

**Cost-benefit Analysis of the New Jersey Clean Energy Program Energy  
Efficiency Programs**

**January 9, 2008**



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## I. Summary

The Center for Energy, Economic and Environmental Policy (CEEPP) presents in this preliminary report its cost-benefit analysis of the residential, commercial and industrial energy-efficiency programs approved by the New Jersey Board of Public Utilities (BPU) as part of New Jersey’s Clean Energy Program.

Since 2006, the Energy Efficiency programs in New Jersey, with the exception of the Residential Low Income programs, are no longer managed by the state’s utilities. Honeywell manages the Residential HVAC, Residential New Construction, and ENERGY STAR Programs. All Commercial and Industrial Programs are managed by TRC Energy Services.

This report is a follow-up to the 2003 Total Resource Cost-Benefit Analysis prepared by CEEPP that was submitted to the BPU on July 28, 2005. The purpose of this report is to update the 2003 cost-benefit analysis to facilitate comparison between the programs in 2003 and 2006. Some key assumptions used in the 2003 analysis that did not have readily available updates – transmission and distribution avoided costs and externality costs – were used in this report. Each major assumption is discussed in detail, and all assumptions should be reviewed as part of further work. The estimated impact of issues such as free-ridership and the rebound effect are not discussed in this paper and are not yet taken into account when analyzing New Jersey programs. Resources for the Future provides an in-depth literature review of cost-benefit analyses and the various issues associated with them.<sup>1</sup> Benefit-cost analyses performed in Wisconsin and New York<sup>2</sup> have also been reviewed by CEEPP.<sup>2</sup>

Table 1 lists the specific programs reviewed in this study. For the Residential HVAC program, which includes both gas and electric components, the program cost-benefit analysis assesses the costs and the benefits of the gas and electric components together. For the Residential Low Income Program, which contains three subprograms, the program was evaluated as a whole.

<b>Table 1 - Programs Reviewed</b>	
<b>Residential</b>	<b>Commercial &amp; Industrial/Other</b>
Residential HVAC	C&I New Construction
Residential New Construction	C&I Retrofit
ENERGY STAR Room AC	NJDEP Cool Cities
Residential Low Income	Combined Heat and Power
Home Performance with ENERGY STAR	New School Construction & Retrofit
Energy Conservation Kits	

Several programs that were approved in New Jersey for 2006 have not been evaluated for this report. ENERGY STAR Maintenance, ENERGY STAR Change a Light, DCA Green Homes, and Treasury HVAC all had no participants during the year, though some of them did have administrative and advertising expenditures. With no participants, these programs resulted in no energy savings during the year. The ENERGY STAR On Line Audit program had a large number of participants, but was an

<sup>1</sup> Gillingham, Kenneth, Richard G. Newell and Karen Palmer. Retrospective Examination of Demand-Side Energy Efficiency Policies. Resources for the Future. September 2004.

<sup>2</sup> Goldberg, Miriam L., Valy Goepfrich, Lori Boeckeler and G. Kennedy Agnew. Focus on Energy Statewide Evaluation: Initial Benefit-Cost Analysis. State of Wisconsin Department of Administration, Division of Energy. March 31, 2003.

NYSERDA, New York Energy Smart Program Evaluation and Status Report, May 2006.

informational program and the Clean Energy Program did not attempt to measure or report the energy savings.

Two additional programs were evaluated, but with limited information available. The Home Performance with ENERGY STAR program is new for 2006 and had low participation and high start up costs and thus the results should be viewed as preliminary. The Energy Conservation Kit program, like the ENERGY STAR Online Audit program, was informational and energy savings were not reported.

This report is organized into five sections, plus appendices. Section I serves as an introduction. Section II describes the cost tests used in the study. Section III reviews the major assumptions used in both the 2006 and multi-year program cost-benefit analyses. Section IV presents in tabular format the 2006 and multi-year program cost-benefit analyses results on a program-by-program basis for each cost test and also provides the emission savings in metric tons. Section V suggests future improvements to the analysis. A reference section at the end of this report provides the citations for documents utilized in preparing this report. Finally, Appendices A and B provide in-depth detail on the inputs and outputs to the cost-benefit analysis for the Residential and Non-Residential programs, respectively. Appendices C through I present the year-by-year cost tests results for each program reviewed.

## II. Cost Tests Used in this Study

The cost-benefit analysis submitted in 2003 utilized the Total Resource Cost (TRC) test. The TRC test requires knowing the incremental cost of specific technologies (measures) as one of its inputs. This information was not available during the last study, but was published in 2006 in Summit Blue's "Energy Efficiency Market Assessment of New Jersey Clean Energy Programs" (hereafter referred to as Summit Blue Report).<sup>3</sup> In addition, four other cost tests are used in this study: the Participant Cost Test (PCT), Program Administration Cost Test (PAC), Ratepayer Impact Measure (RIM) and Societal Cost Test (SCT).

The Participant Cost Test is the measure of the quantifiable benefits and costs to the customer attributed to participation in a program.<sup>4</sup> The benefits to the participant are equal to the sum of any participant incentives paid, any reductions in bills, and any federal or state tax deductions or credits. Participant costs include any out-of-pocket costs associated with the program.

The Program Administrator Cost Test measures the net costs of a program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits for the Program Administrator Cost Test are the avoided supply costs of energy and demand, the reduction in capacity valued at marginal costs for the periods when there is a load reduction. The costs for the Program Administrator Cost Test are the program costs incurred by the administrator, the incentives paid to the customers, and the increased supply costs for the periods in which load is increased.

The Ratepayer Impact Measure Test measures what happens to customer bills or rates due to changes in revenues and operating costs caused by the program. The benefits calculated in the RIM test are the savings from avoided supply costs. These avoided costs include the reduction in capacity costs for periods when load has been reduced and the increase in revenues for any periods in which load has been increased. The costs are the program costs incurred by administration of the program, the incentives paid

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<sup>3</sup> Summit Blue Consulting, LLC., *Energy Efficiency Market Assessment of New Jersey Clean Energy Programs*, July 20, 2006.

<sup>4</sup> All cost test definitions are from *California Standard Practice Manual*, Economic Analysis of Demand-Side Programs and Projects, October 2001.

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to the participant, decreased revenues for any periods in which load has been decreased and increased supply costs for any periods when load has been increased.

The Total Resource Cost Test measures the net costs of a program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. This test represents the combination of the effects of a program on both the customers participating and those not participating in a program. In effect, it is the summation of the benefit and cost terms in the Participant and the Ratepayer Impact Measure tests. The benefits are the avoided supply costs, the reduction in transmission, distribution, generation, and capacity costs valued at marginal cost for the periods when there is a load reduction. The costs are the program costs paid by both the utility and the participants plus the increase in supply costs for the periods in which load is increased.

The Societal Cost Test is structurally similar to the Total Resource Cost Test. It goes beyond the TRC test in that it attempts to quantify the change in the total resource costs to society as a whole rather than to only utility and its ratepayers. In taking society's perspective, the Societal Test utilizes many of the same input variables as the TRC Test, but also considers a broader societal point of view. Benefits associated with the societal perspective include avoided power supply costs, capacity benefits, avoided transmission and distribution (T&D) costs, and emissions savings. The costs include all consumer, utility and program expenses.

The analyses presented herein are useful tools to evaluate programs from a program perspective, participant perspective and a societal perspective. The intended purposes and uses for cost-benefit analysis are to:

1. Inform program planning
2. Demonstrate the relative economic value of programs
3. Assess program results
4. Guide program implementation<sup>5</sup>

Although cost effectiveness is an important input into the decision as to which programs should be funded, other social factors need to be considered. For example, while the Residential Low-Income programs' costs exceed its benefits, other considerations may be taken into account that supports the continuation of these programs.

This report calculates monetary benefits accrued by avoiding environmental externalities. In December 2004, CEEEP conducted a thorough review of the environmental externality literature as part of its *Economic Impact Analysis of New Jersey's Proposed 20% Renewable Portfolio Standard (RPS)*. That assessment concluded that although there are many and substantial health and environmental effects due to air emissions from power plants, quantifying the health and environmental effects for New Jersey requires additional modeling and research. Therefore, the externality values used in the 2003 report were also used in this report.

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<sup>5</sup> CEEEP, *Program Cost Benefit Analysis of 2003 New Jersey Clean Energy Council Energy Efficiency Programs*, 2005.

### III. Cost-Benefit Analysis Assumptions

This section discusses the assumptions used in the cost-benefit analysis.

Participant installations, electricity and natural gas savings, and expense data were all provided by the Clean Energy Program Report.<sup>6</sup>

**Average Per-unit Energy Savings** – Per-unit electricity and natural gas savings were calculated by dividing the total reported savings for each program by the number of participants in the program. For example, in 2006, the Residential New Construction Program reported savings of 5,181 MWh and 164,504 DTh and had 5509 participants. This resulted in per-unit savings of 0.94 MWh and 30 DTh.

