Chapter 1
Background and Overview

Creation of the Michigan Climate Action Council (MCAC)

On November 14, 2007, Governor Jennifer M. Granholm signed Executive Order 2007-42 establishing the Michigan Climate Action Council (MCAC). The purpose of the MCAC is to assist Michigan in identifying the best opportunities to mitigate and adapt to climate change, reduce costs associated with climate change activities, and foster economic growth in Michigan. Governor Granholm charged the advisory group to:

- Produce an inventory and forecast of Greenhouse Gas (GHG) sources and emissions from 1990-2020.
- Consider potential state and multi-state actions to mitigate and adapt to climate change in various sectors including energy supply, residential, commercial and industrial, transportation, land use, agriculture, forestry, and waste management.
- Compile a comprehensive climate action plan with specific goals and recommendations for reducing GHG emissions in Michigan by state and local units of government, businesses, and Michigan residents to minimize climate change and better prepare for the effects of climate change in Michigan.
- Advise state and local government on measures to address climate change.

MCAC's Response

In fulfillment of the requirements of this Executive Order, the MCAC held eight meetings over the last fifteen months. Additionally, the Council formed six Technical Work Groups (TWGs) to assist the MCAC in formulating options. These TWGs met numerous times between the MCAC meetings. *The MCAC developed this Climate Action Plan as an initial step in establishing a basis for moving forward on the implementation of climate change policies in Michigan. Evaluation of key factors such as cost effectiveness, economic impacts, and harmonization with other Michigan programs and policies will be critical to the next stage of climate policy implementation.*

The following key elements and recommendations were identified by the MCAC during this initial process:

- MCAC reviewed over 330 multi-sector policy options and approved for inclusion in this report a package of 54 policy recommendations to reduce GHG emissions and address related energy and commerce issues in Michigan. The recommended policy options cover a wide range of costs and GHG reduction potentials.
- Michigan must prioritize these 54 policy recommendations during 2009 in order to set the stage for strategic implementation of the most promising options. The prioritization should take into account the GHG reduction potential, costs and savings, feasibility, co-benefits, a macro-economic analysis of the selected recommendations, public health and safety and consistency with other Michigan programs and policies.

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MCAC reviewed over 330 multi-sector policy options and approved for inclusion in this report a package of 54 policy recommendations to reduce GHG emissions and address related energy and commerce issues in Michigan.

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- The MCAC approved policy recommendations are estimated to generate a net cumulative savings of about $10 billion between 2009 and 2025. The weighted-average cost-effectiveness of these policies is estimated to be approximately a $10.2/ tCO_2e cost savings. Those policy options that show negative costs (i.e. benefits) should be evaluated as quickly as possible, for implementation. All policy options, particularly those that show a net cost, should be evaluated thoroughly, using tools such as regional economic modeling, before being implemented.
- The MCAC recommends periodic review of Michigan's progress with appropriate adjustments made in the Climate Action Plan to assure the approaches taken and GHG reductions are on target. Michigan's GHG Inventory and Forecast has been prepared which outlines historical conditions for 1990-2005 and projected emissions through 2025 based upon a business as usual scenario. These documents were completed prior to the severe downturn in the current downturn in the global economy. To account for fluctuations such as changes in the economy, updates to this inventory should be performed annually with the projections evaluated every three years.

- The MCAC recommends that Michigan further analyze actions needed for adaptation. The MCAC was unable to thoroughly examine the impacts of climate change on Michigan's natural resources and the Great Lakes due to time and resource constraints. Therefore, the MCAC recommends that Michigan conduct additional analyses of the state's vulnerability to the impacts of climate change and develop specific adaptation plans for key sectors.

- MCAC recommends that Michigan position itself as a leader in the national and regional dialogue on climate change policy as described in the MCAC Position Statement.

Recent Actions

GHG Reductions Associated With Recent Federal and State Actions

The MCAC identified recent actions undertaken in Michigan that will reduce GHG emissions while conserving energy and promoting the development and use of renewable energy sources. One such action was the adoption of Public Act (PA) 295[1]. The resultant emission reductions were estimated. A more recent action was the announcement on February 4, 2009 by Michigan Governor Jennifer Granholm setting a goal of reducing the state's reliance on fossil fuels for generating electricity by 45 percent by 2020. Due to time limits the MCAC was unable to include any additional emission reductions that will result from this policy. Reductions associated with federal actions, such as the federal Energy Independence and Security Act (EISA) of 2007 and the implementation of the Act's Corporate Average Fuel Economy (CAFE) requirements, were also estimated. A total reduction of about 8.9 $MMtCO_2e$ (3.1%) in 2025 from the business-as-usual reference case emissions is projected. These GHG emission reductions are summarized in Figure 1-1.

[1] Public Act 295 is The Clean Renewable and Energy Efficient Act of 2008

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<#>MCAC recommends that Michigan position itself as a leader in the national and regional dialogue on climate … [3]

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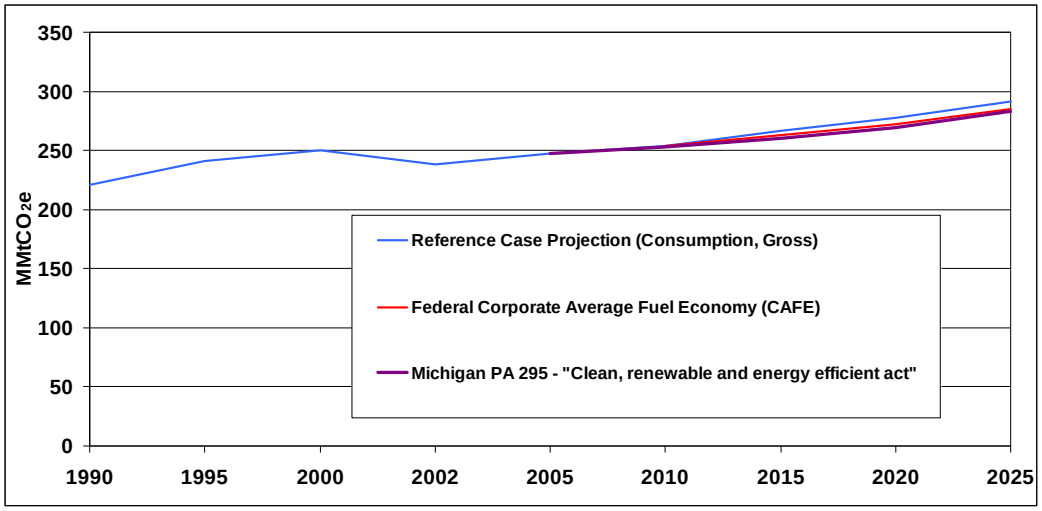
Figure 1-1. Estimated emission reductions associated with the effect of recent federal and state actions in Michigan (consumption-basis, gross emissions)



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Table 1-1. Estimated GHG emission reductions associated with the effect of recent federal and state actions in Michigan (consumption-basis, gross emissions)

Reductions from Existing Action Recent Actions	**1990**	**2005**	**2010**	**2015**	**2020**	**2025**
Federal CAFÉ	0.00	0.00	0.18	3.55	6.22	6.92
Michigan PA 295 - "Clean, renewable and energy efficient act"	0.00	0.00	0.51	2.65	2.13	2.01
Totals	**0.00**	**0.00**	**0.69**	**6.20**	**8.34**	**8.92**

