-time program data and ensuing program evaluations.

As demonstrated in the Impact Evaluation, actual gas savings realization rates varied greatly across the measures and contractors. Furthermore, 22 percent of completed jobs had an increase in gas usage post-treatment. The presence of usage increases is a consistent finding in other low-income weatherization programs, including most recently in the February 2013 Pennsylvania WAP Evaluation. That DCED evaluation found similar results and cited studies demonstrating averages of 30-35 percent of low-income homes failing to reduce energy consumption following weatherization treatments. Despite these facts, PGW is still encouraged by the results of the ELIRP program's calendar year 2011 Impact Evaluation.

The PGW contractor evaluation and funding reallocation model has already been successful in encouraging contractors to continually strive for improved cost-effectiveness, while at the same time seeking greater overall gas savings as well. Some of the issues with high contractor costs cited in the Impact Evaluation have already been addressed in this way, while average savings have continued to increase. By addressing the opportunities identified as part of this Impact Evaluation process, PGW will be able to closer align TRM projected savings with actual gas savings, making the real-time contractor evaluation model that much more effective.

B. *Residential Heating Equipment Rebates Program*

i) Program Description

The RHER program 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, 2014, RHER has issued rebates for over 1,200 high efficiency boilers and furnaces, totaling over $1.1 million in incentives.

Table 19 - RHER Impacts from Inception to February 28, 2014[11]

	Actual Results (Inception to 2/28/2013)
Submission Activity	
Valid Applications[12]	1,108
Invalid Applications[13]	453
Total Applications Processed	1,561
COSTS	
Customer Incentives	$1,129,771
Administration and Management	$2,270
Marketing and Business Development	$124,088
Contractor Costs	$141,194
Inspection and Verification	$3,717
Evaluation	$71,736
Utility Costs	**$1,472,776**
Participant Costs[14]	$1,036,232
Total	**$ 2,509,008**
SAVINGS	
Net Annual BBtu	31.2
Net Lifetime BBtu	683.4
Net Annual MMBtu / Application	28.2
Weighted Lifetime (years)	21.9

While the RHER program continues to under-perform against targeted program participation levels, an ongoing improvement trend continued throughout FY 2013 and into FY 2014. Specific variance causes and PGW responses are addressed in the Variance section below. The program is cost-effective, as demonstrated by the program's Benefit-Cost-Ratio of 1.71 to date. Program participation levels are increasing as additional communication and outreach activities have begun generating increased market awareness, as demonstrated in Figure 3 below. There remains room for program improvement, given the low program spending rate against budgeted goals. The RHER program has not yet met annual participation goals since inception in FY 2011. However it is worth noting that PGW's rebate activity increased by 73 percent between FY 2012 and FY 2013, and the first six months of FY 2014 have seen a 25 percent rise in rebate activity over the same six months of FY 2013

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

[12] Valid applications for landlords and multifamily buildings may cover more than one piece of equipment. A total of 1,204 individual heating units were rebated over this reporting period.

[13] Invalid applications may be corrected and resubmitted.

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

The difference between actual activities and targeted goals can be attributed mainly to marketing and outreach efforts. PGW's recently completed evaluation of the RHER program found that the lack of customer awareness was one of the largest barriers faced by the program. While PGW has continued to ramp-up and include additional communications and marketing efforts since low program participation trends first developed, additional market awareness efforts are necessary to drive further customer participation. HVAC contractor outreach activities, which are found to be the most effective vehicle for marketing an HVAC equipment rebated program, have been increased.

In addition, PGW is working on expanding overall program and portfolio awareness. Efforts are being put in place currently to promote the EnergySense brand and additional spending is being allocated at the portfolio level to ramp up these activities. As a primary point of access for EnergySense participation, the RHER program should be a main beneficiary of this increased activity. PGW continues to work on finding additional ways to raise awareness of this program with both customers and contractors.

One area of improvement identified in earlier plans has been rejection rates. PGW has continued to address this issue by providing additional instructions and education to trade allies. Consequently, cumulative rejection rates have peaked around the end of FY 2013 at 22 percent of applications. Since then, the rejection rate for claims submitted in the first half of FY2014 was 16 percent, which brought the cumulative rejection rate down to 20 percent of claims. PGW expects this trend to continue.

Program Costs

Since inception, PGW spent slightly under $1.5 million on RHER, with around $680,000 of the total coming from recent activity in the last 12 months. Together, fixed costs for Administration and Management as well as additional Contractor Costs were slightly under budget.

Program Savings

Going forward, estimated savings for furnaces and boilers have been lowered significantly to align with evaluated savings, discussed further in the Evaluation section below. These updates are shown in the FY 2015 TRM which is included as Appendix J.

Program Cost-Effectiveness to Date

PGW's initial estimates for RHER achieved positive TRC net benefits with a present value of $1.5 million (in 2009 dollars), a TRC BCR of 1.71, in activity through February 28, 2014. The Gas Energy System test shows net benefits with a present value of $2.2 million, and a BCR of 2.78. Updates to the TRM based on evaluated results will go into effect starting in June of 2014 and should reduce gas benefits by nearly 40 percent. While this will decrease cost-effectiveness results, individual measures, as well as the entire RHER program, are expected to remain cost-effective.

Projections

The program aims to serve 1,352 customers in FY 2015, with associated annualized gas savings of 20.1 BBtu, or 14.9 MMBtu/customer. The program is projected to cost $1.15 million. The following table shows a detailed breakout of participation, costs, and savings.

Table 20 - Projected RHER Impacts for FY 2015

	Projected (FY 2015)
PARTICIPATION	
Valid Applications	n/a
Invalid Applications	n/a
Total Applications	1,352
COSTS	
Customer Incentives	$1,054,520
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$48,000
Inspection and Verification	$8,000
Evaluation	$35,000
Utility Costs	**$1,145,520**
Participant Costs	$1,068,113
Total	**$2,213,633**
BENEFITS	
Net Annual BBtu	20.1
Net Lifetime BBtu	431.7
Net Annual MMBtu / Customer	14.9
Weighted Lifetime (years)	21.5

iii) Workflow

There are no updates to the workflow for RHER.

iv) History, Ramp-Up Strategy and Milestones

RHER launched April 1, 2011 to offer incentives for furnaces and boilers with AFUEs higher than 94 percent. A small incentive was also provided for the purchase of a new programmable thermostat at the same time as the high efficiency heater. In early 2012, PGW increased incentives for furnaces to $500 and incentives for boilers to $2,000 based on additional market research.

On November 19, 2012, AHRI announced an error its testing requirements for modulating condensing residential boilers. The correction resulted in lower AFUE ratings for some models, which made them no longer eligible 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 still 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 had offered a company rebate in conjunction with RHER; this additional, effective sales tool was eliminated since the boiler targeted no longer met PGW's efficiency criteria.

Throughout the launch of PGW's other EnergySense programs, including its retrofit programs for residential and small commercial customers, efforts have been made to align rebates offered through RHER with these programs. This included updating 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

PGW has recently completed an evaluation of the first 18 months of its RHER program; the findings and resulting next steps are discussed in the Evaluation section below.

In FY 2015, PGW plans to decrease incentives for boilers to $1,500 based on updated savings and cost-effectiveness analysis performed using results from the RHER evaluation. On average, PGW's boiler rebates provide more gas benefits than costs, but for many of the lower capacity boiler units this is not the case. Lowering the incentive will bring the incentives more in line with current gas benefits while still covering a large portion of the incremental cost. Also, as PGW existing boiler incentive levels are relatively generous based on a national utility market study performed within the RHER Evaluation, this update will also more closely align PGW's RHER program incentives with national averages.

v) Target Market and Program Eligibility

There are no updates to program eligibility.

vi) Target End-use Measures

Through February 28, 2014, PGW has provided 384 boiler rebates and 820 furnace rebates for a total of 1,204 heating units rebated. PGW also provided 687 thermostat rebates, which are only available with the purchase of a premium-efficiency furnace or boiler. The high participation rates for the additional thermostat rebates continued (57 percent of valid applications) Figure 5 shows how Rebate activity has progressed over time.

Figure 5 – RHER Rebates Issued by Month (Inception through Feb 28, 2013)

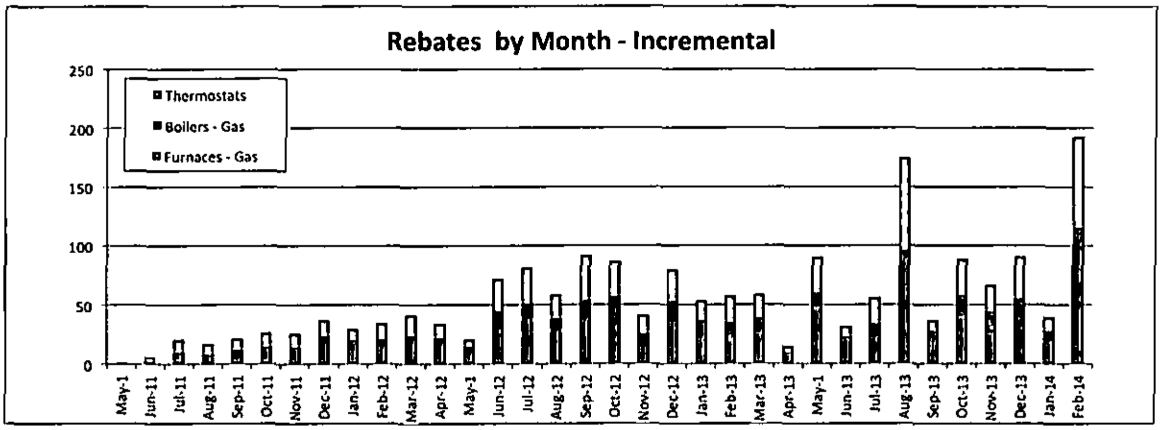


Figure 5 clearly shows an increasing trend in rebates issued, with spikes in August 2013 and February 2014 due to large multifamily projects being processed. Seasonality can also be seen in the data with lulls in program activity throughout the summer months. The amount of heating systems rebated in the first six months of FY 2014 (September 1, 2013 through February 28, 2013) was 25 percent greater than the same period a year before and 72 percent more rebates were issued in FY 2013 than FY 2012. The percentage of rebates going to boilers has stabilized at around 33 percent.

In the past year, PGW has experienced a greater number of applications for large multifamily units. PGW attributes this to multiple factors:

- Developers who were initially interested in HECI and CIRI programs, but chose not to pursue comprehensive projects sought RHER for just heater installations.
- PGW has been promoting RHER opportunities to developers seeking to establish new service.
- New construction in Philadelphia has increased in Philadelphia after a slower period during the recession.

Because of this new trend in activity and differing priorities of larger developers and property managers, PGW has improved its ability to serve these customers. This includes:

- Development of an Excel spreadsheet to allow large applicants provide information about heaters and properties in a format that is easier to use and understand.
- Greater engagement with applicants of larger projects to explain the process and deal directly with PGW staff and not rebate processor.

Starting in FY 2015, PGW will offer new prescriptive equipment rebates for High Efficiency Combination Boilers which offer on-demand water heating to minimize standby heating losses. PGW will incent only those units with AFUEs above 94 percent.

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.

Projections

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

Table 21 - Projected Rebates for FY 2014 to FY 2015 by Equipment Type

Fiscal Year	2014 (remaining)	2015	2014 - 15
Natural Gas Furnace	240	666	906
Natural Gas Furnace w/ ECM	120	334	454
Natural Gas Boiler	120	340	460
Natural Gas Combi-Boiler (new)	0	12	12
Programmable Thermostat	288	804	1,092

vii) Incentive Strategy

The following table shows the current rebate schedule.

Table 22 – Current 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	$2,000
Programmable Thermostat [16]	$30

PGW plans to modify the incentives for boilers based on the results from the RHER evaluation, as well as to add new incentives for combination space and water heating boilers. The following table shows the revised rebate schedule for FY 2015.

[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

Table 23 – FY 2015 Planned Residential Equipment Rebates

Measure	Amount
Natural Gas Furnace 94% AFUE	$500
Natural Gas Furnace 94% AFUE, BFM Fan[17]	$500
Natural Gas Water Boiler 94% AFUE	$1,500
Natural Gas Combi Boiler 94% AFUE	$1,700
Programmable Thermostat [18]	$30

As discussed further in the evaluation section below, PGW found lower savings than originally projected for both boilers and furnaces. After reexamining the impact of lower savings on current incentive levels, PGW found that many of the smaller capacity boilers would not be cost-effective from a gas administrator cost test, meaning that the value of gas savings was less than the incentive being offered. In order to more closely align the value of incentives with the value of benefits, PGW is planning to lower the boiler rebate so that all but the smallest possible capacity boiler will provide gas benefits worth more than the incentives. Only boilers with 40 kBtu/hr rated capacity will have less than $1,500 in benefits, and only one of the nearly 400 boiler incentives has had a capacity this small.

PGW's planned combi-boiler incentive is designed to recognized and promote the additional savings customers can receive from a dual-function boiler. The additional $200 incentive is designed to meet the additional incremental cost found for combi-boilers compared to non-combi boilers of the same size and efficiency.

viii) Roles and Responsibilities

There are no updates to roles and responsibilities

ix) Marketing Strategy

PGW has maintained the ongoing trade ally marketing plan directed towards equipment manufacturers, distributors, installation contractors and retailers/vendors to make the high-efficiency equipment available for purchase. In the past year, PGW has expanded this communication strategy by launching a monthly EnergySense Trade Ally newsletter to provide timely program updates and better establish relationships.

Existing program data to date has confirmed the experience of other gas utility rebate programs in that contractor outreach is the most effective strategy for increasing customer demand for high efficiency gas equipment rebates. This approach has also been validated through the third-party Impact Evaluation, as discussed further in the Evaluation section

[17] 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.

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

below. Interviews conducted with contractors and customers revealed that forty percent of contractors first heard about the rebates through a supplier. Forty eight percent of customers learned about the program through their contractor.

There are still opportunities for further improving trade ally communications. Remaining barriers include the fragmentation of the market, difficulties in reaching all individual contractors, and some businesses' pre-existing preferences for products. In the remaining months of FY2014 and 2015, PGW plans to partner with manufacturers to hold events and contractor training sessions to provide information on effectively pitching high efficiency sales.

Consumer marketing activities will also be continued and increased. Mass marketing of the RHER program to customers has been a challenge simply because of the high cost of new heaters, and the fact that most customers are not in the market to purchase a heater unless their existing units fail. However, the launch of the CRRI program has provided the opportunity to begin marketing the entire EnergySense portfolio available to customer in helping them either reactively or proactively address their home performance and comfort.

Beginning in fall, 2013, PGW launched an expanded portfolio-wide marketing campaign, with the CRRI program as the lead message. This campaign included TV, radio, bill-boards, and online ads. That initial ad campaign has been followed by grass-roots outreach through partnerships with local community organizations, and residential canvassing efforts. The launch of the CRRI program, and subsequent marketing campaign, is expected to continue having a spill-over effect on activity levels of other programs, especially so for the RHER program.

PGW has also increased direct marketing to realtors, developers, owners, and managers of larger multi-family properties, resulting in increased landlord applications for multiple units. These range from landlords rehabbing duplexes to developers building a block of row homes, and companies replacing furnaces in 200 apartments. So far in FY2014, there has been $66,000 worth of multiple-unit rebate applications, with another $200,000 anticipated. PGW expects to maintain this pace in 2015. This increase in multi-family projects is due in part to close coordination between RHER and its commercial/industrial programs, in which developers who cannot complete a HECI or CIRI project will select relatively smaller RHER projects.

x) Coordination with other Programs

Program/Organization	Description of Coordination
EnergyWorks Residential	The ARRA-funded EnergyWorks program ended in fall, 2013. EnergyWorks, through their subsidized energy audits and financing for residential projects, had provided a useful resource in generating and completing PGW RHER projects. Remaining funding had been committed to the Keystone HELP program, allowing the latter to continue providing subsidized low-interest residential loans.
Keystone HELP	The Keystone HELP program, funded by the PA Treasury Department and administered by AFC First, provides low-interest loans for qualified residential energy efficiency projects. The committed funding from the EnergyWorks has allowed Keystone HELP to continue providing subsidized low-interest residential loans into the near future. This partnership will continue to provide PGW RHER customers with attractive financing terms for residential energy efficiency projects (including RHER projects), at least over the duration of their remaining subsidized financing program.
PGW Gas Conversions Rebate Program	The RHER program has continued to coordinate activities with PGW's Gas Conversions program, which offers a $500 PGW bill credit for customers who currently have PGW service but are converting to gas for space heat. This coordination targets 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. To date, over 130 customers have received incentives through both programs.

xi) Evaluation, Monitoring, and Verification

Quality Assurance

PGW performs on-site verifications on at least 3 percent of completed incentive claims to ensure the equipment installed qualifies for the program and matches the equipment listed on the rebate application. 147 verifications have been performed to date, accounting for 11 percent of all heaters rebated.

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. In FY 2014, PGW updated QA protocols to perform verifications ahead of rebate submissions for applications covering five or more rebates. PGW plans to continue this updated protocol in FY 2015.

An additional RHER QA step was necessitated with the launch of the CRRI program, to ensure that customers cannot receive a rebate for heater replacements through both the RHER and CRRI programs. PGW will continue to work with its rebate processor, inspector, and the trade ally network to identify opportunities to improve QA while also protecting the program's customer accessibility.

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

PGW has completed the third-party RHER Impact Evaluation on the program's launch period, from April 1, 2011 through August 31, 2012, program activities, including analysis of actual gas usage reductions. Unfortunately, actual gas savings was found to have been less than PGW's initial projections, demonstrating the need for updated TRM assumptions regarding average equipment size and EFLH.

The decrease in actual gas savings also impacted the measures' and program cost-effectiveness as well. Both furnaces and boilers remained cost-effective at 1.35 and 1.26 BCR, respectively. The RHER program overall also remained cost-effective. However, the reduced measure savings combined with the program's fixed start-up costs and the low participation rates resulted in a reduced program cost-effectiveness of 1.01 for this initial evaluation. PGW expects that the RHER program BCR has improved substantially since the launch period due to increased program participation and reduced relative administrative costs.

The program was found to have been popular with both customers and contractors, and effective in encouraging the purchase of high-efficiency savings. Further evaluation findings and conclusions are discussed in greater detail below.

A. Program Design

The Impact Evaluation found incremental costs for both high-efficiency furnaces and boilers were found to vary widely, primarily dependent upon the additional installation work necessitated by the condensing equipment. Few of the contractors and customers interviewed cited rebates covering a full 80 percent of incremental costs, as the program initially intended, and instead found incentives covering on average 40 to 60 percent. The Evaluation suggests considering increasing incentives and/or providing varied rebates depending on the work required.

However, industry-wide analysis within this Evaluation found PGW RHER program as among the most ambitious, in terms of efficiency levels targeted, and generous, in terms of rebate size. The Evaluation also confirmed that current incentives were sufficient to make a significant reduction in incremental costs and were a major factor in the decision to select high-efficiency equipment. Based on these industry comparisons, interview findings, and PGW's goals of streamlining service delivery and simplifying prescriptive program customer communications, PGW plans to maintain the current incentive structure for furnaces for the immediate future, but plans on lowering the boiler rebate to be more in line with current benefits from lower savings.

The Evaluation also recommended considering additional rebate offerings, given the barriers facing the existing high-efficiency. PGW agrees and is examining additional offerings, including combi-boilers as discussed in the Targeted Measures section above, for potential availability in FY 2015.

B. Marketing and Participation

RHER program participation was low during this launch period of this Evaluation, and though trending has improved to date participation still remains short of annual goals. Based on their research, interview, and analysis within this Impact Evaluation, several recommendations were offered for additional marketing opportunities to pursue. Some of those recommendations are:

- Additional marketing to supply houses given the effectiveness of this communication vehicle to date.
- Improved information and resources to be made available on the PGW web site.
- Integrating program applications and rebate delivery across the PGW gas conversion programs and the DSM RHER program
- Additional contractor training to provide additional sales tools, information, and application assistance in interactions with their customers.
- Additional rebate offerings

PGW agrees with many of the Evaluation's conclusions, and is already moving forward in implementing several specific recommendations, such as supply house outreach and contractor trainings, as discussed in the Marketing Strategy section above. PGW is also exploring opportunities for providing additional web resources in assisting and motivating contractors and customers towards program participation.

C. Market Impact

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 identify opportunities for improvement. Relevant survey results 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 of the project.

- In a majority of cases, contractors were the primary source of information for PGW rebates. This affirms that trade ally outreach has been effective. PGW will seek 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 believes rejections may be reduced by helping contractors to better engage customers and ensure the submission of all required documents and information. This assistance and engagement will be targeted in the upcoming year.

- 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.

D. Energy Savings

The Impact Evaluation found that actual gas savings for the high-efficiency gas furnaces and boilers were less than the initial TRM projections, with boilers replacements averaging 202 ccf and furnace replacements averaging 112 ccf in annual savings. These results were approximately 60 percent PGW's initial estimates. The disparity has been diagnosed as resulting from over-estimating average equipment sizes and the Equivalent Full Load Hours ("EFLH"). PGW is filing a TRM update with this FY 2015 Implementation Plan to revise EFLH assumptions downwards for residential heating equipment rebates, which will make future projections much closer to the actual gas savings found through this Impact Evaluation.

C. *Commercial and Industrial Retrofit Incentives Program*

i) Program Description

The CIRI program 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

As of February 28, 2014, PGW has issued 15 grants totaling $234,415 since program inception. In FY 2014 alone, PGW has issued eight grants for a total of $63,816. This rise in completed projects is a direct result of increased communications conducted during the second half of FY2013. The CIRI project lifecycle from time of application to time of grant payment ranged from 4.5 months to 22 months, with the average project taking about 7 months.

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, 2014

	Actual Results (Inception to 2/28/2014)
PARTICIPATION	
Applications	47
Analyses/Audits	24
Customers with Installations	15
COSTS	
Customer Incentives	$234,415
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$129,556
Inspection and Verification	$14,710
Evaluation	$24,908
Utility Costs	**$403,590**
Participant Costs	$236,538
Total	***$ 640,129***
SAVINGS	
Net Annual BBtu	5.3
Net Lifetime BBtu	95.96
Net Annual MMBtu / Customer	354.7
Weighted Lifetime (years)	

Program Costs

There are no updates to Program Costs.

Program Savings

PGW's initial focus on the multi-family sector resulted in a greater number of relatively small projects compared to the targeted average project savings and incentive sizes, resulting in a decreased amount of incentive funds issued and savings achieved as compared with initial projections. Although these projects were comprehensive and cost-effective, the net benefits were low due to the natural gas consumption at the properties.

Cost-Effectiveness

As of February 28, 2014, CIRI achieved positive TRC net benefits with a present value of $166,000 (in 2009 dollars), a TRC BCR of 1.32. The Gas Energy System saw net benefits with a present value of $102,000 (in 2009 dollars), a BCR of 1.31.

Projections

The CIRI program aims to serve 18 customers in FY 2015, with associated annualized gas savings of 8.2 BBtu, or 454 MMBtu/customer. The program is projected to cost $536,000 in FY 2015.

Table 25 - Projected CIRI Impacts for FY 2015

	Projected (FY 2015)
PARTICIPATION	
Applications	n/a
Analysis/Audits	
Customers with Installations	18
COSTS	
Measure Installation Costs	$345,589
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$120,831
On-site Technical Assessment	$-
Evaluation	$50,000
Utility Costs	**$536,558**
Participant Costs	$275,222
Total	**$811,780**
BENEFITS	
Net Annual BBtu	8.2
Net Lifetime BBtu	151.0
Net Annual MMBtu / Customer	453.8
Weighted Lifetime (years)	18.5

iii) Workflow

PGW had updated existing CIRI workflow to introduce a mid-project verification inspection, as addressed in the Quality Assurance section below.

iv) History, Ramp-Up Strategy and Milestones

Table 26 – Current CIRI Project Activity

Current CIRI Project Activity (Inception to February 28, 2014)	
Committed Projects In-Process	
Committed Projects	2
Committed Incentives	$76,371

As described in previous filings, PGW initially targeted multi-family projects when first launching the CIRI program in FY 2012. This customer base was reached primarily through organizations that service the multi-family building owners. Since then, 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 will seek to identify larger projects among its industrial and commercial customers by conducting increased outreach to these customers. Although very large commercial projects frequently require long project lifecycles, PGW will continue to seek-out these projects that will result in higher net benefits.

