



**MINNESOTA**  
Climate Change  
Advisory Group



# Minnesota Climate Change Advisory Group

Cap and Trade Technical Work Group Meeting #8

December 14, 2007

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


# Agenda

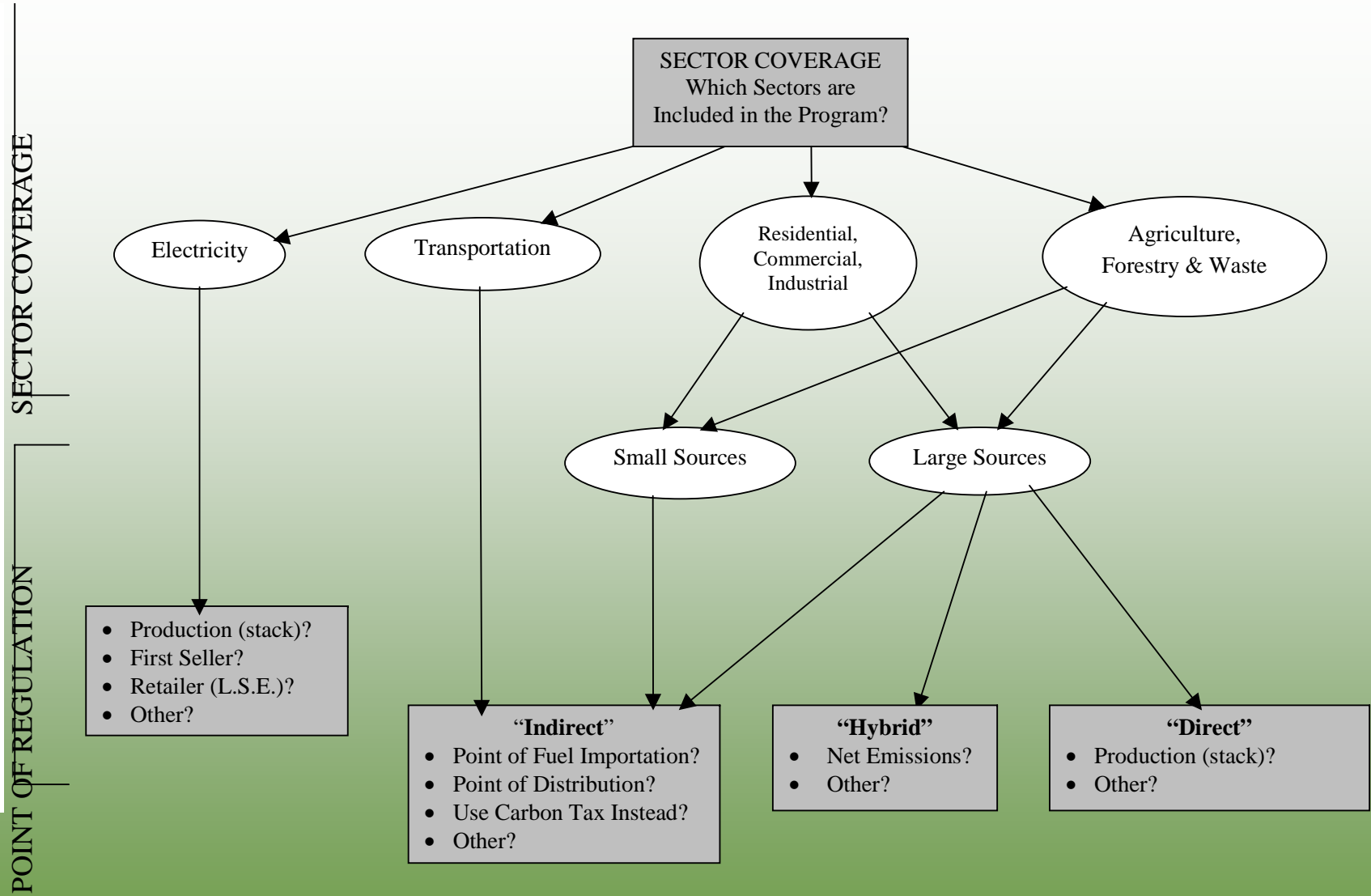
- Call to order and roll call
- Discussion of Meeting Agenda and Outcomes
- Review the “Portfolio of Policy Options”
- Review/Discussion of Updated Modeling Runs
- Policy Discussions/Decisions
- Direct v. Indirect (upstream) Sectors
- Sectors Covered
  - Sectors TWG is Ready to Recommend Included in C&T
  - Sectors TWG is Ready to Recommend Excluded from C&T
  - Sectors TWG is Not Ready to Recommend
  - Identify Reasons
  - Schedule Further TWG Consideration
- Point of Regulation
  - Sector-Dependent?
  - Emissions (production)