	1990	**2005**	**2010**	**2015**	**2020**	**2025**
Reference Case Projection (Consumption, Gross)	220.7	247.5	253.8	266.4	278.0	291.6
Federal Corporate Average Fuel Economy (CAFE)			253.6	262.9	271.7	284.7
Federal Improved Standards for Appliances and Lighting			253.6	262.9	271.7	284.7
Michigan PA 295 - "Clean, renewable and energy efficient act"		247.5	253.1	260.2	269.6	282.7

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The MCAC Process

The MCAC began its deliberative process at its first meeting on December 12, 2007. MCAC met in person a total of seven times, with the final decisional meeting held on January 28, 2009. A teleconference meeting was held on February 26, 2009 exclusively for the review of this report. An additional 74 teleconference meetings of MCAC's six supporting Technical Work Groups were also held to identify and analyze various potential policy actions in advance of the MCAC's January 28, 2009 final decisional meeting.

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

- Energy Supply(ES);
- Market Based Policies (MBP);
- Residential, Commercial and Industrial (RCI);
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste Management (AFW); and
- Cross-Cutting Issues (CCI) (i.e., issues that cut across the above sectors).

The Center for Climate Strategies (CCS) provided facilitation and technical assistance to the MCAC and each of the TWGs, based on a detailed proposal approved by the MDEQ. The TWGs served as advisors to the MCAC and consisted of MCAC members and additional individuals with interest and expertise. Members of the public were invited to observe and provide input at all meetings of the MCAC and TWGs. The TWGs assisted the MCAC by generating initial options on Michigan-specific policy options to be added to the catalog of existing states actions; Where members of a TWG did not fully agree on the recommendations to the MCAC, the summary of their efforts was reported to the MCAC as a part of its consideration and actions. The MCAC reviewed the TWGs' proposals, modified the proposals, if necessary, and made final decisions on the items before them.

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The MCAC process employed a model of informed self-determination through a facilitated, stepwise, fact-based, and consensus-building approach. As noted, the process was facilitated by the Center for Climate Strategies (CCS), an independent, expert facilitation and technical analysis team. It was based on procedures that CCS has used in a number of other state climate change planning initiatives since 2000, but was adapted specifically for Michigan. The MCAC process sought but did not mandate consensus, and it explicitly documented the level of MCAC support for policies and key findings through a voting process established in advance, including barriers to full consensus where they existed on final consideration of proposed actions.

The 54 policy recommendations (out of more than 330 potential options considered) adopted by the MCAC and presented in this report were developed through a stepwise approach that included: (1) expanding a list of existing states actions to include additional Michigan-specific actions; (2) developing a set of "priority for analysis" options for further development; (3) fleshing these proposals out for full analysis by development of "straw proposals" for level of effort, timing and parties involved in implementation; (4) developing and applying a common framework of analysis for options, including sector-specific guidance and detailed specifications for options that include data sources, methods and key assumptions; (5) reviewing results of

analysis and modifying proposals as needed to address potential barriers to consensus; (6) finalizing design and analysis of options to remove barriers to final agreement; and (7) developing other key elements of policy proposals such as implementation mechanisms, co-benefits, and feasibility considerations. At Meetings # 6 and 7, policy recommendations receiving unanimous support, a super majority or majority support (defined as less than half of those present objecting) from the MCAC members present were adopted by the MCAC and included in this report. The TWGs' options to the MCAC were documented and presented at each MCAC meeting. All of the MCAC and TWG meetings were open to the public and all materials for and summaries of the MCAC and TWG meetings were posted on the MCAC Web site (www.miclimatechange.us). A detailed description of the deliberative process is included in Appendix B.

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Analysis of Policy Recommendations

With CCS providing facilitation and technical analysis, the six TWGs submitted policy recommendations for MCAC 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 MCAC reviewed, modified, and reached group agreement on various policy recommendations. The final versions for each sector, conforming to the policy recommendation templates, appear in Appendices F through K and constitute the most detailed record of decisions of the MCAC. Appendix E describes the methods used for quantification of the 33 policy options that were analyzed quantitatively. The quantitative analysis produced estimates of the GHG emission reductions and direct net costs (or cost savings) of implementation of various policies, in terms of both a net present value from 2009 to 2025 and a dollars-per-ton cost (i.e., cost-effectiveness). The key methods are summarized below.

Estimates of GHG Reductions: Using the projection of future GHG emissions (see below) as a starting point, 33 policy options 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 period 2009–2025. The years 2015 and 2025 were chosen as the target years for quantification

and analysis as part of the *MCAC Interim Report to the Governor,* in April 2008.[2] The estimates were prepared in accordance with guidance by the appropriate TWG and the MCAC, which later reviewed the estimates and, in some cases, directed that they be revised with respect to such elements as goals, data sources, assumptions, sensitivity analysis, and methodology. Some policies were estimated to affect the quantity or type of fossil fuel combusted. Other policies affected methane or carbon dioxide (CO_2) being sequestered. Sequestered means the gas is stored in plant materials or geologic formations so it is not contributing to global warming. Among the many assumptions involved in this task was identification 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.[3]

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Estimates of Costs/Cost Savings: The analyses of 33 policy recommendations included estimates of the direct cost of those policies, in terms of both net costs or cost savings during 2009–2025 and a dollars-per-ton cost (i.e., cost-effectiveness). Following is a brief summary of the approach used to estimate the costs or cost savings associated with the policy recommendations:

- *Discounted and annualized costs or cost savings*—Standard approaches were taken here. The net present value of costs or cost savings was calculated by applying a real discount rate of 5%. Dollars-per-ton estimates were derived as an annualized cost per ton, dividing the present value cost or savings by the cumulative GHG reduction measured in tons. As was the case with GHG reductions, the period 2009–2025 was analyzed.
- *Cost savings*— Total net costs or savings were estimated through comparison of monetized costs and savings of policy implementation over time, using discounting. These net costs could be positive or negative. Negative costs indicated that the policy saved money or produced "cost savings." Many policies were estimated to create net financial cost savings (typically through fuel savings and electricity savings associated with new policy actions).
- *Direct vs. indirect effects*—Estimates of costs and cost savings were based on "direct effects" (i.e., those borne by the entities implementing the policy).[4] 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).

Additional Costs and Benefits: The MCAC options were guided by four decision criteria that included GHG reductions and monetized costs and cost savings of various policies, as well as other potential co-benefits and costs (e.g., social, economic, and environmental) and feasibility

[2] "*MCAC Interim Report to the Governor," April 30, 2008*

[3] 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).

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

considerations. The TWGs were asked to examine the latter two in qualitative terms where deemed important and quantify them on a case-by-case basis, as needed, depending on need and where data were readily available. It should be noted that some of these unquantified co-benefits and costs could be quite significant and merit further investigation.

