



**MINNESOTA**  
Climate Change  
Advisory Group



# Minnesota Climate Change Advisory Group

Cap and Trade Technical Work Group Meeting #11  
January 18, 2008

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

# Agenda

- Call to order (3 minutes)
- Roll call of cap-and-trade TWG members and public (2 minutes)
- Discuss committee survey results and 'triage' of remaining issues (10 minutes)
- Tackle 'strong agreement' questions (45 minutes):
  - Set aside inclusion of large farms?
  - Support six GHGs?
  - Support for an early action incentive?
  - Inclusion of reductions from all capped-sector policies and measures within the cap?
  - Set aside Carbon Tax C&T-4?
  - Support a Market Advisory Group C&T-5?
  - Support some form of Carbon Credit System C&T-7?
- Presentation of final modeling runs from completed Policy Options (Adam Rose and Dan Wei) (40 minutes)
- Discuss remaining issues (70 minutes)
  - Allowance distribution
  - Offsets
  - Safety Valve
  - Banking and Borrowing
- Next steps (5 minutes)
- Public input and announcements (5 minutes)
- Adjourn

# TWG Survey Summary

## Analysis:

- The group does not appear ready to include large farms as a covered sector
- There is solid support for including all six GHGs
- There is no clear direction on the issue of offsets
- The group does not appear ready to decide the issue of banking
- There is no clear direction on the issue of borrowing
- There is strong support for early action incentives
- There is no clear direction on the issue of safety valve
- There is strong support for Integration of C&T with other policies
- There is no clear direction on allowance distribution
- C&T-4, the Carbon Tax is not supported
- There is strong support for some form of a MN-only or Midwest regional Market Advisory Group
- There is no clear direction on additional regional GHG reduction efforts
- There is good support for the development of a Minnesota Carbon Credit system

# Overview

This week's updates include:

- Re-developed the marginal cost curve for Minnesota based on the updated reduction and cost data of individual policy options provided by each TWG on Jan. 8 (the finalized numbers for MCCAG meeting #7).
- Estimated marginal cost curves for other Midwestern states based on Minnesota's updated curve.
- Included the scenario assuming no RES and CIP in the baseline condition as the reference case, and ran two sensitivity scenarios: (1) assumes both RES and CIP are in effect in the baseline condition and (2) assumes only RES is in effect in the baseline condition. When we assume that RES and CIP, or RES only, is already factored in the BAU case, the corresponding policy options are excluded from the option list to develop the MN marginal cost curve. The two relevant options are 1) RCI-1: Maximize Savings from the Utility Conservation Improvement Program and 2) ES-5: Renewable and/or Environmental Portfolio Standard.
- Re-ran simulations for four geographical configurations: 1) MGA partner states, 2) MGA partner states and observer states, 3) MGA and WCI partner states, and 4) MGA and WCI partner plus observer states.
- Re-ran the MN-only simulation for the three sensitivity scenarios. The sector coverage is same as last time: 1) Power Sector; 2) Transportation Sector; 3) Sequestration Sector; and 4) Other Sector.

# Interpretation of Results (1)

- For the base scenario, where no RES and CIP are incorporated in the baseline condition, this week's simulations are a major shift from the last few weeks, because the latest updated data we received from the TWGs includes several new cost-saving mitigation/sequestration options and lower cost estimates for some existing options. The results are similar, however, to those we generated in November in qualitative terms:
  - The permit price is \$21.84/tCO<sub>2</sub>e for the basic 7-state MW partners run, compared with a \$40-45/tCO<sub>2</sub>e permit price from last week.
  - The total cost for MN is -\$2.1 billion (i.e., savings) for the group of 7 states run.
  - The average mitigation cost per unit of CO<sub>2</sub>e for Minnesota is -\$28.97/tCO<sub>2</sub>e in the 7-state MW partners run.
  - The relative position of the states in the MGA has not changed much, and MN is still a permit buyer.

# Interpretation of Results (2)

- When both RES and CIP are included in the Minnesota 2025 BAU emission projection, the emission reduction requirement in 2025 reduces from 43.91% of the BAU level to 36.67% in order to meet the same cap of 30% below the 2005 level. On the other hand, the mitigation options of RES and CIP are removed from the policy option list that is used to develop the marginal cost curve. This results in an upward shift of the MN marginal cost curve. The simulation results show that the effects of the lower emission reduction goal relative to the BAU level and the steeper cost curve nearly offset each other. For example, the permit prices in the simulations with RES and CIP in the BAU condition are around one dollar lower than the corresponding simulation cases without RES and CIP in the baseline. The major difference is that the net cost for MN is now around -\$900 million, in contrast to around -\$2.1 billion in the case with no CIP or RES in the baseline. If we look at the CIP and RES options individually, we see that the former has a 13.1 MMtCO<sub>2</sub>e reduction potential at the average cost of -\$48, and the latter has 16 MMtCO<sub>2</sub>e reduction potential at the average cost of -\$13. The implementation of these two options would contribute more than \$800 million cost savings to MN. This partly explains the drop of cost savings to -\$900 when these two options are in the baseline and not included in the mitigation cost calculation.

# Interpretation of Results (3)

- For the case where only RES (but no CIP) is in the baseline, we obtained the highest permit prices in the three scenarios. In this sensitivity case, the percentage reduction goal does not reduce much (from 43.91% to 42.31%), but the cost curve becomes steeper without RES option (which has 16 MMtCO<sub>2</sub>e reduction potential at the cost of -\$13). This is the major reason to get higher permit prices. The result of MN as a permit buyer does not change. The net cost of MN is around -\$1.6 billion.

# Interpretation of Results (4)

- The permit price is lowest for the case of trading among MGA partners than in various other configurations. Including the MGA observers or WCI partners or observers will increase the permit price. The worst case would be to include observers from both MGA and WCI. These results indicate that: 1) on average the MGA observers have higher mitigation costs compared with the MGA partners, and 2) MGA partner states have overall lower mitigation/sequestration costs than the WCI states. As a permit buyer, Minnesota would be better off joining a cap and trade program with only the MGA partner states, because it can buy permits at a lower price than in other configurations.
- The positions in terms of permit buying or selling states did not change in the sensitivity simulations.

# Interpretation of Results (5)

- In the MN-only simulations, the model was run for trading among four major sectors within Minnesota. In all the three scenarios, the simulation results indicate that it would be better (attain more cost savings) for Minnesota to join cap and trade programs than to achieve reduction goals on its own. The Sequestration Sector is a permit seller and Other Sector and Transportation Sector are permit purchasers in all the three scenarios. The Power Sector is a permit seller in the scenarios with no RES/CIP in the baseline or with both RES/CIP in the baseline. It becomes a permit buyer in the case with only RES in the baseline. However, these results for the Transportation Sector and Power Sector are very sensitive to small changes in costs and to the fact that the fitted curves are only an approximation of the step function data.

# **Inter-state Cap and Trade Simulations**

**Scenario 1: CIP and RES are not in effect in the baseline condition**

# Midwestern Partners

TABLE IM1-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading			Cost Saving	Permits Traded (million tCO <sub>2</sub> )	Emission Reduction w/ Trading		Emission Reduction Goal
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> )	(percent from BAU)	(percent from BAU)
IA	-1,746	-1,915	122	-1,793	47	5.60	49.41	39.21	43.65
IL	-3,412	-3,210	-257	-3,468	56	-11.77	134.78	41.83	38.18
KS	-2,266	-2,535	159	-2,376	110	7.26	45.54	37.65	43.65
MI	-3,590	-3,487	-121	-3,608	18	-5.54	109.76	40.21	38.18
MN	-2,080	-2,244	133	-2,110	30	6.09	77.44	40.71	43.91
WI	-1,975	-1,897	-94	-1,992	17	-4.32	66.84	40.82	38.18
MB	-384	-503	59	-444	60	2.68	10.47	38.24	48.04
Total	-15,453	-15,791	0	-15,791	338	21.63 <sup>b</sup>	494.23	40.40	40.40

<sup>a</sup> Permit Price = \$21.84/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 -\$28.97/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 40.71% 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

