

Draft Energy Efficiency Cost-Benefit Analysis Avoided Cost Assumptions

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The Center for Energy, Economic, and Environmental Policy (CEEEP) is requesting comments on the key avoided cost assumptions for the energy efficiency cost-benefit analysis discussed below. Please send any comments or questions to Frank Felder at ffelder@ejb.rutgers.edu. The data sources and processes for determining these components are also discussed. All assumptions have been derived from independent and publicly available sources so as to be transparent to the user. With the exception of certain air emissions, non-energy benefit and cost assumptions associated with specific policies have not been researched.

I. Electricity Prices

Table 1: 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
2012	\$0.17	\$0.14	\$34.36	\$43.65	\$28.04	\$39.67	\$31.50
2013	\$0.16	\$0.13	\$36.74	\$46.67	\$29.98	\$42.42	\$33.68
2014	\$0.17	\$0.13	\$35.79	\$45.46	\$29.21	\$41.32	\$32.81
2015	\$0.17	\$0.13	\$35.99	\$45.72	\$29.37	\$41.56	\$33.00
2016	\$0.18	\$0.14	\$35.88	\$45.58	\$29.28	\$41.42	\$32.89
2017	\$0.18	\$0.14	\$36.19	\$45.98	\$29.54	\$41.79	\$33.18
2018	\$0.18	\$0.14	\$38.37	\$48.75	\$31.32	\$44.30	\$35.18
2019	\$0.18	\$0.15	\$40.36	\$51.28	\$32.94	\$46.60	\$37.00
2020	\$0.18	\$0.15	\$39.53	\$50.21	\$32.26	\$45.63	\$36.24
2021	\$0.19	\$0.15	\$43.34	\$55.06	\$35.37	\$50.04	\$39.74
2022	\$0.19	\$0.15	\$45.53	\$57.84	\$37.15	\$52.56	\$41.74
2023	\$0.19	\$0.15	\$47.53	\$60.38	\$38.79	\$54.88	\$43.58
2024	\$0.20	\$0.16	\$50.03	\$63.55	\$40.82	\$57.76	\$45.86
2025	\$0.21	\$0.16	\$52.29	\$66.42	\$42.67	\$60.37	\$47.93
2026	\$0.21	\$0.16	\$53.68	\$68.19	\$43.80	\$61.97	\$49.21
2027	\$0.22	\$0.16	\$54.73	\$69.53	\$44.67	\$63.19	\$50.18
2028	\$0.23	\$0.17	\$56.10	\$71.27	\$45.78	\$64.77	\$51.43
2029	\$0.23	\$0.17	\$57.99	\$73.67	\$47.32	\$66.95	\$53.16
2030	\$0.23	\$0.18	\$60.08	\$76.32	\$49.03	\$69.37	\$55.08
2031	\$0.24	\$0.18	\$61.51	\$78.14	\$50.19	\$71.01	\$56.39
2032	\$0.25	\$0.18	\$63.90	\$81.18	\$52.15	\$73.78	\$58.59
2033	\$0.25	\$0.19	\$65.53	\$83.25	\$53.48	\$75.66	\$60.07
2034	\$0.26	\$0.20	\$68.16	\$86.59	\$55.62	\$78.69	\$62.49
2035	\$0.27	\$0.20	\$72.10	\$91.60	\$58.84	\$83.25	\$66.10
2036	\$0.27	\$0.21	\$75.97	\$96.51	\$62.00	\$87.71	\$69.65

Retail Electricity Prices: Historic 2012 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 2012 for the Mid-Atlantic region. On average, the annual growth rate was about 1.98%. The NJ Clean Energy Programs do not distinguish between commercial and industrial sectors, therefore the commercial and industrial prices were averaged based on historic 2012 New Jersey retail electricity sales. Retail electricity

prices reported to EIA include the Societal Benefits Charge (SBC) ¹, but not the 7% Sales and Use Tax, which CEEEP added.

Wholesale Electricity Prices: Historic 2012 New Jersey wholesale electric prices from PJM were escalated based on the annual percent change in the EIA Annual Energy Outlook Reliability First Corporation/East Electricity Generation Prices. The annual percent change was, on average, about 2.5%. The seasonal peak and off-peak factors were derived using historic 2012 PJM LMP data. Summer is defined as May through September, winter is defined as October through April, on-peak is defined as Monday through Friday 8am-8pm (HB), and off-peak is defined as Monday-Friday 8pm-8am (HB) and weekends and holidays

II. Natural Gas Prices

Retail Natural Gas Prices: Historic 2012 EIA New Jersey retail natural gas prices were escalated using an annual growth rate derived from the Mid-Atlantic Region EIA Annual Energy Outlook 2013 natural gas price forecasts. On average, the annual growth rate was about 3.2%. The residential natural gas price for August 2012 was missing from the EIA data, so the average of July and September 2012 was used. For industrial natural gas price, November and December 2012 data was missing, and were not included in the annual average. Retail natural gas prices reported to EIA include the Societal Benefits Charge (SBC) ², but not the 7% Sales and Use Tax, which CEEEP added.