**Measure Lives** – Measure lives were estimated from information available in the Summit Blue report and the New Jersey Clean Energy Program Protocols to Measure Resource Savings (Protocols).<sup>7</sup> Three measure lives were not included in the Summit Blue report: Combined Heating and Power (CHP), NJDEP Cool Cities, and Energy Conservation Kits. For these programs, measure life was estimated using available program information in the New Jersey Clean Energy Program Report.<sup>8</sup> The CHP measure life was determined to be 20 years based on the 250 kW micro-turbines used in a project completed in 2006. NJDEP Cool Cities, a program that plants trees in urban areas, was estimated to have a measure life of 20 years, and the Energy Conservation Kits program was estimated to have a lifetime of 10 years based on the length of time natural gas savings were expected to occur as a result of use. The Residential HVAC program measure life was computed using the assumption that 90% of the program outlay was in central air conditioning units and 10% was in heating. In the multi-year analysis, the 2006 values were used and 2006 is used as the starting date for the multi-year analyses.

**Direct Utility Costs** - Utility T&D costs were estimated to be 48.3% of residential retail electricity costs and 42.4% of commercial/industrial retail electricity costs.<sup>9</sup> Commercial and industrial values were averaged together to provide one estimate for the combined, non-residential sector.

**Retail Electricity Prices** – To calculate reductions in customer bills, EIA 2006 New Jersey retail electricity prices of \$0.1261 for residential customers and \$0.1051 for commercial/industrial customers were used, with an annual adjustment for inflation.<sup>10</sup> These retail prices include taxes, refunds and other fees billed to the end-user. The commercial and industrial prices were provided separately, but were combined using a load weighted average since the Energy Efficiency programs do not make a distinction between the two sectors.

**Wholesale Electricity Prices** – Wholesale electricity prices were projected using the EIA retail electricity prices and multiplying by the ratio of wholesale electricity prices to retail electricity prices (49% for the Residential sector, 54% for the C&I sectors). The forecasted electricity prices for each time period are shown in Table 2.<sup>11</sup>

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<sup>6</sup> New Jersey Clean Energy Program, Data Forming Basis of Report to the New Jersey Board of Public Utilities. 4<sup>th</sup> Quarter 2001 - 2006.

<sup>7</sup> New Jersey Board of Public Utilities. *Protocols to Measure Resource Savings*. December 2007.

<sup>8</sup> New Jersey's Clean Energy Program Report. April 9, 2007.

<sup>9</sup> These estimates were arrived at after conversations with program administrators in the Clean Energy Program.

<sup>10</sup> Energy Information Administration, U.S.A. *Department of Energy, Annual Energy Outlook 2006. (EIA), 2006 Supplemental Tables to the Annual Energy Outlook 2006 Part 1: Consumption and Prices*. pg 78-82.

<sup>11</sup> <http://www.ces-us.com/download/dayzer%20v3.5-101.pdf>

**Natural Gas Prices** - Natural gas prices are based upon retail projections for the Mid-Atlantic Region from the Annual Energy Outlook 2007.<sup>12</sup> Forecasted prices for each sector are in Table 2.

<b>Table 2 - Electricity and Natural Gas Price Forecast</b>									
Year	Wholesale Electricity Prices (\$/MWh)					Retail Natural Gas Prices (\$/MMBTU)			
	Avg. Price	Summer Peak	Summer Off-Peak	Non-Summer Peak	Non-Summer Off-Peak	Avg. Price	Residential	Commercial	Industrial
2006	\$ 61.79	\$ 79.48	\$ 64.95	\$ 73.95	\$ 56.05	\$ 12.05	\$ 15.10	\$ 12.73	\$ 9.09
2007	\$ 68.60	\$ 88.80	\$ 72.72	\$ 82.41	\$ 62.09	\$ 11.32	\$ 13.80	\$ 11.41	\$ 8.79
2008	\$ 69.82	\$ 90.89	\$ 74.58	\$ 84.15	\$ 63.05	\$ 11.32	\$ 13.99	\$ 11.49	\$ 8.75
2009	\$ 70.96	\$ 92.87	\$ 76.33	\$ 85.79	\$ 63.95	\$ 10.88	\$ 13.69	\$ 11.09	\$ 8.25
2010	\$ 72.07	\$ 94.77	\$ 78.01	\$ 87.36	\$ 64.82	\$ 10.74	\$ 13.64	\$ 10.96	\$ 8.04
2011	\$ 73.29	\$ 96.80	\$ 79.79	\$ 89.06	\$ 65.79	\$ 10.44	\$ 13.45	\$ 10.69	\$ 7.70
2012	\$ 74.66	\$ 99.01	\$ 81.73	\$ 90.93	\$ 66.91	\$ 10.45	\$ 13.52	\$ 10.69	\$ 7.64
2013	\$ 76.08	\$ 101.27	\$ 83.70	\$ 92.85	\$ 68.07	\$ 10.38	\$ 13.57	\$ 10.63	\$ 7.52
2014	\$ 77.48	\$ 103.48	\$ 85.62	\$ 94.73	\$ 69.20	\$ 10.64	\$ 13.91	\$ 10.88	\$ 7.71
2015	\$ 78.90	\$ 101.98	\$ 86.40	\$ 97.51	\$ 71.34	\$ 10.73	\$ 14.16	\$ 11.03	\$ 7.80
2016	\$ 80.43	\$ 105.45	\$ 89.37	\$ 99.39	\$ 72.49	\$ 11.03	\$ 14.58	\$ 11.35	\$ 8.04
2017	\$ 81.95	\$ 108.86	\$ 92.28	\$ 101.21	\$ 73.59	\$ 11.59	\$ 15.25	\$ 11.89	\$ 8.51
2018	\$ 83.39	\$ 112.12	\$ 95.07	\$ 102.90	\$ 74.61	\$ 11.79	\$ 15.60	\$ 12.12	\$ 8.66
2019	\$ 84.94	\$ 115.52	\$ 97.97	\$ 104.71	\$ 75.72	\$ 12.03	\$ 15.96	\$ 12.37	\$ 8.82
2020	\$ 86.54	\$ 118.59	\$ 104.03	\$ 107.94	\$ 77.16	\$ 12.41	\$ 16.44	\$ 12.74	\$ 9.12
2021	\$ 88.18	\$ 121.40	\$ 106.71	\$ 109.80	\$ 78.54	\$ 12.37	\$ 16.43	\$ 12.67	\$ 9.05
2022	\$ 89.84	\$ 124.23	\$ 109.42	\$ 111.68	\$ 79.93	\$ 12.83	\$ 16.97	\$ 13.09	\$ 9.41
2023	\$ 91.56	\$ 127.14	\$ 112.18	\$ 113.63	\$ 81.37	\$ 13.26	\$ 17.48	\$ 13.48	\$ 9.73
2024	\$ 93.31	\$ 130.09	\$ 114.98	\$ 115.61	\$ 82.84	\$ 13.67	\$ 17.96	\$ 13.87	\$ 10.05
2025	\$ 95.12	\$ 133.11	\$ 117.85	\$ 117.65	\$ 84.35	\$ 13.89	\$ 18.29	\$ 14.08	\$ 10.20

**Capacity Prices** – Capacity prices for 2010, 2015 and 2020 were modeled by determining the carrying cost of a combustion turbine in the modeling years. Capacity prices are 11.57 \$/MWh in 2010, 12.51 \$/MWh in 2015, and 16.55 \$/MWh in 2020. Capacity Prices were linearly interpolated for years other than the modeling years.

**Environmental Externality Benefits** - Emissions savings of \$0.95 per MMBTU and \$0.02 per kWh were used, in real dollars. The estimates are based upon the 2001 Energy Efficiency Assessment and were used in the 2001 and 2003 studies.<sup>13,14</sup>

**Discount Rate** - A nominal discount rate of 8% is used.

<sup>12</sup> Energy Information Administration. *Annual Energy Outlook 2007*. February 2007.

<sup>13</sup> New Jersey Clean Energy Collaborative, *Energy and Economic Assessment of Statewide Energy-Efficiency Programs*, July 9, 2001. (2001 Total Resource Cost Analysis)

<sup>14</sup> In recent years, prices for NO<sub>x</sub> and SO<sub>2</sub> have been established through EPA emission trading programs. Carbon dioxide prices have been forecasted for the Regional Greenhouse Gas Initiative. CEEEP is in the process of conducting a review of the appropriate environmental externality adders to be used in this context.

**Peak Coincidence Factors** – Peak coincidence factors are used to determine capacity benefits in the model. The model is able to take peak coincidence factor data into account, but the necessary data has not been provided to CEEEP. Without these factors, capacity benefits are likely too low for electricity.

