



**MINNESOTA**  
Climate Change  
Advisory Group



# Minnesota Climate Change Advisory Group

Cap and Trade Technical Work Group Meeting #1

October 19, 2007

Minnesota Department of Commerce  
Minnesota Pollution Control Agency  
The Center for Climate Strategies

# Today's Agenda

- Call to order
- Roll Call of cap-and-trade TWG members and public
- Overview of RGGI and EU ETS lessons learned
- Discussion of the modeling platform proposed for the analysis of the economy-wide cap-and-trade option
- Discussion of specific data inputs required for model calibration
- Discussion of potential scenarios for analysis
- Proposed agenda for NEXT meeting
- Public input and announcements

# Education Session (1)

- What is Cap & Trade
- How does Cap & Trade work
- Results and experience to date
- Why GHGs are well suited to Cap & Trade
- Early GHG Cap & Trade approaches
  - EU ETS, CCX, RGGI

# Education Session (2)

- Key issues in designing and implementing a Cap & Trade program
  - GHG reporting & reconciliation capacity
  - Geographic coverage; source/sector coverage; cap level(s); timing
  - Early reductions; Banking/borrowing; Offsets; Safety valves; Price caps
  - Allowance allocation approaches

# Education Session (3)

- Modeling GHG Cap & Trade
  - Joint modeling and consensus building
  - Testing data sources, methods, assumptions
- Outputs provided by modeling
  - GHG reductions
  - Cost per ton
  - Aggregate cost
  - Sensitivity analysis
- Inputs needed for modeling:
  - Coverage (by states, sectors)
  - Reference case GHG emissions (by states, sectors)
  - Targets & timetables (by states, sectors)
  - Cost curves (by states, sectors)
  - Other design specifics

# Rose-Zhang Permit Trading Model

- Purpose: Simulate basic features of cap & trade systems (and related policy refinements) to determine emission & cost implications
  - Extensive prior applications (Global, EU, US regions, RGGI)
  - Flexible & transparent framework
  - Readily accommodates data refinements & updates
  - Readily accommodates simple & complex designs

# R-Z Model Features

- Based on sound economic principles
- Main inputs (for each entity)
  - emission levels
  - marginal mitigation costs
  - initial permit allocations
- Main outputs (for each entity)
  - pre-trading mitigation costs
  - post-trading mitigation costs
  - permit purchases/sales (volume & value)
  - permit price