TABLE IM2-2025. 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	-1,746	-1,910	121	-1,789	44	5.38	49.63	39.38	43.65
IL	-3,412	-3,193	-282	-3,475	64	-12.54	135.55	42.07	38.18
KS	-2,266	-2,531	160	-2,372	105	7.10	45.69	37.78	43.65
MI	-3,590	-3,475	-137	-3,611	22	-6.08	110.30	40.41	38.18
MN	-2,080	-2,235	128	-2,107	26	5.69	77.84	40.92	43.91
WI	-1,975	-1,890	-105	-1,995	20	-4.67	67.19	41.03	38.18
MB	-384	-502	59	-443	59	2.64	10.51	38.39	48.04
IN	-6,376	-6,394	17	-6,376	0	0.77	120.04	37.94	38.18
OH	-6,515	-6,455	-64	-6,519	4	-2.84	151.84	38.91	38.18
SD	-816	-1,031	102	-929	113	4.56	18.19	37.69	47.13
Total	-29,160	-29,616	0	-29,616	456	26.14 <sup>b</sup>	786.78	39.77	39.77

<sup>a</sup> Permit Price = \$22.48/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 -\$28.71/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 40.92% 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 and WCI Partners

TABLE IM1W1-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES, SIX WESTERN STATES, AND TWO CANADIAN PROVINCES 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)	
AZ	-737	-1,947	684	-1,263	526	27.16	92.28	48.74	63.09
CA	392	1,973	-2,010	-37	429	-79.80	381.72	59.06	46.71
NM	403	-407	411	4	399	16.32	31.73	31.90	48.30
OR	129	162	-35	128	1	-1.38	46.92	50.59	49.10
UT	545	-45	394	350	195	15.65	43.57	40.56	55.14
WA	2,641	-854	813	-41	2,683	32.26	27.12	21.70	47.51
BC	23	-52	68	16	7	2.70	32.18	39.75	43.09
IA	-1,746	-1,889	113	-1,776	30	4.47	50.55	40.11	43.65
IL	-3,412	-3,116	-398	-3,514	102	-15.78	138.80	43.08	38.18
KS	-2,266	-2,515	162	-2,353	87	6.43	46.36	38.33	43.65
MI	-3,590	-3,420	-211	-3,631	41	-8.36	112.58	41.24	38.18
MN	-2,080	-2,194	101	-2,094	13	4.00	79.53	41.81	43.91
WI	-1,975	-1,855	-155	-2,009	34	-6.15	68.66	41.93	38.18
MB	-384	-498	62	-436	52	2.47	10.68	39.01	48.04
Total	-12,056	-16,656	0	-16,656	4,600	111.47 <sup>b</sup>	1,162.66	45.33	45.33

<sup>a</sup> Permit Price = \$25.19/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 -\$27.59/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 41.48% 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 and WCI Partners+Observers

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TABLE IM2W2-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG NINE MIDWESTERN STATES, ELEVEN WESTERN STATES, AND TWO CANADIAN PROVINCES IN YEAR 2020

(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)
AZ	-737	-1,824	705	-1,119	382	22.78	96.66	51.06	63.09
CA	392	2,989	-3,594	-605	997	-116.09	418.00	64.67	46.71
NM	403	-349	441	92	311	14.25	33.80	33.97	48.30
OR	129	290	-183	106	22	-5.92	51.47	55.49	49.10
UT	545	63	366	429	116	11.81	47.41	44.15	55.14
WA	2,641	-819	960	141	2,500	31.01	28.38	22.70	47.51
BC	23	26	-3	23	0	-0.09	34.98	43.21	43.09
CO	7,099	-1,278	1,958	680	6,419	63.24	48.22	26.44	61.12
ID	17	53	-39	14	3	-1.25	21.52	46.23	43.55
MT	-173	-75	-161	-236	63	-5.19	17.11	41.28	28.75
NV	638	209	332	540	98	10.71	44.47	51.94	64.45
WY	1,634	-695	663	-33	1,666	21.41	22.33	28.65	56.12
IA	-1,746	-1,835	79	-1,756	10	2.56	52.46	41.62	43.65
IL	-3,412	-2,928	-696	-3,624	213	-22.50	145.51	45.16	38.18
KS	-2,266	-2,476	156	-2,320	54	5.03	47.76	39.49	43.65
MI	-3,590	-3,287	-406	-3,693	103	-13.10	117.32	42.98	38.18
MN	-2,080	-2,096	15	-2,081	0	0.49	83.04	43.65	43.91
WI	-1,975	-1,769	-285	-2,054	79	-9.21	71.72	43.80	38.18
MB	-384	-488	66	-422	39	2.12	11.03	40.30	48.04
IN	-6,376	-6,245	-149	-6,394	18	-4.80	125.61	39.70	38.18
OH	-6,515	-6,238	-340	-6,578	63	-10.99	159.98	41.00	38.18
SD	-816	-1,010	116	-894	78	3.75	19.00	39.37	47.13
Total	-16,548	-29,781	0	-29,781	13,233	189.14 <sup>b</sup>	1,697.78	45.23	45.23

<sup>a</sup> Permit Price = \$30.96/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 -\$25.24/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 43.65% below the baseline level in 2020 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.

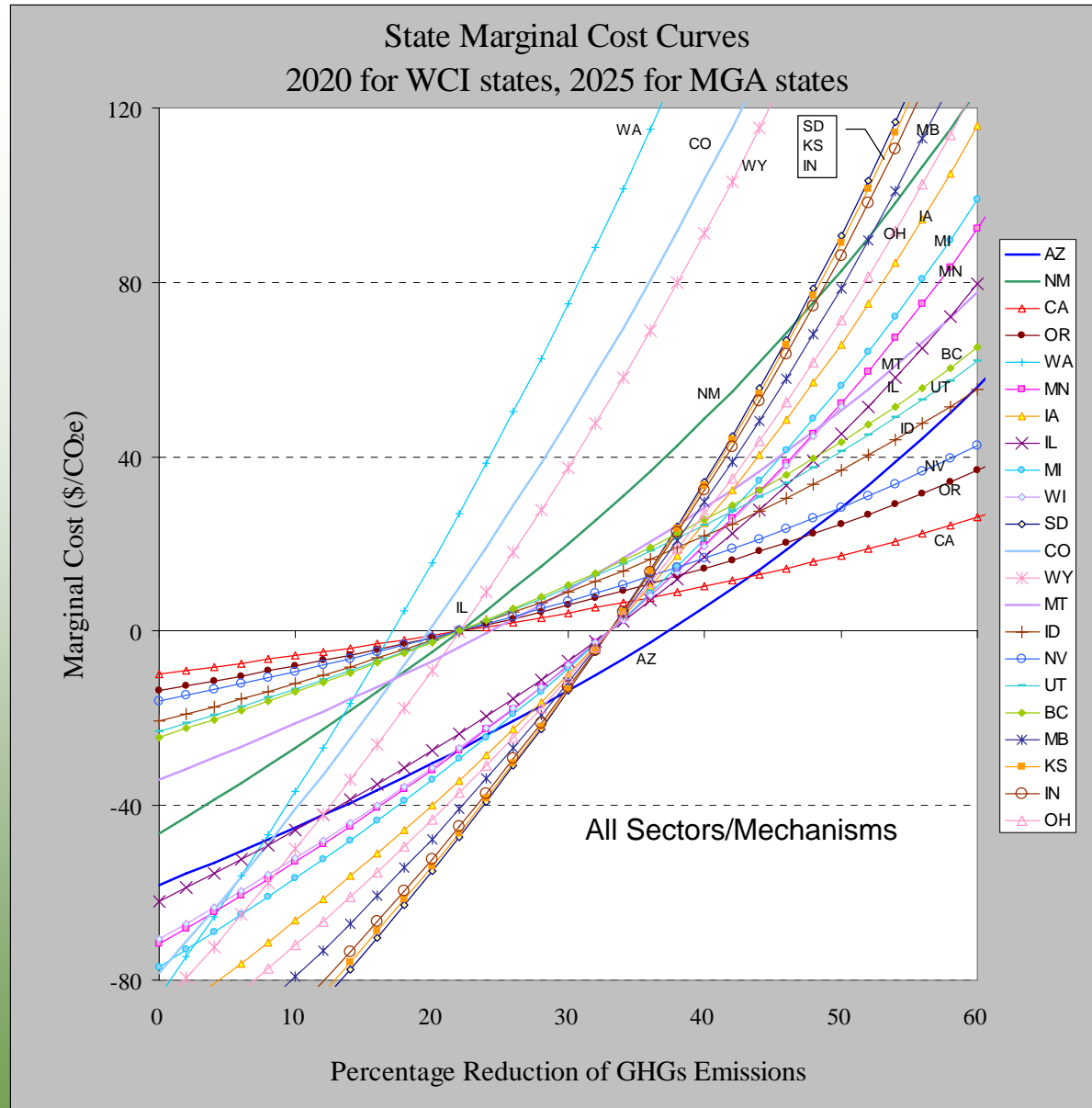
<sup>b</sup> Represents number of permits bought or sold.