**Time Period Allocation Factors** - Since the price of electricity and natural gas vary throughout the year, time period factors are needed to allocate the energy savings by season, and in the case of electricity, by off-peak and on-peak hours in order to calculate the dollar value of these savings. These allocation factors were taken from the Summit Blue report and the Protocols for each energy efficiency measure. Natural gas programs have summer and winter time period allocation factors, and electric programs have summer on-peak, summer off-peak, winter on-peak and winter off-peak time period allocation factors. Seasonal allocations factors for electricity were not available for CHP, Residential New Construction and NJDEP Cool Cities. The CHP and Residential New Construction programs were assumed to have electricity seasonal allocation factors of 25% for each period. The Cool Cities Program, based on the seasonality of trees, was estimated at 70% in the summer and 30% in the winter. Natural gas seasonal allocation factors were not available for the Energy Conservation Kit program, and a value of 50% in the summer and 50% in the winter was used. The Residential HVAC program allocation factors were computed using the assumption that 90% of the program outlay was in air conditioning units and 10% was in heating. In the multi-year analysis, the 2006 values were used.

**Transmission and Distribution Avoided Costs** - In the context of Transmission and Distribution (T&D), avoided costs refer to costs avoided by not having to provide an additional unit of T&D capacity. An initial value of \$15, adjusted for inflation, was estimated for T&D costs based on the white paper prepared by Arthur D. Little (1999) and a study by Baskette et. al. (2006), showing that the average value was generally between \$0 and \$30.<sup>15</sup> For the multi-year analysis, a value of \$15 was used for each year and then indexed to 2006 dollars. Natural gas avoided distribution costs need to be estimated for inclusion in future cost-benefit analyses.

**Participant Capital Incremental Costs** – In this study, the incremental cost is the additional cost of an energy efficient product to the participant above the cost of a standard product. All incremental costs for the Energy Efficiency measures come from the Summit Blue report. For the multi-year analysis, the 2006 value was used for each year and then indexed to 2006 dollars.

The Commercial & Industrial New Construction, Retrofit and New School program participant costs were computed using project data from the 2005 New Jersey Clean Energy Program Annual Report and PSE&G historical costs paid for Energy Efficiency measures.<sup>16</sup> A weighted average was computed by multiplying the average amount requested for the measures by the percentage of that type of project completed in 2005. The C&I Retrofit and New Schools incremental costs need to be refined further by obtaining more detailed information, as the average incentive given out by the Clean Energy Program exceeds the incremental cost for these programs. For example, the average incentive for the C&I New Schools Program in 2006 was \$12,294, while the participant cost was computed to be \$7,760. A detailed description of installed measures is needed to accurately determine the incremental costs for the C&I Retrofit and New Schools programs because there are a plethora of possible measures with wide-ranging incremental costs that could be applied to the analysis.

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<sup>15</sup> Arthur D. Little, Inc., Distributed Generation: Understanding the Economics. 1999. Baskette, C., B. Horii, E. Kollman, and S. Price, “Avoided cost estimation and post-reform funding allocation for California’s energy efficiency programs,” *Energy – The International Journal*, 31:6-7, 1084-1099, 2006.

<sup>16</sup> New Jersey Board of Public Utilities, Office of Clean Energy. *New Jersey Clean Energy Program 2005 Annual Report*



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The Residential HVAC program participant cost was computed in a similar manner. The average price of each HVAC measure was computed using Summit Blue data and a weighted average was computed using a split of 90% central air conditioning units and 10% heat pumps.

**Incentives/Other Program Costs** – Incentives and other program cost for the multi-year analysis were provided by the Clean Energy Program and were indexed to 2006 dollars.

The remainder of this section provides details about specific data assumptions.

In previous year's studies, the Residential HVAC program was divided into an Electric Program and a Gas Program, compared to all other programs, where natural gas and electric savings are combined. In this study, we report a single Residential HVAC Program that combines the Electric and Gas Programs. Similarly, the Residential Low Income Program has three subprograms called Utility Comfort Partners, WRAP and DCA Low-Income. The electric and gas savings, as well as the budget data, were reported separately for each subprogram. Due to a lack of incremental costs and allocation factors data for the subprograms, the three were combined under the heading of Residential Low Income Program with one analysis performed.

This aggregation of program data limits the value of the cost-benefit analysis, and CEEEP is requesting that additional program information be provided for past and future programs, where available. In the case of the Residential HVAC program, it has been assumed that the program outlays are composed of 10% heat pumps and 90% central air conditioners. It has been suggested that the program is weighted even more heavily towards central air conditioning units than heat pumps, which has several implications on the cost-benefit analysis. For example, the measure life would be reduced as air conditioners have shorter lifetimes than ground source heat pumps, and seasonal allocation factors would change to be weighted more heavily in the summer season than the winter season.

We also need more program data to improve the incremental cost estimates. Incremental costs for the Commercial and Industrial programs are very difficult to estimate because of the variety of measures involved in each particular program. A breakdown of measures installed for each program is necessary.

The Combined Heating and Power Program reported savings in electricity generation as well as usage. In order to complete the analysis, a capacity factor and peak coincidence factor were needed. A capacity factor of 80% and a peak coincidence factor of 35% were used, respectively. The incremental cost of the program, \$2,500,000, was based on the use of 250 kW micro-turbines at a cost of \$1,000 per kW. The average CHP incentive for 2006 is \$466,250, which greatly exceeds the incremental cost, so this value needs further examination.

The 2006 Clean Energy Program Report includes installed, committed and total savings for all programs.<sup>17</sup> For the purposes of the cost-benefit analysis, only the installed savings were used. Energy savings and budget data were reported for the total program, but calculations to determine per unit cost and savings were also made.

CEEEP's Cost-Benefit model was developed to calculate benefit-cost (B/C) ratios both into the future and in the past. For future calculations, baseline usage and efficiency measure usage are needed to calculate the change in energy usage. For past program performance, where the energy savings are known, it is adequate to use the program savings as the baseline usage.

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<sup>17</sup> New Jersey Clean Energy Program Report, Reporting Period: (January 1, 2006 through December 31, 2006) April 9, 2007.

Wholesale electricity prices are detailed in Table 2. Price data was reported for the summer and winter, for both on-peak and off-peak times. Summer months included May, June, July, August and September. Winter months included January, February, March, April, October, November and December. On-peak times were from 9:00 am to 8:59 pm on weekdays; off-peak hours were from 9:00 pm to 8:59 am on weekdays, as well as all weekends and national holidays. Holidays included New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

#### IV. Cost-benefit Analysis Results

##### A. 2006 Results

The following tables present the results of the analysis. Table 3 includes the 2006 emission savings in metric tons due to each of the programs. These savings are calculated using electricity and gas savings from the 2006 Clean Energy Program Report and emissions factors from the New Jersey Clean Energy Protocols.<sup>18</sup> Over 1.5 million metric tons of CO<sub>2</sub>, 3,450 metric tons of NO<sub>x</sub> and 12,538 metric tons of SO<sub>2</sub> were mitigated as a result of New Jersey Energy Efficiency Programs.

<b>Table 3 - 2006 Emissions Savings (metric tons)</b>				
	<b>CO<sub>2</sub></b>	<b>NO<sub>x</sub></b>	<b>SO<sub>2</sub></b>	<b>Hg</b>
<b>Residential HVAC</b>	157,523	333	1159	.004
<b>Residential New Construction</b>	77,146	155	520	.002
<b>ENERGY Star Room AC</b>	3,121	7	27	.0001
<b>Home Performance with ES</b>	26	0.05	0.15	0
<b>Residential Low Income</b>	89,489	206	752	.002
<b>Energy Conservation Kits</b>	2	0.002	0	0
<b>C&amp;I New Construction</b>	173,884	404	1480	.005
<b>C&amp;I Retrofit</b>	826,859	1,927	7,062	.002
<b>C&amp;I Schools</b>	32,023	71	256	.001
<b>Combined Heat and Power</b>	144,826	342	1,262	.005
<b>NJDEP Cool Cities</b>	2,257	5	20	.00006
<b>TOTAL</b>	<b>1,507,156</b>	<b>3450</b>	<b>12,538</b>	<b>.021</b>

Note: Presence of significant figures do not necessarily reflect accuracy of emissions estimates.

Tables 4 and 5 present the results of all five cost tests for the residential and non-residential programs, respectively. The tests include the Participant Cost Test, Program Administration Cost Test, Ratepayer Impact Measure, Total Resource Cost Test and Societal Cost Test, which are described in the previous section. For each test, the first line shows the net benefit of the program. The net benefit is the total benefit of the program minus the total cost of the program. Negative numbers are in parentheses and indicate that the cost of the program is greater than the benefit. The second line is the benefit-cost ratio (B/C ratio), which is the total benefit divided by the total cost. A number above 1 indicates the total benefit is greater than the total cost and a number below 1 indicates the total cost is greater than the total benefit. The participant costs for the Residential Low Income Program and NJDEP Cool Cities are both \$0, so a Participant Cost Test cannot be completed

<sup>18</sup> New Jersey Clean Energy Program Protocols to Measure Resource Savings, September 2004.