Implementation Mechanisms: The analysis for each option (see Appendices F through K) of the MCAC includes guidance on the policy instruments or "mechanisms" that were prescribed or assumed for the policy action. This includes a range of potential mechanisms including, for instance, funding incentives, codes and standards, voluntary and negotiated agreements, market based instruments, information and education, reporting and disclosure, and other instruments. In some cases, the recommended instruments are precise. In other cases, they are more general and envision further work to develop concrete programs and steps to achieve the goals recommended by the MCAC.

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Michigan GHG Emissions Inventory and Reference Case Projections

The Center for Climate Strategies (CCS) prepared the Michigan Inventory and Forecast Report[5] for the Michigan Department of Environmental Quality (MDEQ). The report presents an assessment of the State's greenhouse gas (GHG) emissions and anthropogenic sinks (carbon storage) from 1990 to 2025. The preliminary draft inventory and forecast estimates in January 2008 served as a starting point for the Michigan Climate Action Council (MCAC) and Technical Work Groups (TWGs). The MCAC and TWGs reviewed, discussed, and evaluated the draft inventory and methodologies and offered alternative data and approaches for improving the draft GHG inventory and forecast. The inventory and forecast were revised to address the comments received. The final Inventory and Forecast Report was approved by the MCAC at the November 2008 meeting and is available at:
http://www.miclimatechange.us/Inventory_Forecast_Report.cfm .

The inventory and projections cover the six types of gases included in the United States (US) Greenhouse Gas Inventory: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions of these GHGs are presented using a common metric, CO_2 equivalence (CO_2e), which indicates the relative contribution of each gas, per unit mass, to global average radiative forcing on a global warming potential- (GWP-) weighted basis.[6]
The inventory and reference case projections included detailed coverage of all economic sectors and GHGs in Michigan, including future emission trends and assessment issues related to energy, the economy, and population growth. It is important to note that the emission estimates

[5] "*Final Michigan Greenhouse Gas Inventory and Reference Case Projections, 1990- 2025,*" Center for Climate Strategies, November 2008.

[6] Changes in the atmospheric concentrations of GHGs can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth-atmosphere system (IPCC, 2001). Holding everything else constant, increases in GHG concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth), See: Boucher, O., et al. "Radiative Forcing of Climate Change." Chapter 6 in *Climate Change 2001: The Scientific Basis.* Contribution of Working Group 1 of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom. Available at:
http://www.grida.no/climate/ipcc_tar/wg1/212.htm.

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reflect the GHG emissions associated with the electricity sources used to meet Michigan's demands, corresponding to a consumption-based approach to emissions accounting. Another way to look at electricity emissions is to consider the GHG emissions produced by electricity generation facilities in the state—a production-based method. The study covers both methods of accounting for emissions, but for consistency, all total results are reported as consumption-based.

As illustrated in Figure 1-2, activities in Michigan accounted for approximately 248 million metric tons (MMt) of *gross*[7] CO_2e emissions (consumption basis) in 2005, an amount equal to about 3.5% of total US gross GHG emissions (based on 2005 US data).[8] Gross emissions exclude carbon sinks, such as forests. Michigan's gross GHG emissions are rising slower than those of the nation as a whole. From 1990 to 2005, Michigan's gross GHG emissions increased by about 12%, while national emissions rose by 16%. The growth in Michigan's emissions from 1990 to 2005 is primarily associated with the electricity consumption and transportation sectors.

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The principal sources of Michigan's GHG emissions are electricity consumption; residential, commercial, and industrial (RCI) fuel use; and transportation accounting for 36, 24, and 24% of Michigan's gross GHG emissions in 2005, respectively.

As illustrated in Figure 1-2, below, under the reference case projections, Michigan's gross GHG emissions continue to grow, and are projected to climb to about 292 $MMtCO_2e$ by 2025, reaching 32% above 1990 levels. While these projections are made over the long term (e.g. to 2025), they do not account for the current severe global economic downturn and how this will impact future growth projections.

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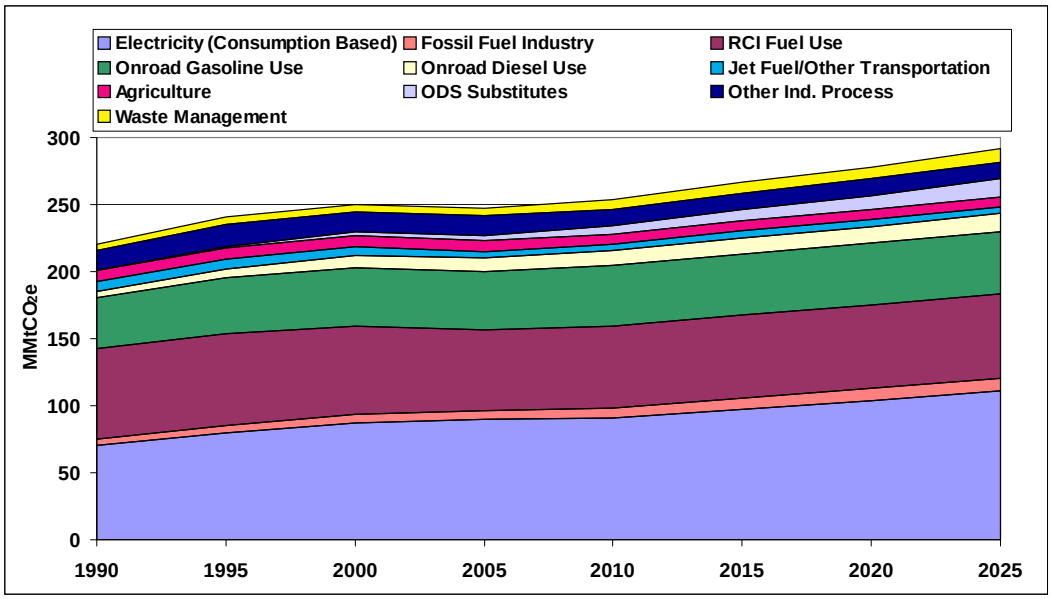
Emissions associated with electricity consumption are projected to be the largest contributor to future GHG emissions growth, followed by emissions associated with the transportation sector. Other sources of emissions growth include the RCI fuel use sector and the increasing use of HFCs and PFCs as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications. The agriculture sector is the only sector in which emissions are projected to decrease from 2005 to 2025. Figure 1-3 depicts the 2005 distribution of sources in Michigan compared to the US.

[7] Excluding GHG emissions removed due to forestry and other land uses and excluding GHG emissions associated with exported electricity.

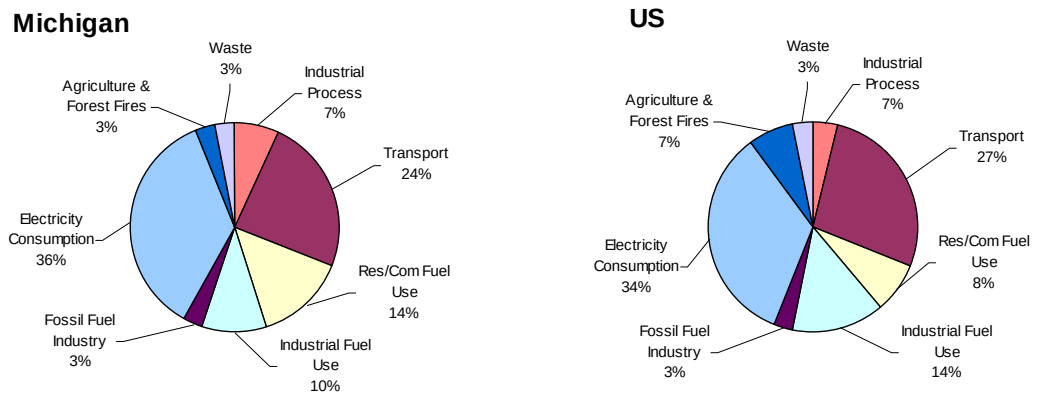
[8] The national emissions used for these comparisons are based on 2005 emissions from *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006*, April 15, 2008, US EPA #430-R-08-005, (http://www.epa.gov/climatechange/emissions/usinventoryreport.html).

