Central Hudson Gas & Electric Corporation

Residential Appliance Recycling Program

2010-2011 Impact Evaluation · March 2014

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Table of Contents

Executive Summary

Applied Energy Group, Inc. ("AEG") was retained by Central Hudson Gas & Electric ("Central Hudson" or "Company") to conduct an impact evaluation of its Residential Appliance Recycling Program. The program is part of Central Hudson's effort to help the State of New York meet its goal of reducing statewide electricity usage by 15% by 2015.

Central Hudson is a regulated transmission and distribution utility serving approximately 300,000 electric customers and 75,000 natural gas customers in New York State's Mid-Hudson River Valley, which extends from the suburbs of metropolitan New York City to the Capital District of Albany.

The Appliance Recycling Program, launched on June 21, 2010, incentivizes households to recycle their primary or secondary, inefficient refrigerators or freezers and replace their room air conditioning units with new ENERGY STAR models. The program offers residential customers a $50 incentive to recycle their old, working refrigerators and freezers and a $50 or $100 rebate to purchase a new ENERGY STAR qualified room air conditioner when they recycle their old room air conditioner.

Table ES1. Appliance Recycling Program Participation, 2010-2011

Measure	Count	Percent
Refrigerator	5,089	59.5%
Top Freezer	*4,203*	*82.6%*
Bottom Freezer	*84*	*1.7%*
Side-by-side	*585*	*11.5%*
Single Door	*217*	*4.3%*
Freezer	1,498	17.5%
Upright	*671*	*44.8%*
Chest	*826*	*55.1%*
Single Door	*1*	*0.1%*
Room Air Conditioner	1,963	23.0%
Wall	*386*	*19.7%*
Window	*1,577*	*80.3%*
Program Total	8,550	100.0%

Overall a total of 8,550 appliances were recycled through the program from June 2010 through December 2011. Table ES1 displays the number of appliances recycled by measure category. Refrigerators had the greatest participation (59.5%), followed by room air conditioners (23.0%) and freezers (17.5%). This report demonstrates how AEG determined the energy savings impacts attributable to the entire Appliance Recycling Program, as well as the energy savings from each measure category.

A telephone survey of a representative random sample of participants was conducted to assess the influences of free ridership and spillover. Participants were randomly selected to achieve a 90 percent confidence level and a +/- 10 percent margin of error. Results from the survey were used to estimate the ratio of net to gross savings. The net-to-gross findings are presented in the table below.

Table ES2 Net to Gross Results

Free Ridership	Spillover	NTG
47%	35%	87%

AEG conducted an engineering analysis and a statistical billing analysis to evaluate the energy and demand savings impacts of the program. The engineering analysis used savings algorithms and program tracking data to estimate the amount of savings expected from the program. The billing analysis included a linear regression of year-over-year changes in average daily kWh use before and after implementation of the program. Results of the two analyses are provided in the table below on a per unit basis.

Table ES3 Net Savings per Unit

Measure Type	Engineering Analysis		Billing Analysis	
	Net kWh per Unit	Net kW per Unit	Net kWh per Unit	Net kW per Unit
Refrigerator	1,440	0.040	516	0.014
Freezer	1,094	0.031	768	0.022
Room Air Conditioner	89	0.306	47	0.162

The overall program savings was calculated by multiplying the unit savings by the number of participants in each measure type. AEG determined the net engineering analysis energy and demand savings for the Appliance Recycling Program to be 9,140,472 kWh and 851 kW, respectively. The net billing analysis program savings was 3,870,425 kWh and 424 kW.

1. Energy and Demand Savings

AEG determined the energy and demand savings for the Appliance Recycling Program based on the International Performance Measurement and Verification Protocols (IPMVP) Options A and C.[1] Consistent with the IPMVP protocols, AEG utilized a two-pronged approach to estimate the energy savings from the program.

To satisfy IMPVP Option A, AEG conducted an engineering analysis to determine the expected savings using engineering algorithms obtained from the *2010 New York Standard Approach Manual for Estimating Energy Savings from Energy Efficiency Programs* ("Tech Manual").[2] The Tech Manual is approved by the New York Public Service Commission to provide a standardized, fair and transparent approach for measuring program energy savings. Additionally, to satisfy IPMVP Option C, AEG conducted a billing analysis to directly evaluate any changes in participants' billed energy usage before and after participation in the program. The methodology and results from these two analyses are detailed in the following sections.

1.1 Engineering Analysis

Methodology

AEG conducted an engineering analysis to determine the expected amount of energy and demand savings from the program using algorithms found in the Tech Manual. AEG used equipment specifications from program tracking data as well as other inputs. The methodology used for each appliance (room air conditioners, refrigerators, and freezers) is described in more detail below.

The Tech Manual specifies the following formulae to estimate the energy (kWh) and peak demand (kW) savings from recycling room air conditioners.

Equation 1. Tech Manual Energy (kWh) Savings

$$\Delta kWh = units \times \frac{tons}{unit} \times \left(\frac{12}{EER_{base}} - \frac{12}{EER_{ee}} \times F_{repl}\right) \times EFLH_{cooling}$$

Equation 2. Tech Manual Peak Demand (kW) Savings

$$\Delta kW_S = units \times \frac{tons}{unit} \times \left(\frac{12}{EER_{base}} - \frac{12}{EER_{ee}} \times F_{repl}\right) \times CF_S$$

Where:

ΔkW_S	= *gross summer coincident demand savings*
ΔkWh	= *gross annual energy savings*
units	= *the number of air conditioning units recycled*
tons/unit	= *tons of air conditioning per unit, based on nameplate data*

1 More information about the IPMVP protocols is available at http://www.evo-world.org/

[2] *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs*, Prepared for New York Department of Public Service by TecMarket Works, October 15, 2010.

EER = *energy efficiency ratio under peak conditions (Btu/watt-hour)*
$EFLH_{cooling}$ = *cooling equivalent full-load hours*
F_{repl} = *fraction of the recycled units that are replaced with a new unit*
CF = *coincidence factor*
12 = *conversion factor (kBtuh/ton)*

Default values from the Tech Manual were used for variables that were not available through the program tracking data. The Tech Manual assumptions used in the analysis are summarized in Table 1 below.

Table 1. Room Air Conditioner Tech Manual Values

Variable	Value
Tons	0.7
EER_{base}	7.7
EER_{ee}	9.8
CF	0.8
$EFLH_{cooling}$	223
F_{repl}	0.76

Using the input assumptions provided in the Tech Manual, the savings algorithm reflects a constant savings value per recycled room air conditioner. This constant savings value was multiplied by the total number of room air conditioners to yield the savings estimate for that measure category.

The Tech Manual uses a constant deemed savings estimate for recycled refrigerators and freezers due to the significant variances in appliance specifications and usages among customers. Deemed savings refers to a constant savings value that is assumed for all measures with the same type and size.

Results

The gross energy and demand savings per unit for each measure type is shown in the table below.

Table 2. Gross Energy and Demand Savings per Unit, Engineering Analysis

Measure	Units	Gross kWh per Unit	Gross kW per Unit
Refrigerator	5,089	1,655	0.046
Freezer	1,498	1,257	0.036
Room Air Conditioner	1,963	102	0.352

AEG calculated the gross savings by multiplying the total number of units by the deemed savings value for each measure type. The table below shows the total gross energy and demand savings for each measure type.

Table 3 Total Gross Energy and Demand Savings, Engineering Analysis

Measure	Total Gross kWh Savings	Total Gross kW Savings
Refrigerator	8,422,295	234
Freezer	1,882,986	54
Room Air Conditioner	201,009	690
Program Total	10,506,290	978

Overall the total gross energy and demand savings attributable to the program was 10,506,290 kWh and 978 kW, respectively. Refrigerators accounted for the majority of energy savings, followed by freezers and room air conditioners. For demand savings, the majority of savings came from room air conditioners, followed by refrigerators and freezers.

1.2 Billing Analysis

Methodology

AEG conducted a statistical billing analysis to directly estimate program savings by examining the change in energy usage of participants before and after participating in the program. The analysis used a year-over-year differencing method to reflect changes in average daily energy usage over the same billing period before and after participating in the program.[3]

The customer billing data was divided into an experimental group (Appliance Recycling Program participants) and a control group (non-participants). AEG was able to estimate the net energy savings attributable to the program by examining the energy usage of the experimental group before and after participation. Observing changes in a control group of non-participants further validates the energy savings of the experimental group by establishing the energy usage over the same time period by the non-participants.

Central Hudson Customer Billing Data

Central Hudson provided approximately two years of customer billing data from July 2010 through September 2012 to conduct the analysis. The data included rate information (account number, name address, etc.) and the periodicity of the billing periods. Central Hudson reads residential meters approximately once every two months for a total of 6 meter readings per year.

The billing period data was normalized across meter read periods to derive the average daily kWh usage for each account using the equation below. The average daily kWh was calculated using a simple average of the total usage over the billing period divided by the number of days in the billing period. The average daily kWh usage was the basic unit of analysis to determine the impact of the Appliance Recycling Program.

Equation 3. Average Daily kWh Usage

$$Average\ Daily\ kWh = \frac{Billing\ Period\ kWh}{Number\ of\ Days}$$

[3] Since each participant had a unique start date the amount of billing data for these two periods varies. However, on average the billing data provides usage information for approximately 8 months before and 13 months after the program start date. For more detail about the statistical analysis and methodology see Appendix D of this report.

AEG cleaned the billing data before conducting the analysis in order to ensure the analysis was statistically valid. In particular, AEG removed customer accounts with the following criteria:

- Customers with outlier average daily kWh usage (+/- 3 standard deviations away from the average)
- All commercial and other non-residential customer classifications
- All gas billing data

After the data was sufficiently cleaned, AEG further separated the billing data into an experimental group and a control group. This process is detailed in the following sections.

Experimental Group Data Cleaning and Sample Extraction

The experimental group includes the Central Hudson customers who only participated in the Appliance Recycling Program. Customers who participated in any other programs in addition to the Appliance Recycling Program are not included in the experimental group in order to isolate the impact of the appliance removal. The primary task for identifying customers in the experimental group was to merge the billing data and the program participant data.

Merging the billing data and program participant data presented several challenges. The primary challenges related to matching billing data to program participant data. Many participants lacked sufficient uniquely identifying information to reliably merge the two data sets. Nevertheless, AEG performed comprehensive data scrubbing techniques to make the participant data align with the billing information (i.e. removing dashes, spaces and other special characters from the account and telephone number fields, etc.).

Participants with a valid 11-digit customer account number were identified by matching it directly to the billing data. Participants without a valid 11-digit account number, however, were identified using an alternate method by matching the billing telephone number. As Table 4 indicates, 23 percent of program participants lacked sufficient data necessary to be reliably matched to the billing information. Of those customers who were able to be matched, 28 percent were matched on telephone and/or account number and 72 percent were matched on telephone number only (see Table 7).

Table 4. Appliance Recycling Program and Billing Data Matches

Billing Data Match	Refrigerator	Freezer	Room Air Conditioner	Total
Yes	75%	75%	85%	77%
No	25%	25%	15%	23%
Total	100%	100%	100%	100%

Table 5. Appliance Recycling Program and Billing Data Match Types

Billing Match Type	Refrigerator	Freezer	Room Air Conditioner	Total
Telephone Only	62%	68%	97%	72%
Account Only	12%	8%	1%	8%
Telephone and Account	27%	24%	2%	20%
Total Matched	100%	100%	100%	100%

Once the program participants were sufficiently identified and extracted from the customer billing data some further modifications were performed before commencing the analysis. In particular, the following participants were removed from the experimental group to facilitate the analysis:

- Customers with tracking data indicating something other than refrigerators and freezers (e.g. CFLs or AC units) were removed from the data.
- Customers that reportedly had more than one appliance removed under the program.

Account information for participants who received CFLs or recycled AC units through the program was not collected. As a result, AEG was unable to reliably identify the billing data for these participants and they were removed from the data, and consequently were not included in the billing analysis.

The billing analysis relied on a statistical sample from the experimental group to represent the geographical dispersion of participation in the experimental group population. AEG used the 3-digit zip code of the experimental and control group to ensure that the control group approximately resembled the experimental group. The following tables show the participation rates for each appliance by 3-digit zip code.

Table 6. Appliance Unit Removals in Experimental Group Population

3-Digit Zip code	Freezer	Refrigerator	Total	Percent of Total
105	14	73	92	1%
109	15	39	54	1%
120	70	155	227	3%
121	43	81	130	2%
124	438	1,497	1,972	29%
125	743	2,634	3,448	51%
126	163	574	749	11%
127	11	36	47	1%
Total	1,497	5,089	6,719	100%

Table 7. Appliance Unit Removals in Regression Sample

3-Digit Zip code	Freezer	Refrigerator	Total	Percent of Total:
105	0	21	21	2%
109	0	8	8	1%
120	10	39	49	4%
121	8	16	24	2%
124	80	345	425	31%
125	64	612	676	49%
126	33	147	180	13%
127	0	3	3	0%
Total	195	1,191	1,386	100%

The geographic dispersion for the sample is roughly proportionate to the population parameters.

Control Group

The control group represents the energy usage of customers who did not participate in the Appliance Recycling Program or any other program offered by Central Hudson. Differences in energy usage between the pre and post treatment time frames represent changes in energy usage that are not attributable to Central Hudson program influences. The following set of sampling criteria was used to select the control group for the analysis to ensure that the control group was statistically similar to the customer population:

- 3-Digit zip code geographical location
- Average daily kWh use in the pre-treatment period
- Coefficient of Variation (CV) in use during the pre-treatment period
- Non-participation in any CHG&E EE program during the analysis period

Appliance Recycling Program participants were removed from the control group in the same fashion as the experimental group, by matching the account and/or telephone number. In addition to the Appliance Recycling Program, Central Hudson also offered two other programs over the same time period – the Home Energy Comparison Reports (OPower) Program and the Residential HVAC Program – intended to reduce electricity usage among residential customers. All participants in these programs were identified and removed from the control group using their 11-digit Central Hudson account number obtained from the program tracking data.