Table 2: Retail and Wholesale Natural Gas (\$/MMBtu)

	<i>Retail Prices</i>			<i>Henry Hub Wholesale Prices</i>		
	Residential	Commercial	Industrial	Average Price	Summer	Winter
2012	\$12.35	\$8.75	\$7.35	\$2.66	\$2.57	\$2.76
2013	\$12.51	\$9.35	\$7.91	\$3.36	\$3.25	\$3.48
2014	\$12.51	\$9.21	\$7.82	\$3.28	\$3.16	\$3.39
2015	\$12.51	\$9.20	\$7.96	\$3.32	\$3.21	\$3.44
2016	\$13.18	\$9.76	\$8.56	\$3.86	\$3.72	\$3.99
2017	\$13.63	\$10.08	\$8.86	\$4.06	\$3.92	\$4.20
2018	\$14.23	\$10.56	\$9.35	\$4.42	\$4.26	\$4.57
2019	\$14.65	\$10.85	\$9.64	\$4.59	\$4.43	\$4.75
2020	\$15.07	\$11.15	\$9.92	\$4.77	\$4.60	\$4.93
2021	\$15.46	\$11.41	\$10.15	\$5.00	\$4.82	\$5.17
2022	\$16.02	\$11.83	\$10.58	\$5.35	\$5.16	\$5.53
2023	\$16.54	\$12.22	\$10.97	\$5.68	\$5.49	\$5.88
2024	\$17.03	\$12.57	\$11.33	\$5.93	\$5.72	\$6.13
2025	\$17.48	\$12.88	\$11.62	\$6.14	\$5.92	\$6.35
2026	\$18.17	\$13.41	\$12.20	\$6.44	\$6.22	\$6.67
2027	\$18.60	\$13.68	\$12.44	\$6.65	\$6.42	\$6.89
2028	\$19.14	\$14.06	\$12.82	\$6.94	\$6.70	\$7.19
2029	\$19.69	\$14.44	\$13.19	\$7.18	\$6.93	\$7.43
2030	\$20.24	\$14.82	\$13.57	\$7.45	\$7.19	\$7.71
2031	\$20.89	\$15.29	\$14.05	\$7.78	\$7.51	\$8.05
2032	\$21.48	\$15.69	\$14.44	\$8.06	\$7.78	\$8.34
2033	\$22.15	\$16.17	\$14.91	\$8.41	\$8.12	\$8.71
2034	\$22.94	\$16.77	\$15.54	\$8.96	\$8.65	\$9.27
2035	\$23.78	\$17.40	\$16.20	\$9.55	\$9.22	\$9.89
2036	\$24.80	\$18.22	\$17.09	\$10.30	\$9.94	\$10.66

Wholesale (Henry Hub) Natural Gas Prices: Wholesale natural gas prices are taken from the EIA Annual Energy Outlook 2012. The winter and summer prices were derived from the 1994 to 2012 historic average

¹ The Societal Benefits Charge for electric customers of 3.6% for residential and 4.8% for C&I is included in the retail prices reported to EIA by the utilities..

² The Societal Benefits Charge for natural gas customers of 4.1% for residential and 5.0% for C&I is included in the retail prices reported to EIA by the utilities.

ratio of summer and winter prices to Henry Hub. The summer average ratio was 96.5% and the winter average ratio was 103.5%.

III. Environmental Externalities

Environmental Externality Benefits: Avoided emission savings are calculated by multiplying the emission permit prices by the energy savings. In the cost benefit analysis, CEEEP assumes that the emission allowance prices for SO₂ and NO_x are already accounted for in energy prices. CEEEP is currently researching reputable sources of SO₂ and NO_x allowance price projections and also determining a value for avoided mercury emissions.

Forecasted CO₂ Social Cost: Values for the Social Cost of Carbon were taken from the Interagency Working Group on Social Cost of Carbon³. Values were reported in 2007\$/metric ton, and were converted to nominal dollars using the EIA projected U.S. GDP Price Index⁴. The study presented three values for the social cost of carbon, using a discount rate of 2.5%, 3%, and 5%. The scenario using a discount rate of 3% is presented here.

Table 3: Social Cost of Carbon (Nominal \$/metric ton) and U.S. GDP Chain-type Price Index

	CO ₂	GDP Chain-type Price Index
2012	\$38.02	1.15
2013	\$39.77	1.17
2014	\$41.45	1.19
2015	\$43.22	1.21
2016	\$45.05	1.23
2017	\$46.91	1.25
2018	\$48.86	1.27
2019	\$50.84	1.29
2020	\$52.92	1.31
2021	\$55.09	1.33
2022	\$57.36	1.35
2023	\$59.70	1.38
2024	\$62.09	1.40
2025	\$64.56	1.43
2026	\$67.10	1.45
2027	\$68.32	1.48
2028	\$70.99	1.51
2029	\$73.75	1.54
2030	\$76.58	1.56
2031	\$79.51	1.59
2032	\$82.51	1.62
2033	\$85.57	1.65
2034	\$88.71	1.68
2035	\$91.92	1.71
		1.74

³ Interagency Working Group on Social Cost of Carbon, "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866", United States Government, May 2013.