# Summary Data Table

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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)
AZ	69.9	189.3	63.09%	66.2	481,628
CA	344.4	646.4	46.71%	14.9	2,923,222
NM	51.4	99.5	48.30%	76.5	94,564
OR	47.2	92.8	49.10%	23.6	297,081
UT	48.2	107.4	55.14%	51.3	204,725
WA	65.6	125.0	47.51%	203.3	471,781
BC	46.1	81.0	43.09%	30.8	146,610
CO	70.9	182.4	61.12%	257.9	563,455
ID	26.3	46.5	43.55%	26.9	98,835
MT	29.5	41.4	28.75%	7.4	41,520
NV	30.4	85.6	64.45%	50.2	236,707
WY	34.2	78.0	56.12%	200.3	39,577
IA	71.0	126.0	43.65%	38.9	206,621
IL	199.2	322.2	38.18%	12.4	768,315
KS	68.2	121.0	43.65%	52.6	146,593
MI	168.7	273.0	38.18%	15.4	524,088
MN	106.7	190.2	43.91%	31.8	392,084
WI	101.2	163.7	38.18%	14.2	342,743
MB	14.2	27.4	48.04%	68.2	37,581
IN	195.6	316.4	38.18%	23.6	396,501
OH	241.2	390.2	38.18%	19.6	590,200
SD	25.5	48.3	47.13%	73.5	57,361
Total	2,055.8	3,753.6	45.23%		9,061,793



Note: Marginal cost curves of Midwestern states are developed based on MN 2025 curve. Marginal cost curves of WCI states other than for AZ, CO, MT and WA are developed based on NM 2020 curve. In order to run simulations including both MGA and WCI states in year 2025, we used 2020 marginal cost curves for WCI states for the year 2025. 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.

**Scenario 2: both CIP and RES are in effect in the  
baseline condition**

# Midwestern Partners

TABLE IIM1-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading			Cost Saving	Permits Traded	Emission Reduction w/ Trading		Emission Reduction Goal
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO <sub>2</sub> )	(million tCO <sub>2</sub> )	(percent from BAU)	(percent from BAU)
IA	-1,746	-1,907	120	-1,787	41	5.23	49.78	39.50	43.65
IL	-3,412	-3,182	-299	-3,481	69	-13.06	136.07	42.23	38.18
KS	-2,266	-2,529	160	-2,369	102	6.99	45.80	37.87	43.65
MI	-3,590	-3,466	-148	-3,614	24	-6.45	110.66	40.54	38.18
MN	-840	-1,152	219	-933	93	9.58	52.20	30.99	36.67
WI	-1,975	-1,884	-113	-1,997	22	-4.91	67.43	41.18	38.18
MB	-384	-501	60	-441	58	2.61	10.53	38.49	48.04
Total	-14,212	-14,621	0	-14,621	409	24.42 <sup>b</sup>	472.48	39.32	39.32

<sup>a</sup> Permit Price = \$22.91/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 -\$22.07/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 30.99% 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

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TABLE IIM2-2025. 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 (percent from BAU)
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost			(million tCO <sub>2</sub> e)	(percent from BAU)	
IA	-1,746	-1,905	119	-1,785	40	5.13	49.88	39.58	43.65
IL	-3,412	-3,173	-312	-3,485	73	-13.44	136.45	42.35	38.18
KS	-2,266	-2,527	161	-2,366	100	6.92	45.88	37.93	43.65
MI	-3,590	-3,460	-156	-3,616	26	-6.71	110.93	40.64	38.18
MN	-840	-1,148	219	-929	90	9.42	52.37	31.08	36.67
WI	-1,975	-1,880	-118	-1,998	23	-5.08	67.60	41.28	38.18
MB	-384	-501	60	-441	57	2.59	10.55	38.56	48.04
IN	-6,376	-6,382	6	-6,376	0	0.28	120.53	38.09	38.18
OH	-6,515	-6,439	-83	-6,522	7	-3.57	152.57	39.10	38.18
SD	-816	-1,030	104	-925	110	4.48	18.27	37.84	47.13
Total	-27,919	-28,445	0	-28,445	526	28.81 <sup>b</sup>	765.03	39.10	39.10

<sup>a</sup> Permit Price = \$23.23/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 -\$21.93/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 31.08% 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 and WCI Partners

TABLE IIM1W1-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES, SIX WESTERN STATES, AND TWO CANADIAN PROVINCES 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)
AZ	-737	-1,941	687	-1,254	517	26.91	92.53	48.87	63.09
CA	392	2,028	-2,091	-63	455	-81.96	383.87	59.39	46.71
NM	403	-404	413	10	394	16.20	31.85	32.01	48.30
OR	129	169	-42	127	2	-1.64	47.19	50.87	49.10
UT	545	-39	394	355	190	15.43	43.79	40.77	55.14
WA	2,641	-852	821	-31	2,672	32.19	27.19	21.75	47.51
BC	23	-48	65	17	7	2.54	32.34	39.95	43.09
IA	-1,746	-1,886	111	-1,775	29	4.36	50.65	40.19	43.65
IL	-3,412	-3,106	-412	-3,519	107	-16.16	139.17	43.20	38.18
KS	-2,266	-2,513	162	-2,351	85	6.35	46.44	38.40	43.65
MI	-3,590	-3,413	-220	-3,634	44	-8.63	112.84	41.34	38.18
MN	-840	-1,120	211	-909	70	8.26	53.52	31.77	36.67
WI	-1,975	-1,850	-161	-2,011	36	-6.32	68.84	42.04	38.18
MB	-384	-497	63	-435	51	2.45	10.70	39.08	48.04
Total	-10,816	-15,474	0	-15,474	4,658	114.71 <sup>b</sup>	1,140.92	44.87	44.87

<sup>a</sup> Permit Price = \$25.51/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 -\$20.93/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 31.77% 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 and WCI Partners+Observers

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TABLE IIM2W2-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG NINE MIDWESTERN STATES, ELEVEN WESTERN STATES, AND TWO CANADIAN PROVINCES IN YEAR 2020

(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)
AZ	-737	-1,817	705	-1,112	375	22.54	96.90	51.18	63.09
CA	392	3,047	-3,688	-642	1,034	-117.93	419.85	64.96	46.71
NM	403	-345	442	97	307	14.14	33.91	34.09	48.30
OR	129	297	-193	104	24	-6.16	51.71	55.74	49.10
UT	545	70	363	433	112	11.60	47.62	44.34	55.14
WA	2,641	-817	968	151	2,490	30.94	28.45	22.76	47.51
BC	23	31	-8	23	0	-0.24	35.13	43.39	43.09
CO	7,099	-1,274	1,974	700	6,399	63.12	48.34	26.51	61.12
ID	17	56	-42	14	3	-1.34	21.61	46.44	43.55
MT	-173	-73	-164	-237	65	-5.25	17.17	41.43	28.75
NV	638	215	329	543	95	10.51	44.67	52.18	64.45
WY	1,634	-694	668	-26	1,660	21.36	22.38	28.72	56.12
IA	-1,746	-1,832	77	-1,755	9	2.45	52.56	41.70	43.65
IL	-3,412	-2,916	-715	-3,631	220	-22.86	145.87	45.27	38.18
KS	-2,266	-2,474	155	-2,319	52	4.96	47.84	39.55	43.65
MI	-3,590	-3,279	-418	-3,697	107	-13.36	117.58	43.07	38.18
MN	-840	-1,039	169	-870	30	5.40	56.38	33.47	36.67
WI	-1,975	-1,764	-293	-2,057	82	-9.37	71.89	43.91	38.18
MB	-384	-487	66	-422	38	2.10	11.05	40.37	48.04
IN	-6,376	-6,239	-157	-6,395	19	-5.01	125.82	39.76	38.18
OH	-6,515	-6,229	-353	-6,582	66	-11.29	160.28	41.07	38.18
SD	-816	-1,009	116	-893	77	3.72	19.03	39.43	47.13
Total	-15,307	-28,571	0	-28,571	13,264	192.83 <sup>b</sup>	1,676.03	44.91	44.91

<sup>a</sup> Permit Price = \$31.28/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 -\$18.42/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 33.47% below the baseline level in 2020 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.