**Table 4 - New Jersey Residential Program Cost Tests**

	<u>Residential HVAC</u>	<u>Residential New Construction</u>	<u>Residential Low Income</u>	<u>ENERGY STAR Room AC</u>	<u>Home Performance with ENERGY STAR</u>	<u>Energy Conservation Kits</u>
<b>Participant Cost Test Net Benefit</b>	<u>\$42,921,364</u>	\$29,449,938.19	\$18,217,619	\$253,794	\$16,701	(\$4,540)
<b>Benefits-Cost Ratio</b>	<u>4.34</u>	3.14	N/A	1.56	N/A	0.92**
<b>Program Administration Cost Test Net Benefit</b>	<u>\$24,724,889</u>	\$9,308,380.91	(\$5,987,865)	(\$147,794)	(\$1,937,277)	(\$363,837)
<b>Benefits-Cost Ratio</b>	<u>2.77</u>	1.50	0.67	0.68	0.01*	0.01**
<b>Ratepayer Impact Measure Net Benefit</b>	<u>\$17,231,703</u>	\$5,490,039.57	(\$12,378,190)	(\$403,603)	(\$1,938,525)	(\$363,837)
<b>Benefits-Cost Ratio</b>	<u>1.80</u>	1.24	0.50	0.44	0.01*	0.01**
<b>Total Resource Cost Test Net Benefit</b>	<u>\$24,508,714</u>	\$8,044,359.64	(\$4,507,653)	(\$365,087)	(\$1,936,065)	(\$371,836)
<b>Benefits-Cost Ratio</b>	<u>2.54</u>	1.38	0.75	0.51	0.01*	0.01**
<b>Societal Cost Test Net Benefit</b>	<u>\$26,454,653</u>	\$9,579,745.29	(\$4,172,823)	(\$365,014)	(\$1,935,186)	(\$371,600)
<b>Benefits-Cost Ratio</b>	<u>2.66</u>	1.46	0.77	0.51	0.01*	0.01**

\* Home Performance with Energy Star was a new program in 2006, which had large start up costs and small reported energy savings.

\*\* Energy Conservation Kits were an informational program; Energy savings were not reported

<b>Table 5 - New Jersey Non-Residential Program Cost Tests</b>					
	<u>C&amp;I New Construction</u>	<u>C&amp;I Retrofit</u>	<u>C&amp;I New Schools</u>	<u>Combined Heat and Power</u>	<u>NJDEP Cool Cities</u>
<b>Participant Cost Test Net Benefit</b>	\$18,379,080	\$101,257,269	\$5,627,012	\$6,366,712.31	\$228,184
<b>Benefits-Cost Ratio</b>	14.75	8.08	5.20	1.64	N/A
<b>Program Administration Cost Test Net Benefit</b>	\$10,437,632	\$53,856,434	\$2,986,334	\$7,391,818.20	(\$978,492)
<b>Benefits-Cost Ratio</b>	8.78	4.39	2.90	5.26	0.13
<b>Ratepayer Impact Measure Net Benefit</b>	\$2,611,020	\$17,411,267	\$1,666,377	\$1,184,517.37	(\$1,075,242)
<b>Benefits-Cost Ratio</b>	1.28	1.33	1.58	1.15	0.12
<b>Total Resource Cost Test Net Benefit</b>	\$12,784,684	\$65,657,589	\$3,340,266	\$1,251,757.77	(\$945,244)
<b>Benefits-Cost Ratio</b>	8.61	4.96	3.00	1.13	0.16
<b>Societal Cost Test Net Benefit</b>	\$12,812,589	\$67,195,260	\$3,589,314	\$1,254,850.68	(\$945,206)
<b>Benefits-Cost Ratio</b>	8.62	5.05	3.15	1.13	0.16

The Residential HVAC and Residential New Construction programs both have Benefit-Cost ratios greater than 1 for all of their cost tests, indicating that they are cost efficient programs based on the information provided and the assumptions that were made. The Residential Low Income, Home Performance with Energy Star and Energy Conservation Kit Programs all had Benefit-Cost ratios less than one. As stated in the Summary section, the Home Performance with Energy Star Program had large start up costs in 2006 and low participation in its first year, thus these results will likely improve in subsequent years. Also, the Energy Conservation Kit program was primarily an educational program, so energy savings were not reported by the Clean Energy Program. The Energy Star Room Air Conditioner program had a Benefit-Cost ratio greater than 1 for the Participant Cost Test and below 1 for all of the rest of the tests. The low Benefit-Cost ratios are likely due to the small electricity bill reductions (\$7/year) coupled with the relatively large incremental cost (\$49).

The C&I New Construction, Retrofit, New School and CHP Programs have B/C ratios above 1 for all tests. The ratios for Combined Heat and Power and the C&I Programs may be artificially high as a result of incomplete information on the participant incremental costs. The test results and the specific program input values may be examined further in the Appendices, which show the cost-benefit analyses input and output in their entirety.

## **B. Multi-year Results (2001-2006)**

Tables 6 and 7 present the multi-year results of all five cost tests for the residential and non-residential programs, respectively. As Tables 4 and 5 showed results programs whose measures are installed in 2006 only, Tables 6 and 7 represent the cost-benefit analysis for all installations in every year of the program's existence. The years in the tables show when data is available for the programs. As with the previous tables, a number above 1 indicates the total benefit is greater than the total cost and a number below 1 indicates the total cost is greater than the total benefit. The participant costs for the Residential Low Income Program and NJDEP Cool Cities are both \$0, so a Participant Cost Test cannot be completed. The full data tables for each program in all years available can be found in Appendices C – I.

<b>Table 6 - New Jersey Residential Programs Cost Test for All Years</b>				
	<b><u>Residential HVAC (2001-2006)</u></b>	<b><u>Residential New Construction (2003-2006)</u></b>	<b><u>Residential Low Income (2001-2006)</u></b>	<b><u>ENERGY STAR Room AC (2003-2006)</u></b>
<b>Participant Cost Test Net Benefit</b>	\$213,562,442	\$122,584,415	\$97,438,204	\$1,671,378
<b>Benefits-Cost Ratio</b>	3.59	2.91	N/A	1.45
<b>Program Administration Cost Test Net Benefit</b>	\$85,417,137	\$43,577,418	(\$21,392,954)	\$315,985
<b>Benefits-Cost Ratio</b>	1.89	1.56	0.77	1.14
<b>Ratepayer Impact Measure Net Benefit</b>	\$30,499,774	\$28,374,804	(\$46,275,715)	(\$1,700,274)
<b>Benefits-Cost Ratio</b>	1.20	1.30	0.61	0.60
<b>Total Resource Cost Test Net Benefit</b>	\$86,669,278	\$34,022,420	(\$13,845,439)	(\$1,691,387)
<b>Benefits-Cost Ratio</b>	1.80	1.37	0.85	0.64
<b>Societal Cost Test Net Benefit</b>	\$94,131,032	\$40,785,726	(\$10,854,460)	(\$1,690,814)
<b>Benefits-Cost Ratio</b>	1.87	1.45	0.88	0.64

<b>Table 7 - New Jersey Non-Residential Programs Cost Test for All Years</b>					
	<u><b>C&amp;I New Construction (2003-2006)</b></u>	<u><b>C&amp;I Retrofit (2003-2006)</b></u>	<u><b>C&amp;I New Schools (2003-2006)</b></u>	<u><b>Combined Heat and Power (2005-2006)</b></u>	<u><b>NJDEP Cool Cities (2005-2006)</b></u>
<b>Participant Cost Test Net Benefit</b>	\$87,264,624	\$766,363,838	\$36,318,367	\$38,373,344	\$5,022,374
<b>Benefits-Cost Ratio</b>	16.38	9.08	4.37	2.07	N/A
<b>Program Administration Cost Test Net Benefit</b>	\$39,096,171	\$429,163,414	\$16,442,218	\$42,220,422	(\$614,729)
<b>Benefits-Cost Ratio</b>	4.03	6.23	2.70	20.00	0.84
<b>Ratepayer Impact Measure Net Benefit</b>	\$5,491,044	\$111,412,681	\$1,854,643	\$11,622,748	(\$2,744,215)
<b>Benefits-Cost Ratio</b>	1.12	1.28	1.08	1.35	0.54
<b>Total Resource Cost Test Net Benefit</b>	\$56,786,177	\$519,568,059	\$19,083,171	\$19,271,213	\$144,316
<b>Benefits-Cost Ratio</b>	8.63	5.81	2.55	1.54	1.04
<b>Societal Cost Test Net Benefit</b>	\$57,042,507	\$523,768,130	\$19,525,984	\$19,284,008	\$145,163
<b>Benefits-Cost Ratio</b>	8.66	5.85	2.58	1.54	1.04

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The results for both the Residential and Non-Residential Programs are very similar to the 2006 results. There are a few interesting differences to note. For the ENERGY STAR Room AC program, the Program Administrator Benefit-Cost ratio goes from below 1 in 2006 to above 1 in the 2003-2006 average. This is due to low program costs coupled with large avoided power supply costs in 2004 and 2005.

