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Cost-Benefit Analysis of the New Jersey Clean Energy Program Energy Efficiency Programs:

2010 Retrospective

Summary Report

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I. Summary

The Center for Energy, Economic and Environmental Policy (CEEEP) of the Edward J. Bloustein School of Planning and Public Policy, Rutgers University was asked by the New Jersey Board of Public Utilities (NJBPU) to conduct a cost-benefit analysis of the 2010 residential, commercial and industrial New Jersey Clean Energy Program (NJCEP) energy efficiency programs. The purpose of this report is to summarize the evaluation of the 2010 energy efficiency programs and compare the 2010 program cost-benefit analyses to 2006, 2007, 2008, and 2009. Please note that non-energy impacts, such as reductions in water usage and improved health and safety, have not been included in this analysis. These types of impacts should be investigated and quantified in the future. The ten NJCEP Energy Efficiency programs available to New Jersey residential, commercial and industrial customers in 2010 are provided in Table 1. The Energy Star Products program includes Change a Light, Room Air Conditioner, Dehumidifier Clothes Washer, and Refrigerator Turn-in.

Table 1: NJCEP Energy Efficiency Programs

Residential	Commercial & Industrial
Residential HVAC	C&I New Construction
Residential New Construction	C&I Retrofit
Residential Low Income	Direct Install
EnergyStar Products	Combined Heat and Power
Home Performance with Energy Star	Pay-for-Performance

The key assumptions and data sources are explained in Section III.

II. Cost-Benefit Tests

Five costs tests are utilized for the cost-benefit analysis: Participant Cost Test, Program Administration Cost Test, Ratepayer Impact Measure Test, Total Resource Cost Test and Societal Cost Test.[1]

Participant Cost Test: The measure of the quantifiable benefits and costs to the customer attributed to participation in a program. The participant benefits 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.

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

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

Total Resource Cost Test: The 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

[1] California Standard Practice Manual. Economic Analysis of Demand-Side Programs and Projects. (October 2001).

effects of a program on both the participating and non-participating customers. The benefits are the avoided supply costs, federal tax credits, and the reduction in 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 the utility and participants plus the increase in supply costs for the periods in which load is increased.

Societal Cost Test: Attempts to quantify the change in the total resource costs to society as a whole rather than only to the utility and its ratepayers. Costs include all consumer, utility and program expenses. Benefits associated with the societal perspective include avoided power supply costs, capacity benefits, avoided transmission and distribution costs, and emissions savings.

It is assumed by CEEEP that wholesale electricity prices account for the national sulfur dioxide and nitrogen oxide allowance programs and the Regional Greenhouse Gas Initiative carbon dioxide program (until New Jersey withdrew from the program in May 2011). Therefore, the societal cost test does not differ from the total resource cost test because emissions savings are not accounted for separately for 2010 cost-benefit model societal cost test. Federal tax credits are not included.

III. Cost-Benefit Analysis Assumptions

The key components of the energy efficiency cost-benefit analysis and the data sources and processes for determining these components are discussed in this section. The number of participant installations, participant electricity and natural gas savings, and administrative costs were provided by the New Jersey Clean Energy Program.

Retail Electricity Prices: Historic U.S. Energy Information Administration (EIA) New Jersey retail electricity prices were escalated using an annual growth rate derived from the EIA Annual Energy Outlook 2011 for the Mid-Atlantic region. The NJ Clean Energy Programs do not distinguish between commercial and industrial sectors, therefore the commercial and industrial prices were averaged based on historic 2010 New Jersey retail electricity sales.[2]

Wholesale Electricity Prices: Historic 2010 New Jersey wholesale electric prices were escalated based on the annual percent change in the wholesale natural gas price forecast (described below). Seasonal peak and off-peak factors were derived from historic 2010 seasonal factors.[3]

Retail Natural Gas Prices: Historic New Jersey retail natural gas prices were escalated using an annual growth rate derived from the EIA Annual Energy Outlook 2011 for the Mid-Atlantic region.[4]

Wholesale (Henry Hub) Natural Gas Prices: Wholesale natural gas prices are taken from EIA Natural Gas Year-In-Review 2009[5] and EIA Annual Energy Outlook 2011.

