Chapter 1
Background and Overview

The Governor's Initiative

On December 12, 2006, Minnesota Governor Tim Pawlenty announced the state's "Next Generation Energy Initiative," including "development of a comprehensive plan to reduce Minnesota's emissions of greenhouse gases (GHGs)." In this announcement, the Governor requested assistance from the Center for Climate Strategies (CCS) in the development of a Minnesota Climate Mitigation Action Plan (Action Plan) and formation of the Minnesota Climate Change Advisory Group (MCCAG). This broad-based group of Minnesota citizens and leaders was charged with developing a comprehensive set of state-level policy recommendations to the Governor through a stakeholder-based consensus building process facilitated by CCS in coordination with the Minnesota Department of Commerce (DOC) and Minnesota Pollution Control Agency (PCA).

This report documents the results of the MCCAG's work. This chapter provides an overview of what Minnesota is already doing to control GHG emissions, lists the MCCAG's recommendations for additional action to control GHG emissions, and evaluates the potential effects of the MCCAG's recommendations (coupled with progress under way) toward meeting Minnesota's statewide GHG reduction goals. Chapter 2 provides a summary of Minnesota's historic and forecasted GHG emissions. Chapters 3 through 8 summarize the MCCAG's recommendations that are documented in detail in Appendixes E through K. Appendix A of the report contains Governor Pawlenty's invitation to CCS to facilitate and provide technical support to Minnesota's process for developing its Action Plan. Appendix B provides a copy of the memorandum that outlines the process. Appendix C provides the list of Technical Work Group (TWG) members, and Appendix D provides the reference to the final report for Minnesota's GHG emissions inventory and reference case projections.

Recent Developments

Next Generation Energy Act of 2007 and Statewide GHG Reduction Goals

On May 25, 2007, Governor Tim Pawlenty signed the Next Generation Energy Act of 2007.[1] This state law, coupled with other state initiatives to control GHG emissions, positions Minnesota as a leader on the way toward our nation's energy future. The Next Generation Energy Act of 2007 includes requirements for Minnesotans to increase energy efficiency and expand community-based energy development. In addition, it established a statewide goal to reduce GHG emissions. The state law also supplements the aggressive 25x'25 renewable energy standard proposed by the Governor and signed earlier this year.

The Act established aggressive goals for Minnesotans to reduce statewide GHG emissions across all sectors to a level at least 15% below 2005 levels by 2015, to a level at least 30% below 2005 levels by 2025, and to a level at least 80% below 2005 levels by 2050. In 2005, Minnesota's

[1] Minnesota Session Laws 2007, Chapter 136, S.F. (Senate File) No. 145, http://www.revisor.leg.state.mn.us/bin/getbill.php?number=SF145&session=ls85&version=list&session_number=0&session_year=2007

GHG emissions were 152 million metric tons (MMt) of carbon dioxide equivalent (CO_2e) and, if no reducing actions were taken, the state's GHG emissions would be almost 198 $MMtCO_2e$ in 2025.

This means that to meet the 2015 emissions goal, Minnesotans will have to reduce their emissions to about 131.8 $MMtCO_2e$ (or by about 41.3 $MMtCO_2e$ below 2015 levels). To meet the 2025 emissions goal, Minnesotans will have to reduce their emissions to about 108.5 $MMtCO_2e$ (or by about 89 $MMtCO_2e$ below 2025 levels).

Note that MCCAG chose to focus its quantitative analyses on achieving the 2015 and 2025 GHG reduction goals. The MCCAG felt that extending the emissions forecast and estimating the effects of its policy recommendations in 2050 is just too speculative at this time. It is expected that full and complete implementation of all of the recent actions and MCCAG's recommendations will set Minnesota on course to meet the 2050 goal, which will require a transformation in how Minnesotans generate and use energy and identify ways to sequester carbon.

GHG Reductions Associated With Recent Actions[2]

At the beginning of the MCCAG process, DOC and PCA identified more than 40 different actions Minnesota has undertaken to control GHG emissions while at the same time conserving energy and promoting the development and use of renewable energy sources.[3] These actions also include assessments of both terrestrial and geologic carbon storage opportunities in Minnesota. The MCCAG recognized the importance of these recent actions as essential for setting Minnesota on the path toward meeting its aggressive statewide goals and used these actions to formulate the baseline from which it considered and developed its wide range of recommendations to ensure that Minnesota stays the course toward meeting its goals.

A total of nine recent actions were identified for which data were available to estimate the emission reductions and costs/cost savings of the actions relative to the business-as-usual reference case projections. Other actions were not analyzed because they were enabling policies (e.g., studies, technical assistance, loan programs, or program funding), their emission reductions would be double-counted with the emission reductions quantified for one of the nine actions, or because data were not readily available to quantify their reductions. Figure 1-1 illustrates the emission reductions associated with each of the nine recent actions analyzed. Table 1-1 provides the numeric estimates underlying Figure 1-1 and shows the costs or cost savings estimated for each of the actions.

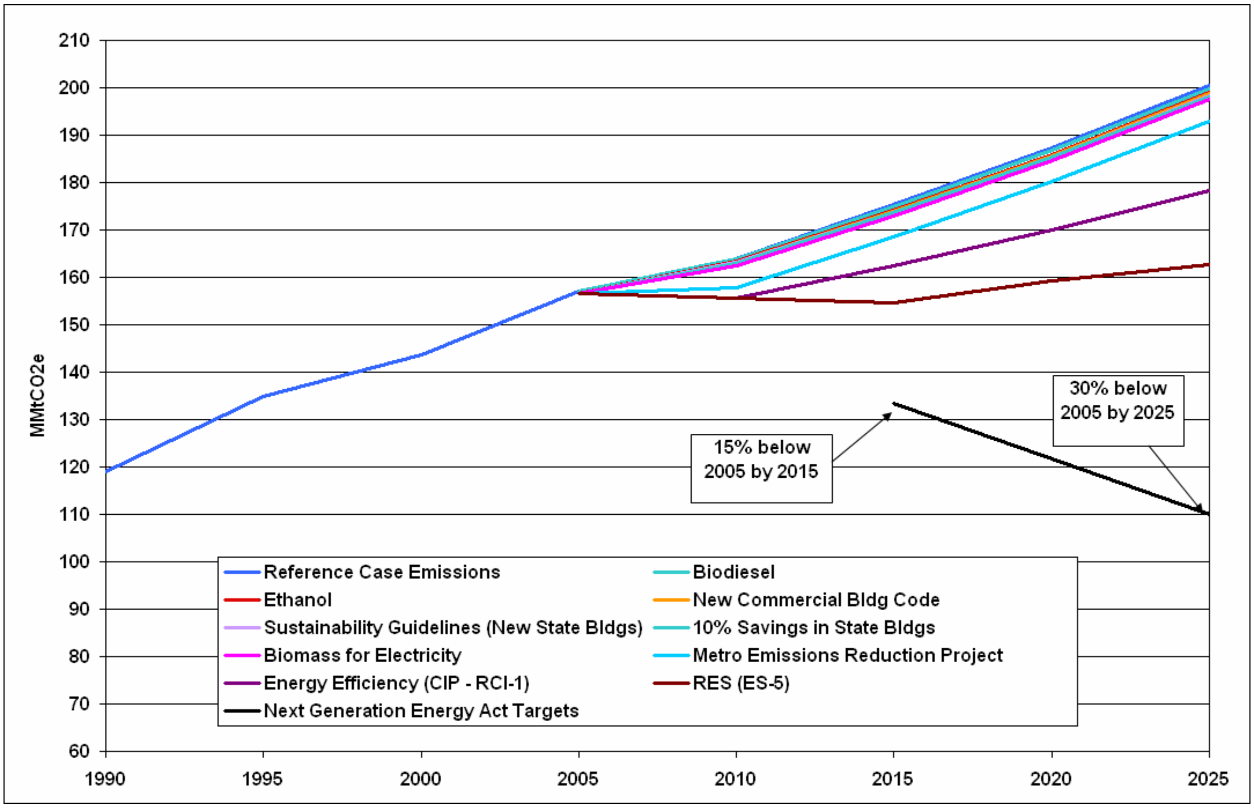
Implementation of the recent actions analyzed indicates that emissions reductions will be about 50% of the total emission reductions needed to meet the state's 2015 goal and about 42% of the total emission reductions needed to meet the state's 2025 goal. These results underscore the importance of the contribution of these recent actions toward Minnesota's ability to meet its statewide reduction goals. Note that the MCCAG selected two of the recent actions as priorities for analysis during its process in order to develop detailed emission reduction and cost/cost

[2] Note that actions recently adopted by the state of Minnesota have also been referred to as "existing" actions.