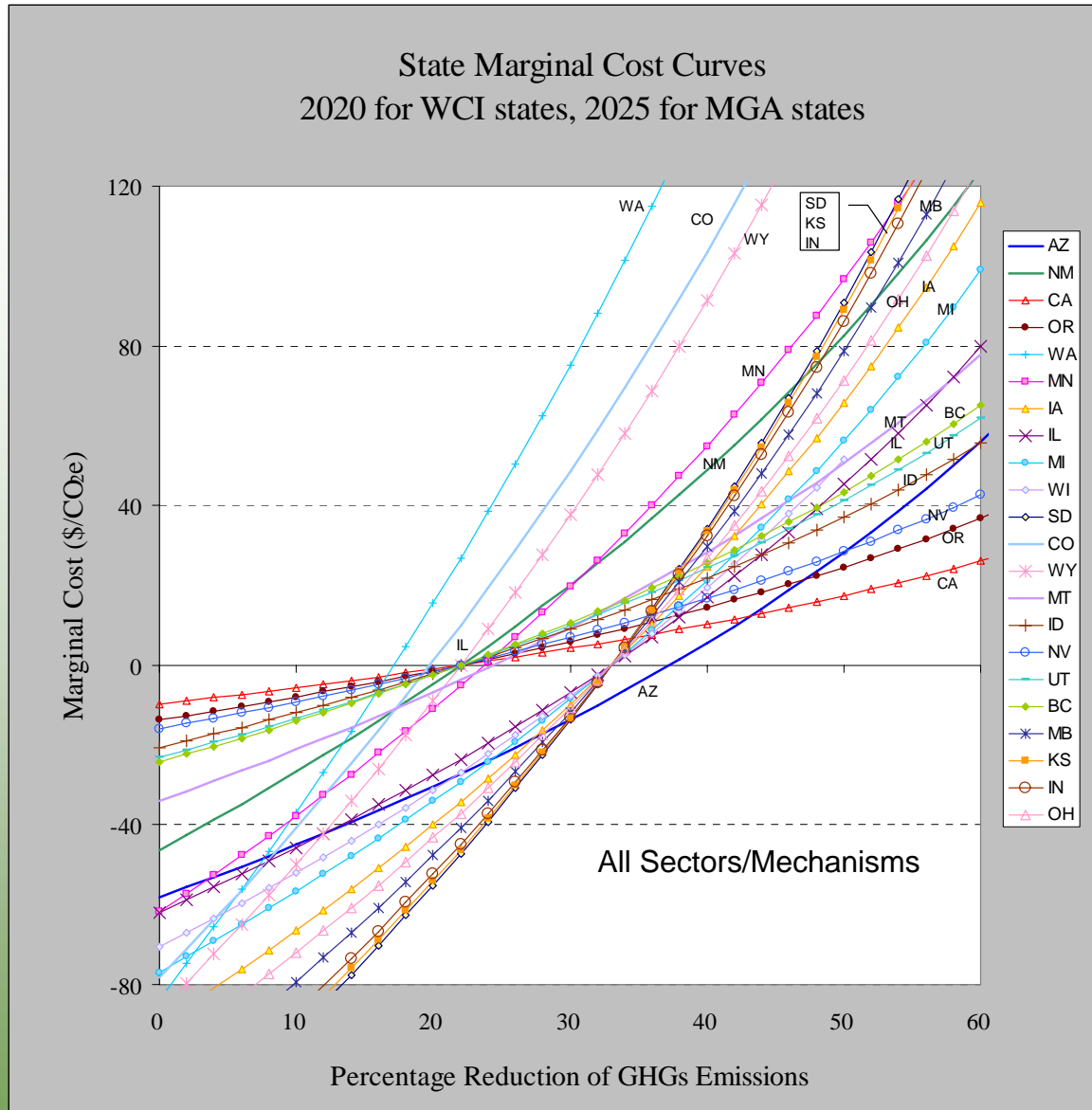
<sup>b</sup> Represents number of permits bought or sold.

# Summary Data Table

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)
AZ	69.9	189.3	63.09%	66.2	481,628
CA	344.4	646.4	46.71%	14.9	2,923,222
NM	51.4	99.5	48.30%	76.5	94,564
OR	47.2	92.8	49.10%	23.6	297,081
UT	48.2	107.4	55.14%	51.3	204,725
WA	65.6	125.0	47.51%	203.3	471,781
BC	46.1	81.0	43.09%	30.8	146,610
CO	70.9	182.4	61.12%	257.9	563,455
ID	26.3	46.5	43.55%	26.9	98,835
MT	29.5	41.4	28.75%	7.4	41,520
NV	30.4	85.6	64.45%	50.2	236,707
WY	34.2	78.0	56.12%	200.3	39,577
IA	71.0	126.0	43.65%	38.9	206,621
IL	199.2	322.2	38.18%	12.4	768,315
KS	68.2	121.0	43.65%	52.6	146,593
MI	168.7	273.0	38.18%	15.4	524,088
MN	106.7	168.5	36.67%	42.6	392,084
WI	101.2	163.7	38.18%	14.2	342,743
MB	14.2	27.4	48.04%	68.2	37,581
IN	195.6	316.4	38.18%	23.6	396,501
OH	241.2	390.2	38.18%	19.6	590,200
SD	25.5	48.3	47.13%	73.5	57,361
Total	2,055.8	3,731.8	44.91%		9,061,793



Note: Marginal cost curves of Midwestern states are developed based on MN 2025 curve assuming no CIP and RES in effect in the baseline condition. The MN 2025 curve shown in this figure assumes that both CIP and RES are in effect in the baseline condition. Marginal cost curves of WCI states other than for AZ, CO, MT and WA are developed based on NM 2020 curve. In order to run simulations including both MGA and WCI states in year 2025, we used 2020 marginal cost curves for WCI states for the year 2025. 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.

## **Scenario 3: RES is in effect, but no CIP in the baseline condition**

# Midwestern Partners

TABLE IIM1-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES PLUS MANITOBA IN YEAR 2025

(million dollars or otherwise specified)

State	Before Trading	After Trading			Cost Saving	Permits Traded	Emission Reduction w/ Trading		Emission Reduction Goal
	Mitigation Cost	Mitigation Cost	Trading Cost	Net Cost		(million tCO <sub>2</sub> )	(million tCO <sub>2</sub> )	(percent from BAU)	(percent from BAU)
IA	-1,746	-1,898	117	-1,781	36	4.86	50.16	39.80	43.65
IL	-3,412	-3,150	-346	-3,496	85	-14.40	137.41	42.65	38.18
KS	-2,266	-2,522	161	-2,361	95	6.72	46.08	38.10	43.65
MI	-3,590	-3,444	-178	-3,622	32	-7.39	111.60	40.89	38.18
MN	-1,426	-1,916	317	-1,599	173	13.19	65.07	35.18	42.31
WI	-1,975	-1,870	-133	-2,003	28	-5.52	68.03	41.55	38.18
MB	-384	-500	61	-439	55	2.54	10.60	38.74	48.04
Total	-14,798	-15,301	0	-15,301	503	27.31 <sup>b</sup>	488.96	40.14	40.14

<sup>a</sup> Permit Price = \$24.03/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 -\$29.45/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 35.18% 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

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TABLE IIM2-2025. 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	-1,746	-1,898	117	-1,782	36	4.87	50.14	39.79	43.65
IL	-3,412	-3,151	-344	-3,496	84	-14.36	137.37	42.64	38.18
KS	-2,266	-2,523	161	-2,361	95	6.73	46.07	38.09	43.65
MI	-3,590	-3,445	-177	-3,621	32	-7.36	111.57	40.88	38.18
MN	-1,426	-1,917	317	-1,600	174	13.21	65.05	35.17	42.31
WI	-1,975	-1,871	-132	-2,002	27	-5.50	68.01	41.54	38.18
MB	-384	-500	61	-439	55	2.55	10.60	38.73	48.04
IN	-6,376	-6,371	-6	-6,376	0	-0.23	121.04	38.25	38.18
OH	-6,515	-6,421	-104	-6,525	10	-4.32	153.31	39.29	38.18
SD	-816	-1,028	106	-922	106	4.41	18.34	37.99	47.13
Total	-28,505	-29,124	0	-29,124	618	31.76 <sup>b</sup>	781.51	39.61	39.61