[2] EIA. Current and Historical Monthly Retail Sales, Revenues and Average Revenue per Kilowatthour by State and by Sector (Form 826) http://www.eia.gov/cneaf/electricity/page/sales_revenue.xls

[3] PJM. Monthly Locational Marginal Pricing: Daily Day-Ahead www.pjm.com/markets-and-operations/energy/real-time/monthlylmp.aspx; PJM. Historic Load Data http://www.pjm.com/markets-and-operations/ops-analysis/historical-load-data.aspx. NJCEP Protocols to Measure Resource Savings (December 2009) www.njcleanenergy.com/files/file/Library/Protocols%20Final%2012-7-09.pdf

[4] EIA. Natural Gas Prices http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm

[5] Available at www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2010/ngyir2009/ngyir2009.html

Table 2: Retail and Wholesale Electricity Prices

	Retail ($/kWh)		*Wholesale ($/MWh)*				
	Residential	Commercial & Industrial	Average Price	Summer Peak	Summer Off-Peak	Non-Summer Peak	Non-Summer Off-Peak
2010	$0.18	$0.15	$50.30	$70.78	$47.02	$54.10	$44.51
2011	$0.17	$0.13	$51.54	$72.52	$48.18	$55.43	$45.61
2012	$0.18	$0.13	$52.33	$73.63	$48.91	$56.27	$46.31
2013	$0.18	$0.13	$53.90	$75.85	$50.39	$57.97	$47.70
2014	$0.19	$0.13	$55.03	$77.43	$51.44	$59.18	$48.70
2015	$0.19	$0.13	$57.28	$80.60	$53.54	$61.60	$50.69
2016	$0.19	$0.14	$59.31	$83.45	$55.44	$63.78	$52.48
2017	$0.19	$0.14	$60.88	$85.67	$56.91	$65.47	$53.87
2018	$0.20	$0.14	$62.79	$88.36	$58.70	$67.53	$55.57
2019	$0.20	$0.15	$64.93	$91.37	$60.70	$69.83	$57.46
2020	$0.21	$0.15	$68.65	$96.59	$64.17	$73.82	$60.75
2021	$0.21	$0.16	$72.58	$102.14	$67.85	$78.06	$64.23
2022	$0.21	$0.16	$76.07	$107.04	$71.11	$81.81	$67.32
2023	$0.21	$0.16	$80.12	$112.75	$74.90	$86.17	$70.90
2024	$0.21	$0.17	$84.74	$119.24	$79.21	$91.13	$74.99
2025	$0.22	$0.17	$88.90	$125.10	$83.10	$95.61	$78.67
2026	$0.22	$0.17	$92.39	$130.01	$86.36	$99.36	$81.76
2027	$0.22	$0.18	$96.33	$135.55	$90.05	$103.59	$85.24
2028	$0.23	$0.18	$99.25	$139.66	$92.78	$106.74	$87.83
2029	$0.23	$0.18	$101.73	$143.15	$95.09	$109.40	$90.02
2030	$0.23	$0.19	$104.43	$146.95	$97.62	$112.31	$92.41

Table 3: Retail and Wholesale Natural Gas Prices ($/MMBtu)

	Retail Prices			*Henry Hub Wholesale Prices*		
	Residential	Commercial	Industrial	Average Price	Summer	Winter
2010	$15.71	$11.02	$10.54	$4.47	4.30	4.64
2011	$14.56	$11.33	$10.78	$4.58	4.41	4.75
2012	$14.65	$11.15	$10.90	$4.65	4.48	4.82
2013	$14.72	$10.95	$11.02	$4.79	4.61	4.97
2014	$14.69	$10.64	$10.98	$4.89	4.71	5.07
2015	$15.03	$10.85	$11.19	$5.09	4.90	5.28
2016	$15.43	$11.12	$11.46	$5.27	5.07	5.47
2017	$15.88	$11.40	$11.76	$5.41	5.21	5.61
2018	$16.39	$11.75	$12.13	$5.58	5.37	5.79
2019	$16.96	$12.15	$12.57	$5.77	5.55	5.99
2020	$17.57	$12.57	$13.02	$6.10	5.87	6.33
2021	$18.17	$12.98	$13.46	$6.45	6.21	6.69
2022	$18.75	$13.39	$13.95	$6.76	6.51	7.01
2023	$19.35	$13.82	$14.45	$7.12	6.85	7.39
2024	$19.94	$14.26	$14.97	$7.53	7.25	7.81
2025	$20.58	$14.69	$15.50	$7.90	7.60	8.20
2026	$21.16	$15.09	$15.95	$8.21	7.90	8.52
2027	$21.81	$15.54	$16.48	$8.56	8.24	8.88
2028	$22.45	$16.00	$17.01	$8.82	8.49	9.15
2029	$23.13	$16.45	$17.53	$9.04	8.70	9.38
2030	$23.80	$16.92	$18.07	$9.28	8.93	9.63