# Agenda (cont'd)

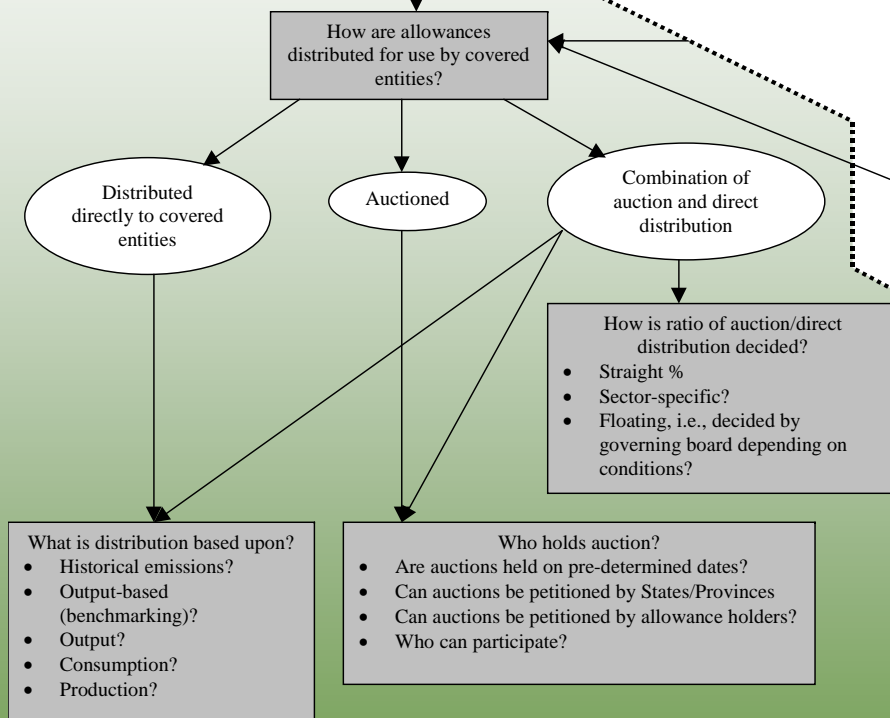
- Load (consumption)
- First Seller (hybrid)
- Role of Offsets
  - Limited Sectors (safety-valve) vs. Broad Sectors
  - Limited Geography vs. Broad Geography
- Allowance Distribution
  - Free Distribution
  - Auction
  - Use of Revenues?
  - Hybrid
- Discussion of C&T-1 Straw Policy Option
- Discussion of C&T-4 Carbon Tax
  - Needed Information, Briefing
- Discussion of Remaining Policy Options
  - C&T-5 Market Advisory Group
  - C&T-6 Regional and Multi-State Efforts
  - C&T-7 Carbon Credit System
- Other
- Proposed Agenda for Next Meeting
- Public Input and Announcements

# A “Portfolio” of Policy Options

	Codes & Standards	Market Mechanisms	Funding Mechanisms	Voluntary Agreements	Technical & Financial Assistance	Information & Education	Pilots & Demo Projects	Reporting & Disclosure
Agriculture & Forestry								
Energy Supply								
Residential, Commercial, & Industrial								
Transportation & Land Use								
Waste Management								
Cross-Cutting Issues (Education, Registries, etc.)								



These issues decided by MGA regional participants.



MN Cap and Trade "30,000 Foot" TWG Decision Tree

# Overview (1)

- This week's updates include:
  - Re-developed the marginal cost curve for Minnesota based on the updated mitigation and cost data of individual policy options from MCCAG Meeting #6.
  - Since three policy options in the Energy Supply sector have more than one sensitivity scenario, we developed marginal cost curves for both high and low cost cases. In the high cost case, we used the highest cost scenario for each of the three options. In the low cost case, we used the lowest cost scenario for each option. Note that the high cost scenario has smaller mitigation potential (especially for the Generation Performance Standard option).
  - We weighted each policy option in re-developing the marginal cost curve. The weights are based on each option's GHG mitigation potential. This gives relatively greater influence to those options that have the potential for higher levels of application and should improve the accuracy of the estimation.

# Overview (2)

- Estimated marginal cost curves for other Midwestern states based on Minnesota's updated curve.
- Re-ran simulations for two geographical configurations for both economy-wide and power sector only cases, and for both high and low cost cases: 1) Midwestern regional C&T partner states (including Manitoba) and 2) All Midwestern regional C&T partners and observers.
- Please note in this week's simulations, we continued to use 2025 as the study base year and applied the emission cap of 30% below 2005 level in 2025 to all Midwestern states and Manitoba

# Interpretation of Results (1)

- For economy-wide C&T simulations, both the equilibrium permit price and the costs of compliance are still higher than the simulations before we use Minnesota-specific data, but the results are lower than last week:
  - The permit price is \$38.19/tCO<sub>2</sub>e (high cost case) and \$33.90/tCO<sub>2</sub>e (low cost case) for the basic 7-state MW partners run.
  - The overall cost is \$322 million (high cost case) and negative \$234 million (low cost case) for the group of 7 states run.
  - The average mitigation cost per unit of CO<sub>2</sub>e for Minnesota is \$0.25/tCO<sub>2</sub>e (high cost case) and -\$0.85/tCO<sub>2</sub>e (low cost case) in the 7-state MW partners run.
  - The relative position of the states has not changed much, and MN is still a permit buyer .
  - Including the observer states will increase the permit price and total compliance cost but will not change the relative positions of the core partners.

# Interpretation of Results (2)

- The explanation for the higher costs than prior to using Minnesota- specific data (i.e., prior to last week) stems from 2 sources:
  - We are now simulating a cap of 30% below 2005 levels in the Year 2025 (an effective 43.1% reduction in the year 2025), rather than 22.5% below 2005 levels in 2020 (an effective 36.12% reduction in year 2020).
  - The shape of the marginal cost curves is exponential, so the 20% higher reduction level leads to a cost increases a few times that percentage in each state.
  - Decomposing these effects for the 7-state MW partners case and comparing it with the \$11.97 tCO<sub>2</sub>e price two weeks ago, the more stringent cap is responsible for about \$9 of the permit price increase, and the new curve for about \$16 of it in the high cost case, and \$13 of it in the low cost case.
- The major reasons for getting lower permit price and lower compliance costs than last week's economy-wide simulations are: (1) according to the updated results from MCCAG Meeting #6, many options are estimated to have lower mitigation costs than before; and (2) several low cost options have been added into the mitigation option list (especially in agriculture and forestry sectors)

# Interpretation of Results (3)

- The permit price for power sector only simulations increase this week. Compared to last week's power sector cost curve, the new curve becomes steeper. The major cause is that according to the latest analysis results from MCCAG Meeting #6, GHG mitigation potentials have reduced for some low cost power sector options. However, the permit prices of power sector only simulations are still lower than the corresponding economy-wide simulations.
  - The permit price is \$26.94/tCO<sub>2</sub>e (high cost case) and \$20.06/tCO<sub>2</sub>e (low cost case) for the basic 7-state MW partners run.
  - The overall cost is \$547 million (high cost case) and \$407 million (low cost case) for the group of 7 states run.
  - The average mitigation cost per unit of CO<sub>2</sub>e for Minnesota is \$-0.60/tCO<sub>2</sub>e (high cost case) and -\$0.45/tCO<sub>2</sub>e (low cost case) in the 7-state MW partners run.
  - The relative position of the states has not changed much, and MN still buys the most permits.
  - Including the observer states will increase the permit price and total compliance cost but will not change the relative positions of the core partners.