In the CHP program results, there is a large increase in the Program Administrator Benefit-Cost ratio, from 5.26 in 2006 to 20 in the multiyear analysis (2005-2006). There were very small incentive payments in 2005 as compared to 2006, and this is likely what the increased ratio resulted from.

Figure 1 shows the Residential HVAC B/C ratio for each cost test between 2001 and 2006. The Residential HVAC PCT remained fairly consistent over the six years the program has been in place. For the rest of the cost tests, the greatest changes occurred between 2005 and 2006 when federal standards were changed. The PAC, RIM, TRC and SCT all increased steadily over the six years. Figure 2 shows the Residential Low Income cost tests between 2001 and 2006. Note that all of the cost tests fluctuated in the same way over the time period of the study. From 2001 through 2005, the Residential Low Income Benefit-Cost ratios tended to decrease or stay the same from year to year. From 2005 to 2006, though, the ratio increased for the SCT and TRC test and continued to decrease for the RIM. Figure 3 shows the results of the cost tests for each year of the C&I Retrofit program. The program was the most cost effective in 2005 due to large energy savings that year (135 MWh of electricity savings per unit).



Figure 1 - Residential HVAC Cost Tests

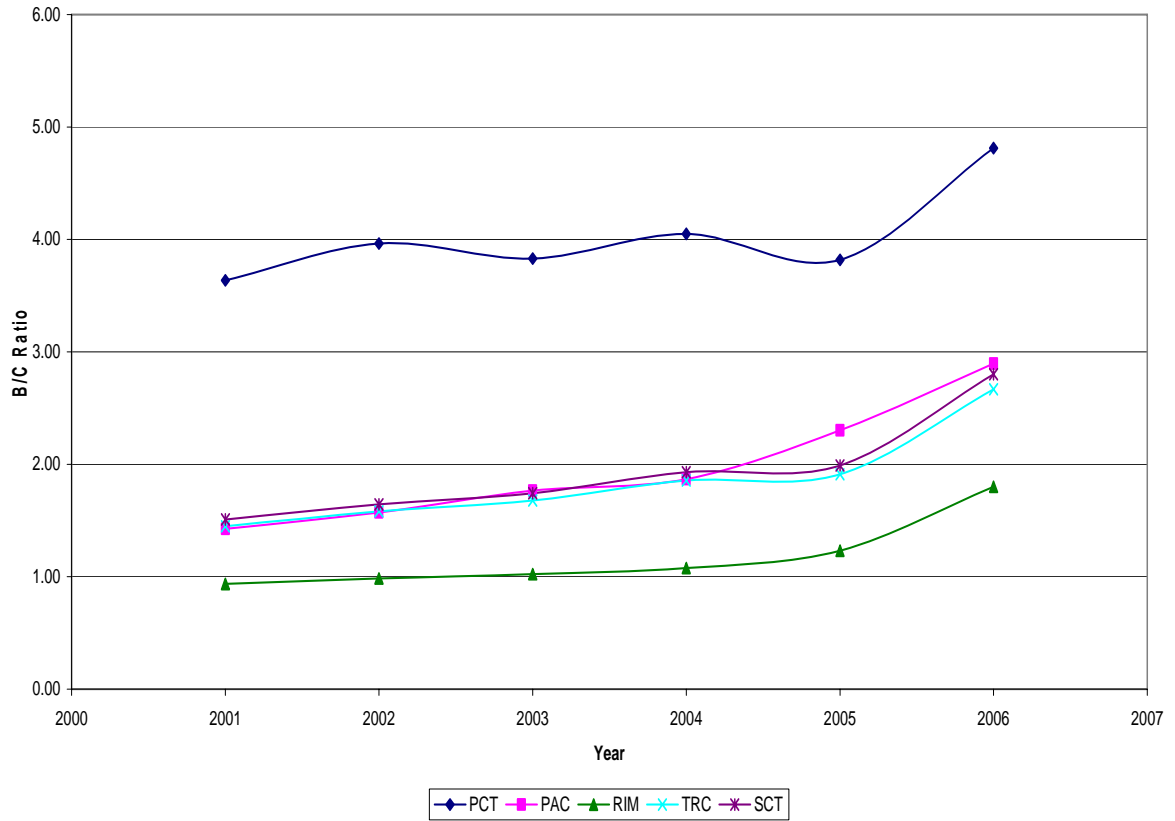


Figure 2 - Residential Low Income Cost Tests

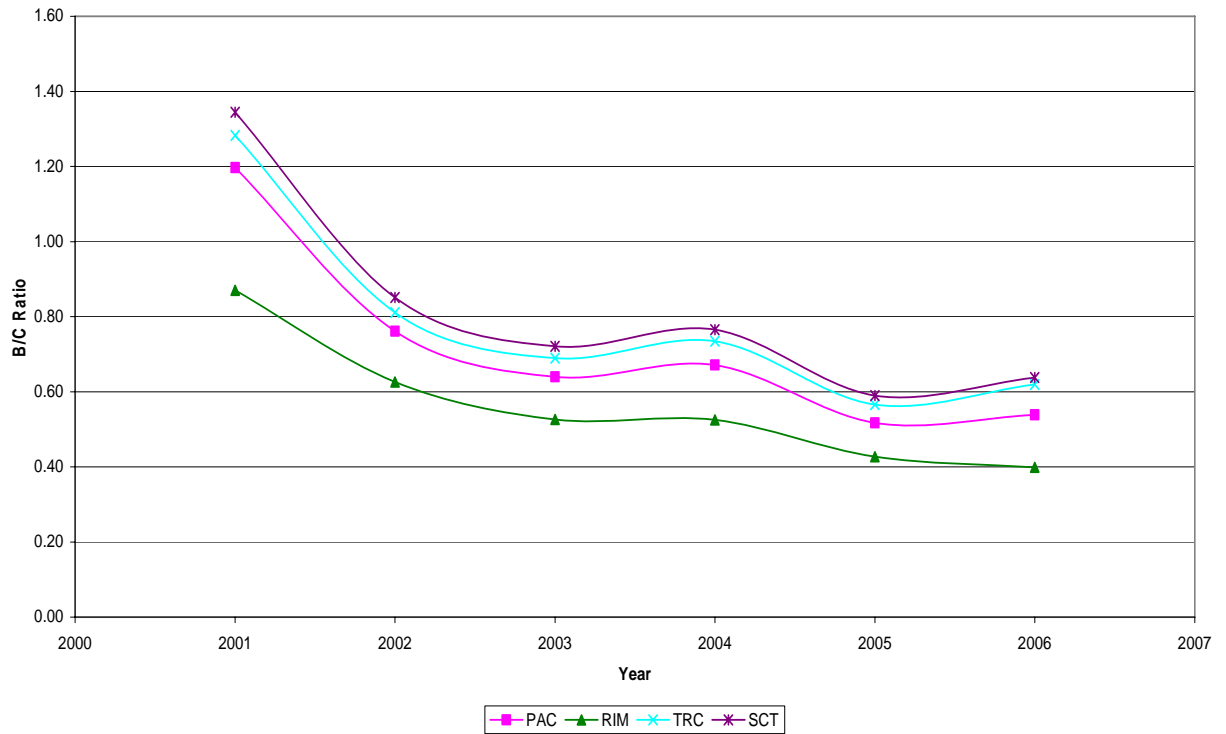


Figure 3 - C&I Retrofit Cost Tests

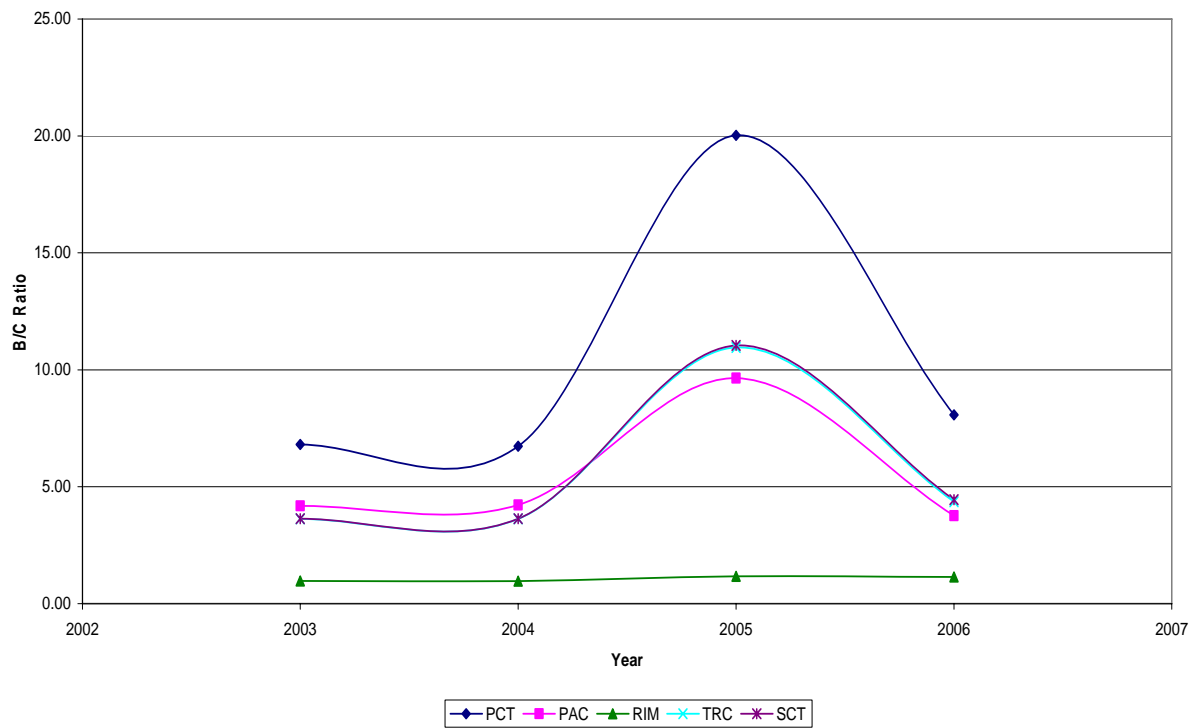


Table 8 presents the emissions savings for each program over the life of the program (see Tables 6 and 7). Overall, New Jersey has saved over 10 million tons of CO<sub>2</sub>, 24 thousand tons of NO<sub>x</sub>, 91 thousand tons of SO<sub>x</sub> and 0.29 tons of Hg. Over 80% of these savings have been from the Commercial and Industrial programs, with the Retrofit program accounting for over two-thirds of the emissions savings.

<b>Table 8 - 2001-2006 Emissions Savings (metric tons)</b>				
	<b>CO<sub>2</sub></b>	<b>NO<sub>x</sub></b>	<b>SO<sub>2</sub></b>	<b>Hg</b>
<b>Residential HVAC</b>	1,068,569	2,375	8,491	0.02733
<b>Residential New Construction</b>	314,559	622	2,070	0.00666
<b>Energy Star Room AC</b>	24,600	58	214	0.00069
<b>Residential Low Income</b>	364,473	816	2,929	0.00943
<b>C&amp;I New Construction</b>	735,613	1,727	6,355	0.02045
<b>C&amp;I Retrofit</b>	7,110,187	16,722	61,573	0.19816
<b>C&amp;I Schools</b>	329,105	770	2,827	0.00910
<b>Combined Heat and Power</b>	737,044	1,704	6,220	0.02104
<b>NJDEP Cool Cities</b>	49,684	117	433	0.00139
<b>Residential Total</b>	1,772,201	3,871	13,704	0.04410
<b>C&amp;I Total</b>	8,961,633	21,040	77,408	0.25014
<b>TOTAL</b>	<b>10,733,834</b>	<b>24,911</b>	<b>91,112</b>	<b>0.29424</b>

Note: Presence of significant figures do not necessarily reflect accuracy of emissions estimates.

## V. Future Work

As mentioned throughout this report, there are some areas where this cost-benefit analysis can be augmented. More information about which incremental expenses are to be included in the Commercial & Industrial programs is needed. Similarly, disaggregated data is needed for all the programs, where available, so that CEEEP can provide more accurate cost-benefit analysis results on the various Energy Efficiency programs. Second, the environmental externality estimate can be further improved by using allowance trading data available for SO<sub>2</sub> and NO<sub>x</sub> as well as forecasted CO<sub>2</sub> prices available through the Regional Greenhouse Gas Initiative. Third, there have been more recent studies conducted on T&D avoided costs, which need to be reviewed. Fourth, peak coincidence factors for the various programs need to be determined and included in the study. Finally, any available federal tax credits and energy efficiency incentives from the recently passed 2007 Energy Legislation should be incorporated into the analysis.