By removing participants in other Central Hudson programs, the billing analysis offers a conservative estimate of program savings. Namely, the analysis does not include participants who recycled an appliance through the program, but also participated in another program offered by Central Hudson. Although these participants likely achieve some savings partially attributable to the Appliance Recycling Program, AEG did not account for the appliance recycling savings of customers who participated in multiple programs. The exclusion of these participants from the analysis could have a positive or negative influence on program savings.

A stratified random sample was extracted from the non-participant population to conduct the billing analysis. The sample was stratified according to 3-Digit zip code location to reproduce a geographic dispersion proportionate to the population. Table 8 presents the distribution of the non-participant sample employed in this study, by 3-digit zip code.

Table 8. Non-Participant (Control Group) Sample

3-Digit Zip Code	Count	Proportion
126	165	11%
125	765	51%
124	435	29%
120, 121 or 127	90	6%
105 or 109	45	3%
Total	1,500	100%

Table 9 shows the experimental group stratified by 3-digit zip code grouped in the same way as the control group sample. The data presented in Table 8 and Table 9 show that the proportion of cases in each group are comparable.

Table 9. Experimental Group Sample

3-Digit Zip Code	Count	Proportion
126	180	13%
125	676	49%
124	425	31%
120, 121 or 127	76	5%
105 or 109	29	2%
Total	1,386	100%

Results

The evaluation plan for the appliance removal program included a statistical analysis of energy savings applied to billing period data for samples of program participants, and a control group sample of non-participants. The statistical analysis performed in this study involved a linear regression of year-over-year changes in average daily kWh use before and after removal of a refrigerator or freezer unit through the program. The following equation displays the simplified linear billing analysis of pre/post changes in billed energy use.

Equation 4. Simplified Regression Model

$$\Delta\, Average\ Daily\ kWh = \mathrm{y_i} + \beta_1\{Refrigerator\ Savings\} + \beta_2\{Freezer\ Savings\} + \beta_3\{Weather\} + e_i$$

Average Daily kWh is the basic unit of analysis in this statistical billing study. With 12 billing data points for each participant, each covering roughly 60 days between meter read dates, average daily kWh is a measure of average total kWh consumption per household, each day, within each two-month interval in the billing cycle. This simple change model provides estimates of the average daily change in billed kWh usage associated with the removal of a refrigerator or freezer unit.

The model also accounts for the change in average daily kWh use attributable to seasonal influences. This was estimated using the average daily cooling degree days (CDD) and heating degree days (HDD) in the current billing period from what was observed during the same billing cycle 1-year earlier (i.e. a 6-period differencing in average daily CDD or HDD). Table 10 shows the estimated average daily impact on kWh usage for each variable included in the billing analysis. The coefficient estimates for refrigerator (a reduction of 1.42 avg kWh/day), and freezer (a reduction of 2.10 avg kWh/day) removals by program participants reveal marginal changes in average daily kWh.

Table 10. Simple Linear Billing Analysis Results

Variable	Parameter Estimate (kWh)	Standard Error	t-value	Pr > |t|
Intercept	-0.14	0.11	-1.31	0.1917
Refrigerator Savings	-1.41	0.20	-7.07	<.0001
Freezer Savings	-2.10	0.44	-4.81	<.0001
CDD Impact	0.76	0.11	6.7	<.0001
HDD Impact	0.25	0.02	12.37	<.0001

Although the model as a whole only explains a small proportion of the observed variance in the data sample (R-squared statistic ~2%), estimates of the change in average daily billed kWh use following appliance removals are statistically significant at almost any level of statistical precision. The billing

analysis was completed at a 90 percent confidence interval with ±10 percent statistical precision. Range estimates for the average daily energy savings for each recycled appliance are shown in the table below.

Table 4. Average Daily Energy Savings Estimates, Billing Analysis (90% CI, ±10%)

Measure Type	Energy Savings Estimate (kWh/day)		
	Lower	Mid	Upper
Refrigerator	1.09	1.41	1.74
Freezer	1.38	2.10	2.82

Room air conditioners were not included in the billing analysis due to data limitations. Without a valid account number, participants who recycled a room air conditioner were unable to be identified in the billing data. However, AEG was able to estimate the savings attributable to room air conditioners using the average realization rate of refrigerators and freezers. Due to the indirect methodology for calculating savings, the program savings for room air conditioners is uncertain. The realization rate was calculated simply by dividing the savings results of the billing analysis by the results of the engineering analysis. The average realization rate used to estimate savings for room air conditioners is shown in the table below.

Table 5. Average Realization Rate by Measure Type

Measure Type	Realization Rate
Refrigerator	31%
Freezer	61%
Average	46%

The mid-range average daily savings estimates from the billing analysis were converted to annualized savings figures per unit for refrigerators and freezers. Demand savings for each measure type were estimated proportionate to the engineering analysis results presented above. The savings for room air conditioners were determined using the average realization rate. The savings figures for room air conditioners were calculated indirectly and therefore they do not carry the same statistical certainty as the other measure types that were included in the billing analysis. The table below shows the energy and demand savings per unit for each measure type.

Table 6. Net Energy and Demand Savings per Unit, Billing Analysis

Measure Type	Net kWh per Unit	Net kW per Unit
Refrigerator	516	0.014
Freezer	768	0.022
Room Air Conditioner	47	0.162

The results of the billing analysis reflect net savings. The billing analysis accounted for the influences of free ridership and spillover by comparing the participants' energy usage to a control group. The control group is used to represent participant behavior without the influence of the program.

The total net energy and demand savings of the program were determined by multiplying the annual savings figures by the number of participants in each measure type. The total net savings for each measure type and the program overall are shown in the table below.

Table 7. Total Net Energy and Demand Savings by Measure Type, Billing Analysis

Measure Type	Total Net kWh	Total Net kW
Refrigerator	2,627,431	73
Freezer	1,150,246	33
Room Air Conditioner	92,748	318
Program Total	3,870,425	424

2. Net-to-Gross Analysis

Net energy and demand savings are the direct savings attributable to the Appliance Recycling Program, accounting for impacts resulting from other influences such as free ridership or spillover. Net impacts were calculated in the billing analysis provided in the previous section. In addition to calculating the net program savings, AEG also calculated program net-to-gross ("NTG") factors that can be applied to gross savings in the future. Calculating the NTG ratio helps aid program planning and implementation to determine the direct effects a program can expect. The following sections describe the methodology for determining the NTG factor and the net impacts.

2.1 Net-to-Gross Methodology

Sample Design

In October 2012, AEG conducted a survey of 80 Central Hudson customers who participated in the Appliance Recycling Program. The 80 survey participants were randomly selected from the entire participant population. Equation 5 shows the statistical formula used to determine the sample size of the NTG survey.

Equation 5. Sample Size

$$n = \frac{\hat{p}(1-\hat{p})z^2}{MOE^2}$$

Where:

n = sample size
MOE = Margin of error (10%)
z = standardized z-score of confidence level (90% = 1.645)
$\hat{p}$ = sample proportion (0.5)

For large populations 68 randomly selected respondents is the minimum target number of completed surveys needed to achieve the desired margin of error of +/- 10 percent and a 90 percent level of confidence. The survey was designed to capture free ridership and spillover to determine the net-to-gross ratio for the program.[4]

Free Ridership

Free ridership estimates the number of appliances that would have been recycled without the incentives provided through Central Hudson's Appliance Recycling Program. Two survey questions were specifically designed to reveal the portion of savings that should be attributed to free ridership, for each appliance. Each participant was assigned a value based on the probability that they were a free rider. The following two tables present the free ridership probabilities for the two free ridership survey questions.

[4] The complete survey instrument is included in Appendix A of this report.

Free Ridership Question 1

QF1a. Were you planning on recycling the appliance prior to participating in the program?

Q1 Response	Min	Max	Est.
Yes	0%	50%	25%
No	0%	0%	0%

Free Ridership Question 2

QF1c. How likely is it that you would have recycled the EXACT SAME EQUIPMENT, if the utility had NOT OFFERED the REBATE?

Q2 Response	Min	Max	Est.
Very Unlikely	0%	0%	0%
Somewhat Unlikely	10%	30%	20%
Neither Likely or Unlikely	30%	50%	40%
Somewhat Likely	50%	70%	60%
Very Likely	70%	90%	80%

The free ridership estimate for each response ranges from zero to 100 percent. For example, respondents who answered "yes" to Question 1 were assigned a 25 percent probability that they would have recycled their appliance even without taking advantage of the program. Similarly, in Question 2 the probability of free ridership increases with the likelihood that the participant would have recycled their appliance if Central Hudson had not offered an incentive. The free ridership estimate reflects the free ridership probability weighted by the proportion of responses for each appliance category. The tables below show how estimates of free ridership were determined using the survey results.

Table 8. Free Ridership Estimate, Question 1

Measure	Probability	Count	Weight	FR Est.
Primary Refrigerator	25% 0%	22 4	0.85 0.15	21%
Secondary Refrigerator	25% 0%	31 4	0.89 0.11	22%
Freezer	25% 0%	15 1	0.94 0.06	23%
Room Air Conditioner	25% 0%	8 6	0.57 0.43	14%
Program Total	25% 0%	76 15	0.84 0.16	21%

Table 9. Free Ridership Estimate, Question 2

Measure	Probability	Count	Weight	FR Est.	Total
Primary Refrigerator	0%	15	0.52	0.00	25%
	20%	2	0.07	0.01	
	40%	5	0.17	0.07	
	60%	4	0.14	0.08	
	80%	3	0.10	0.08	
Secondary Refrigerator	0%	21	0.53	0.00	23%
	20%	3	0.08	0.02	
	40%	9	0.23	0.09	
	60%	3	0.08	0.05	
	80%	4	0.10	0.08	
Freezer	0%	7	0.44	0.00	34%
	20%	0	0.00	0.00	
	40%	3	0.19	0.08	
	60%	3	0.19	0.11	
	80%	3	0.19	0.15	
Room Air Conditioner	0%	7	0.47	0.00	31%
	20%	0	0.00	0.00	
	40%	4	0.27	0.11	
	60%	1	0.07	0.04	
	80%	3	0.20	0.16	
Program Total	0%	50	0.50	0.00	26%
	20%	5	0.05	0.01	
	40%	21	0.21	0.08	
	60%	11	0.11	0.07	
	80%	13	0.13	0.10	

The free ridership estimates from both questions were added together to get a total estimate for the overall program and each individual measure. The table below shows the overall free ridership estimate for the program as 47 percent.

Table 10. Total Free Ridership Estimate

Measure	FR Q1	FR Q2	Total FR
Primary Refrigerator	21%	25%	46%
Secondary Refrigerator	22%	23%	45%
Freezer	23%	34%	57%
Room Air Conditioner	14%	31%	45%
Program Total	21%	26%	47%

Spillover

Spillover represents the estimated portion of savings that occurred as a result of the Appliance Recycling Program, but were not directly incentivized through the program. The survey was designed to capture only participant spillover, non-participant spillover was not included in the analysis. Participants were asked a series of questions to determine the spillover impacts attributable to the program. The questions and scoring method are outlined below.

Spillover Question 1

QS1a. Have you taken any other steps to reduce energy use as a result of your participation in the Central Hudson Appliance Recycling Program?

Response	Count
Yes	34
No	36
DK/Refused	5
Program Total	75

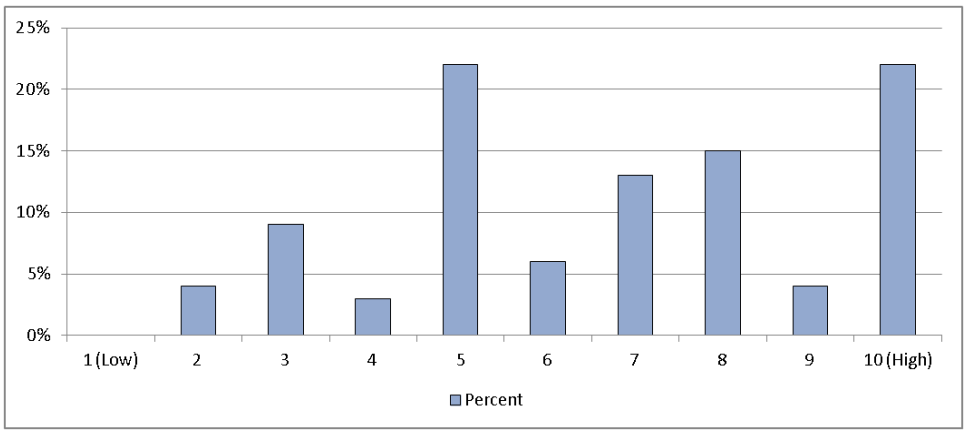
Spillover Question 2

QS1b. Have you done any of the following actions as a result of your participation in the program?

Response	Count
Shared your experience in the Appliance Recycling Program with your friends, neighbors and/or family members	20
Purchased Energy Star Appliances	21
Installed new energy efficient doors and/or windows in part of your home.	9
Installed new energy efficient doors and/or windows in all of your home.	3
Installed / upgraded insulation in your home (walls, ceiling, attic)	15
Insulated your water heater and/or installed pipe insulation	12
Other	14

Spillover Question 3

On a scale of 1-10 with 10 being very important and 1.0 meaning little importance, what influence did the program have in your decision to take additional EE actions in your home?