# Midwestern Partners -- High Cost Case Draft (All Sectors)

TABLE M1-2025 (High). ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded (million tCO <sub>2</sub> e)	Emission Reduction After Trading		Emission Reduction Cap
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> e)	(percent from BAU)	(percent from BAU)
IA	580	-481	625	144	436	16.37	38.01	30.51	43.65
IL	21	1,256	-1,653	-397	418	-43.29	165.36	51.72	38.18
KS	620	-563	647	84	536	16.94	35.26	29.48	43.65
MI	30	240	-223	17	13	-5.84	109.15	40.34	38.18
MN	433	18	358	376	57	9.38	71.45	38.10	43.10
WI	22	-44	64	20	2	1.67	60.12	37.15	38.18
MB	251	-104	182	78	172	4.78	8.37	30.58	48.04
Total	1,956	322	0	322	1,634	49.14 <sup>b</sup>	487.73	40.27	40.27

<sup>a</sup> Permit Price = \$38.19/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is \$0.25/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 38.10% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Midwestern Partners -- Low Cost Case Draft (All Sectors)

TABLE M1-2025 (Low). ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded	Emission Reduction After Trading		Emission Reduction Cap
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO <sub>2</sub> e)	(million tCO <sub>2</sub> e)	(percent from BAU)	(percent from BAU)
IA	421	-504	543	38	382	16.01	38.37	30.80	43.65
IL	-51	1,019	-1,434	-414	363	-42.29	164.37	51.41	38.18
KS	449	-581	561	-20	469	16.56	35.65	29.81	43.65
MI	-74	110	-197	-86	12	-5.80	109.11	40.32	38.18
MN	305	-61	315	254	51	9.29	71.54	38.15	43.10
WI	-54	-108	52	-56	2	1.55	60.25	37.22	38.18
MB	203	-109	159	50	153	4.70	8.45	30.87	48.04
Total	1,199	-234	0	-234	1,432	48.09 <sup>b</sup>	487.73	40.27	40.27

<sup>a</sup> Permit Price = \$33.90/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is -\$0.85/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 38.10% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Midwestern Partners+Observers – High Cost Case (All Sectors)

TABLE M2-2025 (High). ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG  
NINE MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded	Emission Reduction After Trading		Emission Reduction Cap
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO <sub>2</sub> e)	(million tCO <sub>2</sub> e)	(percent from BAU)	(percent from BAU)
IA	580	-407	637	230	350	14.56	39.81	31.96	43.65
IL	21	1,706	-2,374	-668	689	-54.28	176.36	55.16	38.18
KS	620	-498	672	173	446	15.36	36.84	30.81	43.65
MI	30	519	-554	-35	65	-12.66	115.97	42.86	38.18
MN	433	194	222	416	17	5.07	75.75	40.40	43.10
WI	22	101	-82	19	3	-1.89	63.68	39.34	38.18
MB	251	-88	192	104	147	4.38	8.77	32.04	48.04
IN	77	-1,223	966	-257	334	22.09	97.33	31.12	38.18
OH	57	-9	66	56	1	1.50	145.58	37.79	38.18
SD	271	-131	256	126	145	5.86	15.19	32.62	45.20
Total	2,361	165	0	165	2,197	68.83 <sup>b</sup>	775.27	39.64	39.64

<sup>a</sup> Permit Price = \$43.73/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is \$2.56/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 40.40% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Midwestern Partners+Observers – Low Cost Case (All Sectors)

TABLE M2-2025 (Low). ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG  
NINE MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded (million tCO <sub>2</sub> e)	Emission Reduction After Trading		Emission Reduction Cap
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> e)	(percent from BAU)	(percent from BAU)
IA	421	-441	554	112	309	14.28	40.09	32.19	43.65
IL	-51	1,406	-2,053	-647	595	-52.95	175.02	54.74	38.18
KS	449	-526	583	57	392	15.04	37.16	31.07	43.65
MI	-74	349	-479	-131	56	-12.36	115.67	42.75	38.18
MN	305	90	199	289	16	5.14	75.68	40.36	43.10
WI	-54	16	-73	-56	3	-1.87	63.67	39.34	38.18
MB	203	-95	167	72	131	4.32	8.83	32.26	48.04
IN	-190	-1,300	825	-474	284	21.29	98.13	31.37	38.18
OH	-141	-194	52	-141	1	1.35	145.73	37.83	38.18
SD	208	-145	223	79	129	5.76	15.29	32.83	45.20
Total	1,075	-840	0	-840	1,916	67.19 <sup>b</sup>	775.27	39.64	39.64

<sup>a</sup> Permit Price = \$38.77/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is \$1.19/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 40.36% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Summary Data Table -- All Sectors

Draft

DATA TABLE

State	Cap: 30% Below 2005 Emissions in 2025 (million tCO <sub>2</sub> e)	2025 BAU Gross Emissions (Consumption- based) (million tCO <sub>2</sub> e)	GHG Mitigation Goal in 2025 (relative to BAU emissions)	Autarkic Marginal Mitigation Cost (dollars per tCO <sub>2</sub> e)		Gross State Product in 2025 (million 2000 dollars)
				Low	High	
IA	70.2	124.6	43.65%	83.4	93.4	169,873
IL	197.7	319.7	38.18%	17.4	19.6	1,530,932
KS	67.4	119.6	43.65%	92.7	103.9	146,593
MI	167.3	270.6	38.18%	29.8	33.6	757,008
MN	106.7	187.5	43.10%	45.1	50.5	459,636
WI	100.1	161.9	38.18%	36.1	40.8	373,455
MB	14.2	27.4	48.04%	102.2	113.9	37,581
IN	193.4	312.8	38.18%	65.9	74.5	394,939
OH	238.1	385.2	38.18%	39.6	44.8	808,808
SD	25.5	46.6	45.20%	85.1	95.1	67,246
Total	1,180.5	1,955.8	39.64%			4,746,072