[3] A summary of these actions can be found on the MCCAG's project Web site under "Background, What MN Is Already Doing?" at: http://www.mnclimatechange.us/background-alreadydoing.cfm

savings estimates for these actions, as well as to consider the possibility of increasing the stringency of the recent actions. These two actions include the Conservation Improvement Program (CIP) and the Renewable Energy Standard (RES). The CIP and RES together account for more than 66% and 80% of the total reductions for all of the recent actions together in 2015 and 2025, respectively. The costs associated with the RES are significantly (but not completely) offset by the cost savings associated with the CIP. The following provides a brief summary of each of the nine recent actions.

Figure 1-1. Emission reductions associated with recent actions in Minnesota (consumption-basis, gross emissions)



CIP = Conservation Improvement Program; RCI = Residential, Commercial, and Industrial [sectors]; RES = Renewable Energy Standard; ES = Energy Supply.

It is important to note that the top line in Figure 1-1 represents total emissions associated with all GHG-emitting activities across all sectors in Minnesota on a consumption basis prior to the implementation of any existing actions. For the electricity supply sector, this assumes the installation of the planned Big Stone 2 and Mesaba coal units and an assumed electricity demand growth rate of 2.04% per year.

New Commercial Building Code: Beginning in 2009, Minnesota will implement one of the most stringent commercial building codes in the country. It will combine best construction practices with acceptance testing to ensure that systems are working properly. Minnesota's new commercial building code will achieve a 30% better energy performance over a typical commercial building.[4]

Sustainable Building Guidelines for New State Buildings: New buildings developed using state bonds must adhere to the State's sustainable design guidelines. These guidelines ensure that all new state buildings initially exceed existing energy code by at least 30%. The guidelines focus on achieving the lowest possible lifetime cost for new buildings and encourage continual energy conservation improvements as well as use of renewable energy systems.[5]

Table 1-1. Emission reductions and costs/cost savings associated with recent actions in Minnesota (consumption-basis, gross emissions)

Sector / Recent Action	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effective-ness ($\$/tCO_2e$)
	2015	2025	Total 2008–2025		
Residential, Commercial, and Industrial (RCI)					
New Commercial Building Code	0.18	0.21	3.16	–$1.8	–$0.6
Sustainability Guidelines (New State Buildings)	0.22	0.46	4.72	–$1.7	–$0.4
10% Savings in State Buildings	0.09	0.11	1.75	–$0.9	–$0.5
Conservation Improvement Program (CIP)	6.01	14.72	133.8	–$8,449	–$63.2
RCI Totals	6.50	15.50	143.4	–$8,454	–$59.0
Energy Supply (ES)					
Biomass for Electricity	0.60	0.60	11.4	$285.3	$25.0
Metro Emissions Reduction Project	4.52	4.52	80.4	$2,330	$29.0
Renewable Energy Standard (RES)	7.72	15.7	133.1	$7,502	$56.4
ES Totals	12.8	20.8	225	$10,116	$45.0
Transportation and Land Use (TLU)					
Biodiesel	0.64	0.75	8.1	*Not quantified*	*Not quantified*
Ethanol	0.78	0.79	12.1	*Not quantified*	*Not quantified*
TLU Totals	1.4	1.5	20.2		
TOTAL (includes all adjustments for overlaps with MCCAG recommendations)	20.7	37.8	385.7	$995.5	$0.4

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO2e = dollars per metric ton of carbon dioxide equivalent.

Negative values represent net cost savings and positive values represent net costs associated with the policy recommendation.

[4] See the following website for additional information: http://www.doli.state.mn.us/buildingcodes.html

[5] For additional information, see http://www.msbg.umn.edu/

Reduce Energy Use by 10% in State-Owned Buildings: On November 10, 2005, Governor Pawlenty signed Executive Order 05-16 instructing all State agencies to undertake measures including, but not limited to, the measures set forth in this order to reduce energy usage in state-owned buildings by 10% over calendar year 2006 compared with calendar year 2005.[6]

Energy Conservation Improvement Program: The Next Generation Energy Act of 2007 establishes an energy policy goal for Minnesota to achieve annual savings equal to 1.5% of annual retail energy sales of electricity and natural gas. At least 1% of these sales should come directly through energy conservation improvement programs and rate design. The additional 0.5% of savings can come indirectly through energy codes and appliance efficiency standards, programs designed to transform the market or change consumer behavior, energy savings resulting from efficiency improvements to the utility infrastructure and system, and other activities to promote energy efficiency and energy conservation. These savings are based on the average of the last 3 years of sales for the utility.

Biomass for Electricity: District Energy St. Paul operates a new combined heat and power plant that uses clean waste wood to generate steam heat and electricity for downtown St. Paul, reducing its dependence on coal by 80%. In addition, the Hibbing and Virginia [MN] Public Utilities created an energy authority, Laurentian Energy, to re-power their coal-fired district heating boilers in Hibbing and Virginia that produce steam and electricity. Laurentian Energy produces 35 megawatts (MW) of power fueled by renewable biomass and closed-loop hybrid poplars. The PCA is working with an energy-intensive industry in St. Paul—Rock-Tenn—and District Energy St. Paul to build a power plant that relies on renewable energy. Rock-Tenn processes half of all recycled paper in the state. Refuse-derived fuel is being explored as a fuel source.[7]

Metro Emissions Reduction Project: Xcel Energy is in the process of replacing three coal-fired power plants in Minnesota with cleaner solutions such as new natural gas-fired plants or retrofitted technology.[8]

Renewable Energy Standard: The Minnesota legislature overwhelmingly passed a bill on February 2007 requiring the state's utilities to generate at least 25% of their electricity from renewables by 2025. Under the new law, Minnesota will add between 5,000 and 6,000 MW of new renewable energy. The law also establishes a renewable energy trading program for utilities by 2008. This legislation is expected to reduce carbon dioxide (CO_2) emissions by about 16% over what they would otherwise have been.

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[6] For additional information, see http://www.governor.state.mn.us/priorities/governorsorders/executiveorders/2005/PROD005605.html

[7] For additional information see "Minnesota Biomass - Hydrogen and Electricity Generation Potential, A study by the National Renewable Energy Laboratory," Golden, Colorado, for the Minnesota Department of Commerce and the Minnesota Office of Environmental Assistance, February 2005, at: http://www.pca.state.mn.us/oea/p2/forum/MNbiomass-NREL.pdf

[8] For additional information, see http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_11824_22655-877-0_0_0-0,00.html and http://www.pca.state.mn.us/hot/xcel.html

Biodiesel: As of September 29, 2005, Minnesota requires nearly all diesel fuel sold in the state to contain at least a 2% biodiesel blend. It is estimated that the 2% fuel use requirement for Minnesota will replace 16 million gallons of diesel fuel.[9]

Ethanol: Minnesota established an ethanol production incentive to provide payment to producers to help develop a new market for Minnesota's agricultural products. On the market side, Minnesota requires that all gasoline sold in the state be blended with a 10% ethanol mix. In addition, Minnesota began efforts in 1997 to develop a network of fueling stations for flex-fuel vehicles that could run on an 85% ethanol blend. As of 2007, Minnesota has more than 300 E85 fueling stations around the state that together sold a total of 18,160,000 gallons of E85 blended gasoline during 2006.[10]

The MCCAG Process

The MCCAG first met on April 20, 2007, and met a total of eight times, with the final decisional meeting held on January 24, 2008, and a final meeting for review of this report. In all, more than 80 meetings and teleconference calls of the MCCAG and the six supporting TWGs were held to identify and analyze various potential policy actions in advance of the MCCAG's January 24, 2008, final decisional meeting.

The six TWGs considered information and potential recommendations in the following sectors:

- Energy Supply (ES);
- Residential, Commercial, and Industrial (RCI);
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste Management (AFW);
- Cross-Cutting Issues (CC); and
- Cap-and-Trade (C&T).