<sup>a</sup> Permit Price = \$23.99/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 -\$29.46/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 35.17% 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 and WCI Partners

TABLE IIM1W1-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG SIX MIDWESTERN STATES, SIX WESTERN STATES, AND TWO CANADIAN PROVINCES 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)
AZ	-737	-1,935	689	-1,246	509	26.68	92.76	49.00	63.09
CA	392	2,080	-2,168	-88	480	-83.98	385.89	59.70	46.71
NM	403	-401	415	14	389	16.09	31.96	32.12	48.30
OR	129	176	-49	127	2	-1.89	47.44	51.14	49.10
UT	545	-34	393	359	185	15.23	43.99	40.96	55.14
WA	2,641	-851	829	-21	2,663	32.13	27.26	21.81	47.51
BC	23	-44	62	17	6	2.39	32.49	40.14	43.09
IA	-1,746	-1,883	110	-1,773	28	4.26	50.75	40.27	43.65
IL	-3,412	-3,097	-426	-3,524	112	-16.52	139.53	43.31	38.18
KS	-2,266	-2,511	162	-2,349	83	6.28	46.51	38.46	43.65
MI	-3,590	-3,407	-229	-3,636	47	-8.88	113.10	41.43	38.18
MN	-1,426	-1,893	317	-1,576	151	12.26	66.00	35.68	42.31
WI	-1,975	-1,846	-167	-2,013	38	-6.48	69.00	42.14	38.18
MB	-384	-497	63	-434	50	2.43	10.71	39.15	48.04
Total	-11,402	-16,144	0	-16,144	4,743	117.75 <sup>b</sup>	1,157.40	45.22	45.22

<sup>a</sup> Permit Price = \$25.81/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 -\$28.68/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 35.68% 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 and WCI Partners+Observers

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TABLE IIIM2W2-2025. ECONOMY-WIDE EMISSION TRADING SIMULATION AMONG NINE MIDWESTERN STATES, ELEVEN WESTERN STATES, AND TWO CANADIAN PROVINCES IN YEAR 2020

(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)	
AZ	-737	-1,811	705	-1,106	369	22.35	97.09	51.28	63.09
CA	392	3,093	-3,765	-672	1,064	-119.41	421.33	65.18	46.71
NM	403	-342	443	101	303	14.05	34.00	34.18	48.30
OR	129	303	-200	103	26	-6.35	51.90	55.95	49.10
UT	545	75	361	436	109	11.44	47.78	44.49	55.14
WA	2,641	-815	974	159	2,482	30.88	28.50	22.80	47.51
BC	23	35	-11	23	0	-0.36	35.25	43.54	43.09
CO	7,099	-1,271	1,987	716	6,383	63.02	48.44	26.56	61.12
ID	17	59	-45	14	3	-1.42	21.69	46.60	43.55
MT	-173	-72	-167	-239	66	-5.31	17.22	41.55	28.75
NV	638	220	326	546	92	10.34	44.83	52.37	64.45
WY	1,634	-693	672	-20	1,654	21.32	22.43	28.77	56.12
IA	-1,746	-1,829	75	-1,754	9	2.37	52.64	41.77	43.65
IL	-3,412	-2,907	-730	-3,637	226	-23.15	146.16	45.37	38.18
KS	-2,266	-2,472	154	-2,317	51	4.89	47.90	39.60	43.65
MI	-3,590	-3,273	-428	-3,700	111	-13.57	117.78	43.15	38.18
MN	-1,426	-1,809	295	-1,515	89	9.34	68.92	37.26	42.31
WI	-1,975	-1,759	-300	-2,059	84	-9.51	72.02	43.99	38.18
MB	-384	-487	66	-421	37	2.08	11.07	40.43	48.04
IN	-6,376	-6,233	-163	-6,397	20	-5.17	125.98	39.81	38.18
OH	-6,515	-6,221	-364	-6,585	69	-11.53	160.52	41.13	38.18
SD	-816	-1,008	116	-892	76	3.69	19.06	39.48	47.13
Total	-15,893	-29,218	0	-29,218	13,325	195.78 <sup>b</sup>	1,692.51	45.15	45.15

<sup>a</sup> Permit Price = \$31.53/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 -\$26.25/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 37.26% below the baseline level in 2020 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.

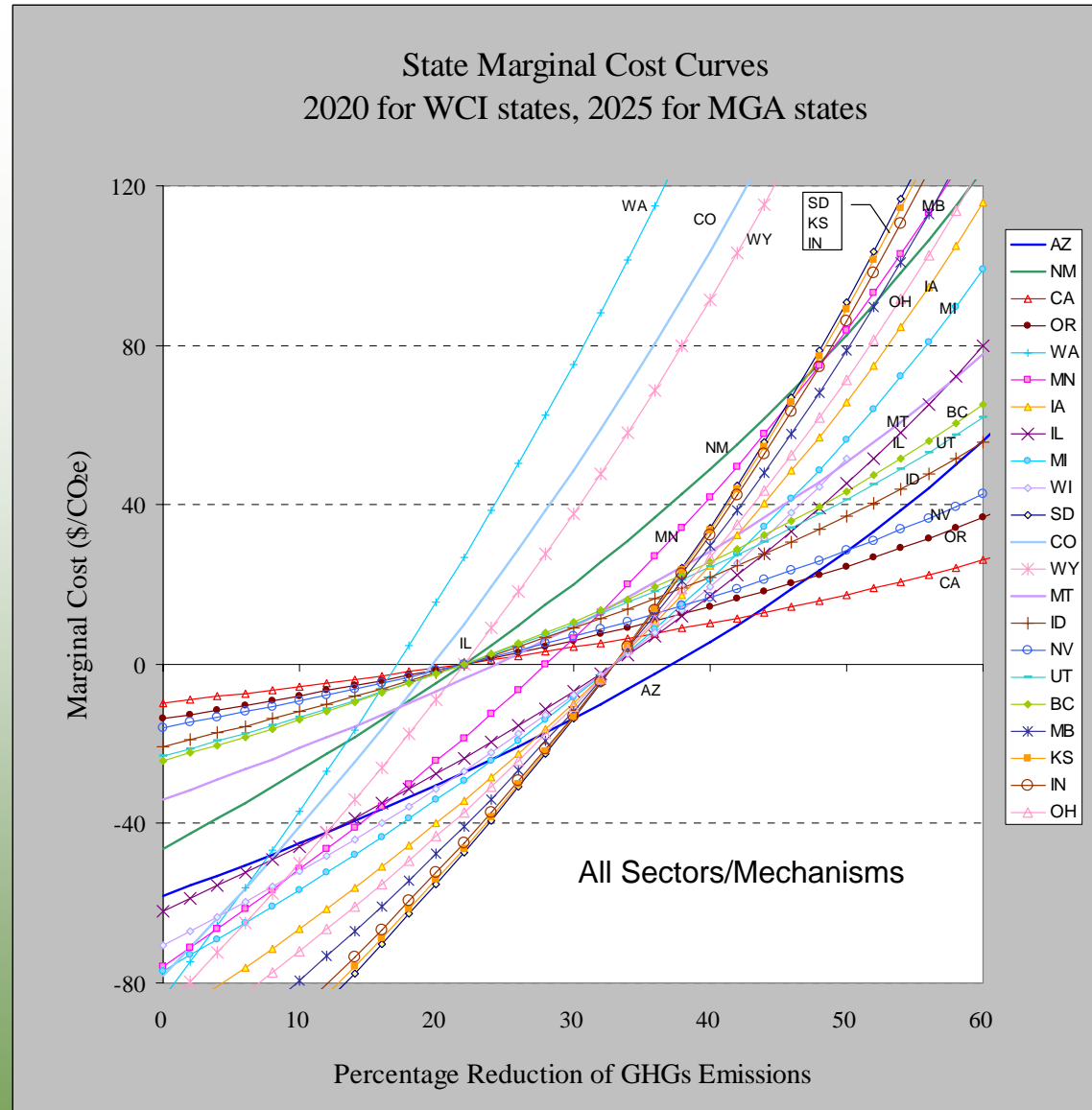
<sup>b</sup> Represents number of permits bought or sold.