In general, energy conservation is not top-of-mind or a priority investment for many customers. Industrial and true commercial customers have been the hardest customer segment to reach. These customers may recognize the savings potential of energy efficiency investments, but either don't have the management capacity or the financial resources to invest in a project. PGW will launch a Trade Ally Network in summer 2014 to ease the resource burden of retrofit projects by directing customers to contractors that can design and build projects, and commercial lenders that can finance the projects. The need for this resource was confirmed through interviews conducted in the CIRI evaluation market study discussed in the Evaluations, Monitoring and Verification section below.

Additionally, the Philadelphia Benchmarking Ordinance data will become public in FY 2015. PGW anticipates this data release is expected to result in new demand for large commercial and industrial building owners to implement energy efficiency retrofits. PGWs past involvement with conducting outreach about this regulation is listed below.

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

There are no updates to the upfront incentive strategy.

viii) Roles and Responsibilities

There are no updates to roles.

ix) Marketing Strategy

In prior filings, PGW noted that CIRI marketing and communications activities would result in a "slow-burn" of projects. This statement continues to hold true, as applications received in FY 2013 have resulted in a steady rise in the number of incentive agreements and grants issued in the first half of FY 2014.

Due to PGW's initial focus on multifamily projects, nearly all CIRI projects paid to-date have been multi-family. As described in the FY 2014 IP, PGW pursued two paths to drive higher participation in FY 2014. First, broad awareness campaigns to high-usage building owners and service companies that work with building owners to reduce energy usage. Second, narrowly targeted outreach to promising leads for retrofit projects that are already planned and partially or wholly funded.

The broader outreach campaign has been successful in opening up new channels to reach additional customers. A successful C& I Projects Request for Applications ("RFA") was implemented in FY 2013. The campaign resulted in six grant applications including one which led to an incentive agreement. The campaign also increased awareness about PGW's other incentive programs available to commercial and industrial customers. As a result of this success, the RFA will be repeated in FY 2014 and in FY 2015.

In FY 2013, PGW also developed a customer data-set to inform a targeted direct-to-customer communications campaign to engage specific commercial and industrial customers about the PGW EnergySense programs. The mailer resulted in 781 customers actively seeking additional information about the PGW EnergySense programs, including 55 which contacted PGW with potential projects or questions about their buildings. PGW will follow-up to this mailer with additional direct to customer communications.

Additionally, PGW is launching a new EnergySense C&I Trade Ally Network, designed to assist customers with two main hurdles in implementing an energy efficiency retrofit project – identifying energy conservation service providers to perform upgrades, and commercial lenders to finance the work. Through the Trade Ally Network, connect customers with energy conservation firms that can design and build retrofit projects. The network will also provide a directory of private lenders interested in financing commercial, industrial or multi-family energy efficiency projects.

PGW will also seek new ways to help customers achieve greater savings through greater involvement of PGW's technical assistance provider. This may include providing low-flow faucet aerators or showerheads, and performing tank turndowns on visits to customer sites, or conducting steam trap analyses to identify savings opportunities.

Finally, PGW is also considering additional opportunities to further diversify and grow the CIRI projects base, potentially including offering limited-scope energy assessments for small commercial customers to identify comprehensive savings opportunities. Customers would be offered further project support by connecting them with CSPs and commercial lenders through the EnergySense C&I Trade Ally Network directory.

x) Coordination with other Programs

Program/Organization	Description of Coordination

Program/Organization	Description of Coordination
EnergyWorks	The EnergyWorks Commercial program, providing low-interest financing for larger commercial energy efficiency projects is still available. PGW will continue to identify opportunities to partner with EnergyWorks on individual projects in combining PGW's rebates and grants with the attractive EnergyWorks financing.
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.
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. Additionally, the Philadelphia Benchmarking Ordinance went into effect in FY 2014. PGW partnered with the Philadelphia Mayor's Office of Sustainability and the Energy Efficiency Green Buildings Hub in FY 2013-2014 to conduct outreach to commercial property owners impacted by the legislation. PGW expects to expand its outreach to these building owners to in FY2015 when the building benchmarking data is made public.
Green Stormwater Initiative ("GSI")	PGW has partnered with the GSI to collaborate on outreach to large facility owners that are impacted by the City of Philadelphia's storm water management regulations. Storm water management projects may be combined with energy efficiency retrofits to address multiple needs and provide positive cash flow for projects that would otherwise just address one issue. PGW plans to collaborate with the GSI on outreach activities, including a combined event for commercial property owners.

xi) Evaluation, Monitoring, and Verification

Quality Assurance

On-site verification inspections are performed on every completed 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.

The majority of project inspections show no change in equipment; however PGW has identified several projects with inconsistencies that resulted in modified grant awards. These ranged from changes to equipment size and type, to installations not being fully completed. In one instance, PGW's inspectors identified inefficient equipment that the general contractor had installed unbeknownst to the customer; as a result of the verification, the customer was able to correct the issue.

Data Collection

There is no update to data collection for CIRI.

Reporting

There is no update to reporting for CIRI.

Evaluation

PGW began its third-party CIRI program impact evaluation in FY 2014. Although the full evaluation will not be complete until the end of FY 2014, PGW has conducted an initial market study with participant customers, non-participant applicants, and non-participant customers. Although the market study is not finalized, important initial findings are listed below.

- The three participants interviewed stated that participation in the program was very easy.
- Two of the three participants interviewed stated that the program was very important to their decision to implement the retrofit project, and that PGW's technical assistance provided efficiency measure recommendations that may not have otherwise been considered.
- Non-participants identified several opportunities for PGW to assuage barriers to participation. Suggestions that PGW will implement prior to FY2015 include updates to the programs communications strategy; improvements to increase ease-of-use of the application; and new resources to help customers identify strategies for efficiency improvements.

PGW will carefully review all market study results, and implement necessary optimizations for the remainder of FY2014 and FY2015. PGW will complete its CIRI evaluation by early FY 2015, and will use the findings to inform potential improvements in its administration of the CIRI program.

D. *Commercial and Industrial Equipment Rebates Program*

i) Program Description

The CIER program 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, 2014, CIER has received 36 valid applications and 17 invalid applications, and issued incentives totaling $103,000.

Table 27 - CIER Impacts from Inception to February 28, 2014[19]

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

	Actual Results (Inception to 2/28/2014)
PARTICIPATION	
Valid Equipment Applications[20]	32
Invalid Equipment Applications	17
Total Equipment Applications	49
COSTS	
Customer Incentives	$ 103,000
Administration and Management	$ 0
Marketing and Business Development	$ 3,252
Contractor Costs	$ 85,295
Inspection and Verification	$ 0
Evaluation	$ 0
Utility Costs	**$191,547**
Participant Costs[21]	$36,518
Total	**$228,065**
SAVINGS	
Net Annual BBtu	4.93
Net Lifetime BBtu	119.45
Net Annual MMBtu / Customer	136.99
Weighted Lifetime (years)	22.71

Program Costs

PGW spent slightly over $85,000 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 Savings

In FY 2014, PGW identified a calculation error in savings for commercial boilers that undercounted savings reported in the FY 2013 Annual Report. PGW has corrected the error, which resulted in an increase in annual savings of 88 MMBtu over the previously reported figure reported in the FY 2013 Annual Report. The corrected FY2013 savings figures are below.

Table 28- Corrected CIER Impacts from Inception to August 31, 2013

SAVINGS	
Net Annual BBtu	4.14
Net Lifetime BBtu	102.60
Net Annual MMBtu / Customer	206.79

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

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

Weighted Lifetime (years)	24.04

In January 2014, ENERGY STAR announced new eligibility criteria for convection ovens. The new criteria require that ovens manufactured after January 1, 2014 must meet higher efficiency standards than products certified prior to that date. As a result, several ovens that met the previous certification standards became ineligible for continued certification and thereby became ineligible for PGW EnergySense rebates. PGW will continue to use the assumptions outlined in the FY 2014 TRM to report savings for this measure through the end of the current fiscal year. The TRM entry for this measure will be updated accordingly for FY 2015.

Program Cost-Effectiveness to Date

As of February 28, 2014, CIER achieved positive TRC net benefits with a present value of $404,000 (in 2009 dollars), a TRC BCR of 3.14. The Gas Energy System saw net benefits with a present value of $434,000 (in 2009 dollars), a BCR of 3.74.

Projections

The program aims to serve 144 customers in FY 2015, with associated annualized gas savings of 10.1 BBtu, or 69.8 MMBtu/customer. The program is projected to cost $337,792. The following table shows a detailed breakout of participation, costs, and savings.

Table 29 - Projected CIER Impacts for FY 2015

	Projected (FY 2015)
PARTICIPATION	
Analyses/Audits	n/a
Customers with Installations	144
COSTS	
Measure Installation Costs	$236,592
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$60,000
Inspection and Verification	$1,200
On-site Technical Assessment	$-
Evaluation	$40,000
Utility Costs	**$337,792**
Participant Costs	$91,614
Total	**$429,406**
BENEFITS	
Net Annual BBtu	10.1
Net Lifetime BBtu	156.4
Net Annual MMBtu / Customer	69.8

Weighted Lifetime (years)	15.6

iii) Workflow

Beginning in FY 2014, PGW began offering custom rebates for cost-effective equipment replacements that were not covered under the prescriptive rebate program and do not qualify as comprehensive projects under CIRI. PGW has combined its CIER application and CIRI data collection worksheet into an Excel-based custom rebate application that collects the necessary information for PGW to calculate incentives and savings.

Custom equipment rebates are processed in-house by PGW's program manager and implementation consultant. Payment for custom equipment rebates will be processed internally by PGW, similar to the process currently used for CIRI. Accordingly, costs associated with the processing of custom equipment rebates are reflected at the portfolio level.

iv) History, Ramp-Up Strategy and Milestones

After a slow start after launching the program in FY 2013, CIER program participation is beginning to trend upwards.

The commercial food service equipment rebates activity increased in FY2014, with 15 applications to-date. This is 25 percent higher activity than in the first full fiscal year of the program. Boiler rebate activity has remained constant, with an average of 1 check issued per-month over the past year.

The recent activity reflects an improvement in program activity, built on the targeted marketing and outreach efforts during FY 2013. A review of the first year and a half of activity shows a significant lag-time between the times that equipment is installed to when PGW receives a rebate application. On-average, this lag-time is five months for food service equipment and three months for commercial boilers. As a result, the impact of PGW marketing activities may not be reflected in the program activity metrics until several months after completion.

One challenge PGW found facing the food service equipment program was that many of the supply houses did not stock high-efficiency equipment. Walk-in customers were unable to purchase equipment for immediate use and frequently had to pre-order the eligible ENERGY STAR equipment. PGW has worked with restaurant supply houses to update stocking procedures so the high-efficiency equipment is readily available. In instances where this is not possible, PGW will continue to work with the supply houses through outreach events to educate customers about the energy and resource savings possible through ENERGY STAR equipment.

In FY 2014, ENERGY STAR implemented new standards that resulted in approximately 29 of commercial ovens to become no longer ENERGY STAR certified. Through CIER, PGW has paid the most commercial food service rebate offers to customers purchasing ovens, which became ineligible. Equipment manufactured prior to January 1, 2014 was eligible under the old standards, and PGW took steps to grandfather that equipment into the program. As of February 28, 2014, 27 commercial gas ovens remained eligible for the program, and PGW has taken steps to contact its supply chain and trade allies to alert them to the change and encourage stocking the equipment that remains eligible.

As described in the FY 2014 Implementation Plan, PGW began offering custom equipment rebates in FY 2014 and has offered the first custom project rebate. PGW's custom rebate program provides incentives to customers installing single measures that are not included in the prescriptive CIER program. For this equipment, PGW has designated a separate application process that collects detailed information about the projected energy conservation measure and its standard efficiency alternative. PGW requires that customers provide itemized cost information for both situations. Customers whose equipment is determined to be cost-effective are offered an incentive covering 80 percent of the incremental cost of the proposed high efficiency equipment for replacement measures and 33 percent of the incremental cost for retrofit measures, with a rebate maximum of $75,000.

The custom equipment rebate that PGW offered to date in FY 2014 was for an infrared heater installation at an industrial facility. The project was determined to be cost-effective, and PGW offered an incentive of $75,000 because the project's incremental cost warranted the maximum custom rebate incentive. At the time of this filing, the customer was still reviewing the project and had not committed to proceeding.

Since the infrared rebate offer was issued, PGW has received applications from customers for two additional projects. One custom equipment rebate application was for a new domestic hot water heater installed in a laundromat. The second application was for faucet aerators and low-flow showerheads installed in a multifamily apartment building. PGW expects new applications for these and other custom rebate measures to grow in FY 2015.

v) Target Market and Program Eligibility

There are no updates to program eligibility.

vi) Target End-use Measures

In response to commercial food service rebate activity levels that were less than projected, PGW conducted an incremental cost study in FY 2014 to confirm that all rebate levels provided adequate incentives based on current incremental costs. The study, conducted through Internet research and calls to local supply houses, found that incremental costs for several commercial food service equipment measures are higher than originally estimated. Below are impacts that the study's findings will have on commercial food service equipment rebates for the FY 2015 program year.

- ENERGY STAR Convection Ovens: PGW will discontinue its rebate for this measure because it is no longer proven to be cost-effective. This change is the result of increased baseline efficiencies, as proposed by ENERGY STAR that create a smaller delta between baseline and efficient equipment. Additionally, PGW found incremental cost to be about $1,500, an increase of over 100 percent more than the original estimate of $600.

- ENERGY STAR Gas Fryers: Through conversations with customers, PGW learned that its fryer rebate was not compelling for customers purchasing large fryer units. PGW studied this issue and found that many standard vat and large vat fryers are assembled into bays, and should be rebated on a per-fry pot basis rather than per-fryer. As a result of this finding PGW will now offer fryer rebates, for large vat and standard vat fryers, by fry pot, so customers purchasing a very large system will be incentivized to install an ENERGY STAR rated unit.

- ENERGY STAR Steam Cooker: Review of the steam cooker incremental costs showed that cost scaled proportionally to the equipment size, which ranged from 3 pans up to 10. To accommodate the spectrum of steam cooker units, PGW will begin to apply its incremental cost assumption and rebates on a per-pan basis, rather than provide a blanket assumption and rebate across all equipment sizes.

- ENERGY STAR Commercial Gas Griddles: PGW will discontinue its rebate for this measure because it is no longer proven to be cost-effective. This is due to findings that the incremental cost for this measure is over $4,000, significantly higher than original incremental cost assumption of $700.

- Pre-rinse Spray Valves: PGW's incremental cost study found that the incremental cost for these units is $17, an increase of $12 over the original assumptions. Despite this increase, PGW will not change the rebate level because the $25 (nominal) rebate continues to provide an adequate incentive for this measure. Additionally, for FY 2015 PGW will change the eligibility requirements for this measure to a maximum flow rate of 1.28 gallons per-minute. This change is consistent with the EPA WaterSense program requirements, and will result in higher savings for customers.

In response to market opportunities, PGW will expand its CIER program in FY 2015 to provide rebates for several new measures. These measures include high-efficiency commercial and industrial domestic hot water ("DHW") heaters, and steam traps.

Starting in FY 2015, PGW will provide incentives for commercial sized storage and tankless style water heaters with ENERGY STAR® certification. The ENERGY STAR®

program has identified over 150 eligible models currently on the market, and PGW's analysis found significant cost-effective savings.

In an effort to serve customers with steam boiler systems that do not qualify for the prescriptive CIER boiler rebates, PGW plans to identify other opportunities to help these customers with heating system improvements. Although many of these activities will fall outside the scope of CIER, PGW will launch a Steam Trap rebate program in FY 2015. A Steam Trap enhances the efficiency of steam boilers and can help customers achieve additional natural gas conservation. By addressing the steam traps, PGW will help steam boiler customers address a cost-effective upgrade that may be easier for customers to invest in than an expensive heating system replacement.

PGW found that incremental costs and savings justified offering three tiers of incentives for steam traps:

- Low pressure steam traps with pressure of less than 15 pounds per square inch gauge ("PSIG") used by dry cleaners, multifamily buildings, and other smaller commercial and industrial operations

- Medium pressure steam traps with pressure greater than or equal to 15 PSIG and less than 75 PSIG, used in industrial applications.

- High pressure steam traps with pressure greater than or equal to 75 PSIG, used in industrial applications.

Details for how PGW will count savings for the commercial DHW heaters and steam traps are included in the FY 2015 TRM.

vii) Incentive Strategy

For the FY2015 program year, PGW will revise its commercial food service equipment rebates based on the incremental cost findings discussed above. CIER incentives will continue to be calculated to cover approximately 80 percent of the incremental cost of premium-efficiency equipment.

In addition to the changes to previously offered rebates, PGW plans to introduce new prescriptive rebates for commercial and industrial domestic hot water heaters, and steam traps. The following two tables show the previous rebate schedule and the new schedule for FY 2015.

Table 30 – FY 2013-FY 2014 CIER Incentive Strategy

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

Table 30 – FY 2015 CIER Incentive Strategy

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 Large Vat Fryer (Per-Frypot)	ENERGY STAR®	$1,900
Commercial Gas Standard Vat Fryer (Per-Frypot)	ENERGY STAR®	$1,400
Commercial Gas Steam Cooker (Per Pan)	ENERGY STAR®	$600
High-Efficiency Pre-Rinse Spray Valve	1.28 Gallons per Minute (GPM) maximum	$25
CI Domestic Hot Water Heaters	ENERGY STAR® (≥94% Et)	$4/MBH of rated input capacity
Low Pressure Steam Trap	PSIG < 15	$50
Medium Pressure Steam Trap	15 ≤ PSIG < 75	$150
High Pressure Steam Trap	75 ≤ PSIG	$250

viii) Roles and Responsibilities

There are no updates to roles and responsibilities.

ix) Marketing Strategy

PGW is implementing a CIER marketing plan similar to the RHER program that targets equipment manufacturers, distributors, retailers, architects, engineers, and installation contractors. PGW conducts regular outreach to a network of over 800 trade allies that perform energy efficiency upgrades in Philadelphia. Through a monthly newsletter, PGW updates these firms and individuals about grant and rebate opportunities available to their customers. PGW will continue to work closer with its trade allies and supply chain partners to encourage greater market up-take of CIER eligible equipment. As new, rebate-eligible, equipment enters the market through FY 2014- 2015, PGW will seek to establish new supply chain partnerships and outreach opportunities to promote the equipment.

Through its trade ally network, PGW also plans to continue identifying new opportunities for custom equipment rebates. Target equipment could range from infrared space heaters to Combined Heat and Power ("CHP") plants. PGW will use the custom equipment rebate option to identify new equipment that may be built into its prescriptive rebate program.

Despite this ongoing and increased outreach through trade allies, PGW has found some of the firms' customers still are not informed of the benefits of selecting high efficiency heating equipment. PGW has increased direct outreach to customers over the past fiscal year, and plans to continue increasing its direct outreach to customers. The successful C&I Projects RFA distribution and earned media campaign that was implemented in FY 2013 will be repeated in FY 2014 and will be continued in FY 2015. Although these efforts are expected to result in project leads, program data to date demonstrates that long project lifetimes will result in many projects not reaching completion until eight months or more after the marketing campaign is launched.

PGW will also improve its targeted marketing for CIER food service rebates by identifying customers most likely to be capable of purchasing the premium ENERGY STAR equipment. This targeted marketing effort will utilize direct outreach to chain restaurants, and premium restaurants with high volume. Other targeted C&I market tactics for engaging specific customers are addressed in the CIRI program section above.

In addition to issues regarding availability of food service equipment at regional supply housed as discussed above, this category of offerings is also impacted by the fact that most small restaurants in Philadelphia continue to value the low up-front cost of standard efficiency equipment over the premium ENERGY STAR equipment. Through the end of FY 2014 and into FY 2015, PGW will target large restaurant chains and restaurateurs deemed to have higher equipment budgets, and high sales volume that would benefit from the operational savings of ENERGY STAR equipment.

Developing additional relationships with supply houses and manufacturers has helped provide insight into targeted marketing opportunities for high efficiency food service equipment, including identifying new products that will enter the market and could increase high efficiency equipment uptake. These supply chain relationships have also resulted in new opportunities to conduct customer outreach. For the first time, PGW reported program performance back to the top-performing boiler manufacturers, in an effort to motivate greater sales through industry competition. In mid-FY 2014, PGW met with representatives of the top performing boiler manufacturers to identify opportunities to increase performance. In FY 2015, PGW plans to continue this coordination.

x) Coordination with other Programs

Program/Organization	Description of Coordination

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's program manager conducts CIER installation verifications and will continue to do so through FY 2014. Costs for the verifications are reflected at the portfolio level. PGW will begin conducting verifications for the FY 2014 program year during the late-Spring of 2014.

Data Collection
There are no updates to data collection for the CIER program.

Reporting
There are no updates to reporting for the CIER program.

Evaluation
In FY 2015, PGW will begin its evaluation of the CIER program. Consistent with the other Energy Sense program evaluations, the CIER evaluation will consist of a market study and an impact study. In FY 2013, PGW contracted with a vendor to conduct the evaluations for all EnergySense programs.

E. High Efficiency Construction Incentives Program

i) Program Description

The HECI program 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) Costs, Savings, and Benefits

At the end of February, HECI had received 63 applications, had 15 applications withdrawn or rejected, and has issued $32,330 in incentives. In February 2014, PGW was finalizing a new single family and small multi-family application to simplify participation in HECI, and increase cost-effectiveness of project reviews. When this new application launches in spring 2014 PGW anticipates an up-tick in incentive offers to be issued for projects currently in the application queue.

Table 31 - HECI Impacts from Inception to February 28, 2014[22]

	Actual Results (Inception to 2/28/2014)
PARTICIPATION	
Applications Received	63
Applications Withdrawn or Rejected	15
Incentives Issued	3
COSTS	
Customer Incentives	$ 32,330
Administration and Management	$ 0
Marketing and Business Development	$ 0
Contractor Costs	$ 92,158
Inspection and Verification	$ 2,600
Evaluation	$0
Utility Costs	$ 127,087
Participant Costs[23]	$23,999
Total	$ 151,087
SAVINGS	
Net Annual BBtu	.66
Net Lifetime BBtu	12.66
Net Annual MMBtu / Customer	220
Weighted Lifetime (years)	n/a

Program Costs

PGW spent slightly over $127,000 on HECI over this reporting period. Together, fixed costs for Administration and Management as well as additional Contractor Costs were higher than expected due to activities to develop the new application process. These costs are expected to be recouped through decreased variable costs associated with review of single family and small multi-family projects. Overall, non-incentive costs still remain below levels budgeted for in the FY 2014 Implementation Plan.

Program Cost-Effectiveness to Date

As of February 28, 2014, HECI has completed 3 project worth $32,330 in PGW incentives, achieving TRC Net Benefits of $42,000 (2009$) and a BCR of 1.9. Accounting for program costs brings the net benefits down to -$37,500 (2009$), a BCR of 0.70. As projects themselves have been cost-effective, PGW attributes the programmatic BCR to under-participation as compared to the administrative fixed costs

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

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

needed to implement the program. PGW has increased marketing efforts, as discussed elsewhere in this Implementation Plan, and has focused on stream-lining the HECI Residential application to encourage additional projects to complete the full process.

PGW believes the HECI program is integral within the overall DSM portfolio in providing additional energy-efficiency programming for commercial and industrial customers. PGW is continuing to develop a pipeline of new projects, which should provide incremental net benefits and pull the program cost-effectiveness up closer to and eventually beyond 1.0, as demonstrated by this plan's projected HECI BCR of 1.25 by the end of FY 2015. A potential Phase II extension of the program would allow for the inclusion of the typical longer-lead time projects that otherwise may miss the current program deadline, and allow for ongoing project pipeline development.

Despite the fact that the HECI program has not yet achieved cost-effectiveness on its own, PGW continues to believe that the program has significant potential to deliver savings to customers and is still committed to offering the program within the DSM portfolio.

Projections

The program aims to serve 50 single-family residential units, 12 multifamily buildings, and three (3) commercial new construction projects in FY 2014, with associated annualized gas savings of 3.7 BBtu, or 57.1 MMBtu/customer. The program is projected to cost approximately $300,000.

