



Commission on Climate Change

Maryland Climate Change Commission Mitigation Working Group

Energy Supply Technical Work Group

Meeting #12

April 9, 2008

Maryland Department of the Environment
Maryland Energy Administration
Center for Climate Strategies

Call to Order and Roll Call

- Technical Work Group (TWG) Members
- Maryland Department of the Environment (MDE) and Maryland Energy Administration (MEA)
- Members of the Public
- Center for Climate Strategies

Agenda

- Call to order and roll call
- Review and approve call #11 summary
- Review and discuss quantification of priority policy options
- Approve those policy options that are ready for final recommendation
- Propose modifications for options that need more work
- Receive and discuss first round cap and trade modeling results
- Receive and discuss first round carbon tax modeling results
- Public Input and Announcements
- Agenda, Time and Date for Next Meeting

Stepwise Planning Process

1. Develop inventory and forecast of emissions - Ongoing
2. Identify a full range of possible actions - Sept. 7
3. Identify initial priorities for analysis - Sept. 28
4. Develop straw proposals - Oct. 26
5. Quantify GHG reductions and costs/savings - Dec/Jan
6. Evaluate externalities, feasibility issues - Dec/Jan
7. Develop alternatives to address barriers - Jan/Feb
8. Aggregate results - Feb
9. Iterate to final agreements - Feb/Mar
10. Finalize and report recommendations - Mar

Review Policy Options

ES-1	Promotion of renewable energy (zoning, siting, incentives for centralized facilities, long-terms contracting, performance-based contracting)
ES-2	Technology-focused initiatives for electricity supply (biomass co-firing, energy storage, fuel cells, landfill gas, clean energy incentives)
ES-3	GHG cap-and-trade
ES-4	CCSR incentives, requirements and/or enabling policies (administration, regulation, liability, incentives)
	Low efficiency
	Medium efficiency
ES-5	Clean Distributed Generation: standards, incentives and barrier removal for distributed generation, including combined heat and power (CHP), district heating and cooling, landfill gas, solar, fuel cells and other forms of renewable energy.
	Distributed Generation
	Combined Heat & Power
ES-6	Integrated resource planning (IRP) with or without re-regulation and/or state energy plan
ES-7	Renewable and/or Environmental Portfolio Standard (e.g., add CHP and/or EE to RPS as additional tier) and/or Energy Efficiency Portfolio Standard
ES-8	Efficiency improvements and repowering existing plants
	Biomass component
	Repowering component
ES-9	Carbon (GHG) tax
ES-10	Generation performance standards and/or mitigation requirements for electricity

	Policy Option	GHG Reductions (MMtCO ₂ e)			Net Present Value 2008–2020 (Million \$)	Cost-Effective-ness (\$/tCO ₂ e)	Level of Support
		2012	2020	Total (2008–2020)			
ES-1	Promotion of renewable energy (zoning and siting incentives for centralized facilities)	0.2	0.5	3.3	\$89	\$27.0	Pending
ES-2	Technology-focused initiatives for electricity supply (biomass co-firing, energy storage, fuel cells, landfill gas, clean energy incentives)	U	U	U	U	U	Pending
ES-3	GHG cap-and-trade	Pending	Pending	Pending	Pending	Pending	Pending
ES-4	CCSR incentives, requirements and/or enabling policies (administration, regulation, liability, incentives)	0.0	3.4	27.2	\$2,001	\$73.5	Pending
	Low efficiency	0.0	3.2	25.8	\$1,230	\$47.8	
	Medium efficiency	0.0	3.4	27.2	\$2,001	\$73.5	
	High efficiency	0.0	3.6	28.8	\$3,002	\$104.2	
ES-5	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.						Pending
	ES-5a Distributed Generation	0.3	1.1	6.7	\$250	\$37.5	
	ES-5b Combined Heat & Power	0.3	1.0	6.3	\$90	\$14.4	
ES-6	Integrated resource planning (IRP) with or without re-regulation and/or state energy plan	U	U	U	U	U	Pending
ES-7	Renewable Portfolio Standard	5.2	13.8	100.7	\$2,589	\$25.7	Pending
ES-8	Efficiency improvements and repowering existing plants						Pending
	ES-8a Biomass component	1.2	2.0	17.9	\$389	\$21.8	
	ES-8b Repowering component	0.5	2.9	15.5	\$980	\$63.2	
ES-9	Carbon (GHG) tax	Pending	Pending	Pending	Pending	Pending	Pending
ES-10	Generation Performance Standards						Pending
	GPS - 1125 lb CO ₂ e per MWh	6.2	6.6	74.3	\$5,155	\$69.4	
	GPS - 1100 lb CO ₂ e per MWh	7.1	7.6	85.4	\$5,926	\$69.4	
	GPS - 1050 lb CO ₂ e per MWh	8.9	9.6	107.7	\$7,469	\$69.4	