# Summary Data Table

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)
AZ	69.9	189.3	63.09%	66.2	481,628
CA	344.4	646.4	46.71%	14.9	2,923,222
NM	51.4	99.5	48.30%	76.5	94,564
OR	47.2	92.8	49.10%	23.6	297,081
UT	48.2	107.4	55.14%	51.3	204,725
WA	65.6	125.0	47.51%	203.3	471,781
BC	46.1	81.0	43.09%	30.8	146,610
CO	70.9	182.4	61.12%	257.9	563,455
ID	26.3	46.5	43.55%	26.9	98,835
MT	29.5	41.4	28.75%	7.4	41,520
NV	30.4	85.6	64.45%	50.2	236,707
WY	34.2	78.0	56.12%	200.3	39,577
IA	71.0	126.0	43.65%	38.9	206,621
IL	199.2	322.2	38.18%	12.4	768,315
KS	68.2	121.0	43.65%	52.6	146,593
MI	168.7	273.0	38.18%	15.4	524,088
MN	106.7	185.0	42.31%	50.8	392,084
WI	101.2	163.7	38.18%	14.2	342,743
MB	14.2	27.4	48.04%	68.2	37,581
IN	195.6	316.4	38.18%	23.6	396,501
OH	241.2	390.2	38.18%	19.6	590,200
SD	25.5	48.3	47.13%	73.5	57,361
Total	2,055.8	3,748.3	45.15%		9,061,793



Note: Marginal cost curves of Midwestern states are developed based on MN 2025 curve assuming no CIP and RES in effect in the baseline condition. The MN 2025 curve shown in this figure assumes that RES is in effect in the baseline condition, but no CIP in the baseline. Marginal cost curves of WCI states other than for AZ, CO, MT and WA are developed based on NM 2020 curve. In order to run simulations including both MGA and WCI states in year 2025, we used 2020 marginal cost curves for WCI states for the year 2025. 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.

# **MN-only Cap and Trade Simulation**

- GHG mitigation policy options are proposed and designed for Minnesota in the following four sectoral categories: 1) Energy Supply, 2) RCI (Residential, Commercial, Industrial), 3) Transportation and Land Use, and 4) Agriculture, Forestry, and Waste Management. Table 1 presents a list of options that currently have quantified mitigation potential and cost information. In this section, we study a cap and trade program between major sectors in Minnesota. In the last column of Table 1, we classify the options into four major sectors: 1) Power Sector; 2) Transportation Sector; 3) Sequestration; and 4) Other (including Industrial, Commercial, Ag, Forestry, Small Power Generation, etc.).

# Minnesota Mitigation Options List

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Option #	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO2e)	Estimated Cost or Cost Savings per ton GHG Removed	Sector
AFW-1a	Agricultural Crop Management_A. Soil Carbon Management	1.3	-\$2.00	Sequestration
AFW-1b	Agricultural Crop Management_B. Nutrient Management	1.35	-\$37.00	Sequestration
AFW-2a	Land Use Management Approaches for Protection and Enrichment of Soil Carbon_A. Preserve Land	0.44	\$33.00	Sequestration
AFW-2b	Land Use Management Approaches for Protection and Enrichment of Soil Carbon_B. Reinvest in Minnesota-Clean Energy (RIM-CE)	0.19	\$34.00	Sequestration
AFW-3a	In-State Liquid Biofuels Production_A. Ethanol carbon content	2.2	-\$9.00	Transportation
AFW-3b	In-State Liquid Biofuels Production_B. Fossil diesel displacement	0.19	\$55.00	Transportation
AFW-3c	In-State Liquid Biofuels Production_C. Gasoline Displacement	13.6	\$5.00	Transportation
AFW-4	Expanded Use of Biomass Feedstocks for Electricity, Heat, or Steam Production	3.84	\$3.00	Other
AFW-5a	Forestry Management Programs to Enhance GHG Benefits_A. Forestation	2.19	\$13.00	Sequestration
AFW-5b	Forestry Management Programs to Enhance GHG Benefits_B. Urban forestry	2.7	-\$12.00	Sequestration
AFW-5d	Forestry Management Programs to Enhance GHG Benefits_D. Restocking	8.4	\$33.45	Sequestration
AFW-6	Forest Protection—Reduced Clearing and Conversion to Non-Forest Cover	2.7	\$2.95	Sequestration
AFW-7a	Front-End Waste Management Techs._A. Source Reduction	3.6	\$3.00	Other
AFW-7b	Front-End Waste Management Techs._B. Recycling	3.4	-\$11.00	Other
AFW-7c	Front-End Waste Management Techs._C. Composting	0.08	\$14.00	Other
AFW-8a	End of Life Waste Management Practices_A. Landfilled Waste Methane	0.73	\$1.00	Other
AFW-8b	End of Life Waste Management Practices_B. Residuals Management	0.63	\$80.00	Other
AFW-8c	End of Life Waste Management Practices_C. WTE Preprocessing	0.84	\$32.00	Other
ES-1	Generation Performance Standard	5	-\$126.00	Power
ES-3	Efficiency Improvements, Repowering and other Upgrades to Existing Plants	3	\$17.00	Power
ES-4	Transmission System Upgrading, Including Reducing Transmission Line and Distribution System Loss	0	-\$13.00	Power
ES-5	Renewable and/or Environmental Portfolio Standard	16	-\$13.00	Power
ES-6	Nuclear Power Support and Incentives	8	\$70.00	Power
ES-8	Carbon Capture and Storage and/or Reuse Policies	1	\$84.00	Power
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)	13.1	-\$48.00	Power
RCI-2	Improved Uniform Statewide Building Codes	0.005	-\$402.00	Other
RCI-3	Green Building Guidelines and Standards Based on <i>Architecture 2030</i>	0.94	-\$27.00	Other
RCI-4	Incentives & Resources To Promote Combined Heat and Power (CHP)	4.95	\$30.00	Other
RCI-5	Program To Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs	0.05	-\$5.00	Other
RCI-6	Non-Utility Strategies and Incentives To Encourage Energy Efficiency and Reduce GHG Emissions	1.3	-\$37.00	Other
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency	0.05	-\$28.00	Other
RCI-10	Support Strong Federal Appliance Standards and Require High State Standards in the Absence of Federal Standards	1.4	-\$91.00	Other
TLU-2	Expand Transit, Bicycle, and Pedestrian Infrastructure	0.3	\$0.00	Transportation
TLU-5	Climate-Friendly Transportation Pricing / Pay as You Drive	2.7	-\$1.00	Transportation
TLU-3	Low GHG Fuel Standard (Overlap With AFW-7)	4.4	\$119.00	Transportation

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**Minnesota Gross GHG Emissions from Three Major Sectors, 1990-2025: Historical and Projected**  
MMTCO<sub>2</sub>e

	1990	1995	2000	2005	2010	2015	2020	2025
Power sector	35.03	40.88	43.40	51.46	53.23	60.93	62.61	67.07
Transportation sector	28.70	31.68	35.42	37.22	38.21	40.30	42.59	44.64
Other (Industrial, Commercial, Ag, Forestry, Small Power Generation, etc.)	51.96	59.76	62.58	63.75	68.06	71.69	74.80	78.51
<b>Total</b>	<b>115.69</b>	<b>132.31</b>	<b>141.40</b>	<b>152.43</b>	<b>159.50</b>	<b>172.92</b>	<b>180.00</b>	<b>190.23</b>

**Table 4. Cap in Year 2025: 30% below 2005 level**  
MMTCO<sub>2</sub>e

	2025 BAU Emission	2025 Cap	Reduction Goal
Power sector	67.07	36.02	31.05
Transportation sector	44.64	26.06	18.58
Other	78.51	44.62	33.89