Table 32 - Projected HECI Impacts for FY 2015

	Projected (FY 2015)
PARTICIPATION	
Analyses/Audits	n/a
Customers with Installations	65
COSTS	
Measure Installation Costs	$214,389
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$23,148
Inspection and Verification	$10,255
On-site Technical Assessment	$-
Evaluation	$50,000
Utility Costs	**$297,791**
Participant Costs	$106,887
Total	**$404,678**
BENEFITS	
Net Annual BBtu	3.7
Net Lifetime BBtu	68.5
Net Annual MMBtu / Customer	57.1

Weighted Lifetime (years)	18.4

iii) Workflow

PGW has updated the HECI single family and small multi-family application workflow in order to make the program more cost-effective and customer friendly for small projects. Under the new workflow, PGW's technical assessment team will no longer require an energy model for single family and small multi-family buildings. All single-family construction applications will utilize the new application process, and small multi-family projects without energy models will have the option to use the new application.

iv) History, Ramp-Up Strategy and Milestones

Since launching the HECI program in the beginning of FY 2013, PGW has experienced slow program uptake, long project lead times, and volatility in program participation levels. PGW continues to apply data and lessons learned to date in identifying further program improvement opportunities, including a redesign of the HECI residential program protocols and application processes, which is detailed below. This update resulted in limited short-term project activity during the first half of FY 2014, however is expected to result in a much greater program performance over the remainder of FY 2014 and 2015.

Due to the complexity and long-planning process required for new construction projects, HECI projects were found to take eight months or more from initial engagement to project completion. As a result, business development activities conducted in FY 2013 and FY 2014 may not result in grant payments until late FY 2014 and into FY 2015. PGW will continue to see benefits of the prior marketing activities as customers proceed with projects under consideration for HECI incentives from prior PGW fiscal years. Unfortunately, these long-lead times for HECI projects may require setting a deadline on new applications and incentive pay-outs based on the termination of the current DSM Phase I approval period, unless a Phase II extension occurs.

Unlike CIER and CIRI, where program participants will directly reap the benefits of lower operating savings, HECI requires developers to make a higher investment in high efficiency equipment without a guarantee of future cash flow. Although sophisticated developers understand the return on investment and know how to build high efficiency properties, many others aren't certain of the price premium the properties will yield. Nor are they aware of the upgrades necessary to achieve cost-effective energy savings. Through the end of FY 2014, and in FY 2015, PGW will seek to further engage the developer community to showcase the financial benefit of participating in HECI.

Similar to the challenges encountered in CIRI, PGW has found that competing obligations have resulted in many builders refusing to take the time to participate in the EnergySense program due to the time required. Many of PGW's HECI applications have remained incomplete for months, as developers were unresponsive, due to the limited time they had to dedicate to understanding HECI and participating. Part of this hurdle to participation was attributed to the initial application of review protocols for residential projects, which required developers without an energy model for their building to provide a detailed list of building characteristics so PGW could create a model. PGW found that most developers did not have energy models, and when confronted with the data collection requirements of HECI, chose not to participate.

In response, PGW developed a new application in FY 2014 that made HECI even more prescriptive for residential and small multifamily customers. This redesigned application eliminates the need for conducting an energy model on each home. Customers are presented with two tracks, one for single-family residences and the other for small multi-family buildings with distributed heating systems. An Excel workbook application shows specific cost-effective upgrades that developers can consider when designing their projects. The efficiency conservation measures include above-code thermal envelope insulation, heating equipment, and domestic hot water heater and fixtures. The workbook calculates a projected grant, incremental cost, and energy savings based on the user inputs. This redesigned process will streamline the requirements to participate in HECI and reduce uncertainty regarding potential benefits.

Although multifamily and commercial customers who already have completed an energy model will be given the option to submit it for consideration, the new application will cater to the majority of HECI applicants and especially small businesses and independent developers. PGW expects this application to result in increased customer participation, a higher lead conversion rate for new projects, and reduced program administration costs as fewer projects will undergo an energy modeling review.

v) Target Market and Program Eligibility

There are no updates to program eligibility.

vi) 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. Through implementation of the new single family and small multi-family applications, PGW has identified several cost-effective measures that will be the center of recommended HECI projects. The measures included in the new applications include thermal envelope insulation, heating equipment, and water heating equipment and fixtures.

Larger commercial facilities and apartment buildings that do not qualify to use the new application will continue to proceed through the original application design requiring a customized full energy model for each building. 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, high-efficiency windows, etc.).

vii) Incentive Strategy

There are no updates to the HECI program incentive strategy.

viii) Roles and Responsibilities

There are no updates to roles and responsibilities

ix) Marketing Strategy

In the HECI program, unlike the CIER or CIRI programs, the property's end-user is often not the entity responsible for the project. As a result, PGW has experienced an even greater challenge in marketing the program because some developers may not be able to justify additional investment in high-efficiency measures even when incentives are available. 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. PGW will continue conducting outreach to these groups through relevant trade organizations.

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 the real-estate industry network, including realtors, appraisers and inspectors. This outreach is expected to forge deeper ties with real estate and developer industry organizations. PGW plans to further focus outreach activities on this market to identify additional projects and help PGW better gauge the end-user demand for high-efficiency homes and buildings.

PGW has also leveraged the data collected to better inform its marketing activities. PGW has increasingly educated developers about the benefits of EnergySense at the time they first engage PGW for service, whether it's for new service turn-ons, or to request an estimate to develop a project site with natural gas. When developers have made the choice to install natural gas, PGW has provided them with information about the benefits of high-efficiency equipment.

Finally, PGW's new EnergySense C&I Trade Ally Network will provide deeper engagement with trade allies and commercial lenders that may be active in new developments. The new directory will provide a platform for PGW to educate trade allies on the benefits of participating in HECI, and to refer customers to firms that are familiar with the PGW EnergySense programs.

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
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.
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

Post-construction verification inspections are performed on all commercial, industrial and multi-family properties, and 10 percent of all single-family residential properties that participate in HECI. The inspections will allow PGW to validate that the correct equipment was installed. PGW's technical assessment provider conducted three inspections during FY 2013 for projects completed that year and found that all projects met the incentive agreement requirements.

Data Collection

Under the new HECI single-family and small multi-family building application, developers are no longer required to provide equipment spec-sheets, or make and model information at the time of the application. PGW discontinued this practice when it found that many applicants did not have a specific equipment make and model selected at the time of the application. This caused delays in the application submissions and customer confusion. The new application only collects information about the equipment efficiencies. Details about equipment makes and models are collected through invoices or other documentation submitted at the end of the project, and used to confirm the equipment efficiencies.

Reporting
There are no updates to reporting for the HECI program.

Evaluation
In FY 2015, PGW will begin its evaluation of the HECI program. Consistent with the other EnergySense program evaluations, the HECI evaluation will consist of a market study and an impact study.

F. Comprehensive Residential Retrofit Incentives Program

i) Program Description

The CRRI program provides 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 percent in annual gas heating consumption among all participants.
- Promote better understanding of energy efficiency options available for the residential market.

CRRI provides incentives to single-family residential customers for implementing natural gas saving measures in their home, such as air sealing, insulation, and heating system replacements. Customers are eligible for a subsidized energy assessment and can earn rebates based on the deemed first-year MMBtu savings of their completed measures. PGW, through a third-party administrator, oversees a network of contractors approved to perform work under CRRI. The program builds on the lessons learned from implementing ELIRP, which promotes similar energy efficiency packages among PGW's low-income population through use of approved conservation service providers ("CSPs").

ii) Costs, Savings, and Benefits

As of February 28, 2014, 208 energy assessments have been performed and 59 energy efficiency projects have been completed totaling over $106,265 in incentives and achieving 43 BBtu in lifetime savings.

Table 33 – CRRI Impacts from Inception to February 28, 2014

	Actual Results (Inception to 2/28/2014)
PARTICIPATION	
Audits Performed	208
Projects Completed	59
COSTS	
Customer Incentives	$ 106,265
Administration and Management	$ 0
Marketing and Business Development	$ 0
Contractor Costs	$ 376,961
Inspection and Verification	$ 0
Evaluation	$0
Utility Costs	$ 483,227
Participant Costs[24]	$168,661
Total	$ 545,622
SAVINGS	
Net Annual BBtu	1.5
Net Lifetime BBtu	43.0
Net Annual MMBtu / Customer	26.2
Weighted Lifetime (years)	27.8

Completed projects to date have been lower than initial program projections, due to the extended soft-launch period transitioning into the program's FY 2014 hard-launch, as explained in the FY 2013 Annual Report. During the soft-launch period, the Home Rebates contractors began limited offerings of program. Initial participants were developed through word of mouth and targeted outreach effort, as a means of slowly market-testing the program design before launching larger mass-market lead generation campaigns. The hard-launch, beginning with the start of FY 2014, was supported with increased city-wide marketing and outreach activities.

Program participation has increased, but at a slower rate than initially projected. PGW has taken several steps in FY 2014 to increase program activity; further details on these developments are provided in the Marketing Strategy section below.

Program Costs

PGW spent slightly over $483,000 on CRRI over this reporting period. The difference between budgeted and actual costs is mainly due to slower than anticipated start-up.

Program Savings

[24] Cost of project and installation not covered by PGW rebate.

On average, CRRI projects are saving 26.2 MMBtus, an average of 25 percent savings per home.

Program Cost-Effectiveness to Date

As of February 28, 2014, CRRI has completed 59 projects worth $71,491 in PGW incentives, achieving TRC Net Benefits of $37,567 and a BCR of 1.15. However, taking into account program start-up costs, ongoing contractor costs, and costs for audits with no completed projects, net benefits drop to -$294,000, or a BCR of 0.44. Though PGW expects to continue to provide incentives for cost-effective projects, given the large fixed start-up costs and slower than anticipated ramp-up, PGW does not anticipate reaching positive net benefits since inception for another 18 months.

One metric that PGW watches closely to ensure that the program will eventually become cost-effective is the ratio of completed jobs to audits performed, also called the "conversion rate'. PGW initially anticipated a conversion rate of 35 percent for CRRI. Currently, CRRI has a conversion rate of 28 percent. This value has been steadily increasing over the past few months due to the lead time for projects often being over two months. Recent activity and trends are showing conversion rates reaching to 30 percent and beyond. PGW fully anticipates meeting a 35 percent conversion rate in its upcoming Fiscal Year 2015.

Initially, cost-effectiveness at the project level has not been required, for the sake of allowing increased customer choice in determining project scopes. The only limitation to CRRI projects has been to measures for which PGW can claim natural gas savings. While most projects have achieved cost-effectiveness, a few have not, often with significantly less net benefits due to expensive heating system retrofits. These few have a larger impact on overall program cost-effectiveness. PGW intends to maintain the current design of allowing customer discretion and contractor pricing, for the sake of lowering hurdles allowing both groups to participate in the program. Additionally, the CRRI program will incorporate a CSP evaluation model, similar to the existing ELIRP model, which will effectively encourage CSPs to improve overall project savings and cost-effectiveness. As with ELIRP, this model is expected to improve program performance over both the short- and long-term.

At the moment, the program's current BCR is more attributable to overall participation levels rather than individual project cost-effectiveness. As the majority of projects are cost effective and provide net benefits, PGW's current program goal is to increase total program participation at two points: Assessment Applications and Project Conversions. Initiatives for targeting both are addressed further in the Marketing Strategy section below.

As stated elsewhere, the CRRI program has not achieved cost-effectiveness, though PGW does expect to achieve TRC BCR over 1.0 within the next 18 months based on trending to date and future forecasts. However, this time-frame would mean that the program would end the current DSM Phase I approval period on August 31, 2015 with a BCR under 1.0, and a Phase II extension would be necessary to achieve program cost-effectiveness. If the DSM portfolio is extended, PGW believes CRRI should continue to be an essential component within it. Based on the program activity to date, issues identified, and solutions currently underway, the CRRI program would likely develop into one of the most effective DSM programs in terms of production scale and gas savings impact.

Projections

PGW aims to complete 652 Home Rebates projects in FY 2015, with associated annualized gas savings of 17.7 BBtu, or 27.1 MMBtu/customer. The program is projected to cost $1.4 million.

Over FY 2013 to FY 2015, the program is expected to provide lifetime net present benefits of -$1 million with a BCR of 0.78.

Table 34 - Projected CRRI Impacts for FY 2015

	Projected (FY 2015)
PARTICIPATION	
Analyses/Audits	n/a
Customers with Installations	652
COSTS	
Measure Installation Costs	$1,111,000
Administration and Management	$-
Marketing and Business Development	$-
Contractor Costs	$178,000
Inspection and Verification	$61,000
On-site Technical Assessment	$-
Evaluation	$50,000
Utility Costs	**$1,400,000**
Participant Costs	$2,226,823
Total	**$3,626,823**
BENEFITS	
Net Annual BBtu	17.7
Net Lifetime BBtu	453.7
Net Annual MMBtu / Customer	27.1
Weighted Lifetime (years)	25.7

iii) Workflow

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

- A customer enters CRRI either through CSP lead generation and enrollment or the program's central web intake application and customer hotline.

- 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 developed an audit subsidy model in which PGW, the CSP, and the customer 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.

iv) History, Ramp-Up Strategy and Milestones

The following qualitative CRRI developments have occurred as of February 28, 2014:

- Issued an RFP for a Program Administrator.
- Issued an RFP for CSPs.
- Selected a Program Administrator.
- Finalized a financing referral relationship with the Keystone HELP program.
- Selected and trained five initial participating CSPs.
- Began the program soft-launch with limited outreach.
- Began the program hard-launch accompanied by a mass marketing campaign.
- Issued an RFP to select an additional one to three participating CSPs, selections are expected by May, 2014.

The next major program milestone will be the CRRI Impact Evaluation, which is expected to begin in early FY 2016, based upon FY 2014 activities and actual gas savings.

v) 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 program, including those who previously participated for single-measure projects, or did not follow through on applications.

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 single-family residential customers that are pursuing these targeted project types and are paying the Energy-Efficiency surcharge are eligible for participation.

vi) Target End-use Measures

There are no updates to CRRI targeted end-use measures.

vii) 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

CRRI CSPs are required to conduct comprehensive Energy Assessments, using PGW provided tools, to identify all cost-effective energy efficiency opportunities as well as any necessary health/safety measures.

PGW's goal in development the assessment fee model was to obtain a consistent and affordable cost for all participating customers. This cost structure was to result in a modest fee, discounted from the average market cost of approximately $450, 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"). PGW has targeted a flat customer fee of $150 for all energy assessments, regardless of CSP, in order to clearly communicate the program to consumers and to drive intake and participation.

In order to achieve that $150 level, PGW developed a model requiring the participating CSPs to provide subsidized, flat assessment rates through the RFP-selection and contracting processes. PGW then further subsidized assessment by a fixed amount per completed audit, which PGW views as a necessary program marketing cost in lowering the barrier to entry.

<u>Incentives</u>

CRRI incentives are designed to accomplish several goals:

1. Encourage both homeowners and contractors to seek the greatest savings possible;
2. Protect program cost-effectiveness and budgets, while also providing a clearly communicated and comprehensible incentive design methodology;
3. Appropriately align with RHER program rebates amounts, to avoid adversely incentivizing customers away from comprehensive projects.

PGW has developed an Excel-based energy assessment tool for CSPs use in the home. This tool incorporates PGW's TRM energy-savings formulas, CSPs costs, and outputs of project energy savings and cost-effectiveness. The outputs can be exported to a PDF and printed on-site for the customer or emailed. The report provides savings estimates for the measures, project cash-flows incorporating financing and rebates, and also health and safety information. The tools outputs can also be automatically uploaded into the CRRI program database to allow streamlined approval and reporting processes.

After the assessment is performed and recommended work scope is provided, CSPs will return to install measures as selected by the customer, which may include: air sealing, insulation, duct sealing, heater and water heater repairs and replacements, low-flow devices and other energy saving improvements.

The rebate design for these customized work-scopes is as follows:

- **Customers** will qualify for a rebate of $40 per first year MMBtu saved as calculated within the PGW Contractor Tool.
    - <u>Estimated Customer Incentives</u> are calculated during the initial assessment, based on the CSPs recommended work scope. This allows a

greater level of customer certainty in determining whether to proceed with their project.

- Actual Customer Incentives are calculated based upon:
  - The final installed work scope for all measures other than air sealing (CFM-50) and duct sealing (CFM-25) results;
  - ***Assessment test-in*** savings estimates for air sealing and duct sealing measures, so long as final test-out readings are within 25 percent of initial estimated test-out readings;
  - **Final test-out** readings for air sealing and duct sealing measures if such readings are either 25 percent greater or less than initial assessment's estimated test-in readings. In these cases, the CSP must explain to the customer that the project scope changed significantly, resulting in a revised Customer Incentive level.

- CSPs are eligible for rebates of $10 per first year MMBtu saved, as calculated within the PGW Contractor Tool, for completed comprehensive projects only if completed conservation measures result in a 15 percent natural gas usage reduction.

- For projects including the installation of new high-efficiency heaters (94 percent AFUE or greater), PGW's rebate amounts are consistent with the RHER program for ease of customer communication and to properly align incentive offers through a single streamlined process.

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.

viii) Roles and Responsibilities

PGW
PGW oversees and coordinates program activity with the Program Administrator and other partners. PGW provides approved CSPs with the Contractor cost-effectiveness tool. PGW will also assist with marketing the program, as well as paying incentives.

Program Administrator
The Program Administrator is responsible for contractor oversight, including training, mentoring, reporting, and inspections; rebate processing; and programmatic communications and marketing activities.

Certified CSPs
Certified CSPs are responsible for selling projects, performing audits, and installing measures. Approved CRRI contractors are required to have BPI Energy Analyst

certification for those developing and selling work scopes, and Retrofit Installer certification for those supervising crews' installations.

Evaluator
PGW has selected a third-party program evaluator to conduct an impact evaluation of all CRRI program activities

ix) Marketing Strategy

As initially designed, the CRRI program was intended to provide CSPs with PGW rebates as a resource in further assisting their existing sales activities. PGW CRRI program general marketing had always been planned, but was anticipated to provide market awareness and would act in tandem with the CSP ground-level lead generation.

During the program's soft-launch period, PGW and the Program Administrator identified that further programmatic marketing would be required. The general marketing campaign already underway, involving mass market TV, radio, billboard, print, and online ads, was expanded. In addition, PGW and the Program Administrator began implementing a grass-roots outreach plan to bolster the CSPs lead generation. These initiatives included direct outreach end-users through community organizations, businesses on key commercial corridors, EnergySense at Work presentations, and neighborhood sweeps with "Home Performance Technicians" to discuss the value of the program and attempt to schedule energy assessments.

PGW has seen an uptick in program activity due to the new marketing activities beginning in January, 2014, as average number of audits completed per month has increased from 16 to 20. While increasing program leads in the short-term, these grass-roots activities have been designed and implemented to include the CSPs and instill the experiential knowledge into their businesses. The hope is to eventually transfer these activities entirely to the CSPs and revert to a limited PGW marketing footprint, as initially envisioned.

PGW has also re-posted the CRRI CSP RFP as an additional response to initial program participation. Initial plans had involved re-posting the RFP at a later date to grow the program's network of participating contractors. However, the timeline for the re-posting was moved forward in FY 2014 in order to more immediately incorporate the increased lead-generation activities and increased project capacity that the additional CSPs should provide. PGW expects to have the new round of CSPs selected and trained by summer, 2014.

The above activities are expected to assist in providing additional program intake to the point of assessment applications. However, the assessment is only the first step towards a completed project. As part of a comprehensive approach to increasing program participation, PGW is also examining and addressing the project conversion rate between assessments performed and projects completed.

As of February 28, 2014, the CRRI program conversion rate was 28 percent, as compared to PGW's initial forecasted 35 percent rate. The conversion rate has climbed steadily since inception and is anticipated to continue to reach towards the anticipated rate of 35 percent. Conversion rates are a difficult metric in that customers typically wait several weeks or months after an audit before proceeding with work. This rate is always delayed and in flux, and newly launched programs like CRRI only exacerbate those issues. PGW will both monitor and consider useful revisions to this metric going forward.

Regardless, there appears to be opportunity for improving the conversion rate. Marketing and training have served to assist CSPs to better close leads, qualify leads and maintain useful customer data. PGW is planning future efforts to help convert projects, including follow-up emails and surveys to customers who receive audits but have yet to proceed with improvements. PGW will also be performing analysis on the estimated number of days projects remain open so that it can determine a fair conversion rate.

Additionally, homes that receive Energy Assessments but do not proceed with comprehensive measures are obviously missed savings opportunities. However, even these homes typically have some amount of energy savings work performed, which PGW is currently not capturing in savings analyses nor in the customer rebate calculations. In the remainder of FY 2014, PGW plans to incorporate a Direct Install component into the CRRI program to capture and reward savings for these assessment measures, such as recalibrations and installations, water heater turn-downs, and low-flow water devices. PGW views this additional Direct Install component as a means of increasing program savings and hopefully encouraging increased customers to proceed with comprehensive jobs through the additional education and rebate value provided.

In FI 2015, PGW will also evaluate data to determine if it is feasible to incorporate additional prescriptive measures into the Direct Install components, such as pipe wrapping, and HVAC service-type improvements like boiler tune-ups.

x) Coordination with other Programs

Program/Organization	Description of Coordination

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	The ARRA-funded EnergyWorks program ended in fall, 2013. Remaining funding had been committed to the Keystone HELP program, allowing the latter to continue providing subsidized low-interest residential loans. PGW's ongoing partnership with Keystone HELP will continue to provide PGW CRRI customers with attractive financing terms for residential energy efficiency projects (including CRRI projects), at least over the duration of their remaining subsidized financing program. PGW and Keystone HELP have developed co-branded marketing materials to advertise the benefits of both programs in conjunction. In cross-matching customers with Keystone HELP's database, PGW can confirm at least 30 percent of Home Rebates have received financing through Keystone HELP. CSPs have stated that in their experience closer to 75 percent of their customers seek financing and that it is a major asset to program. PGW will improve reporting protocols with Keystone HELP. Keystone HELP also performs inspections and verifications in a number of their customers' homes. PGW has identified opportunities for coordination in homes that are in both programs and scheduled for inspections.

Program/Organization	Description of Coordination
PA CareerLink Philadelphia	PGW has partnered with Philadelphia Works Inc. 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. To date, PGW has not evaluated on this metric since the first few months of the program CSPs were more strategic in staffing decisions by shifting employees from other programs and assessing the project load before hiring staff. However, at minimum, all future opportunities will be posted on Careerlink and contractors will be encouraged to hire new entry-level workers through Careerlink until targets are met.
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.
Housing Revitalization programs	PGW is exploring targeted partnerships with organizations focused on housing revitalization that may want to take advantage of EnergySense rebates when rehabbing homes. PGW will continue attempting to identify further opportunities to partner with existing agencies and organizations to leverage additional resources and increase overall synergies.

xi) Evaluation, Monitoring, and Verification

<u>Quality Assurance</u>

PGW and the CRRI program administrator have implemented a rigorous QA/QC process in order to ensure the highest quality CSP performance, customer service, and continuous improvement. All CRRI customers are required to utilize the PGW selected and trained participating CSPs, for both initial assessments and measure installations, in order to be eligible for the program's rebates. All CSPs were thoroughly vetted as part of the RFP selection process and are held to strict certification standards. After selection, a training session was held to introduce CSPs to the program protocols and requirements.

An extended field shadowing and inspections process occurred with each CSP before they became fully approved to begin implementing the program. Three of the first five energy assessments by each CSP were shadowed by the program administrator and two of the first three projects completed were inspected to validate the scope and quality of the CSPs' work. Additionally, regardless of whether the CSP has already been approved, all field staff must individually participate in a supervised field audit to confirm their participation in the program. These individual supervised audits evaluate personnel for both technical understanding of BPI protocols and building science best practices, along with customer service skills.

Even after CSPs and their staff have been approved, ongoing QA/QC protocols continue. All assessment reports are first submitted to the program administrator and approved before can work can begin. Random inspections are then performed on a minimum of 5 percent of all completed CRRI projects. Targeted mentoring and increased oversight is directed when necessitated by specific CSP performance issues.