CCS provided facilitation and technical assistance to each of the TWGs and the MCCAG. The TWGs consisted of MCCAG members as well as individuals who were not on the MCCAG but who did have an interest in and expertise regarding the issues being addressed by each TWG (see Appendix C for a listing of the members of each TWG). The TWGs served as advisers to the MCCAG and helped generate initial recommendations on priority policy recommendations for analysis. They then developed draft proposals on the design characteristics and quantification of the proposed policy recommendations. Where members of a TWG did not fully agree on recommendations to the MCCAG, the summary of their efforts was reported to the MCCAG for further consideration and actions. The MCCAG then made its decisions after reviewing the TWGs' proposals.

The MCCAG process involved a model of informed self-determination through a facilitated, stepwise, consensus-building approach. With oversight by DOC and PCA, the process was

[9] For additional information, see http://www.mda.state.mn.us/renewable/biodiesel/default.htm

[10] For additional information, see http://www.mda.state.mn.us/renewable/ethanol/default.htm

conducted by CCS, an independent, expert facilitation and technical analysis team. It was based on procedures that CCS consultants have used in a number of other state climate change planning initiatives since 2000 but was adapted specifically for Minnesota. The MCCAG process sought but did not mandate consensus, and it explicitly documented the level of MCCAG support for some policies and key findings established through a voting process established in advance.

The 46 policy recommendations (out of more than 300 potential options considered) adopted by the MCCAG and presented in this report underwent two levels of screening by the MCCAG. First, a potential policy recommendation being considered by a TWG was not accepted as a "priority for analysis" and fleshed out for full analysis unless it had a supermajority of support from MCCAG members present at the decisional meetings (with "supermajority" defined as four objections or fewer by MCCAG members attending a meeting). Second, after the analyses were conducted, only policy recommendations that received at least majority support (defined as less than half of those present objecting) from MCCAG members present at the decisional meetings were adopted by the MCCAG and included in this report.

Of the 46 policy recommendations adopted by the MCCAG, 38 were approved unanimously, 4 were approved by a supermajority, and 4 were approved by a simple majority.

The TWGs' recommendations to the MCCAG were documented and presented to the MCCAG at each MCCAG meeting. All of the MCCAG and TWG meetings were open to the public and all materials for and summaries of the MCCAG and TWG meetings were posted on the MCCAG Web site.

Analysis of Policy Recommendations

With CCS providing facilitation and technical analysis, the six TWGs submitted recommendations for policies for MCCAG consideration using a "policy option template" conveying the following key information:

Policy Description
Policy Design (Goals, Timing, Parties Involved)
Implementation Mechanisms
Related Policies/Programs in Place
Type(s) of GHG Reductions
Estimated GHG Reductions and Net Costs or Cost Savings
Key Uncertainties
Additional Benefits and Costs
Feasibility Issues
Status of Group Approval
Level of Group Support
Barriers to Consensus

In its deliberations, the MCCAG modified and embraced various policy recommendations. The final versions for each sector, conforming to the policy option templates, appear in Appendixes E through K and constitute the most detailed record of decisions of the MCCAG. Appendix E describes the methods used for quantification of the 31 policy recommendations that were analyzed quantitatively. Three key methods are summarized below.

Estimates of GHG Reductions: Using the projection of future GHG emissions (see below) as a starting point, 31 policy recommendations were analyzed by CCS to estimate GHG reductions attributable to each policy in the individual years of 2015 and 2025 and cumulative reductions over the time period 2008–2025.[11] The CCS estimates were prepared in accordance with guidance by the appropriate TWG and the MCCAG, which later reviewed the estimates and, in some cases, directed that they be revised with respect to such elements as goals, data sources, and methodology. Many policies were estimated to affect the quantity or type of fossil fuel combusted; others affected methane (CH_4) or CO_2 sequestered. Among the many assumptions involved in this task was selection of the appropriate GHG accounting framework, namely, the choice between taking a "production-based" approach versus a "consumption-based" approach to various sectors of the economy.[12] The MCCAG took a "production-based" approach in all sectors except the electricity sector, in both forecasting emissions and in estimating the GHG impacts of policies. This issue, along with other GHG estimation issues (e.g., analysis of overlapping or interacting policy impacts), is discussed in detail in Appendix E (Methods for Quantification).

Estimates of Costs/Cost Savings: The analyses of 25 policy recommendations included estimates of the cost of those policies, both in terms of net costs or cost savings during 2008–2025 and a dollars-per-ton cost (i.e., cost-effectiveness).[13] (The other 6 policy recommendations that were analyzed with respect to their GHG reductions were such that their costs or cost savings could not be readily estimated.) While the cap-and-trade policy (C&T-1) was analyzed and resulted in cost savings, those savings are not included in the aggregate results. This is because the analysis was limited to a single year, 2025, which prevented the calculation of a levelized dollars-per-ton cost-effectiveness number consistent with the other options.)[14] The approach used for the 46 policy recommendations was similar to a conventional cost-benefit framework but had some important differences:

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[11] Since the policies recommended by the MCCAG fully satisfy the GHG reduction goals for 2015 and are within 1 $MMtCO_2e$ of meeting the goal for 2025, the cap-and-trade policy (C&T-1) did not generate 'reductions' of its own (i.e., the 'cap' was met). Instead, C&T-1 enabled the achievement of the projected reductions (within the covered sectors) at a lower cost than would have been possible without the cap-and trade-program.

[12] A production-based approach estimates GHG emissions associated with goods and services produced within the state, and a consumption-based approach estimates GHG emissions associated with goods and services consumed within the state. In some sectors of the economy, these two approaches may not result in significantly different numbers, however, the power sector is notable in that it is responsible for large quantities of GHG emissions, and states often produce more or less electricity than they consume (with the remainder attributable to power exports or imports). Minnesota imports electric power and must account for the emissions this consumption creates, even though they are not produced in-state.

[13] The analysis addressed the costs / cost savings of each policy recommendation and, with the exception of a few recommendations that address rate structures, did not attempt to estimate specific price changes or utility rate changes that might result from implementation of a policy.

[14] The analysis of a regional cap-and-trade program required the development of marginal cost curves for Minnesota and any other jurisdiction participating in the program, which ultimately totaled 22 states and Canadian provinces. The limitations of time and the demands on the model to provide results of multiple scenarios limited the model's results to the single 'snapshot' year of 2025.

- *Discounted and "levelized" costs*—Fairly standard approaches were taken here. The "net present value" of costs was calculated by applying a real discount rate of 5%. Dollars-per-ton estimates were derived as a "levelized" cost per ton, dividing the "present value cost" by the cumulative GHG reduction measured in tons. As was the case with GHG reductions, the period 2008–2025 was analyzed.
- *Benefits vs. costs*—The principal benefit of the MCCAG policy recommendations is reduced GHG emissions and these were quantified simply as metric tons. There was no attempt to monetize the benefit of these reductions in atmospheric concentration (e.g., health benefits). Many policies did create easily monetized non-GHG benefits (e.g., fuel savings and electricity savings). In these cases, monetized benefits were subtracted from monetized costs, resulting in net costs. These net costs could be positive or negative; negative costs indicated that the policy saved money or produced "cost savings."
- *Direct vs. indirect effects*—Cost estimates were based on "direct effects" (i.e., those borne by the entities implementing the policy).[15] Implementing entities could be individuals, companies, and/or government agencies. In contrast, conventional cost-benefit analysis takes the "societal perspective" and tallies every conceivable impact on every entity in society (and quantifies these wherever possible).

Contributing Issues: The MCCAG recommendations were guided in part by the GHG reductions and monetized costs and benefits of various options, but members also felt that other considerations (e.g., social, economic, and environmental) should also have weight. The TWGs were asked to examine these qualitative terms where deemed important and quantify them on a case-by-case, as needed, depending on need and where data were readily available.

Minnesota GHG Emissions Inventory and Reference Case Projections

The CCS, with assistance from the Minnesota PCA, prepared a draft of Minnesota's GHG emissions inventory and reference case projections for the MCCAG.[16] The draft inventory and reference case projections, completed in July 2007, provided the MCCAG with an initial, comprehensive understanding of current and possible future GHG emissions. The draft report was provided to the MCCAG and the TWGs to assist the MCCAG in understanding past, current, and possible future GHG emissions in Minnesota and thereby inform the policy recommendation development process. The MCCAG and TWGs have reviewed, discussed, and evaluated the draft inventory and methodologies as well as alternative data and approaches for improving the draft GHG inventory and forecast. The inventory and forecast was revised to address the comments approved by the MCCAG and was subsequently approved by the MCCAG at its seventh meeting.