Capacity Prices: 2010 to 2013 PJM Reliability Pricing Model (RPM) prices were weighted by historic 2010 peak load[6] and forecasted based on the annual change in U.S. Consumer Price Index (CPI).[7]

Discount Rate: Discount rates are used to convert future economic values into present day dollars. A nominal discount rate of 8% is used.[8]

Time Period Allocation Factors: Time period allocation factors account for the variation of electricity and natural gas prices throughout the year. Allocation factors were taken from Summit Blue Consulting[9], California,[10] Connecticut[11] Vermont[12] and the New Jersey Protocols[13]. 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. The Low Income, Residential New Construction, and all C&I EE Program allocation factors were estimated based on a list of available measures that were anticipated to be included in the programs. The Residential HVAC, Home Performance with Energy Star, and Energy Star Products allocation factors were estimated based on the weighted average of measures actually installed under the programs. The CHP program was assumed to have electricity seasonal allocation factors of 25% for each period.

Avoided Electric and Natural Gas Losses: Taken from the NJCEP Protocols to Measure Resource Savings, avoided electric transmission losses are assumed to be 11% and avoided distribution losses are assumed to be 1%.

Avoided Electric and Natural Gas Transmission and Distribution Costs: CEEEP is currently researching reputable sources for Avoided Natural Gas T&D costs, so they are not included in the cost-benefit analyses.

Incremental Costs: Incremental cost is the additional cost of purchasing an energy efficient product instead of a standard product or the full cost of weatherization and insulation products. The average incremental cost of each measure was estimated using data from Summit Blue Consulting, California, Connecticut and Vermont. The CHP program incremental cost was estimated at $250,000, based on the use of 250 kW micro-turbines at a cost of $1,000 per kW. The Residential HVAC, Low Income, Home Performance with Energy Star, and Energy Star Products incremental costs were estimated based on the weighted average of measures actually installed under the programs. The Commercial & Industrial New Construction, Retrofit, Direct Install, and Pay for Performance program participant costs were computed using a list of measures that are common in C&I Energy Efficiency Programs. These incremental costs will be refined further by obtaining more detailed installed measure information because there are a plethora of possible measures with wide-ranging incremental costs that could be applied to the analysis. In addition, the 2012 Energy Efficiency Market Potential Study is expected to provide additional measure level data that will be useful for the cost-benefit analysis, including measure cost and energy savings.

Measure Lives: The number of years that an energy efficient product will accrue energy savings. The measure life of each program was calculated using the same method as the incremental cost, using data

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[6] PJM Reliability Pricing Model User Information. Base Residual Auction Results www.pjm.com/markets-and-operations/rpm/rpm-auction-user-info.aspx#Item01; PJM. Historic Load Data.
[7] U.S. Department of Labor ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt; EIA Annual Energy Outlook 2010.
[8] Levitan & Associates, Inc. Long-term Capacity Agreement Pilot Program (March 2011).
[9] Summit Blue Consulting. Energy Efficiency Market Assessment of New Jersey Clean Energy Programs. (July 20, 2006).
[10] Database for Energy-Efficiency Resources. Technology and Measure Cost Data, California Public Utilities Commission (October 26, 2005).
[11] Connecticut Energy Efficiency Fund. CL&P and UI Program Savings Documentation for 2008 Program Year, Connecticut Light & Power Company and The United Illuminating Company (September 25, 2007).
[12] Efficiency Vermont. Technical Reference User Manual (July 18, 2008).
[13] NJCEP. New Jersey Clean Energy Program Protocols to Measure Resource Savings. (December 2007).

from the New Jersey Protocols,[14] Energy Star,[15] Connecticut and Vermont. The Combined Heat and Power (CHP) measure life was determined to be 20 years based on the 250 kW micro-turbines used in a project completed in 2006.

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

In order to increase the accuracy of the cost-benefit analyses, especially for the C&I programs, CEEEP suggests that the Market Manager provide 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. CEEEP has received this breakdown of measures installed for the Residential HVAC, Energy Star Products, and Home Performance with Energy Star programs, but not for the C&I programs.