PGW has created four CSP categories to ensure CSPs maintain high standards of quality:

1. Provisional – Initial status. CSP is subject to advanced oversight and QA on two of initial three projects.

2. Full – CSP completes training requirements and demonstrates satisfactory performance.

3. Probationary – CSP is found to have breached ethical standards or fails two consecutive QA inspections. A written action plan must be submitted. PGW increases number of QA reviews.

4. Suspended – CSP fails to fulfill probationary terms. Already started projects may be completed, but program benefits (incentives, new leads, etc.) are discontinued.

Data Collection
The Program Administrator maintains a database of program activity related to each step of the process in CRRI, including initial leads, assessment data, loan information, completed project scope, and inspections reports. These data are collected and monitored for the sake of program performance reporting and to better inform future marketing strategies.

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 DSM Portfolio, a third-party contractor will perform in-depth evaluations every two years. The first evaluation for the CRRI is scheduled for FY 2016 on FY 2014 activities.

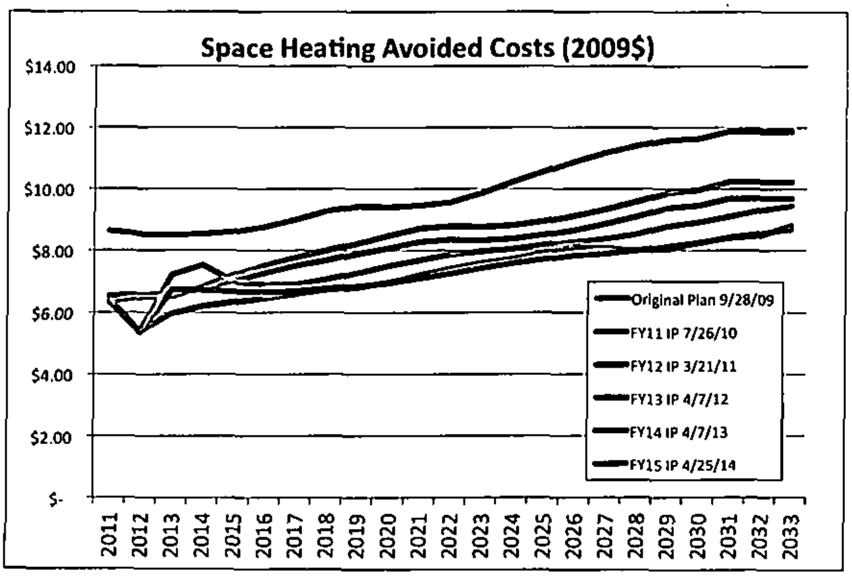
Appendix A – Avoided Gas Costs Over Time

III.Appendices

A. PGW Avoided Gas Costs Over Time

Comparison of Space Heating Avoided Costs (2009$)

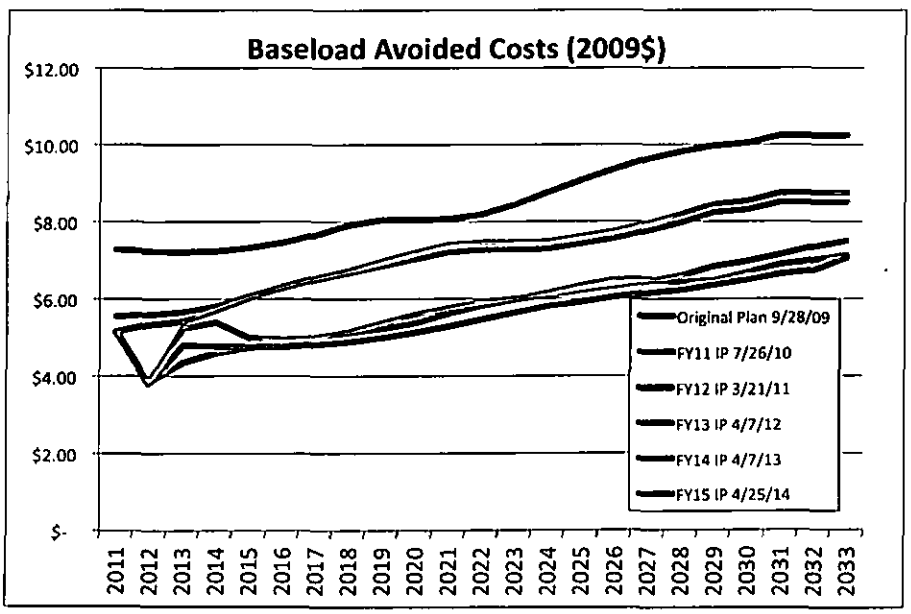
Year	*Original* Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12	FY14 IP 4/7/13	FY15 IP 4/25/14
2011	$8.63	$6.54	$6.35	$6.35	$6.35	$6.35
2012	$8.55	$6.57	$6.48	$5.40	$5.40	$5.40
2013	$8.51	$6.59	$6.51	$5.97	$6.75	$7.24
2014	$8.54	$6.77	$6.84	$6.22	$6.73	$7.54
2015	$8.62	$7.04	$7.21	$6.34	$6.67	$7.00
2016	$8.77	$7.30	$7.51	$6.46	$6.67	$6.90
2017	$9.00	$7.52	$7.76	$6.60	$6.70	$6.91
2018	$9.29	$7.70	$8.00	$6.72	$6.76	$7.08
2019	$9.44	$7.90	$8.25	$6.81	$6.85	$7.29
2020	$9.43	$8.09	$8.50	$6.97	$6.96	$7.51
2021	$9.46	$8.27	$8.71	$7.22	$7.11	$7.70
2022	$9.57	$8.36	$8.80	$7.42	$7.27	$7.87
2023	$9.88	$8.34	$8.78	$7.59	$7.44	$7.97
2024	$10.24	$8.38	$8.82	$7.73	$7.61	$8.06
2025	$10.58	$8.51	$8.96	$7.94	$7.71	$8.18
2026	$10.91	$8.66	$9.12	$8.10	$7.85	$8.29
2027	$11.19	$8.87	$9.34	$8.08	$7.92	$8.38
2028	$11.41	$9.12	$9.60	$8.00	$8.01	$8.55
2029	$11.59	$9.38	$9.88	$8.04	$8.13	$8.80
2030	$11.65	$9.48	$9.98	$8.23	$8.26	$8.92
2031	$11.87	$9.69	$10.24	$8.45	$8.41	$9.10
2032	$11.87	$9.69	$10.24	$8.57	$8.50	$9.32
2033	$11.87	$9.69	$10.24	$8.70	$8.83	$9.46



Appendix A – Avoided Gas Costs Over Time

Comparison of Baseload Avoided Costs (2009$)

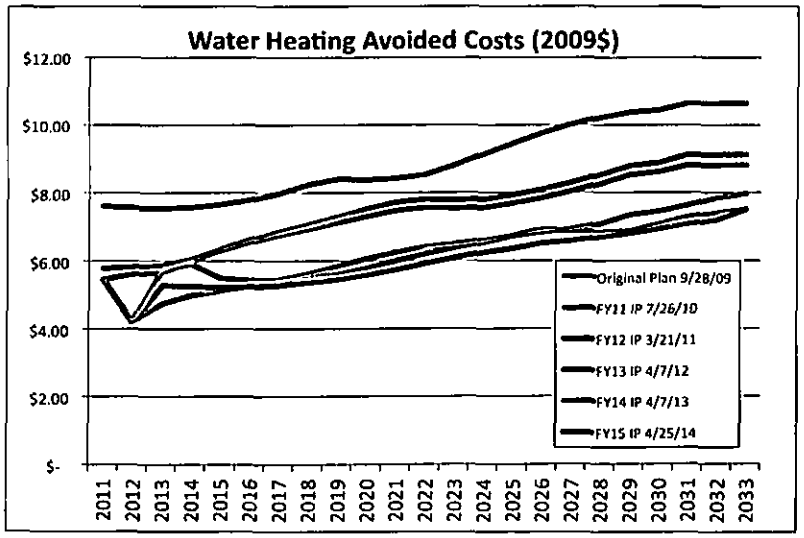
Year	Original Plan 9/28/09	FY11 IP 7/26/10	FY12 IP 3/21/11	FY13 IP 4/7/12	FY14 IP 4/7/13	FY14 IP 4/25/14
2011	$7.28	$5.54	$5.15	$5.15	$5.15	$5.15
2012	$7.24	$5.59	$5.32	$3.82	$3.82	$3.82
2013	$7.21	$5.64	$5.40	$4.36	$4.80	$5.23
2014	$7.24	$5.82	$5.70	$4.59	$4.78	$5.38
2015	$7.32	$6.07	$6.04	$4.73	$4.74	$5.00
2016	$7.45	$6.30	$6.30	$4.85	$4.76	$4.94
2017	$7.65	$6.51	$6.53	$4.99	$4.81	$4.97
2018	$7.91	$6.68	$6.74	$5.12	$4.89	$5.14
2019	$8.05	$6.86	$6.97	$5.21	$5.00	$5.36
2020	$8.04	$7.04	$7.19	$5.38	$5.13	$5.58
2021	$8.07	$7.21	$7.38	$5.61	$5.29	$5.76
2022	$8.17	$7.29	$7.46	$5.81	$5.45	$5.92
2023	$8.45	$7.27	$7.44	$5.99	$5.63	$6.01
2024	$8.78	$7.30	$7.48	$6.13	$5.80	$6.10
2025	$9.08	$7.43	$7.61	$6.33	$5.92	$6.23
2026	$9.37	$7.57	$7.75	$6.50	$6.06	$6.34
2027	$9.63	$7.76	$7.95	$6.49	$6.13	$6.44
2028	$9.82	$7.99	$8.18	$6.42	$6.24	$6.60
2029	$9.99	$8.23	$8.43	$6.47	$6.36	$6.85
2030	$10.04	$8.32	$8.52	$6.66	$6.49	$6.97
2031	$10.24	$8.52	$8.76	$6.88	$6.64	$7.14
2032	$10.24	$8.52	$8.76	$7.00	$6.74	$7.36
2033	$10.24	$8.52	$8.76	$7.13	$7.06	$7.49



Appendix A – Avoided Gas Costs Over Time

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 4/7/13	FY14 IP 4/25/14
2011	$7.62	$5.79	$5.45	$5.45	$5.45	$5.45
2012	$7.57	$5.83	$5.61	$4.21	$4.21	$4.21
2013	$7.54	$5.88	$5.68	$4.76	$5.29	$5.74
2014	$7.57	$6.06	$5.98	$5.00	$5.26	$5.92
2015	$7.65	$6.31	$6.33	$5.13	$5.23	$5.50
2016	$7.78	$6.55	$6.61	$5.26	$5.24	$5.43
2017	$7.99	$6.76	$6.84	$5.39	$5.28	$5.45
2018	$8.26	$6.94	$7.05	$5.52	$5.36	$5.62
2019	$8.40	$7.12	$7.29	$5.61	$5.46	$5.85
2020	$8.39	$7.30	$7.52	$5.78	$5.59	$6.06
2021	$8.42	$7.48	$7.72	$6.02	$5.74	$6.24
2022	$8.52	$7.55	$7.80	$6.21	$5.91	$6.40
2023	$8.81	$7.54	$7.78	$6.39	$6.08	$6.50
2024	$9.14	$7.57	$7.82	$6.53	$6.25	$6.59
2025	$9.45	$7.70	$7.95	$6.74	$6.36	$6.72
2026	$9.76	$7.84	$8.09	$6.90	$6.50	$6.83
2027	$10.02	$8.04	$8.30	$6.88	$6.58	$6.92
2028	$10.22	$8.27	$8.54	$6.82	$6.68	$7.09
2029	$10.39	$8.52	$8.80	$6.86	$6.80	$7.34
2030	$10.44	$8.61	$8.89	$7.05	$6.93	$7.46
2031	$10.65	$8.81	$9.13	$7.27	$7.08	$7.63
2032	$10.65	$8.81	$9.13	$7.40	$7.18	$7.85
2033	$10.65	$8.81	$9.13	$7.52	$7.50	$7.99



B. Additional Avoided Costs for PGW

Paul Chernick
Resource Insight, Inc.
April 11, 2013, updated April 25, 2014

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.[25] Most of these studies used EIA's National Energy Modeling System (NEMS), which is also used in the Annual Energy Outlook.[26] 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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[25] 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.

[26] 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

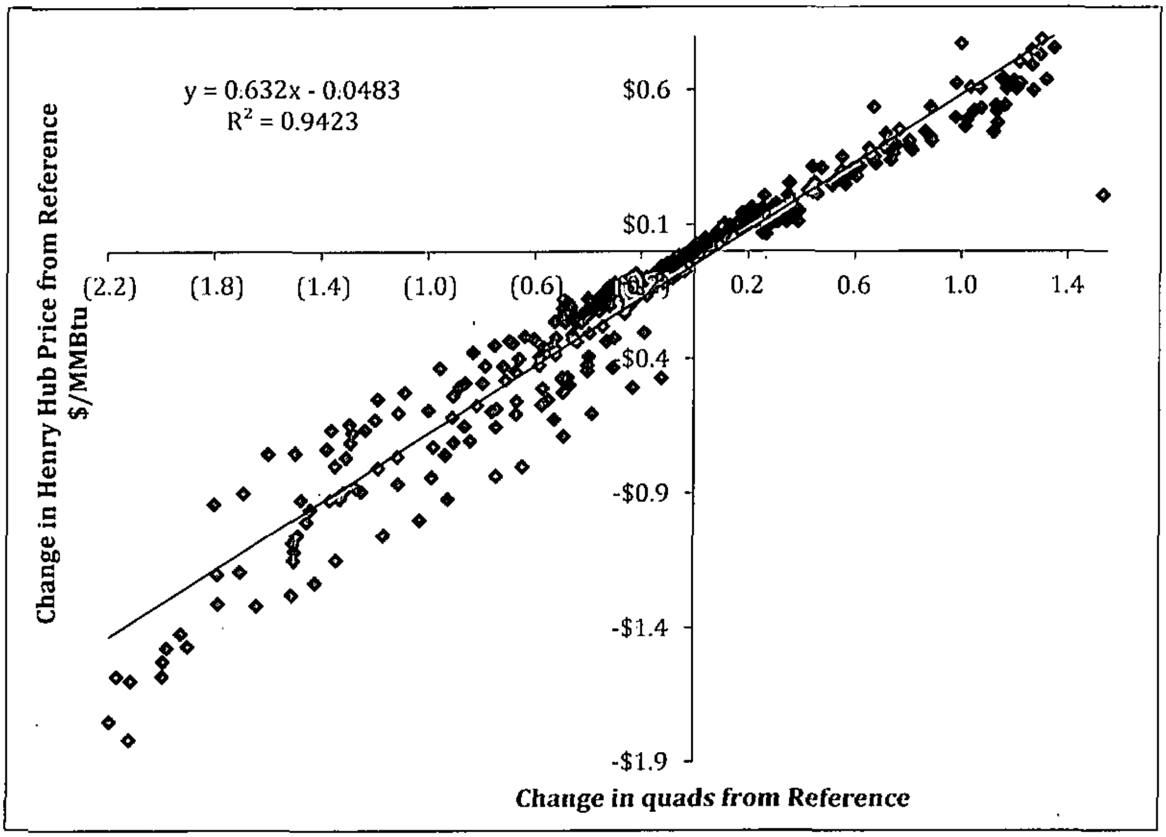
The structure of natural gas supply has changed considerably since 2007, with the growing importance of shale gas and the transition from forecasts of large LNG imports to forecasts of significant LNG exports. As a result, we have not used these older analyses to estimate gas-supply DRIPE. Instead, we 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

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

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.[27] 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

[27] 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.[28] 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.[29] The solid markers identify the data for November through March for each of the indicated winters.

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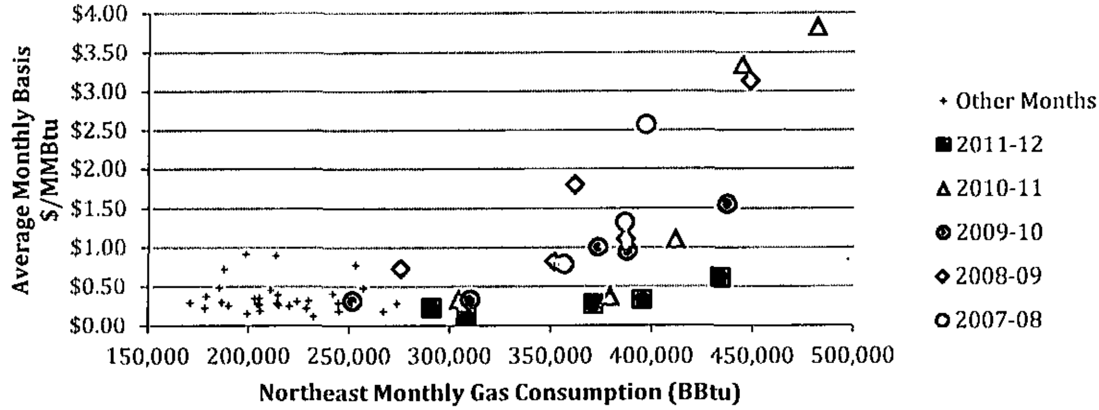
[28] Data from http://www.monitoringanalytics.com/data/marginal_fuel.shtml.

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

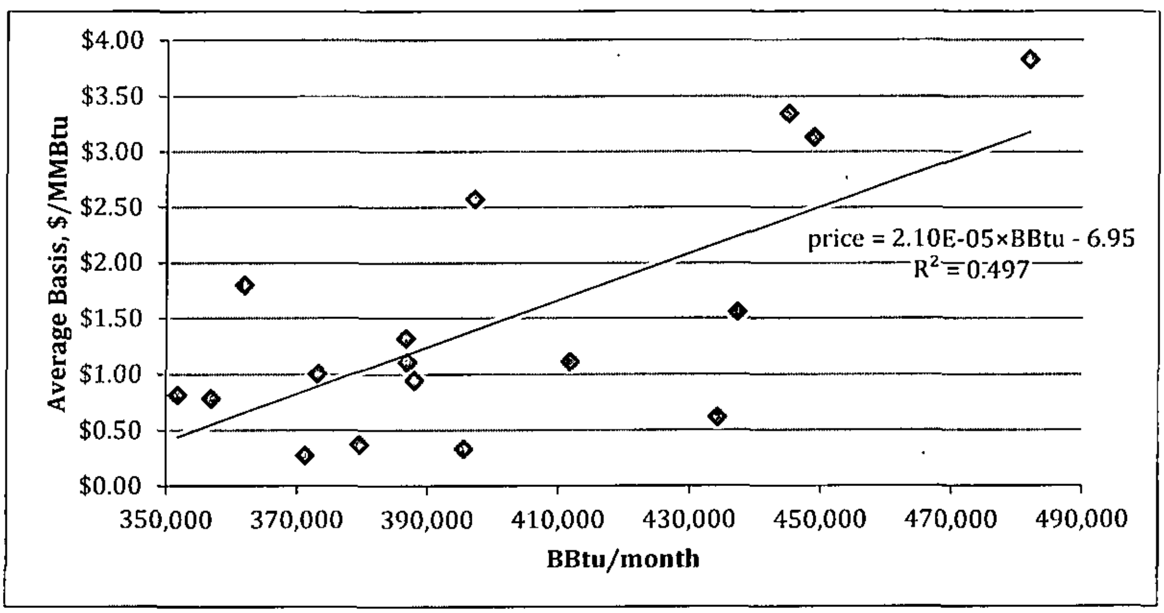
Basis has mostly been under $0.50/MMBtu (reflecting pipeline commodity and fuel charges) for consumption under 350,000 BBtu/month. The four non-winter months with basis over $0.50/MMBtu were April–July 2008, when gas prices were in the range of $12–$13/MMBtu, which would have substantially increased 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).

Environmental Costs

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	$15.00	$0.92
2021	$17.25	$1.06
2022	$19.50	$1.20
2023	$21.75	$1.34
2024	$24.00	$1.47
2025	$26.25	$1.61
2026	$28.50	$1.75
2027	$30.75	$1.89
2028	$33.00	$2.03
2029	$35.25	$2.16
2030	$37.50	$2.30
2031	$39.75	$2.44
2032	$42.00	$2.58
2033	$44.25	$2.72
2034	$46.50	$2.85
2035	$48.75	$2.99
2036	$51.00	$3.13
2037	$53.25	$3.27
2038	$55.50	$3.41
2039	$57.75	$3.54
2040	$60.00	$3.68

Sources:

"2013 Carbon Dioxide Price Forecast," P. Luckow, E. Stanton, B. Biewald, J. Fisher, F. Ackerman, and E. Hausman, Synapse Energy Economics, 11/1/2013, Table 1

118 lb CO_2/MMBtu

Social Cost of Carbon

The Synapse forecast is a projection of the costs of carbon that are likely to be incorporated in market costs for fuels. It is not an estimate of the total cost to society of carbon emissions. The Federal government has developed estimates of the cost social cost of carbon (SCC).[30]

The Interagency Working Group found that "the average SCC from three integrated assessment models (IAMs), at [real] discount rates of 2.5, 3, and 5 percent," with a 95th percentile estimate at a 3% rate, would be as shown in Table B-4.

Table 35: Federal Estimates of the Social Cost of Carbon (2007$/T)

Discount Rate	5.0%	3.0%	2.5%	3.0%
Damage Estimate	**Avg**	**Avg**	**Avg**	**95th**
Year				
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

Table B-5 compares the average results with a 3% discount rate to the Synapse expected market price.

30 Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866; Interagency Working Group on Social Cost of Carbon, United States Government, May 2013.

Table B-5. Mid-Range Cost of Carbon

	Federal Mid Case Damages 2007$/T		Synapse Mid Case Market Price 2014$/MMBtu
2015	$38.00	$2.61	
2016	$39.00	$2.68	
2017	$40.00	$2.74	
2018	$41.00	$2.81	
2019	$42.00	$2.88	
2020	$43.00	$2.95	$0.92
2021	$44.00	$3.02	$1.06
2022	$45.00	$3.09	$1.20
2023	$46.00	$3.16	$1.34
2024	$47.00	$3.22	$1.47
2025	$48.00	$3.29	$1.61
2026	$48.80	$3.35	$1.75
2027	$49.60	$3.40	$1.89
2028	$50.40	$3.46	$2.03
2029	$51.20	$3.51	$2.16
2030	$52.00	$3.57	$2.30
2031	$53.00	$3.64	$2.44
2032	$54.00	$3.70	$2.58
2033	$55.00	$3.77	$2.72
2034	$56.00	$3.84	$2.85
2035	$57.00	$3.91	$2.99
2036	$58.00	$3.98	$3.13
2037	$59.00	$4.05	$3.27
2038	$60.00	$4.12	$3.41
2039	$61.00	$4.18	$3.54
2040	$62.00	$4.25	$3.68

Damage Costs from Precursors to Particulate Matter

While CO_2 is the major air pollutant emitted by end-use gas combustion, burning fossil fuels to produce electricity produces additional pollutants, including SO_2 and NOx, both of which have adverse effects on health, welfare, visibility and ecosystems.[31] One major effect of the particular pollutants is the damage to human respiratory systems when the gaseous pollutants convert to fine particles in the atmosphere. For the Philadelphia-New York area, EPA estimates the health-

[31] Depending on the type of generation, it may also emit significant quantities of particulates and toxic metals, and also have multiple effects on water quality and aquatic organisms.

related damages of particulate matter resulting from releases of SO_2 and NOx by electric generators at the levels in Table B-6.[32]

Table B-6. Health Damages of SO_2 and NOx (2006$/Ton)

	SO_2	NOx
2015	85,000	1,700
2020	80,000	1,700
2030	110,000	2,500

These estimates of damage costs do not include any costs for acid deposition, smog, pollution of waterways, or any other effects of these pollutants.

Avoided Environmental Costs of Saved Electricity

The emissions avoided by reducing electric use depend on the nature of the marginal units and their emission rates, which depends on their fuel, efficiency, design (for NOx) and controls. Table B-7 shows the mix of marginal units in the PJM real-time market, from Table 3-6 of the 2013 State of the Market Report for PJM (Monitoring Analytics, March 13, 2014).