# Mitigation Cost Data for Minnesota – High Cost Case

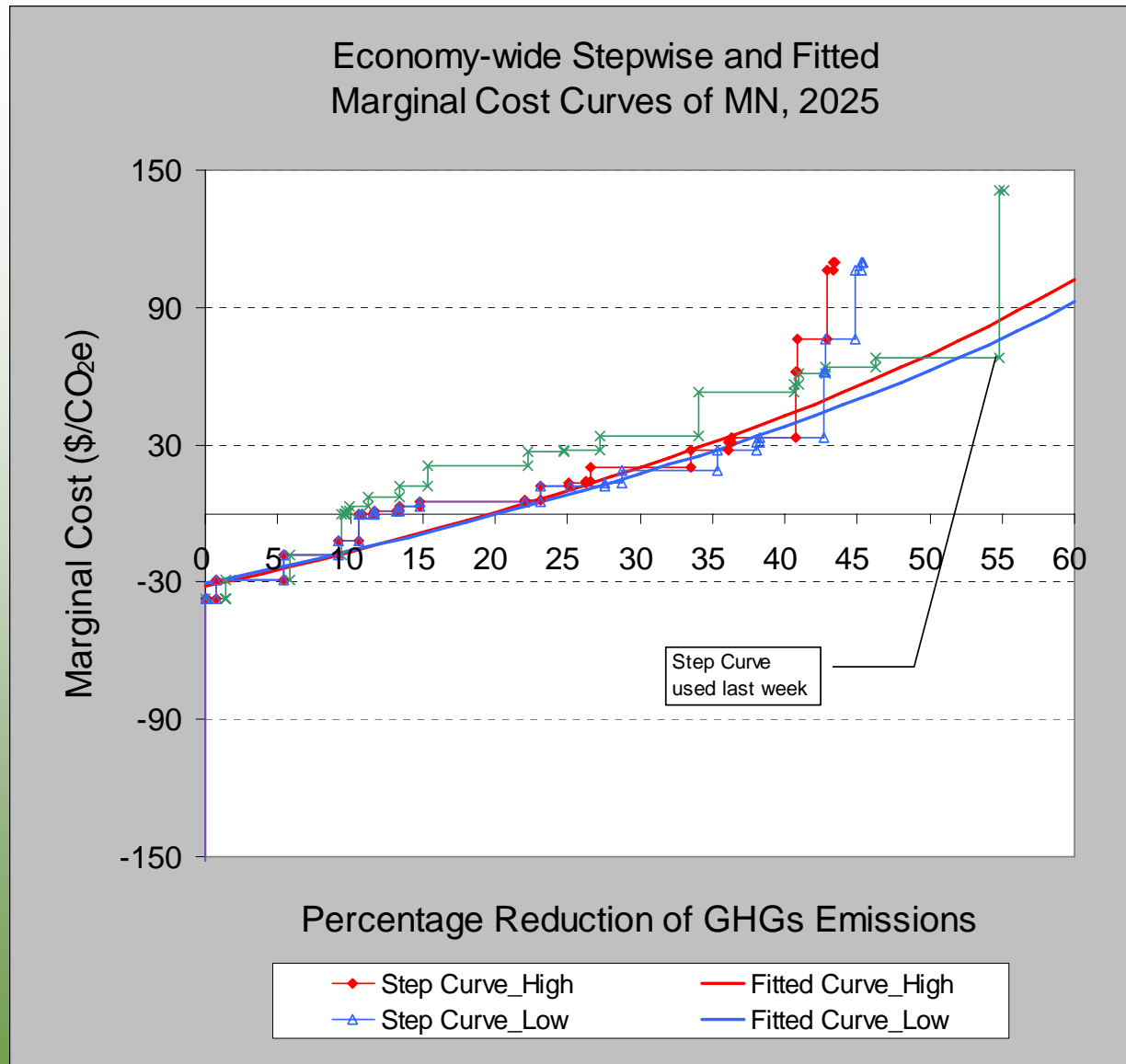
Sector	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO <sub>2</sub> e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2025 Baseline Emissions <sup>1</sup>	Cumulative GHG Reduction Potential
RCI	Improved Uniform Statewide Building Codes	0.0037	-\$189.70	0.00%	0.00%
RCI	Non-utility Strategies and Incentives to Encourage Energy Efficiency and Reduce GHG Emissions	0.13	-\$37.10	0.07%	0.07%
Ag	Agricultural Crop Management_B. Nutrient Management	1.35	-\$37.00	0.72%	0.79%
RCI	Maximize Savings from the Utility Conservation Improvement Program (CIP) (with RPS)	8.7	-\$29.10	4.64%	5.43%
TLU	Adopt California Clean Car Standards	7	-\$18.00	3.73%	9.16%
Forest	Urban Forestry	2.7	-\$12.00	1.44%	10.60%
RCI	Green Building Guidelines and Standards Based on Architecture 2030	0.421	-\$0.26	0.22%	10.83%
Ag	Agricultural Crop Management_A. No Till	1.3	-\$0.25	0.69%	11.52%
TLU	Expand Transit, Bicycle, and Pedestrian Infrastructure	0.2	\$0.00	0.11%	11.63%
Ag	In-state Liquid Biofuels Production_A. Ethanol carbon content	3	\$1.00	1.60%	13.23%
Waste	End of Use Waste Management Practices - Landfilled Waste Methane	0.34	\$1.00	0.18%	13.41%
Forest	Forest Protection - Reduced Clearing and Conversion to Non-Forest Cover	2.7	\$3.00	1.44%	14.85%
Ag	In-state Liquid Biofuels Production_C. Gasoline Displacement	13.6	\$5.00	7.25%	22.10%
ES	Efficiency Improvements, Repowering and other Upgrades to Existing Plants (with RPS)_Reference Scenerio #2	1.87	\$5.65	1.00%	23.10%
Ag	Expanded Use of Biomass Feedstocks for Electricity, Heat, or Steam Production	3.8	\$12.00	2.03%	25.12%
Forest	Forestration	2.19	\$13.00	1.17%	26.29%
ES	Generation Performance Standard_Reference Scenerio #3	0.62	\$13.90	0.33%	26.62%
ES	Renewable and/or Environmental Portfolio Standard_No coal additions	12.83	\$20.10	6.84%	33.46%
RCI	Incentives & Resources to Promote Combined Heat and Power (CHP) (with RPS)	4.9	\$27.50	2.61%	36.08%
Ag	Land Use Management Approaches for Protection and Enrichment of Soil Carbon_A. Preserve Land	0.45	\$31.00	0.24%	36.32%
Forest	Restocking	8.4	\$33.00	4.48%	40.80%
Ag	In-state Liquid Biofuels Production_B. Fossil diesel displacement	0.19	\$62.00	0.10%	40.90%
ES	Carbon Capture and Storage and/or Reuse Policies	3.8	\$76.10	2.03%	42.92%
ES	Advanced Fossil Fuel Technology Incentives, Support or Requirements (with RPS)	0.8	\$106.20	0.43%	43.35%
Ag	Land Use Management Approaches for Protection and Enrichment of Soil Carbon_B. Reinvest in Minnesota - Clean Energy (RIM-CE)	0.19	\$110.00	0.10%	43.45%