Cap and Trade Modeling Results; Carbon Tax Modeling Results

- Receive and review modeling analysis
- Accept or refine policy option design, implementation and feasibility issues

Overview

We have performed the following three analyses:

- Cap and Trade among power sectors of RGGI states — assume free allocation of allowances.
- Cap and Trade among power sectors of RGGI states — assume auction of all allowances.
- Carbon Tax to non-C&T sectors in Maryland to achieve the state reduction target in 2020 — 25% below 2006 levels.

C&T with Freely Granted Allowances

April 9, 2008

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Introduction

- The Non-linear Programming (NLP) Model we used in the study is capable of analyzing various environmental policy instruments, under a variety of conditions.
- Because of the extensive availability of low-cost mitigation options in RGGI, the supply of allowances in a C&T would exceed the demand for allowances at all positive allowance prices. Hence, trading would not be possible, i.e., a feasible solution for a positive allowance price cannot be obtained from the NLP model that equalizes supply and demand of allowances in the market.
- Instead, we analyze two scenarios with different assumptions for allowance price levels that resolve this problem. We then evaluate the supply and demand of allowances from each state, and the costs/savings of individual states before and after entering the C&T system.

RGGI States 2020 Emission Projections and Caps

	2020 BAU Emissions (MMtCO2)	Cap/Budget (MMtCO2)	Reduction Target (%)	Allowance beyond BAU (MMtCO2)	Reduction Target (MMtCO2)
CT	13.26	9.09	31.45%	0.00	4.17
DE	11.07	6.43	41.94%	0.00	4.65
MD	38.83	31.88	17.90%	0.00	6.95
ME	1.90	5.06	0.00%	3.15	-3.15
NH	4.93	7.33	0.00%	2.40	-2.40
NJ	23.40	19.46	16.86%	0.00	3.95
NY	56.11	54.66	2.58%	0.00	1.45
VT	0.03	1.04	0.00%	1.01	-1.01
MA	24.97	22.66	9.26%	0.00	2.31
RI	1.78	2.26	0.00%	0.48	-0.48
Total	176.30	159.87	9.32%	7.04	16.43

* The shaded states, ME, NH, VT, and RI, have allocated allowances higher than their projected 2020 BAU emission levels. As a result, these states have zero emission reduction targets in their power sector. In addition, they can sell the excess allowances in the market at zero mitigation cost.

Sources: 1. RGGI States GHG Caps by Year from 2009 to 2018 are provided by Jeff Wennberg from CCS. Numbers for year 2019 and year 2020 are estimated by extrapolating 2014 to 2018 numbers.

2. RGGI states 2020 BAU emission projections are obtained from RGGI website <http://www.rggi.org/documents.htm>, the Reference Case projections. The 2020 values are computed by interpolating 2018 and 2021 projections.

First Scenario:

$$\text{Marginal Cost (MC)} = \text{Allowance Price} = \$7/\text{tCO}_2$$

According to the table on the previous slide, ME, NH, VT, and RI do not have any GHG mitigation targets, since the allocated allowances to these states exceed their 2020 BAU emission levels. For the remaining 6 states, which have binding mitigation goals, the reduction target (%) is first computed in the following table. Next, we calculate the reduction potential level in percentage terms with MC=\$7. If this percentage is lower than the reduction target, the state would be a buyer of allowances. As shown below, CT and NJ would be the buyers. In total, the allowances demand from these two states is 5.36 MMtCO₂. The allowance selling states would be DE, MD, ME, NH, NY, VT, MA, and RI.

