Cost-Benefit Analysis of the 2007 New Jersey Clean Energy Program Energy Efficiency Programs

Summary Report

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Center for Energy, Economics & Environmental Policy

Edward J. Bloustein School of Planning and Public Policy

Rutgers, The State University of New Jersey

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 2007 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 2008 energy efficiency programs and compare the 2006 and 2007 program cost-benefit analyses.

The eleven NJCEP Energy Efficiency programs available to New Jersey residential, commercial and industrial customers in both 2006 and 2007 are listed in Table 1. The Change a Light program began in 2007. One additional program, the Energy Conservation Kits, ended in early 2007. The program is not presented in the report due to a lack of program data.

Table 1: NJCEP Energy Efficiency Programs

Residential	Commercial & Industrial
Residential HVAC	C&I New Construction
Residential New Construction	C&I Retrofit
Residential Low Income	C&I Schools
Energy Star Room Air Conditioner	Combined Heat and Power
Home Performance with Energy Star	DEP Cool Cities
Change a Light	

In 2006 and previous years, customer incentives were reported separately from contractor incentives, which allowed CEEEP to calculate the total participant benefits of the program. However, customer and contractor incentives were reported as a combined value in 2007. Due to this reporting change, CEEEP recalculated the 2006 cost-benefit ratios using the combined customer and contractor incentives. It was assumed that any incentives provided to the contractors would be passed along to program participants. The assumption increases the cost-benefit ratios for the participant, total resource and societal cost tests.

The 2007 cost-benefit model utilized updated avoided retail and wholesale costs as well as incremental costs from the 2006 cost-benefit model. The key assumptions and data sources are explained in Section III and should be reviewed in future evaluations.

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.

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

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 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 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 the utility and participants plus the increase in supply costs for the periods in which load is increased.

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

III. Cost-benefit Analysis Assumptions

The key components to the energy efficiency benefit-cost 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 New Jersey retail electricity price projections are a September 2008 output of the Rutgers Economic Advisory Service (R/ECON^{TM}) econometric time series model of the New Jersey economy. The commercial and industrial prices were provided separately, but were averaged because the Clean Energy Program does not distinguish between the two sectors.

Wholesale Electricity Prices: Wholesale electricity price projections are outputs of DAYZER, a modeling tool that simulates the operation of the PJM electricity market and replicates the calculations made by PJM in solving for security-constrained, least-cost unit commitment and dispatch day-ahead markets.

Table 2: Retail and Wholesale Electricity

	Retail ($/kWh)		*Wholesale ($/MWh)*				
	Residential	Commercial & Industrial	Average Price	Summer Peak	Summer Off-Peak	Non-Summer Peak	Non-Summer Off-Peak
2007	$0.14	$0.12	$63.36	$81.50	$66.61	$75.83	$57.48
2008	$0.14	$0.12	$65.17	$84.84	$53.47	$73.53	$48.83
2009	$0.14	$0.12	$66.97	$87.65	$55.05	$75.27	$49.93
2010	$0.14	$0.12	$68.78	$90.45	$56.62	$77.02	$51.03
2011	$0.15	$0.13	$67.87	$89.64	$55.95	$75.75	$50.14
2012	$0.15	$0.13	$66.96	$88.80	$55.27	$74.50	$49.27
2013	$0.16	$0.13	$66.05	$87.92	$54.59	$73.28	$48.42
2014	$0.16	$0.14	$65.14	$87.01	$53.90	$72.07	$47.58
2015	$0.17	$0.14	$64.23	$83.02	$54.42	$72.49	$46.99
2016	$0.17	$0.14	$75.25	$98.65	$63.77	$83.69	$54.88
2017	$0.17	$0.14	$86.26	$114.59	$73.12	$94.61	$62.72
2018	$0.18	$0.15	$97.28	$130.81	$82.48	$105.29	$70.53
2019	$0.19	$0.15	$108.29	$147.28	$91.84	$115.75	$78.31
2020	$0.20	$0.16	$119.31	$163.49	$104.67	$123.80	$85.29
2021	$0.20	$0.16	$122.06	$167.27	$107.08	$126.66	$87.25
2022	$0.20	$0.16	$124.88	$171.12	$109.55	$129.57	$89.26
2023	$0.21	$0.17	$127.79	$175.11	$112.10	$132.59	$91.34
2024	$0.21	$0.17	$130.79	$179.23	$114.74	$135.71	$93.49
2025	$0.22	$0.18	$133.82	$183.38	$117.40	$138.86	$95.66
2026	$0.22	$0.18	$137.01	$187.74	$120.19	$142.16	$97.94

Retail Natural Gas Prices: Historic New Jersey retail natural gas price projections a September 2008 output of the Rutgers Economic Advisory Service (R/ECON™) econometric time series model of the New Jersey economy.