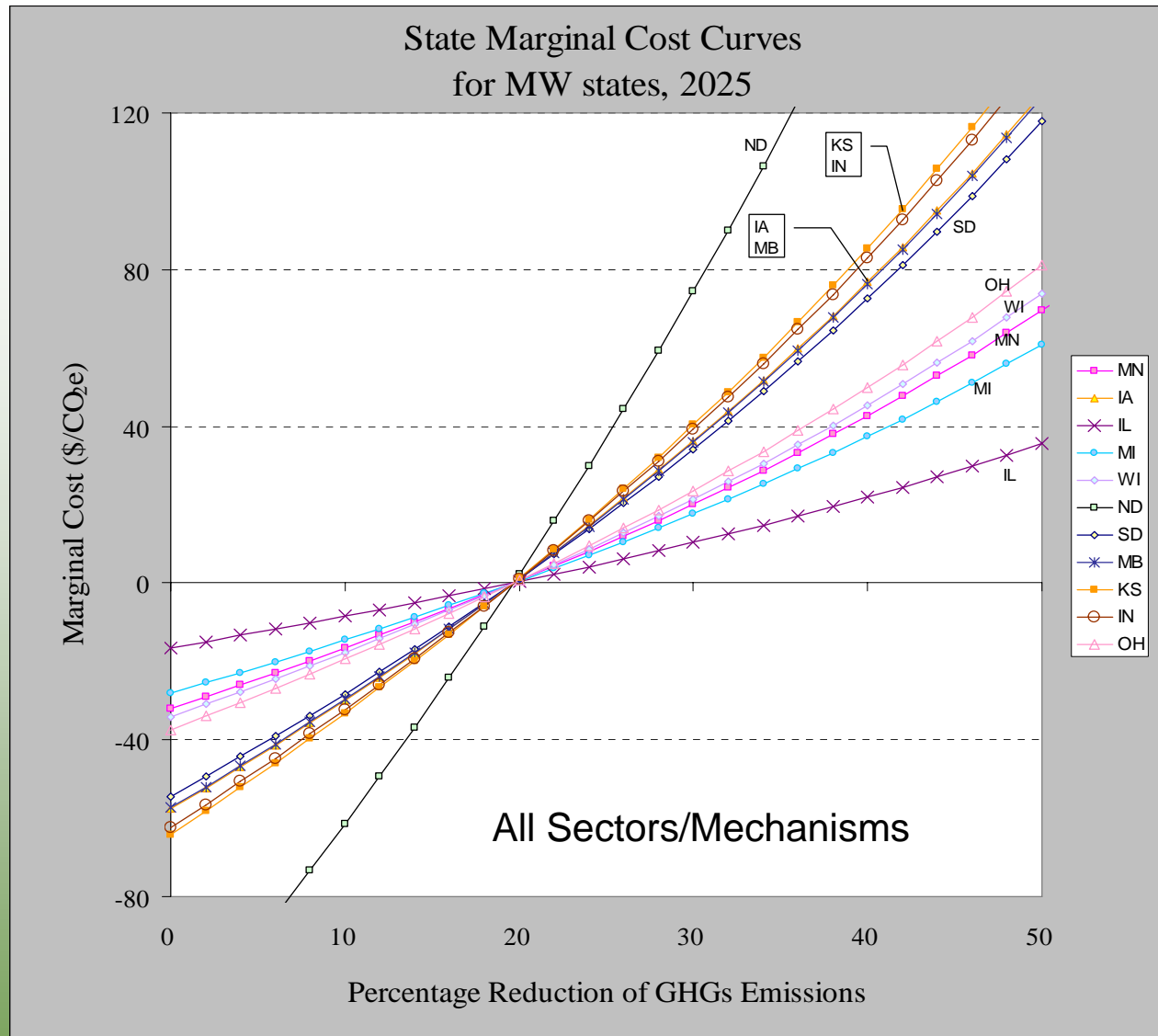
<sup>1</sup> 2025 projected consumption-based gross CO<sub>2</sub> emission level is 187.53 Million Metric Tons CO<sub>2</sub>e.