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 2010 Clean Energy Program Report includes installed, committed and total savings for all programs. 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.

IV. Cost-benefit Analysis Results

The cost-benefit analysis results for the 2010 energy efficiency programs are presented in Tables 4 and 5. The Home Performance with Energy Star results will be reported at a later date when CEEEP has received further Tier-level data from the program administrators.

Table 4: Residential Programs

	Low Income	HVAC	Energy Star Products	New Construction
Participant	$46,457,313	$48,313,840	$187,035,876	$16,727,733
Ratio	#DIV/0!	3.4	8.4	2.5
Program Administration	($24,542,398)	$6,711,517	$55,099,067	$309,170
Ratio	0.2	1.4	4.4	1.0
Ratepayer Impact Measure	($31,407,315)	($6,534,510)	($39,861,492)	($6,027,886)
Ratio	0.2	0.8	0.6	0.6
Total Resource	($19,690,063)	($2,035,648)	$43,942,512	($6,069,909)
Ratio	0.3	0.9	2.6	0.6

[14] NJCEP. New Jersey Clean Energy Program Protocols to Measure Resource Savings. (December 2007).
[15] U.S. Environmental Protection Agency and U.S. Department of Energy, *Energy Star.* Available at www.energystar.gov/

Table 5: Commercial and Industrial Programs

	C&I CHP	C&I New Construction	C&I Retrofit	Direct Install	Pay-for-Performance
Participant	$13,164,265	$23,626,420	$177,369,732	$7,911,826	$1,043,543
Ratio	1.9	15.7	6.7	4.0	2.1
Program Administration	$9,537,085	$9,520,002	$89,545,987	($292,750)	($526,618)
Ratio	4.5	4.9	6.2	0.9	0.6
Ratepayer Impact Measur	$5,089,596	$3,337,108	$12,713,905	($3,150,529)	($1,064,794)
Ratio	1.7	1.4	1.1	0.5	0.4
Total Resource	($2,761,003)	$9,987,014	$73,537,480	$553,422	($752,358)
Ratio	0.8	6.0	3.2	1.2	0.5

A comparison of 2006 through 2010 participant and total resource cost test cost-benefit analysis results are presented in Tables 6 and 7 respectively. The numerous updates made from year to year on the cost-benefit model inputs and assumptions have an impact on the cost-benefit results, making a direct comparison between the years difficult.

Table 6: 2006 to 2010 Participant Cost Test Ratios

	2006	2007	2008	2009	2010
Residential Programs					
Low Income	N/A	N/A	N/A	N/A	N/A
HVAC	4.3	5.1	7.4	3.4	3.4
Home Performance with Energy Star					
Energy Star Products	1.6	1.8	4.3	10.3	8.4
New Construction	3.1	3.2	4.0	2.7	2.5
Commercial & Industrial Programs					
CHP	1.6	7.3	1.2	8.2	1.9
New Construction	14.7	11.9	20.1	13.3	15.7
Retrofit	8.1	3.7	7.5	5.0	6.7
Schools	5.2	7.7	4.0	4.1	

Table 7: 2006 to 2010 Total Resource Cost Test Ratios

	2006	2007	2008	2009	2010
Residential Programs					
Low Income[16]				0.3	0.3
HVAC[17]	2.7	3.5	1.7	1.1	0.9
Home Performance with Energy Star					
Energy Star Products	0.5	1.9	1.9	4.5	2.6
New Construction	1.5	1.5	1.5	0.7	0.6
Commercial & Industrial Programs					
CHP[18]	1.1	7.5	1.4	5.3	0.8
New Construction	8.6	5.1	12.2	6.7	6.0
Retrofit	5.0	1.7	5.0	2.8	3.2
Schools	3.1	3.1	2.3	2.3	

[16] The Low Income values for 2006 through 2008 were initially calculated using an incorrect incremental cost and will be updated in the future to reflect a corrected value.

[17] The slight decrease in benefit-cost ratio between 2009 and 2010 for the Residential HVAC program can be attributed to slightly higher per unit energy savings and incentives in 2010 as compared to those in 2009.

[18] The difference between the 2009 and 2010 CHP program results can be attributed to the fact that in 2010 there were 6 projects with a similar amount of energy savings as the one project in 2009. The difference in project numbers resulted in a larger participant cost in 2010 and, thus, a smaller benefit-cost ratio.