	Reduction Target (%)	In-state Reduction Potential with MC ≤ \$7 (%)	Whether an Allowance Buyer	The Amount of Allowances to Buy
CT	31.45%	5.78%	Yes	3.40
DE	41.94%	44.05%	No	
MD	17.90%	42.90%	No	
ME	0.00%	39.92%	No	
NH	0.00%	6.78%	No	
NJ	16.86%	8.49%	Yes	1.96
NY	2.58%	5.44%	No	
VT	0.00%	100.00%	No	
MA	9.26%	47.72%	No	
RI	0.00%	62.95%	No	
Total	9.32%	23.54%	—	5.36

First Scenario:

Marginal Cost (MC) = Allowance Price = \$7/tCO₂

- After achieving its own reduction target, the total allowances available for DE to sell with mitigation cost less than \$7 are 0.23 MMtCO₂. We assume the remaining RGGI allowance demand (5.36-0.23=5.13 MMtCO₂) would be provided by the other 7 allowance selling states evenly, i.e., each of the selling states would sell 5.13/7=0.73 MMtCO₂ in the market.
- MD, NY, and MA will provide all of the 0.73 MMtCO₂ allowances by autarkic (their own) mitigation actions with costs less than \$7/tCO₂ (they have excess capability to do so after they reach their own reduction targets).
- ME, NH, RI, and VT will make their decisions following three steps:
 - To gain the largest profit, they would choose to utilize all the cost-saving mitigation potentials inside the state first, since selling these allowances would bring them not only the cost-savings associated with the implementation of the options, but also the revenues from selling the allowances at the price of \$7/tCO₂.
 - After exhausting cost-saving mitigation potentials, they will next choose to sell the excess allowances they hold. They can sell these allowances without incurring any mitigation cost.
 - After using up the excess allowances, they would be willing to sell allowances they can achieve through autarkic mitigation actions with costs less than \$7/tCO₂.

First Scenario:

Marginal Cost (MC) = Allowance Price = \$7/tCO₂

Power Sector Cap and Trade Simulation among 10 RGGI States in Year 2020

Scenario 1: Allowance Price = \$7/tCO₂

(million dollars or otherwise specified)

State	Before Trading	After Trading			Cost Saving	Allowances Traded	Emission Reduction w/ Trading		Emission Reduction Goal
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO ₂)	(million tCO ₂)	(percent from BAU)	(percent from BAU)
CT	1,200.05	-49.64	23.83	-25.81	1,225.86	3.40	0.77	5.78	31.45
DE	-171.89	-170.83	-1.61	-172.43	0.55	-0.23	4.88	44.05	41.94
MD	-407.91	-439.20	-5.13	-444.33	36.43	-0.73	7.68	19.79	17.90
ME	0.00	-41.49	-5.13	-46.62	46.62	-0.73	0.72	38.00	0.00
NH	0.00	-25.72	-5.13	-30.85	30.85	-0.73	0.32	6.50	0.00
NJ	38.45	-313.93	13.71	-300.22	338.67	1.96	1.99	8.49	16.86
NY	-418.66	-530.22	-5.13	-535.36	116.70	-0.73	2.18	3.89	2.58
VT	0.00	-2.34	-5.13	-7.48	7.48	-0.73	0.03	100.00	0.00
MA	-235.68	-301.68	-5.13	-306.81	71.13	-0.73	3.05	12.20	9.26
RI	0.00	-61.48	-5.13	-66.61	66.61	-0.73	1.07	60.45	0.00
Total	4.37	-1,936.53	0.00	-1,936.53	1,940.89	5.36 ^a	22.69	12.87	13.31

^a Represents number of allowances bought or sold.

Second Scenario:

Marginal Cost (MC) = Allowance Price = \$1/tCO₂

Power Sector Cap and Trade Simulation among 10 RGGI States in Year 2020

Scenario 2: Allowance Price = \$1/tCO₂

(million dollars or otherwise specified)

State	Before Trading	After Trading			Cost Saving	Allowances Traded	Emission Reduction w/ Trading		Emission Reduction Goal
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO ₂)	(million tCO ₂)	(percent from BAU)	(percent from BAU)
CT	1,200.05	-49.77	3.44	-46.33	1,246.38	3.44	0.73	5.54	31.45
DE	-171.89	-171.97	0.06	-171.91	0.03	0.06	4.59	41.45	41.94
MD	-407.91	-441.27	-0.78	-442.06	34.15	-0.78	7.73	19.92	17.90
ME	0.00	-41.49	-0.78	-42.27	42.27	-0.78	0.72	38.00	0.00
NH	0.00	-25.72	-0.78	-26.50	26.50	-0.78	0.32	6.50	0.00
NJ	38.45	-314.07	1.99	-312.07	350.52	1.99	1.95	8.34	16.86
NY	-418.66	-535.40	-0.78	-536.18	117.52	-0.78	2.23	3.98	2.58
VT	0.00	-2.34	-0.78	-3.13	3.13	-0.78	0.03	100.00	0.00
MA	-235.68	-306.07	-0.78	-306.85	71.17	-0.78	3.10	12.40	9.26
RI	0.00	-61.48	-0.78	-62.26	62.26	-0.78	1.07	60.45	0.00
Total	4.37	-1,949.58	0.00	-1,949.58	1,953.94	5.49 ^a	22.49	12.76	13.31

^a Represents number of allowances bought or sold.