The inventory and reference case projections included detailed coverage of all economic sectors and GHGs in Minnesota, including future emissions trends and assessment issues related to

[15] "Additional benefits and costs" were defined as those borne by entities other than those implementing the policy recommendation. These indirect effects were quantified on a case-by-case basis depending on magnitude, importance, need, and availability of data.

[16] *Draft Minnesota Greenhouse Gas Inventory and Reference Case Projections, 1990–2020*, prepared by the Center for Climate Strategies for the Minnesota Pollution Control Agency, July 2007.

energy, economic, and population growth. The assessment included estimates of total statewide "gross emissions" (leaving aside carbon sequestration[17]) on a production basis for all sources and a consumption basis for the electricity sector (see prior discussion under "Analysis of Policy Recommendations" in this chapter for an explanation of the production versus consumption approach). The assessment found that forests and agricultural lands in Minnesota have been a net source rather than a sink of carbon emissions largely due to the loss of these lands to other uses. Consequently, in Minnesota "net emissions" (in which reductions due to sequestration are subtracted from gross emissions) are equal to gross emissions. Further discussion of the issues involved in developing the inventory and reference case projections is summarized in Chapter 2 (Inventory and Projections of GHG Emissions) and discussed in detail in the final report for the inventory and reference case projections.

The inventory and reference case projections revealed substantial emissions growth rates and related mitigation challenges. Figure 1-2 shows the reference case projections for Minnesota's gross GHG emissions as rising fairly steeply to 200 $MMtCO_2e$ by 2025, growing by 68% over 1990 levels. Figure 1-2 also provides the sectoral breakdown of forecasted GHG emissions.

The inventory and projection of Minnesota's GHG emissions provided the following critical findings:

- As is common in many states, the production and consumption of electricity and transportation are the sectors with the largest emissions, and they are expected to continue to grow faster than other sectors.
- Emissions associated with electricity generation and imports to meet in-state demand is projected to be the largest contributor to future emissions growth, followed by emissions associated with the RCI fuel use sectors. Other sources of emissions growth include agriculture, primarily from agricultural soils; transportation fuel use, primarily from on-road diesel; the transmission and distribution of natural gas; and the increasing use of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) as substitutes for ozone-depleting substances (ODSs) in refrigeration, air conditioning, and other applications.

While Minnesota's emissions estimated growth rate (68% from 1990 to 2025 on a gross emissions, consumption basis) presents challenges, it also provides major opportunities. Key choices regarding technologies and infrastructure can have a significant impact on the emissions of a fast growing state. The MCCAG's recommendations document the opportunities for the state to reduce its GHG emissions while continuing its strong economic growth by being more energy efficient, using more renewable energy sources, and increasing the use of cleaner transportation modes, technologies, and fuels.

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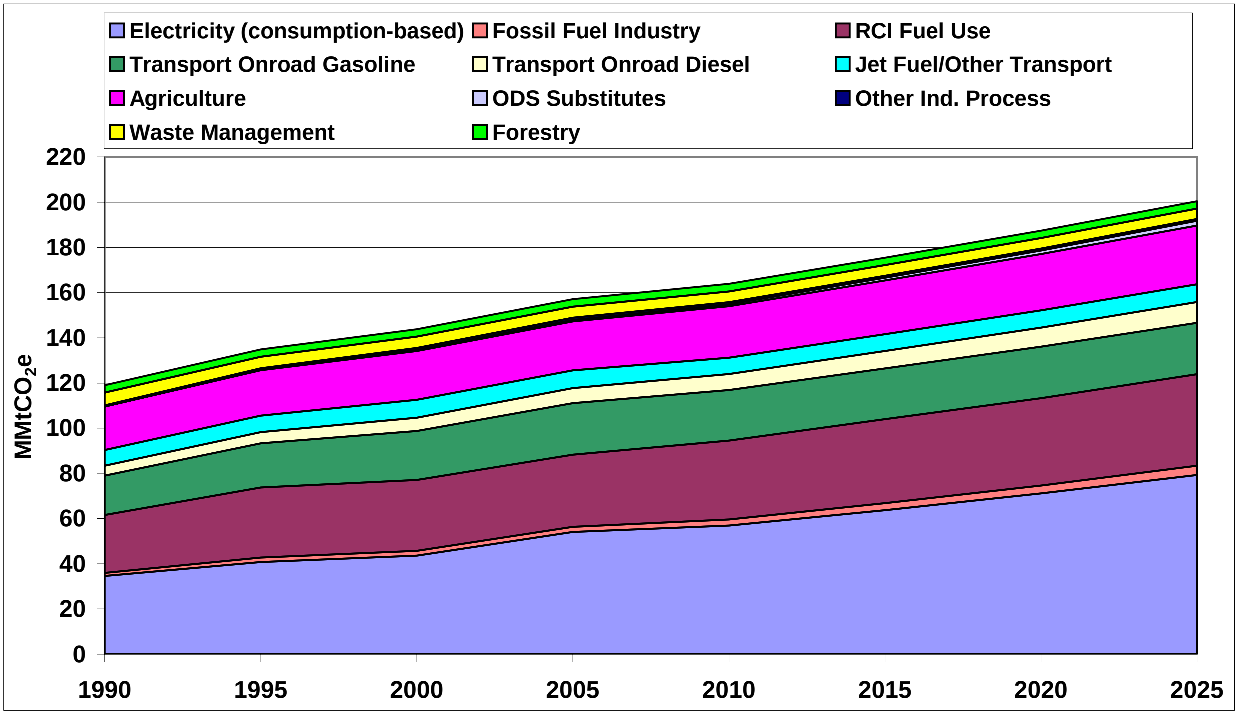
[17] Sequestration refers to the storing of carbon in mines, brine strata, oceans, plants and soil. As trees and other plants grow they remove CO_2, the principal GHG, from the atmosphere transforming the carbon (C) through photosynthesis into cellulose, starch and sugars, thus sequestering it in their structures and roots. The oxygen (O_2) is released back into the atmosphere. Minnesota's forests and agricultural lands are capable of sequestering much CO_2, as described in Chapter 6 (Agriculture, Forestry, and Waste Management).

Figure 1-2. Gross GHG emissions by sector, 1990–2020: historical and projected (consumption-based approach) business as usual/base case



RCI = direct fuel use in residential, commercial, and industrial sectors; ODS = ozone depleting substance.

MCCAG Policy Recommendations (Beyond Recent Actions)