## Low Cost Case

Low cost estimates for the three green highlighted options above. Other options are the same.

ES	Efficiency Improvements, Repowering and other Upgrades to Existing Plants (with RPS)_Reference Scenerio #3	1.93	\$5.41	3.00%
ES	Generation Performance Standard_Reference Scenerio #1	4.56	\$12.00	7.08%
ES	Renewable and/or Environmental Portfolio Standard_With coal additions	12.47	\$19.10	19.37%





Note: Marginal cost curves of Midwestern states are developed based on MN 2025 curve. These curves are for the high cost scenario. The relative positions of state curves for the low cost scenario are the same, except all the curves shift downward slightly. These marginal cost curves are presented for a range of mitigation levels, including those higher than required to meet the cap in year 2025. We anticipate that there will be technology innovations in the future, i.e., the marginal cost curves will shift downward over time before higher levels of mitigation are necessary.

# Midwestern Partners -- High Cost Case Draft (Power Sector)

TABLE M1P-2025 (High). POWER SECTOR EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded (million tCO <sub>2</sub> e)	Emission Reduction After Trading		Emission Reduction Cap
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> e)	(percent from BAU)	(percent from BAU)
IA	148	-40	124	85	64	4.62	12.14	29.75	41.06
IL	94	409	-438	-28	122	-16.24	53.01	64.34	44.63
KS	157	-33	124	92	65	4.61	11.62	30.11	42.05
MI	71	221	-182	39	32	-6.77	35.56	48.91	39.60
MN	287	-13	205	193	94	7.62	20.74	32.21	44.04
WI	221	0	161	161	59	5.98	19.72	32.92	42.90
MB	13	0	5	5	8	0.19	0.17	34.90	72.22
Total	991	547	0	547	445	23.01 <sup>b</sup>	152.97	42.57	42.57

<sup>a</sup> Permit Price = \$26.94/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is -\$0.60/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 32.21% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Midwestern Partners -- Low Cost Case Draft (Power Sector)

TABLE M1P-2025 (Low). POWER SECTOR EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded (million tCO <sub>2</sub> e)	Emission Reduction After Trading		Emission Reduction Cap (percent from BAU)
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> e)	(percent from BAU)	
IA	111	-29	93	63	47	4.62	12.14	29.75	41.06
IL	70	305	-326	-21	91	-16.24	53.01	64.34	44.63
KS	117	-24	92	68	49	4.61	11.62	30.11	42.05
MI	53	165	-136	29	24	-6.77	35.56	48.91	39.60
MN	214	-9	153	144	70	7.62	20.74	32.21	44.04
WI	164	0	120	120	44	5.98	19.72	32.92	42.90
MB	10	0	4	4	6	0.19	0.17	34.90	72.22
Total	738	407	0	407	331	23.01 <sup>b</sup>	152.97	42.57	42.57

<sup>a</sup> Permit Price = \$20.06/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is -\$0.45/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 32.21% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Midwestern Partners+Observers – High Cost Case (Power Sector)

TABLE M2P-2025 (High). POWER SECTOR EMISSION TRADING SIMULATION AMONG  
NINE MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded	Emission Reduction After Trading		Emission Reduction Cap
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO <sub>2</sub> e)	(million tCO <sub>2</sub> e)	(percent from BAU)	(percent from BAU)
IA	148	-24	122	99	50	4.06	12.70	31.12	41.06
IL	94	489	-574	-84	179	-19.04	55.81	67.73	44.63
KS	157	-17	122	105	52	4.06	12.17	31.52	42.05
MI	71	281	-267	14	57	-8.85	37.64	51.77	39.60
MN	287	17	198	215	72	6.59	21.78	33.81	44.04
WI	221	29	150	179	42	4.98	20.72	34.59	42.90
MB	13	1	5	6	7	0.18	0.18	36.75	72.22
IN	194	-34	186	152	41	6.17	33.74	31.89	37.72
OH	196	143	51	194	2	1.69	53.12	36.56	37.72
SD	20	15	5	20	0	0.16	3.37	40.13	42.05
Total	1,401	900	0	900	501	27.88 <sup>b</sup>	251.22	40.60	40.60

<sup>a</sup> Permit Price = \$30.13/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is \$0.78/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 33.81% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Midwestern Partners+Observers – Low Cost Case (Power Sector)

TABLE M2P-2025 (Low). POWER SECTOR EMISSION TRADING SIMULATION AMONG  
NINE MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading <sup>a</sup>			Cost Saving	Permits Traded (million tCO <sub>2</sub> e)	Emission Reduction After Trading		Emission Reduction Cap (percent from BAU)
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> e)	(percent from BAU)	
IA	111	-18	91	73	37	4.06	12.70	31.12	41.06
IL	70	364	-427	-63	133	-19.04	55.81	67.73	44.63
KS	117	-13	91	79	38	4.06	12.17	31.52	42.05
MI	53	209	-199	10	43	-8.85	37.64	51.77	39.60
MN	214	13	148	160	53	6.59	21.78	33.81	44.04
WI	164	21	112	133	31	4.98	20.72	34.59	42.90
MB	10	0	4	4	5	0.18	0.18	36.75	72.22
IN	144	-25	138	113	31	6.17	33.74	31.89	37.72
OH	146	106	38	144	1	1.69	53.12	36.56	37.72
SD	15	11	4	15	0	0.16	3.37	40.13	42.05
Total	1,043	670	0	670	373	27.88 <sup>b</sup>	251.22	40.60	40.60

<sup>a</sup> Permit Price = \$22.44/tonCO<sub>2</sub>e. This is the price of the last permit sold, which is also equal to the price of the last ton of CO<sub>2</sub>e mitigated (its *marginal* mitigation cost). It is the same for each state for a given case. The *average* mitigation cost per unit of CO<sub>2</sub> equivalent in this simulation differs for each state. For MN, for example, it is \$0.58/tonCO<sub>2</sub>e. Please note that the average mitigation cost is related to mitigation level of a state, which for this case is 33.81% below the baseline level in 2025 for MN. Multiplying the average mitigation cost by the number of tons of CO<sub>2</sub> mitigated will equal the *total* mitigation cost for each state.