- In the Scenario where the Allowance Price=\$1/tCO₂, DE would be the third buyer besides CT and NJ, since the state autarkic mitigation potentials with marginal cost less than \$1 fall short of meeting the state target (though DE's demand for allowances is very small (0.06 MMtCO₂e) compared with the other two buyers CT and NJ).
- We also did similar simulations with assumptions of allowance prices at \$3/tCO₂ and \$5/tCO₂. These two cases yield similar simulation results as the \$7 case, with only CT and NJ as the buyers.
- From the three cases with price at the levels of \$3, \$5, and \$7, the results show that there is a negative relationship between the level of allowance price and the amount of allowances traded among the states. Approximately, allowance transactions are reduced 11 thousand tCO₂ with each increased dollar in the allowance price.

C&T with All Allowances Auctioned

April 9, 2008

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- In the auction case, there would be no trading among states. According to the Coase Theorem, in equilibrium, each state would choose to mitigate emissions as long as its marginal abatement cost is lower than or equal to the price of allowances, and purchase the remaining allowance (the difference between the state's BAU level and the amount mitigated by autarkic actions) from the auctioneer.
- In usual C&T cases, where the equilibrium point corresponds to a positive allowance price, auction and free granting would reach the same cost-effectiveness level, i.e., the auction price would be at the same level as the equilibrium price in the allowance trading market, and the collaborative CO₂ reductions achieved by the partner states in these two allocation cases would be the same and equal to the overall emission reduction target of the region.
- The only difference between these two allocation cases would be that the auction can generate revenues to the state government, which in turn can be recycled to fund R&D in clean energy technologies, end-use energy efficiencies, etc., and thus lower the impacts to the electricity ratepayers.

- In RGGI's case, the supply of allowances would exceed the demand for allowances at all positive allowance prices.
- In the free granting case with the assumed market price at \$7/tCO₂, to ensure the balance of trade in the market (supply equalizing demand), states like MD, NY, and MA would not use up all their mitigation potentials with MC < \$7/tCO₂. Collaboratively, the emission reductions achieved by the 10 states are 22.69 MMtCO₂. Beyond the C&T, a state would still be willing to mitigate any ton of GHG that would bring net cost savings. The additional cost saving mitigation potential for the 10 states beyond C&T (free granting case) is 16.61 MMtCO₂.
- In the auction case, each state would utilize all its mitigation potential with marginal cost less than \$7/tCO₂ before purchasing allowances from the auctioneer. As a result, the total emission reductions achieved by the 10 states in this case are 41.50 MMtCO₂.
- Since considerable amounts of unused mitigation potentials of some states, such as MD and MA in the free granting case, are associated with cost savings, the total cost savings of mitigation in the auction case (\$2.53 billion) are higher than the total mitigation cost savings in the free granting case (\$1.94 billion).
- In addition, in the auction case, many states would reduce more emissions than required by the state mitigation target (because it is cheaper to mitigate than to buy from the auctioneer). The additional reductions achieved by these states can be saved for future use.

First Scenario:

Marginal Cost (MC) = Auction Price = \$7/tCO₂

Simulation Results of an Auction Case among RGGI States
(with assumed auction price at \$7/tCO₂)

State	Total BAU Emissions in 2020 (million tCO ₂)	2020 Emissions Cap/Budget (million tCO ₂)	Emission Reduction Undertaken by the State ^a		Mitigation Cost (million dollars)	Emission Allowances Bought from Auctioneer (million tCO ₂)	Auction Cost (million dollars) ^b	Net Cost (million dollars) ^c
			(percent from BAU)	(million tCO ₂)				
CT	13.26	9.09	5.78	0.77	-49.64	12.50	87.47	37.83
DE	11.07	6.43	44.05	4.88	-170.83	6.20	43.37	-127.45
MD	38.83	31.88	42.90	16.66	-604.01	22.17	155.20	-448.81
ME	1.90	1.90	39.92	0.76	-41.36	1.14	8.00	-33.36
NH	4.93	4.93	6.78	0.33	-25.67	4.59	32.16	6.48
NJ	23.40	19.46	8.49	1.99	-313.93	21.42	149.92	-164.01
NY	56.11	54.66	5.44	3.05	-573.12	53.06	371.43	-201.69
VT	0.03	0.03	100.00	0.03	-2.34	0.00	0.00	-2.34
MA	24.97	22.66	47.72	11.92	-692.28	13.06	91.40	-600.88
RI	1.78	1.78	62.95	1.12	-61.32	0.66	4.61	-56.71
Total	176.30	152.82	23.54	41.50	-2,534.51	134.79	943.56	-1,590.95

^a In equilibrium, each state will choose to mitigate to the level that its marginal abatement cost equals the auction price.