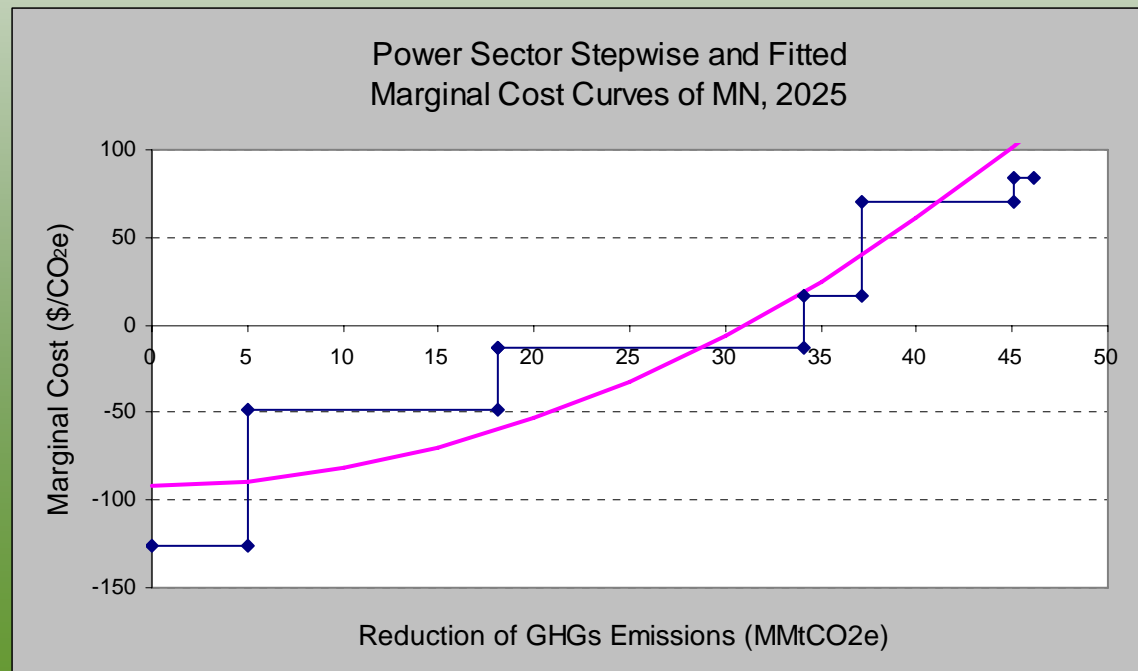
The 2025 emission cap in Minnesota is 30% below the 2005 level. We assume this emission cap applies to each of the three major sectors other than sequestration, i.e., each sector has an emission cap of 70% of its emission level in 2005. Sequestration Sector does not have a cap and we assume its BAU emission in 2025 is zero.

- Next, we develop marginal cost curves for each of the four sectors. In the following figures of sector by sector cost curves, the horizontal axis represents the amount of GHG emission reduction. In previous inter-state simulations, we designated the horizontal axis to represent percentage reduction of emissions. We did not use percentage reduction here because Sequestration Sector has zero emission.

**Power Sector**

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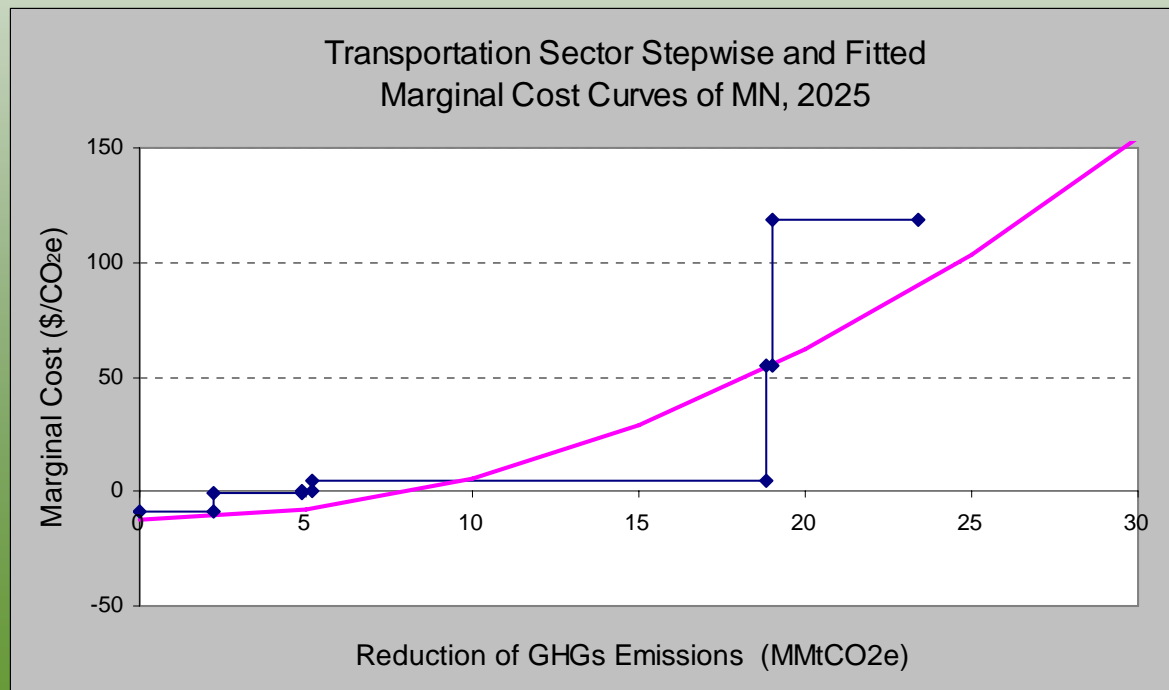
	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO <sub>2</sub> e)	Estimated Cost or Cost Savings per ton GHG Removed	Cumulative GHG Reduction Potential (MMtCO <sub>2</sub> e)
ES-1	Generation Performance Standard	5	-\$126.00	5
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)	13.1	-\$48.00	18.1
ES-4	Transmission System Upgrading, Including Reducing Transmission Line and Distribution System Loss	0	-\$13.00	18.1
ES-5	Renewable and/or Environmental Portfolio Standard	16	-\$13.00	34.1
ES-3	Efficiency Improvements, Repowering and other Upgrades to Existing Plants	3	\$17.00	37.1
ES-6	Nuclear Power Support and Incentives	8	\$70.00	45.1
ES-8	Carbon Capture and Storage and/or Reuse Policies	1	\$84.00	46.1



## Transportation Sector

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	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO <sub>2e</sub> )	Estimated Cost or Cost Savings per ton GHG Removed	Cumulative GHG Reduction Potential (MMtCO <sub>2e</sub> )
AFW-3a	In-State Liquid Biofuels Production_A. Ethanol carbon content	2.2	-\$9.00	2.2
TLU-5	Climate-Friendly Transportation Pricing / Pay as You Drive	2.7	-\$1.00	4.9
TLU-2	Expand Transit, Bicycle, and Pedestrian Infrastructure	0.3	\$0.00	5.2
AFW-3c	In-State Liquid Biofuels Production_C. Gasoline Displacement	13.6	\$5.00	18.8
AFW-3b	In-State Liquid Biofuels Production_B. Fossil diesel displacement	0.19	\$55.00	18.99
TLU-3	Low GHG Fuel Standard (Overlap With AFW-7)	4.4	\$119.00	23.39



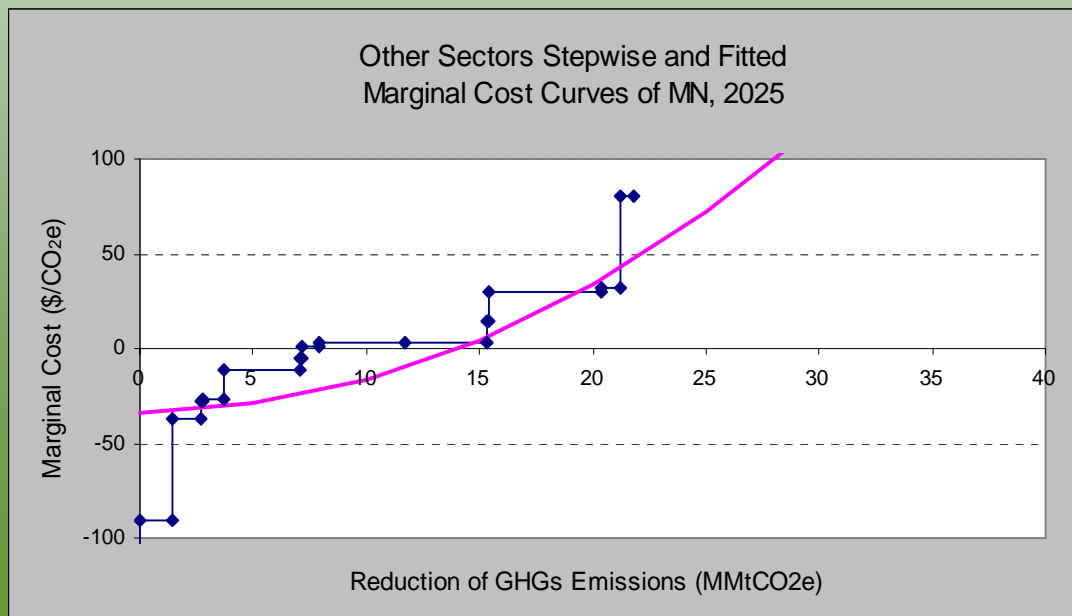
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### Other Sectors

