

Development of Florida and RGGI State Power Sector Marginal Cost Curves
 by Dan Wei and Adam Rose, University of Southern California (June 17, 2008)

I. Basic Considerations

This is a summary of the development of the marginal cost curves for greenhouse gas mitigation in several states. The curves are based on the GHG reduction potential and mitigation cost/saving data of individual options relating to the power sector. These options not only include those designed directly for electricity supply (such as renewable energy utilization, repowering existing plants, generation performance standards, etc.), but also include options in Residential, Commercial, and Industrial (RCI) sectors that contribute to the reduction of electricity consumption (e.g., demand-side management, energy efficient appliances, building codes, etc.). Also, for those options that apply to the use of both electricity and other fuel types, the emission reduction potentials are adjusted by multiplying the percentage of electricity consumption to total energy consumption in the RCI sector. RCI options that relate entirely to reduction of other fossil fuels consumption (such as gas, oil) are not included in the power sector cost curve development.

II. The Florida Cost Curve

The quantitative analysis results of GHG mitigation options for Florida are not yet available from the Energy Supply and Demand Technical Working Group (equivalent to Energy Supply TWG plus Residential, Commercial, and Industry TWG of other state stakeholder processes). For now the marginal cost curve for the state is estimated based on the mitigation option data for South Carolina. When the direct data for Florida become available, we will re-develop the Florida power sector cost curve accordingly.

Table 1 presents the list of options for South Carolina that contribute to emission reductions from the power sector. Please note only options that have both quantified mitigation potentials and associated cost/cost savings in the state action plan are included in the list.

Table 1. GHG Mitigation Options for the South Carolina Power Sector

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Improved Design and Construction in new and existing state and local government buildings, "Government Lead-by-example"	4.38	-\$33.00	8.03%	8.03%	12.56

ES	Energy Efficiency: 5% of baseline energy demand met by energy efficiency in 2020	4.20	-\$26.00	7.71%	15.73%	12.05
RCI	Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity (including expansion of same) (Residential, Commercial, and Industrial)	8.20	-\$26.00	15.05%	30.78%	23.53
RCI	Incentives and Policies for Improving Appliance Efficiency, Including Appliance Standards	0.63	-\$17.00	1.16%	31.94%	1.81
RCI	Incentives and policies for improving building and appliance efficiency, including building energy codes	6.28	-\$16.00	11.52%	43.46%	18.02
RCI	Incentives, Resources, and Regulatory Reform (including net-metering) to Promote Energy Recycling Including Combined Heat and Power	5.74	-\$8.00	10.53%	53.99%	16.47
ES	Renewables: 5% of baseline energy served by new renewable resources by 2020	3.80	\$19.00	6.97%	60.96%	10.91
ES	Green power purchases and marketing, 1% participation by 2012	0.20	\$27.00	0.37%	61.33%	0.57
RCI	Incentives and Regulatory Reform (including net-metering) to Promote Implementation of Renewable Energy Systems, Including PV and solar thermal (Residential, Commercial, and Industrial)	0.42	\$41.00	0.77%	62.10%	1.21
ES	Distributed renewable energy incentives and/or barrier removal (Including Interconnection Rules)	0.10	\$50.00	0.18%	62.28%	0.29
ES	Renewable Energy Financing, Tax Incentives, Loans	0.90	\$84.00	1.65%	63.93%	2.58

¹ 2020 projected production-based gross emission level is 54.5 Million Metric Tons CO₂e from the power sector.
Data Source: South Carolina Climate, Energy & Commerce Advisory Committee. 2008. *Draft South Carolina Climate Change Action Plan*. <http://www.sccclimatechange.us/plenarygroup.cfm>.

In Table 1, Column 3 presents the estimated 2020 annual GHG reduction potential for each relevant option, with reduction potentials translated into percentages of the 2020 power sector BAU emissions level in Column 5. The estimated cost or cost saving per ton of GHG removed by each option in 2020 is presented in Column 4. The options are ordered in ascending sequence in terms of cost, beginning with the least expensive one. Column 6 calculates the cumulative

GHG reduction potentials of the first n policy options listed in the table. The last column presents the proportion of GHG mitigation that can be contributed by each option.

Table 2 presents the mitigation options data we used for Florida, which are approximated from the South Carolina data. First, we assume the list of mitigation options for South Carolina is applicable to Florida. Second, the estimated cost or cost savings per unit GHG removed for each option is assumed to be at the same level as South Carolina. Third, the mitigation potentials of each option are assumed to be proportional in each state; this requires that each option be adjusted by the ratio of emissions from the relevant sector of the two states. For example, the emissions from the power sector are 168.7 MMtCO₂e and 54.5 MMtCO₂e in Florida and South Carolina, respectively. Therefore, the mitigation potentials of the ES options for South Carolina are multiplied by a factor of 3.1 ($168.7/54.5=3.1$) for application to Florida. This methodology is also applied below to several RGGI states for which complete data are not yet available.

Table 2. GHG Mitigation Options Adapted to Florida

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Improved Design and Construction in new and existing state and local government buildings, “Government Lead-by-example”	14.38	-\$33.00	8.52%	8.52%	19.71
ES	Energy Efficiency: 5% of baseline energy demand met by energy efficiency in 2020	13.00	-\$26.00	7.71%	16.23%	17.82
RCI	Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity (including expansion of same) (Residential, Commercial, and Industrial)	10.16	-\$26.00	6.02%	22.25%	13.93
RCI	Incentives and Policies for Improving Appliance Efficiency, Including Appliance Standards	0.78	-\$17.00	0.46%	22.71%	1.07
RCI	Incentives and policies for improving building and appliance efficiency, including building energy codes	11.52	-\$16.00	6.83%	29.54%	15.79

RCI	Incentives, Resources, and Regulatory Reform (including net-metering) to Promote Energy Recycling Including Combined Heat and Power	7.11	-\$8.00	4.21%	33.75%	9.75
ES	Renewables: 5% of baseline energy served by new renewable resources by 2020	11.76	\$19.00	6.97%	40.73%	16.13
ES	Green power purchases and marketing, 1% participation by 2012	0.62	\$27.00	0.37%	41.09%	0.85
RCI	Incentives and Regulatory Reform (including net-metering) to Promote Implementation of Renewable Energy Systems, Including PV and solar thermal (Residential, Commercial, and Industrial)	0.52	\$41.00	0.31%	41.40%	0.71
ES	Distributed renewable energy incentives and/or barrier removal (Including Interconnection Rules)	0.31	\$50.00	0.18%	41.59%	0.42
ES	Renewable Energy Financing, Tax Incentives, Loans	2.79	\$84.00	1.65%	43.24%	3.82

¹ 2020 projected production-based gross emission level is 168.7 Million Metric Tons CO₂e from the power sector.

Based on the data presented in Table 2, a stepwise marginal cost function for Florida in 2020 is first drawn in Figure 1. The horizontal axis represents the percentage of GHG emissions reduction, and the vertical axis represents the marginal cost or savings of mitigation. In the figure, each horizontal segment represents an individual mitigation option. The width of the segment indicates the GHG emission reduction potential of the option in percentage terms. The height of the segment relative to the x-axis shows the average cost (saving) of reducing one ton of GHG with the application of the option.

Next, we used the following functional form to fit the smooth Florida marginal cost (MC) curve through the step function points to be used in our analysis:

$$MC = a + b \times \ln(1 - R)$$

Where, *MC* is the marginal cost; *R* is the percentage reduction of GHG emissions; *a* and *b* are parameters.

The logarithmic functional form utilized here is consistent with theoretical expectations and empirical findings of diminishing returns in GHG emission mitigation. As the emission reductions increase along the X axis, the cost to reduce one additional unit of emissions is increasing at an accelerating rate.