⁴ EIA Annual Energy Outlook 2010. 2005=1.0

Historical Emissions Permit Prices: Historical emission permit prices for SO₂ and NO_x in Table 4 were taken from EIA⁵, except where noted. All emission permits are in \$/short ton.

Table 4: Historical SO₂ and NO_x Emissions Allowance Prices (Nominal \$/short ton)

	SO ₂	NO _x
2007	\$534.43	\$776.04
2008	\$278.50	\$807.33
2009	\$81.11	\$304.33
2010	\$16.52	\$44.66
2011	\$2.12	\$15.89
2012	\$0.67 ⁶	

IV. Other Assumptions

Capacity Prices: New Jersey Utility PJM Reliability Pricing Model (RPM) prices for the four electric utilities (AE, JCP&L, PSE&G and RECO) for 2010 to 2016 were weighted by each utility's historic 2012 peak load⁷ to estimate an average New Jersey capacity price. From 2017 to 2030, the capacity prices were escalated based on the EIA projected annual change in U.S. GDP Chain-type Price Index, which was reported in Table 3.

Table 5: Capacity Price (\$/kW-year)

	\$/kW-year
2012	\$49.13
2013	\$75.39
2014	\$70.96
2015	\$59.43
2016	\$61.76
2017	\$62.69
2018	\$63.70
2019	\$64.71
2020	\$65.79
2021	\$66.93
2022	\$68.14
2023	\$69.38
2024	\$70.63
2025	\$71.90
2026	\$73.21
2027	\$74.54
2028	\$75.90
2029	\$77.30
2030	\$78.73
2031	\$80.20
2032	\$81.68
2033	\$83.18
2034	\$84.69
2035	\$86.21
2036	\$87.77

⁵ <http://www.eia.gov/todayinenergy/detail.cfm?id=4830>

⁶ <http://www.epa.gov/airmarkets/trading/2012/12summary.html>

⁷ 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.

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

Avoided Electric and Natural Gas Losses: Avoided average electric transmission and distribution losses are assumed to be 7.6%⁹ and avoided natural gas losses are assumed to be 1.4%¹⁰ based on data calculations from EnerNOC Utility Solutions¹¹. The unreferenced 2012 New Jersey Protocols assume 11% and 1% respectively. The updated avoided loss estimates were submitted to Applied Energy Group in 2012 to update the New Jersey Protocols for 2013.

Avoided Electric and Natural Gas Transmission and Distribution (T&D): EnerNOC has recommended that CEEEP use an Avoided Electric T&D cost of \$30/kW-yr. Further research should be undertaken to develop an estimate of avoided T&D for New Jersey.

CEEEP is currently researching reputable sources for Avoided Natural Gas T&D costs.

PJM Marginal Units

Table 6 shows the type of fuel used by marginal resources in the PJM Real-Time Energy Market¹² in 2012.

Table 6: 2012 PJM Marginal Units

Fuel Type	% on the Margin
Coal	58.8%
Gas	30.4%
Oil	6.0%
Wind	4.2%
Other	0.5%
Municipal Waste	0.1%

Power Plant Emission Rates

Power plant emission rates for CO₂, NO_x, and SO_x are shown in Table 7. Emission rates are in pounds per MWh. CEEEP is currently researching externality values and emission rates for mercury.

Table 7: Power Plant Emission Rates (lbs/MWh)

	CO ₂	NO _x	SO _x
Coal ¹³	2,249	6	13
Natural Gas ¹⁴	1,135	1.7	0.1
Oil ¹⁵	1,672	4	12
Wind	0	0	0
Other	0	0	0
Municipal Waste ¹⁶	2,988	5.4	0.8

⁸ Levitan & Associates, Inc. Long-term Capacity Agreement Pilot Program (March 2011).

⁹ 10 year (2001-2010) Average: "New Jersey Supply and Disposition of Electricity" <http://www.eia.gov/electricity/state/newjersey>

¹⁰ Energy Information Administration natural Gas Transmission: <http://www.eia.gov/pub/itg/ghgp9.htm>

¹¹ EnerNOC Utility Solutions performed the calculations as part of the 2012 Energy Efficiency Market Potential Study for the New Jersey Clean Energy Program. The line losses are derived from EIA data referenced above.

¹² PJM State of the Market – 2012, Section 2 – Energy Market, pg. 62

¹³ U.S. EPA, eGRID 2000.

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ U.S. EPA, Compilation of Air Pollutant Emission Factors (AP-42).

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CEEEP recognizes that there is a range of uncertainty associated with each of the avoided cost estimates given. These avoided cost estimates will be updated in summer 2014 as updated EIA and PJM data becomes available.