These three questions were designed to capture the additional indirect energy savings achieved as a result of the program. Only those respondents who answered "yes" to Spillover Question 1 were included in the spillover calculations. Spillover Question 2 captured the spillover energy savings action(s) that each respondent took as a result of participating in the program. Spillover Question 3 captures how much influence the program had in the participant's decision to engage in additional energy savings actions. Based on the responses to these questions, AEG used the following set of equations to determine the spillover savings for the program.

Equation 6. Weighted Spillover Score

$$Weighted\ Spillover\ Score = \frac{Spillover\ Question\ 3}{10}$$

Equation 6 converts the score from Spillover Question 3 to a percentage. This percentage shows how much influence the program had in each participant's decision to engage in additional energy savings actions.

Equation 7. Spillover Measure Savings

$$Spillover\ Measure\ Savings_{(participant\ i, measure\ j)} = TRM\ kWh\ Savings_{(measure\ j)} \times Weighted\ Spillover\ Score_{(participant\ i, measure\ j)}$$

Equation 7 determines the spillover measure savings for each participant based on the specific additional energy action(s) they took as a result of participating in the program. Each participant reported their actions in response to Spillover Question 2. AEG estimated the spillover measure savings of each participant using the appropriate Tech Manual algorithms from each reported action.

Table 23 shows the energy savings estimate for each action along with a general description of the assumptions used in the Tech Manual calculation. In order to incorporate energy savings in terms of both kWh and therms, spillover savings were converted to mmBTUs. For a complete overview of the assumptions and methodology used in the spillover savings calculations, see Appendix E.

Table 11. Spillover Actions and Tech Manual Savings Estimates

Response	Energy Savings (mmBTUs)	Assumption Summary
Shared your experience in the Appliance Recycling Program with your friends, neighbors and/or family members	0.00	No spillover savings associated with this action.
Purchased Energy Star Appliances	0.94	Average savings of a refrigerator/freezer, clothes washer/dryer, dishwasher
Installed new energy efficient doors and/or windows in *PART* of your home.	2.93	Reflects energy savings from upgrading 3 windows to high performance energy star windows
Installed new energy efficient doors and/or windows in *ALL* of your home.	9.78	Reflects energy savings from upgrading 10 windows to high performance energy star windows
Installed / upgraded insulation in your home (walls, ceiling, attic)	15.87	Average savings from upgrading wall and roof insulation.
Insulated your water heater and/or installed pipe insulation	2.47	Average savings from upgrading pipe and hot water heater insulation.
Installed Energy Efficient Lighting*	-13.73	Energy savings from installing 10 CFLs.
Installed Energy Efficient Furnace*	40.56	Energy savings from installing high efficiency gas furnace.

* Response included in "Other" category

Finally, Equation 8 determines the spillover factor adjustment, which reflects the ratio of all participant spillover measure savings to the total energy savings of all survey respondents. The spillover measure savings is the sum of all the energy savings from each participant as a result of the program. The total kWh savings for all survey respondents includes the spillover measure savings plus the non-spillover savings from recycling an appliance through the program.[5] Appendix G of this report includes the spillover results and calculations for each participant.

Equation 8. Spillover Factor Adjustment

$$Spillover\ Factor\ Adjustment = \frac{\sum Spillover\ Measure\ Savings_{(participant\ i, measure\ j)}}{\sum Total\ kWh\ Savings\ for\ All\ Survey\ Respondents}$$

[5] To calculate total energy savings, each respondent was given an additional 1,228 kWh (4.19 mmBTUs), the average participant energy savings from the Appliance Recycling Program. For a more detailed overview of the Tech Manual algorithms and savings assumptions, see Appendix E.

Table 12. Spillover Measure Savings (mmBTU) and Adjustment Factor

Measure	Spillover Savings	Gross Savings	Spillover Factor Adjustment
Refrigerator	257.4	662.5	39%
Freezer	75.9	222.1	34%
Room Air Conditioner	62.9	133.9	47%
Program Total	545.8	1,573.2	35%

The table above presents the spillover savings adjustment factors for each measure type as well as the entire program. AEG has determined that the spillover savings adjustment factor for the Appliance Recycling Program is 35 percent.

2.2 Net-to-Gross Results

The NTG ratio reflects the amount of savings that are attributable to the Appliance Recycling Program. As described in Equation 9, the NTG removes the estimated free ridership savings that would have occurred without the program and adds the additional spillover savings.

Equation 9. Net-to-Gross Ratio

$$NTG\ Ratio = 1 - Free\ Ridership + Spillover$$

AEG determined the NTG factor for each measure type shown in the table below.

Table 13 Net-to-Gross Factor

Free Ridership	Spillover	NTG
47%	35%	87%

The NTG factor was applied to the gross savings for each measure type estimated in the engineering analysis to calculate the net energy and demand savings attributable to the program. Note that the billing analysis was designed to estimate net savings so the NTG factor was not applied to those savings.

Table 14 Total Net Energy and Demand Savings, Engineering Analysis

Measure	Total Net kWh	Total Net kW
Refrigerator	7,327,397	204
Freezer	1,638,198	47
Room Air Conditioner	174,878	600
Program Total	9,140,472	851

A comparison of the total net energy and demand savings estimated from the engineering and billing analyses can be used to determine the realization rate of the program. The overall realization rate for the program is 42 percent for energy savings and 49 percent for demand savings.

3. Program Cost Effectiveness

Cost-effectiveness analysis compares the costs and benefits of efficient equipment with those of baseline (non-efficient) equipment. Cost-effectiveness analysis indicates whether the efficient technology(s) improve a customer's financial position, decrease overall energy costs to ratepayers, or raise society's well-being. A program is considered cost-effective if the benefit-cost ratio is greater than one (1.0). There are many approaches to performing cost-effectiveness tests and key assumptions regarding critical factors, such as future energy prices, can vary among experts. DPS has not required cost-effectiveness tests as part of EEPS evaluation studies and has not confirmed the assumptions and approaches in this analysis.

AEG analyzed the cost-effectiveness of the Residential Appliance Recycling Program utilizing four standard cost-effectiveness tests taken from the California Standard Practices Manual.[6] Each test analyzes cost-effectiveness from a different perspective and answering a separate question:

- Participant Cost Test: Compares customer costs and benefits of installing the measure. Will the participant benefit over the life of the measure?
- Program Administrator Cost Test (Utility Cost Test): Comparison of program administrator costs to supply-side resource benefits. Will utility costs to save energy be less than utility costs to deliver the same amount of energy?
- Ratepayer Impact Measure: Measures the impact of the DSM program on utility rates if rates were to be adjusted to account for the program. Comparison of utility program costs and bill reductions associated with energy savings to supply-side resource benefits. Will customer rates increase?
- Total Resource Cost Test: Comparison of program administrator and customer costs to utility resource savings. Will the total costs of energy in the utility service territory decrease?

Results from the impact evaluation, utilizing IPMVP best practices, are utilized in the four cost-effectiveness tests taken from the California Standard Practices Manual.

BenCost, an updated version of a public domain model that AEG customized for Central Hudson, was utilized to perform the cost-effectiveness modeling. BenCost is an input-output model that calculates all four cost-effectiveness tests. Central Hudson specific inputs, including avoided costs, discounts rates, participation and incentives, were used to conduct the cost-effectiveness analysis (see Appendix F for result summary and Appendix H for avoided costs). All program costs and benefits are discounted to present-day dollar values in order to accurately compare future benefits with current costs.

AEG conducted separate cost-effectiveness analysis of the program using the results from both the engineering and billing analyses. The table below shows the cost-effectiveness results using engineering analysis savings.

[6] The California Standard Practices Manual details cost-effectiveness guidelines and procedures for standardized cost-effectiveness evaluations.

Table 15. Engineering Analysis Program Cost-Effectiveness Results

Test	NPV	B/C Ratio	Total Costs	Total Benefits
Total Resource Cost Test	$3,397,982	4.10	$1,095,328	$4,493,310
Societal Test	$3,723,363	4.40	$1,095,328	$4,818,691
Participant Test	$7,118,780	N/A	$0	$7,118,780
Ratepayer Impact Measure Test	($3,720,798)	0.55	$8,214,108	$4,493,310
Utility Cost Test	$2,982,423	2.97	$1,510,887	$4,493,310

Table 23 shows the billing analysis cost-effectiveness results.

Table 16. Billing Analysis Program Cost-Effectiveness Results

Test	NPV	B/C Ratio	Total Costs	Total Benefits
Total Resource Cost Test	$798,084	1.73	$1,095,328	$1,893,412
Societal Test	$935,195	1.85	$1,095,328	$2,030,523
Participant Test	$3,240,194	0.00	$0	$3,240,194
Ratepayer Impact Measure Test	($2,442,110)	0.44	$4,335,522	$1,893,412
Utility Cost Test	$382,525	1.25	$1,510,887	$1,893,412

Note that the Participant Test has a benefit-cost ratio of zero because there are no direct participant costs associated with the Appliance Recycling Program. The benefit-cost ratios for the billing analysis cost-effectiveness analysis are lower than the engineering analysis results due to the lower savings estimates from the billing analysis. Nevertheless, the total benefits exceed the total costs in the total resource cost (TRC) test used by the NY Department of Public Services.

AEG also conducted a measure level cost-effective analysis for the three appliance categories. Program costs (administrative and incentives) were weighted to each measure based on their proportion of participation, defined as the number of recycled units. The measure level results are shown in the table below. The benefits exceed the costs in the TRC tests for all measures, except room air conditioners.

Table 17. Total Resource Cost Test Results

Measure	TRC B/C Ratio	
	Engineering Analysis	Billing Analysis
Refrigerator	5.12	1.60
Freezer	3.89	2.38
Room Air Conditioner	1.62	N/A
Program Total	4.10	1.73

The results of the TRC tests are shown in Table 30. The benefits exceed the costs in the TRC tests for all measures. AEG has determined an overall TRC benefit cost ratio of 4.10 (engineering analysis) and 1.54 (billing analysis) demonstrating that the Appliance Recycling Program is cost-effective.

Appendix A. Appliance Recycling Impact Evaluation Survey

NOTE: To avoid duplication with interviews conducted in the Phase I Evaluation, check list of names prior to making phone call.

Customer Name	
Customer Phone Number	
Interviewer	

CONTACT RECORD		
Date	Time	Response

Response Codes

1. Busy Signal
2. No Answer
3. Call Back
4. Wrong Number (Cannot be Surveyed)
5. Refused (Cannot be Surveyed)
6. Interview – Incomplete (Cannot be Surveyed)
7. Interview Complete

Hello, I'm _____with Applied Energy Group. We are conducting a survey for Central Hudson Gas & Electric Company as part of Central Hudson's continual effort to improve its energy efficiency programs. According to our records, your household participated in the "Central Hudson Appliance Recycling Program" in _____ {List Program Year as being either 2010 or 2011}.

The survey should only take about 10 minutes. The information you provide will be kept strictly confidential and will be used to improve Central Hudson's Energy Savings programs.

May I ask you a few questions about your participation?

1. Yes
2. No *(Determine if they would agree to another date/time: If "No," thank them for their time, and exit.)*

Do you recall participating in the Appliance Recycling Program offered by Central Hudson?

1. Yes
2. No *(The program provides rebates to customers who recycle a refrigerator, freezer or room air conditioner through Central Hudson. According to our records, your household recycled _____ {List measures rebated}. If they still do not remember,* ***Terminate the Interview.****)*

Participation Process

QP1. Do you recall the main reason you decided to participate? (**DO NOT READ** - ***Mark all that apply***)

1. No longer needed the appliance
2. Wanted a new appliance
3. Wanted to save money
4. Seemed like a good deal/offer from the utility
5. Wanted to save energy
6. Other (verbatim)

Customer Satisfaction

QS1. Please rate your satisfaction with the following program components on a five-point scale, where "5" means "Very Satisfied" and "1" means "Very Dissatisfied." How satisfied are you with the:

	NA	5	4	3	2	1	DK/Refused
a) Program application process							
b) Appliance getting picked up from your home							
c) Dropping off appliance at collection points							
d) Receiving the rebate in the mail							
e) Overall program experience							

Comments (verbatim)

Free Ridership

QF1a. For each Appliance you recycled, were you planning on recycling your appliance within three months before or after participating in the program?

	Yes	No (Skip to QF1d)	Don't Know/Refused (Skip to QF1d)
Freezer			
Primary Refrigerator			
Secondary Refrigerator			
Air Conditioner			

QF1b. What factors stopped you from recycling the appliance before participating in the program? (**READ RESPONSES - *Mark all that apply***)

1. I was not convinced I would save energy.
2. I did not know how to go about getting it recycled.
3. I did not want to pay to get it picked up.
4. Other (verbatim)
5. Don't Know/Refused (**DO NOT READ**)

QF1c. Was one factor most significant?

1. Yes (list which factor)

2. No
3. Don't Know/Refused (**DO NOT READ**)

QF1d. How likely is it that you would have recycled the EXACT SAME EQUIPMENT within 3 months of when you did participate in the program if the utility had NOT OFFERED the PROGRAM? (**READ RESPONSES**)

1. Very Unlikely
2. Somewhat Unlikely
3. Neither Likely nor Unlikely
4. Somewhat Likely
5. Very Likely
6. Don't Know/Refused (**DO NOT READ**)

	1	2	3	4	5	6
Freezer						
Primary Refrigerator						
Secondary Refrigerator						
Air Conditioner						

QF1e. On a scale of one to five, with one being very low and five being very high, how would you rate energy efficiency as a priority for your household?

LOW 1 2 3 4 5 HIGH

<u>Program Spillover Impacts</u>

QS1a. Have you taken any other steps to reduce energy use as a result of your participation in the Central Hudson Appliance Recycling Program?