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**Appendix A: Residential Energy Efficiency Program Cost-Benefit Analyses**

**Inputs**

	<u>Residential HVAC</u>	<u>Residential New Construction</u>	<u>Residential Low Income</u>	<u>ENERGY STAR Room AC</u>	<u>Home Performance with ENERGY STAR</u>	<u>Energy Conservation Kits</u>
Number of Units Installed	26,379	5,509	8,552	9,607	3	10,859
Total MWh Saved by Program	11,545	5,181	10,708	542	2	0
Electricity Savings (Per Unit)						
Baseline Usage (MWh)	0.44	0.94	1.25	0.06	0.67	0.00
Baseline Generation (kW)	0	0	0	0	0	0
Electricity Season Allocation Factors						
Summer Peak	61%	25%	21%	65%	32%	0%
Summer Off-Peak	33%	25%	22%	35%	19%	0%
Non-Summer Peak	3%	25%	28%	0%	25%	0%
Non-Summer Off-Peak	3%	25%	29%	0%	24%	0%
Total	100%	100%	100%	100%	100%	0%
Total Natural Gas Savings Program (MMBtu)	231,174	164,504	42,526	0	108	37
Natural Gas Savings (Per Unit)						
Baseline Input (MMBtu)	9	30	5	0	36	0
Efficiency Measure Input (MMBtu)	0	0	0	0	0	0
Natural Gas Season Allocation Factors						
Summer	31%	50%	25%	0%	31%	50%
Winter	69%	50%	75%	0%	69%	50%
Total	100%	100%	100%	0%	100%	100%

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Capacity Factor	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Peak Coincidence Factor	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Peak Load Reduction (kW Per Unit)	0	0	0	0	0	0
Tax Credits (Per Unit)	\$0	\$0	\$0	\$0	\$0	\$0
Total Incentives Paid	\$11,780,000	\$12,560,000	\$14,000	\$191,000	\$1,000	\$50,000
Incentives Paid (Per Unit)	\$447	\$2,280	\$2	\$20	\$333	\$5
Electricity Bill Reductions in First Year (Per Unit)	\$55	\$119	\$158	\$7	\$84	\$0
Natural Gas Bill Reduction in First Year (Per Unit)	\$132	\$451	\$75	\$0	\$544	\$0
Participant Costs (Per Unit)						
Capital Incremental Costs	\$487	\$2,500	\$0	\$47	\$0	\$5
Yearly Incremental Costs	\$0	\$0	\$0	\$0	\$0	\$0
Other Program Costs						
Capital Costs	\$3,069,000	\$7,168,000	\$18,195,000	\$290,000	\$1,951,000	\$321,000
Yearly Costs	\$0	\$0	\$0	\$0	\$0	\$0
Utility Impact						
Revenue Gain from Increased Sales	\$0	\$0	\$0	\$0	\$0	\$0
Revenue Loss from Reduced Sales	\$27	\$57	\$76	\$3	\$41	\$0
Electricity Transmission and Distribution Costs	\$15	\$15	\$15	\$15	\$15	\$15
Natural Gas Distribution Costs	\$0	\$0	\$0	\$0	\$0	\$0
Fuel Escalations	0	0	0	0	0	0
Discount Rate	8%	8%	8%	8%	8%	8%

### Outputs

	<u>Residential HVAC</u>	<u>Residential New Construction</u>	<u>Residential Low Income</u>	<u>ENERGY STAR Room AC</u>	<u>Home Performance with ENERGY STAR</u>	<u>Energy Conservation Kits</u>
Avoided Power Supply Costs	\$38,701,296	\$28,106,011	\$12,220,098	\$319,057	\$14,649	\$3,459
Avoided Power Supply Costs Per Measure	\$1,467	\$5,102	\$1,429	\$33	\$4,883	\$0
Capacity Benefits	\$0	\$0	\$0	\$0	\$0	\$0
Electric and Natural Gas Avoided T&D Costs	\$1,722,990	\$878,849	\$1,467,249	\$58,538	\$287	\$0
Emission Savings	\$1,945,940	\$1,535,386	\$334,830	\$73	\$879	\$236
Reduced Emissions						
CO2 (Million Metric Tons)	0.13	0.08	0.09	0.00	0.00	0.00
Nox (Metric Tons)	267	155	206	7	0	0
SO2 (Metric Tons)	927	520	752	27	0	0
Hg (Lbs)	6.58	3.69	5.34	0.19	0.00	0.00
Participant Benefits	\$55,767,937	\$43,222,438	\$18,217,619	\$706,475	\$16,701	\$49,755
Participant Benefits Per Measure	\$2,114	\$7,846	\$2,130	\$74	\$5,567	\$5
Utility Revenue Gained	\$0	\$0	\$0	\$0	\$0	\$0
Direct Utility Costs	\$7,493,186	\$3,818,341	\$6,390,325	\$255,808	\$1,247	\$0
Tax Credits	\$0	\$0	\$0	\$0	\$0	\$0
Incentive Payments	\$10,907,407	\$11,629,630	\$12,963	\$176,852	\$926	\$46,296
Participant Costs	\$12,858,686	\$13,772,500	\$0	\$452,682	\$0	\$54,295
Participant Costs Per Measure	\$487	\$2,500	\$0	\$47	\$0	\$5
Other Program Costs	\$3,069,000	\$7,168,000	\$18,195,000	\$290,000	\$1,951,000	\$321,000
Other Program Costs Per Measure	\$116	\$1,301	\$2,128	\$30	\$650,333	\$30