Table 3: Retail Natural Gas ($/MMBtu)

	Residential	*Commercial*	*Industrial*
2007	$ 14.74	$ 11.74	$ 9.40
2008	$ 16.31	$ 14.80	$ 12.41
2009	$ 20.13	$ 18.61	$ 15.83
2010	$ 21.67	$ 19.28	$ 16.43
2011	$ 22.62	$ 19.66	$ 16.76
2012	$ 22.81	$ 19.38	$ 16.51
2013	$ 22.44	$ 18.65	$ 15.87
2014	$ 22.02	$ 18.14	$ 15.41
2015	$ 21.94	$ 18.17	$ 15.43
2016	$ 22.23	$ 18.61	$ 15.83
2017	$ 22.72	$ 19.18	$ 16.33
2018	$ 23.27	$ 19.75	$ 16.84
2019	$ 23.89	$ 20.36	$ 17.39
2020	$ 24.55	$ 20.99	$ 17.95
2021	$ 25.05	$ 21.43	$ 18.32
2022	$ 25.56	$ 21.87	$ 18.70
2023	$ 26.09	$ 22.31	$ 19.08
2024	$ 26.62	$ 22.77	$ 19.47
2025	$ 27.17	$ 23.24	$ 19.87
2026	$ 27.73	$ 23.72	$ 20.28

Capacity Prices: Capacity prices for 2010, 2015 and 2020 were modeled determining the carrying cost of a combustion turbine in the modeling years. The prices are 13.06 $/MWh in 2010, 14.09 $/MWh in 2015 and 18.79 $/MWh in 2020. Capacity prices were linearly interpolated for the other modeling years.

Environmental Externality Benefits: Avoided emission savings are calculated by multiplying the emission permit prices by the energy savings. The emission permit prices are $0.95 per MMBtu and $0.02 per kWh, based on the 2001 Energy Efficiency Assessment.[2]

Avoided Emissions Factors: Reduced emissions are determined by applying the avoided emissions factors to the energy savings. Average avoided emission factors for electricity are taken from the PJM Regional Average Disclosure Label for 2003 and for natural gas are taken from the EIA *Natural Gas 1998 Issues and Trends*.

Avoided Emission Factors		
	Electricity *lbs/MWh*	Natural Gas *lbs/MMBtu*
CO_2	1,268	117
NOx	3	0.092
SO_2	11.06	
Hg	0.0000356	

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

Time Period Allocation Factors: Time period allocation factors account for the variation of electricity and natural gas prices throughout the year. Taken from Summit Blue Consulting,[3] 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 CHP program was assumed to have electricity seasonal allocation factors of 25% for each period.

Avoided Transportation and Distribution Costs: Avoided transmission and distribution (T&D) costs refer to the costs avoided by not having to provide an additional unit of T&D capacity. Avoided electric transmission and distribution costs are estimated at $15, adjusted for inflation, based on the white paper prepared by Little (1999) and a study by Baskette et. al. (2006) that determined the average value was generally between $0 and $30.[4,5] Avoided natural gas transportation and distribution costs are zero.

Incremental Costs: The 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,[6] Connecticut[7] and Vermont.[8] The CHP program incremental cost was estimated at $2.5 billion, based on the use of 250 kW micro-turbines at a cost of $1,000 per kW.

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[2] New Jersey Clean Energy Collaborative. Energy and Economic Assessment of Statewide Energy-Efficiency Programs. (July 9, 2001).
[3] Summit Blue Consulting, LLC. Energy Efficiency Market Assessment of New Jersey Clean Energy Programs. (July 20, 2006).
[4] Arthur D. Little, Inc. Distributed Generation: Understanding the Economics. (1999).
[5] 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).
[6] Database for Energy-Efficiency Resources. Technology and Measure Cost Data, California Public Utilities Commission (October 26, 2005).
[7] 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).
[8] Efficiency Vermont. Technical Reference User Manual (July 18, 2008).

Measure Lives: The measure life is used to determine the number of years that an energy efficient product will accrue energy savings. The measure life of each product was estimated based on data from Summit Blue Consulting and the New Jersey Protocols to Measure Resource Savings.[9] 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.

IV. Cost-benefit Analysis Results

The cost-benefit analysis results for the 2007 energy efficiency programs are presented in Tables 4 and 5. The percent change in cost-benefit analysis results from 2006 and 2007 are shown in Tables 6 and 7.