<sup>b</sup> Represents number of permits bought or sold.

# Summary Data Table – Power Sector<sup>Draft</sup>

DATA TABLE  
(for Power Sector)

State	Cap: 30% Below 2005 Emissions in 2025 (million tCO <sub>2</sub> e)	2025 BAU Gross Emissions (Consumption- based) (million tCO <sub>2</sub> e)	GHG Mitigation Goal in 2025 (relative to BAU emissions)	Autarkic Marginal Mitigation Cost (dollars per tCO <sub>2</sub> e)		Gross State Product in 2025 (million 2000 dollars)
				Low	High	
IA	24.0	40.8	41.06%	41.2	55.3	3,359
IL	45.6	82.4	44.63%	9.6	12.9	34,334
KS	22.4	38.6	42.05%	41.9	56.3	3,273
MI	43.9	72.7	39.60%	13.1	17.6	17,393
MN	36.0	64.4	44.04%	39.1	52.5	6,426
WI	34.2	59.9	42.90%	35.2	47.3	6,293
MB	0.1	0.5	72.22%	90.4	121.4	583
IN	65.9	105.8	37.72%	32.6	43.8	9,228
OH	90.5	145.3	37.72%	24.0	32.2	17,221
SD	4.9	8.4	42.05%	24.7	33.1	1,211
Total	367.6	618.8	40.60%			99,321

# Mitigation Cost Data for Minnesota – High Cost Case

Sector	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO <sub>2</sub> e)	Estimated Cost or Cost Savings per ton GHG Removed	GHG Reduction Potential as Percentage of 2025 Baseline Emissions <sup>1</sup>	Cumulative GHG Reduction Potential
RCI <sup>2</sup>	Maximize Savings from the Utility Conservation Improvement Program (CIP) (with RPS)	8.7	-\$29.10	13.52%	13.52%
ES	Efficiency Improvements, Repowering and other Upgrades to Existing Plants (with RPS)_Reference Scenerio #2	1.87	\$5.65	2.91%	16.42%
ES	Generation Performance Standard_Reference Scenerio #3	0.62	\$13.90	0.96%	17.38%
ES	Renewable and/or Environmental Portfolio Standard_No coal additions	12.83	\$20.10	19.93%	37.32%
ES	Carbon Capture and Storage and/or Reuse Policies	3.8	\$76.10	5.90%	43.22%
ES	Advanced Fossil Fuel Technology Incentives, Support or Requirements (with RPS)	0.8	\$106.20	1.24%	44.46%

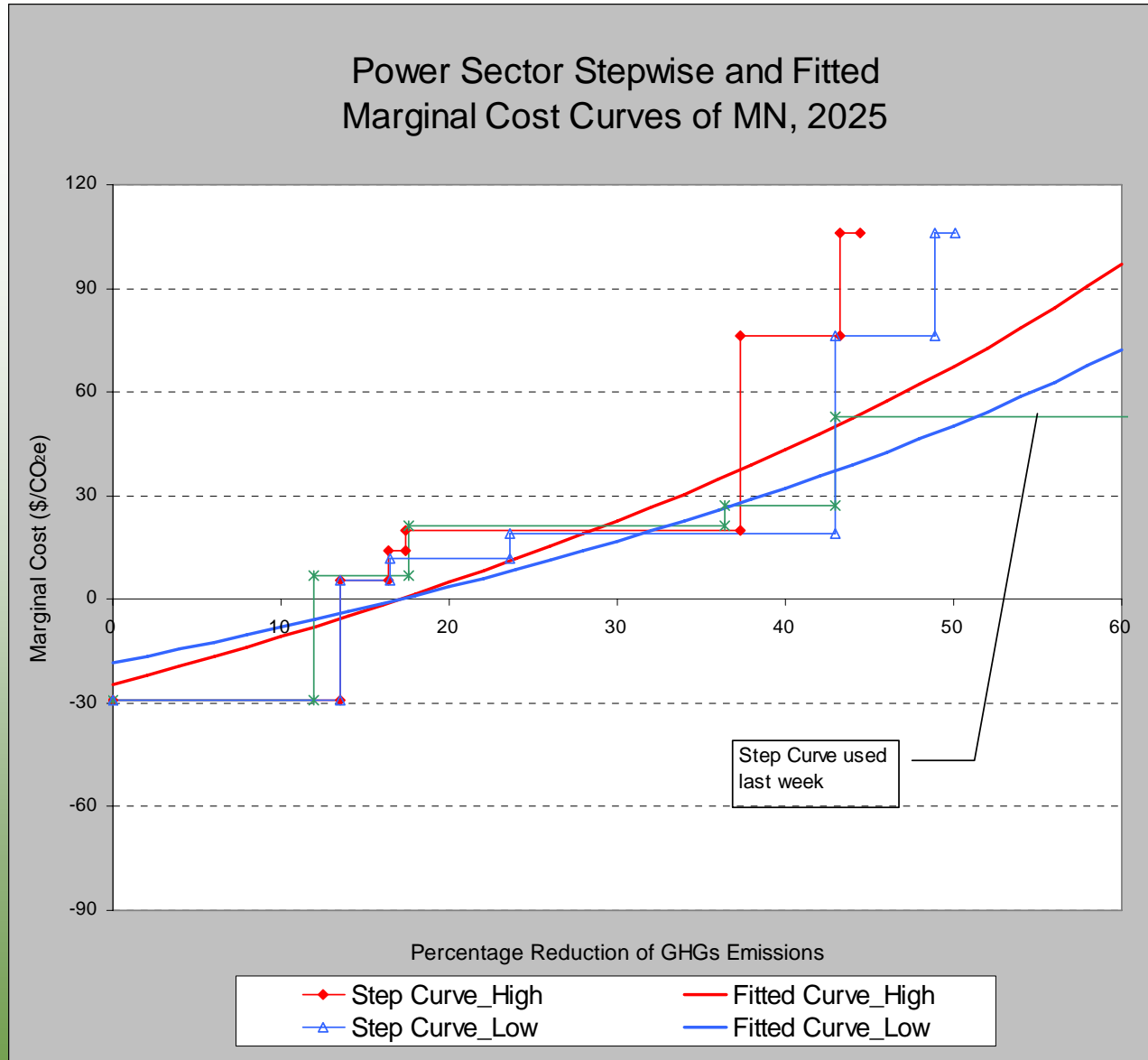
<sup>1</sup> 2025 projected consumption-based gross CO<sub>2</sub> emission level is 64.37 Million Metric Tons CO<sub>2</sub>e ( assuming a same average annual emssion growth rate from 2020