Table B-7. Fuel Used by Marginal Units in PJM (2012 and 2013)

Fuel Type	2012	2013
Coal	58.84%	57.75%
Gas	30.35%	32.39%
Oil	6.00%	4.79%
Other	4.81%	5.07%

Using data on actual emission in 2007 through 2009, Zivin, et. al., estimated the marginal emissions by time of day for each NERC region.[33] Table B-8 presents the simple average marginal emission rate for each pollutant in the ReliabilityFirst (RFC) region, which roughly corresponds to PJM and closely connected portions of MISO.

Table B-8. Marginal Emission Rates in RFC, from Zivin et. al.

	CO_2	SO_2	Nox
lb/MWh	1,285	5.89	1.53

The Regional Greenhouse Gas Initiative (RGGI) estimated the emission rates of fossil-fueled imports from non-RGGI areas (including Pennsylvania) to the PJM portion of

[32] Fann, N., C.M. Fulcher, B.J. Hubbell. 2009. The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution. Air Qual Atmos Health 2:169–176. Updated at http://www.epa.gov/airquality/benmap/bpt.html.

[33] Joshua Graff Zivin, Matthew J. Kotchen and Erin T. Mansur, Spatial and Temporal Heterogeneity of Marginal Emissions: Implications for Electric Cars and Other Electricity-Shifting Policies, June 7, 2013.

RGGI at about 2,000 lb/MWh in 2008 and 2009.[34] Using a historical dispatch model, Resource Systems Group estimated marginal CO_2 emission in Eastern PHM of 1,888 lb/MWh.[35] Those estimates are all for recent conditions. Over time, the marginal SO_2 and NOx (and to some extent the marginal CO_2) emissions are likely to decline as older units are retired, emission controls are added, coal and oil units are converted to burn gas, and rising gas prices result in coal being dispatched lower to the loading order and gas being on the margin more often. On the other hand, additions of renewables may push more coal onto the margin. Synapse Energy Economics estimated the emissions avoided in 2026 by an incremental of wind energy in PJM, as shown in Table B-9.[36]

Table B-9 Synapse Estimate of 2026 Emissions Avoided by More PJM Wind

	CO_2	SO_2	NOx
lb/MWh	904	0.27	0.18

Table B-10 combines the emission rates and values above, interpolating from 2008 values equal to the SO_2 and NOx emissions estimated by Zivin, et al, and 1,600 lb CO_2 per MWh (splitting the difference between Zivin and RSG), to the values estimated by Synapse for 2026.

[34] CO2 Emissions from Electricity Generation and Imports in the 10-State Regional Greenhouse Gas Initiative: 2009 Monitoring Report, RGGI, September 14, 2011, Table 7.

[35] Jeff King and Colin High, EPA Webinar on Quantifying Emission Impacts of Clean Energy Initiatives, Using a Time-Matched *Hourly Marginal Emissions Tool in Metropolitan Washington*, June 14, 2011.

[36] Bob Fagan, Patrick Luckow, David White, Rachel Wilson, "Net Benefits of Increased Wind Power in PJM: Final Report," May 9, 2013, Tables 2 and A.1.

Table B-10. Summary of Avoided Emissions Values for Electricity

	2014$/Ton			Avoided Emissions lb/MWh			2014$/MWh			
	CO_2	SO_2	NOx	CO_2	SO_2	NOx	CO_2	SO_2	NOx	Total
2015	38	99,620	1,992	1,542	1.96	0.58	29.3	97.4	0.6	127.3
2016	39	98,448	1,992	1,484	1.39	0.45	28.9	68.6	0.4	98.0
2017	40	97,276	1,992	1,426	0.83	0.31	28.5	40.5	0.3	69.3
2018	41	96,104	1,992	1,368	0.27	0.18	28.0	13.0	0.2	41.2
2019	42	94,932	1,992	1,310	0.27	0.18	27.5	12.8	0.2	40.5
2020	43	93,760	1,992	1,252	0.27	0.18	26.9	12.7	0.2	39.8
2021	44	97,276	2,086	1,194	0.27	0.18	26.3	13.1	0.2	39.6
2022	45	100,792	2,180	1,136	0.27	0.18	25.6	13.6	0.2	39.4
2023	46	104,308	2,274	1,078	0.27	0.18	24.8	14.1	0.2	39.1
2024	47	107,824	2,367	1,020	0.27	0.18	24.0	14.6	0.2	38.7
2025	48	111,340	2,461	962	0.27	0.18	23.1	15.0	0.2	38.3
2026	48.8	114,856	2,555	904	0.27	0.18	22.1	15.5	0.2	37.8
2027	49.6	118,372	2,649	904	0.27	0.18	22.4	16.0	0.2	38.6
2028	50.4	121,888	2,742	904	0.27	0.18	22.8	16.5	0.2	39.5
2029	51.2	125,404	2,836	904	0.27	0.18	23.2	16.9	0.3	40.3
2030	52	128,920	2,930	904	0.27	0.18	23.5	17.4	0.3	41.2
2031	53	132,436	3,024	904	0.27	0.18	24.0	17.9	0.3	42.1
2032	54	135,952	3,118	904	0.27	0.18	24.4	18.4	0.3	43.0
2033	55	139,468	3,211	904	0.27	0.18	24.9	18.8	0.3	44.0
2034	56	142,984	3,305	904	0.27	0.18	25.3	19.3	0.3	44.9
2035	57	146,500	3,399	904	0.27	0.18	25.8	19.8	0.3	45.9
2036	58	150,016	3,493	904	0.27	0.18	26.2	20.3	0.3	46.8
2037	59	153,532	3,586	904	0.27	0.18	26.7	20.7	0.3	47.7
2038	60	157,048	3,680	904	0.27	0.18	27.1	21.2	0.3	48.7
2039	61	160,564	3,774	904	0.27	0.18	27.6	21.7	0.3	49.6
2040	62	164,080	3,868	904	0.27	0.18	28.0	22.1	0.3	50.5

Table B-11 combines the marginal carbon emission rates from Table B-10 with the Synapse 2013 carbon allowance price from Table B-3, to estimate the costs of carbon emissions that are likely to be reflected in market prices for electricity after 2019.

Table B-11. Avoided Carbon Allowances, $/MWh

	2012$/ton CO_2	lb CO_2/MWh	2014$/MWh
2020	$15.00	1,252	$9.7
2021	$17.25	1,194	$10.6
2022	$19.50	1,136	$11.4
2023	$21.75	1,078	$12.1
2024	$24.00	1,020	$12.6
2025	$26.25	962	$13.0
2026	$28.50	904	$13.3
2027	$30.75	904	$14.3
2028	$33.00	904	$15.4
2029	$35.25	904	$16.4
2030	$37.50	904	$17.5
2031	$39.75	904	$18.5
2032	$42.00	904	$19.5
2033	$44.25	904	$20.6
2034	$46.50	904	$21.6
2035	$48.75	904	$22.7
2036	$51.00	904	$23.7
2037	$53.25	904	$24.8
2038	$55.50	904	$25.8
2039	$57.75	904	$26.9
2040	$60.00	904	$27.9

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

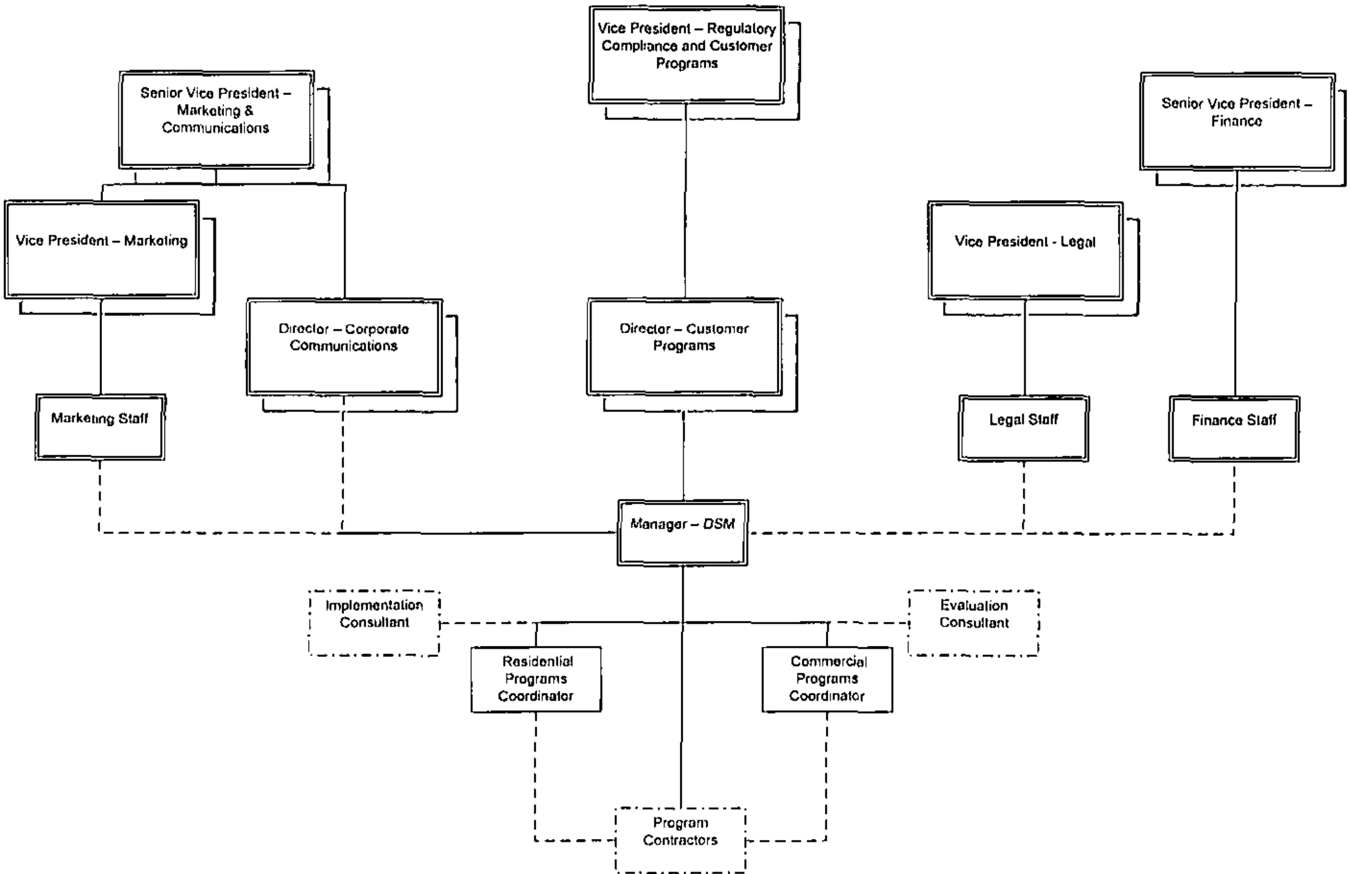
Ccf = 100 cubic feet
Mcf = 1,000 cubic feet
MMcf = 1,000,000 cubic feet
Bcf = 1,000,000,000 cubic feet

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

Portfolio

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives & Measure Installation Costs	$ 1,796,470	$ 5,045,870	$ 6,699,295	$ 7,229,553	$ 8,890,090	$ 29,661,279
Administration and Management	$ 649,155	$ 622,558	$ 747,821	$ 905,000	$ 910,000	$ 3,864,533
Marketing and Business Development	$ 8,250	$ 114,961	$ 138,051	$ 345,000	$ 480,000	$ 1,086,262
Contractor Costs	$ 1,077,872	$ 1,327,692	$ 2,082,690	$ 2,141,950	$ 1,911,978	$ 8,542,183
Inspection and Verification	$ 11,830	$ 39,493	$ 47,158	$ 157,194	$ 175,593	$ 431,268
Evaluation	$ -	$ -	$ 54,625	$ 133,362	$ 310,000	$ 497,987
TOTAL:	$ 3,543,577	$ 7,150,575	$ 9,769,640	$ 10,912,059	$ 12,707,662	$ 44,083,513

Enhanced Low Income Retrofit

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Measure Installation Costs	$ 1,787,141	$ 4,813,036	$ 5,874,928	$ 5,811,814	$ 5,928,000	$ 24,214,919
Administration and Management	$ 37,477	$ -	$ -	$ -	$ 30,000	$ 67,477
Marketing and Business Development	$ -	$ -	$ -	$ -	$ -	$ -
Contractor Costs	$ 1,018,855	$ 1,225,553	$ 1,605,311	$ 1,664,825	$ 1,482,000	$ 7,026,543
Inspection and Verification	$ 11,830	$ 38,393	$ 34,863	$ 75,000	$ 75,000	$ 235,086
Evaluation	$ -	$ -	$ 23,726	$ 48,362	$ 85,000	$ 157,088
TOTAL:	$ 2,885,303	$ 6,076,982	$ 7,538,827	$ 7,600,000	$ 7,600,000	$ 31,701,113

Residential Heating Equipment Rebates

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ *9,329*	$ *232,834*	$ *532,495*	$ *783,753*	$ *1,054,520*	$ *2,612,931*
Administration and Management	$ -	$ 2,270	$ -	$ -	$ -	$ 2,270
Marketing and Business Development	$ 8,250	$ 111,709	$ 4,128	$ 100,000	$ -	$ 224,088
Contractor Costs	$ 29,017	$ 47,984	$ 42,402	$ 48,000	$ 48,000	$ 215,402
Inspection and Verification	$ -	$ 1,100	$ 1,133	$ 23,000	$ 8,000	$ 33,233
Evaluation	$ -	$ -	$ 30,899	$ 50,000	$ 35,000	$ 115,899
TOTAL:	$ 46,596	$ 395,897	$ 611,057	$ 1,004,753	$ 1,145,520	$ 3,203,823

Commercial and Industrial Retrofit Incentives

	FY 2011	*FY 2012*	*FY 2013*	*FY 2014*	*FY 2015*	*FY 2011 - FY 2015*
Customer Incentives	$ -	$ -	$ 170,597	$ 135,495	$ 345,589	$ 651,681
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ -	$ 50,000	$ -	$ 50,000
Contractor Costs	$ -	$ 43,768	$ 54,419	$ 40,747	$ 120,831	$ 259,764
Inspection and Verification	$ -	$ -	$ 8,348	$ 4,714	$ 20,138	$ 33,200
Evaluation	$ -	$ -	$ -	$ 25,000	$ 50,000	$ 75,000
TOTAL:	$ -	$ 43,768	$ 233,363	$ 255,956	$ 536,558	$ 1,069,645

Commerical and Industrial Equipment Rebates

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 83,100	$ 45,465	$ 236,592	$ 365,158
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ 3,252	$ -	$ 25,000	$ -	$ 28,252
Contractor Costs	$ -	$ 10,388	$ 50,898	$ 54,009	$ 60,000	$ 175,295
Inspection and Verification	$ -	$ -	$ -	$ -	$ 1,200	$ 1,200
Evaluation	$ -	$ -	$ -	$ 10,000	$ 40,000	$ 50,000
TOTAL:	$ -	$ 13,640	$ 133,998	$ 134,475	$ 337,792	$ 619,905

High Efficiency Construction Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 32,330	$ 113,026	$ 214,389	$ 359,745
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ -	$ 20,000	$ -	$ 20,000
Contractor Costs	$ -	$ -	$ 55,331	$ 54,369	$ 23,148	$ 132,848
Inspection and Verification	$ -	$ -	$ 2,814	$ 4,480	$ 10,255	$ 17,549
Evaluation	$ -	$ -	$ -	$ -	$ 50,000	$ 50,000
TOTAL:	$ -	$ -	$ 90,475	$ 191,875	$ 297,791	$ 580,142

Comprehensive Residential Retrofit Incentives

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ 5,846	$ 340,000	$ 1,111,000	$ 1,456,846
Administration and Management	$ -	$ -	$ -	$ -	$ -	$ -
Marketing and Business Development	$ -	$ -	$ -	$ -	$ -	$ -
Contractor Costs	$ -	$ -	$ 274,330	$ 280,000	$ 178,000	$ 732,330
Inspection and Verification	$ -	$ -	$ -	$ 50,000	$ 61,000	$ 111,000
Evaluation	$ -	$ -	$ -	$ -	$ 50,000	$ 50,000
TOTAL:	$ -	$ -	$ 280,176	$ 670,000	$ 1,400,000	$ 2,350,176

Portfolio-wide Costs

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2011 - FY 2015
Customer Incentives	$ -	$ -	$ -	$ -	$ -	$ -
Administration and Management	$ 611,678	$ 620,288	$ 747,821	$ 905,000	$ 910,000	$ 3,794,786
Marketing and Business Development	$ -	$ -	$ 133,922	$ 150,000	$ 480,000	$ 763,922
Contractor Costs	$ -	$ -	$ -	$ -	$ -	$ -
Inspection and Verification	$ -	$ -	$ -	$ -	$ -	$ -
On-site Potential Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
Evaluation	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL:	$ 611,678	$ 620,288	$ 881,743	$ 1,055,000	$ 1,390,000	$ 4,558,709

Comparison of Budget Projections

Real 2009$

Program	FY 2013	FY 2014	FY 2015	FY 2013 - 15
FY 2015 IP (New)				
PORTFOLIO TOTAL	$9,074,665	$9,946,950	$11,363,951	**$30,385,565**
ELIRP	$7,004,603	$6,932,004	$6,792,996	**$20,729,604**
RHER	$568,949	$915,308	$1,021,908	**$2,506,165**
CIRI	$215,768	$232,696	$480,206	**$928,670**
CIER	$124,346	$122,238	$305,239	**$551,822**
HECI	$84,323	$174,465	$269,718	**$528,506**
CRRI	$258,840	$609,724	$1,251,376	**$2,119,940**
Portfolio-wide	$817,836	$960,514	$1,242,509	**$3,020,858**
FY 2014 IP (Old)				
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	**$2,292,440**
Difference ($)				
PORTFOLIO TOTAL	$(570,121)	$(3,039,756)	$(2,162,665)	**$(5,772,542)**
ELIRP	$(95,359)	$3,156	$503	**$(91,700)**
RHER	$(112,688)	$(413,369)	$(331,752)	**$(857,809)**
CIRI	$23,219	$(446,892)	$(209,489)	**$(633,162)**
CIER	$(139,464)	$(396,440)	$(319,913)	**$(855,817)**
HECI	$(21,798)	$(171,164)	$(232,815)	**$(425,778)**
CRRI	$(264,239)	$(1,810,655)	$(1,561,800)	**$(3,636,694)**
Portfolio-wide	$40,207	$195,609	$492,602	**$728,418**
Difference (%)				
PORTFOLIO TOTAL	-5.9%	-23.4%	-16.0%	**-16.0%**
ELIRP	-1.3%	0.0%	0.0%	**-0.4%**
RHER	-16.5%	-31.1%	-24.5%	**-25.5%**
CIRI	12.1%	-65.8%	-30.4%	**-40.5%**
CIER	-52.9%	-76.4%	-51.2%	**-60.8%**
HECI	-20.5%	-49.5%	-46.3%	**-44.6%**
CRRI	-50.5%	-74.8%	-55.5%	**-63.2%**
Portfolio-wide	5.2%	25.6%	65.7%	**31.8%**

G. Sales Reduction Projections

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

FY	Total	Total (excluding CRP)
2011	11,543	267
2012	48,342	4,726
2013	117,125	19,404
2014	205,401	43,881
2015	305,021	86,874
2016	359,200	115,876
2017	358,508	115,876
2018	358,508	115,876
2019	358,508	115,876
2020	358,068	115,753
2021	356,692	115,106
2022	355,340	114,583
2023	354,541	114,583
2024	353,925	114,442
2025	352,901	113,605
2026	348,902	112,722
2027	341,581	111,947
2028	329,266	108,100
2029	315,306	101,833
2030	307,054	96,330
2031	297,541	93,643
2032	273,823	90,798
2033	231,000	84,446
2034	174,847	75,816
2035	112,228	65,148
2036	78,743	58,516
2037	73,384	53,157
2038	64,192	43,965
2039	55,762	35,535
2040	47,317	27,090
2041	40,899	20,672
2042	31,311	11,084
2043	22,416	2,189
2044	20,877	649
2045	20,321	94
TOTAL	**7,575,105**	**2,489,050**

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	44	56
FY 2013	52	70	87
FY 2014	54	71	89
FY 2015	60	81	101
TOTAL	**214**	**285**	**356**
NON-RESIDENTIAL PROGRAMS			
FY 2011	0	0	0
FY 2012	0	0	0
FY 2013	5	7	8
FY 2014	5	6	8
FY 2015	11	14	18
TOTAL	**20**	**27**	**34**
TOTAL PORTFOLIO			
FY 2011	14	19	24
FY 2012	33	45	56
FY 2013	57	76	95
FY 2014	58	77	97
FY 2015	71	95	118
TOTAL	**234**	**312**	**390**

I. Cost-Recovery Schedules

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

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

STATEMENT OF RECONCILIATION

UNIVERSAL SERVICES & ENERGY CONSERVATION SURCHARGE

SEPTEMBER 2010 THROUGH AUGUST 2011

Month		Applicable Volumes	USC Charge	USC Revenue Billed	USC Expenses	Monthly Over/(Under) Recovery	Cumulative Over/(Under) Recovery
FY 10 Reconciliation							($19,939,314)
September 2010	Actual	1,109,653	$ 2.2855	$ 2,536,111	$ (2,118,782)	$ 4,654,893	($15,284,421)
October	Actual	1,573,676	$ 2.3678	$ 3,726,155	$ (374,819)	$ 4,100,973	($11,183,448)
November	Actual	3,244,696	$ 2.3678	$ 7,682,791	$ 7,224,051	$ 458,739	($10,724,709)
December	Actual	6,848,148	$ 2.1703	$ 14,862,536	$ 17,190,745	$ (2,328,209)	($13,052,918)
January 2011	Actual	10,697,049	$ 1.9728	$ 21,103,137	$ 28,669,860	$ (7,566,723)	($20,619,641)
February	Actual	9,291,679	$ 1.9728	$ 18,330,623	$ 25,370,341	$ (7,039,717)	($27,659,358)
March	Actual	6,780,663	$ 2.3098	$ 15,661,974	$ 20,422,074	$ (4,760,100)	($32,419,458)
April	Actual	4,708,175	$ 2.6468	$ 12,461,598	$ 12,927,927	$ (466,329)	($32,885,786)
May	Actual	2,278,994	$ 2.6468	$ 6,032,041	$ 4,525,304	$ 1,506,738	($31,379,049)
June	Actual	1,383,215	$ 2.7215	$ 3,764,351	$ 177,376	$ 3,586,975	($27,792,074)
July	Actual	1,159,585	$ 2.7961	$ 3,242,316	$ (1,685,909)	$ 4,928,225	($22,863,849)
August	Actual	1,065,364	$ 2.7961	$ 2,978,864	$ (428,152)	$ 3,407,016	($19,456,833)

USC Expenses		Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11
Conservation Works		$ 4,565	$ 13,656	$ 179,959	$ 198,424	$ 5,494	$ 221,064	$ 5,718	$ 9,054	$ 50,189	$ 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	$ 2,739,453	$ (1,416,837)	$ (3,028,412)	$ (3,315,405)
CRP Forgiveness		$ 851,310	$ 794,420	$ 762,875	$ 744,519	$ 764,345	$ 769,414	$ 981,477	$ 881,749	$ 925,968	$ 938,061	$ 846,067	$ 767,337
Senior Citizen Discount		$ 213,777	$ 305,238	$ 693,239	$ 1,222,757	$ 1,803,644	$ 1,572,397	$ 1,258,279	$ 873,722	$ 459,214	$ 253,530	$ 207,616	$ 185,807
Bad Debt Expense Offset*		$ -	$ -	$ -	$ -	$ -	$ (9,426)	$ (30,844)	$ (24,070)	$ (5,752)	$ 2,672	$ 1,358	$ -
Total		$ (2,118,782)	$ (374,819)	$ 7,224,051	$ 17,190,745	$ 28,669,860	$ 25,370,341	$ 20,422,074	$ 12,927,927	$ 4,525,304	$ 177,376	$ (1,685,909)	$ (428,152)
CRP Participation													
Rate Case Participation Rate		84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000
Actual Participation Rate*		81,292	79,732	81,855	82,544	83,198	84,492	86,072	86,658	86,560	86,292	84,534	83,535
CRP Under(Over) Participation		2,708	4,268	2,145	1,456	802	(492)	(2,072)	(2,658)	(2,560)	(2,292)	(534)	465
Average Shortfall Per CRP Participant													
CRP Discount		$ (3,188,434)	$ (1,488,133)	$ 5,532,786	$ 14,965,360	$ 25,990,955	$ 22,798,212	$ 18,046,143	$ 11,052,977	$ 2,739,453	$ (1,416,837)	$ (3,028,412)	(3,315,405)
Actual Participation Rate		81,292	79,732	81,855	82,544	83,198	84,492	86,072	86,658	86,560	86,292	84,534	83,535
Average Shortfall per CRP Participant		$ (39)	$ (19)	$ 68	$ 181	$ 312	$ 270	$ 210	$ 128	$ 32	$ (16)	$ (36)	(40)
Shortfall*		$ -	$ -	$ -	$ -	$ -	$ (132,755)	$ (434,422)	$ (339,020)	$ (81,019)	$ 37,633	$ 19,130	-
Bad Debt Expense Offset*	7.1%	$ -	$ -	$ -	$ -	$ -	$ (9,426)	$ (30,844)	$ (24,070)	$ (5,752)	$ 2,672	$ 1,358	$ -