Figure 1-2. Gross GHG emissions by sector, 1990–2025: historical and projected (consumption-based approach) business as usual / base case



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; RCI = direct fuel use in residential, commercial, and industrial sectors; ODS = ozone-depleting substance; Ind. = industrial.

Figure 1-3. Gross GHG emissions by sector, 2005: Michigan and U.S.



MCAC Policy Recommendations (Beyond Recent Actions)

The MCAC approved 54 policy recommendations for consideration of further action in Michigan. Of these, 33 were analyzed quantitatively to calculate both emission reductions and

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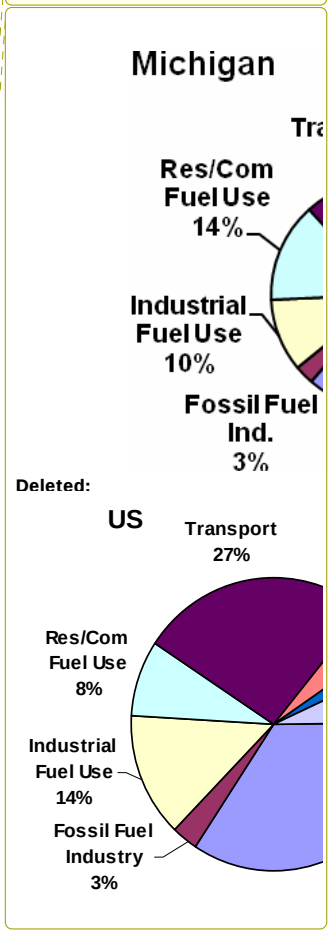

costs or savings. Based on this analysis, the 33 quantified policies have the cumulative effect of reducing annual GHG emissions by approximately 41 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) in 2015 and by 117 $MMtCO_2e$ in 2025. The additional policy recommendations were not quantifiable but are considered valuable recommendations to support the overall Climate Action Plan.

Figure 1-4 presents a graphical summary of the potential cumulative emission reductions associated with the 33 policy options and federal actions relative to the business-as-usual reference case projections.

- The blue line shows actual (for 1990, 1995, 2000, and 2005) and projected (for 2010, 2015, 2020 and 2025) levels of Michigan's gross GHG emissions on a business as usual basis. This consumption-based approach accounts for emissions associated with the generation of electricity in Michigan to meet the state's demand for electricity.

- The red line shows the projected emissions adjusted for the recent state and federal actions described in Table 1.1.
- The green line shows the projected emissions if all of the MCAC's 33 recommended options are implemented and the estimated reductions are fully achieved. While the other MCAC options have the effect of reducing emissions, those reductions were not quantified and are not reflected in the green line.

It is important to note, to yield these emission reductions from the 33 MCAC recommended options, implementation must be timely, aggressive, and thorough. *Evaluation of key factors such as cost effectiveness, economic impacts, and harmonization with other Michigan programs and policies will be critical to the next stage of climate policy implementation.*

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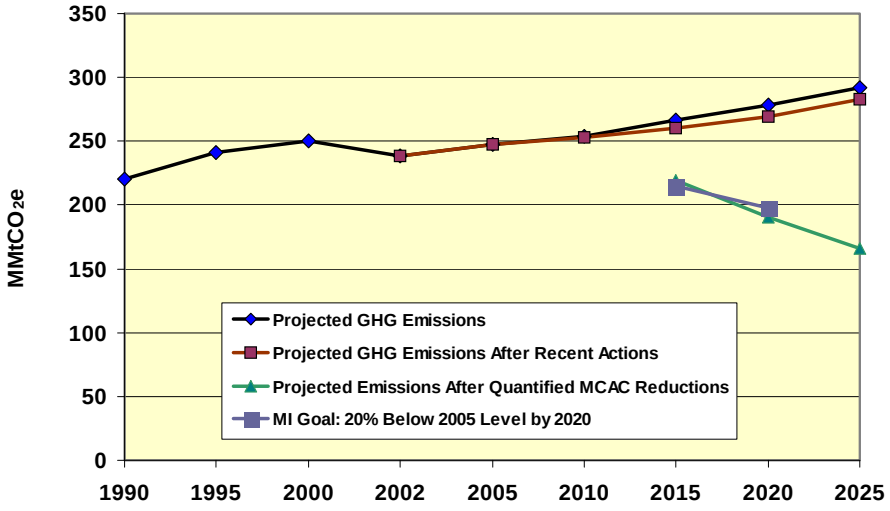
Figure 1-4. Annual GHG emissions: reference case projections and MCAC recommendations (consumption basis, gross emissions)



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; MCAC = Michigan Climate Action Council.

Table 1-2 provides the numeric estimates underlying Figure 1-4. In summary, if all of the Policy recommendations are fully implemented and successful in achieving all of the GHG reductions projected then MI should over-achieve its GHG reduction goals by 7.3 MMtCO2e in 2020. Another way to look at this is that the MCAC package of policy recommendations entail a surplus of GHG reductions of about 7.3MMTCO2e.

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

Consumption Basis - Gross Emissions							
	1990	2000	2005	2010	2015	2020	2025
Projected GHG Emissions	220.7	250.0	247.5	253.8	266.4	278.0	291.6
Reductions from Recent Actions			0.0	0.7	6.2	8.3	8.9
Projected GHG Emissions After Recent Actions			247.5	253.1	260.2	269.6	282.7
GHG Reduction Goal Recommended by MCAC					NA	198.0	NA
Total GHG Reductions from MCAC Policies					41.2	78.9	116.6
Difference Between MCAC 2020 Goal & Remaining Emissions after Reductions					NA	7.3	NA
Projected Emissions After Quantified MCAC Reductions					219.0	190.7	166.1

GHG = greenhouse gas; MCAC = Michigan Climate Action Council; N/A = not applicable.
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Reductions from recent actions include the Energy Independence and Security Act of 2007, Title III. GHG reductions from Titles IV and V of this Act have not been quantified because of the uncertainties in how they will be implemented.

Table 1-3 depicts the final policy recommendations of the Council and their associated GHG reductions and costs or savings for each sector.

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In Table 1-3 and throughout the Climate Action Plan, negative cost (- $) figures indicate **cost savings**. For example, in Table 1-3 the column totals for the Net Present Value (NPV) of (-$10,093 million) portrays a cost savings of $10,093,000,000 over the 2009- 2025 period of analysis.