1. Yes
2. No (***Skip to QS1c***)
3. Don't Know/Refused (**DO NOT READ - *Skip to QS1c***)

QS1b. Have you completed any of the following actions as a result of your participation in the program? (**READ RESPONSES - *Mark all that apply***)

____Shared your experience in the Appliance Recycling Program with your friends, neighbors and/or family members
____Purchased Energy Star Appliances
____Installed new energy efficient doors and/or windows in part of your home. If yes, approximately how many?
____Installed new energy efficient doors and/or windows in all of your home. If yes, approximately how many?
____Installed / upgraded insulation in your home (walls, ceiling, attic)

____Insulated your water heater and/or installed pipe insulation
____Can you think of any other energy savings actions you have taken, not mentioned in this list? **VERBATIM**

QS1c. On a scale of 1-10 with 10 being very important and 1 meaning little importance, what influence did the program have in your decision to take additional energy efficiency actions?

(RECORD SCORE FROM 1-10)

Household / Dwelling Information

QD1. Which of the following best describes your residence?

(READ RESPONSES)

1. Single-family, detached /owner occupied
2. Single-family, attached / owner occupied
3. Single-family / Renter occupied
4. Multi-family Building
5. Other, please specify:_____
9. DK/Refused (DO NOT READ)

QD2. Approximately how many square feet of living space is in your residence?

1. [Write-In]: _____
2. DK/Refused

QD3. Approximately when was your home built?

1. Sometime before 1940
2. Between 1940 and 1959
3. 1960s
4. 1970s
5. 1980s
6. 1990s
7. 2000 or after
9. DK/Refused (DO NOT READ)

QD4. How long did you have your appliance before you chose to recycle it?

1. [Write-In]: _____
2. DK/Refused (DO NOT READ)

QD5. How many air conditioners/refrigerators do you currently have in your house?

1. Number of air conditioners: _____
2. Number of refrigerators: _____

3. DK/Refused (DO NOT READ)

QD6. About how often do you use the following recycled appliances:

	NA	Never	Daily	Weekly	Monthly	Yearly	DK/Refused
Freezer							
Refrigerator							
Air Conditioner							

1. Every day
2. Several times a week
3. Several times a month
4. Several times a year
5. Never
6. DK/Refused (DO NOT READ)

QD7. Is your residence occupied year-round?

1. Yes
2. No (Approximately what percent of the year is it occupied? _____%)

QD8. Okay, we are almost done. I have one final set of questions to ask you concerning other energy savings actions you may have taken in your home during the last 1 to 3 years. I am going to read you a list of ways to cut energy use. Please let me know when I list an action that you have taken to reduce energy use in your home sometime during the last 1 to 3 years: ***(Mark all that apply)***

1. ____Installed / upgraded wall insulation
2. ____Installed / upgraded ceiling insulation
3. ____Installed new energy efficient doors and/or windows
4. ____Purchased Energy Star-Rated Appliances
5. ____Replaced incandescent light bulbs w/ compact fluorescent bulbs
6. ____Insulated my existing water heater and/or installed pipe insulation
7. ____Installed a tankless or solar water heating system
8. ____Installed a home energy management system
9. ____Can you think of any other energy savings actions you have taken that I haven't mentioned? VERBATIM

Thank you for taking the time to respond to this survey. The information you have provided will be kept strictly confidential, and will be combined with information from other program participants to improve Central Hudson's Energy Savings programs.

Appendix B. Appliance Recycling Program Survey Results

Participation Process

QP1. Do you recall the main reason you decided to participate? (**DO NOT READ** - ***Mark all that apply***)

Response	Count	PCT of Response	PCT of n = 77
No longer needed the appliance	40	27%	52%
Wanted a new appliance	8	5%	10%
Wanted to save money	21	14%	27%
Seemed like a good deal/offer from the utility	33	22%	43%
Wanted to save energy	25	17%	32%
DK/Refused	4	3%	5%
Other (please specify)*	18	12%	23%
Total	149	100%	194%

*Other responses included: newspaper/radio/flyer/TV advertisement, referral.

Customer Satisfaction

QS1. Please rate your satisfaction with the following program components on a five-point scale, where "5" means "Very Satisfied" and "1" means "Very Dissatisfied."

Response	Program application process	Appliance getting picked up from your home	Dropping off appliance at collection points	Receiving the rebate in the mail	Overall program experience
Very Satisfied	60	62	6	65	65
Satisfied	10	2	5	4	11
Neutral	6	2	0	1	1
Dissatisfied	0	1	0	0	0
Very Dissatisfied	0	2	0	1	0
DK/Refused	1	8	66	6	0
Total	77	77	77	77	77

Response	Program application process	Appliance getting picked up from your home	Dropping off appliance at collection points	Receiving the rebate in the mail	Overall program experience
Very Satisfied	78%	81%	8%	84%	84%
Satisfied	13%	3%	6%	5%	14%
Neutral	8%	3%	0%	1%	1%
Dissatisfied	0%	1%	0%	0%	0%
Very Dissatisfied	0%	3%	0%	1%	0%
DK/Refused	1%	10%	86%	8%	0%
Total	100%	100%	100%	100%	100%

Free Ridership

QF1a. For each Appliance you recycled, were you planning on recycling your appliance within three months before or after participating in the program?

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator	Total
Yes	8	15	22	31	76
No	6	1	4	4	15
DK/Refused	3	2	3	1	9
Total	17	18	29	36	100

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator	Total
Yes	47%	83%	76%	86%	76%
No	35%	6%	14%	11%	15%
DK/Refused	18%	11%	10%	3%	9%
Total	100%	100%	100%	100%	100%

QF1b. What factors stopped you from recycling the appliance before participating in the program? **(READ RESPONSES - Mark all that apply)**

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator	Total
You weren't convinced you would save energy.	0	1	2	2	5
You didn't know how to go about getting it recycled.	7	4	14	18	43
You didn't want to pay to get it picked up.	1	7	9	13	30
DK/Refused	10	10	11	15	46
Total	18	22	36	48	124

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator	Total
You weren't convinced you would save energy.	0%	5%	6%	4%	4%
You didn't know how to go about getting it recycled.	39%	18%	39%	38%	35%
You didn't want to pay to get it picked up.	6%	32%	25%	27%	24%
DK/Refused	56%	45%	31%	31%	37%
Total	100%	100%	100%	100%	100%

QF1c. Was one factor most significant?

Response	Count	Percent
Yes	17	23%
No	55	73%
DK/Refused	3	4%
Total	75	100%

If Yes, please specify factor.

Factor	Count	Percent
You didn't know how to go about getting it recycled.	8	47%
You didn't want to pay to get it picked up.	8	47%
Did not want to spend on new appliance	1	6%
Total	17	100%

QF1d. How likely is it that you would have recycled the EXACT SAME EQUIPMENT within 3 months of when you did participate in the program if the utility had NOT OFFERED the PROGRAM? (**READ RESPONSES**)

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator	Total
Very Likely	3	3	3	4	13
Likely	1	3	4	3	11
Neutral	4	3	5	9	21
Unlikely	0	0	2	3	5
Very Unlikely	7	7	15	21	50
Total	15	16	29	40	100

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator	Total
Very Likely	20%	19%	10%	10%	13%
Likely	7%	19%	14%	8%	11%
Neutral	27%	19%	17%	23%	21%
Unlikely	0%	0%	7%	8%	5%
Very Unlikely	47%	44%	52%	53%	50%
Total	100%	100%	100%	100%	100%

QF1e. On a scale of one to five, with one being very low and five being very high, how would you rate energy efficiency as a priority for your household?

Response	Count	Percent
1 (Low)	0	0%
2	0	0%
3	1	1%
4	22	29%
5 (High)	49	65%
DK/Refused	3	4%
Total	75	100%

Program Spillover Impacts

QS1a. Have you taken any other steps to reduce energy use as a result of your participation in the Central Hudson Appliance Recycling Program?

Response	Count	Percent
Yes	34	45%
No	36	48%
DK/Refused	5	7%
Total	75	100%

Response	Count	PCT of Resp.	PCT of Yes	PCT of n
Shared your experience in the Appliance Recycling Program with your friends, neighbors and/or family members	20	20%	59%	26%
Purchased Energy Star Appliances	21	21%	62%	27%
Installed new energy efficient doors and/or windows in part of your home. How many?	9	9%	26%	12%
Installed new energy efficient doors and/or windows in all of your home. How many?	3	3%	9%	4%
Installed / upgraded insulation in your home (walls, ceiling, attic)	15	15%	44%	19%
Insulated your water heater and/or installed pipe insulation	12	12%	35%	16%
DK/Refused	4	4%	12%	5%
Can you think of any other energy savings actions you have taken that I didn't mention? (List how many new energy efficient doors and/or windows)	15	15%	44%	19%

QS1c. On a scale of 1-10 with 10 being very important and 1 meaning little importance, what influence did the program have in your decision to take additional energy efficiency actions?

Response	Count	Percent
1 (Low)	0	0%
2	3	4%
3	6	9%
4	2	3%
5	15	22%
6	4	6%
7	9	13%
8	10	15%
9	3	4%
10 (High)	15	22%
Total	67	100%

Demographics

QD1. Which of the following best describes your residence?

Response	Count	Percent
Single-family, detached / owner occupied	61	84%
Single-family, attached / owner occupied	4	5%
Single-family / Renter occupied	2	3%
Multi-family Building	4	5%
DK/Refused	2	3%
Total	73	100%

QD2. Approximately how many square feet of living space is in your residence?

Response	Count	Percent
< 1500 ft^2	12	16%
1500 < 1800	11	15%
1800 < 2160	16	22%
≥ 2160	14	19%
DK/Refused	20	27%
Total	73	100%

QD3. Approximately when was your home built?

Response	Count	Percent
2000 or after	1	1%
1990s	7	10%
1980s	8	12%
1970s	6	9%
1960s	11	16%
Between 1940 and 1959	11	16%
Sometime before 1940	16	24%
DK/Refused	7	10%
Total	67	100%

QD4. How long did you have your appliance before you chose to recycle it?

	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator
Max	30.0	40.0	30.0	40.0
3rd Quartile	12.5	20.0	15.0	20.0
Median	6.5	10.0	10.0	10.0
1st Quartile	4.5	5.0	8.0	5.8
Min	1.0	1.0	0.3	0.3
Count	8	15	21	34

QD5. How many air conditioners/refrigerators do you currently have in your house?

Response	Air Conditioners	Refrigerators
0	17	1
1	15	39
2	13	23
3	14	2
≥4	7	2
DK/Refused	7	6
Total	73	73

Response	Air Conditioners	Refrigerators
0	23%	1%
1	21%	53%
2	18%	32%
3	19%	3%
≥4	10%	3%
DK/Refused	10%	8%
Total	100%	100%

QD6. About how often do you use the following recycled appliances:

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator
Yearly	12	0	0	3
Monthly	2	1	0	4
Weekly	0	0	0	1
Daily	0	14	27	23
Never	0	1	0	3
DK/Refused	4	3	3	5
Total	18	19	30	39

Response	Air Conditioner	Freezer	Primary Refrigerator	Secondary Refrigerator
Yearly	67%	0%	0%	8%
Monthly	11%	5%	0%	10%
Weekly	0%	0%	0%	3%
Daily	0%	74%	90%	59%
Never	0%	5%	0%	8%
DK/Refused	22%	16%	10%	13%
Total	100%	100%	100%	100%

QD7. Is your residence occupied year-round?

Response	Count	Percent
Yes	70	96%
No	0	0%
DK/Refused	3	4%
Total	73	100%

QD8. I am going to read you a list of ways to cut energy use. Please let me know when I list an action that you have taken to reduce energy use in your home sometime during the last 1 to 3 years: ***(Mark all that apply)***

Response	Count	PCT of Resp.	PCT of n
Installed / upgraded wall insulation	18	8%	23%
Installed / upgraded ceiling insulation	25	11%	32%
Installed new energy efficient doors and/or windows	28	12%	36%
Purchased Energy Star-Rated Appliances	39	17%	51%
Replaced incandescent light bulbs w/ compact fluorescent bulbs	51	22%	66%
Insulated my existing water heater and/or installed pipe insulation	27	12%	35%
Installed a tankless or solar water heating system	1	0%	1%
Installed a home energy management system	0	0%	0%
DK/Refused	15	7%	19%
Can you think of any other energy savings actions you have taken that I haven't mentioned?	26	11%	34%

Other responses include: Programmable thermostat, install solar panels, NYSERDA home energy audit

Appendix C. Net-to-Gross Methodology

Memorandum

To: Central Hudson Gas & Electric Company
From: Applied Energy Group
Subject: Appliance Recycling Net-To-Gross Scoring Algorithms
Date: August 21, 2012

Free Ridership

Two survey questions were designed to determine customer free ridership. Each participant was assigned a value based on the probability that they are a free rider. The weighted mean of the participant probabilities provides an estimate of free ridership for the entire Appliance Recycling Program. The following two tables present the participant probability by survey question.

Question 1: Were you planning on recycling your appliance within three months before or after participating in the program?

Q2 Free Ridership Probability	Min	Max	Est.
Yes	0%	50%	25%
No	0%	0%	0%

Question 2: How likely is it that you would have recycled the EXACT SAME EQUIPMENT within 3-months of when you did participate in the program if the utility had NOT OFFERED the PROGRAM?

Q1 Free Ridership Probability	Min	Max	Est.
Very Unlikely	0%	0%	0%
Somewhat Unlikely	10%	30%	20%
Neither Likely or Unlikely	30%	50%	40%
Somewhat Likely	50%	70%	60%
Very Likely	70%	90%	80%

Free ridership participant probabilities for question 1 and question 2 were added together to get a free ridership estimate by customer surveyed, bound by 0% and 100%. The free ridership probability estimates are shown in the table below.

$$Free\ Ridership\ =\ Question\ 1\ +\ Question\ 2$$

Spillover

The following survey questions and scoring methodology is proposed for the calculation of program spill-over impacts.