Table 4: Residential Programs

		Low Income	HVAC	Home Performance w/ Energy Star	Energy Star Room Air Conditioner	New Construction	Energy Star Change a Light
Participant		$35,845,736	$58,583,789	$179,998	$496,141	$33,402,441	$70,580,654
	Ratio	N/A	5.1	3.4	1.8	3.2	6.0
Program Administration		$(15,130,621)	$46,890,226	$(3,263,838)	$(633,505)	$15,401,757	$37,051,762
	Ratio	0.4	5.2	0.1	0.5	1.8	18.8
Ratepayer Impact Measure		$(18,977,786)	$36,460,471	$(3,279,438)	$(1,006,503)	$10,838,592	$(2,996,672)
	Ratio	0.3	2.7	0.0	0.4	1.5	0.9
Total Resource		$8,212,482	$42,455,143	$(3,268,559)	$(825,549)	$13,630,303	$33,688,936
	Ratio	5.4	3.4	0.1	0.4	1.6	3.3
Societal		$8,459,545	$44,371,700	$(3,261,596)	$(825,446)	$14,801,717	$33,708,974
	Ratio	5.5	3.5	0.1	1.9	1.5	3.3

Table 5: Commercial and Industrial Programs

		C&I CHP	C&I New Construction	C&I Retrofit	C&I Schools	Cool Cities
Participant		$79,016,073	$ 9,910,314	$24,747,450	$2,972,645	$3,921,983
	Ratio	7.3	11.9	3.7	7.7	N/A
Program Administration		$85,945,036	$ 3,731,169	$4,279,753	$1,119,086	$(1,717,515)
	Ratio	31.7	2.7	1.3	2.4	0.3
Ratepayer Impact Measure		$85,945,036	$ 295,891	$(3,692,684)	$29,750	$(2,365,191)
	Ratio	31.7	1.1	0.8	1.0	0.3
Total Resource		$76,213,555	$ 5,598,105	$7,647,242	$1,505,912	$870,064
	Ratio	7.1	5.1	1.7	3.0	5.4
Societal		$81,125,498	$ 5,653,923	$7,929,766	$1,525,599	$870,275
	Ratio	7.5	5.1	1.7	3.1	5.4

[9] NJCEP. New Jersey Clean Energy Program Protocols to Measure Resource Savings. (December 2007).

Table 6: 2007 and 2008 Residential Program Comparison

	Low Income	HVAC	Home Performance w/ Energy Star	Energy Star Room Air Conditioner	New Construction
Participant	N/A	15%	N/A	-4%	-11%
Program Administration	-47%	85%	535%	-33%	19%
Ratepayer Impact Measure	-38%	48%	533%	-21%	15%
Total Resource	-67%	21%	143%	-31%	-16%
Societal	-67%	19%	138%	-31%	-18%

Table 7: 2007 and 2008 Commercial and Industrial Program Comparison

	C&I CHP	C&I New Construction	C&I Retrofit	C&I Schools	Cool Cities
Participant	347%	-20%	-56%	46%	N/A
Program Administration	503%	-70%	-69%	-18%	146%
Ratepayer Impact Measure	2656%	-18%	-37%	-36%	115%
Total Resource	529%	-48%	-68%	-6%	388%
Societal	564%	-48%	-68%	-10%	388%

Overall, the cost-benefit results for the Residential New Construction and Energy Star Room Air Conditioner programs showed very little change between 2006 and 2007 (a difference of less than 33 percent). The Residential HVAC, Low Income and Home Performance with Energy Star programs demonstrated greater differences based on changes in program budget, participation or energy savings.

- The Residential HVAC Program electric savings doubled while participant incentives decreased;
- The Residential Low Income Program energy savings decreased while program costs increased; and
- The Home Performance with Energy Star Program participants, energy savings and incremental costs increased as the participant incentives decreased.

The commercial and industrial programs experienced large differences between 2006 and 2007. The overall decreases in SmartStart Program (New Construction, Retrofit, New Schools) cost-benefit results are due primarily to revised incremental costs. Incremental costs are highly uncertain and a detailed description of the measures installed is needed to accurately estimate the incremental cost.

The New Jersey Department of Environmental Protection's Cool Cities program cost-benefit ratios increased primarily because of a 500 percent increase in energy savings that was attributed to the 2007 program.

The large increased in the cost-benefit ratios of the Combined Heat and Power program are due the variability of CHP project size, cost and energy savings. In 2007, CHP projects saved over 500,000 DTh of energy, while in 2006 there was no gas savings attributed. In 2006, there were over 12,000 MWh generated from CHP while in 2007 there were over 102,000 MWh generated, with only one additional project.