The marginal cost curve of Florida has the following specification:

$$MC = -53.98 - 142.98 \times \ln(1 - R)$$

Figure 1 shows both the step and fitted marginal cost curves for the Florida Power Sector.

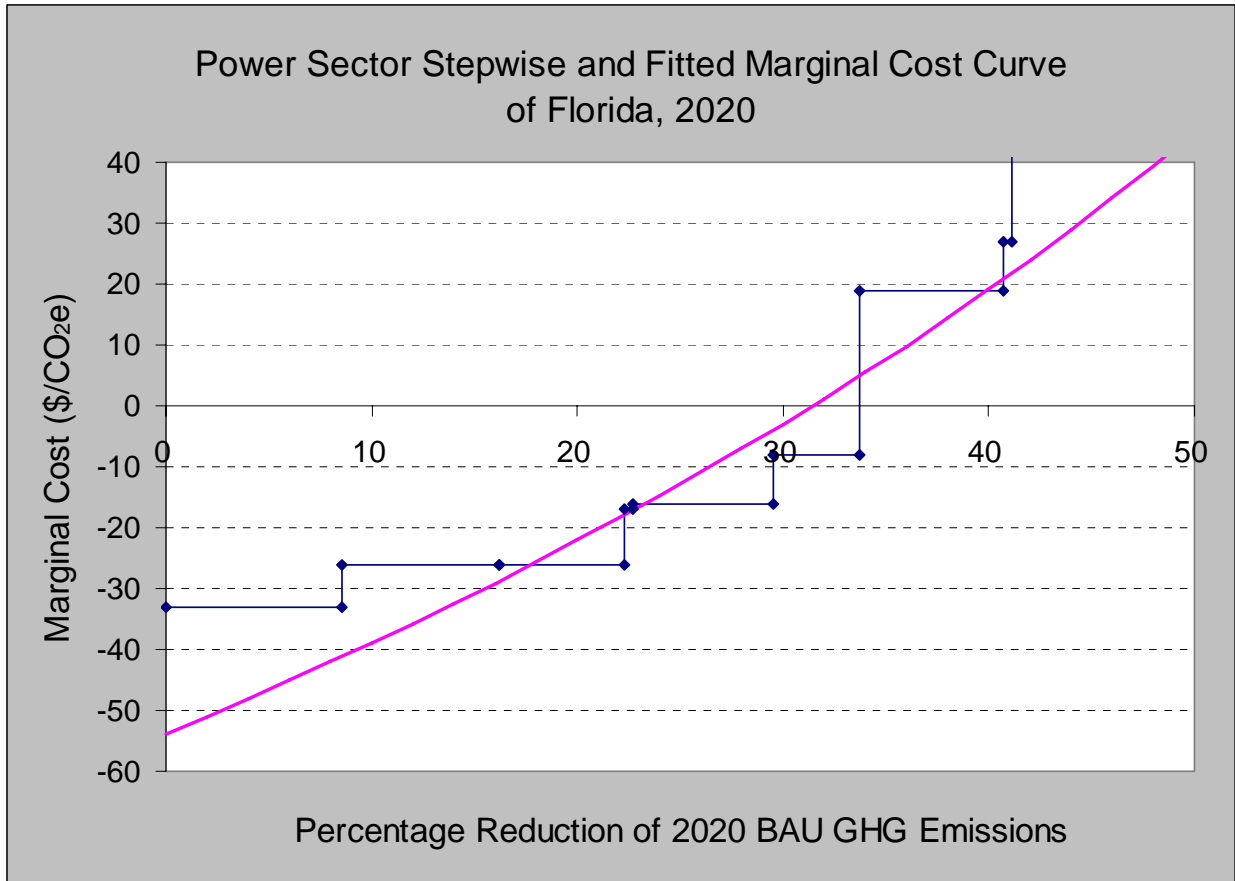


Figure 1. Marginal Cost Curves of Florida Power Sector

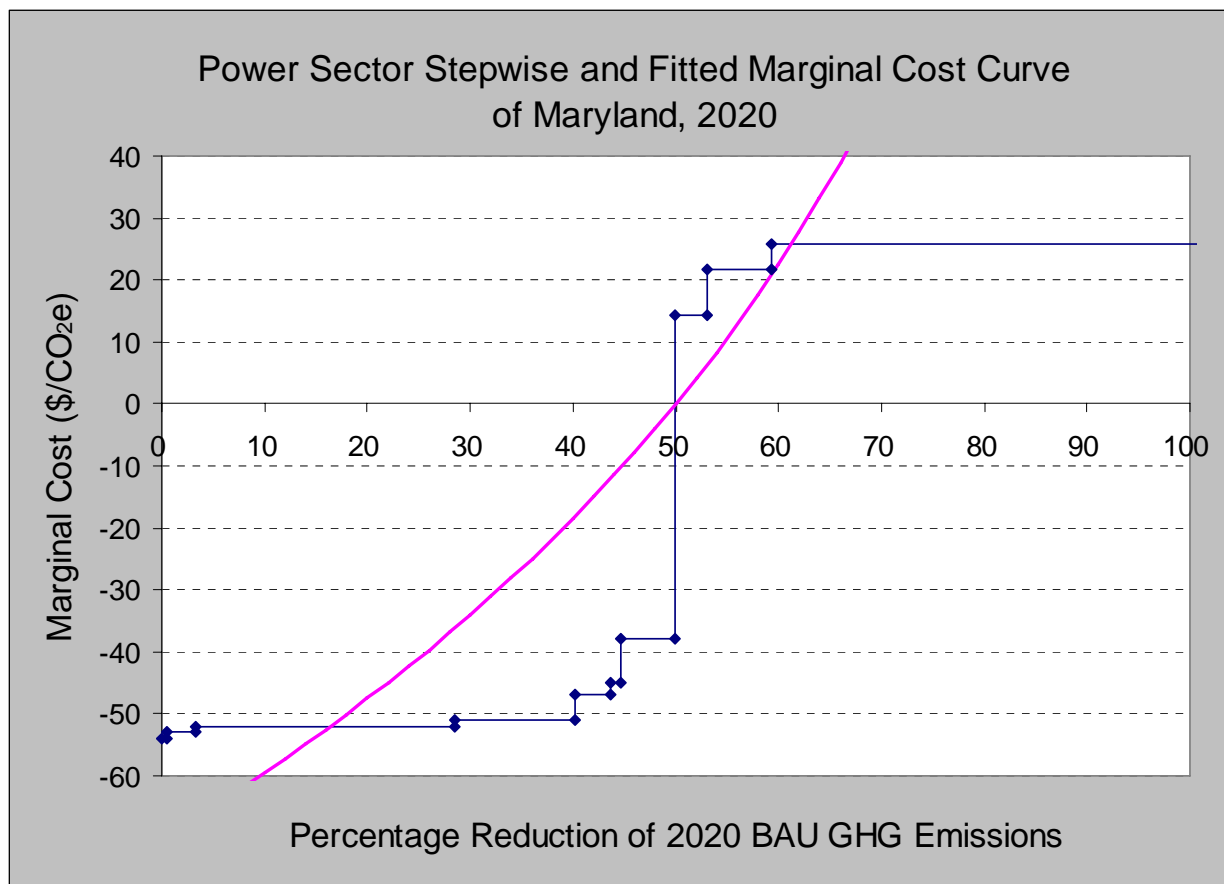
III. GHG Mitigation Options and Cost Curves for Individual RGGI States