Question SQ1: Since you participated in the Central Hudson program, have you taken any other actions to reduce energy use in your home? [1=Yes / 0 = No]

Question SQ2: [Ask only If Yes to SQ1]

Can you brief describe what EE measures/actions you took and from the following list I am going to read to you:

Measure/Action Taken (Measure/Action)	How Many?
Shared your experience in the Commercial Lighting Program with other businesses, colleagues, friends, neighbors and/or family members	
Purchase Energy Star appliances	
Install new energy efficient doors and/or windows in part of your business	
Install new energy efficient doors and/or windows in all of your business	
Install / upgrade insulation in your business (walls, ceiling, attic)	
Insulate your water heater and/or install pipe insulation	
Can you think of any other energy savings actions you have taken, not mentioned in this list?	

Question SQ3: {Only Ask If yes [=1] to Q1}: On a scale of 1-10 with 10 being very important and 1.0 meaning little importance, what influence did the program have in your decision to take additional EE actions in your home?

Scoring Method:

Spillover = If Question 1 is 'No,' then Spillover Score is 0%

Else, If **Q1=1**, then Weighted Spillover Score =

SQ3 Score/10 (= Weighted (%) Spill-over Score)

We will then estimate kWh savings from spillover actions reported in the table above, *for only those measure(s) for which savings estimates are available from the Tech Manual*, using the following calculations:

Estimated Weighted, Annualized Energy Savings from Spill-over Measure-j, for each respondent – i:

Spill-over Measure Savings $_{(participant\text{-}i,\ measure\text{-}j)}$ =

Tech Manual kWh Savings $_{(measure\text{-}j)}$ * Weighted (%) Spill-over Score$_{(participant\text{-}i,\ measure\text{-}j)}$

Next, to develop the ***Spill-over Factor Adjustment***, we will sum over all estimates of program spill-over savings (measures and participants), and calculate the following ratio:

$$\frac{\sum \text{Spill-over Measure kWh Savings}_{\text{(participant-i, measure-j)}}}{\sum \textbf{Total kWh for EE Measures for } \textit{All} \textbf{ Survey Respondents}}$$

This ratio we define as, the ***Spill-over Adjustment Factor*** to be included in the net-to-Gross (NTG) Adjustment to Savings.

Note: This ratio should be a very, very small number (i.e. 1.0 <<<), as only a few respondents will most likely respond Yes (SQ1=1), which will then we weighted down by their 1-10 ranking in SQ3.

Appendix D. Billing Analysis Methodology

Background

The Applied Energy Group (AEG) conducted a statistical analysis of changes in billed energy use in a sample of residential customers that participated in CHG&Es Appliance Removal (AR) program sometime between 2009 and 2011, according to data obtained from the program tracking database. Table 1 below presents a summary of the number of refrigerators removed under the AR program, according to the tracking database furnished for this study. Similarly, Table 2 lists the number of freezers removed under the program during this period.

Program participants during this period were first identified by account numbers, and merged with billing data from the company's billing database. Approximately 24-months of billing data were obtained for each participant, along with rate information, and the periodicity of the billing periods (i.e. meter read dates). Residential meters are read approximately once every two months by CHG&E.

Table 1: Appliance Recycling Program, Refrigerator Results

Refrigerator Removals	Units:
Bottom Freezer	84
Side-by-Side	583
Side-by-Side Ice maker	2
Single Door	217
Top Freezer	1
Top Freezer	4201
Top Freezer Ice maker	1
Total	5089

Table 2: Appliance Recycling Program, Freezer Results

Freezer Removals	Units:
Chest	825
Single Door	1
Upright	671
Total	1497

Analysis of the Participant Database: Cleaning and Preparation Steps.

To prepare the merged tracking and billing data base for the statistical impact evaluation, the participant data under-went several data cleaning and editing steps, to address multiple anomalies and/or deficiencies evident in the raw participant dataset obtained from the company, including the following:

1. Removal of AR customer accounts with missing interval reads, defined as those customers having less than 8 billing period reads (~ about 16 months of billing period usage data), and/or those that had zero usage for more than one billing cycle (i.e. > 2 months)
2. Removal of customers with tracking data records indicating something other than refrigerators and freezers in the DB (e.g. CFLs or AC units)
3. High and low average daily kWh usage: Customers that had average daily kWh +/- 3 standard deviations above/below the statistical average for all participants were likewise removed from the eligible.
4. Customers that may have had a non-residential (e.g. small commercial) customer class code in the data.

Additionally, there were a small number of customers that reportedly had more than one appliance removed under the program. These customers were also removed from the eligible sample, to facilitate identification of the measurement of average kWh savings per appliance unit removed, under the program.

Some additional things to note regarding the cleaning and editing of the participant dataset:

1. Applying cleaning/editing steps 1 - 4 above, requires that the billing period data first be *normalized* across meter read periods, by dividing billing period kWh, by the number of days in each billing period interval:

$$\textit{Average Daily kWh} = \frac{\text{Billing Period kWh}}{\text{Number of Days}}$$

2. *Average Daily kWh* is retained as *the basic unit of analysis in this statistical billing study of changes in energy use*, following participation in the AR program.

3. Since there are 12 billing data points for each participant, each covering roughly 60 days between meter read dates (~ 2 years of metered kWh consumption per customer), *Average Daily kWh* is a measure of average total metered kWh consumption per household, each day, within each two-month interval in the billing cycle.[7]

Tables 3 and 4 below compare the number of unit removals included in the population of program participants, with the number of units included within the participant billing data sample used in the statistical modeling of impacts, segmented by 3-digit zip code. A comparison of the frequencies and proportions of appliance removals in the population samples, with those in the model sample, reveal that proportions within the model sample are very similar in most instances to the appliance distribution(s) in the population of AR program participants.

[7] Billing cycles *do not line-up* contiguously w/ calendar months, in most instances.

Table 3: Appliances Frequencies by 3-digit Zip Codes

Appliance Unit Removals in Tracking Data Population:				Percent
3-Digit Zip code	Freezer	Refrigerator	Appliance Totals	of Total:
105	14	73	92	1%
109	15	39	54	1%
120	70	155	227	3%
121	43	81	130	2%
124	438	1,497	1,972	29%
125	743	2,634	3,448	51%
126	163	574	749	11%
127	11	36	47	1%
Total:	*1,497*	*5,089*	*6,719*	*100%*

Table 4: Model-based Appliance Sample

Appliance Unit Removals in Regression Sample:				Percent
3-Digit Zip code	Freezer	Refrigerator	Appliance Totals:	of Total:
105	-	21	21	2%
109	-	8	8	1%
120	10	39	49	4%
121	8	16	24	2%
124	80	345	425	31%
125	64	612	676	49%
126	33	147	180	13%
127	-	3	3	0%
Total:	*195*	*1,191*	*1,386*	*100%*

Development of the Representative Sample(s) of Non-Participants to Serve as the Control Group

The evaluation plan for the AR program included the use of a c*ontrol group* of non-participants, as a key component of the statistical measurement approach selected for this study. As described in greater detail in the methodology section below, conceptually, the control group represents billed household energy use patterns, absent the influence of AR program participation, observed over the entire 2-year analysis period.

Selection of the control group for this analysis was based on the following set of sampling criteria:

1. Geographical location by 3-digit zip code
2. Average daily kWh use in the pre-treatment period
3. Coefficient of Variation (CV) in billed use during the pre-treatment period
4. Non-participation in any CHG&E EE program during the analysis period

In addition, the billing period data must be complete (i.e. covering the pre and post-treatment analysis periods), and free of errors and/ omissions in the billing units. These requirements are based on the underlying assumption that changes in average daily use observed in the control group, reflect all underlying influences on energy use, excluding the programmatic intervention over the analysis period. If the control group is similar in all respects to the participant, or treatment group, except for program participation, then including billing period data for a representative control group helps identify and separate programmatic influence(s) from typical, or baseline changes in use observed within the treatment group.

The statistical theory underlying this experimental design is more complex than what is described here. However, the above discussion captures the basic arguments in support of including a control group of non-participants in the statistical identification and measurement of program savings among the sample of AR program participants.[8]

Table 5, below presents the distribution of the non-participant sample employed in this study, by 3-digit zip code.

Table 5: Non-Participant Res Sample

NP Billing Data Samples:		Pop N =
3-Digit Zip:	**Proportion:**	**1,500**
126	11%	165
125	51%	765
124	29%	435
120, 121 or 127	6%	90
105 or 109	3%	45
Totals:	100%	1,500

The control group sample shows no significant difference in geographical distribution from the sample of program participants - one of the key sampling and segmentation criteria listed above.

Based on this comparison, along with the similarities in billing period use, we can conclude that the sample of residential customers included in the control group provides an acceptable representation of baseline electricity use as it exists, absent the impact(s) of program participation, over the 24-month analysis period.

[8] For example, self-selection bias is often cited as a common problem in statistical studies of program impacts. We return to this potential issue, in the section discussing impact analysis results.

Statistical Measurement of Energy Impacts from AR Program Participation.

The evaluation plan for the appliance removal program included a statistical analysis of energy savings applied to billing period data for samples of AR program participants, and a control group sample of non-participants. The statistical analysis performed in this study included the following:

1. A linear regression analysis of year-over-year changes in average daily, billing period kWh use occurring after removal of a refrigerator or freezer unit through the program, including use of a control group of non-participants. This methodology is also known as a "difference of differences" analysis.

2. A follow-up regression analysis similar to (1), which also includes heating and cooling degree-day variables, mapped into each participant and non-participant billing period samples.

Simplified Linear Regression Analysis of pre/post changes in Billed Energy Use.

The first stage of this statistical analysis was to fit this simple linear regression model to the sample of AR program participants, and control group of non-program-participants:

EQ1) Delta_Avg_Daily_kWh =

Intercept + β1*{Refrigerator Savings Vbl) + β2*{Freezer Savings Vbl)

This simple change model provides estimates of the average daily change in billed kWh use associated with: 1) removal of a refrigerator unit; 2) removal of a freezer unit and; 3) the mean change in average daily kWh use attributable to all other influences within both the participant and control group samples, represented by the parameter estimate for the intercept term. The subtleties within this simple model structure require further description.

Modeling (delta) changes in average daily kWh use.

This model makes use of a set of variables that have been differenced over time. This means, for example, that Delta_Avg_Daily_kWh is calculated in the following manner:

Delta_Avg_Daily_kWh = $\text{Avg\_Daily\_kWh}_{(\text{period - t})}$ - $\text{Avg\_Daily\_kWh}_{(\text{t - 6})}$

Since the billing period data covers approximately 2-months (~ 60 days), application of this year-over-year differencing of the billing period data reveals the change(s) in average daily use in the current billing period, over average daily billed kWh use, over the same billing period, one-year earlier.

A similar year-over-year differencing is applied to both savings variables on the right-hand-side of EQ1, above. Tables 6 and 7 on the following page, illustrate the results of this differencing on a representative participant and non-participant included in the model sample:

Table 6: Differencing of the Model Dataset – An Illustration

Bill Read	Illustrative *Participant*:			
Date	Part_Indicator	Delta_Avg_kWh	Refrige_Save	Freezer_Save
11/5/2010	0	.	.	0
1/7/2011	0	.	.	0
3/15/2011	.32	.	0.32	0
5/10/2011	1	.	1	0
7/11/2011	1	.	1	0
9/13/2011	1	.	1	0
11/9/2011	1	-12.54	1	0
1/10/2012	1	-8.93	1	0
3/8/2012	1	-3.97	0.68	0
5/9/2012	1	-12.97	0	0
7/10/2012	1	-11.15	0	0
9/7/2012	1	0.75	0	0

Table 7: Differencing of a Non-Participating Customer

Bill Read	Illustrative Non-Participant:			
Date	Part_Indicator	Delta_Avg_kWh	Refrige_Save	Freezer_Save
10/27/2010	0	.	0	0
12/30/2010	0	.	0	0
3/1/2011	0	.	0	0
4/28/2011	0	.	0	0
6/28/2011	0	.	0	0
8/26/2011	0	.	0	0
10/25/2011	0	1	0	0
12/27/2011	0	7.6	0	0
2/28/2012	0	-9.1	0	0
4/26/2012	0	-13.2	0	0
6/27/2012	0	-5.8	0	0
8/28/2012	0	-4.3	0	0

Year-over-year differencing of the dependent variable (delta average daily kWh) creates a set of missing values in the front of the series, reflecting the number of billing data reads available for each participant/non-participant (~ 12 read dates or 24 months), in the model sample. (The regression procedure in SAS ignores the data rows with missing observations in the dependent variable.)[9]

Explanatory variables used on the right-hand-side of EQ1.

The same differencing calculation is applied to the savings (indicator) variables for refrigerator and freezer removals, on the right-hand-side of EQ1.[10] Note that this differencing is a rather trivial step when applied to non-participants, as the savings indicators variables are set to zero throughout. The more interesting consequences of estimating a difference model is revealed in the participation variables in Table 6, above.

[9] Proc REG in SAS was used to estimate this linear regression model.
[10] These savings variables are sometimes referred to as program *signaling,* or program *intervention* variables.

The first thing to note is the participation indicator (Part_Indicator) has been adjusted to reflect approximately when the refrigerator removal occurred within the billing period, in relation to number of days in the billing period. In the above illustration, a value of 0.32 indicates that the estimated date when the appliance was removed, occurred about two-thirds of the way into the bill read period from January 8th through March 15th. In other words, the impact of removing the appliance will only be about one-third of what it would be, if the appliance removal date equaled the start of the new billing period (= January 8th).

The second thing to note about this differencing of the appliance removal variables for participants occurs on the back-end of the time series. Specifically, the delta change in average daily kWh use vanishes (i.e. sets-back to 0.0) from the differenced billing data series and participant indicator variables, since appliance removal is a one-time event, with a (year-over-year) memory of only 6 (bi-monthly) bill read dates.

