Cost-Benefit Analysis of the 2008 New Jersey Clean Energy Program Energy Efficiency Programs

Summary Report

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Center for Energy, Economics & Environmental Policy

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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 2008 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 2007 and 2008 program cost-benefit analyses.

The nine NJCEP Energy Efficiency programs available to New Jersey residential, commercial and industrial customers in both 2007 and 2008 are listed in Table 1. In 2007, the Energy Star Products program was analyzed by its sub-programs, Room Air Conditioner and Change a Light. In 2008, energy savings and administrative cost data were not available for the sub-programs; therefore the program is evaluated as a whole. The 2008 Energy Star Products program includes Change a Light, Room Air Conditioner, Dehumidifier and Clothes Washer.

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 Products	Combined Heat and Power
Home Performance with Energy Star	

The cost-benefit model utilized for the 2008 analyses was updated from the 2007 cost-benefit model. The key assumptions and data sources are explained in Section III and should be reviewed in future evaluations. The 2008 model updates include:

- Wholesale natural gas prices were incorporated;
- Avoided emissions savings are determined via emission permit prices and emissions factors;
- Avoided retail and wholesale costs were updated;
- Electric and natural gas avoided transmission and distribution costs were updated; and
- Avoided electric and natural gas transmission and distribution line losses were included.

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

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

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 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 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 New Jersey retail electricity price projections are a January 2010 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
2008	$ 0.16	$ 0.13	$ 65.17	$ 84.84	$ 53.47	$ 73.53	$ 48.83
2009	$ 0.16	$ 0.13	$ 66.97	$ 87.65	$ 55.05	$ 75.27	$ 49.93
2010	$ 0.16	$ 0.12	$ 68.78	$ 90.45	$ 56.62	$ 77.02	$ 51.03
2011	$ 0.16	$ 0.12	$ 67.87	$ 89.64	$ 55.95	$ 75.75	$ 50.14
2012	$ 0.16	$ 0.12	$ 66.96	$ 88.80	$ 55.27	$ 74.50	$ 49.27
2013	$ 0.16	$ 0.12	$ 66.05	$ 87.92	$ 54.59	$ 73.28	$ 48.42
2014	$ 0.17	$ 0.12	$ 65.14	$ 87.01	$ 53.90	$ 72.07	$ 47.58
2015	$ 0.17	$ 0.13	$ 64.23	$ 83.02	$ 54.42	$ 72.49	$ 46.99
2016	$ 0.18	$ 0.13	$ 75.25	$ 98.65	$ 63.77	$ 83.69	$ 54.88
2017	$ 0.19	$ 0.13	$ 86.26	$ 114.59	$ 73.12	$ 94.61	$ 62.72
2018	$ 0.20	$ 0.14	$ 97.28	$ 130.81	$ 82.48	$ 105.29	$ 70.53
2019	$ 0.21	$ 0.14	$ 108.29	$ 147.28	$ 91.84	$ 115.75	$ 78.31
2020	$ 0.22	$ 0.15	$ 119.31	$ 163.49	$ 104.67	$ 123.80	$ 85.29
2021	$ 0.24	$ 0.16	$ 122.06	$ 167.27	$ 107.08	$ 126.66	$ 87.25
2022	$ 0.25	$ 0.17	$ 124.88	$ 171.12	$ 109.55	$ 129.57	$ 89.26
2023	$ 0.27	$ 0.19	$ 127.79	$ 175.11	$ 112.10	$ 132.59	$ 91.34
2024	$ 0.29	$ 0.20	$ 130.79	$ 179.23	$ 114.74	$ 135.71	$ 93.49
2025	$ 0.31	$ 0.21	$ 133.82	$ 183.38	$ 117.40	$ 138.86	$ 95.66
2026	$ 0.33	$ 0.23	$ 137.01	$ 187.74	$ 120.19	$ 142.16	$ 97.94
2027	$ 0.36	$ 0.24	$ 65.17	$ 84.84	$ 53.47	$ 73.53	$ 48.83
2028	$ 0.39	$ 0.26	$ 66.97	$ 87.65	$ 55.05	$ 75.27	$ 49.93
2029	$ 0.42	$ 0.29	$ 68.78	$ 90.45	$ 56.62	$ 77.02	$ 51.03

Retail Natural Gas Prices: Historic New Jersey retail natural gas price projections are a January 2010 output of the Rutgers Economic Advisory Service (R/ECON™) econometric time series model of the New Jersey economy.

Wholesale (Henry Hub) Natural Gas Prices: Wholesale natural gas prices are taken from EIA Annual Energy Outlook 2009.