Maryland

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	More Stringent Appliance/Equipment Efficiency Standards (State-Level, or Advocate for Regional or Federal-Level Standards)	0.14	-\$54.00	0.42%	0.42%	0.329
RCI	Improved Design, Construction, Appliances, and Lighting in New and Existing State and Local Government Buildings, Facilities and Operations: "Government Lead-by-Example"	0.89	-\$53.00	2.80%	3.22%	2.167
RCI	Energy Efficiency Resource Standard (EERS)	8.04	-\$52.00	25.28%	28.50%	19.592
RCI	Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity and Natural Gas (including expansion of existing programs and peak load reduction)	3.70	-\$51.00	11.64%	40.14%	9.021
RCI	Promotion and Incentives for Energy Efficient Lighting	1.10	-\$47.00	3.46%	43.60%	2.682
RCI	Low-Cost Loans for Energy Efficiency	0.35	-\$45.00	1.09%	44.69%	0.847
RCI	Improved Building and Trade Codes and Beyond-Code Building Design and Construction in the Private Sector	1.67	-\$38.00	5.25%	49.94%	4.067
ES	Clean Distributed Generation: standards, incentives and barrier removal for distributed generation, including combined heat and power (CHP), district heating and cooling, landfill gas, solar, and other forms of renewable energy--Combined Heat & Power	1.00	\$14.40	3.15%	53.08%	2.438
ES	Efficiency improvements and repowering existing plants-Biomass component	2.00	\$21.80	6.29%	59.37%	4.876
ES	Renewable Portfolio Standard	13.80	\$25.70	43.41%	102.79%	33.647
ES	Promotion of renewable energy (zoning and siting incentives for centralized facilities)	0.50	\$27.00	1.57%	104.36%	1.219

ES	Clean Distributed Generation: standards, incentives and barrier removal for distributed generation, including combined heat and power (CHP), district heating and cooling, landfill gas, solar, and other forms of renewable energy--Distributed Generation	1.10	\$37.50	3.46%	107.82%	2.682
ES	Generation Performance Standards GPS - 1125 lb CO ₂ e per MWh	6.60	\$42.40	20.76%	128.58%	16.092
RCI	Rate Structures and Technologies to Promote Reduced Greenhouse Gas (GHG) Emissions (Including Peak Pricing and Inverted Block Rates)	0.14	\$120.00	0.44%	129.02%	0.339

¹ 2020 projected production-based gross emission level is 31.79 Million Metric Tons CO₂e from the power sector.
 Data Source: Maryland Commission on Climate Change. 2008. *Maryland Climate Change Action Plan*.
<http://www.mdclimatechange.us/index.cfm>.



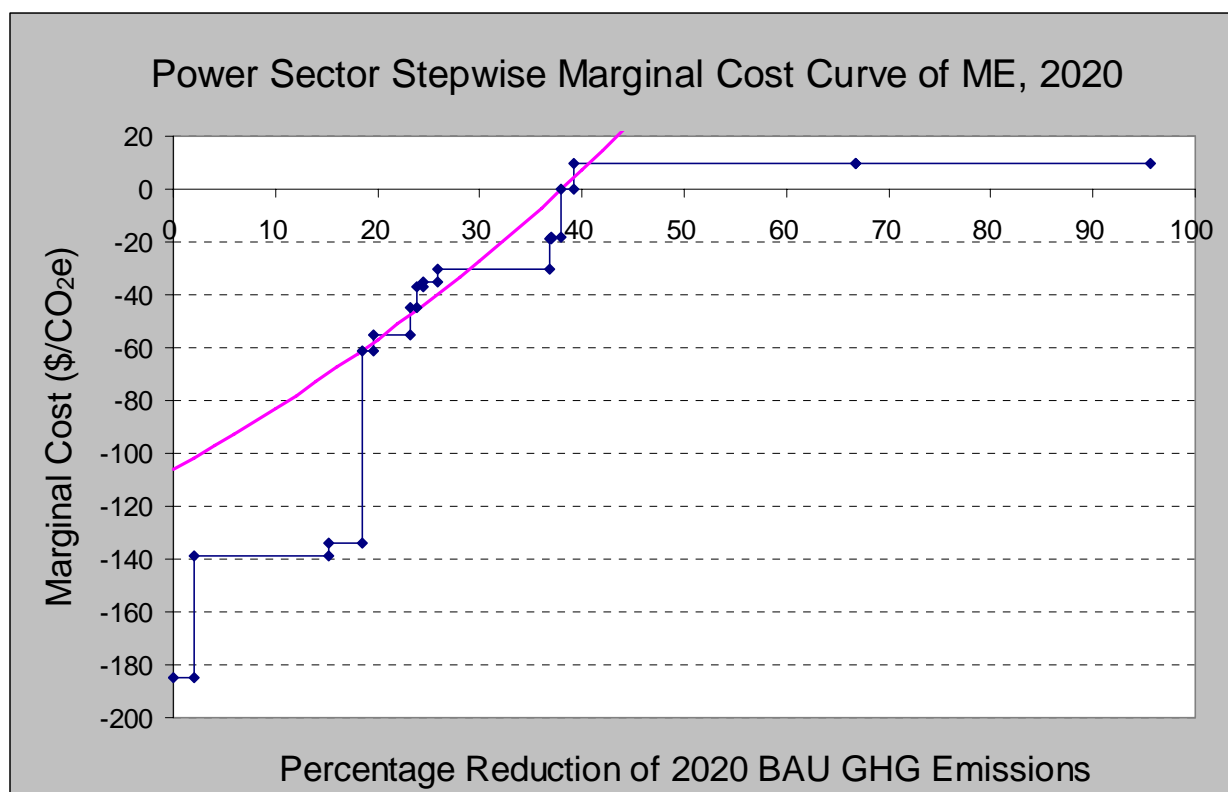
Notes: 1. The x-intercept is forced to be at 50%, which is consistent with the step function.
 2. The policy options are ordered from the lowest cost to highest. Only the first 9 option points are used in the development of the cost curve, since adding the next option point would yield over 100% cumulative mitigation potential.

Maine

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
ES	Combined Heat and power Incentive policy	0.038	-\$185.00	2.00%	2.00%	1.064
RCI	Improve Electrical Efficiency: Commercial/Institutional	0.251	-\$139.00	13.19%	15.19%	7.027
RCI	Energy Efficiency Appliance Standards	0.062	-\$134.00	3.28%	18.47%	1.749
RCI	Enforce Commercial Building Energy Code	0.020	-\$61.00	1.06%	19.53%	0.564
RCI	Increase Public Expenditures for Electrical Efficiency	0.071	-\$55.00	3.73%	23.26%	1.988
RCI	Voluntary Green Building Design Standards	0.012	-\$45.00	0.61%	23.87%	0.325
RCI	Energy Savings in State Buildings	0.012	-\$37.00	0.65%	24.53%	0.348
RCI	Improve Residential Building Energy Codes	0.027	-\$35.00	1.39%	25.92%	0.742
RCI	Electrical Efficiency Measures: Manufacturing	0.207	-\$30.00	10.88%	36.80%	5.795
RCI	Promote Energy Efficiency Buildings	0.004	-\$19.00	0.21%	37.01%	0.114
RCI	Green Campus Initiatives	0.018	-\$18.00	0.93%	37.95%	0.498
RCI	Voluntary Partnerships and Recognition Programs	0.022	\$0.00	1.17%	39.12%	0.624
ES	Renewable Portfolio Standards	0.527	\$10.00	27.70%	66.81%	14.755
ES	Offset Requirements	0.549	\$10.00	28.85%	95.67%	15.371
ES	Biomass Restart Nonoperating units	0.269	\$15.00	14.14%	109.80%	7.531
ES	Biomass Generation: Existing Units	0.422	\$16.00	22.15%	131.96%	11.801

ES	Emission Standards for Electricity Generation	0.327	\$23.00	17.19%	149.14%	9.155
ES	State Green Power Purchases	0.045	\$28.00	2.37%	151.51%	1.260
ES	Renewable Energy System Benefit Charge	0.689	\$30.00	36.21%	187.72%	19.290

¹ 2020 projected production-based gross emission level is 1.90 Million Metric Tons CO₂e from the power sector.
 Data Source: Maine Department of Environmental Protection. 2004. *Final Maine Climate Action Plan 2004*.
<http://www.maine.gov/dep/air/greenhouse/>.