Estimation Results for the Differences in Use Model Specification.

The model in EQ1 was fitted to the combined sample of participants and non-participants to yield the set of results in Table 8, below.

The coefficient estimates for refrigerators (a mean reduction of 1.58 kWh/day), and freezer removals (a mean reduction of 2.30 kWh/day), by program participants reveal marginal changes in average daily kWh almost 2 and 3 times as large as the overall average change in kWh use observed among both non-participants, and participants over billing periods, not impacted by the AR program, represented in the model, by the coefficient estimate for the intercept term (= -0.79).

Similar impact estimates were obtained using a T-test scoring algorithm in SAS, with refrigerators reporting a change estimates of 1.6 kWH/day and freezer removals with a change estimate of 2.25kwh/day per unit removed. (These statistical results appear in the appendix.)

Table 8: Simple Linear Regression Analysis Results for AR Program kWh Savings:

Difference Model Specification w/ & w/o Weather Change Vbls

The REG Procedure					
Model: MODEL1					
Dependent Variable: Delta_Avg_kWh					
Number of Observations Read	13,586				
Number of Observations Used	13,586				
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	6,638.17	3,319.08	40.79	<.0001
Error	13,583	1,105,179	81.36		
Corrected Total	13,585	1,111,817			
Root MSE	9.02	R-Square	0.0060		

Dependent Mean	(1.20)	Adj R-Sq	0.0058		
Coeff Var	(754.01)				
Parameter Estimates					
Variable	DF	Parameter	Standard	t Value	Pr > |t|
		Estimate	Error		
Intercept	1.00	(0.79)	0.09	(8.86)	<.0001
Refrige_Save	1.00	(1.58)	0.20	(7.87)	<.0001
Freezer_Save	1.00	(2.30)	0.44	(5.23)	<.0001

Both estimates of the change in average daily billed kWh use following appliance removals, are also statistically significant, at almost any level of statistic precision, even though the model as a whole does a poor job at explaining even a small proportion of the observed total variance in the data sample (R-squared statistic < 1%).[11]

The frequency profile of *sample observations* used in the regression analysis is presented in Table 9, below.

Table 9: Billing-period designations in the model sample.

The FREQ Procedure:	**Difference of Differences Model Specification:**				
Sample Sizes Used in Regression Analysis:				**Cumulative**	**Cumulative**
Model Sample:	**1 = AR Removal**	**Frequency**	**Percent**	**Frequency**	**Percent**
Non-Participant (= 0)	0	6,035	44.42	6,035	44.42
Participant (=1)	0	3,756	27.65	9,791	72.07
	1	3,795	27.93	13,586	100

Billing periods defined as "Event Periods" reflecting the impacts of appliance removal interventions represent about 28% of all observations in the model sample.

Of the remaining observations wherein appliance removals have no marginal impact on changes in year-over-year changes average daily billing-period kWh use, about 48% come from non-participants, with the balance of this sample coming from participants (~28%).

The participant sample can be further segmented by the type of appliance removed (refrigerator or freezer): This segmentation is reported in Table 10, below.

Table 10: Billing period designations among participants by appliance type.

Frequencies of Participant Sample Size By Appliance Type Used in Regression Analysis					
Participant Sample (=1):	**1 = AR**			**Cumulative**	**Cumulative**
Appliance_Type:	**Removal:**	**Frequency**	**Percent**	**Frequency**	**Percent**
Freezer	0	509	6.7	509	6.7

[11] This is not an unusual result for linear regression models applied to datasets wherein the data have been differenced. However, the poor overall fit to the data as evidenced by the R-squared statistic, is still gives reason for concern, in these model results.

Freezer	1	551	7.3	1060	14.0
Refrige	0	3247	43.0	4307	57.0
Refrige	1	3244	43.0	7551	100.0

When viewed by appliance type, each participant sample is fairly balanced in terms of the number of billing periods impacted by the AR program intervention (event periods), and non-removal billing periods that provides one set of (baseline) change estimates in average daily use, not impacted by appliance removals.

The final set of segmentations for the samples used in this first regression analysis, are presented in Table 11 for non-participants, and Table 12 for participants (by 3-Digit Zip Code only), below.

Table 11: Non-participants by 3-digit Zip Code

Frequencies of Sample Size By 3-Digit Zip Code:					
Part_Indicator=0				**Cumulative**	**Cumulative**
ZIP_3Digit	**Event_Flag**	**Frequency**	**Percent**	**Frequency**	**Percent**
105	0	218	3.6	218	3.6
120	0	166	2.8	384	6.4
121	0	165	2.7	549	9.1
124	0	1581	26.2	2130	35.3
125	0	3345	55.4	5475	90.7
126	0	560	9.3	6035	100.0

Table 12 on the next page shows the distribution of participants by appliance type within each 3-digit zip code.

Table 12: Participants by 3-digit Zip Code:

Appliance_Type	ZIP_3Digit	AR Program	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Freezer	120	0	19	0.25	19	0.25
Freezer	120	1	32	0.42	51	0.68
Freezer	121	0	27	0.36	78	1.03
Freezer	121	1	19	0.25	97	1.28
Freezer	124	0	204	2.7	301	3.99
Freezer	124	1	234	3.1	535	7.09
Freezer	125	0	181	2.4	716	9.48
Freezer	125	1	165	2.19	881	11.67
Freezer	126	0	78	1.03	959	12.7
Freezer	126	1	101	1.34	1060	14.04
Refrige	105	0	56	0.74	1116	14.78
Refrige	105	1	59	0.78	1175	15.56
Refrige	109	0	25	0.33	1200	15.89
Refrige	109	1	15	0.2	1215	16.09
Refrige	120	0	113	1.5	1328	17.59
Refrige	120	1	82	1.09	1410	18.67

Refrige	121	0	35	0.46	1445	19.14
Refrige	121	1	57	0.75	1502	19.89
Refrige	124	0	879	11.64	2381	31.53
Refrige	124	1	1007	13.34	3388	44.87
Refrige	125	0	1698	22.49	5086	67.36
Refrige	125	1	1639	21.71	6725	89.06
Refrige	126	0	431	5.71	7156	94.77
Refrige	126	1	378	5.01	7534	99.77
Refrige	127	0	10	0.13	7544	99.91
Refrige	127	1	7	0.09	7551	100

The above table shows the pairings of (0/1) billing periods in the participant sample, wherein a value of 1 indicates the number of billing period impacted by appliance removal, and 0 for (base) periods *not impacted by the AR program*, segmented by 3-digit zip code.

Including Weather (Change) Variables in the Model Specification.

A second regression model was estimated, using the same samples of participants and control group non-participants as the first, but with weather variables added to the same

Year-over-year changes in average daily kWh use. Specifically, the following two (2) variables were added to the regression model:

- Change in average daily cooling degree days (CDD) in the current billing period, from what was observed during the same billing cycle, 1-year earlier (i.e. a 6-period differencing in average daily CDD).
- Similarly, we calculated a heating degree variable (HDD) in differenced form, by taking the (delta) change in average daily HDD from what was observed 6-billing periods (1-year) earlier.

Both HDD and CDD variable construct were lined-up exactly with the bill-read start and end dates for each customer, so that the calculation of the delta weather variables line-up with metered (billing period) usage, over each respective billing period interval, for each customer in the model sample (participants and non-participants).

This second regression analysis was performed to address possible problems with omitted variables (weather), which could bias the appliance savings variables for two reasons;

1. While refrigerators and freezers are typically not viewed as being strongly weather-sensitive end-uses, year-over-year changes in weather is often a statistically meaningful correlate with changes in total energy use, even when modeling year-over-year changes in average daily kWh, smoothed over bill-reads taken every two months.
2. Adding these two weather (change) variables provides an interesting sensitivity analysis of the savings parameters for refrigerators and freezers, and we would expect their inclusion in the

model to remove any changes in use due to weather, from the savings estimates, even if these cross-correlations are weak.[12]

The result from this second set of regressions confirms the importance of taking weather-induced changes in average daily kWh into account, within the model structure. Both coefficient estimates – one measuring the impact of year-over-year changes in average daily heating degree days (delta HDD) within each billing period during the winter months, and a similar change variable for the summer (delta CDD) – are both statistically significant causal variables in the model.

Perhaps more importantly, both savings estimates for refrigerators and freezers fall within the model, when weather-related influences are included in the model.

Table 13: Regression Model w/ Weather Impacts

The REG Procedure				
Model: MODEL2				
Dependent Variable: Delta_Avg_kWh				
Number of Obs Read	13586			
Number of Obs Used	13586			
Analysis of Variance				
Source	DF	Sum of	Mean	F Value
		Squares	Square	76.68
Model	4	24556	6139.106	
Error	13581	1087261	80.0575	Pr > F
Corrected Total	13585	1111817		<.0001
Root MSE	8.94749	R-Square	0.0221	
Dependent Mean	-1.1963	Adj R-Sq	0.0218	
Coeff Var	-747.92873			
Parameter Estimates:				
Variable	Parameter	Standard	t Value	Pr > |t|
	Estimate	Error		
Intercept	-0.14369	0.11005	-1.31	0.1917
Refrige_Save	-1.41451	0.20003	-7.07	<.0001
Freezer_Save	-2.10371	0.43738	-4.81	<.0001
Avg_Delta_CDD	0.75948	0.1133	6.7	<.0001
Avg_Delta_HDD	0.25013	0.02022	12.37	<.0001

The coefficient estimates representing the change in average daily billed kWh use following the removal of refrigerators/freezers, fall from 1.58 to 1.41 (10% lower), and from 2.30 to 2.10 or about 9% lower, (in absolute value terms), respectively, when weather variables are included in the model.

[12] The consequence of omitted variables is determined by the correlations between explanatory variables. Even when these cross-correlations are small to moderate, omission of weather could inflate the savings estimates for appliance removals, in the deficient model.

It is also worth noting that the coefficient estimates for the intercept falls even further on a percentage basis, and is now statistically insignificant in the weather-adjusted model, since it has also been purged of the average (delta) influence of weather conditions in the billing data.

A final observation, however, is that the model still only explains about 2.2% of the total observed variation in average daily kWh use in the billing data sample, even with weather influences included in the specification. However, this result does not invalidate the statistical significance of the individual variables and coefficient estimates within the model.

Calculation of Net Annualized Savings from Appliance Removals.

Before calculating estimates of gross, unadjusted estimates of annualized kWh savings from refrigerator and freezer removals, we report on the statistical precision of these model estimates, in Table 14, below:

Table 14: Relative Precision of Changes Average Daily kWh Use Following Appliance Removal

Relative Statistical Precision of Model Savings Estimates:				*Relative*
Savings Variable:	Estimate:	Std. Err:	t-statistic:	*Precision:*
Refrige_Save	-1.41451	0.20003	1.645	*+/- 23.3%*
Freezer Save	-2.10371	0.43738	1.645	*+/- 34.2%*

At the 90 +/-10% level of statistical significance, the relative precision (*RP%*) of the savings estimate for refrigerators in markedly superior to freezers, due mainly to the lower standard error used in the calculation for refrigerators, which, as we've seen, has a much larger sample of program participants represented in the model dataset.

Table 15: 90% Confidence Intervals Around Impact Estimates

Lower & Upper Level Confidence Intervals at 90 +/- 10%:			
Savings Variable:	Estimate:	Lower:	Upper:
Refrige_Save	-1.41451	-1.744	-1.085
Freezer_Save	-2.10371	-2.823	-1.384

Table 15 (above) presents the lower and upper bounds on the impact estimates, for refrigerators and freezers, based on the 90/ (+/-)10% confidence interval range.

Estimates of Gross Unadjusted, 1st- Year Energy Savings from Appliance Removals

We define *average annual, unadjusted gross kWh savings per appliance unit removed,* to represent the measured, per unit impact (i.e. kWh savings) of appliance removal in the first year following program intervention, with *no adjustments* made for the following;

1. The specific make or model(s) of refrigerator/freezer removed in the program, as represented in the model sample,
2. Whether the appliance that was removed, was a first refrigerator or first freezer, or served as a second, or back-up unit within the household,

3. Whether or not the removed appliance was replaced by another unit that took its place in the household,
4. Timing considerations involving when the removed unit, *might* have been replaced sometime during the first 12-months following removal,
5. What the customer would have done, absent program participation and availability, for example, was the customer planning on removing the unit anyway (free rider) and,
6. And, lastly, when the appliance might have simply failed, because of old age, wear and tear, etc., which represents forced removal of the unit from the appliance stock, sometime during the program period.

Each of the above are (possible) contributing factors in explaining why there are significant differences between reported, or (Engineering Analysis) savings, and measured savings obtained from the impact estimates obtained from the model.

Our control group sample of non-participants helps define baseline conditions as they would exist, absent the AR program, mitigating the above influences to varying degrees. However, we are still unable to isolate how much of the observed variation in savings is attributable to each influence. (It would take a more comprehensive and expensive experimental design to isolate and quantify the relative importance of each of these influences, outside of the scope and budget for this impact study.)

Table 16, below, provides estimates of annual savings per appliance type, the first year following removal of the unit. Applying these unit estimates, to the total number of units removed, provides estimates of total unadjusted gross kWh savings for the program, in 2011. Gross savings presented below are well below savings as reported in the Company's tracking database, owing to unit savings estimates obtained in this study, that are slightly above 50% of per unit savings used in the tracking DB for refrigerators, and about 75% for unit savings applied to freezer removals and reported in the tracking DB.