^b We assume the auction price is \$7/tCO₂ in this case.

^c Sum of Mitigation Cost and Auction Cost.

Second Scenario:

Marginal Cost (MC) = Auction Price = \$1/tCO₂

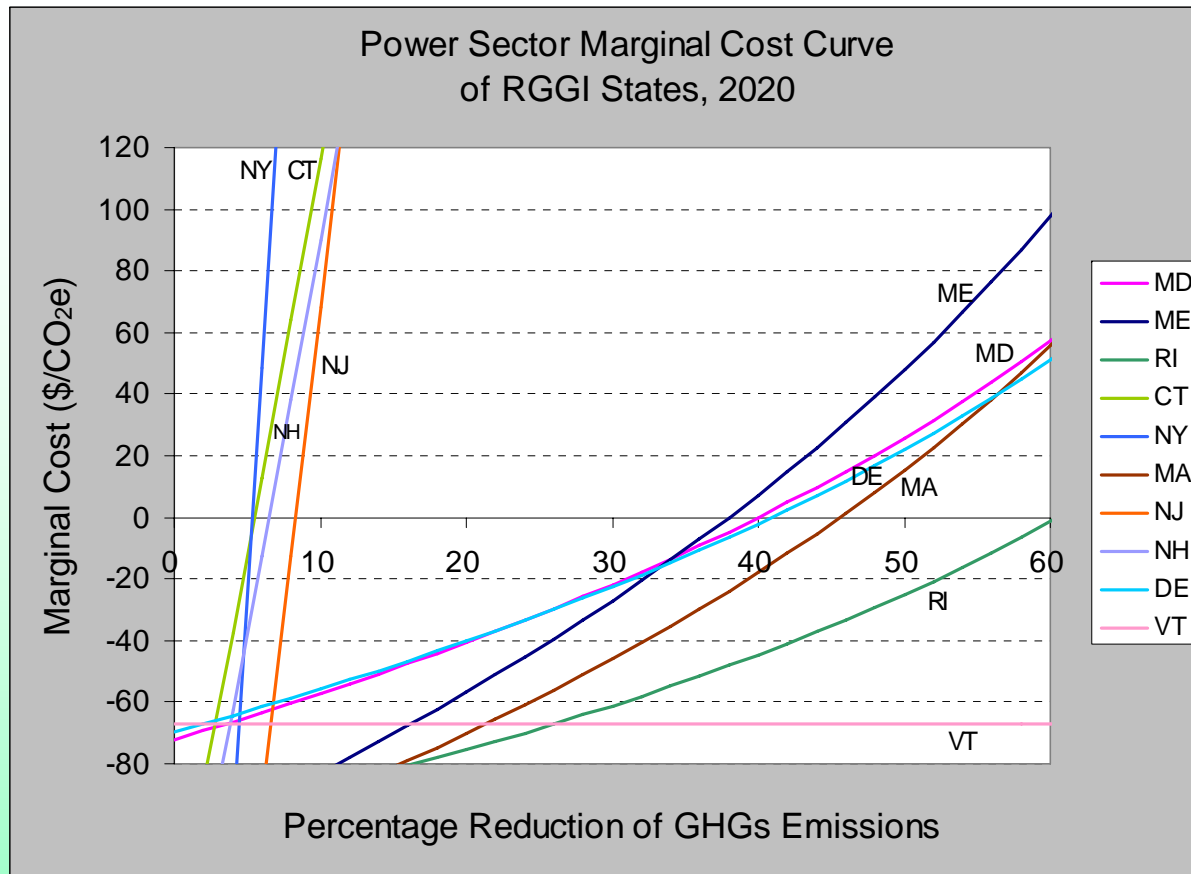
Simulation Results of an Auction Case among RGGI States
(with assumed auction price at \$1/tCO₂)