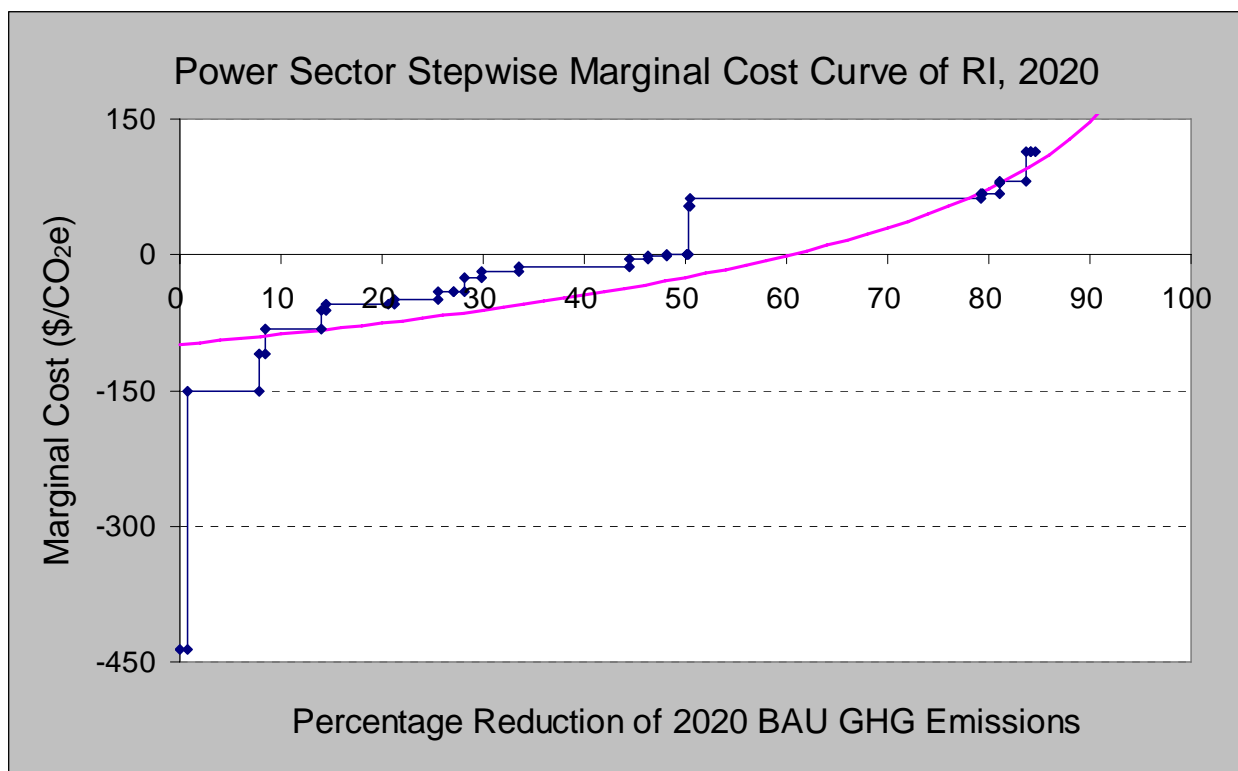
Notes: 1. The x-intercept is forced to be at 38%, which is consistent with the step function. Otherwise the smoothed curve would be skewed by the last two option points shown in the figure.
 2. The policy options are ordered from the lowest cost to highest. Only the first 14 option points are used in the development of the cost curve, since adding the next option point would yield over 100% cumulative mitigation potential.

Rhode Island

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Public Facilities Efficiency Initiative	0.012	-\$436.36	0.70%	0.70%	0.824
RCI	Compact Residential Appliances Initiative	0.127	-\$150.00	7.15%	7.84%	8.450
RCI	Compact Floorspace Initiative	0.010	-\$109.09	0.55%	8.40%	0.653
RCI	Upgrade New Commercial Construction Building Code	0.099	-\$81.82	5.58%	13.97%	6.593
RCI	Efficient Residential Lighting and Appliances Programs	0.008	-\$61.64	0.45%	14.42%	0.528
RCI	Electric Energy Efficiency Retrofit in Non-Residential buildings and Facilities	0.110	-\$54.55	6.19%	20.61%	7.317
RCI	Efficient Non-Residential Construction	0.011	-\$54.55	0.64%	21.25%	0.762
RCI	Energy Efficiency Targeting Initiative (Industrial)	0.075	-\$49.09	4.23%	25.49%	5.006
RCI	Tax Credits for Energy Efficiency	0.029	-\$40.91	1.66%	27.14%	1.960
RCI	Electric Equipment Retrofit Program (Small Commercial & Industrial)	0.018	-\$40.91	1.03%	28.18%	1.220
RCI	Combined Heat & Power (CHP) Initiative (Non-industrial)	0.029	-\$24.55	1.66%	29.83%	1.960
RCI	Combined Heat & Power (CHP) Initiative (Industrial)	0.066	-\$19.09	3.70%	33.54%	4.380
RCI	Upgrade and Extend Appliance Efficiency Standards	0.195	-\$13.64	10.98%	44.51%	12.978
RCI	Upgrade New Residential Construction Building Code	0.032	-\$5.45	1.79%	46.30%	2.113
RCI	Retrofit Program for Electricity Heated Residences	0.033	-\$1.91	1.86%	48.16%	2.195
RCI	Efficient Residential Electric Cooling Initiative	0.037	\$0.00	2.06%	50.22%	2.439
RCI	Energy Star Home Construction Program	0.002	\$0.00	0.09%	50.31%	0.106
ES	Direct Government Investments Or Expenditures in Renewable Energy	0.002	\$54.55	0.10%	50.41%	0.122

ES	Renewable Portfolio Standards	0.513	\$62.73	28.88%	79.29%	34.148
RCI	State Facilities Renewable Purchase Requirement	0.001	\$68.18	0.08%	79.38%	0.098
ES	Promote New Renewable Electricity Supply Using System Benefit Charge Funds	0.029	\$68.18	1.65%	81.03%	1.951
ES	Net metering	0.001	\$80.18	0.04%	81.07%	0.049
ES	Promote Green Power Purchases Using System Benefit Charge Funds	0.048	\$81.82	2.68%	83.75%	3.171
ES	Production tax credit	0.007	\$113.73	0.41%	84.16%	0.488
ES	Investment tax credit	0.007	\$113.73	0.41%	84.58%	0.488