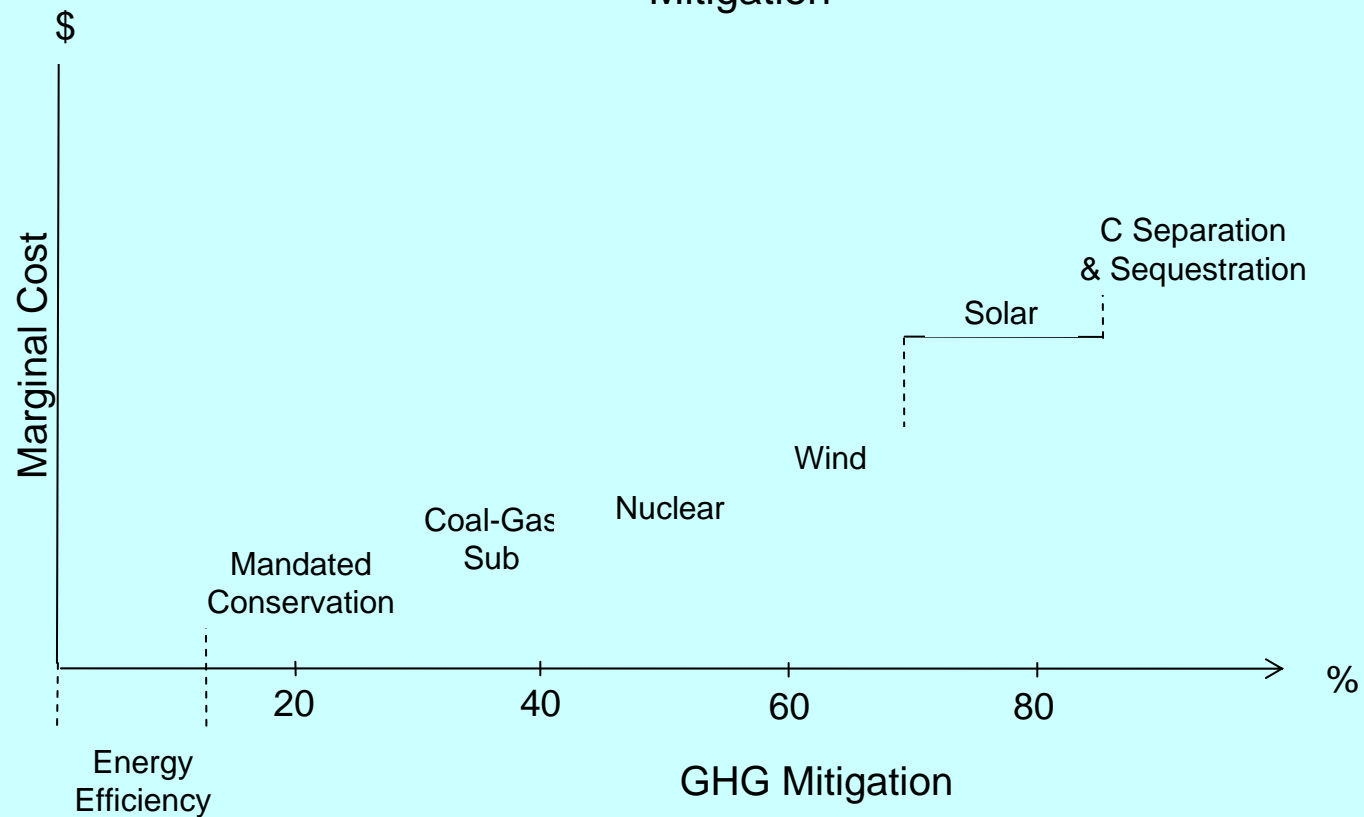
# Evaluation Of Permit Trading Flexibility

(All entries represent departure from CO2 mitigation only unless otherwise indicated)

Study/Application	How	What	Where
Rose-Oladosu (2002) U.S.	Sequestration Permit price 64% lower	Methane Permit price 23% lower	
Stevens-Rose (2002) Global			Global trading Cost savings 85%
Springer (2003) Global		Methane and nitrous oxide Permit price 25-49% lower	From Annex I trading to global trading Average permit price 67% Lower
Zhang (2004) Global			From Annex I trading to global trading Permit price 76 - 79% lower
Akimoto et al. (2004) Global	Sequestration CO <sub>2</sub> shadow price 32% lower		
IPCC (2001) Global			Global trading Marginal abatement costs 29 - 78% lower
Rose-Zhang (2004) U.S.			National trading Cost savings 41%