State	Total BAU Emissions in 2020 (million tCO ₂)	2020 Emissions Cap/Budget (million tCO ₂)	Emission Reduction Undertaken by the State ^a		Mitigation Cost (million dollars)	Emission Allowances Bought from Auctioneer (million tCO ₂)	Auction Cost (million dollars) ^b	Net Cost (million dollars) ^c
			(percent from BAU)	(million tCO ₂)				
CT	13.26	9.09	5.54	0.73	-49.77	12.53	12.53	-37.24
DE	11.07	6.43	41.45	4.59	-171.97	6.48	6.48	-165.49
MD	38.83	31.88	40.42	15.70	-607.83	23.13	23.13	-584.70
ME	1.90	1.90	38.28	0.73	-41.49	1.17	1.17	-40.31
NH	4.93	4.93	6.54	0.32	-25.72	4.61	4.61	-21.11
NJ	23.40	19.46	8.34	1.95	-314.07	21.45	21.45	-292.62
NY	56.11	54.66	5.35	3.00	-573.31	53.11	53.11	-520.20
VT	0.03	0.03	100.00	0.03	-2.34	0.00	0.00	-2.34
MA	24.97	22.66	45.96	11.48	-694.03	13.50	13.50	-680.54
RI	1.78	1.78	60.81	1.08	-61.47	0.70	0.70	-60.78
Total	176.30	152.82	22.47	39.62	-2,542.01	136.68	136.68	-2,405.33

^a In equilibrium, each state will choose to mitigate to the level that its marginal abatement cost equals the auction price.

^b We assume the auction price is \$1/tCO₂ in this case.

^c Sum of Mitigation Cost and Auction Cost.



Notes:

1. Marginal cost curves of CT, MD, ME, NY, VT, and RI are developed based on mitigation options data of these state (from state final or drafted climate action plans).
2. The marginal cost curves of the states are developed based on the reduction potential and mitigation cost/saving data of individual options that contribute to the emission reductions from power sector. These options not only include those designed directly for the electricity supply sector (such as promotion of renewable energy utilization, repowering existing plants, generation performance standards, etc.), but also include options in RCI sectors that contribute to the reduction of electricity consumption (e.g., demand-side management, energy efficiency appliances, building codes, etc.). The emission reduction potentials of these options 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 cost curves above.
3. There are no direct data for MA, NJ, NH, and DE. Marginal cost curves for these four states are developed based on cost curves of RI, NY, CT, and MD, respectively.

Carbon Tax in Maryland Non-C&T Sectors

April 9, 2008

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Emission Reduction Target by Sector to Achieve the Maryland State Goal

	2006 (MMtCO ₂)	2020 (MMtCO ₂)	Emission Cap in 2020 (25% below 2006) (MMtCO ₂)	Emission Reduction Target	
				(MMtCO ₂)	Percentage
Emissions from Electricity -- Production Based	28.2	38.8	21.2	17.7	45.5%
Emissions from Electricity -- Consumption Based	43.3	52.8	32.5	20.3	38.4%
Emissions from Non- electricity Sector	63.4	76.9	47.6	29.4	38.2%
Total Gross Emissions (Consumption Based)	106.8	129.7	80.1	49.6	38.3%

According to analyses above, the Power Sector in Maryland can reach the state mitigation goal by implementing in-state policies and measures affecting the power sector and by purchasing allowances from the RGGI C&T system. The power sector would implement in-state mitigation options as long as the marginal abatement cost is less than or equal to the price of the allowance, and purchase the remaining allowances from power sectors in other states (in the free granting case) or the auctioneer (in the auction case).

- The list of mitigation options of the non-C&T sectors in Maryland is examined in order to evaluate:
 - whether the contributions of mitigation options from all the non-C&T sectors would meet the state goal and,
 - if not, what would be the carbon tax level to non-C&T sectors to achieve the goal;
 - if the mitigation options meet the state goal, how many incremental tons of CO₂ will be abated for each increasing \$ of carbon tax.