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

Sector	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2015	2025	Total 2009–2025		
Residential, Commercial and Industrial	21.9	65.1	524.6	–$13,014	–$25
Energy Supply	8.1	23.6	220.3	$7,980	$36
Transportation and Land Use	4.8	10.5	95.1	–$3,425	–$36
Agriculture, Forestry, and Waste Management	6.4	17.4	147.0	-$1,634	-$11.1
Cross-Cutting Issues	Non-quantified, enabling options				
TOTAL (includes all adjustments for overlaps)	**41.2**	**116.6**	**987.0**	**-$10,093**	**-$10.2**

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 policy options.

Within each sector, values have been adjusted to eliminate double counting for policies or elements of policies that overlap. In addition, values associated with policies or elements of policies within a sector that overlap with policies or elements of policies in another sector have been adjusted to eliminate double counting. Appendix F (for the ES sectors), Appendix H (for the RCI sectors), Appendix I (for the TLU sectors), and Appendix J (for the AFW sectors) of this report provide documentation of how sector-level emission reductions and costs (or cost savings) were adjusted to eliminate double counting associated with overlaps between policies.

Table 1-4 Summary List Policy Recommendations for all Sectors

Energy Supply (ES) Policy Recommendation

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO$_2$e)	Level of Support
		2015	2025	Total 2009–2025			
RECENT ACTION	PA 295, Clean, Renewable, and Efficient Energy Act	2.7	2.0	30.8	$1,024	$33	N/A
ES-1	Renewable Portfolio Standard and Distributed Generation "Carve-Out"	5.0	14.6	137.5	$6,600	$48.00	Unanimous
	Renewable Portfolio Standard (RPS)	4.6	13.7	129.5	$5,546	$42.83	
	Wind	3.7	10.3	100.4	$4,748	$47.31	
	Biomass	0.9	2.7	25.2	$376	$15	
	Solar Photovoltaic (PV)	0.0	0.4	2.6	$392	$152	
	Plasma Gasification	0.0	0.3	1.3	$29	$22	
	Distributed Generation "Carve-Out"	0.4	0.9	8.0	$1,054	$131.51	
	Solar Hot Water	0.0	0.2	1.2	$26	$22.27	
	Geothermal	0.1	0.2	1.5	$82	$55	
	Wind (distributed)	0.1	0.3	2.7	$503	$186	
	Solar PV (distributed)	0.1	0.2	1.84	$508	$276	
	Biogas	0.1	0.2	2.3	$17	$7	
ES-3	Energy Optimization Standard	0.0	13.6	86.3	–$1,632	–$19	Unanimous
ES-5	Advanced Fossil Fuel Technology (e.g., IGCC, CCSR) Incentives, Support, or Requirements	*Not Quantifiable*					Unanimous
ES-6	New Nuclear Power	0.0	6.3	38.5	$1,001	$25.98	Majority
ES-7	Integrated Resource Planning (IRP), Including combined heat & power.	*Not Quantifiable*					Unanimous
ES-8	Smart Grid, Including Advanced Metering	*Not Quantifiable*					Unanimous
ES-9	CCSR Incentives, Requirements, R&D, and/or Enabling Policies	*Not Quantifiable*					Unanimous
ES-10	Technology-Focused Initiatives (Biomass Co-firing, Energy Storage, Fuel Cells, Etc.), Including Research, Development, & Demonstration						Super Majority
	Co-firing at 5%	0.2	0.2	3.3	$34.48	$10.6	
	Co-firing at 10%	0.5	0.5	6.5	$69.43	$10.7	
	Co-firing at 20%	0.9	0.9	13.0	$134.09	$10.3	
ES-11	Power Plant Replacement, Energy Efficiency, and Repowering	2.5	2.0	33.2	$313	$9.4	Unanimous
ES-12	Distributed Renewable Energy Incentives, Barrier Removal, and Development Issues, Including Grid Access	*ES-12 Fully incorporated in distributed generation "carve-out" under ES-1.*					Unanimous

Policy No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2009–2025			
ES-13	Combined Heat and Power (CHP) Standards, Incentives and/or Barrier Removal	0.4	0.5	7.8	$31.91	$4.09	Unanimous
ES-15	Transmission Access and Upgrades	*Not Quantifiable*					Unanimous
	Sector Totals	**8.1**	**37.2**	**306.6**	**$6,348**	**$22**	
	Sector Total After Adjusting for Overlaps	**8.1**	**23.6**	**220.3**	**$7,980**	**$36**	
	Reductions From Recent Actions	**2.7**	**1.9**	**30.1**	**$1,025**	**$34**	
	Sector Total Plus Recent Actions	**10.8**	**25.5**	**250.4**	**$9,005**	**$36**	

$/tCO2e = dollars per metric tons of carbon dioxide equivalent; CCI = Cross-Cutting Issues; CCSR = carbon capture and storage or reuse; CHP = combined heat and power; GHG = greenhouse gas; IGCC = integrated gasification combined cycle; IRP = integrated resource planning; MCAC = Michigan Climate Action Council; MMtCO2e = millions of metric tons of carbon dioxide equivalent; N/A = not applicable; PA = Public Act; R&D = research and development.

Note: The numbering used to denote all the policy recommendations in Table 1-4 and in other parts of this report is for reference purposes only; it does not reflect prioritization among these important recommendations.

Table 1-4 (cont'd.) Market Based Policy (MBP) Recommendations

No.	Policy Recommendations		GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of Support
			2020	2025	Total 2009–2025			
MBP-1	Cap and Trade	20% below 2005 by 2020 (*Free-Granting Allowances*)[9]	92.48				–$25.83	Unanimous
		20% Below 2005 by 2020 (*Auctioning Allowances)*[10]	92.48				–$19.33	
MBP-3	MI Joins Chicago Climate Exchange		*Not Quantified*					Unanimous
MBP-6	Market Advisory Group		*Not Quantifiable*					Unanimous

[9] These results include the direct cost of reducing emissions, plus costs associated with purchase of emissions allowances from entities outside of Michigan, minus revenues from the sale of allowances to entities outside Michigan.

[10] These results include the direct cost of reducing emissions but do not include payments by Michigan entities for the purchase of allowances at auction, nor do they include revenues to the state from the sale of those allowances. The full cost and revenue implications of allowance distribution by auction can be found in Table G-1-2 and Annex G-1.

Deleted: mitigation costs, including payments or revenues resulting from the purchase or sale of allowances between Michigan emitters and out-of-state Midwestern Governors Association (MGA) partners.