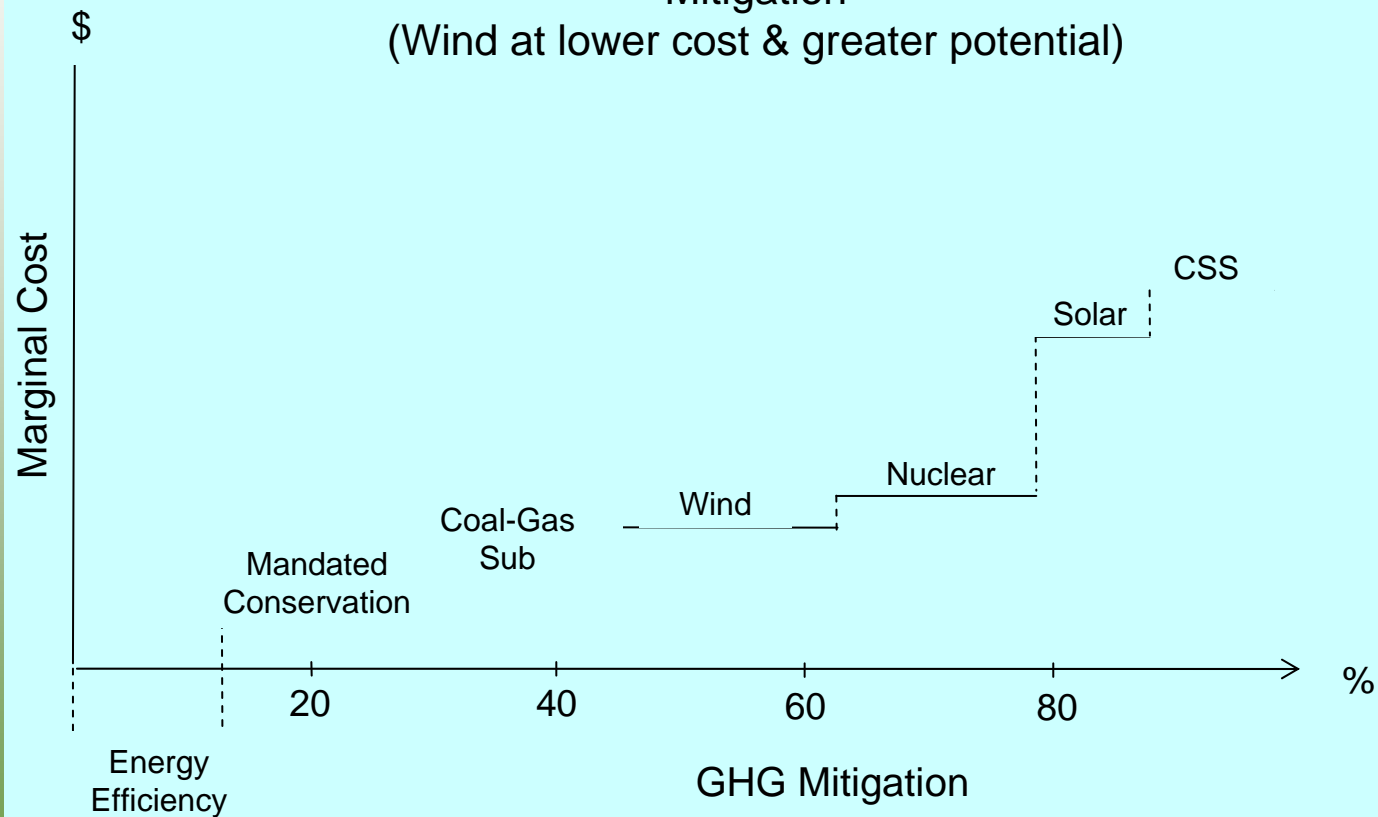
# Sample Cost Curve

Figure 1. Marginal Costs of GHG Mitigation



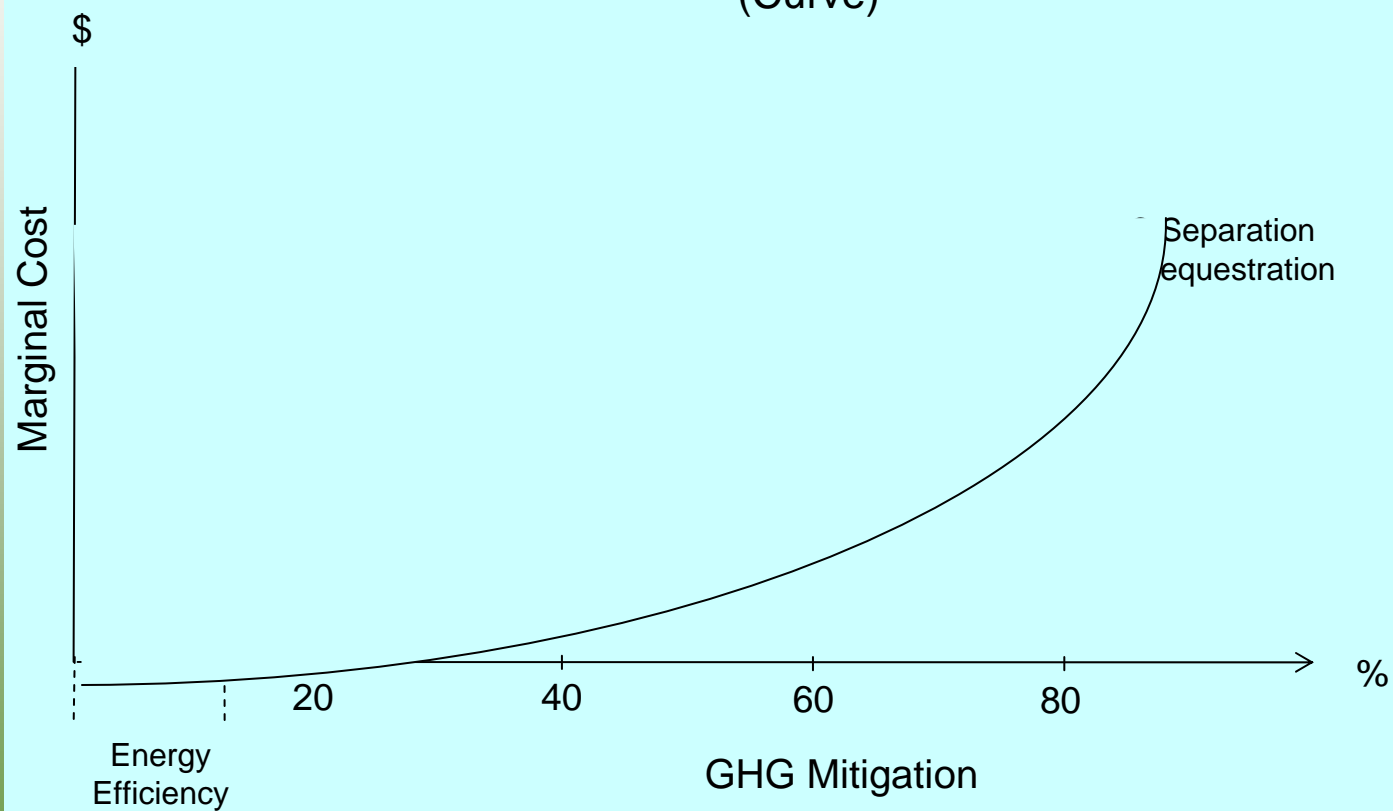
# Sample Cost Curve

Figure 2. Marginal Costs of GHG Mitigation  
(Wind at lower cost & greater potential)



# Sample Cost Curve

Figure 3. Marginal Costs of GHG Mitigation (Curve)



# Sample Outputs

**TABLE 2. COST OF ACHIEVING 190 CARBON EMISSION CAPS IN YEAR 2010: RGGI STATES**  
(million \$2004)

State	Before Trading Mitigation Cost	After Trading		
		Mitigation Cost	Trading Cost	Net Cost
CT	396	550	-169	381
MA	968	1,001	-33	968
ME	385	139	180	319
NH	176	169	7	176
RI	81	121	-44	77
VT	62	62	-4	62
NY	2,211	2,758	-579	2,178
NJ	1,434	1,283	147	1,430
DE	323	143	143	286
MD	1,085	686	348	1,034
Total	7,125	6,916	0	6,916