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

** Revised

STATEMENT OF RECONCILIATION

UNIVERSAL SERVICES & ENERGY CONSERVATION SURCHARGE

SEPTEMBER 2011 THROUGH AUGUST 2012

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

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

CRP Participation		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)*	*$ (1,491,658)*	*$ 5,408,379*	*$ 10,821,473*	*$ 19,679,942*	*18,919,974*
Actual Participation Rate		82679	82023	80752	80298	80686	81,921
Average 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		Applicable Volumes	USC Charge	USC Revenue Billed	USC Expenses	Monthly Over/(Under) Recovery	Cumulative Over/(Under) Recovery
FY 12 Reconciliation							($12,100,465)
September 2012	Actual	1,169,843	$ 2.0689	$ 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	6,043,512	$ 2.0269	$ 12,249,595	$ 13,512,866	$ (1,263,271)	($4,305,500)
January 2013	Actual	8,011,065	$ 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	2,401,008	$ 2.1239	$ 5,099,502	$ 2,913,031	$ 2,186,471	($15,710,016)
June	Estimated	1,347,631	$ 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*	*Mar-13*	*Apr-13*	*May-13*	*Jun-13*	*Jul-13*	*Aug-13*
ELIRP Expense	$ 3,438	$ 457,807	$ 499,011	$ 3,347	$ 1,075,078	$ 872,125	$ 854,845	$ 854,845	$ 854,845	$ 854,845	$ 854,845	$ 854,845
ELIRP Labor	$ 5,331	$ 5,489	$ 9,190	$ 7,826	$ 7,834	$ 7,951	$ 11,643	$ 11,643	$ 11,643	$ 11,643	$ 11,643	$ 11,643
CRP Discount	$ (2,956,763)	$ (1,446,565)	$ 5,210,746	$ 12,093,600	$ 17,968,024	$ 18,835,842	$ 15,728,256	$ 10,441,689	$ 1,088,110	$ (2,620,749)	$ (3,025,194)	$ (3,180,060)
CRP Forgiveness	$ 681,304	$ 658,753	$ 533,301	$ 472,759	$ 547,865	$ 497,360	$ 587,261	$ 588,750	$ 588,750	$ 585,000	$ 577,500	$ 570,000
Senior Citizen Discount	$ 170,794	$ 237,187	$ 580,528	$ 935,334	$ 1,207,464	$ 1,255,510	$ 1,069,728	$ 818,275	$ 369,684	$ 191,804	$ 169,513	$ 158,930
Bad Debt Expense Offset*	$ -	$ -	$ -	$ -	$ -	$ -						
Total	$ (2,095,896)	$ (87,330)	$ 6,832,776	$ 13,512,866	$ 20,806,263	$ 21,468,788	$ 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)	$ 5,210,748	$ 12,093,600	$ 17,968,024	$ 18,835,842
Actual Participation Rate		78,732	77,790	76,177	75,224	75,387	75,671
Average Shorfall 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

STATEMENT OF RECONCILIATION
UNIVERSAL SERVICES & ENERGY CONSERVATION SURCHARGE
SEPTEMBER 2013 THROUGH AUGUST 2014

Month		Applicable Volumes	USC Charge	USC Revenue Billed	USC Expenses	Monthly Over/(Under) Recovery	Cumulative Over/(Under) Recovery
FY 13 Reconciliation							($6,919,694)
September 2013	Actual	1,177,368	$ 1.9462	$ 2,291,393	$ (1,707,399)	$ 3,998,792	($2,920,902)
October	Actual	1,435,177	$ 1.8732	$ 2,688,374	$ (369,357)	$ 3,057,730	$136,828
November	Actual	3,421,654	$ 1.8732	$ 6,409,441	$ 5,764,138	$ 645,303	$782,131
December	Actual	6,701,383	$ 1.7880	$ 11,982,073	$ 13,299,609	$ (1,317,536)	($535,405)
January 2014	Actual	9,256,342	$ 1.7028	$ 15,761,699	$ 17,931,169	$ (2,169,470)	($2,704,875)
February	Actual	10,394,269	$ 1.7028	$ 17,699,361	$ 21,185,077	$ (3,485,717)	($6,190,592)
March	Estimated	8,463,925	$ 1.8499	$ 15,656,992	$ 19,352,171	$ (3,695,179)	($9,885,771)
April	Estimated	5,194,084	$ 1.9969	$ 10,372,067	$ 11,067,585	$ (695,517)	($10,581,288)
May	Estimated	2,361,580	$ 1.9969	$ 4,715,839	$ 2,388,651	$ 2,327,188	($8,254,100)
June	Estimated	1,359,943	$ 1.9969	$ 2,715,670	$ (798,493)	$ 3,514,163	($4,739,938)
July	Estimated	1,202,378	$ 1.9969	$ 2,401,029	$ (1,136,561)	$ 3,537,589	($1,202,348)
August	Estimated	1,098,649	$ 1.9969	$ 2,193,893	$ (1,305,451)	$ 3,499,343	$2,296,995

USC Expenses	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14
ELIRP Expense	$ 31,547	$ 530,549	$ 763,865	$ 799,164	$ 36,659	$ 1,330,538	$ 780,593	$ 780,593	$ 780,593	$ 780,593	$ 780,593	$ 780,593
ELIRP Labor	$ 7,337	$ 7,370	$ 19,928	$ 7,314	$ 9,083	$ (1,231)	$ 9,966	$ 9,966	$ 9,966	$ 9,966	$ 9,966	$ 9,966
CRP Discount	$ (2,491,002)	$ (1,676,044)	$ 3,993,630	$ 11,198,218	$ 16,308,015	$ 18,201,042	$ 16,952,004	$ 9,027,346	$ 707,253	$ (2,337,781)	$ (2,647,009)	$ (2,798,705)
CRP Forgiveness	$ 583,851	$ 572,257	$ 514,189	$ 462,173	$ 466,239	$ 453,954	$ 576,000	$ 588,000	$ 596,000	$ 588,000	$ 576,000	$ 568,000
Senior Citizen Discount	$ 160,868	$ 196,511	$ 472,526	$ 832,740	$ 1,111,173	$ 1,200,774	$ 1,033,608	$ 661,680	$ 294,840	$ 160,729	$ 143,889	$ 134,696
Bad Debt Expense Offset*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ (1,707,399)	$ (369,357)	$ 5,764,138	$ 13,299,609	$ 17,931,169	$ 21,185,077	$ 19,352,171	$ 11,067,585	$ 2,388,651	$ (798,493)	$ (1,136,561)	$ (1,305,451)

CRP Participation							
Rate Case Participation Rate		84,000	84,000	84,000	84,000	84,000	84,000
Actual Participation Rate*		73,924	72,598	70,464	68,458	65,978	65,829
CRP Under(Over) Participation		10,076	11,402	13,536	15,542	18,022	18,171

Average Shortfall Per CRP Participant							
CRP Discount		$ (2,491,002)	$ (1,676,044)	$ 3,993,630	$ 11,198,218	$ 16,308,015	$ 18,201,042
Actual Participation Rate		73,924	72,598	70,464	68,458	65,978	65,829
Average Shorfall per CRP Participant		$ (34)	$ (23)	$ 57	$ 164	$ 247	$ 276
Shortfall*		$ -	$ -	$ -	$ -	$ -	$ -
Bad Debt Expense Offset*	7.1%	$ -	$ -	$ -	$ -	$ -	$ -

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

EFFICIENCY COST RECOVERY (ECR) SURCHARGE

STATEMENT OF RECONCILIATION

SEPTEMBER 2010 THRU AUGUST 2011

RESIDENTIAL & PHA GS

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

COMMERCIAL & PHA

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

INDUSTRIAL

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

* Volumes include 50% of Dec 2010 billed sales

EFFICIENCY COST RECOVERY (ECR) SURCHARGE

STATEMENT OF RECONCILIATION

FISCAL YEAR 2012

		Actual Sep-11	Actual Oct-11	Actual Nov-11	Actual Dec-11	Actual Jan-12	Actual Feb-12	Estimated Mar-12	Estimated Apr-12	Estimated May-12	Estimated Jun-12	Estimated Jul-12	Estimated Aug-12	
RESIDENTIAL & PHA GS														
FY 2011 Over-Collection														$ 405,038
Volume Billed		815,328	1,000,881	2,519,255	3,580,810	5,873,552	5,663,270	4,352,256	2,748,257	1,721,910	882,982	780,910	693,736	
ECR Surcharge		$ 0.0174	$ 0.0158	$ 0.0158	$ 0.0290	$ 0.0421	$ 0.0421	$ 0.0491	$ 0.0560	$ 0.0560	$ 0.0560	$ 0.0560	$ 0.0560	
Revenue Billed		$ 14,187	$ 15,814	$ 39,804	$ 103,664	$ 247,277	$ 238,424	$ 213,478	$ 153,902	$ 96,427	$ 49,447	$ 43,731	$ 38,849	
RHER	Expense	$ 19,403	$ 14,453	$ 38,570	$ 20,187	$ 25,197	$ 29,162	$ 126,353	$ 126,353	$ 126,353	$ 126,353	$ 126,353	$ 126,353	
RHER	Labor	$ 1,833	$ 1,220	$ 1,113	$ 1,546	$ 1,784	$ 1,113	$ 2,435	$ 2,435	$ 2,435	$ 2,435	$ 2,435	$ 2,435	
HECI	Expense	$ 32	$ 33	$ 170	$ 249	$ 32	$ 523	$ 441	$ 441	$ 441	$ 441	$ 441	$ 441	
HECI	Labor	$ 84	$ 56	$ 51	$ 71	$ 82	$ 51	$ 112	$ 112	$ 112	$ 112	$ 112	$ 112	
CRRI	Expense	$ 306	$ 319	$ 1,630	$ 2,396	$ 307	$ 5,026	$ 4,239	$ 4,239	$ 4,239	$ 4,239	$ 4,239	$ 4,239	
CRRI	Labor	$ 811	$ 540	$ 492	$ 684	$ 789	$ 492	$ 1,077	$ 1,077	$ 1,077	$ 1,077	$ 1,077	$ 1,077	
Total		$ 22,469	$ 16,620	$ 42,027	$ 25,133	$ 28,190	$ 36,368	$ 134,658	$ 134,658	$ 134,658	$ 134,658	$ 134,658	$ 134,658	
Monthly Over/(Under)		$ (8,282)	$ (806)	$ (2,222)	$ 78,531	$ 219,086	$ 202,056	$ 78,821	$ 19,245	$ (38,231)	$ (85,211)	$ (90,927)	$ (95,808)	
Cumulative Over/(Under)		$ 396,756	$ 395,950	$ 393,728	$ 472,259	$ 691,345	$ 893,401	$ 972,221	$ 991,466	$ 953,236	$ 868,025	$ 777,099	$ 681,290	
COMMERCIAL & PHA														
FY 2011 Over-Collection														$ 40,738
Volume Billed		$ 379,865	$ 439,026	$ 830,817	$ 1,064,342	$ 1,529,860	$ 1,465,433	$ 1,076,882	$ 808,642	$ 542,719	$ 404,790	$ 379,953	$ 339,733	
ECR Surcharge		$ 0.0141	$ 0.0144	$ 0.0144	$ 0.0201	$ 0.0257	$ 0.0257	$ 0.0280	$ 0.0302	$ 0.0302	$ 0.0302	$ 0.0302	$ 0.0302	
Revenue Billed		$ 5,337	$ 6,322	$ 11,964	$ 21,340	$ 39,317	$ 37,662	$ 30,099	$ 24,421	$ 16,390	$ 12,225	$ 11,475	$ 10,260	
RHER	Expense	$ 196	$ 146	$ 390	$ 204	$ 255	$ 295	$ 1,276	$ 1,276	$ 1,276	$ 1,276	$ 1,276	$ 1,276	
RHER	Labor	$ 19	$ 12	$ 11	$ 16	$ 18	$ 11	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	
CIRI	Expense	$ 121	$ 126	$ 644	$ 946	$ 121	$ 11,819	$ 27,252	$ 27,252	$ 27,252	$ 27,252	$ 27,252	$ 27,252	
CIRI	Labor	$ 320	$ 213	$ 195	$ 270	$ 312	$ 195	$ 426	$ 426	$ 426	$ 426	$ 426	$ 426	
CIER	Expense	$ 17	$ 18	$ 91	$ 134	$ 17	$ 282	$ 238	$ 238	$ 238	$ 238	$ 238	$ 238	
CIER	Labor	$ 46	$ 30	$ 28	$ 38	$ 44	$ 28	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	
HECI	Expense	$ 32	$ 33	$ 170	$ 249	$ 32	$ 523	$ 441	$ 441	$ 441	$ 441	$ 441	$ 441	
HECI	Labor	$ 84	$ 56	$ 51	$ 71	$ 82	$ 51	$ 112	$ 112	$ 112	$ 112	$ 112	$ 112	
Total		$ 834	$ 635	$ 1,579	$ 1,929	$ 881	$ 13,203	$ 29,830	$ 29,830	$ 29,830	$ 29,830	$ 29,830	$ 29,830	
Monthly Over/(Under)		$ 4,503	$ 5,687	$ 10,385	$ 19,411	$ 38,437	$ 24,458	$ 269	$ (5,409)	$ (13,440)	$ (17,606)	$ (18,356)	$ (19,570)	
Cumulative Over/(Under)		$ 45,241	$ 50,928	$ 61,313	$ 80,723	$ 119,160	$ 143,618	$ 143,887	$ 138,478	$ 125,038	$ 107,432	$ 89,077	$ 69,507	
INDUSTRIAL														
FY 2011 Over-Collection														$ 27,064
Volume Billed		42,818	43,580	72,363	91,294	124,564	119,367	80,132	64,817	40,893	31,321	29,677	26,512	
ECR Surcharge		$ (0.0077)	$ (0.0222)	$ (0.0222)	$ 0.0293	$ 0.0807	$ 0.0807	$ 0.1224	$ 0.1641	$ 0.1641	$ 0.1641	$ 0.1641	$ 0.1641	
Revenue Billed		$ (328)	$ (967)	$ (1,606)	$ 2,670	$ 10,052	$ 9,633	$ 9,808	$ 10,636	$ 6,711	$ 5,140	$ 4,870	$ 4,351	
CIRI	Expense	$ 12	$ 13	$ 67	$ 98	$ 13	$ 205	$ 173	$ 173	$ 173	$ 173	$ 173	$ 173	
CIRI	Labor	$ 33	$ 22	$ 20	$ 28	$ 32	$ 20	$ 44	$ 44	$ 44	$ 44	$ 44	$ 44	
CIER	Expense	$ 17	$ 18	$ 91	$ 134	$ 17	$ 282	$ 238	$ 238	$ 238	$ 238	$ 238	$ 238	
CIER	Labor	$ 46	$ 30	$ 28	$ 38	$ 44	$ 28	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	
Total		$ 108	$ 83	$ 206	$ 299	$ 106	$ 535	$ 515	$ 515	$ 515	$ 515	$ 515	$ 515	
Monthly Over/(Under)		$ (436)	$ (1,051)	$ (1,812)	$ 2,372	$ 9,946	$ 9,098	$ 9,293	$ 10,121	$ 6,195	$ 4,624	$ 4,355	$ 3,835	
Cumulative Over/(Under)		$ 26,628	$ 25,577	$ 23,765	$ 26,137	$ 36,083	$ 45,181	$ 54,473	$ 64,594	$ 70,789	$ 75,414	$ 79,768	$ 83,603	

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		776,091	1,060,326	2,860,862	4,639,892	6,128,404	6,752,192	5,431,965	4,047,954	1,771,513	887,841	764,200	697,871
ECR Surcharge		$ 0.0399	$ 0.0411	$ 0.0411	$ 0.0588	$ 0.0765	$ 0.0765	$ 0.0820	$ 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	$ 66,867	$ 61,064
RHER	Expense	$ 21,577	$ 46,918	$ 97,327	$ 903	$ 117,724	$ 57,524	$ 252,347	$ 252,347	$ 252,347	$ 252,347	$ 252,347	$ 252,347
RHER	Labor	$ 1,438	$ 1,481	$ 2,479	$ 2,112	$ 2,114	$ 2,145	$ 3,141	$ 3,141	$ 3,141	$ 3,141	$ 3,141	$ 3,141
HECI	Expense	$ 52	$ 500	$ 11,279	$ 4,314	$ 926	$ 5,988	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194
HECI	Labor	$ 81	$ 84	$ 140	$ 119	$ 119	$ 121	$ 178	$ 178	$ 178	$ 178	$ 178	$ 178
CRRI	Expense	$ 401	$ 3,828	$ 4,501	$ 391	$ 7,089	$ 499	$ 99,320	$ 99,320	$ 99,320	$ 99,320	$ 99,320	$ 99,320
CRRI	Labor	$ 622	$ 641	$ 1,073	$ 913	$ 914	$ 928	$ 1,359	$ 1,359	$ 1,359	$ 1,359	$ 1,359	$ 1,359
Total		$ 24,172	$ 53,452	$ 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	481,856	970,072	1,243,320	1,653,469	1,693,783	1,528,904	1,060,655	579,678	421,504	386,634	355,436
ECR Surcharge		$ 0.0421	$ 0.0457	$ 0.0457	$ 0.0538	$ 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
RHER	Expense	$ 1,055	$ 2,295	$ 4,760	$ 44	$ 5,758	$ 2,814	$ 12,342	$ 12,342	$ 12,342	$ 12,342	$ 12,342	$ 12,342
RHER	Labor	$ 70	$ 72	$ 121	$ 103	$ 103	$ 105	$ 154	$ 154	$ 154	$ 154	$ 154	$ 154
CIRI	Expense	$ 200	$ 5,609	$ 2,246	$ 195	$ 4,231	$ 8,770	$ 71,751	$ 71,751	$ 71,751	$ 71,751	$ 71,751	$ 71,751
CIRI	Labor	$ 311	$ 320	$ 535	$ 456	$ 456	$ 463	$ 678	$ 678	$ 678	$ 678	$ 678	$ 678
CIER	*Expense*	*$ 197*	*$ 5,924*	*$ 6,267*	*$ 192*	*$ 19,656*	*$ 9,247*	*$ 60,836*	*$ 60,836*	*$ 60,836*	*$ 60,836*	*$ 60,838*	*$ 60,836*
CIER	Labor	$ 306	$ 315	$ 527	$ 449	$ 450	$ 456	$ 668	$ 668	$ 668	$ 668	$ 668	$ 668
HECI	Expense	$ 52	$ 500	$ 11,279	$ 4,314	$ 926	$ 5,988	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194	$ 13,194
HECI	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	45,761	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*
CIRI	Expense	$ 35	$ 990	$ 396	$ 34	$ 747	$ 1,548	$ 12,662	$ 12,662	$ 12,662	$ 12,662	$ 12,662	$ 12,662
CIRI	Labor	$ 55	$ 56	$ 94	$ 80	$ 81	$ 82	$ 120	$ 120	$ 120	$ 120	$ 120	$ 120
CIER	Expense	$ 13	$ 378	$ 400	$ 12	$ 1,255	$ 590	$ 3,883	$ 3,883	$ 3,883	$ 3,883	$ 3,883	$ 3,883
CIER	Labor	$ 20	$ 20	$ 34	$ 29	$ 29	$ 29	$ 43	$ 43	$ 43	$ 43	$ 43	$ 43
Total		$ 122	$ 1,444	$ 925	$ 156	$ 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