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Table 1-4 (cont'd.) Transportation and Land Use (TLU) Policy Recommendations

Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$) 2015	2025	Total 2009–2025	Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO$_2$e)	Level of Support
TLU-1	Promote Low-Carbon Fuel Use	2.6	5.9	53	$820	$16	Unanimous
TLU-2	Eco-Driver Program	1.1	2.2	22	–$3,921	–$176	Unanimous
TLU-3	Truck Idling Policies	0.36	0.76	7.0	–$596	–$85	Unanimous
TLU-4	Advanced Vehicle Technology	0.01	0.03	0.19	$281	$1,458	Unanimous
TLU-5	Congestion Mitigation	0.08	0.18	1.7	–$135	–$81	Unanimous
TLU-6	Land Use Planning and Incentives	0.14	0.43	3.2	–$598	–$189	Unanimous
TLU-7	Transit and Travel Options	0.13	0.54	3.5	$655	$185	Unanimous
TLU-8	Increase Rail Capacity, and Address Rail Freight System Bottlenecks	0.10	0.19	2.0	$69	$35	Unanimous
TLU-9	Great Lakes Shipping	0.24	0.27	2.5	NQ	NQ	Unanimous
	Sector Totals	**4.76**	**10.5**	**95.1**	**–$3,425**	**–$36**	**N/A**
	Sector Total After Adjusting for Overlaps	**4.76**	**10.5**	**95.1**	**–$3,425**	**–$36**	**N/A**
	Reductions From Recent Actions	**0**	**0**	**0**	**$0**	**$0**	**N/A**
	Sector Total Plus Recent Actions	**4.76**	**10.5**	**95.1**	**–$3,425**	**–$36**	**N/A**

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent. Note: Negative numbers indicate cost savings.

Table 1-4 (cont'd.) Residential, Commercial and Industrial (RCI) Policy Recommendations

	Policy Option	GHG Reductions ($MMtCO_2e$) 2015	2025	Total 2009-2025	Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO$_2$e)	Level of Support
RCI-1	Utility Demand-Side Management for Electricity and Natural Gas	0.0	13.6	86.3	–1,632	–19	Unanimous
RCI-2	Existing Buildings Energy Efficiency Incentives, Assistance, Certification, and Financing	17.6	53.8	428.6	–12,107	–28	Unanimous
RCI-3	Regulatory (PSC) Changes to Remove Disincentives and Encourage Energy Efficiency Investments by IOUs	*Not Quantifiable*					Unanimous
RCI-4	Adopt More Stringent Building Codes for Energy Efficiency	3.6	9.8	82	–2,865	–35	Unanimous
RCI-5	MI Climate Challenge & Related Consumer Education Programs	*Not Quantifiable*					Unanimous
RCI-6	Incentives to Promote Renewable	0.7	1.5	14.0	1,958	140	Unanimous

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2009-2025			
	Energy Systems Implementation						
RCI-7	Promotion and Incentives for Improved Design and Construction in the Private Sector	15.6	47.6	380	–11,693	–31	Unanimous
RCI-8	Net Metering for Distributed Generation	Fully incorporated into RCI-6					Unanimous
RCI-9	Training & Education for Bldg. Design, Construction, and Operation	*Not Quantifiable*					Unanimous
RCI-10	Water Use and Management	*Not Quantifiable*					Unanimous
	Sector Total After Adjusting for Overlaps*	**21.8**	**64.9**	**523.9**	***–13,014***	***–24.8***	
	Reductions From Recent Actions	**Figures adjusted include recent actions**					
	Sector Total Plus Recent Actions	**21.8**	***64.9***	***523.9***	***–13,014***	***–24.8***	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; PSC = Public Service Commission; IOU = investor-owned utility.

Note: The numbering is for reference purposes only; it does not reflect prioritization among these policy options. Negative net present values and cost effectiveness numbers above reflect "negative costs" or net savings.

*The figures listed show totals for the options net of recent legislation.

Table 1-4 (cont'd.) Agriculture, Forestry and Waste (AFW) Management Policy Recommendations

Policy No.	Policy Recommendation		GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million 2005$)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
			2015	2025	Total 2009–2025			
AFW-1	Expanded Use of Biomass Feedstocks for Electricity, Heat, or Steam Production		3.3	10	79	$1,649	$21	Unanimous
AFW-2*	In-State Liquid Biofuels Production		*Included in the Results of TLU-1*					Unanimous
AFW-3	Methane Capture and Utilization From Manure and Other Biological Waste		0.09	0.14	1.5	$4.7	$3	Unanimous
AFW-4	Expanded Use of Bio-based Materials	A. Use of Bio-based Products	.08	.21	1.7	–$108	–$62	Unanimous
		B. Utilization of Solid Wood Residues	*Not Quantified*					Unanimous
AFW-5	Land Use Management That Promotes	A. Increase in Permanent Cover Area	0.08	0.21	1.8	$63	$34	Unanimous

Policy No.	Policy Recommendation		GHG Reductions ($MMtCO_2e$) 2015	2025	Total 2009–2025	Net Present Value 2009–2025 (Million 2005$)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
	Permanent Cover	B. Retention of Lands in Conservation Programs†	0.05	0.11	1.1	$24	$23	Unanimous
		C. Retention/ Enhancement of Wetlands	*Not Quantified*					Unanimous
AFW-6	Forestry and Agricultural Land Protection	A. Agricultural Land Protection	0.46	1.1	10	$864	$85	Unanimous
		B. Forested Land Protection	*Not Quantified*					Unanimous
		C. Peatlands/ Wetlands Protection	*Not Quantified*					Unanimous
AFW-7**	Promotion of Farming Practices That Achieve GHG Benefits	A. Soil Carbon Management	0.7	1.7	15	–$200	–$13	Unanimous
		B. Nutrient Efficiency	0.05	0.12	1.1	–$27	–$26	Unanimous
		C. Energy Efficiency	0.13	0.32	2.9	–$102	–$35	Unanimous
		D. Local Food	*Not Quantified*					Unanimous
AFW-8	Forest Management for Carbon Sequestration and Biodiversity	A. Enhanced Forestland Management	0.53	1.42	12.05	$800	$66	Unanimous
		B. Urban Forest Canopy	1.2	2.9	26	–$346	–$13	Unanimous
		C. Reduce Wildfire	*Not Quantified*					Unanimous
AFW-9**	Source Reduction, Advanced Recycling, and Organics Management							Unanimous
	In-State GHG Reductions		1.4	3.0	28	–$3,136	–$112	
	Full Life-Cycle Reductions		14.5	35.3	314	–$3,136	–$10	
AFW-10	Landfill Methane Energy Programs		0.91	2.7	22	–$35	–$2	Unanimous
	Sector Totals†		**9**	**23**	**201**	**–$548**	**–$3**	
	Sector Total After Adjusting for Overlaps††		**6**	**17**	**147**	**–$1,634**	**–$11**	
	Reductions From Recent Actions		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	
	Sector Total Plus Recent Actions		6	17	147	-$1,634	-$11	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; TLU = Transportation and Land Use; N/A = not applicable.

Note that negative costs represent a monetary savings.

* The quantification results for AFW-2 (biofuel production volumes and costs) were used as inputs to the quantification of the results of TLU-1, which covers consumption of biofuels in Michigan.

** The analyses for AFW-5, AFW-7, and AFW-9 include the full life-cycle costs of the policies. In the case of AFW-9, it is estimated that a significant fraction of the reductions will occur out of state. In-state reductions refer only to those occurring from reduced landfilling and waste combustion (these are broken out separately in the table above).

† The reductions from AFW-5B (Retention of Lands in Conservation Programs) have been left out of the sector totals, since they relate to a soil carbon protection measure where the estimated emissions (from conservation acres being returned to active cultivation) are not included in the business as usual (BAU) inventory and forecast (I&F). The costs have been included in the sector totals, since these will be incurred in order to retain the level of emissions in the BAU I&F. For AFW-5, AFW-7, and AFW-9, these include the reductions that are expected to occur within the state.