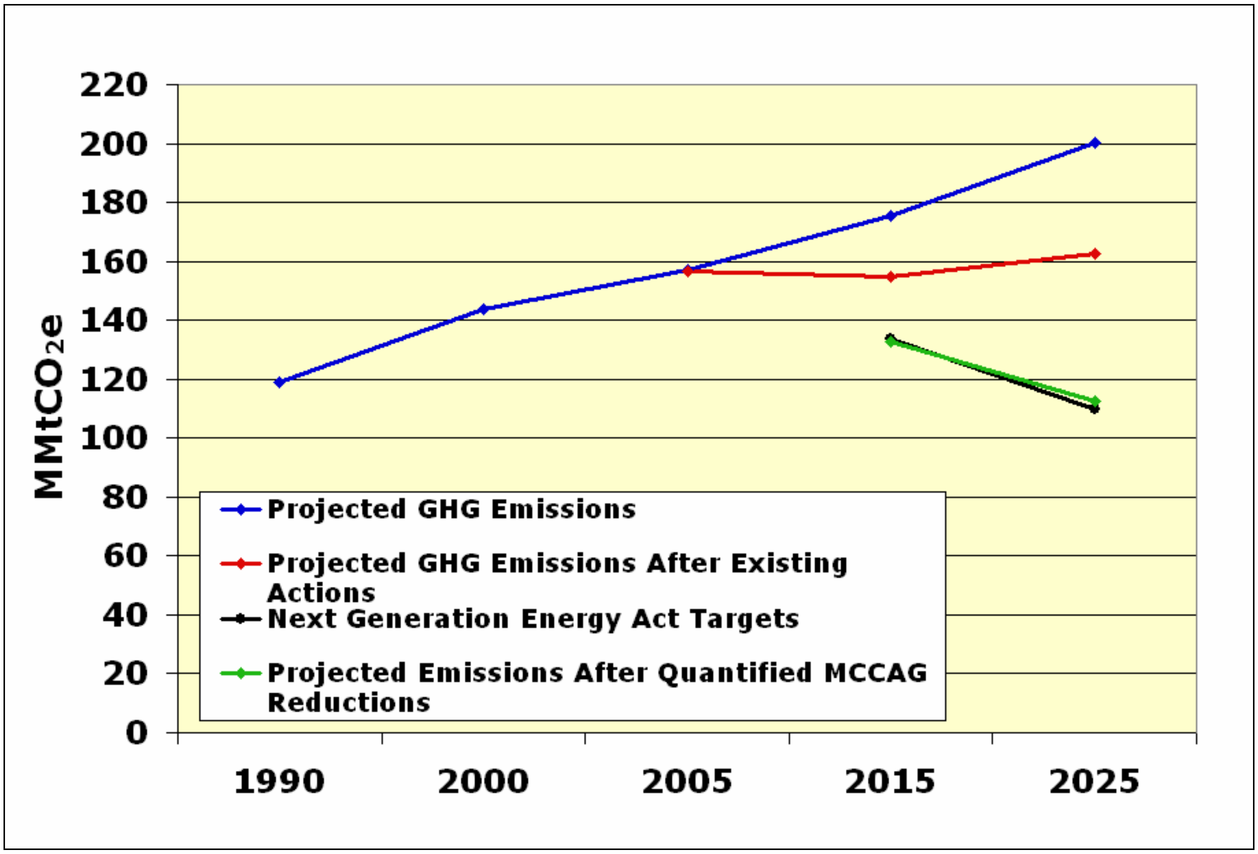
The MCCAG recommended 46 policy actions. The MCCAG members present and voting approved 38 policy actions unanimously, approved 4 by a supermajority (four objections or fewer), and approved 4 by a majority (less than half object). Explanations of both individual objections and qualifications are in the appendixes to this report, which contain detailed accounts of the MCCAG's recommendations.

Figure 1-3 presents a summary of the policy recommendations for which emission reductions were quantified. Table 1-2 provides the numeric estimates underlying Figure 1-3. In Figure 1-3,

- Actual (for 1990, 2000, and 2005) and projected (for 2015 and 2025) levels of Minnesota's gross GHG emissions on a consumption basis are shown by the blue line. (The consumption-based approach accounts for emissions associated with the generation of electricity in-state and imported from out-of-state to meet Minnesota's demand for electricity.)
- Projected emissions associated with Minnesota's existing actions that were analyzed quantitatively are shown by the red line.
- Projected emissions if all of the MCCAG's 31 recommendations that were analyzed quantitatively with respect to their GHG reduction potential are completely implemented and the estimated reductions are fully achieved are shown by the green line. (Note that other MCCAG recommendations would have the effects of reducing emissions, but those reductions were not analyzed quantitatively and they are not reflected in the green line.)

- Projected emissions associated with Minnesota's statewide GHG reduction targets are shown by the black line.

Figure 1-3. Annual GHG emissions: reference case projections and MCCAG recommendations (consumption-basis, gross emissions)



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; MCCAG = Minnesota Climate Change Advisory Group.

Table 1-2. Annual emissions: reference case projections and impact of MCCAG recommendations (consumption-basis, gross emissions)

Annual Emissions ($MMtCO_2e$)	1990	2000	2005	2015	2025
Reference Case Projections	119.0	143.8	157.1	175.5	200.5
Reductions From Recent Actions	0.0	0.4	0.4	20.8	37.8
Projected GHG Emissions After Recent Actions			156.6	154.7	162.6
Next Generation Energy Act Targets				133.5	110.0
Total GHG Reductions From MCCAG Recommendations				22.2	50.3
Difference Between MCCAG Reductions and Next Generation Energy Act Targets				–1.0	2.4
Projected Annual Emissions After Quantified MCCAG Reductions				132.5	112.4

$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; MCCAG = Minnesota Climate Change Advisory Group.

The MCCAG approved 46 recommendations to reduce emissions, of which 31 were analyzed quantitatively to estimate their effects on emissions and 25 were analyzed quantitatively to estimate their costs/cost savings. The analyzed measures were estimated to have a cumulative effect of reducing emissions by about 22 $MMtCO_2e$ in 2015 and 50 $MMtCO_2e$ in 2025. Together, the estimated emission reductions associated with the MCCAG's recommendations and recent actions would be enough to achieve Minnesota's GHG reduction goal for 2015 and be within 2.4 $MMtCO_2e$ of meeting Minnesota's goal for 2025. The 25 recommendations analyzed in terms of their cost-effectiveness were estimated to have a total net cost of about $726 million between now and 2025, representing the incremental cost to the recent actions. While the MCCAG's 15 other recommendations were not readily quantifiable, many of them would likely achieve additional reductions and net savings (e.g., recommendations for the TLU sector). Should Minnesota implement the MCCAG's recommendations to participate in a cap-and-trade program, opportunities exist for reducing the costs associated with the MCCAG's policy recommendations for the electricity supply sector. In addition, emerging technologies may hold the potential to reduce emissions even more.

Table 1-3 provides a summary by sector of the estimated cumulative impacts of implementing all of the MCCAG's recommendations. Table 1-4 shows the estimated GHG reductions, costs, or savings from each policy recommendation and the recommendation's cost-effectiveness (cost or savings per ton of reduction) upon which the cumulative impacts in Table 1-3 are based. Note that the cumulative impacts shown in Table 1-3 account for overlaps between policies by eliminating potential double counting of emission reductions and costs or cost savings. Chapters 3 through 8 and the Appendixes provide detailed descriptions and analysis of GHG reductions, costs or cost savings, additional impacts, and feasibility for each policy developed by the six TWGs for each sector.

In order for the policies recommended by the MCCAG to yield the levels of estimated emission reductions and cost savings shown in Table 1-3, the policies must be implemented in a timely, aggressive, and thorough manner. In some cases, the actions recommended by the MCCAG are precise, concrete steps. In other cases, the recommendations are more general, and work must be done to develop precise, concrete steps to achieve goals recommended by the MCCAG. In the latter case, the additional work to identify precise, concrete actions is needed before they can be implemented. While there are considerable benefits to both the environment and to consumers from implementation of the policy recommendations, careful, comprehensive, and detailed planning and implementation as well as consistent support of these policies will be required if these benefits are to be achieved. It should be noted that the MCCAG's policy recommendations complement the numerous other climate-related efforts underway in Minnesota outlined at the beginning of this chapter, underscoring the potential co-benefits of their implementation.

Table 1-3. Summary by sector of estimated impacts of implementing all of the MCCAG recommendations (cumulative reductions and costs/savings)

Sector	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2015	2025	Total 2008–2025		
Residential, Commercial, and Industrial (RCI, non-electricity)	0.76	0.69	10.41	–$464	–$44.6
Integrated RCI and ES for electricity	1.56	7.34	51.06	–$1,098	–$21.5
Energy Supply (ES, including RCI options with impacts on electricity consumption, and adjusted for RCI and ES electricity options that overlap)	1.97	3.43	37.55	$462.2	–$12.3
Transportation and Land Use	4.70	9.30	91.2	–$264	N/A
Agriculture, Forestry, and Waste Management	13.2	29.5	279	$2,090	$7
Cross-Cutting Issues	*Non-quantified, enabling options*				
TOTAL (includes all adjustments for overlaps and recent actions)*	**20.2**	**50.3**	**469.2**	**$725.8**	**N/A**

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net *cost savings* associated with the options. Within each sector, values have been adjusted to eliminate double counting for options or elements of options that overlap. In addition, values associated with options or elements of options within a sector that overlap with options or elements of options in another sector have been adjusted to eliminate double counting.

N/A = not available; for TLU policies, an overall cost-effectiveness value is not provided because costs or cost savings were not estimated for all of the policies (due to the lack of data) for which emission reductions were estimated. Similarly, an overall cost-effectiveness value for all sectors is not provided for the same reason.