## RESULTS

	<u>Residential HVAC</u>	<u>Residential New Construction</u>	<u>Residential Low Income</u>	<u>ENERGY STAR Room AC</u>	<u>Home Performance with ENERGY STAR</u>	<u>Energy Conservation Kits</u>
Participant Cost Test Net Benefit	\$42,909,251	\$29,449,938	\$18,217,619	\$253,794	\$16,701	(\$4,540)
Benefits-Cost Ratio	4.34	3.14	N/A	1.56	N/A	0.92
Program Administration Cost Test Net Benefit	\$24,724,889	\$9,308,381	(\$5,987,865)	(\$147,794)	(\$1,937,277)	(\$363,837)
Benefits-Cost Ratio	2.77	1.50	0.67	0.68	0.01	0.01
Ratepayer Impact Measure Net Benefit	\$17,231,703	\$5,490,040	(\$12,378,190)	(\$403,603)	(\$1,938,525)	(\$363,837)
Benefits-Cost Ratio	1.80	1.24	0.50	0.44	0.01	0.01
Total Resource Cost Test Net Benefit	\$24,496,600	\$8,044,360	(\$4,507,653)	(\$365,087)	(\$1,936,065)	(\$371,836)
Benefits-Cost Ratio	2.54	1.38	0.75	0.51	0.01	0.01
Societal Cost Test Net Benefit	\$26,442,540	\$9,579,745	(\$4,172,823)	(\$365,014)	(\$1,935,186)	(\$371,600)
Benefits-Cost Ratio	2.66	1.46	0.77	0.51	0.01	0.01



**Appendix B: Non-Residential Energy Efficiency Program Cost-Benefit Analyses**

**Inputs**

	<u>C&amp;I New Construction</u>	<u>C&amp;I Retrofit</u>	<u>C&amp;I New Schools</u>	<u>Combined Heat and Power</u>	<u>NJDEP Cool Cities</u>
Number of Units Installed	187	1,798	109	4	2,004
Total MWh Saved by Program	17,351	78,194	2,832	12,575	196
Electricity Savings (Per Unit)					
Baseline Usage (MWh)	93	43	26	3,144	0
Baseline Generation (kW)	0	0	0	794	0
Electricity Season Allocation Factors					
Summer Peak	31%	32%	32%	25%	35%
Summer Off-Peak	27%	28%	28%	25%	35%
Non-Summer Peak	22%	20%	20%	25%	15%
Non-Summer Off-Peak	20%	20%	20%	25%	15%
Total	100%	100%	100%	100%	100%
Total Natural Gas Savings Program (MMBtu)	2,855	171,062	27,913	0	0
Natural Gas Savings (Per Unit)					
Baseline Input (MMBtu)	15	95	256	0	0
Efficiency Measure Input (MMBtu)	0	0	0	0	0
Natural Gas Season Allocation Factors					
Summer	50%	31%	31%	0%	0%
Winter	50%	69%	69%	0%	0%
Total	100%	100%	100%	0%	0%
Capacity Factor	0.0%	0.0%	0.0%	80.0%	0.0%

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Peak Coincidence Factor	0.0%	0.0%	0.0%	35.0%	0.0%
Peak Load Reduction (kW Per Unit)	0	0	0	0	0
Tax Credits Per Unit (\$)	\$0	\$0	\$0	\$0	\$0
Total Incentives Paid (\$)	1,078,000	14,683,000	1,340,000	1,865,000	0
Incentives Paid Per Unit (\$)	\$5,765	\$8,166	\$12,294	\$466,250	\$0
Electricity Bill Reductions in First year (Per Unit)	\$9,752	\$4,571	\$2,731	\$330,408	\$10
Natural Gas Bill Reduction in First year (Per Unit)	\$167	\$1,038	\$2,793	\$0	\$0
Participant Costs (Per Unit)					
Capital Incremental Costs	\$7,150	\$7,958	\$12,294	\$2,500,000	\$0
Yearly Incremental Costs	\$0	\$0	\$0	\$0	\$0
Other Program Costs					
Capital Costs	\$344,000	\$2,290,000	\$332,000	\$10,000	\$1,123,000
Yearly Costs	\$0	\$0	\$0	\$0	\$0
Utility Impact					
Revenue Gain from Increased Sales	\$0	\$0	\$0	\$0	\$0
Revenue Loss from Reduced Sales	\$4,135	\$1,938	\$1,158	\$140,093	\$4
Electricity Transmission and Distribution Costs	\$15	\$15	\$15	\$15	\$15
Natural Gas Distribution Costs	\$0	\$0	\$0	\$0	\$0
Fuel Escalations	0	0	0	0	0
Discount Rate	8%	8%	8%	8%	8%

**Outputs**

	<b><u>C&amp;I New Construction</u></b>	<b><u>C&amp;I Retrofit</u></b>	<b><u>C&amp;I New Schools</u></b>	<b><u>Combined Heat and Power</u></b>	<b><u>NJDEP Cool Cities</u></b>
Avoided Power Supply Costs	\$11,779,780	\$69,741,804	\$4,559,075	\$9,015,924	\$144,508
Avoided Power Supply Costs Per Measure	\$62,993	\$38,789	\$41,826	\$2,253,981	\$72
Capacity Benefits	\$0	\$0	\$0	\$112,746	\$0
Avoided Electric and Gas T&D Costs	\$2,685,954	\$12,514,269	\$453,237	\$2,133,088	\$33,247
Emission Savings	\$27,906	\$1,537,672	\$249,048	\$3,093	\$38
Reduced Emissions					
CO2 (Million Metric Tons)	0.17	0.83	0.03	0.18	0.00
Nox (Metric Tons)	401	1,927	71	428	5
SO2 (Metric Tons)	1,480	7,062	256	1,581	20
Hg (Lbs)	10.50	50.11	1.81	11.21	0.14
Participant Benefits	\$19,716,130	\$115,565,753	\$6,967,058	\$16,366,712	\$228,184
Participant Benefits Per Measure	\$105,434	\$64,275	\$63,918	\$4,091,678	\$114
Utility Revenue Gained	\$0	\$0	\$0	\$0	\$0
Direct Utility Costs	\$7,826,612	\$36,445,167	\$1,319,957	\$6,207,301	\$96,750
Tax Credits	\$0	\$0	\$0	\$0	\$0
Incentive Payments	\$998,148	\$13,595,370	\$1,240,741	\$1,726,852	\$0
Participant Costs	\$1,337,050	\$14,308,484	\$1,340,046	\$10,000,000	\$0
Participant Costs Per Measure	\$7,150	\$7,958	\$12,294	\$2,500,000	\$0
Other Program Costs	\$344,000	\$2,290,000	\$332,000	\$10,000	\$1,123,000
Other Program Costs Per Measure	\$1,840	\$1,274	\$3,046	\$2,500	\$560

## RESULTS

	<u>C&amp;I New Construction</u>	<u>C&amp;I Retrofit</u>	<u>C&amp;I New Schools</u>	<u>Combined Heat and Power</u>	<u>NJDEP Cool Cities</u>
Participant Cost Test Net Benefit	\$18,379,080	\$101,257,269	\$5,627,012	\$6,366,712	\$228,184
Benefits-Cost Ratio	14.75	8.08	5.20	1.64	N/A
Program Administration Cost Test Net Benefit	\$10,437,632	\$53,856,434	\$2,986,334	\$7,391,818	(\$978,492)
Benefits-Cost Ratio	8.78	4.39	2.90	5.26	0.13
Ratepayer Impact Measure Net Benefit	\$2,611,020	\$17,411,267	\$1,666,377	\$1,184,517	(\$1,075,242)
Benefits-Cost Ratio	1.28	1.33	1.58	1.15	0.12
Total Resource Cost Test Net Benefit	\$12,784,684	\$65,657,589	\$3,340,266	\$1,251,758	(\$945,244)
Benefits-Cost Ratio	8.61	4.96	3.00	1.13	0.16
Societal Cost Test Net Benefit	\$12,812,589	\$67,195,260	\$3,589,314	\$1,254,851	(\$945,206)
Benefits-Cost Ratio	8.62	5.05	3.15	1.13	0.16