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

	Retail Prices			*Henry Hub Wholesale Prices*		
	Residential	Commercial	Industrial	Average Price	Summer	Winter
2008	$ 13.61	$ 16.31	$ 14.80	$ 9.25	$ 9.13	$ 9.42
2009	$ 17.22	$ 20.13	$ 18.61	$ 6.82	$ 6.73	$ 6.94
2010	$ 17.85	$ 21.67	$ 19.28	$ 7.01	$ 6.92	$ 7.14
2011	$ 18.21	$ 22.62	$ 19.66	$ 7.06	$ 6.97	$ 7.19
2012	$ 17.94	$ 22.81	$ 19.38	$ 7.33	$ 7.24	$ 7.47
2013	$ 17.26	$ 22.44	$ 18.65	$ 7.49	$ 7.39	$ 7.62
2014	$ 16.78	$ 22.02	$ 18.14	$ 7.73	$ 7.63	$ 7.86
2015	$ 16.80	$ 21.94	$ 18.17	$ 7.99	$ 7.89	$ 8.13
2016	$ 17.22	$ 22.23	$ 18.61	$ 8.30	$ 8.20	$ 8.45
2017	$ 17.76	$ 22.72	$ 19.18	$ 8.68	$ 8.57	$ 8.84
2018	$ 18.30	$ 23.27	$ 19.75	$ 9.13	$ 9.01	$ 9.29
2019	$ 18.87	$ 23.89	$ 20.36	$ 9.57	$ 9.45	$ 9.74
2020	$ 19.47	$ 24.55	$ 20.99	$ 9.60	$ 9.48	$ 9.77
2021	$ 20.76	$ 26.16	$ 22.38	$ 9.49	$ 9.37	$ 9.66
2022	$ 22.21	$ 27.99	$ 23.94	$ 9.72	$ 9.60	$ 9.90
2023	$ 23.75	$ 29.94	$ 25.61	$ 10.00	$ 9.88	$ 10.18
2024	$ 25.39	$ 32.01	$ 27.38	$ 10.61	$ 10.48	$ 10.80
2025	$ 27.18	$ 34.26	$ 29.31	$ 11.14	$ 11.00	$ 11.34
2026	$ 29.17	$ 36.77	$ 31.45	$ 11.67	$ 11.52	$ 11.88
2027	$ 31.37	$ 39.55	$ 33.82	$ 12.21	$ 12.05	$ 12.43
2028	$ 33.89	$ 42.71	$ 36.53	$ 12.67	$ 12.51	$ 12.90
2029	$ 36.69	$ 46.24	$ 39.55	$ 13.05	$ 12.88	$ 13.28
2030	$ 13.61	$ 16.31	$ 14.80	$ 9.25	$ 9.13	$ 9.42

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.

Forecasted Emissions Permit Prices: Emission permit prices were taken from available market data and escalated using growth rates generated from the market data or the U.S. Consumer Price Index (CPI). All emission permits are in $/ton.

- **CO_2:** 2009 and future 2012 allowance prices were taken from the Regional Greenhouse Gas Initiative Auction. 2010-2011 and 2013-2014 values were derived by escalating historic prices by the 2009-2012 growth rate and the 2008 value was derived by adjusting the 2009 historic price by the annual change in the CPI. It is assumed that a national CO_2 program will be in place beginning in 2015. Values for the national program are taken from the proposed American Clean Energy and Security Act of 2009 (Waxman-Markey Bill) analysis provided by the U.S. Environmental Protection Agency (EPA).[2]
- **SO_2:** Spot and 7-year advance allowance auction data were taken from the EPA Annual Auction Results and escalated using the annual change in the CPI. The 2000-2008 CPI is

[2] Analysis available at www.epa.gov/climatechange/economics/economicanalyses.html#wax

historic U.S. Department of Labor data and the 2009-2030 forecast is from the EIA Annual Energy Outlook 2009.

- **NO_x:** Current and future allowance prices were taken from the Chicago Climate Futures Exchange. The allowance prices were escalated using the annual change in the CPI. The 2000-2008 CPI is historic U.S. Department of Labor data and the 2009-2030 forecast is from the EIA Annual Energy Outlook 2009.

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 2006 and for natural gas are taken from the EIA *Natural Gas 1998 Issues and Trends*.

Avoided Emission Factors		
	Electricity	Natural Gas
	lbs/MWh	*lbs/MMBtu*
CO_2	1,252	117
NOx	2.21	0.092
SO_2	7.99	
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 T&D Costs: Avoided transmission savings are assumed to be zero.

Avoided Natural Gas T&D Costs: The avoided transportation savings per year are the annual Henry Hub natural gas prices adjusted for the historic ratio of Henry Hub to New Jersey Citygate prices, calculated at 1.4 for the past 15 years. Avoided distribution savings are assumed to be 40% of the difference between New Jersey Citygate prices and retail prices in 2009, adjusted for inflation in future years.[4]

Avoided Electric and Natural Gas Losses: Taken from the New Jersey Clean Energy Program Protocols to Measure Resource Savings,[5] avoided electric transmission losses are assumed to be 11% and avoided distribution losses are assumed to be 1%.