Note that the row in Table 1-3 for the RCI sectors includes only that portion of RCI emissions reductions and net cost savings that are from RCI options (or elements of options) that affect fuels combusted for purposes other than generating electricity. RCI emissions reductions and net cost savings that affect electricity use or generation are included in the "Integrated RCI and ES for electricity" row in Table 1-3 because the benefits and costs of electricity-sector options are dependent on the electrical load served, which is affected by RCI electricity savings.

Table 1-4. Residential, Commercial, and Industrial Policy Recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value (Million $)	Cost-Effective-ness ($/t$CO_2$e)	Level of Support
		2015	2025	Total (2008–2025)			
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP) *	*Quantified as a "Recent Action"*					Enacted
RCI-2	Improved Uniform Statewide Building Codes	0.004	0.005	0.077	–$44	–$576	Unanimous
RCI-3	Green Building Guidelines and Standards Based on *Architecture 2030*	0.62	0.94	11.1	–$296	–$27	Unanimous
RCI-4	Incentives and Resources to Promote Combined Heat and Power (CHP)	0.96	4.95	33.1	$125	$3.8	Unanimous
RCI-5	Program to Reduce Emissions of Non-Fuel, High-Global-Warming-Potential GHGs	0.02	0.05	0.5	–$2	–$5	Unanimous
RCI-6	Non-Utility Strategies and Incentives to Encourage Energy Efficiency and Reduce GHG Emissions	0.25	1.30	8.3	–$307	–$37	Unanimous
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency	0.05	0.05	0.7	–$21	–$28	Unanimous
RCI-8	Energy Performance Disclosure	*Not quantified*					Unanimous
RCI-9	Promote Technology-Specific Applications to Reduce GHG Emissions	*Not quantified*					Unanimous
RCI-10	Support Strong Federal Appliance Standards and Require High State Standards in the Absence of Federal Standards	0.8	1.4	15.3	–$1,895	–$124	Unanimous
	Sector Total After Adjusting for Overlaps (RCI, Non-Electricity)	**0.76**	**0.69**	**10.41**	**–$464**	**–$44.6**	
	Sector Total After Adjusting for Overlaps (Integrated RCI and ES for Electricity)	**1.56**	**7.34**	**51.06**	**–$1,098**	**–$21.5**	
	Reductions From Recent Actions	**6.50**	**15.50**	**143.4**	**–$8,454**	**–$59.0**	
	New Commercial Building Code	**0.18**	**0.21**	**3.16**	**–$1.8**	**–$0.6**	
	Sustainability Guidelines (New State Buildings)	**0.22**	**0.46**	**4.72**	**–$1.7**	**–$0.4**	
	10% Savings in State Buildings	**0.09**	**0.11**	**1.75**	**–$0.9**	**–$0.5**	
	RCI-1: New CIP*	**6.01**	**14.72**	**133.8**	**–$8,449**	**–$63.2**	
	Sector Total Plus Recent Actions	**8.82**	**23.5**	**204.9**	**–$10,016**	**–$48.9**	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent; ES = Energy Supply.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

Only the results of recommendations included in the final tabulation of GHG reductions and costs are shown in this table. For discussion of any sensitivity analyses undertaken, please see the discussion in RCI Appendix F, Annex 1.

* The CIP considered here is based on the CIP requirements (i.e., 1.5% energy savings goal) included in the Next Generation Energy Act of 2007; therefore, the emission reductions and cost savings estimated are included under "recent actions."

Table 1-4 (continued). Energy Supply Policy Recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effective-ness ($\$/tCO_2e$)	Level of Support
		2015	2025	Total (2008–2025)			
ES-1	Generation Performance Standard	0.0	0.0	0.0	$0	$0.0	Majority (16 objections)
ES-3	Efficiency Improvements, Re-powering and other Upgrades to Existing Plants	1.8	3.0	33.3	$554.4	$16.7	Unanimous
ES-4	Transmission System Upgrading, Including Reducing Transmission Line and Distribution System Loss	0.2	0.4	3.9	–$92.2	–$26.1	Unanimous
ES-5	Renewable and/or Environmental Portfolio Standard *	*Quantified as a "Recent Action"*					Enacted
ES-6	Nuclear Power Support and Incentives	0	0	0	$0	$0	Unanimous
ES-8	Advanced Fossil Fuel Technology Incentives, Support or Requirements, Including Carbon Capture and Storage	0.0	0.0	0.0	$0	$0.0	Unanimous
ES-10	Voluntary GHG targets	*Not quantified*					Unanimous
ES-12	Distributed Renewable Energy Incentives and/or Barrier Removal	0.021	0.023	0.37	$29.1	$78.1	Unanimous
ES-13	Technology-Based Approaches, Including Research and Development, Fuel Cells, Energy Storage, Distributed Renewable Energy Technologies, etc.	*Not quantified*					Unanimous
	Sector Total After Adjusting for Overlaps	**2.0**	**3.4**	**37.5**	**$462.2**	**$12.3**	
	Reductions From Recent Actions	**12.8**	**20.8**	**225**	**$10,116**	**$45.0**	
	Biomass for Electricity	**0.60**	**0.60**	**11.4**	**$285.3**	**$25.0**	
	Metro Emissions Reduction Project	**4.52**	**4.52**	**80.4**	**$2,330**	**$29.0**	
	ES-5: Renewable Energy Standard*	**7.72**	**15.7**	**133.1**	**$7,502**	**$56.4**	
	Sector Total Plus Recent Actions	**14.8**	**24.2**	**262.5**	**$10,578**	**$40.3**	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

All totals are relative to the underlying assumption that electricity expansion in Minnesota proceeds with the recently legislated Conservation Improvement Program (CIP), Renewable Energy Standard (RES), and all planned additions including the Mesaba and Big Stone 2 stations.

* The RES considered here is based on the RES requirements included in the Next Generation Energy Act of 2007; therefore, the emission reductions and cost s estimated are included under "recent actions."

Table 1-4 (continued). Transportation and Land Use Policy Recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$) 2015	2025	Total 2008–2025	Net Present Value 2008–2025 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of Support
TLU Area 1: Reduce VMT (VMT goal to be established based on VMT implied by selected strategies)							
TLU-1	Improved Land-Use Planning and Development Strategies	0.7	1.9	14.9	*Net savings*	*Net savings*	Unanimous
TLU-2	Expand Transit, Bicycle, and Pedestrian Infrastructure	0.1	0.3	3.0	$0	$0	Unanimous
TLU-5	Climate-Friendly Transportation Pricing/Pay as You Drive	1.1	2.1	20.9	–$1	–$1	Super-majority (3 objections)
TLU-7	“Fix-it-First” Transportation Investment Policy and Practice	*Not quantified*					Super - majority (2 objections)
TLU-9	Workplace Tools To Encourage Carpooling, Bicycling, and Transit Ridership	0.3	0.4	4.5	*Large net savings*	*Large net savings*	Unanimous
TLU-14	Freight Mode Shifts: Intermodal and Rail	*N/A*					Super - majority (1 objection)
TLU Area 2: Reduce Carbon per Unit of Fuel							
TLU-3	Low-GHG Fuel Standard	1.7	3.6	36.2	*Not quantified*		Unanimous
TLU Area 3: Reduce Carbon per Mile and/or per Hour							
TLU-4	Infrastructure Management	0.04	0.1	0.7	*Not quantified*		Unanimous
TLU-6	Adopt California Clean Car Standards	0.74	1.16	13.1	–$263	–$39	Majority (16 objections)
TLU-12	Voluntary Fleet Emission Reductions	0.4	0.4	6.1	*Not quantified*		Unanimous
TLU-13	Reduce Maximum Speed Limits	0.4	0.4	6.1	*N/A*	$50 at $2.40/gal –$19 at $3.40/gal	Majority (16 objections)
	Sector Total After Adjusting for Overlaps	**4.7**	**9.3**	**91.2**	**–$264**	***Not quantified***	
	Reductions From Recent Actions	**1.4**	**1.5**	**20.2**	***Not quantified***		
	Biodiesel	**0.64**	**0.75**	**8.1**			
	Ethanol	**0.78**	**0.79**	**12.1**			
	Sector Total Plus Recent Actions	**6.1**	**10.8**	**111.4**	**–$264**	***Not quantified***	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent, VMT = vehicle miles traveled; N/A = not available.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