Permit Price = \$69.13/tC

# Sample Outputs

**TABLE 3. COST OF ACHIEVING 1990 CARBON EMISSIONS CAPS IN YEAR 2010:  
RGGI STATES PLUS PENNSYLVANIA (million \$2004)**

State	Before Trading Mitigation Cost	After Trading		
		Mitigation Cost	Trading Cost	Net Cost
CT	396	785	-466	319
MA	968	1,434	-517	917
ME	385	205	150	356
NH	176	242	-70	172
RI	81	172	-110	62
VT	62	92	-33	59
NY	2,211	3,935	-2,006	1,925
NJ	1,434	1,848	-444	1,404
DE	323	209	103	312
MD	1,085	997	88	1,082
PA	6,945	2,336	3,308	5,644
Total	14,074	12,251	0	12,251

Permit Price = \$84.77/tC

# Sample Outputs

**TABLE 5. SUMMARY OF PERMIT TRADING RESULTS**

Case	Permit Price (\$/tC)	Largest Seller (\$ million)	Largest Buyer (\$ million)	Largest Gainer <sup>a</sup> (\$ million)	PA Gain <sup>a</sup> (%)
RGGI + PA	84.77	NY 2,006	PA 3,308	PA 1,301	PA 19
RGGI + PA (MP)	82.09	NY 1,734	PA 2,673	PA 1,353	PA 19
RGGI+EU+PA	87.43	NY 2,285	PA 3,271	PA 1,199	PA 17
RGGI - MARI + PA	87.45	NY 2,305	PA 3,266	PA 1,193	PA 17
N. Central + PA	156.13	IL 5,155	WV4,331	WV6,013	PA 0 <sup>b</sup>
Western + PA	99.87	CA 5,867	PA 2,986	WY5,248	PA 11
NC + W + PA	105.87	CA 7,144	IN 4,375	WV7,496	PA 9

<sup>a</sup>Refers to difference between Net Cost Before Trading and Net Cost After Trading.

<sup>b</sup>Less than 0.5 percent.

# Sample Outputs

APPENDIX TABLE A. BASIC DATA FOR HIGH STATES

State	Emissions in 1990 (million tC)	Emissions in 2010 (million tC)	Autarkic Marginal Mitigation Cost (\$2004 per tC)	Gross State Product in 2000 (\$2004 million)
CT	10.63	14.60	57.39	175,268
MA	21.98	30.19	67.89	306,390
ME	4.98	6.82	119.71	39,264
NH	3.86	5.29	71.04	51,288
RI	2.28	3.13	55.20	39,059
VT	1.41	1.94	67.96	19,617
NY	55.80	76.65	61.11	864,149
NJ	30.06	41.29	73.52	386,898
DE	4.61	6.34	108.28	40,315
MD	18.81	25.84	88.89	200,292
PA	69.94	96.07	153.06	432,396

# Policy Refinements

- Production-based vs. Consumption-based allocation
- Economic sector (emitter) disaggregation
- Offsets
- Flexibility
  - how (e.g., sequestration)
  - what (e.g., CO<sub>2</sub>, methane, nitrous oxides, SFCs)
  - where (e.g., alternative configurations of states)
  - when (e.g., permit banking & borrowing)

# Potential Permit Trading Anomalies

- Participants as a whole gain from flexibility
- However, individual states may not because new entrants:
  - may raise the permit price
  - may undercut existing states' permit sales
  - may be able to exercise monopoly power
  - may increase inequities

# Modeling Specification Session

- Reminder: Purpose is a CCAG scoping assessment, not drafting rules
- Modeling Input Decisions:
  - Coverage of states and sectors
  - Reference case GHG emissions for states and sectors
  - Targets & timetables for states and sectors
  - Cost curves for states and sectors
  - Production vs. consumption design, other specifics

# Next Steps

- Developing model inputs for CCAG scoping assessment
  - Straw proposals from ES/RCI TWG members
  - Assess feasibility of developing modeling data and assumptions
  - Approval of proposed modeling scenarios by CCAG
  - Generate and review draft results in TWGs
  - Iterate if needed and as possible in TWGs and CCAG

# Call to the Public, Announcements