EFFICIENCY COST RECOVERY (ECR) SURCHARGE

STATEMENT OF RECONCILIATION

FISCAL YEAR 2014

		Actual Sep-13	Actual Oct-13	Actual Nov-13	Actual Dec-13	Actual Jan-14	Actual Feb-14	Estimated Mar-14	Estimated Apr-14	Estimated May-14	Estimated Jun-14	Estimated Jul-14	Estimated Aug-14
RESIDENTIAL & PHA GS													
FY 2013 Over-Collection													
Volume Billed		778,681	915,798	2,461,098	5,056,256	7,089,097	8,088,151	6,493,914	4,024,236	1,723,511	886,583	766,372	698,536
ECR Surcharge		$ 0.0924	$ 0.1071	$ 0.1071	$ 0.0938	$ 0.0804	$ 0.0804	$ 0.0755	$ 0.0705	$ 0.0705	$ 0.0705	$ 0.0705	$ 0.0705
Revenue Billed		$ 71,911	$ 98,082	$ 263,583	$ 474,024	$ 569,963	$ 650,287	$ 489,966	$ 283,709	$ 121,508	$ 62,504	$ 54,029	$ 49,247
RHER	Expense	$ 5,701	$ 51,711	$ 78,789	$ 93,954	$ 49,972	$ 36,679	$ 176,732	$ 176,732	$ 176,732	$ 176,732	$ 176,732	$ 176,732
RHER	Labor	$ 1,326	$ 1,332	$ 595	$ 1,322	$ 1,642	$ 1,880	$ 1,952	$ 1,952	$ 1,952	$ 1,952	$ 1,952	$ 1,952
HECI	Expense	$ 833	$ 80	$ 74	$ 4,107	$ 14,801	$ 3,092	$ 28,572	$ 28,572	$ 28,572	$ 28,572	$ 28,572	$ 28,572
HECI	Labor	$ 194	$ 195	$ (78)	$ 193	$ 240	$ 505	$ 274	$ 274	$ 274	$ 274	$ 274	$ 274
CRRI	Expense	$ 11,267	$ 54,613	$ 33,007	$ 51,388	$ 93,481	$ 76,042	$ 398,412	$ 398,412	$ 398,412	$ 398,412	$ 398,412	$ 398,412
CRRI	Labor	$ 2,620	$ 2,632	$ (2,463)	$ 2,612	$ 3,244	$ 8,159	$ 3,723	$ 3,723	$ 3,723	$ 3,723	$ 3,723	$ 3,723
CIRI	Expense	$ 1,049	$ 100	$ (1,150)	$ 9,621	$ 969	$ 37,814	$ 34,289	$ 34,289	$ 34,289	$ 34,289	$ 34,289	$ 34,289
CIRI	Labor	$ 244	$ 245	$ (489)	$ 243	$ 302	$ 1,234	$ 311	$ 311	$ 311	$ 311	$ 311	$ 311
CIER	Expense	$ 200	$ 628	$ (828)	$ 1,104	$ 514	$ (1,843)	$ 7,299	$ 7,299	$ 7,299	$ 7,299	$ 7,299	$ 7,299
CIER	Labor	$ 46	$ 47	$ (93)	$ 46	$ 57	$ (175)	$ 127	$ 127	$ 127	$ 127	$ 127	$ 127
Total		$ 23,481	$ 111,582	$ 107,364	$ 164,591	$ 165,221	$ 163,388	$ 651,692	$ 651,692	$ 651,692	$ 651,692	$ 651,692	$ 651,692
Monthly Over/(Under)		$ 48,430	$ (13,500)	$ 156,219	$ 309,433	$ 404,742	$ 486,900	$ (161,726)	$ (367,983)	$ (530,184)	$ (589,188)	$ (597,662)	$ (602,445)
Cumulative Over/(Under)		$ 2,571,423	$ 2,557,923	$ 2,714,142	$ 3,023,575	$ 3,428,317	$ 3,915,217	$ 3,753,491	$ 3,385,508	$ 2,855,324	$ 2,266,136	$ 1,668,474	$ 1,066,029
COMMERCIAL & PHA													
FY 2013 Over-Collection													
Volume Billed		365,998	469,135	851,536	1,426,426	1,791,184	1,870,065	1,687,878	1,014,141	566,636	428,646	393,720	361,274
ECR Surcharge		$ 0.0883	$ 0.0961	$ 0.0961	$ 0.0916	$ 0.0871	$ 0.0871	$ 0.0827	$ 0.0782	$ 0.0782	$ 0.0782	$ 0.0782	$ 0.0782
Revenue Billed		$ 32,299	$ 45,084	$ 81,833	$ 130,661	$ 156,012	$ 162,883	$ 139,503	$ 79,306	$ 44,311	$ 33,520	$ 30,789	$ 28,252
RHER	Expense	$ 377	$ 3,417	$ (1,563)	$ 6,209	$ 3,302	$ 27,411	$ 8,643	$ 8,643	$ 8,643	$ 8,643	$ 8,643	$ 8,643
RHER	Labor	$ 88	$ 88	$ (122)	$ 87	$ 108	$ 595	$ 78	$ 78	$ 78	$ 78	$ 78	$ 78
CIRI	Expense	$ 2,058	$ 20,697	$ 2,076	$ 18,873	$ 27,318	$ (17,391)	$ 74,152	$ 74,152	$ 74,152	$ 74,152	$ 74,152	$ 74,152
CIRI	Labor	$ 479	$ 481	$ 401	$ 477	$ 593	$ 371	$ 725	$ 725	$ 725	$ 725	$ 725	$ 725
CIER	Expense	$ 2,227	$ 7,005	$ 2,907	$ 12,312	$ 5,729	$ 21,239	$ 72,431	$ 72,431	$ 72,431	$ 72,431	$ 72,431	$ 72,431
CIER	Labor	$ 518	$ 520	$ (178)	$ 516	$ 641	$ 1,336	$ 731	$ 731	$ 731	$ 731	$ 731	$ 731
HECI	Expense	$ 833	$ 80	$ 74	$ 4,107	$ 14,801	$ 3,092	$ 28,572	$ 28,572	$ 28,572	$ 28,572	$ 28,572	$ 28,572
HECI	Labor	$ 194	$ 195	$ (78)	$ 193	$ 240	$ 505	$ 274	$ 274	$ 274	$ 274	$ 274	$ 274
Total		$ 6,773	$ 32,483	$ 3,515	$ 42,775	$ 52,729	$ 37,158	$ 185,606	$ 185,606	$ 185,606	$ 185,606	$ 185,606	$ 185,606
Monthly Over/(Under)		$ 25,526	$ 12,601	$ 78,317	$ 87,885	$ 103,283	$ 125,725	$ (46,102)	$ (106,300)	$ (141,295)	$ (152,085)	$ (154,817)	$ (157,354)
Cumulative Over/(Under)		$ 563,102	$ 575,703	$ 654,020	$ 741,906	$ 845,188	$ 970,913	$ 924,811	$ 818,511	$ 677,216	$ 525,131	$ 370,314	$ 212,960
INDUSTRIAL													
FY 2013 Over-Collection													
Volume Billed		24,001	40,832	59,249	103,098	149,939	156,735	133,516	75,557	44,895	35,886	33,280	30,507
ECR Surcharge		$ (0.2443)	$ (0.2276)	$ (0.2276)	$ (0.3069)	$ (0.3862)	$ (0.3862)	$ (0.2961)	$ (0.2059)	$ (0.2059)	$ (0.2059)	$ (0.2059)	$ (0.2059)
Revenue Billed		$ (5,862)	$ (9,293)	$ (13,485)	$ (31,641)	$ (57,906)	$ (60,531)	$ (39,528)	$ (15,557)	$ (9,244)	$ (7,389)	$ (6,852)	$ (6,281)
CIRI	Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CIRI	Labor	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CIER	Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CIER	Labor	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Monthly Over/(Under)		$ (5,862)	$ (9,293)	$ (13,485)	$ (31,641)	$ (57,906)	$ (60,531)	$ (39,528)	$ (15,557)	$ (9,244)	$ (7,389)	$ (6,852)	$ (6,281)
Cumulative Over/(Under)		$ 372,989	$ 363,695	$ 350,210	$ 318,569	$ 260,663	$ 200,132	$ 160,604	$ 145,047	$ 135,803	$ 128,414	$ 121,562	$ 115,280

J. Technical Reference Manual

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

Technical Reference Manual

Measure Savings Algorithms

PGW | energysense

May 6, 2014

Table of Contents

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.

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

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 (730 hours for furnaces, 854 for boilers)[1]

Electric Savings Algorithms

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

Energy Savings

$\Delta kWh = 700\ kWh$

Demand Savings

$\Delta kW = 0\ kW$

Where:

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

Freeridership/Spillover

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

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

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Furnaces	20
Gas Boilers	25

Source: Lifetime estimates used by Efficiency Vermont.

Water Savings

There are no water savings for this measure.

[1] EFLH based on adjustments applied based on 2014 evaluation by APPRISE.

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

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

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

ΔkWh_{Cool} = 0 kWh if house has no air conditioning
= ΔkWh_{CAC} if house has central air conditioning
= 0 if house has room air conditioning

[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*

= 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

$\Delta kW = 0$ 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)*
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).

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 stand-alone storage water heater 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

$\Delta kW = 0\ kW$

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
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.

Water Savings

There are no water savings for this measure.

C.Combined Space and Domestic Hot Water Usage

1) Combination Boiler - Space Heating and DHW

Unique Measure Code(s): TBD
Draft date: 7/29/13
Effective date: TBD
End date: TBD

Measure Description

This measure applies to residential-sized combination boilers purchased at the time of natural replacement. These are integrated boilers that provide hot water for space heating and on-demand domestic hot water and have minimal or no hot water storage. A qualifying combination boiler (combi boiler) must meet minimum efficiency requirements (AFUE).

Definition of Baseline Condition

The efficiency levels of the gas-fired boiler and stand-alone storage water heater that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Baseline

Gas Boiler	80% AFUE
Gas DHW tank	0.60 EF

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 Combi Boiler	94% AFUE 0.94 EF

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.

$$Annual\ Gas\ Savings\ (MMBtu) = Annual\ Gas\ Savings_{SH} + Annual\ Gas\ Savings_{DHW}$$

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

Where:

$Annual\ Gas\ Savings_{SH}$ = Space heating annual gas savings (MMBtu)
$Annual\ Gas\ Savings_{DHW}$ = Domestic Hot Water annual gas savings (MMBtu)
$Capacity_{Out}$ = 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 (854 hours)[5]

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

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

Where:

EF_{Base} = Energy Factor of baseline water heater = 0.60
EF_{Eff} = Energy Factor of efficient combi boiler. Since the combi boiler has no or little storage, standby losses are assumed to be negligible and the EF is assumed to be the same as the AFUE.

Electric Savings Algorithms

[5] Based on 2014 APPRISE evaluation for boilers.

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
Gas Combi Boiler	0%	0%

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Combi Boiler	20

Source: Same as lifetime estimate used for tankless water heater.

Water Savings
There are no water savings for this measure.

D.All End Uses

1) Custom Measure

Unique Measure Code(s): TBD
Draft date: 7/22/13
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.

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

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.

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)

$AFUE_{EE}$ = 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[6]/day to estimate heating slope* (MMbtu/HDD63) and baseload daily use (MMBtu/day) with an annual HDD63 of 4033[7] 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

ΔkWh = 700 kWh

Demand Savings

ΔkW = 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%

[6] 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.

[7] 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.

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 of the house or unit and the outdoors *without buffering from any adjacent unit(s) 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*[8]

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.[9]

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:

ΔkWh = gross customer annual kWh savings for the measure.

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

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[8] 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.

[9] 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

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[10]
$SEER_{CAC}$	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[11]

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

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[12]	$EFLH_{cool\ RAC}$ (Hours)[13]	CDD (Base 65)[14]	HDD (Base 65)[15]
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.

Water Savings
There are no water savings for this measure.

3) Roof and Cavity Insulation

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 attic or walls which directly define the boundary between the house or unit and the outdoors.

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

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[11] 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). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$
[12] PA 2010 TRM Table 2-1.
[13] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement
[14] 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
[15] *Ibid.*

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[16].
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.[17]

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

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

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

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

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

[16] From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820
[17] 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

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

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

Term	Type	Value	Source
DUA	Fixed	0.75	OH TRM[18]
$SEER_{CAC}$	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[19]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[20]	$EFLH_{cool\ RAC}$ (Hours)[21]	CDD (Base 65)[22]	HDD (Base 65)[23]
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.

Measure Lifetimes

Measure	Measure Lifetime
Roof Insulation	40
Cavity Insulation	40

[18] "State of Ohio Energy Efficiency Technical Reference Manual," prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation. August 6, 2010.
[19] 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). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$
[20] PA 2010 TRM Table 2-1.
[21] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement
[22] 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
[23] Ibid.

Source: NYSERDA Home Performance with Energy Star.

Water Savings
There are no water savings for this measure.

4) Programmable Thermostat

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

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

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

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

Gas Savings Algorithms

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

Where:

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

HDD_{62} = 3820

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

HDD_{63} = 4033

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

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

Electric Savings Algorithms

*If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-*conditioning is not known, then assume that 83% have air-conditioning and estimate the cooling savings as 83% of a house with central air conditioning.[24]

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

Energy Savings

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

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

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

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

Demand Savings

$\Delta kW = 0\ kW$

Where:

ΔkWh = gross customer annual kWh savings for the measure.

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

CAP_{COOL} = *capacity of the air conditioning unit in tons, based on nameplate capacity (see table below)*

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*

[24] 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

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).

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 an un-insulated 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

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{EFLH_{heat}}{24 \times 365} \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{AFUE \times 1{,}000{,}000}$$

Where:

Length = Number of linear feet of duct work insulated

$EFLH_{heat}$ = Equivalent full load heating hours = 730

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[25]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Condensation Control Thickness	=	N/A
Hours Per Year	=	2000[26]
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.

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[27].

6) Heating Pipe Insulation

[25] Average winter temperature for Philadelphia from "Cost Savings and Comfort for Existing Buildings", 3rd Edition, by John Krigger, Saturn Resource Management, Page 255.
[26] 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
[27] NYSERDA Home Performance with Energy Star

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 space heating pipes in unconditioned spaces.

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

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

$$H_{Heat} = \frac{HDD \times 24}{Dt} = \frac{4{,}033 \times 24}{59} = 1{,}640$$

Where:

Length	=	Number of linear feet of heating pipe insulated
H_{heat}	=	Heating hours for a properly sized boiler. Used as an estimate of the hours in which the space-heating pipe would be hotter than the ambient temperature and would therefore experience heat loss.
Th_{base}	=	Thickness of base condition insulation (inches)
Th_{eff}	=	Thickness of efficient condition insulation (inches)
HeatLoss(x)	=	Heat loss through pipe as a function of insulation thickness x (Btu/ft /hr)
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 pipe insulation.
HDD	=	Base 63° F Heating Degree Days for Philadelphia = 4,033[28]
Dt	=	Design temperature difference (assume from 11° F to 70° F for properly sized boiler)[29] = 59° F

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

Insulation Thickness (inches)	Steam Heat Loss (Btu/ft/hr)	Hot Water Heat Loss (Btu/ft/hr)
Bare	201.4	72.12
0.5	47.75	15.24

[28] Based on NCDC ASOS temperature data for PHL from 2002 through 2009.
[29] 11 degree design temperature source: 5th Edition Residential Energy, Cost Savings and Comfort for Existing Buildings. John Krigger and Chris Dorsi, 2009, Saturn Resource Management, Appendix A-8, p. 280.

1.0	31.15	11.2
1.5	24.09	8.67
2.0	20.28	7.51
2.5	17.98	6.42
3.0	16.35	5.98
3.5	15.13	5.64
4.0	14.06	5.37
4.5	13.31	5.12

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 piping
System Application	=	Pipe - Horizontal
Dimensional Standard	=	ASTM C 585 Rigid
Calculation Type	=	Heat Loss Per Hour Report
Process Temperature	=	212
Ambient Temperature	=	60
Wind Speed	=	0
Nominal Pipe Size	=	2
Bare Metal	=	Copper
Bare Surface Emittance	=	0.6
Insulation Layer 1	=	850F Mineral Fiber PIPE, Type I, C547-11
Outer Jacket Material	=	All Service Jacket
Outer Surface Emittance	=	0.9

Item Description	=	hot water piping
System Application	=	Pipe - Horizontal
Dimensional Standard	=	ASTM C 585 Rigid
Calculation Type	=	Heat Loss Per Hour Report
Process Temperature	=	180
Ambient Temperature	=	60
Wind Speed	=	0
Nominal Pipe Size	=	0.75
Bare Metal	=	Copper
Bare Surface Emittance	=	0.6
Insulation Layer 1	=	Phenolic SHEET+TUBE,Type III, C1126-11
Outer Jacket Material	=	All Service Jacket
Outer Surface Emittance	=	0.9

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[30].

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 into unconditioned spaces. In order to verify savings, a duct-leakage 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[31]

Electric Savings Algorithms
Electric savings per 100 CFM-25 reduction:[32]

- 110.0 kWh in heating fan savings
- If a central air conditioner is present

[30] NYSERDA Home Performance with Energy Star
[31] Based on 3.5 MMBtus savings per 100 CFM reduction for duct sealing from UI/CL&P Program Savings Documentation – 2011, page 131
[32] UI/CL&P *Program Savigns Documentation*, 2011, page 131

  - 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.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life is assumed to 18 years[33].

8) High Efficiency Window

Unique Measure Code(s): TBD
Draft date: 7/29/13
Effective date: TBD
End date: TBD

Measure Description
This involves installing a window with a U-factor less than a baseline window.

Definition of Baseline Condition
The baseline is the minimum window required by code. IECC 2009 for Philadelphia requires a U-factor of 0.35 or less.

Definition of Efficient Condition
An efficient window is any window exceeding Energy Star® requirements for U-factor of 0.32 or less.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{HDD_t \times 24 \times AREA \times (U_{base} - U_{eff})}{(AFUE \times 1{,}000{,}000)}$$

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[34].
24	=	Hours per day
AREA	=	Square feet of window area.
U_{base}	=	U-factor of new baseline window. U_{base} = 0.35 based on IECC 2009.
U_{eff}	=	U-factor of efficient window.
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. Use default AFUE of 80% if actual AFUE

[33] California DEER estimage.
[34] From NWS data for PHL from 2002-2009. HDD63=4033 and HDD62 = 3820

is not available.

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.[35]

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

Energy Savings

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

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

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

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

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

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.*

[35] 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

$SEER_{CAC}$	= *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[36]
$SEER_{CAC}$	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[37]

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

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

EFLH, CDD and HDD by City

City	EFLH$_{cool}$ (Hours)[38]	EFLH$_{cool\ RAC}$ (Hours)[39]	CDD (Base 65)[40]	HDD (Base 65)[41]
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
Window	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetime

Measure	Measure Lifetime
Window	30

Source: NREL Measure Database.

Water Savings

There are no water savings for this measure.

[38] PA 2010 TRM Table 2-1.
[39] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement
[40] 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
[41] Ibid.

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[42].

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[43]
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[44]
11.6	=	Average gallons of water per person per day used for showering[45]
365	=	Days per year
1.6	=	Average number of showers per home[46]

Natural Gas Savings Algorithms

[42] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[43] The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)
[44] Pennsylvania, Census of Population, 2000.
[45] 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)
[46] 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)[47]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[48]

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[49].

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.

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[50].

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[47] *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
[48] 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).
[49] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[50] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

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[51]
GPM_{eff}	=	Gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[52]
10.9	=	Average gallons per day used by faucet[53]
365	=	Days per year
50%	=	Drain rate, the percentage of water flowing down the drain[54]
3.5	=	Average Number of Faucets per home[55]

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).[56]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[57]

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.

[51] 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

[52] Pennsylvania, Census of Population, 2000.

[53] 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)

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

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

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

[57] See assumption for low flow shower head.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a faucet aerator is assumed to be 12 years[58].

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[59].

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.

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

Where:

EF_{base}	=	Energy Factor of baseline water heater
EF_{eff}	=	Energy Factor of efficient water heater. If combi boiler use AFUE.
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.*

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

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[60].

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.

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

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[61]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[62]

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[60] DEER values, updated October 10, 2008
http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls
[61] 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

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[63].

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.

[62] See assumption for low flow showerhead.
[63] Page 410. Vermont Technical Reference Manual and New Jersey Clean Energy Program Protocols

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*[64]

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)[65]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[66]

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.

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[64] 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)
[65] 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
[66] See assumption for low flow showerhead.

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

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 on the hot water pipe.
If the diameter of the cold/hot feeds directly to/from the storage tank is 1" or less, a maximum length of three feet for both the cold water inlet and hot water outlet piping above the tank (six total feet) per unit will be included in the savings calculations under the program and should be installed in accordance with best practices.

For each ½" increase in diameter of the hot feed directly from the storage tank beyond 1", an additional 6' length of pipe insulation should be installed along the hot water supply piping only and the additional savings will be credited.

If a DHW recirculating system is present, all hot water supply and return piping accessible without demolition should be insulated and the additional savings will be credited.

The *thickness of the DHW pipe insulation should be equivalent to the diameter of the piping. For example, a 1"* diameter pipe should be insulated with 1" thick insulation; a 2-1/2" diameter pipe with 2-1/2" thick insulation.[67]

If the hot water piping diameter is in other than a ½" increment, the dimension should be rounded to the next protocol increment.

In the event that the above appears not to cover the specific DHW piping circumstance, suitable pictures and descriptions should be sent to PGW or their implementation contractor for judgment.

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

Natural Gas Savings Algorithms

[67] Recommendation based on method pioneered by Gary Klein expert on DHW based in California

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

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%[68]

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

Insulation Thickness (inches)	Heat Loss (Btu/ft/yr)
Bare	268,231
0.5	86,461
1.0	65,350
1.5	51,421
2.0	44,851
2.5	38,544
3.0	36,004
3.5	33,989
4.0	32,412
4.5	30,923
5.0	29,872

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

System Application = Pipe - Horizontal

Dimensional Standard = ASTM C 585 Rigid

Calculation Type = Heat Loss Per Hour Report

Process Temperature = 120

Ambient Temperature = 60

Wind Speed = 0

Nominal Pipe Size = 0.75

Bare Metal = Copper

Bare Surface Emittance = 0.6

Insulation Layer 1 = Polystyrene PIPE, Type XIII, C578-11b

Outer Jacket Material = All Service Jacket

[68] See assumption for low flow showerhead.

Outer Surface Emittance = 0.9

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[69].

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."[70]

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

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.

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

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

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[71] 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[72]
8,760	=	Number of hours in a year
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[73]
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

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[74].

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[71] 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

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

[73] See assumption for low flow showerhead.

[74] 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[75]/day to estimate heating slope (MMbtu/HDD63) and baseload daily use (MMBtu/day) with an annual HDD63 of 4033[76] 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%

[75] 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.
[76] 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.

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 of the house or unit and the outdoors without buffering from any adjacent unit(s) 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[77]

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

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

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

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:

ΔkWh = gross customer annual kWh savings for the measure.

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

[77] 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.

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

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]

[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.

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
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.

Water Savings
There are no water savings for this measure.

3) Roof and Cavity Insulation

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 attic or walls which directly define the boundary between the house or unit and the outdoors.

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

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[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.

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[85].
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.[86]

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

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

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

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

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

[85] From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820

[86] 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

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

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

Term	Type	Value	Source
DUA	Fixed	0.75	OH TRM[87]
$SEER_{CAC}$	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[88]

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[89]	$EFLH_{cool\ RAC}$ (Hours)[90]	CDD (Base 65)[91]	HDD (Base 65)[92]
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.

Measure Lifetimes

Measure	Measure Lifetime
Roof Insulation	40
Cavity Insulation	40

[87] "State of Ohio Energy Efficiency Technical Reference Manual," prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation. August 6, 2010.
[88] 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). $F_{Room,AC} = (425\ ft^2 * 2.1)/(2323\ ft^2) = 0.38$
[89] PA 2010 TRM Table 2-1.
[90] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement
[91] 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
[92] Ibid.

Source: NYSERDA Home Performance with Energy Star.

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.[93]

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

Energy Savings

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

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

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

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

Demand Savings

$\Delta kW = 0\ kW$

Where:

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

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*

[93] 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

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).

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 an un-insulated 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

$$Annual\ Gas\ Savings\ (MMBtu) = Length \times \frac{EFLH_{heat}}{24 \times 365} \times \frac{\left(HeatLoss(Th_{base}) - HeatLoss(Th_{eff})\right)}{AFUE \times 1{,}000{,}000}$$

Where:

Length = Number of linear feet of duct work insulated

$EFLH_{heat}$ = Equivalent full load heating hours = 730 hours

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[94]
Ave. Wind Speed	=	0 mph
Relative Humidity	=	N/A
Dew Point	=	N/A
Condensation Control Thickness	=	N/A
Hours Per Year	=	2000[95]
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.

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[96].

6) Heating Pipe Insulation

[94] Average winter temperature for Philadelphia from "Cost Savings and Comfort for Existing Buildings", 3rd Edition, by John Krigger, Saturn Resource Management. Page 255.
[95] 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
[96] NYSERDA Home Performance with Energy Star

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 space heating pipes in unconditioned spaces.

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

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

$$H_{Heat} = \frac{HDD \times 24}{Dt} = \frac{4{,}033 \times 24}{59} = 1{,}640$$

Where:

Length	=	Number of linear feet of heating pipe insulated
H_{heat}	=	Heating hours for a properly sized boiler. Used as an estimate of the hours in which the space-heating pipe would be hotter than the ambient temperature and would therefore experience heat loss.
Th_{base}	=	Thickness of base condition insulation (inches)
Th_{eff}	=	Thickness of efficient condition insulation (inches)
HeatLoss(x)	=	Heat loss through pipe as a function of insulation thickness x (Btu/ft /hr)
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 pipe insulation.
HDD	=	Base 63° F Heating Degree Days for Philadelphia = 4,033[97]
Dt	=	Design temperature difference (assume from 11° F to 70° F for properly sized boiler)[98] = 59° F

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

Insulation Thickness (inches)	Steam Heat Loss (Btu/ft/hr)	Hot Water Heat Loss (Btu/ft/hr)
Bare	201.4	72.12
0.5	47.75	15.24

[97] Based on NCDC ASOS temperature data for PHL from 2002 through 2009.
[98] 11 degree design temperature source: 5th Edition Residential Energy, Cost Savings and Comfort for Existing Buildings. John *Krigger and Chris Dorsi, 2009, Saturn Resource Management, Appendix A-8, p. 280.*

1.0	31.15	11.2
1.5	24.09	8.67
2.0	20.28	7.51
2.5	17.98	6.42
3.0	16.35	5.98
3.5	15.13	5.64
4.0	14.06	5.37
4.5	13.31	5.12

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 piping*
System Application	=	Pipe - Horizontal
Dimensional Standard	=	ASTM C 585 Rigid
Calculation Type	=	Heat Loss Per Hour Report
Process Temperature	=	212
Ambient Temperature	=	60
Wind Speed	=	0
Nominal Pipe Size	=	2
Bare Metal	=	Copper
Bare Surface Emittance	=	0.6
Insulation Layer 1	=	850F Mineral Fiber PIPE, Type I, C547-11
Outer Jacket Material	=	All Service Jacket
Outer Surface Emittance	=	0.9

Item Description	=	hot water piping
System Application	=	Pipe - Horizontal
Dimensional Standard	=	ASTM C 585 Rigid
Calculation Type	=	Heat Loss Per Hour Report
Process Temperature	=	180.
Ambient Temperature	=	60
Wind Speed	=	0
Nominal Pipe Size	=	0.75
Bare Metal	=	Copper
Bare Surface Emittance	=	0.6
Insulation Layer 1	=	Phenolic SHEET+TUBE,Type III, C1126-11
Outer Jacket Material	=	All Service Jacket
Outer Surface Emittance	=	0.9

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[99].