Table 1-4 (continued). Agriculture, Forestry, and Waste Management Policy Recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effective-ness ($/$tCO_2e$)	Level of Support
		2015	2025	Total 2008–2025			
AFW-1	Agricultural Crop Management						Unanimous
	A. Soil Carbon Management	0.72	1.3	15	–$34	–$2	
	B. Nutrient Management	0.79	1.3	15	–$543	–$37	
AFW-2	Land Use Management Approaches for Protection and Enrichment of Soil Carbon						Unanimous
	A. Preserve Land	0.15	0.44	3.7	$120	$33	
	B. Reinvest in Minnesota–Clean Energy (RIM-CE)	0.09	0.19	1.8	$59	$34	
	C. Protection of Peatlands & Wetlands	*Not Quantified*					
AFW-3	In-State Liquid Biofuels Production						Super Majority (4 objections)
	A. Ethanol Carbon Content	1.8	2.2	27	–$242	–$9	
	B. Fossil Diesel Displacement	0.03	0.19	1.4	$74	$55	
	C. Gasoline 35% Displacement	2.8	9.1	73	$336	$5	
AFW-4	Expanded Use of Biomass Feedstocks for Electricity, Heat, or Steam Production	1.3	3.8	31	$102	$3	Unanimous
AFW-5	Forestry Management Programs to Enhance GHG Benefits						Unanimous
	A. Forestation	0.55	2.2	17	$218	$13	
	B. Urban Forestry	1.2	2.7	26	–$295	–$12	
	C. Wildfire Reduction	*Not Quantified*					
	D. Restocking	2.1	8.4	65	$2,187	$33	
	E. Forest Health and Enhanced Sequestration	*Not Quantified*					
AFW-6	Forest Protection—Reduced Clearing and Conversion to Non-Forest Cover	2.2	2.7	34	$101	$3	Unanimous
AFW-7	Front-End Waste Management Technologies						Unanimous
	A. Source Reduction	0	3.6	20	$59	$3	
	B. Recycling	3.1	3.4	45	–$207	–$5	
	C. Composting	0.29	0.41	4.9	$137	$28	
AFW-8	End-of-Life Waste Management Practices						Unanimous
	A. Landfill Methane Recovery	0.07	0.73	4.4	$5.7	$1	
	B. Residuals Management	0.52	0.63	8.1	$650	$80	
	C. WTE Preprocessing	0.37	0.84	7.9	$257	$32	
	Sector Total After Adjusting for Overlaps*	**13.2**	**29.5**	**279**	**$2,090**	**$7**	
	Reductions From Recent Actions	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
	Sector Total Plus Recent Actions	**13.2**	**29.5**	**279**	**$2,090**	**$7**	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; WTE = waste-to-energy.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

*Overlaps include an assumed 100% overlap of AFW-3b&3c with TLU-3 (reductions excluded from AFW totals); an assumed 100% overlap of AFW-4 with ES-5 (reductions and costs excluded from AFW totals); overlap of AFW-7&8 (incremental benefits and costs of AFW-8 included in the AFW totals).

Table 1-4 (continued) Cross-Cutting Issues Policy Recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2025 (Million $)	Cost-Effective-ness ($/$tCO_2e$)	Level of Support
		2015	2025	Total 2008-2025			
CC-1	GHG Inventories, Forecasting, Reporting, and Registry	*Not quantified*					Unanimous
CC-2	Statewide GHG Reduction Goals and Targets	*Not quantified*					Unanimous
CC-3	State and Local Government GHG Emissions (Lead-by-Example)	*Not quantified*					Unanimous
CC-4	Public Education and Outreach	*Not quantified*					Unanimous
CC-7	Participate in Regional and Multistate GHG Reduction Efforts	*Not quantified*					Unanimous
CC-8	Encourage the Creation of a Business-Oriented Organization to Share Information and Strategies, Recognize Successes, and Support Aggressive GHG Reduction Goals	*Not quantified*					Unanimous
CC-9	Dedicate Greater Public Investment to Climate Data and Analysis	*Not quantified*					Unanimous
	Sector Total After Adjusting for Overlaps	***Not quantified***					
	Reductions From Recent Actions	***Not quantified***					
	Sector Total Plus Recent Actions	***Not quantified***					

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Table 1-4 (continued) Cap-and-Trade (C&T) Policy Recommendations

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value (Million $)	Cost-Effective-ness* ($\$/tCO_2e$) 2025	Permit Price† ($\$/tCO_2e$) 2025	Level of Support
		2015	2025	Total (2008–2025)				
C&T-1	Cap-and-Trade Program							
	MGA Partners C&T *—no RES/CIP in the baseline*		79.82			–$12.17	$48.45	Majority (9 objections)
	MGA Partners C&T *—with both RES/CIP in the baseline*		52.94			$2.65	$45.95	
	MGA Partners C&T *—with only RES in the baseline*		67.35			–$15.42	$46.64	
	MGA Partners+Observers C&T *—no RES/CIP in the baseline*		81.97			–$10.52	$52.44	
	MGA Partners+Observers C&T *—with both RES/CIP in the baseline*		55.45			$4.71	$50.72	
	MGA Partners+Observers C&T *—with only RES in the baseline*		69.45			–$13.48	$51.27	
	MGA plus WCI Partners C&T *—no RES/CIP in the baseline*		72.64			–$17.52	$35.69	
	MGA plus WCI Partners C&T *—with both RES/CIP in the baseline*		46.93			–$2.19	$34.95	
	MGA plus WCI Partners C&T *—with only RES in the baseline*		61.92			–$20.36	$35.07	
	MGA and WCI Partners+Observers C&T *—no RES/CIP in the baseline*		76.17			–$14.92	$41.87	
	MGA and WCI Partners+Observers C&T *—with both RES/CIP in the baseline*		50.41			$0.59	$41.25	
	MGA and WCI Partners+Observers C&T *—with only RES in the baseline*		64.92			–$17.65	$41.39	
C&T-2	MN-Only C&T *—no RES/CIP in the baseline*		89.18			–$2.39	$65.48	Merged into C&T-1
C&T-3	National C&T	*Not quantified*						Merged into C&T-1
C&T-5	Market Advisory Group (Formerly CC-11)	*Not quantified*						Unanimous
C&T-6	Regional and Multistate GHG Reduction Efforts (Formerly CC-7)	*Not quantified*						Unanimous

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; MGA = Midwestern Governors Association; C&T = cap-and-trade; RES = renewable electricity standard; CIP = Conservation Improvement Program; WCI = Western Climate Initiative; CC = Cost-Cutting Issues.

Negative numbers represent cost savings.

MGA C&T Partners include Illinois, Iowa, Kansas, Michigan, Minnesota, Wisconsin, and Manitoba; MGA C&T Observers include Indiana, Ohio, and South Dakota; WCI Partners include Arizona, California, New Mexico, Oregon, Utah, Washington, British Columbia, and Manitoba; WCI Observers include Colorado, Idaho, Montana, Nevada, and Wyoming. To run simulations including both MGA and WCI states in 2025, the C&T Technical Work Group (TWG) used 2020 marginal cost curves for WCI states for 2025. The emission cap for both MGA and WCI states (or provinces) is assumed to be 30% below the 2005 level in 2025.