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	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO <sub>2</sub> e)	Estimated Cost or Cost Savings per ton GHG Removed	Cumulative GHG Reduction Potential (MMtCO <sub>2</sub> e)
RCI-2	Improved Uniform Statewide Building Codes	0.005	-\$402.00	0.005
RCI-10	Support Strong Federal Appliance Standards and Require High State Standards in the Absence of Federal Standards	1.4	-\$91.00	1.405
RCI-6	Non-Utility Strategies and Incentives To Encourage Energy Efficiency and Reduce GHG Emissions	1.3	-\$37.00	2.705
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil	0.05	-\$28.00	2.755
RCI-3	Green Building Guidelines and Standards Based on Architecture 2030	0.94	-\$27.00	3.695
AFW-7b	Front-End Waste Management Techs._B. Recycling	3.4	-\$11.00	7.095
RCI-5	Program To Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs	0.05	-\$5.00	7.145
AFW-8a	End of Life Waste Management Practices_A. Landfilled Waste Methane	0.73	\$1.00	7.875
AFW-4	Expanded Use of Biomass Feedstocks for Electricity, Heat, or Steam Production	3.84	\$3.00	11.715
AFW-7a	Front-End Waste Management Techs._A. Source Reduction	3.6	\$3.00	15.315
AFW-7c	Front-End Waste Management Techs._C. Composting	0.08	\$14.00	15.395
RCI-4	Incentives & Resources To Promote Combined Heat and Power (CHP)	4.95	\$30.00	20.345
AFW-8c	End of Life Waste Management Practices_C. WTE Preprocessing	0.84	\$32.00	21.185
AFW-8b	End of Life Waste Management Practices_B. Residuals Management	0.63	\$80.00	21.815



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Sequestration

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	Climate Mitigation Actions	Estimated 2025 Annual GHG Reduction Potential (MMtCO <sub>2</sub> e)	Estimated Cost or Cost Savings per ton GHG Removed	Cumulative GHG Reduction Potential (MMtCO <sub>2</sub> e)
AFW-1b	Agricultural Crop Management_B. Nutrient Management	1.35	-\$37.00	1.35
AFW-5b	Forestry Management Programs to Enhance GHG Benefits_B. Urban forestry	2.7	-\$12.00	4.05
AFW-1a	Agricultural Crop Management_A. Soil Carbon Management	1.3	-\$2.00	5.35
AFW-6	Forest Protection—Reduced Clearing and Conversion to Non-Forest Cover	2.7	\$2.95	8.05
AFW-5a	Forestry Management Programs to Enhance GHG Benefits_A. Forestation	2.19	\$13.00	10.24
AFW-2a	Land Use Management Approaches for Protection and Enrichment of Soil Carbon_A. Preserve Land	0.44	\$33.00	10.68
AFW-5d	Forestry Management Programs to Enhance GHG Benefits_D. Restocking	8.4	\$33.45	19.08
AFW-2b	Land Use Management Approaches for Protection and Enrichment of Soil Carbon_B. Reinvest in Minnesota—Clean Energy (RIM-CE)	0.19	\$34.00	19.27

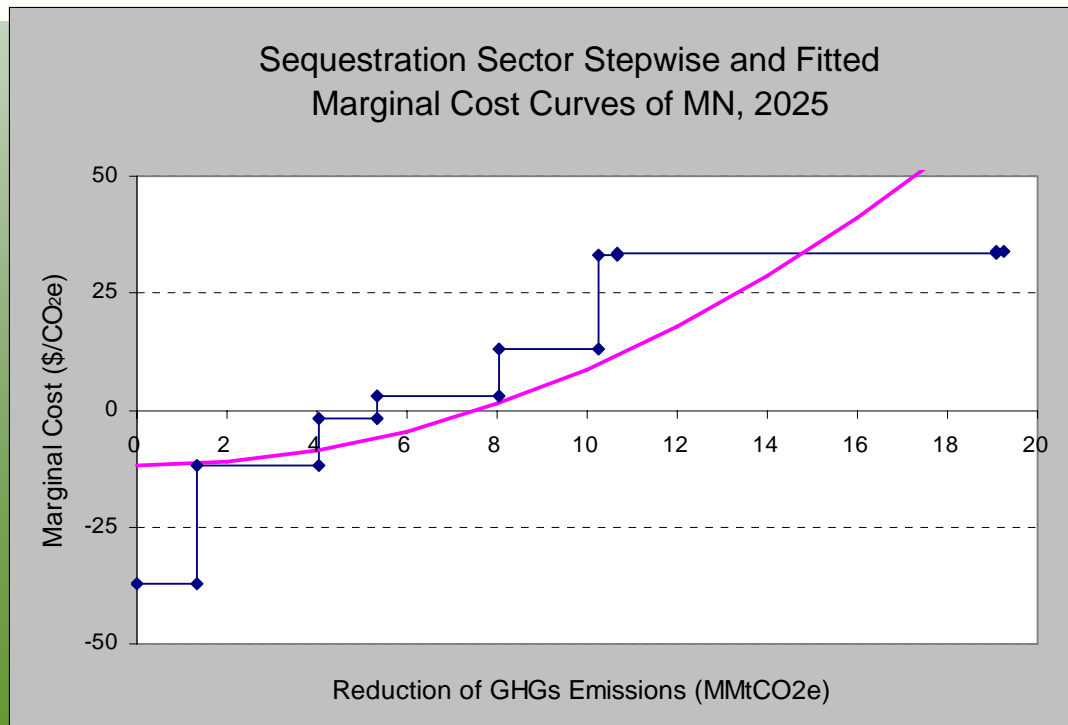


Table 5. Emission Trading Simulation Among Four Sectors in Minnesota  
(assume no CIP/RES in baseline)  
(million dollars or otherwise specified)

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)
Power Sector	-1,889	-1,826	-128	-1,954	65	-4.48	35.53	52.97	46.29
Transportation Sector	163	16	106	122	41	3.70	14.89	33.36	41.64
Other	1,064	-245	422	176	887	14.75	19.14	24.38	43.16
Sequestration	0	21	-399	-378	378	-13.97	13.97	n.a.	n.a.
Total	-663	-2,034	0	-2,034	1,372	18.45 <sup>b</sup>	83.53	43.91	43.91

<sup>a</sup> Permit Price = \$28.58/tonCO<sub>2</sub>e.

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

The simulation results show that Transportation Sector and Other Sector would buy permits from Power Sector and Sequestration Sector.

Table 6. Emission Trading Simulation Among Four Sectors in Minnesota  
 (assume with CIP/RES in baseline)  
 (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)
Power Sector	-324	-284	-84	-368	44	-2.59	11.90	26.24	20.53
Transportation Sector	163	37	98	135	28	3.03	15.56	34.86	41.64
Other Sector	1,063	-228	459	231	832	14.17	19.72	25.11	43.16
Sequestration	0	41	-473	-432	432	-14.61	14.61	n.a.	n.a.
Total	903	-435	0	-434	1,337	17.20 <sup>b</sup>	61.78	36.67	36.67

<sup>a</sup> Permit Price = \$32.38/tonCO<sub>2</sub>e.

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

The simulation results show that Transportation Sector and Other Sector would buy permits from Power Sector and Sequestration Sector.

Table 7. Emission Trading Simulation Among Four Sectors in Minnesota  
(assume with only RES in baseline)  
(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)
Power Sector	-1,555	-1,558	2	-1,555	0	0.07	25.72	41.62	41.72
Transportation Sector	163	70	79	149	14	2.09	16.50	36.97	41.64
Other	1,064	-199	507	308	755	13.35	20.54	26.16	43.16
Sequestration	0	72	-589	-517	517	-15.50	15.50	n.a.	n.a.
Total	-328	-1,615	0	-1,615	1,286	15.50 <sup>b</sup>	78.27	42.32	42.32

<sup>a</sup> Permit Price = \$38.00/tonCO<sub>2</sub>e.

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

The simulation results show that Power Sector, Transportation Sector, and Other Sector would buy permits from Sequestration Sector.

# Public Input & Announcements