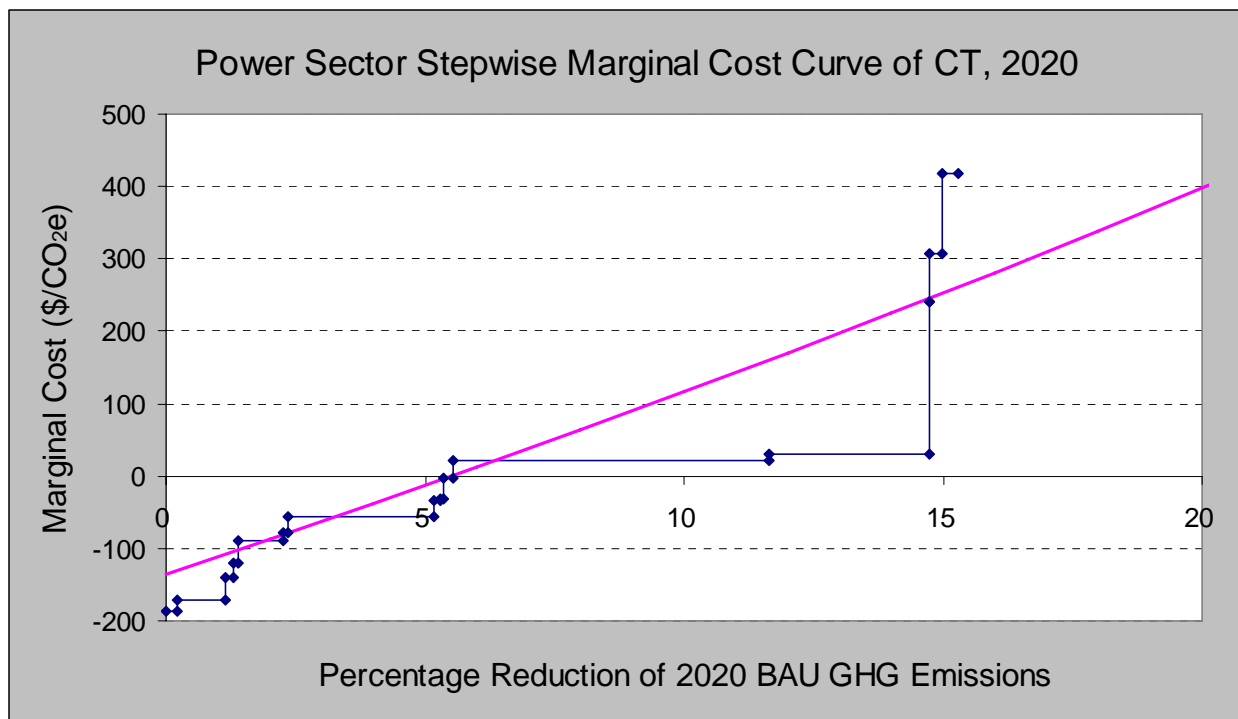
¹ 2020 projected production-based gross emission level is 1.78 Million Metric Tons CO₂e from the power sector.
 Data Source: Rhode Island Greenhouse Gas Process. 2002. *Rhode Island Greenhouse Gas Action Plan*.
<http://righg.raabassociates.org/>.



Connecticut

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Bulk Purchasing of Appliances	0.03	-\$187.00	0.21%	0.21%	1.342
RCI	Mandate Upgrades to Residential and Commercial Building Energy Codes	0.13	-\$172.00	0.95%	1.15%	6.185
RCI	Training of Building Operators	0.02	-\$140.00	0.14%	1.29%	0.918
RCI	Heat Pump Water Heater Replacement Program	0.01	-\$121.00	0.10%	1.39%	0.641
RCI	Appliance Standards	0.12	-\$89.00	0.88%	2.26%	5.729
RCI	Appliance-Swapping Program	0.01	-\$78.00	0.08%	2.34%	0.498
RCI	Restore Conservation and Load Management Fund	0.37	-\$56.00	2.81%	5.15%	18.414
RCI	Remove Current Barriers to Third-Party Load-Management Techniques	0.02	-\$34.00	0.15%	5.31%	1.003
RCI	Promote Energy Efficient and Energy Improvement Mortgages	0.01	-\$32.00	0.05%	5.36%	0.348
RCI	Energy Star Homes Program	0.02	-\$3.00	0.17%	5.53%	1.095
ES	Clean Energy Option	0.81	\$21.92	6.11%	11.64%	39.963
ES	Restore Clean Energy Fund	0.41	\$29.66	3.09%	14.73%	20.228
RCI	Weatherization Assistance Program	0.00	\$241.00	0.02%	14.75%	0.149
RCI	High-Performance Buildings: Privately Funded Projects	0.03	\$308.00	0.22%	14.97%	1.446
RCI	High-Performance Schools and State-Funded Buildings	0.04	\$419.00	0.31%	15.28%	2.040

¹ 2020 projected production-based gross emission level is 13.26 Million Metric Tons CO₂e from the power sector.
 Data Source: Connecticut Governor's Steering Committee on Climate Change. 2005. *2005 CT Climate Change Action Plan*. <http://www.ctclimatechange.com/StateActionPlan.html>.



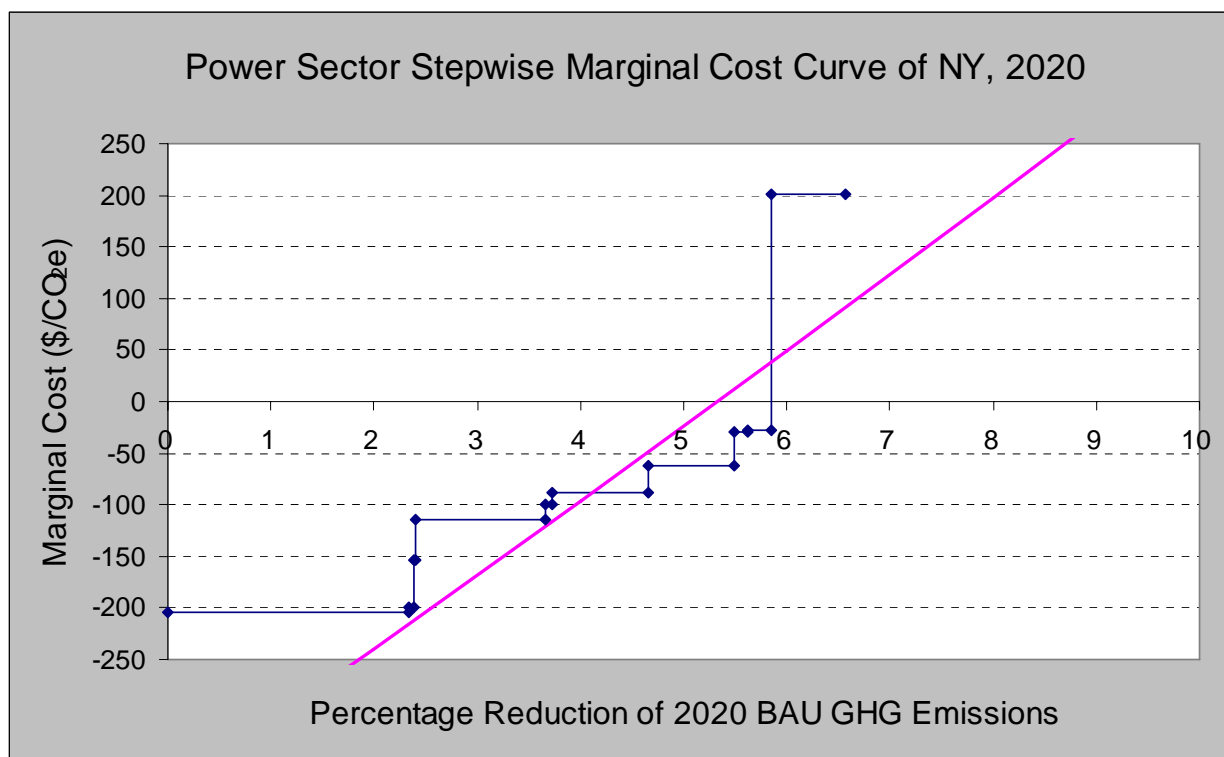
Note: The x-intercept is forced to be at 5.5%, which is consistent with the step function.