Mitigation Options List of Non-C&T Sectors in 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	Cumulative GHG Reduction Potential
TLU-3	Transit	2.8	-\$917.00	3.64%	3.64%
TLU-9	Commuter Choice and other Pricing Measures	2.2	-\$322.00	2.86%	6.50%
AFW-2	Managing Urban Trees and Forests for Greenhouse Gas Benefits (With Mitigation of Forest Loss Due to Insects, Disease, Pests, and Invasive Species)	1.9	-\$251.00	2.47%	8.97%
AFW-5	“Buy Local” Programs for Sustainable Agriculture, Wood, and Wood Products--a. Farmer’s Market	0.03	-\$167.00	0.04%	9.01%
RCI -4	Improved design, construction, appliances, and lighting in new and existing state and local government buildings, “Government Lead-by-example”	0.44	-\$60.00	0.58%	9.59%
RCI -7	More Stringent Appliance/Equipment Efficiency Standards (<i>state-level, or advocate for regional or federal-level standards</i>)	0.06	-\$54.00	0.08%	9.67%
RCI -10	Energy Efficiency Resource Standard (EERS)	3.83	-\$52.00	4.98%	14.65%
RCI -1	Improved Building and Trade Codes and Beyond-Code Building Design and Construction	0.73	-\$39.00	0.95%	15.61%
AFW-8	Nutrient Trading With Carbon Benefits	0.14	-\$30.00	0.18%	15.79%
AFW-9	Waste Management Through Source Reduction and Advanced Recycling	29.2	-\$6.00	37.96%	53.75%

Mitigation Options List of Non-C&T Sectors in Maryland (cont.)

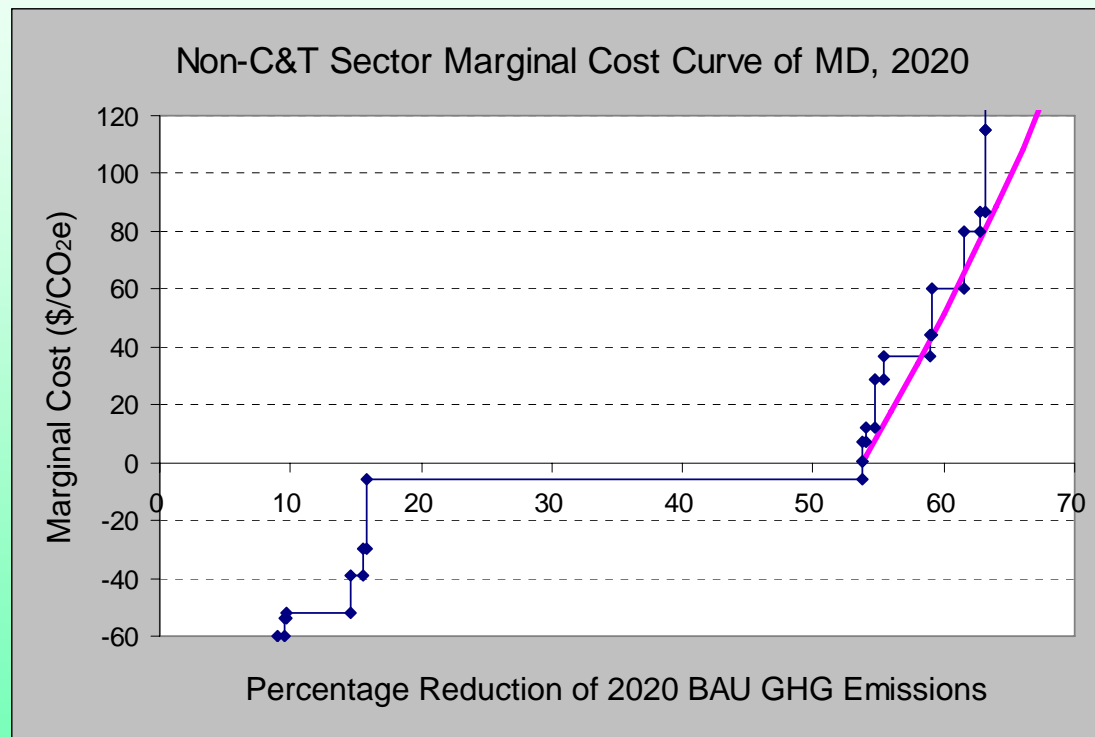
Sector	Climate Mitigation Actions	Estimated 2020 Annual GHG Reduction Potential (MMtCO ₂ e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2020 Baseline Emissions	Cumulative GHG Reduction Potential
AFW-6	Expanded Use of Forest and Farm Feedstocks and By-Products for Energy Production--Methane Utilization From Livestock Manure and Poultry Litter	0.04	\$0.20	0.05%	53.80%
AFW-7	In-State Liquid Biofuels Production-Biodiesel	0.18	\$7.00	0.23%	54.04%
AFW-6	Expanded Use of Forest and Farm Feedstocks and By-Products for Energy Production--Biomass (Inc. Ag. Residue, Forest Feedstocks, and Energy Crops)	0.5	\$12.00	0.65%	54.69%
AFW-3	Afforestation, Reforestation, and Restoration of Forests and Wetlands-- a. Afforestation	0.6	\$29.00	0.78%	55.47%
AFW-4	Forested Land--b. Forested land	2.7	\$37.00	3.51%	58.98%
AFW-3	Afforestation, Reforestation, and Restoration of Forests and Wetlands-- b. Riparian areas	0.1	\$44.00	0.13%	59.11%
TLU-4	Low Greenhouse Gas Fuel Standard	1.9	\$60.00	2.47%	61.58%
AFW-7	In-State Liquid Biofuels Production-Ethanol	0.91	\$80.00	1.18%	62.76%
AFW-4	Forested Land--a. Agricultural Land	0.28	\$87.00	0.36%	63.12%
RCI -8	Rate structures and Technologies to Promote Reduced GHG Emissions (including inverted block rates)	0.06	\$115.00	0.08%	63.20%
AFW-1	Forest Management for Enhanced Carbon Sequestration (With Mitigation of Forest Loss Due to Insects, Disease, Pests, and Invasive Species)	0.09	\$135.00	0.12%	63.32%
TLU-10	Transportation Technologies	3.2	\$650.00	4.16%	67.48%