Table 16: Estimates of Adjusted Gross Energy Savings by Appliance Type

Estimates of Unadjusted Gross Annual kWh Savings:				*Total*
Appliance:	Avg Daily kWh savings:	Annualized Unadj Gross:	Number of Units:	*Unadjusted Gross kWh:*
Refrigerators	1.4	516	5,089	*2,625,924*
Freezers	2.1	768	1,497	*1,149,696*

Again, it needs to be emphasized that the impacts reported in this study most closely approximate the measured change in energy use, in the 12-months immediately following appliance removal(s). Actual savings, beyond this 12-month (post-treatment) could vary significantly from these estimates, in response to long-term and more permanent changes in the appliance holdings made by customers, over time.

Another issue potentially impacting savings that was not explored in this study, concerns the disposition of appliances, after they are removed. It is asssumed in this analysis that the units that are removed under the program, are quickly dismantled in an environmentally safe manner, consistent with program (and contract) requirements established between the Company and the program contractors, such the units are taken out of the supply stock, i.e. cannot be re-sold or recycled for further use elsewhere.

If this latter condition is not met, then actual savings from appliance removal may be much smaller, from a societal standpoint, that what is reported here.

Appendix E. Spillover Savings Estimates and Assumptions

AEG determined the spillover impacts of the Appliance Recycling program based on the survey responses of program participants. Participants were asked if they had engaged in any additional energy efficiency behaviors or actions that were not offered through the program. AEG estimated the energy savings of each action for each participant using methodology consistent with the 2010 New York Standard Approach Manual for Estimating Energy Savings from Energy Efficiency Programs.

Response	Count
Shared your experience in the Appliance Recycling Program with your friends, neighbors and/or family members	20
Purchased Energy Star Appliances	21
Installed new energy efficient doors and/or windows in PART of your home.	9
Installed new energy efficient doors and/or windows in ALL of your home.	3
Installed / upgraded insulation in your home (walls, ceiling, attic)	15
Insulated your water heater and/or installed pipe insulation	12
DK/Refused	4
Can you think of any other energy savings actions you have taken that I didn't mention? (List how many new energy efficient doors and/or windows)	15

All spillover savings was converted to mmBTUs to reflect energy savings in terms of kWh and therms. The conversion factors used in the analysis are detailed below. AEG calculated the sum of spillover savings for each respondent multiplied by that respondent's unique spillover weighting score. Next, AEG added the average program participant savings (5.41 mmBTUs) to each participant as a result of participating in the program. The ratio of spillover savings to total energy savings results in the spillover estimate for each appliance, shown in the table below.

Appliance	SO Savings	Total EE	Spillover Estimate
Air Conditioner	62.94	133.93	47%
Freezer	75.86	222.15	34%
Refrigerator	257.35	662.54	39%
Program Total	545.77	1,573.19	35%

The assumptions and algorithms used to estimate the spillover energy savings are detailed in the tables below.

Conversion Factors	
3413	BTU/kWh
100,000	BTU/therm

Table 18. Lighting Spillover Assumptions

Variable	Value	Description
kwh	636.26	kwh = units * leakage * ΔWatts * Hours * DPY/1000 * (1+HVACc)
kw	56.78	kw = units * leakage * ΔWatts * CF * (1+HVACd)
therm	-159.06	therm = kwh * HVACg
Units	10	Number of CFLs installed
Leakage	1	
CFL Watts	26	
ΔWatts	65.78	
CF	0.08	Coincidence Factor
Hours	2.5	Deemed value
DPY	365	
HVACc	0.06	AC with Gas Heat, assumed HVAC type
HVACd	0.08	AC with Gas Heat, assumed HVAC type
HVACg	-0.03	AC with Gas Heat, assumed HVAC type

Table 19. High Efficiency Gas Furnace Spillover Assumptions

Variable	Value	Description
therms	405.58	therms = units * kBTUin / units * [1-(AFUE_base / AFUE_ee)] * (EFLH_heat/100)
Units	1	
kBTUin/unit	225	the nominal heating input capacity in kBtu/hr
AFUE_base	0.78	Average fuel utilization efficiency (0-100) for HW boiler, Steam Boiler, Furnace
AFUE_ee	0.92	Average fuel utilization efficiency (0-100)
EFLH_heat	1,157	Average Poughkeepsie Vintage

Table 20. Refrigerator/Freezer Spillover Assumptions

Variable	Value	Description
kwh	148.01	kwh = units * (kWh_base - kWh_ee) * (1 + HVACc) * Focc * Fmarket
kw	0.02	kw = units * ((kWh_base/8760) - (kWh_ee/8760)) * CF * (1 + HVACd) * Fmarket
therms	-3.70	therm = kwh * HVACg
Units	1	
kWh_base	556.47	Average annual kWh federal baseline
kWh_ee	432.90	Average annual kWh ENERGY STAR qualified
Focc	1.13	occupant adjustment factor
Occupants	3	2.5 average from RASS
Fmarket	1	market effects factor accounting for replaced refrigerators that enter the used appliance market
CF	1	Coincidence Factor
HVACc	0.06	HVAC system interaction factor for annual energy consumption (AC with Gas Heat)

HVACd	0.08	HVAC system interaction factor at utility peak hour (AC with Gas Heat)
HVACg	-0.03	HVAC system interaction factor for annual gas consumption (AC with Gas Heat)

Table 21. Clothes Washer and Dryer Spillover Assumptions

Appliance	Clothes Washer	Clothes Dryer	Total	Description
kWh	151	73	224	Deemed value
kW	0.001	0.001	0.002	kW = kWh * CF / 8760
therm	9.0	2.9	11.9	Deemed value

Table 22. Dishwasher Spillover Assumptions

Variable	Value	Description
kwh	93.80	kwh = units * Esavdw
kw	0.02	kw = units * Dsavref * CFdw
units	1	
eSAVdw	93.8	Weighted average of deemed values (77 kWh, 137 kWh) based on RASS water heater types
dSAVref	0.0225	
CFdw	1	

Table 23. Opaque Shell Insulation

Variable	Value	Description
kwh	49.64	kwh = SF * (ΔkWh/SF) * (SEER_base / SEER_part) * (n_dist_base / n_dist_part)_cool
kw	0.04	kw = SF * (ΔkW/SF) * CF * (EER_base / EER_part) * (n_dist_pk_base / n_dist_pk_part)_cool
therm	48.16	therm = SF * (Δtherm/SF) * (AFUE_base / AFUE_part) * (n_dist_pk_base/n_dist_pk_part)_heat
SF	733	Average for SF 1 and 2 story, divide by 1/3 of total house SF
kw/SF	0.00, 0.00	Average change from baseline. Wall, Roof insulation.
kwh/SF	0.07, 0.39	Average change from baseline. Wall, Roof insulation.
therm/SF	0.07, 0.35	Average change from baseline. Wall, Roof insulation.
EER_base	11.1	Deemed value
EER_part	11.1	Deemed value
SEER_base	13	Deemed value
SEER_part	13	Deemed value
AFUE_base	0.78	Deemed value
AFUE_part	0.78	Deemed value
n_dist_base	0.956	distribution system seasonal efficiency, deemed value
n_dist_part	0.956	distribution system seasonal efficiency, deemed value

n_dist_pk_base	0.956	distribution system efficiency under peak conditions, deemed value
n_dist_pk_part	0.956	distribution system efficiency under peak conditions, deemed value
CF	0.8	Coincidence factor

Table 24. Pipe Insulation Spillover Assumptions

Variable	Value	Description
kwh	257.94	kwh = L * [(UA/L_base - UA/L_ee)/n_heater * 3413] * T_avg * Hrs
kw	0.03	kwh = L * [(UA/L_base - UA/L_ee)/n_heater * 3413] * T * CF
therm	8.80	kwh = L * [(UA/L_base - UA/L_ee)/n_heater * 100,000] * T_avg * Hrs
L	2	length of insulation installed (ft)
T	60	temperature difference between water within the pipe and air under peak conditions (Service hot water)
T_avg	60	average temperature difference between water within the pipe and air temperature (°F), (Service hot water)
UA/L_base	0.85	overall pipe heat loss coefficient per unit length (Btu/hr-°F-ft)
UA/L_ee	0.17	overall pipe heat loss coefficient per unit length (Btu/hr-°F-ft)
CF	1	coincidence factor
n_heater	0.81	water heater or boiler efficiency
Hours	8760	

Table 25. Hot Water Tank Insulation Spillover Assumptions

Variable	Value	Description
kwh	402	Deemed value
kw	0.046	Deemed value
therm	18.1	Deemed value

Table 26. High Performance Window Upgrade Spillover Assumptions

Variable	Value	Description
kwh	65.3	Deemed value
kw	0.079	Deemed value
therm	7.55	Deemed value

Appendix F. Cost-Effectiveness Analysis Inputs

Engineering Analysis Cost-Effectiveness Results

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PROJECT SCREENING TOOL

Measure Description : Appliance Recycling Program
Measure Type : Ex Ante

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr
Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	
Participants =	1	
Administrative Costs =	$1,095,328	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$ 415,559	
Project Costs:		
Direct Participant Costs =	$ -	
Other Participant Costs =	$ -	
Other Costs Escalation Rate =	2.50%	
Project Savings		
Project Life =	5	years
Demand Savings =	378.32	kW
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	13,554,046	kWh
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	6,777,023	kWh
Winter Energy Savings =	6,777,023	kWh
Other Participant Savings =		

Test Results	**NPV**	**B/C**	**Total Costs**	**Total Benefits**
Total Resource Cost Test	$4,062,522	4.71	$1,095,328	$5,157,850
Societal Test	$4,262,661	4.89	$1,095,328	$5,357,989
Participant Test	$8,200,250	#DIV/0!	$0	$8,200,250
Ratepayer Impact Measure Test	($3,460,543)	0.60	$8,618,393	$5,157,850
Utility Cost Test	$3,646,963	3.41	$1,510,887	$5,157,850

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	255.96	kW	Levelized Costs =	$0.01	per kWh
Annual Utility Energy Reduction =	12,736,282	kWh		$343.01	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	1,272	Lifetime kW	Annual Participant Savings =	$1,519,537	
Total Utility Energy Reduction =	63,298,071	Lifetime kWh			
			Simple Payback =	-	years

Notes:

1.) Utility Energy and Demand reductions include line losses and net-to-gross ratios.
2.) Energy and Demand prices are weighted by the seasonal allocation factors for each measure & building type.
3.) Coincident Factor is taken into account with the weighted Capacity cost, so it is not applied to the Avg. Demand Savings

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PROJECT SCREENING TOOL

Measure Description : Refrigerator
Measure Type : Ex Ante

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	5,089	

Administrative Costs =	$651,944	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$ 247,343	

Project Costs:		
Direct Participant Costs =	$ -	
Other Participant Costs =	$ -	
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	0.05	per participant
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	1,655	per participant
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	828	per participant
Winter Energy Savings =	828	per participant
Other Participant Savings =		

Test Results	NPV	B/C	Total Costs	Total Benefits
Total Resource Cost Test	$2,552,754	4.92	$651,944	$3,204,698
Societal Test	$2,677,117	5.11	$651,944	$3,329,061
Participant Test	$5,084,641	#DIV/0!	$0	$5,084,641
Ratepayer Impact Measure Test	($2,111,094)	0.60	$5,315,792	$3,204,698
Utility Cost Test	$2,305,411	3.56	$899,287	$3,204,698

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	0.03	kW	Levelized Costs =	$0.01	per kWh
Annual Utility Energy Reduction =	1,555	kWh		$329.94	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	787	Lifetime kW	Annual Participant Savings =	$186	
Total Utility Energy Reduction =	39,332,538	Lifetime kWh			
			Simple Payback =	-	years

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PROJECT SCREENING TOOL

Measure Description : Freezer
Measure Type : Ex Ante

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	1,498	

Administrative Costs =	$191,907	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$72,808	

Project Costs:		
Direct Participant Costs =	$ -	per participant
Other Participant Costs =	$ -	per participant
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	0.04	per participant
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	1,257	per participant
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	629	per participant
Winter Energy Savings =	629	per participant
Other Participant Savings =		

Test Results	NPV	B/C	Total Costs	Total Benefits
Total Resource Cost Test	$525,085	3.74	$191,907	$716,991
Societal Test	$552,889	3.88	$191,907	$744,795
Participant Test	$1,154,290	#DIV/0!	$0	$1,154,290
Ratepayer Impact Measure Test	($535,128)	0.57	$1,252,120	$716,991
Utility Cost Test	$452,277	2.71	$264,714	$716,991

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	0.02	kW	Levelized Costs =	$0.02	per kWh
Annual Utility Energy Reduction =	1,181	kWh		$421.59	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	181	Lifetime kW	Annual Participant Savings =	$141	
Total Utility Energy Reduction =	8,793,638	Lifetime kWh			

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PROJECT SCREENING TOOL

Measure Description : Room Air Conditioner
Measure Type : Ex Ante

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	1,963	

Administrative Costs =	$251,477	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$ 95,408	

Project Costs:		
Direct Participant Costs =	$ -	per participant
Other Participant Costs =	$ -	per participant
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	0.046	per participant
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	1,655	per participant
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	828	per participant
Winter Energy Savings =	828	per participant
Other Participant Savings =		

Test Results	**NPV**	**B/C**	**Total Costs**	**Total Benefits**
Total Resource Cost Test	$984,684	4.92	$251,477	$1,236,161
Societal Test	$1,032,655	5.11	$251,477	$1,284,132
Participant Test	$1,961,319	#DIV/0!	$0	$1,961,319
Ratepayer Impact Measure Test	($814,321)	0.60	$2,050,481	$1,236,161
Utility Cost Test	$889,275	3.56	$346,886	$1,236,161

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	0.03	kW	Levelized Costs =	$0.01	per kWh
Annual Utility Energy Reduction =	1,555	kWh		$329.94	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	304	Lifetime kW	Annual Participant Savings =	$186	
Total Utility Energy Reduction =	15,171,895	Lifetime kWh			
			Simple Payback =	-	years