New York

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Other Appliance Sandards w/ State Authority	1.32	-\$204.04	2.34%	2.34%	35.668
RCI	Building Operator Training	0.02	-\$199.95	0.04%	2.38%	0.605
RCI	Efficient Conductor Sizing	0.01	-\$154.02	0.02%	2.40%	0.302
RCI	CHP High Impact	0.70	-\$114.66	1.25%	3.65%	19.012
RCI	SEER 13 A/C Standards	0.04	-\$100.15	0.08%	3.73%	1.209
RCI	Negotiated Agreements With Industry	0.52	-\$88.22	0.92%	4.65%	14.011
RCI	System Benefit Charge Extension to reduce electric demand	0.47	-\$62.42	0.83%	5.49%	12.696

RCI	AL Recycling	0.07	-\$30.14	0.13%	5.62%	1.988
RCI	NYP&A LIPA Extension to reduce electric demand	0.13	-\$28.34	0.24%	5.86%	3.627
RCI	Appliance Standards Requiring Federal Waiver	0.40	\$201.06	0.72%	6.57%	10.882

¹ 2020 projected production-based gross emission level is 56.11 Million Metric Tons CO₂e from the power sector.
 Data Source: Center for Clean Air Policy and New York GHG Task Force. 2003. *Recommendations to Governor Pataki for Reducing New York State Greenhouse Gas Emissions*. http://www.ccap.org/pdf/04-2003_NYGHG_Recommendations.pdf.



Vermont

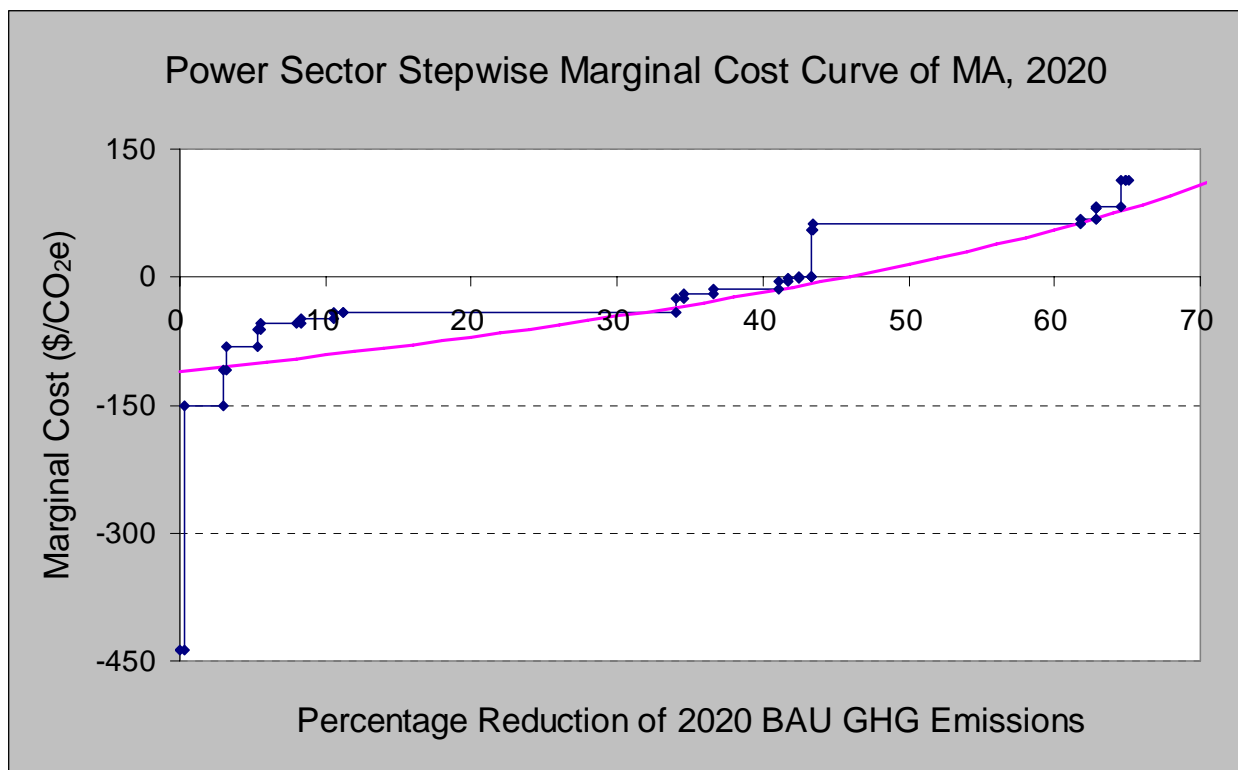
According to the *Final Report and Recommendations of the Governor's Commission on Climate Change* by Vermont Governor's Commission on Climate Change, the RCI option: Building Efficiency Codes, Training, Tracking has estimated GHG reduction potentials (related to electricity consumption reduction) of 0.064 MMtCO₂e at the cost of -\$67.14/tCO₂e. The RGGI website shows that the reference case projection of VT 2020 power sector emissions are 0.03 MMtCO₂e. Therefore, the cost curve of VT used in this study is a horizontal line at -\$67.14.

Massachusetts (estimated based on Rhode Island data)

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Public Facilities Efficiency Initiative	0.067	-\$436.36	0.27%	0.27%	0.415
RCI	Compact Residential Appliances Initiative	0.678	-\$150.00	2.72%	2.99%	4.169
RCI	Compact Floorspace Initiative	0.053	-\$109.09	0.21%	3.20%	0.324
RCI	Upgrade New Commercial Construction Building Code	0.539	-\$81.82	2.16%	5.36%	3.316
RCI	Efficient Residential Lighting and Appliances Programs	0.042	-\$61.64	0.17%	5.53%	0.261
RCI	Electric Energy Efficiency Retrofit in Non-Residential buildings and Facilities	0.625	-\$54.55	2.50%	8.03%	3.840
RCI	Efficient Non-Residential Construction	0.071	-\$54.55	0.28%	8.31%	0.436
RCI	Energy Efficiency Targeting Initiative (Industrial)	0.576	-\$49.09	2.30%	10.62%	3.539
RCI	Tax Credits for Energy Efficiency	0.158	-\$40.91	0.63%	11.25%	0.973
RCI	Electric Equipment Retrofit Program (Small Commercial & Industrial)	5.678	-\$40.91	22.74%	33.99%	34.909
RCI	Combined Heat & Power (CHP) Initiative (Non-industrial)	0.158	-\$24.55	0.63%	34.62%	0.973
RCI	Combined Heat & Power (CHP) Initiative (Industrial)	0.504	-\$19.09	2.02%	36.64%	3.096
RCI	Upgrade and Extend Appliance Efficiency Standards	1.108	-\$13.64	4.44%	41.07%	6.811
RCI	Upgrade New Residential Construction Building Code	0.170	-\$5.45	0.68%	41.75%	1.042
RCI	Retrofit Program for Electricity Heated Residences	0.187	-\$1.91	0.75%	42.50%	1.152
RCI	Efficient Residential Electric Cooling Initiative	0.208	\$0.00	0.83%	43.34%	1.280
RCI	Energy Star Home Construction Program	0.008	\$0.00	0.03%	43.37%	0.052
ES	Direct Government Investments Or Expenditures in Renewable Energy	0.016	\$54.55	0.07%	43.44%	0.101

ES	Renewable Portfolio Standards	4.585	\$62.73	18.36%	61.79%	28.187
ES	Promote New Renewable Electricity Supply Using System Benefit Charge Funds	0.262	\$68.18	1.05%	62.84%	1.611
RCI	State Facilities Renewable Purchase Requirement	0.008	\$68.18	0.03%	62.88%	0.051
ES	Net metering	0.007	\$80.18	0.03%	62.90%	0.040
ES	Promote Green Power Purchases Using System Benefit Charge Funds	0.426	\$81.82	1.70%	64.61%	2.617
ES	Production tax credit	0.065	\$113.73	0.26%	64.87%	0.403
ES	Investment tax credit	0.065	\$113.73	0.26%	65.13%	0.403