†† See the section below for discussion of overlap adjustments.

Table 1-4 (cont'd.) Cross Cutting Issues (CCI) Policy Recommendations

No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost Effective-ness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2009–2025			
CCI-1	GHG Inventories, Forecasting, Reporting, and Registry	*Not Quantified*					Unanimous
CCI-2	Statewide GHG Reduction Goals and Targets	*Not Quantified*					
CCI-3	State, Local, and Tribal Government GHG Emission Reductions (Lead-by-Example)	*Not Quantified*					Unanimous
CCI-4	Comprehensive Local Government Climate Action Plans (Counties, Cities, Etc.)	*Not Quantified*					Unanimous
CCI-5	Public Education and Outreach	*Not Quantified*					Unanimous
CCI-6	Tax and Cap/ Cap and Trade	*MCAC approved creation of a new Market-Based Policies Technical Work Group as the lead for this policy* recommendation.					Transferred
CCI-7	Seek Funding for Implementation of MCAC Recommendations	*Not Quantified*					Unanimous
CCI-8	Adaptation and Vulnerability	*Not Quantified*					Unanimous
CCI-9	Participate in Regional, Multi-State, and National GHG Reduction Efforts	*Not Quantified*					Unanimous
CCI-10	Enhance and Encourage Economic Growth and Job Creation Opportunities Through Climate Change Mitigation	*Not Quantified*					Unanimous
CCI-11	Enhance and Encourage Community Development Through Climate Change Mitigation: Address Environmental Justice	*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

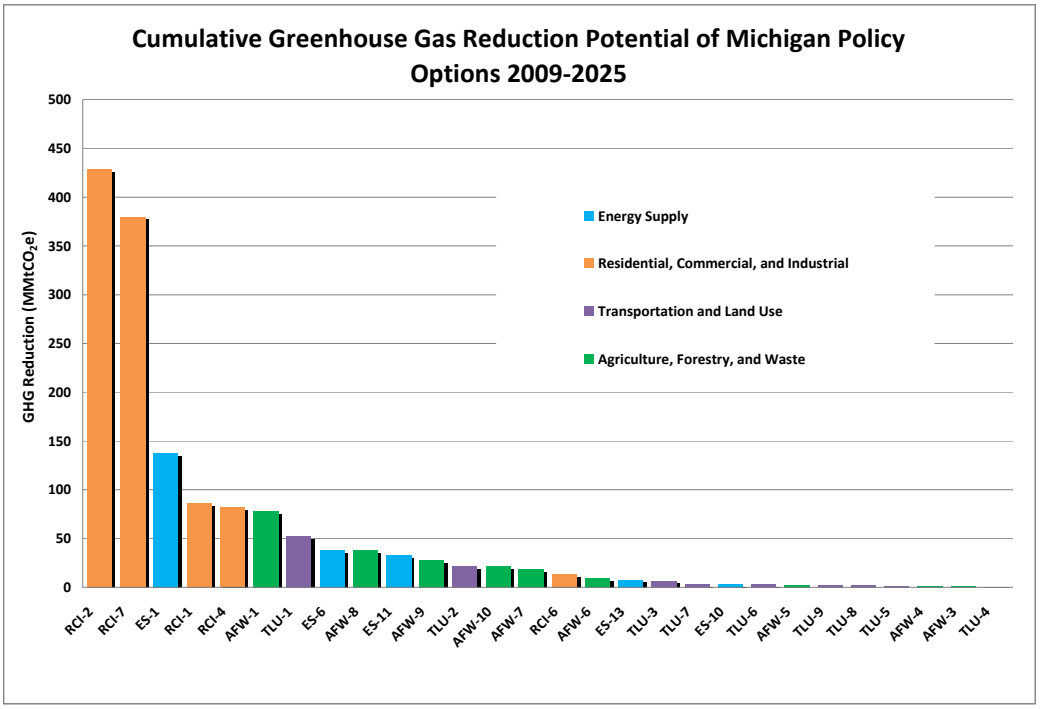
Perspectives on Policy Options

As explained previously, the MCAC considered the estimates of the GHG reductions that could be achieved and the costs (or cost savings) for the 33 options that were quantifiable. Figure 1-5, below, presents the estimated tons of GHG emission reductions for each of these policy recommendations, expressed as a cumulative figure for the period 2009–2025.

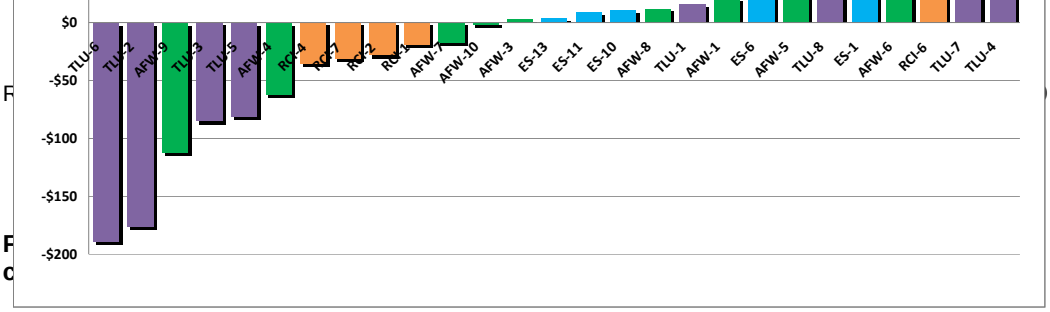
Figure 1-6 presents the estimated dollars-per-ton cost (or cost savings, depicted as a negative number) for each quantified policy recommendation. The dollars per ton value is calculated by dividing the net present value of the cost of the policy recommendation by the cumulative GHG reductions, all for the period 2009–2025.