Billing Analysis Cost-Effectiveness Results

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PROJECT SCREENING TOOL

Measure Description : Appliance Recycling Program
Measure Type : Ex Post

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	1	

Administrative Costs =	$1,095,328	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$ 415,559	

Project Costs:		
Direct Participant Costs =	$ -	
Other Participant Costs =	$ -	
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	147.28	kW
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	5,276,696	kWh
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	2,638,348	kWh
Winter Energy Savings =	2,638,348	kWh
Other Participant Savings =		

Test Results	NPV	B/C	Total Costs	Total Benefits
Total Resource Cost Test	$912,663	1.83	$1,095,328	$2,007,991
Societal Test	$990,579	1.90	$1,095,328	$2,085,907
Participant Test	$3,446,200	#DIV/0!	$0	$3,446,200
Ratepayer Impact Measure Test	($2,269,903)	0.47	$4,277,895	$2,007,991
Utility Cost Test	$497,104	1.33	$1,510,887	$2,007,991

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	99.65	kW	Levelized Costs =	$0.04	per kWh
Annual Utility Energy Reduction =	4,958,334	kWh		$881.07	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	495	Lifetime kW	Annual Participant Savings =	$591,567	
Total Utility Energy Reduction =	24,642,432	Lifetime kWh			
			Simple Payback =	-	years

Notes:

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PROJECT SCREENING TOOL

Measure Description : Refrigerator
Measure Type : Ex Post

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	5,089	

Administrative Costs =	$651,944	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$ 247,343	

Project Costs:		
Direct Participant Costs =	$ -	
Other Participant Costs =	$ -	
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	0.014	per participant
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	516	per participant
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	258	per participant
Winter Energy Savings =	258	per participant
Other Participant Savings =		

Test Results	NPV	B/C	Total Costs	Total Benefits
Total Resource Cost Test	$347,798	1.53	$651,944	$999,742
Societal Test	$386,594	1.59	$651,944	$1,038,539
Participant Test	$1,756,393	#DIV/0!	$0	$1,756,393
Ratepayer Impact Measure Test	($1,277,324)	0.44	$2,277,066	$999,742
Utility Cost Test	$100,455	1.11	$899,287	$999,742

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	0.01	kW	Levelized Costs =	$0.04	per kWh
Annual Utility Energy Reduction =	485	kWh		$1,057.64	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	246	Lifetime kW	Annual Participant Savings =	$58	
Total Utility Energy Reduction =	12,270,234	Lifetime kWh			
			Simple Payback =	-	years

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PROJECT SCREENING TOOL

Measure Description : Freezer
Measure Type : Ex Post

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	1,498	

Administrative Costs =	$191,907	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$ 72,808	

Project Costs:		
Direct Participant Costs =	$ -	per participant
Other Participant Costs =	$ -	per participant
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	0.022	per participant
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	768	per participant
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	384	per participant
Winter Energy Savings =	384	per participant
Other Participant Savings =		

Test Results	NPV	B/C	Total Costs	Total Benefits
Total Resource Cost Test	$246,077	2.28	$191,907	$437,983
Societal Test	$263,061	2.37	$191,907	$454,968
Participant Test	$733,445	#DIV/0!	$0	$733,445
Ratepayer Impact Measure Test	($429,900)	0.50	$867,883	$437,983
Utility Cost Test	$173,269	1.65	$264,714	$437,983

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	0.01	kW	Levelized Costs =	$0.03	per kWh
Annual Utility Energy Reduction =	722	kWh		$690.16	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	111	Lifetime kW	Annual Participant Savings =	$86	
Total Utility Energy Reduction =	5,371,704	Lifetime kWh			
			Simple Payback =	-	years

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Central Hudson
Gas & Electric Corporation

PROJECT SCREENING TOOL

Measure Description : Room Air Conditioner
Measure Type : Ex Post

Input Data

General

Utility Costs:		
Electric Retail Rate =	$0.1193	per kWh
First Year Weighted Commodity Cost =	$0.0852	per kWh
Natural Gas Retail Rate =	$1.7973	per Therm
First Year Demand Cost =	$94.05	per kW/Yr

Other Inputs:		
Environmental Externalities =	$0.00973	per kWh
Energy Net-To-Gross Factor =	13.32%	
Demand Net-To-Gross Factor =	13.32%	
Participant Discount Rate =	5.50%	
Utility Discount Rate =	5.50%	
Societal Discount Rate =	5.50%	
General Input Data Year =	2010	
Project Analysis Year 1 =	2011	
Line Losses (Energy) =	7.20%	
Line Losses (Peak) =	7.20%	

Participants =	1,963	

Administrative Costs =	$251,477	
Utility Variable O&M =	$0.00	per kWh
Utility O&M Escalation Rate =	2.50%	
Increased Project O&M =		per kWh
Increased O&M Escalation Rate =	0.00%	

Project Specific

Utility Project Costs (First Year):		
Rebate Costs =	$95,408	

Project Costs:		
Direct Participant Costs =	$ -	per participant
Other Participant Costs =	$ -	per participant
Other Costs Escalation Rate =	2.50%	

Project Savings		
Project Life =	5	years
Demand Savings =	0.021	per participant
Summer Peak Coincident Factor =	72%	
Annual Energy Savings =	764	per participant
Summer Load Factor =	50%	
Winter Load Factor =	50%	
Summer Energy Savings =	382	per participant
Winter Energy Savings =	382	per participant
Other Participant Savings =		

Test Results	NPV	B/C	Total Costs	Total Benefits
Total Resource Cost Test	$318,902	2.27	$251,477	$570,379
Societal Test	$341,037	2.36	$251,477	$592,514
Participant Test	$956,362	#DIV/0!	$0	$956,362
Ratepayer Impact Measure Test	($562,566)	0.50	$1,132,945	$570,379
Utility Cost Test	$223,494	1.64	$346,886	$570,379

Cost & Savings Summary

Coincident Peak Utility Demand Reduction =	0.01	kW	Levelized Costs =	$0.03	per kWh
Annual Utility Energy Reduction =	718	kWh		$715.07	per kW
			Incremental Cost	$0.00	per kWh
				$0.00	per kW
Total Utility Demand Reduction =	140	Lifetime kW	Annual Participant Savings =	$86	
Total Utility Energy Reduction =	7,000,494	Lifetime kWh			

Appendix G. Spillover Results

ID	Air Conditioner	Freezer	Refrigerator	Prim/Sec/Both	Shared Exp.	Appliances	Windows (PART)	Windows (ALL)	Insulation (Wall, Ceiling)	Insulation (Pipe, HW)	Lighting	Furnace	SO Savings (Gross)	SO Weight	SO Savings (Net)	Total EE
1	0	1	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
2	0	0	1	Prim	0.00	0.94	0.00	0.00	15.87	2.47	0.00	0.00	19.28	0.70	13.50	24.69
3	0	1	1	Sec	0.00	0.94	0.00	0.00	0.00	2.47	0.00	0.00	3.41	0.80	2.73	8.82
4	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
5	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
6	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
7	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
8	0	0	1	Both	0.00	0.94	0.00	0.00	15.87	0.00	0.00	0.00	16.81	0.30	5.04	22.22
9	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
10	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
11	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
12	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
13	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
14	0	0	1	Prim	0.00	0.00	0.00	9.78	0.00	0.00	0.00	0.00	9.78	0.50	4.89	15.19
15	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
16	0	1	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
17	0	0	1	Prim	0.00	0.00	2.93	0.00	15.87	2.47	0.00	0.00	21.27	1.00	21.27	26.68

ID	Air Conditioner	Freezer	Refrigerator	Prim/Sec/Both	Shared Exp.	Appliances	Windows (PART)	Windows (ALL)	Insulation (Wall, Ceiling)	Insulation (Pipe, HW)	Lighting	Furnace	SO Savings (Gross)	SO Weight	SO Savings (Net)	Total EE
18	1	0	1	Sec	0.00	0.94	0.00	0.00	15.87	2.47	0.00	40.56	59.84	1.00	59.84	65.25
19	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
20	0	0	1	Sec	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.80	0.75	6.35
21	1	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
22	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
23	0	1	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
24	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
25	1	0	1	Sec	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.50	0.47	6.35
26	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
27	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
28	1	0	1	Sec	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	1.00	0.94	6.35
29	0	0	1	Prim	0.00	0.94	0.00	0.00	15.87	2.47	0.00	0.00	19.28	1.00	19.28	24.69
30	1	0	0	N/A	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	1.00	0.94	6.35
31	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
32	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
33	1	0	0	N/A	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.80	0.75	6.35
34	0	1	0	Prim	0.00	0.00	2.93	0.00	0.00	0.00	0.00	0.00	2.93	0.50	1.47	8.34
35	0	1	0	N/A	0.00	0.94	2.93	0.00	15.87	2.47	0.00	0.00	22.21	0.20	4.44	27.62
36	0	0	1	Both	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41

ID	Air Conditioner	Freezer	Refrigerator	Prim/Sec/Both	Shared Exp.	Appliances	Windows (PART)	Windows (ALL)	Insulation (Wall, Ceiling)	Insulation (Pipe, HW)	Lighting	Furnace	SO Savings (Gross)	SO Weight	SO Savings (Net)	Total EE
37	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	-13.73	0.00	-13.73	1.00	-13.73	-8.32
38	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
39	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
40	0	1	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
41	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
42	0	1	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
43	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
44	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
45	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
46	0	0	1	N/A	0.00	0.94	0.00	0.00	15.87	2.47	0.00	0.00	19.28	0.70	13.50	24.69
47	0	1	0	Sec	0.00	0.00	0.00	0.00	15.87	0.00	0.00	0.00	15.87	0.50	7.93	21.28
48	0	0	1	Prim	0.00	0.00	2.93	0.00	0.00	0.00	0.00	0.00	2.93	0.80	2.35	8.34
49	0	1	1	Prim	0.00	0.00	0.00	9.78	15.87	2.47	0.00	0.00	28.12	0.50	14.06	33.53
50	0	1	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
51	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
52	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
53	0	0	1	Sec	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.70	0.66	6.35
54	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
55	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
56	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
57	0	0	1	Sec	0.00	0.00	2.93	0.00	0.00	0.00	0.00	0.00	2.93	1.00	2.93	8.34
58	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
59	0	1	1	Prim	0.00	0.00	2.93	0.00	15.87	2.47	0.00	0.00	21.27	0.80	17.02	26.68
60	0	0	1	Sec	0.00	0.00	2.93	0.00	15.87	0.00	0.00	0.00	18.80	0.80	15.04	24.21
61	0	0	1	Sec	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.80	0.75	6.35
62	0	1	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
63	0	1	1	Prim	0.00	0.94	0.00	9.78	15.87	0.00	0.00	0.00	26.59	1.00	26.59	32.00
64	0	1	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41

ID	Air Conditioner	Freezer	Refrigerator	Prim/Sec/Both	Shared Exp.	Appliances	Windows (PART)	Windows (ALL)	Insulation (Wall, Ceiling)	Insulation (Pipe, HW)	Lighting	Furnace	SO Savings (Gross)	SO Weight	SO Savings (Net)	Total EE
65	0	1	1	Sec	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	1.00	0.94	6.35
66	0	1	1	Sec	0.00	0.94	0.00	0.00	0.00	2.47	0.00	0.00	3.41	0.20	0.68	8.82
67	0	0	1	Sec	0.00	0.94	2.93	0.00	15.87	2.47	0.00	0.00	22.21	1.00	22.21	27.62
68	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
69	0	0	1	Sec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
70	0	0	1	Both	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
71	0	1	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41
72	0	0	1	Both	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.60	0.56	6.35
73	0	0	1	N/A	0.00	0.94	2.93	0.00	0.00	0.00	0.00	0.00	3.87	0.80	3.10	9.28
74	0	0	1	Prim	0.00	0.94	0.00	0.00	15.87	0.00	0.00	0.00	16.81	0.50	8.40	22.22
75	0	0	1	Prim	0.00	0.00	0.00	0.00	0.00	2.47	0.00	0.00	2.47	1.00	2.47	7.88
76	0	0	1	Sec	0.00	0.00	0.00	0.00	15.87	0.00	0.00	0.00	15.87	0.70	11.11	21.28
77	1	0	0	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	5.41

Appendix H. Central Hudson Avoided Costs

Year	Wholesale Prices		
	Wholesale Electricity	Electric Capacity	Natural Gas
	$/kWh	$/kW-yr	$/therm
2011	$0.085	$94.05	$1.17
2012	$0.086	$100.07	$1.18
2013	$0.088	$109.87	$1.21
2014	$0.090	$114.04	$1.25
2015	$0.092	$115.93	$1.29
2016	$0.095	$128.15	$1.34
2017	$0.098	$143.99	$1.39
2018	$0.102	$151.92	$1.44
2019	$0.105	$159.94	$1.48
2020	$0.108	$168.07	$1.52
2021	$0.112	$176.30	$1.57
2022	$0.115	$181.59	$1.62
2023	$0.119	$187.04	$1.67
2024	$0.123	$192.65	$1.72
2025	$0.127	$198.43	$1.77
2026	$0.131	$204.39	$1.82
2027	$0.134	$210.52	$1.88
2028	$0.138	$216.83	$1.93
2029	$0.143	$223.34	$1.99
2030	$0.147	$230.04	$2.05
2031	$0.151	$236.94	$2.11
2032	$0.156	$244.05	$2.17
2033	$0.161	$251.37	$2.24
2034	$0.165	$258.91	$2.31
2035	$0.170	$266.68	$2.31
2036	$0.175	$274.68	$2.31
2037	$0.181	$282.92	$2.31
2038	$0.186	$291.40	$2.31
2039	$0.192	$300.15	$2.31
2040	$0.197	$309.15	$2.31