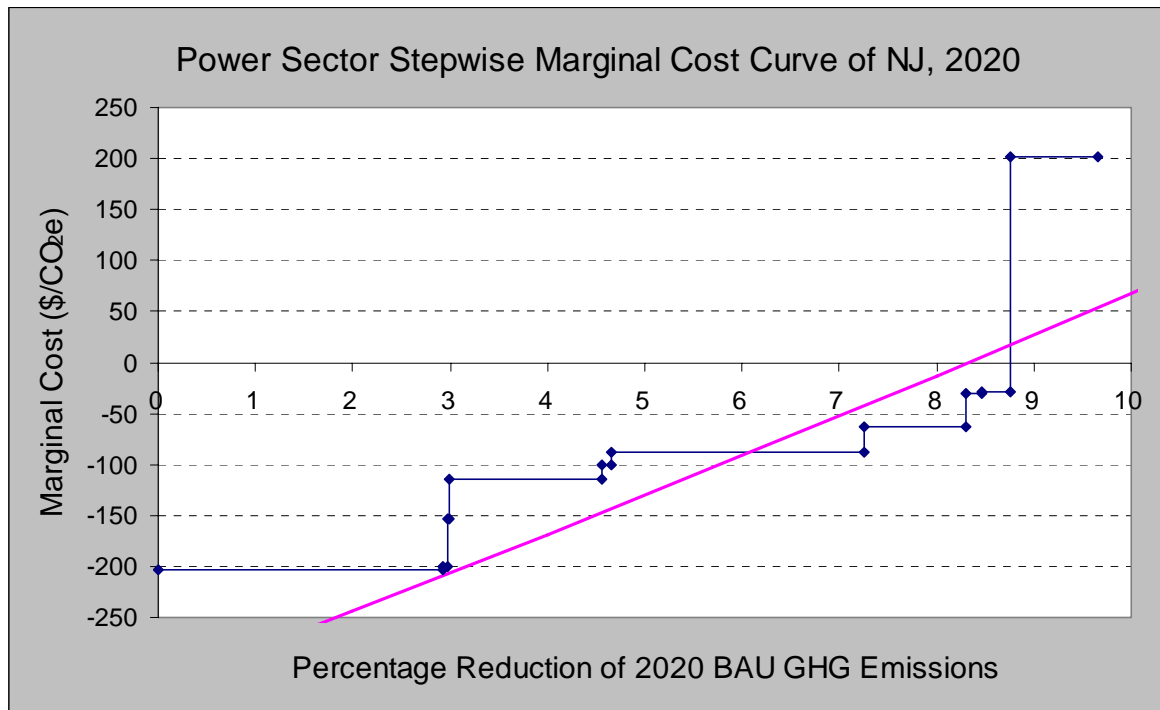
¹ 2020 projected production-based gross emission level is 24.97 Million Metric Tons CO₂e from the power sector.



New Jersey (estimated based on New York data)

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Other Appliance Sandards w/ State Authority	0.68	-\$204.04	2.92%	2.92%	30.269
RCI	Building Operator Training	0.01	-\$199.95	0.05%	2.97%	0.513
RCI	Efficient Conductor Sizing	0.01	-\$154.02	0.02%	3.00%	0.257
RCI	CHP High Impact	0.36	-\$114.66	1.56%	4.55%	16.133
RCI	SEER 13 A/C Standards	0.02	-\$100.15	0.10%	4.65%	1.026
RCI	Negotiated Agreements With Industry	0.61	-\$88.22	2.61%	7.26%	27.029
RCI	System Benefit Charge Extension to reduce electric demand	0.24	-\$62.42	1.04%	8.30%	10.774
RCI	AL Recycling	0.04	-\$30.14	0.16%	8.46%	1.687
RCI	NYPA LIPA Extension to reduce electric demand	0.07	-\$28.34	0.30%	8.76%	3.078
RCI	Appliance Standards Requiring Federal Waiver	0.21	\$201.06	0.89%	9.65%	9.234

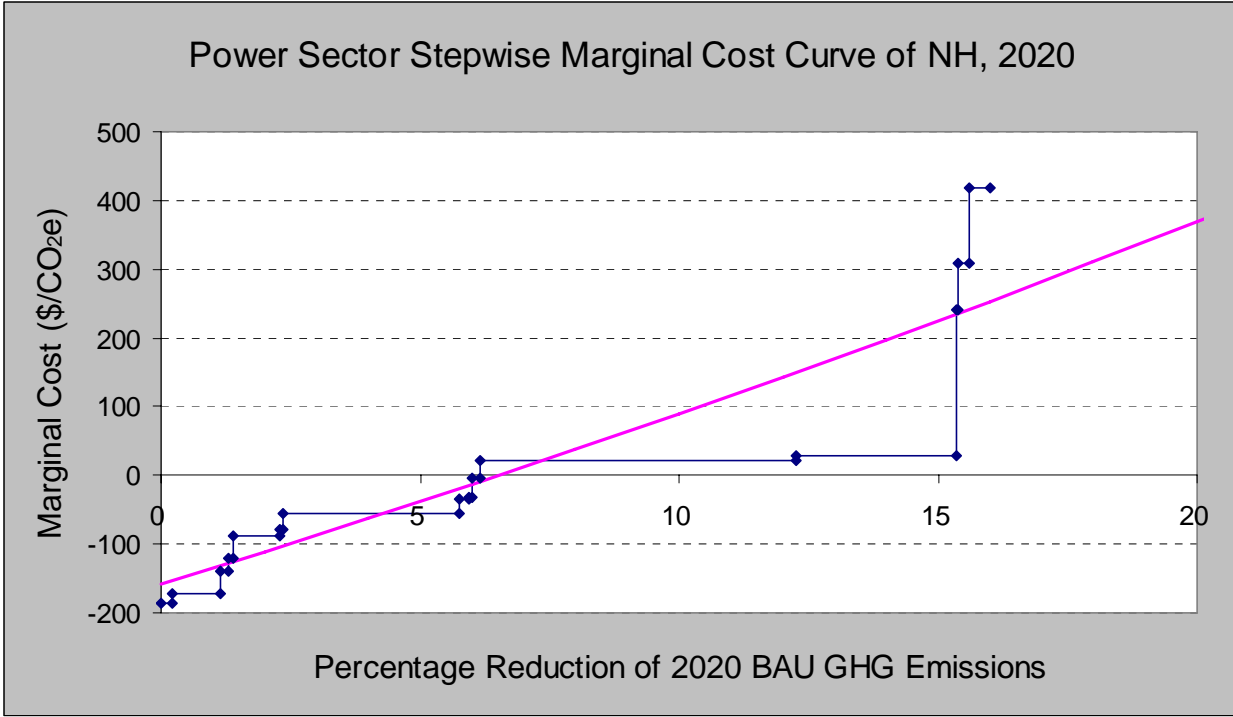
¹ 2020 projected production-based gross emission level is 23.41 Million Metric Tons CO₂e from the power sector.