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 into unconditioned spaces. In order to verify savings, a duct-leakage 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[100]

Electric Savings Algorithms
Electric savings per 100 CFM-25 reduction:[101]

- *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

[99] NYSERDA Home Performance with Energy Star
[100] Based on 3.5 MMBtus savings per 100 CFM reduction for duct sealing from UI/CL&P Program Savings Documentation – 2011, page 131
[101] UI/CL&P Program Savigns Documentation, 2011, page 131

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[102].

8) High Efficiency Window

Unique Measure Code(s): TBD
Draft date: 7/29/13
Effective date: TBD
End date: TBD

Measure Description
This involves installing a window with a U-factor less than a baseline window.

Definition of Baseline Condition
The baseline is the minimum window required by code. IECC 2009 for Philadelphia requires a U-factor of 0.35 or less.

Definition of Efficient Condition
An efficient window is any window exceeding Energy Star® requirements for U-factor of 0.32 or less.

Gas Savings Algorithms

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{HDD_t \times 24 \times AREA \times (U_{base} - U_{eff})}{(AFUE \times 1{,}000{,}000)}$$

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[103].
24	=	Hours per day
AREA	=	Square feet of window area.
U_{base}	=	U-factor of new baseline window. U_{base} = 0.35 based on IECC 2009.
U_{eff}	=	U-factor of efficient window.
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. Use default AFUE of 80% if actual AFUE is not available.

[102] California DEER estimage.
[103] *From NWS data for PHL from 2002-2009, HDD63=4033 and HDD62 = 3820*

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.*[104]

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

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

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

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.*

[104] 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

$SEER_{CAC}$	= *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[105]
$SEER_{CAC}$	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*[106]

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

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

EFLH, CDD and HDD by City

City	$EFLH_{cool}$ (Hours)[107]	$EFLH_{cool\ RAC}$ (Hours)[108]	CDD (Base 65)[109]	HDD (Base 65)[110]
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*
Window	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetime

Measure	Measure Lifetime
Window	30

Source: NREL Measure Database.

Water Savings

There are no water savings for this measure.

[107] PA 2010 TRM Table 2-1.
[108] PA SWE Interim Approved TRM Protocol – Residential Room AC Retirement
[109] 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
[110] Ibid.

B. Domestic Hot Water End Use

9) 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[111].

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[112]
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[113]
11.6	=	Average gallons of water per person per day used for showering[114]
365	=	Days per year
1.6	=	Average number of showers per home[115]

Natural Gas Savings Algorithms

[111] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[112] The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)
[113] Pennsylvania, Census of Population, 2000.
[114] 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)
[115] 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)[116]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[117]

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[118].

10) 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.

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[119].

[116] 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
[117] 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).
[118] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[119] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

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[120]
GPM_{eff}	=	Gallons per minute of the efficient showerhead
2.48	=	Average number of people per household[121]
10.9	=	Average gallons per day used by faucet[122]
365	=	Days per year
50%	=	Drain rate, the percentage of water flowing down the drain[123]
3.5	=	Average Number of Faucets per home[124]

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

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

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).[125]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[126]

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.

[120] 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
[121] Pennsylvania, Census of Population, 2000.
[122] 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)
[123] Estimate consistent with Ontario Energy Board, "Measures and Assumptions for Demand Side Management Planning."
[124] East Bay Municipal Utility District; "Water Conservation Market Penetration Study" http://www.ebmud.com/sites/default/files/pdfs/market_penetration_study_0.pdf
[125] Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)
[126] See assumption for low flow shower head.

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes
The measure life of a faucet aerator is assumed to be 12 years[127].

11) 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[128].

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.

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

Where:

EF_{base}	=	Energy Factor of baseline water heater
EF_{eff}	=	Energy Factor of efficient water heater. If combi boiler use AFUE.
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.

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

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[129].

12) 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.

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

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[130]
8,760	=	Number of hours in a year

[129] DEER values, updated October 10, 2008
http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls
[130] 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

RE_{DHW} = Recovery efficiency of the domestic hot water heater = 75%[131]
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[132].

13) 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.

[131] See assumption for low flow showerhead.
[132] Page 410. Vermont Technical Reference Manual and New Jersey Clean Energy Program Protocols

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*[133]

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)[134]
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75%[135]

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.

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[133] 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)

[134] 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

[135] See assumption for low flow showerhead.

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

14) 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.

If the diameter of the cold/hot feeds directly to/from the storage tank is 1" or less, a maximum length of three feet for both the cold water inlet and hot water outlet piping above the tank (six total feet) per unit will be included in the savings calculations under the program and should be installed in accordance with best practices.

For each ½" increase in diameter of the hot feed directly from the storage tank beyond 1", an additional 6' length of pipe insulation should be installed along the hot water supply piping only and the additional savings will be credited.

If a DHW recirculating system is present, all hot water supply and return piping accessible without demolition should be insulated and the additional savings will be credited.

The thickness of the DHW pipe insulation should be equivalent to the diameter of the piping. For example, a 1" diameter pipe should be insulated with 1" thick insulation; a 2-1/2" diameter pipe with 2-1/2" thick insulation.[136]

If the hot water piping diameter is in other than a ½" increment, the dimension should be rounded to the next protocol increment.

In the event that the above appears not to cover the specific DHW piping circumstance, suitable pictures and descriptions should be sent to PGW or their implementation contractor for judgment.

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

Natural Gas Savings Algorithms

[136] Recommendation based on method pioneered by Gary Klein expert on DHW based in California

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

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%[137]

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

Insulation Thickness (inches)	**Heat Loss (Btu/ft/yr)**
Bare	268,231
0.5	86,461
1.0	65,350
1.5	51,421
2.0	44,851
2.5	38,544
3.0	36,004
3.5	33,989
4.0	32,412
4.5	30,923
5.0	29,872

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
System Application	=	Pipe - Horizontal
Dimensional Standard	=	ASTM C 585 Rigid
Calculation Type	=	Heat Loss Per Hour Report
Process Temperature	=	120
Ambient Temperature	=	60
Wind Speed	=	0
Nominal Pipe Size	=	0.75
Bare Metal	=	Copper
Bare Surface Emittance	=	0.6
Insulation Layer 1	=	Polystyrene PIPE, Type XIII, C578-11b
Outer Jacket Material	=	All Service Jacket

[137] See assumption for low flow showerhead.

Outer Surface Emittance = 0.9

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[138].

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.

15) 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."[139]

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

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.

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

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

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[140] 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[141]

8,760 = Number of hours in a year

RE_{DHW} = Recovery efficiency of the domestic hot water heater = 75%[142]

1,000,000 = Btu to MMBtu

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

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

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

*** Assuming square access area with 4" square and 2" clearance on each side*

Electric Savings Algorithms

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[143].

[140] 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

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

[142] See assumption for low flow showerhead.

[143] 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.

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

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[144]
Dt	= Design temperature difference (assume from 0° F to 70° F)

Equivalent Full Load Heating Hours by Building Type

Building Type	EFLH
Multifamily	854
Education	910
Food Sales	1,099
Food Service	1,203
Health Care	1,654
Lodging	463
Retail	904
Office	867
Public Assembly	1,043
Public Order/Safety	744
Religious Worship	898
Service	1,475
Warehouse/Storage	623

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.

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

Water Savings
There are no water savings for this measure.

1) Steam Trap

Unique Measure Code(s): TBD
Draft date: 4/29/14
Effective date: TBD
End date: TBD

Measure Description
This measure applies to replacing non-residential steam traps on heating systems.

Definition of Baseline Condition
The baseline criterion is a faulty steam trap in need of replacing. No minimum leak rate is required. Any leaking or blow through trap can be repaired or replaced. If a customer chooses to repair or replace all the steam traps at the facility without verification, the savings are adjusted. Savings for full replacement projects are reduced by the percentage of traps found to be leaking on average from the studies listed. If an audit is performed on a site, then the leaking and blowdown can be adjusted.

Definition of Efficient Condition
Customers must have leaking traps to qualify. However, if a customer opts to replace all traps without inspection, the savings are discounted to take into consideration the fact that some traps are being replaced that have not yet failed.

Gas Savings Algorithms

$$\Delta MMBtu = S \times \left(\frac{Hv}{B}\right) \times Hr \times A \times L / 1{,}000{,}000$$

Where:

$\Delta MMBtu$	=	MMBtu of saved gas per year
S	=	Maximum theoretical steam loss per trap (lb/hr/trap). See table of values.
Hv	=	Heat of vaporization of steam, (Btu/lb). See table of values.
B	=	Boiler efficiency, (%)
Hr	=	Annual operating hours of steam plant. See table of values.
A	=	Adjustment factor to account for reducing the maximum theoretical steam flow (S) to the average steam flow (the Enbridge factor).
L	=	Leaking and blow-thru factor. If the steam trap has been audited and is known to be leaking, then this factor is 100%, if unaudited and unknown if leaking, then see table of values below.
1,000,000	=	Btu to MMBtu

Steam Trap Algorithm Input Values

Steam Trap Application and Pressure	Avg Steam Loss, S (lb/hr/trap)[145]	Heat of Vaporization Hv (Btu/lb)[146]	Default Boiler Efficiency B[147]	Operating Hours, H[148]	Adjustment Factor, A[149]	Leaking & Blow-thru factor for unaudited traps, L[150]
Commercial/Multifamily, low pressure	13.8	951	80%	2,720	50%	27%
Dry Cleaners	38.1	890	80%	2,425	50%	27%
Industrial Low Pressure PSIG<15	13.8	951	80%	7,752	50%	16%
Industrial Medium Pressure 15<PSIG<30	12.7	945	80%	7,752	50%	16%
Industrial Medium Pressure 30<PSIG<75	19	928	80%	7,752	50%	16%
Industrial High Pressure 75<PSIG<125	67.9	894	80%	7,752	50%	16%
Industrial High Pressure 125<PSIG<175	105.8	868	80%	7,752	50%	16%
Industrial High Pressure 175<PSIG<250	143.7	846	80%	7,752	50%	16%
Industrial High Pressure PSIG>250	200.5	820	80%	7,752	50%	16%

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
Steam Traps	0%	0%

Persistence
The persistence factor is assumed to be one.

[145] Resource Solutions Group "Steam Traps Revision #1" dated August 2011.
[146] Heat of vaporization of steam at the inlet pressure to the steam trap. Implicit assumption that the average boiler nominal pressure where the vaporization occurs, is essentially that same pressure. Reference Resource Solutions Group "Steam Traps Revision #1" dated August 2011.
[147] California Energy Commission Efficiency Data for Steam Boilers as sited in Resource Solutions Group "Steam Traps Revision #1" dated August 2011.
[148] Resource Solutions Group "Steam Traps Revision #1" dated August 2011, which references Enbridge service territory data and kW Engineering study. Commercial/Multifamily hours adjusted to Philadelphia based on the HDD in Philadelphia relative to Chicago.
[149] Enbridge adjustment factor used as referenced in Resource Solutions Group "Steam Traps Revision #1" dated August 2011 and DOE Federal Energy Management Program Steam Trap Performance Assessment.
[150] Dry cleaners survey data as referenced in Resource Solutions Group "Steam Traps Revision #1" dated August 2011. *If trap is known to be leaking, then this factor is 100%.*

Measure Lifetime
6 years[151]

Water Savings
There may be water savings for this measure, but the amount has not been calculated.

[151] Source paper is the Resource Solutions Group "Steam Traps Revision #1" dated August 2011. Primary studies used to prepare the source paper include Enbridge Steam Trap Survey, KW Engineering Steam Trap Survey, Enbridge Steam Saver Program 2005, Armstrong Steam Trap Survey, DOE Federal Energy Management Program Steam Trap Performance Assessment, Oak Ridge National Laboratory Steam System Survey Guide, KEMA Evaluation of PG&E's Steam Trap Program, Sept. 2007. Communication with vendors suggested a inverted bucket steam trap life typically in the range of 5 - 7 years, float and thermostatic traps 4- 6 years, float and thermodynamic disc traps of 1 - 3 years.

B.Commercial Kitchen End Uses

2) Commercial Convection Ovens

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

Measure Description
A general-purpose chamber designed for heating, roasting, or baking food by forcing hot dry air over the surface of the food product. The rapidly moving hot air strips away the layer of cooler air next to the food and enables the food to absorb the heat energy. For the purposes of this specification, convection ovens do not include ovens that have the ability to heat the cooking cavity with saturated or superheated steam. Maximum water consumption within the oven cavity must not exceed 0.25 gallons/hour. Ovens that include a hold feature are eligible under this specification as long as convection is the only method used to fully cook the food.

- *Full-Size Convection Oven*: A convection oven that is able to accept a minimum of five standard full-size sheet pans measuring 18 x 26 x 1-inch.

This does not cover ovens designed for residential or laboratory applications; hybrid ovens, such as those incorporating steam and/or microwave settings in addition to convection; other oven types, as defined in Section 1, including combination, conventional or standard, conveyor, slow cook-and-hold, deck, mini-rack, rack, range, rapid cook, and rotisserie ovens.

Definition of Baseline Condition
Cooking energy efficiency of 44% and Idle Energy Rate of 15,100 Btu/h[152].

Definition of Efficient Condition
Cooking energy efficiency greater than or equal to 46%[153] and an Idle Energy Rate less than or equal to 12,000 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.[154]

$$Annual\ Gas\ Savings\ (MMBtu) = 12.90\ MMBtu$$

[152] ENERGY STAR calculator default input.
[153] Using ASTM Standard F1496-99 (Reapproved 2005) based on heavy load (potato) cooking test.
[154] 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.

Water Savings
There are no water savings for this measure.

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%.
Idle energy rate:

- 14,000 Btu/h for Standard Fryer
- 16,000 Btu/h for Large Vat Fryer

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.*[155]

Standard Fryer (per frypot):

$$Annual\ Gas\ Savings\ (MMBtu) = 50.80\ MMBtu$$

Large Vat Fryer (per frypot):

$$Annual\ Gas\ Savings\ (MMBtu) = 79.50\ MMBtu$$

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings

ΔkWh = 0 kWh

[155] *http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO*

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 Fryer	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.

Water Savings
There are no water savings for this measure.

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 18% and Idle Energy Rate of 3,000 Btu/h per pan[156].

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.[157]

# of Pans	Annual Gas Savings (MMBtu)
3 pans	76.6
4 pans	86.4
5 pans	96.2
6 pans	105.4
7 + pans	105.4+ 14.2 per pan > 6 pans

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings
$\Delta kWh = 0\ kWh$

Demand Savings

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

[157] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=COO
4 pan is interpolated between 3 and 5 pan.

$\Delta kW = 0\ kW$

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 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.

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.

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[158].

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.[159]

$$Annual\ Gas\ Savings\ (MMBtu) = 13.10\ MMBtu$$

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 Gas Griddle	0%	0%

[158] From the Energy Star calculator

[159] 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.

Water Savings
There are no water savings for this measure.

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 1.6 gpm.

Definition of Efficient Condition

An efficient pre-rinse spray valve uses an average of 1.28 gpm.

Gas Savings Algorithms

The following shows the expected gas savings from an energy efficient pre-rinse spray valve meeting the above specifications.[160]

$$Annual\ Gas\ Savings\ (MMBtu) = 6.38\ MMBtu$$

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%

[160] *ENERGY STAR calculator 4/14.*

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Pre-rinse Spray Valve	5[161]

Water Savings
Expected water savings would be 62,305 gallons per year.[162]

C.Commercial Domestic Hot Water End Use

7) Commercial Domestic Hot Water Heater

Unique Measure Code(s): TBD
Draft date: 4/27/14
Effective date: TBD
End date: TBD

Measure Description
Installation of high-efficiency, gas-fired, storage-type, domestic hot water heaters greater than 75,000 Btu/hr.

Definition of Baseline Condition
Base case heater is a code-compliant storage gas heater as specified in ASHRAE 90.1-2007.

Definition of Efficient Condition
The efficient heater is a storage gas heater equal to or exceeding 94% thermal efficiency.

Gas Savings Algorithms
If multiple heaters are used, they are treated as a single unit, with system input capacity and standby loss rate equal to the sum of all units.

$$\Delta MMBtu = BaselineUse - EfficientUse$$

For commercial buildings other than multifamily:

$$BaselineUse = A \times E_b$$

For multifamily buildings:

$$BaselineUse = U \times E_b$$

All building types:

[161] Massachusetts 2011 Technical Reference Manual.
[162] Massachusetts 2011 Technical Reference Manual.

$$EfficientUse = \frac{[(GPY_W \times \Delta T \times 8.33\ Btu/Gal°F) + (SLR_e \times H)]}{1{,}000{,}000 \frac{Btu}{MMBtu} \times \eta_e}$$

$$GPY_W = \frac{[(BaselineUse \times 1{,}000{,}000\ Btu/MMBtu \times \eta_b) + (SLR_b \times H)]}{\Delta T \times 8.33\ Btu/Gal°F}$$

$$SLR_b = CAP_{H,e} \times \frac{1000}{800} + 110 \times \sqrt{CAP_{W,e}}$$ [163]

$$H = \frac{\left[\left(8760\ h\frac{r}{yr} \times CAP_{H,b} \times 1{,}000\frac{Btu}{MBtu}\right) - \left(BaselineUse \times 1{,}000{,}000\frac{Btu}{MMBtu}\right)\right]}{\left(CAP_{H,b} \times 1000\ Btu/MBtu\right) - \frac{SLR_b}{\eta_b}}$$

$$CAP_{H,b} = CAP_{H,e} \times \frac{\eta_e}{\eta_b}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved gas per year
$BaselineUse$	=	Baseline DHW gas usage (MMBtu)
$EfficientUse$	=	Efficient DHW gas usage (MMBtu)
A	=	Building floor area (ft^2), input
E_b	=	For commercial buildings other than multifamily this is the annual baseline gas energy usage rate per building ft^2 ($MMBtu/ft^2/yr$). For multifamily this is the annual baseline gas energy usage rate per apartment unit (MMBtu/unit/yr). See table of values by building type.
U	=	Number of apartment units in multifamily building, input.
GPY_W	=	Annual building hot water usage (gal/yr)
ΔT	=	Differential temperature rise (75°F)
SLR_e	=	Proposed efficient water heater standby loss rate (Btu/hr), input
H	=	Number of annual standby hours (Hrs/yr)
η_e	=	Thermal efficiency of proposed efficient water heater (%)
η_b	=	Thermal efficiency of baseline water heater (80%)[164]
$CAP_{H,e}$	=	Heat Input capacity of proposed efficient water heater (MBh, 1000 Btu/hr), input
$CAP_{W,e}$	=	Water Storage capacity of proposed efficient water heater (gal), input
$CAP_{H,b}$	=	Heat Input capacity of baseline water heater (MBh)
SLR_b	=	Baseline water heater standby loss rate (Btu/hr)

Annual Baseline Gas Usage Rate by Building Type

Building Type	Annual Baseline Gas Usage Rate, E_b (MMBtu/ft2/yr)[165]
Education	0.00494
Grocery/Convenience Store	0.00299
Restaurant/Cafeteria	0.03739
Inpatient Health Care	0.03677

[163] ASHRAE 90.1-2007, Table 7.8.
[164] ASHRAE 90.1-2007, Table 7.8.
[165] U.S. Energy Information Administration Table E8A. Natural Gas Consumption and Energy Intensities by End Use for All Buildings, 2003.

Outpatient Health Care	0.00330
Lodging	0.02730
Retail (other than in mall)	0.00093
Retail (in mall)	0.00288
Office	0.00155
Police/Fire Station/Jail	0.01411
Other	0.00093
	Annual Baseline Gas Usage Rate, E_b (MMBtu/unit/yr)[166]
Multifamily	22.5

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 DHW Heater	0%	0%

Persistence
The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Commercial DHW Heater	12

Sources: CA DEER, MA 2011 TRM, ENERGY STAR.

[166] GDS Associates, Inc. (2009). Natural Gas Energy Efficiency Potential in Massachussetts. Prepared for GasNetworks.

Water Savings
There are no water savings for this measure.

D.All End Uses

1) Custom Measure

Unique Measure Code(s): TBD
Draft date: 7/22/13
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.

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

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
ΔkWh = *BaselinekWh* - *EfficientkWh*

Demand Savings
ΔkW = *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.

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

VII. Non-Residential Retrofit

A. Space Heating End Use

1) Efficient Space Heating System

Unique Measure Code(s): TBD
Draft date: 5/6/14
Effective date: TBD
End date: TBD

Measure Description

This measure applies to high-efficiency gas furnaces and boilers replacing an existing and functioning furnace or boiler of lower efficiency and possibly different capacity.

Definition of Baseline Condition

The baseline represents the existing equipment that is currently installed. The efficiency level and capacity are 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 following equation accounts for differences between the baseline and efficient space heating equipment efficiencies and capacities.

$$Annual\ Gas\ Savings\ (MMBtu) = \frac{Capacity_{base}}{1{,}000} \times \left[\frac{1}{AFUE_{base}} - \frac{SR \times (1 + A_{avg})}{AFUE_{eff}}\right] \times EFLH_{Heat,base}$$

$$SR = \frac{Capacity_{eff}}{Capacity_{base}}$$

$$EFLH_{Heat,base} = \frac{Annual\ Gas\ Use_{base} \times AFUE_{base}}{Capacity_{base}}$$

Where:

$Annual\ Gas\ Savings\ (MMBtu)$ = The annual gas savings of the efficient space heating equipment compared to the existing equipment.

$Capacity_{base}$ = The existing space heating equipment output capacity (MBH)

$AFUE_{base}$ = Efficiency of existing space heating equipment (Annual Fuel Utilization Efficiency)

SR = Sizing ratio of new efficient relative to the existing baseline equipment (See algorithm above).

A_{avg} = Runtime percent change adjustment. See table of values below based on SR value.[167]

[167] Developed by Practical Energy Solutions using simulation modeling.

$AFUE_{eff}$	=	Efficiency of proposed efficient space heating equipment (Annual Fuel Utilization Efficiency)
$EFLH_{Heat,base}$	=	Equivalent full load heating hours for existing baseline equipment (See algorithm above).
$Capacity_{eff}$	=	The proposed efficient space heating equipment output capacity (MBH)
$Annual\ Gas\ Use_{base}$	=	The annual gas usage of the existing space heating equipment, based on weather-normalized gas bills (kBtu).

Sizing Ratio (*SR*)	**Run Time Adjustment (A_{avg})**
50%	78%
55%	65%
60%	54%
65%	45%
70%	36%
75%	28%
80%	21%
85%	15%
90%	10%
95%	5%
100%	0%
105%	-4%
110%	-8%
115%	-12%
120%	-15%
125%	-18%
130%	-21%
135%	-23%
140%	-26%
145%	-28%
150%	-30%
155%	-32%
160%	-34%
165%	-36%
170%	-37%
175%	-39%
180%	-40%
185%	-42%
190%	-43%
195%	-44%
200%	-46%

Electric Savings Algorithms

Energy Savings

ΔkWh = *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
Space Heating Equipment	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.

Water Savings

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

B.All End Uses

2) 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.

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 Fifth Year Implementation Plan Fiscal Year 2015 upon the participants listed below in accordance with the requirements of § 1.54 (relating to service by a participant).

VIA EMAIL AND FIRST CLASS MAIL

Darryl Lawrence, Esq.
Christy Appleby, Esq.
Office of Consumer Advocate
5th Floor, Forum Place Bldg.
555 Walnut Street
Harrisburg, PA 17101-1921
dlawrence@paoca.org
cabbelby@paoca.org

Charis Mincavage, Esq.
McNEES, WALLACE, NURICK
100 Pine Street
P.O. Box 1166
Harrisburg, PA 17108-1166
cmincava@mwn.com

Sharon Webb, Esq.
Office of Small Business Advocate
Commerce Building, Suite 1102
300 North 2nd Street
Harrisburg, PA 17101
swebb@pa.gov

Thu B. Tran, Esquire
Community Legal Services
1424 Chestnut Street
Philadelphia, PA 19102
ttran@clsphila.org

Richard A. Kanaskie, Esq.
Bureau of Investigation and Enforcement
PA Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor
Harrisburg, PA 17120
rkanaskie@pa.gov

Clean Air Council of Philadelphia
135 South 19th St., Suite 300
Philadelphia, PA 19103

Date: May 14, 2014

Daniel Clearfield, Esq.

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