Notes:

1. Some RCI sector options that entirely or partially contribute to electricity consumption reduction are included in the options list to develop the MD power sector mitigation cost curve. To avoid double-counting, the part of emission mitigation potentials related to electricity consumption reduction of those options are not included in the table above.
2. Numbers presented in the column of "Estimated Cost or Cost Savings per ton GHG Removed" of TLU-4, TLU-9, and TLU-10 are the average of the high and low estimates by the TLU TWG

- From the above table, the cumulative mitigation potential of options with cost savings is around 53.7% of the non-C&T sectors' 2020 BAU emissions level. The reduction goal of 25% below the 2006 level translates to 38.2% below 2020 BAU level for the non-C&T sectors. Therefore, the state goal can be over-achieved by implementing only the cost-saving mitigation options.
- Thus, to achieve the current 2020 goal, the carbon tax is not needed.
- However, we can examine the potential of a carbon tax for additional mitigation in the way shown in the next two slides.

- A smooth curve through the points of options with unit mitigation cost higher than zero is developed.



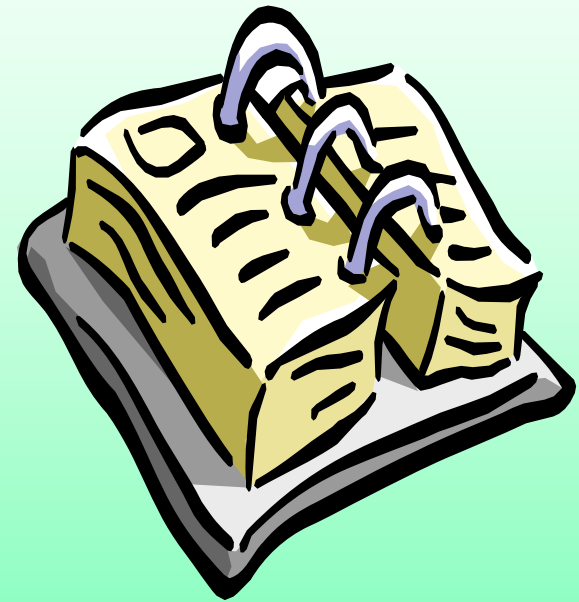
- Based on the curve, the table below presents the total reduction potentials of the non-C&T sectors with assumed carbon tax levels at \$1 to \$7. Approximately, for every \$1 increase in the carbon tax, an additional 100 thousand tons of CO₂ will be abated in the non-C&T sectors.

Carbon Tax Level and Corresponding Total Reduction Potential in Non-C&T Sectors

Carbon Tax (\$/tCO ₂)	Total Reduction Potential		Incremental Reduction per Dollar Increase in the Carbon Tax (thousand tCO ₂)
	% 2020 BAU level	in MMtCO ₂	
0	53.71%	41.31	
1	53.84%	41.41	101.07
2	53.97%	41.51	100.79
3	54.10%	41.62	100.50
4	54.23%	41.72	100.21
5	54.36%	41.82	99.93
6	54.49%	41.92	99.65
7	54.62%	42.01	99.36

Next ES TWG Meeting

- Date and Time:
 - April 29, 2008; 3:30pm – 5:00 pm EDT
- Agenda:
 - Review results of MWG meeting
 - Review/finalize text of PODs



Public Input, Announcements