New Hampshire (estimated based on Connecticut data)

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	Bulk Purchasing of Appliances	0.010	-\$187.00	0.21%	0.21%	1.289
RCI	Mandate Upgrades to Residential and Commercial Building Energy Codes	0.047	-\$172.00	0.95%	1.16%	5.939
RCI	Training of Building Operators	0.007	-\$140.00	0.14%	1.30%	0.899
RCI	Heat Pump Water Heater Replacement Program	0.005	-\$121.00	0.10%	1.40%	0.628
RCI	Appliance Standards	0.044	-\$89.00	0.90%	2.30%	5.610
RCI	Appliance-Swapping Program	0.003	-\$78.00	0.07%	2.37%	0.430
RCI	Restore Conservation and Load Management Fund	0.168	-\$56.00	3.41%	5.77%	21.286
RCI	Remove Current Barriers to Third-Party Load-Management Techniques	0.009	-\$34.00	0.19%	5.96%	1.159
RCI	Promote Energy Efficient and Energy Improvement Mortgages	0.002	-\$32.00	0.05%	6.01%	0.301
RCI	Energy Star Homes Program	0.007	-\$3.00	0.15%	6.16%	0.946
ES	Clean Energy Option	0.301	\$21.92	6.11%	12.27%	38.168
ES	Restore Clean Energy Fund	0.152	\$29.66	3.09%	15.36%	19.320
RCI	Weatherization Assistance Program	0.001	\$241.00	0.02%	15.38%	0.129
RCI	High-Performance Buildings: Privately Funded Projects	0.011	\$308.00	0.23%	15.61%	1.416
RCI	High-Performance Schools and State-Funded Buildings	0.020	\$419.00	0.40%	16.00%	2.482

¹ 2020 projected production-based gross emission level is 4.93 Million Metric Tons CO₂e from the power sector.



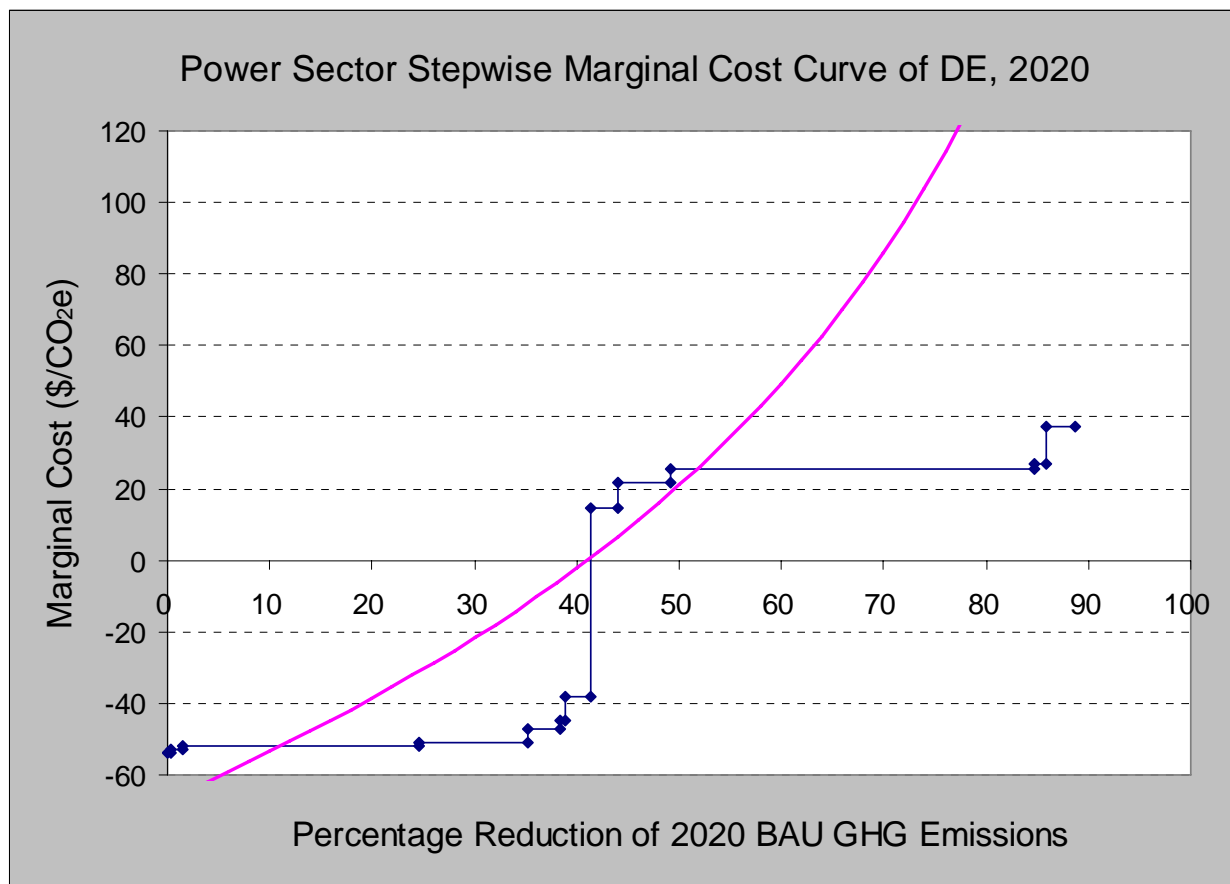
Note: The x-intercept is forced to be at 6.5%, which is consistent with the step function.

Delaware (estimated based on Maryland data)

Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions ¹	Cumulative GHG Reduction Potential	Weights (add-up to 100)
RCI	More Stringent Appliance/Equipment Efficiency Standards (State-Level, or Advocate for Regional or Federal-Level Standards)	0.043	-\$54.00	0.39%	0.39%	0.366
RCI	Improved Design, Construction, Appliances, and Lighting in New and Existing State and Local Government Buildings, Facilities and Operations: "Government Lead-by-Example"	0.131	-\$53.00	1.18%	1.57%	1.115
RCI	Energy Efficiency Resource Standard (EERS)	2.552	-\$52.00	23.05%	24.62%	21.748
RCI	Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity and Natural Gas (including expansion of existing programs and peak load reduction)	1.175	-\$51.00	10.61%	35.23%	10.014
RCI	Promotion and Incentives for Energy Efficient Lighting	0.349	-\$47.00	3.15%	38.38%	2.977
RCI	Low-Cost Loans for Energy Efficiency	0.057	-\$45.00	0.52%	38.90%	0.487
RCI	Improved Building and Trade Codes and Beyond-Code Building Design and Construction in the Private Sector	0.275	-\$38.00	2.48%	41.38%	2.340
ES	Clean Distributed Generation: standards, incentives and barrier removal for distributed generation, including combined heat and power (CHP), district heating and cooling, landfill gas, solar, and other forms of renewable energy--Combined Heat & Power	0.285	\$14.40	2.58%	43.95%	2.430
ES	Efficiency improvements and repowering existing plants-Biomass component	0.570	\$21.80	5.15%	49.10%	4.861
ES	Renewable Portfolio Standard	3.936	\$25.70	35.54%	84.64%	33.539
ES	Promotion of renewable energy (zoning and siting incentives for centralized facilities)	0.143	\$27.00	1.29%	85.93%	1.215

ES	Clean Distributed Generation: standards, incentives and barrier removal for distributed generation, including combined heat and power (CHP), district heating and cooling, landfill gas, solar, and other forms of renewable energy--Distributed Generation	0.314	\$37.50	2.83%	88.77%	2.673
ES	Generation Performance Standards GPS - 1125 lb CO ₂ e per MWh	1.882	\$42.40	17.00%	105.76%	16.040
RCI	Rate Structures and Technologies to Promote Reduced Greenhouse Gas (GHG) Emissions (Including Peak Pricing and Inverted Block Rates)	0.023	\$120.00	0.21%	105.97%	0.195

¹ 2020 projected production-based gross emission level is 11.08 Million Metric Tons CO₂e from the power sector.



Note: The x-intercept is forced to be at 41%, which is consistent with the step function. Also, only the first 9 option points are used to develop the smoothed curve. The 10th option has over 35% mitigation potential relative to the BAU emissions level. Including it would skew the smoothed curve for the most relevant part in the analysis, which is between 30% and 50% cumulative mitigation potential.