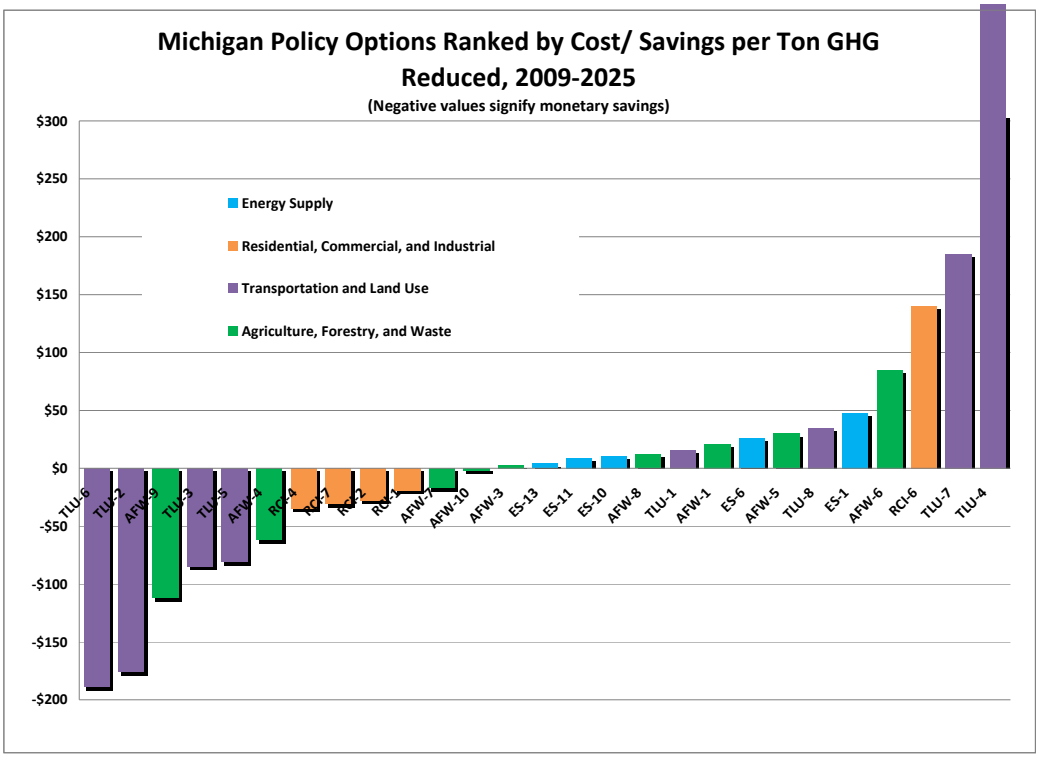
It is important to note that there is some level of uncertainty in projecting GHG reductions and estimating exact costs (or cost savings) per ton of reductions achieved for the time periods of this analysis.

Figure 1-5. MCAC policy recommendations ranked by cumulative (2009–2025) GHG reduction potential



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





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

TLU 4 cost effectiveness is $1458 per ton.

Figure 1-7, below, presents a stepwise marginal cost curve for Michigan. The horizontal axis represents the percentage of GHG emissions reduction in 2025 for each option relative to the business as usual (BAU) forecast. The vertical axis represents the marginal cost of mitigation (expressed as the cost-effectiveness of each policy option on a cumulative basis, 2009-2025). In the figure, each horizontal segment represents an individual policy. The width of the segment indicates the GHG emission reduction potential of the option in percentage terms. The height of the segment relative to the x-axis shows the average cost (saving) of reducing one $MMtCO_2e$ of GHG emissions with the application of the option. For instance, for RCI-2-Energy Efficiency-this policy recommendation should result in approximately a 54 MMTCO2e (19%) reduction of GHG emissions in 2025 below the BAU reference case with an average cost savings of approximately $28/ton.

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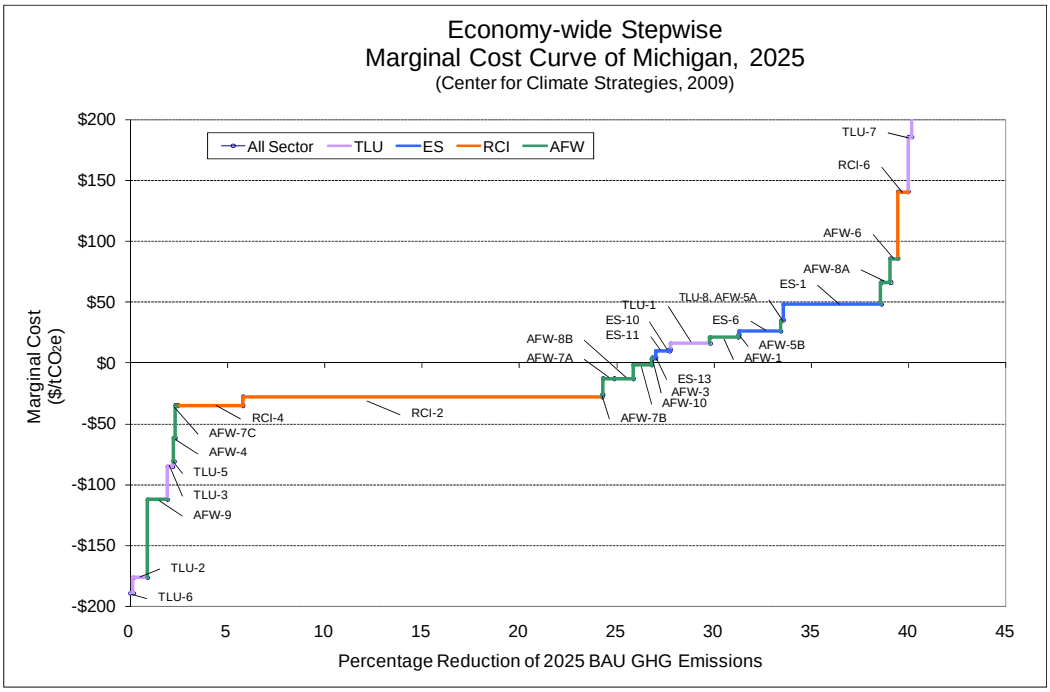
Figure 1-7. Stepwise marginal cost curve for Michigan, 2025



BAU = business as usual; GHG = greenhouse gas; tCO_2e = metric tons of carbon dioxide equivalent; AFW = Agriculture, Forestry, and Waste Management; ES = Energy Supply; TLU = Transportation and Land Use;

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

Note: Results have been adjusted to remove overlaps between policies.

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The recommended policy options cover a wide range of costs and GHG reduction potentials. The MCAC approved policy recommendations are estimated to generate a net cumulative savings of about $10 billion between 2009 and 2025. The weighted-average cost-effectiveness of these policies is estimated to be approximately a $10.2/ tCO_2e cost savings. *Those policy options that show negative costs (i.e. benefits) should be undertaken as quickly as possible, given available resources. However, any policy option that shows a net cost should be evaluated thoroughly, using tools such as regional economic modeling, before being implemented.*

Michigan must prioritize these 54 policy recommendations during 2009 in order to set the stage for strategic implementation of the most promising options. This must take into account the GHG reduction potential, costs and cost savings, feasibility, additional economic analysis of selected recommendations, and other contributing factors.

The MCAC recommends periodic review of Michigan's progress with appropriate adjustments made in the Climate Action Plan to assure the approaches taken and GHG reductions are on target. Michigan's GHG Inventory and Forecast has been prepared which outlines historical conditions for 1990-2005 and projected emissions through 2025 based upon a business as usual scenario. Updates to this inventory should be annually with the projections evaluated every three years.

The MCAC recommends that Michigan further analyze actions needed for adaptation. The MCAC was unable to thoroughly examine the impacts of climate change on Michigan's natural resources and the Great Lakes due to time and resource constraints. Therefore, the MCAC recommends that Michigan conduct additional analyses of the state's vulnerability to the impacts of climate change and develop specific adaptation plans for key sectors.

MCAC recommends that Michigan position itself as a leader in the national and regional dialogue on climate change policy as described in the MCAC Position Statement.

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Those policy options that show negative costs (i.e. benefits) should be undertaken as quickly as possible, given available resources. However, any policy option that shows a net cost should be evaluated thoroughly, using tools such as regional economic modeling, before being implemented.

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MCAC recommends that Michigan position itself as a leader in the national and regional dialogue on climate change policy as described in the MCAC Position Statement.