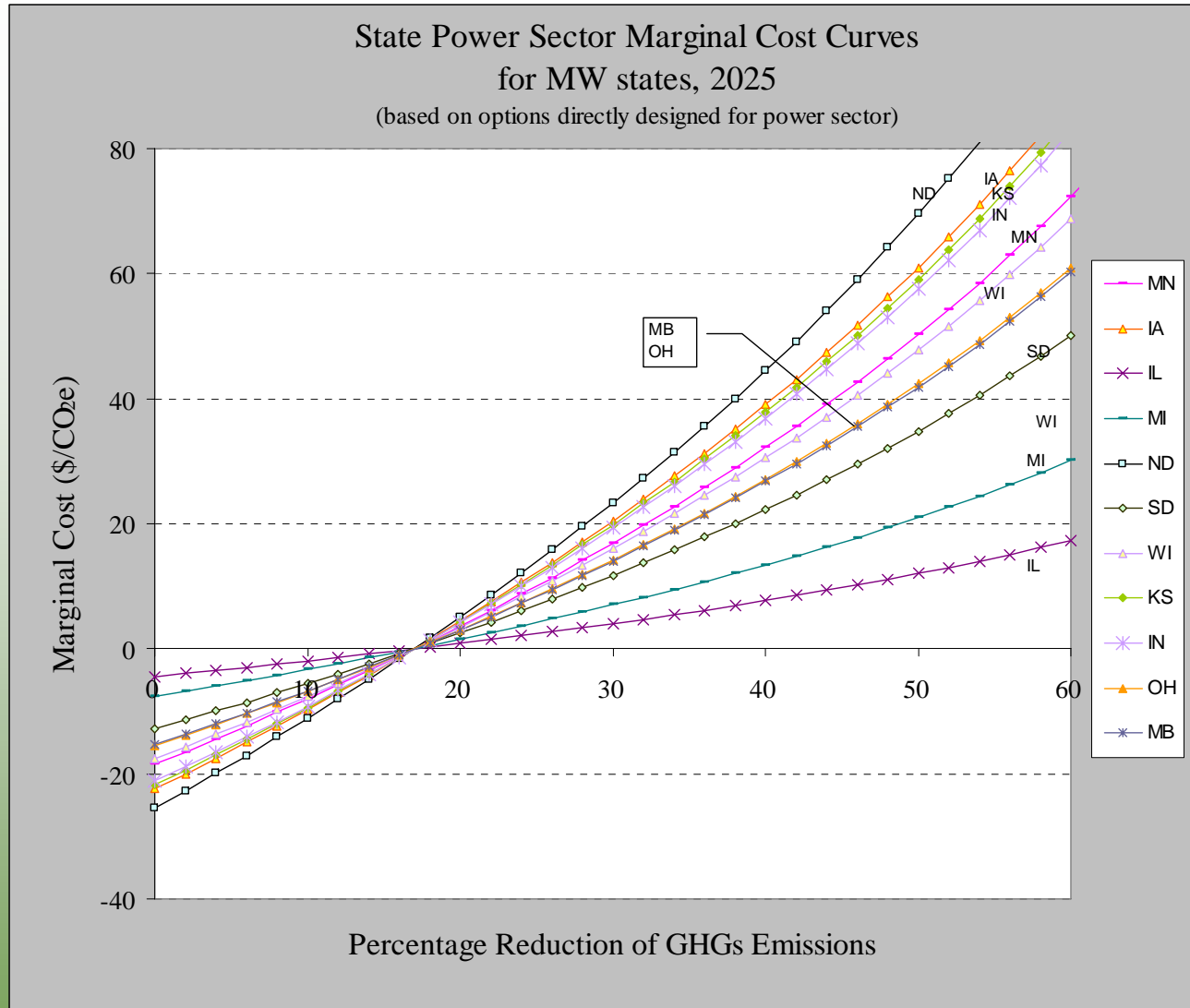
<sup>2</sup> This option is designed for RCI sector. We include it here because we think this mitigation option is also closely related to power sector.

## Low Cost Case

Low cost estimates for the three green highlighted options above. Other options are the same.

ES	Efficiency Improvements, Repowering and other Upgrades to Existing Plants (with RPS)_Reference Scenerio #3	1.93	\$5.41	3.00%
ES	Generation Performance Standard_Reference Scenerio #1	4.56	\$12.00	7.08%
ES	Renewable and/or Environmental Portfolio Standard_With coal additions	12.47	\$19.10	19.37%





Note: Marginal cost curves of Midwestern states are developed based on MN 2025 curve. These curves are for the high cost scenario. The relative positions of state curves for the low cost scenario are the same, except all the curves shift downward slightly. These marginal cost curves are presented for a range of mitigation levels, including those higher than required to meet the cap in year 2025. We anticipate that there will be technology innovations in the future, i.e., the marginal cost curves will shift downward over time before higher levels of mitigation are necessary.

# Public Input & Announcements

# Next Meeting