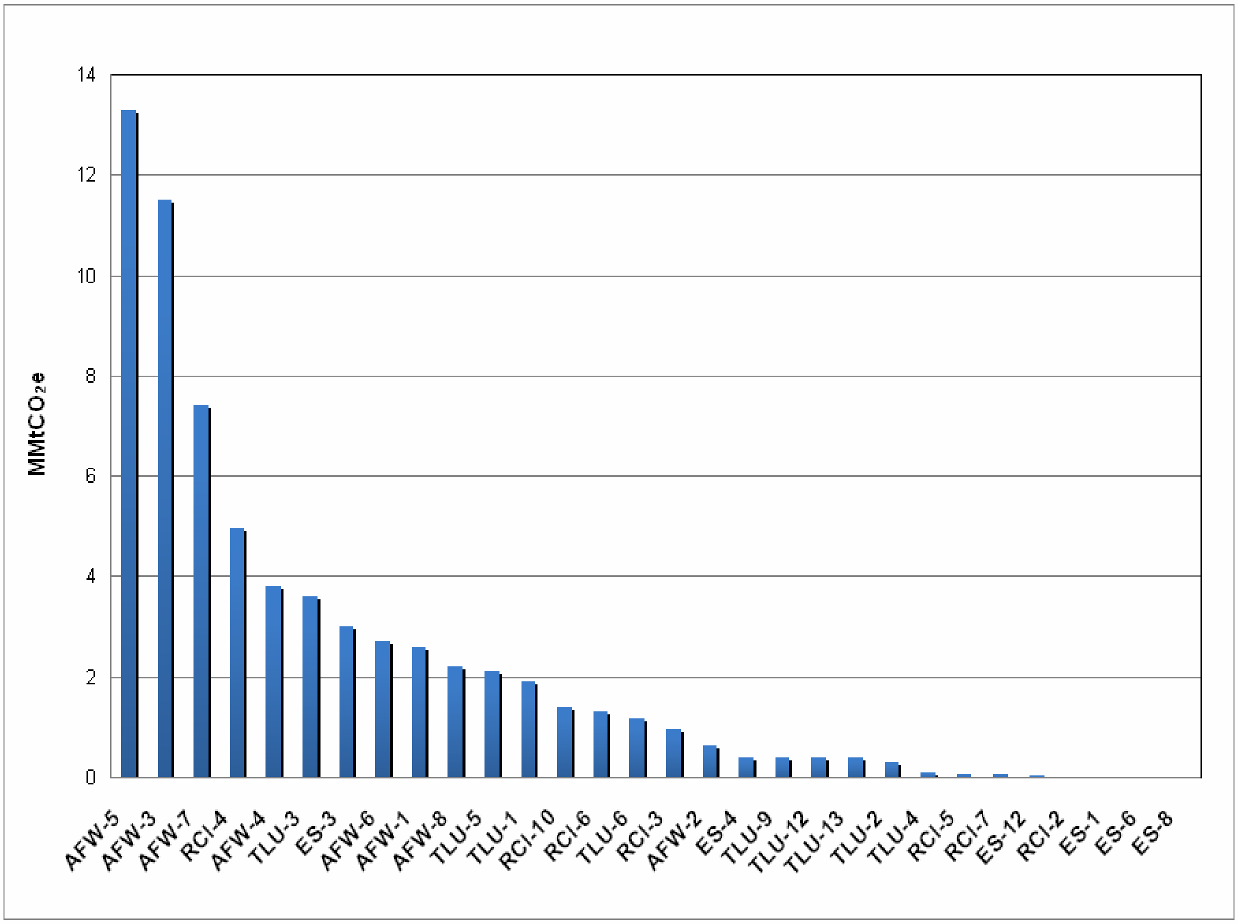
* This represents the average $\$/tCO_2e$ mitigated/sequestered for Minnesota.

† This represents the marginal cost of the last tCO_2e mitigated/sequestered and applies to all states involved in a trading arrangement.

Perspectives on Policy Recommendations

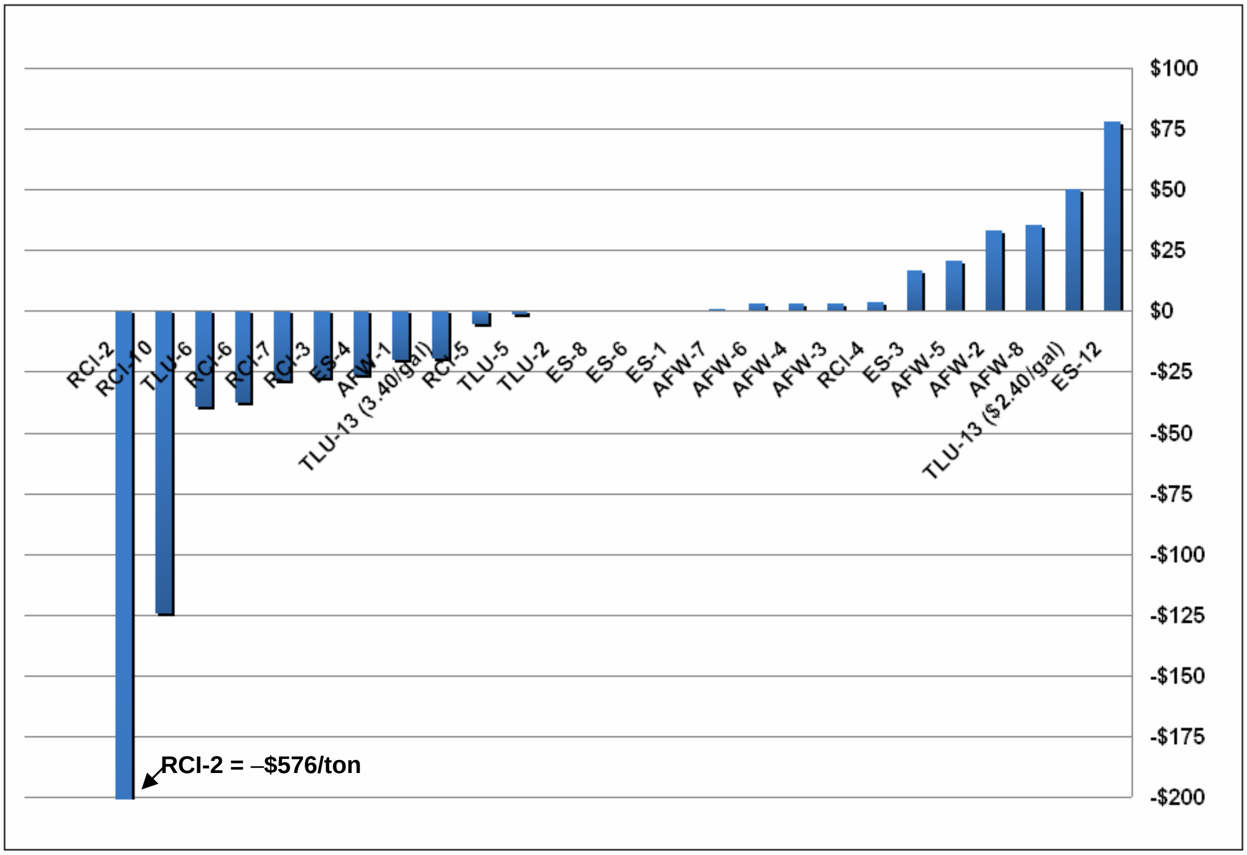
As explained above, the MCCAG considered the estimates of the GHG reductions that could be achieved by 31 of its recommendations, and the costs (or cost savings) of 25 of those 31. Having these analyses was very helpful to the MCCAG, but the MCCAG was mindful that these are estimates. There can be considerable imprecision in the GHG reductions associated with various policy recommendations. Figure 1-4 presents the estimated tons of reductions for each policy recommendation for which estimates were available, expressed as a cumulative figure for the period 2008–2025. In addition to the imprecision in GHG reductions achieved by each policy recommendation, there are also uncertainties in the exact cost (or cost savings) per ton of reduction achieved. Figure 1-5 presents the estimated dollars per ton cost (or cost savings, depicted as a negative number) for each policy recommendation for which cost estimates were available. This measure is calculated by dividing the net present value of the cost of the policy recommendation by the cumulative GHG reductions, all for the period 2008–2025. In some cases, there is a wide variation in the cost-effectiveness of the policy recommendations, depending on the assumptions used in the analysis.

Figure 1-4. MCCAG policy recommendations ranked by 2025 annual GHG reduction potential



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; AFW = Agriculture, Forestry, and Waste Management; RCI = Residential, Commercial, and Industrial; TLU = Transportation and Land Use; ES = Energy Supply.

Figure 1-5. MCCAG policy recommendations ranked by cost/cost savings per ton of GHG removed



RCI = Residential, Commercial, and Industrial; TLU = Transportation and Land Use; ES = Energy Supply; AFW = Agriculture, Forestry, and Waste Management.

Note: Negative values represent net cost savings and positive values represent net costs associated with the policy recommendation.

The MCCAG recognizes that actions to address climate change have the potential to create unintentional yet significant adverse financial, pollutant exposure, and cultural impacts on low-income populations, communities of color, and/or diverse cultural communities. As Minnesota begins the process of refinement and implementation of actions to reduce GHG emissions, the Office of Energy Security, the Minnesota Pollution Control Agency, the Department of Commerce and other relevant state agencies and partners should actively engage meaningful representation from these communities to better understand the nature of their concerns and to facilitate their effective participation.