**Appendix C: Residential HVAC Multi-year Cost Test Results**

<b>Residential HVAC Program</b>							
	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$30,125,525	\$37,812,308	\$32,413,217	\$36,416,259	\$33,873,768	\$42,921,364	\$213,562,442
<b>Benefits-Cost Ratio</b>	3.25	3.52	3.40	3.63	3.43	4.34	3.59
<b>Program Administrator Cost Test</b>	\$7,172,115	\$11,006,319	\$11,656,284	\$13,877,533	\$16,979,997	\$24,724,889	\$85,417,137
<b>Benefits-Cost Ratio</b>	1.41	1.55	1.76	1.88	2.32	2.77	1.89
<b>Ratepayer Impact Measure</b>	(\$761,770)	\$814,417	\$2,166,646	\$3,818,037	\$7,230,742	\$17,231,703	\$30,499,774
<b>Benefits-Cost Ratio</b>	0.97	1.03	1.09	1.15	1.32	1.80	1.20
<b>Total Resource Cost Test</b>	\$8,134,899	\$12,069,225	\$11,772,636	\$14,825,915	\$15,357,890	\$24,508,714	\$86,669,278
<b>Benefits-Cost Ratio</b>	1.43	1.56	1.67	1.85	1.92	2.54	1.80
<b>Societal Cost Test</b>	\$9,122,675	\$13,285,781	\$12,775,030	\$15,963,864	\$16,529,027	\$26,454,653	\$94,131,032
<b>Benefits-Cost Ratio</b>	1.49	1.61	1.73	1.92	1.98	2.66	1.87

**Appendix D: Residential Low Income Multi-year Cost Test Results**

<b>Residential Low Income Program</b>							
	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$19,960,824	\$15,339,144	\$15,536,726	\$15,683,470	\$12,700,420	\$18,217,619	\$97,438,204
<b>Benefits-Cost Ratio</b>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Program Administrator Cost Test</b>	\$3,577,299	(\$3,009,054)	(\$5,712,443)	(\$3,707,100)	(\$6,553,792)	(\$5,987,865)	(\$21,392,954)
<b>Benefits-Cost Ratio</b>	1.29	0.80	0.67	0.76	0.59	0.67	0.77
<b>Ratepayer Impact Measure</b>	(\$830,521)	(\$6,109,925)	(\$9,158,253)	(\$7,881,579)	(\$9,917,246)	(\$12,378,190)	(\$46,275,715)
<b>Benefits-Cost Ratio</b>	0.95	0.66	0.56	0.60	0.49	0.50	0.61
<b>Total Resource Cost Test</b>	\$4,866,301	(\$1,876,760)	(\$4,030,623)	(\$2,581,877)	(\$5,714,826)	(\$4,507,653)	(\$13,845,439)
<b>Benefits-Cost Ratio</b>	1.40	0.87	0.75	0.83	0.64	0.75	0.85
<b>Societal Cost Test</b>	\$5,586,311	(\$1,300,070)	(\$3,520,316)	(\$2,115,345)	(\$5,332,218)	(\$4,172,823)	(\$10,854,460)
<b>Benefits-Cost Ratio</b>	1.46	0.91	0.79	0.86	0.67	0.77	0.88

**Appendix E: Residential New Construction Multi-year Cost Test Results**

<b>Residential New Construction Program</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$22,627,827.47	\$32,249,411.04	\$38,257,238.55	\$29,449,938.19	\$122,584,415
<b>Benefits-Cost Ratio</b>	2.62	2.98	2.89	3.14	2.91
<b>Program Administrator Cost Test</b>	\$8,707,970.21	\$7,852,768.12	\$17,708,298.98	\$9,308,380.91	\$43,577,418
<b>Benefits-Cost Ratio</b>	1.58	1.35	1.80	1.50	1.56
<b>Ratepayer Impact Measure</b>	\$5,190,320.49	\$4,498,730.01	\$13,195,713.76	\$5,490,039.57	\$28,374,804
<b>Benefits-Cost Ratio</b>	1.28	1.17	1.50	1.24	1.30
<b>Total Resource Cost Test</b>	\$5,253,871.53	\$7,548,955.90	\$13,175,233.17	\$8,044,359.64	\$34,022,420
<b>Benefits-Cost Ratio</b>	1.27	1.32	1.48	1.38	1.37
<b>Societal Cost Test</b>	\$6,531,838.51	\$9,263,198.25	\$15,410,943.74	\$9,579,745.29	\$40,785,726
<b>Benefits-Cost Ratio</b>	1.34	1.39	1.56	1.46	1.45

**Appendix F: ENERGY STAR Room AC Multi-year Cost Test Results**

<b>ENERGY STAR Room AC Program</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$592,712	\$359,350	\$465,521	\$253,794	\$1,671,378
<b>Benefits-Cost Ratio</b>	1.44	1.29	1.65	1.56	1.45
<b>Program Administrator Cost Test</b>	(\$91,598)	\$402,068	\$153,309	(\$147,794)	\$315,985
<b>Benefits-Cost Ratio</b>	0.90	1.98	1.39	0.68	1.14
<b>Ratepayer Impact Measure</b>	(\$767,460)	(\$247,835)	(\$281,376)	(\$403,603)	(\$1,700,274)
<b>Benefits-Cost Ratio</b>	0.52	0.77	0.66	0.44	0.60
<b>Total Resource Cost Test</b>	(\$724,936)	(\$423,578)	(\$177,786)	(\$365,087)	(\$1,691,387)
<b>Benefits-Cost Ratio</b>	0.58	0.70	0.78	0.51	0.64
<b>Societal Cost Test</b>	(\$724,744)	(\$423,393)	(\$177,662)	(\$365,014)	(\$1,690,814)
<b>Benefits-Cost Ratio</b>	0.58	0.70	0.78	0.51	0.64



**Appendix G: C&I New Construction Multi-year Cost Test Results**

<b>CI New Construction Program</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$14,995,581	\$36,191,180	\$17,698,784	\$18,379,080	\$87,264,624
<b>Benefits-Cost Ratio</b>	10.96	27.64	13.03	14.75	16.38
<b>Program Administrator Cost Test</b>	\$4,523,280	\$17,429,806	\$6,705,452	\$10,437,632	\$39,096,171
<b>Benefits-Cost Ratio</b>	2.12	5.44	2.86	8.78	4.03
<b>Ratepayer Impact Measure</b>	(\$781,368)	\$3,203,786	\$457,605	\$2,611,020	\$5,491,044
<b>Benefits-Cost Ratio</b>	0.92	1.18	1.05	1.28	1.12
<b>Total Resource Cost Test</b>	\$8,299,138	\$24,924,742	\$10,777,614	\$12,784,684	\$56,786,177
<b>Benefits-Cost Ratio</b>	4.61	15.65	7.10	8.61	8.63
<b>Societal Cost Test</b>	\$8,372,739	\$24,970,149	\$10,887,030	\$12,812,589	\$57,042,507
<b>Benefits-Cost Ratio</b>	4.65	15.67	7.16	8.62	8.66

**Appendix H: C&I Retrofit Multi-year Cost Test Results**

<b>CI Retrofit</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$191,850,706	\$172,542,274	\$300,713,589	\$101,257,269	\$766,363,838
<b>Benefits-Cost Ratio</b>	6.64	6.64	19.91	8.08	9.08
<b>Program Administrator Cost Test</b>	\$103,668,625	\$93,284,036	\$178,354,320	\$53,856,434	\$429,163,414
<b>Benefits-Cost Ratio</b>	4.93	5.07	11.56	4.39	6.23
<b>Ratepayer Impact Measure</b>	\$19,922,671	\$17,017,838	\$57,060,905	\$17,411,267	\$111,412,681
<b>Benefits-Cost Ratio</b>	1.18	1.17	1.41	1.33	1.28
<b>Total Resource Cost Test</b>	\$123,638,443	\$110,439,934	\$219,832,093	\$65,657,589	\$519,568,059
<b>Benefits-Cost Ratio</b>	4.20	4.24	12.76	4.96	5.81
<b>Societal Cost Test</b>	\$124,297,818	\$110,830,645	\$221,444,406	\$67,195,260	\$523,768,130
<b>Benefits-Cost Ratio</b>	4.22	4.26	12.85	5.05	5.85

**Appendix I: C&I New School Construction and Retrofit Multi-year Cost Test Results**

<b>C&amp;I New School Construction and Retrofit</b>					
	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Total</b>
<b>Participant Cost Test</b>	\$5,885,077	\$10,159,832	\$14,646,446	\$5,627,012	\$36,318,367
<b>Benefits-Cost Ratio</b>	3.11	4.14	5.31	5.20	4.37
<b>Program Administrator Cost Test</b>	\$3,227,289	\$3,961,008	\$6,267,587	\$2,986,334	\$16,442,218
<b>Benefits-Cost Ratio</b>	2.88	2.27	2.92	2.90	2.70
<b>Ratepayer Impact Measure</b>	\$473,650	(\$222,118)	(\$63,266)	\$1,666,377	\$1,854,643
<b>Benefits-Cost Ratio</b>	1.11	0.97	0.99	1.58	1.08
<b>Total Resource Cost Test</b>	\$2,789,405	\$4,904,236	\$8,049,263	\$3,340,266	\$19,083,171
<b>Benefits-Cost Ratio</b>	1.87	2.32	3.16	3.00	2.55
<b>Societal Cost Test</b>	\$2,874,933	\$4,991,648	\$8,070,088	\$3,589,314	\$19,525,984
<b>Benefits-Cost Ratio</b>	1.89	2.34	3.16	3.15	2.58