[3] Summit Blue Consulting, LLC. Energy Efficiency Market Assessment of New Jersey Clean Energy Programs. (July 20, 2006).
[4] Synapse Energy Economics. Avoided Energy Supply Costs in New England (January 3, 2008).
[5] Available at www.njcleanenergy.com/main/public-reports-and-library/market-analysis-protocols/energy-savings-protocols/energy-savings-pr

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.

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 calculated using the same method as the incremental cost, using data from the New Jersey Protocols,[9] Energy Star,[10] 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.

IV. Cost-benefit Analysis Results

The cost-benefit analysis results for the 2008 energy efficiency programs are presented in Tables 4 and 5.

Table 4: Residential Programs

		Low Income	HVAC	Home Performance w/ Energy Star	Energy Star Products	New Construction
Participant		$46,903,838	$77,375,390	$1,636,704	$161,390,819	$30,320,537
	Ratio	N/A	7.4	6.2	4.3	4.0
Program Administration		$(5,326,680)	$15,847,246	$(4,436,542)	$78,762,753	$10,210,548
	Ratio	0.7	2.4	0.1	6.4	1.9
Ratepayer Impact Measure		$(13,932,926)	$ 6,267,141	$(4,631,633)	$(17,016,358)	$3,051,201
	Ratio	0.5	1.3	0.1	0.8	1.2
Total Resource		$ 13,630,320	$46,922,678	$(3,757,932)	$40,185,379	$6,325,548
	Ratio	8.9	3.9	0.2	1.8	1.4
Societal		$14,542,822	$11,588,204	$(3,987,946)	$46,799,304	$6,939,271
	Ratio	9.4	1.7	0.1	1.9	1.5

[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).
[9] NJCEP. New Jersey Clean Energy Program Protocols to Measure Resource Savings. (December 2007).
[10] 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	C&I Schools
Participant	$ 2,376,834	$28,969,562	$103,584,038	$4,917,181
Ratio	1.2	20.07	7.46	4.0
Program Administration	$12,607,669	$19,148,216	$69,370,537	$3,025,126
Ratio	6.9	13.40	6.92	3.8
Ratepayer Impact Measure	$11,065,709	$7,561,236	$24,720,042	$918,611
Ratio	4.0	1.58	1.44	1.3
Total Resource	$4,398,669	$18,799,347	$62,869,467	$2,183,472
Ratio	1.4	10.93	4.45	2.1
Societal	$4,462,998	$21,160,876	$73,145,863	$2,644,146
Ratio	1.4	12.18	5.02	2.4

The difference between 2007 and 2008 cost-benefit analysis results are presented in Tables 6 and 7. The numerous updates made to the 2008 cost-benefit model have an impact on the cost-benefit results, making a direct comparison between 2007 and 2008 difficult and inaccurate.

Table 6: 2007 and 2008 Residential Program Comparison

	Low Income	HVAC	Home Performance w/ Energy Star	Energy Star Products	New Construction
Participant	N/A	46%	80%	39%	27%
Program Administration	96%	-54%	126%	-53%	5%
Ratepayer Impact Measure	60%	-52%	118%	-7%	-20%
Total Resource	66%	15%	248%	5%	-13%
Societal	72%	-51%	140%	13%	-13%

Table 7: 2007 and 2008 Commercial and Industrial Program Comparison

	C&I CHP	C&I New Construction	C&I Retrofit	C&I Schools
Participant	-83%	69%	101%	-47%
Program Administration	-78%	400%	413%	58%
Ratepayer Impact Measure	-87%	50%	76%	27%
Total Resource	-80%	116%	165%	-30%
Societal	-81%	139%	194%	-22%

In addition to the cost-benefit model updates, additional changes in program budget, participation and energy savings also account for the differences between the 2007 and 2008 cost-benefit results. These additional changes in 2008 include:

- The Residential Low Income Program had greater energy savings per unit;
- The Residential HVAC Program had fewer energy savings per unit and smaller incentives per unit;
- The Home Performance with Energy Star Program had increased participation and smaller administrative startup costs;
- The Energy Star Products Program included clothes washers and dehumidifiers, which increased the program energy savings and administrative costs;
- The C&I New Construction Program had triple the energy savings over 2007 and approximately one-third smaller incentives for participants;
- The C&I Retrofit Program had triple the electricity savings but similar incentives, administrative costs and natural gas savings in both years;
- The C&I Schools Program had similar energy savings in both years, but only two-thirds of the incentives; and
- The Combined Heat and Power Program had 75% less generation, 90% less natural gas savings, and smaller incentives.