Montana Climate Change Action Plan

Final Report of the Governor's Climate Change Advisory Committee

November 2007

Photo Credit

Cover photo of Piegan Glacier, Glacier National Park, Montana. Park scientists are still debating whether Piegan Glacier, on the slopes of Piegan Mountain, is really still a glacier. Credit: U.S. National Park Service, August 2001.

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Acronyms

ACEEE	American Council for an Energy-Efficient Economy
AEO2006	Annual Energy Outlook 2006 [US DOE Energy Information Administration]
AERLP	Alternative Energy Revolving Loan Program
AERO	Alternative Energy Resources Organization
AFW	Agriculture, Forestry, and Waste Management [TWG]
API	American Petroleum Institute
ARM	Annotated Rules of Montana
ASAP	Appliance Standards Awareness Project
BACT	best available control technology
BAU	business as usual
BC	black carbon
BCAP	Building Code Assistance Project
BEF	Bonneville Environmental Foundation
BLM	Bureau of Land Management
BMP	best management practices
BNSF	Burlington Northern Santa Fe [railroad]
BPA	Bonneville Power Administration
BSCSP	Big Sky Carbon Sequestration Partnership
BTL	biomass-to-liquids
CAFE	corporate automobile fuel economy [standards]
CAIT	Climate Analysis Indicators Tool
CC	Cross-Cutting Issues [TWG]
CCAC	Climate Change Advisory Committee
CCS	carbon capture and sequestration [or storage]
CCS	Center for Climate Strategies
CCSR	carbon capture and sequestration [storage] or reuse
CCX	Chicago Climate Exchange
CDEAC	Clean and Diversified Energy Advisory Committee
CDEI	Clean and Diversified Energy Initiative
CE	cost-effectiveness
CFC	chlorofluorocarbon
CFL	compact fluorescent lamp
CH_4	methane
CHP	combined heat and power
CMAQ	Congestion Mitigation and Air Quality Improvement [Program]
CO_2	carbon dioxide

CO_2e	carbon dioxide equivalent
CORRIM	Consortium for Research on Renewable Industrial Materials
CPUC	California Public Utilities Commission
CRP	Conservation Reserve Program
CSP	Conservation Security Program
CTL	coal-to-liquids
DERA	Diesel Emissions Reduction Act
DG	[clean] distributed generation
DMV	Department of Motor Vehicles
DNRC	[MT] Department of Natural Resources and Conservation
DOA	[MT] Department of Administration
DOC	diesel oxidation catalyst
DOJ	[MT] Department of Justice
DPF	diesel particulate filter
DSM	demand-side management
EA	environmental assessments
ECBM	enhanced coal bed methane
EE	energy efficiency
EIA	Energy Information Administration [US DOE]
EIIP	Emissions Inventory Improvement Project [US EPA]
EIS	environmental impact statement
EOR	enhanced oil recovery
EPS	environmental portfolio standard
EQIP	Environmental Quality Incentives Program
ERS	Economic Research Service
ES	Energy Supply [TWG]
EtOH	ethyl alcohol
EU	European Union
FAQ	frequently asked questions
FBC	fluidized bed combustion
fc	foot-candles
FIA	Forest Inventory Analysis [USFS]
FTE	full-time equivalent
FWP	[MT] Department of Fish, Wildlife and Parks
GHG	greenhouse gas
GPS	generation performance standard
GSP	gross state product
GTR	[USFS] General Technical Report

GVW	gross vehicle weight
GWh	gigawatt-hours (1 million kilowatt-hours)
GWP	global warming potential
HB	House Bill
HDPE	high density polyethylene
HDV	heavy-duty vehicle
HFC	hydrofluorocarbon
HID	high intensity discharge
HPMS	highway performance monitoring system
HVAC	heating, ventilation, and air conditioning
HWP	harvested wood products
I&F	Inventory and Forecast
IECC	International Energy Conservation Codes
IGCC	integrated gasification combined cycle
IOU	investor-owned utility
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
IRP	Integrated Resource Plan
kWh	kilowatt-hour
LCF	low carbon fuel
LCFS	Low Carbon Fuel Standard
LDV	light-duty vehicle
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design
LFGTE	landfill gas to energy
LMOP	Landfill Methane Outreach Program
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LRES	Land Resource and Environmental Sciences
LRR	low rolling resistance
LSE	load-serving entity
m^3/ha/yr	cubic meters per hectare per year
MACo	Montana Association of Counties
MCA	Montana Code Annotated
MDEQ	Montana Department of Environmental Quality
MDOA	Montana Department of Agriculture
MDT	Montana Department of Transportation
MDU	Montana–Dakota Utilities Company

MECA	Montana Electric Cooperatives Association
MEEC	Montana Energy Education Council
MEIC	Montana Environmental Information Center
MG	million gallons
MGY	million gallons per year
MMBtu	one million (a thousand thousand) British thermal units
MMES	Montana Manufacturing Extension Service
MMt	million metric tons
$MMtCO_2e$	million metric tons of carbon dioxide equivalent
MOU	Memorandum of Understanding
MPG	miles per gallon
MRL	Montana Rail Link
MSU	Montana State University
Mt	metric ton (equivalent to 1.102 short tons)
MW	megawatt
MWh	megawatt-hours (1 thousand kilowatt-hours)
MY	model year [cars]
N_2O	nitrous oxide
NAS	National Academy of Sciences
NASS	National Agricultural Statistics Service
NCAT	National Center for Appropriate Technology
NCDC	National Clean Diesel Campaign
NCOC	National Carbon Offset Coalition
NCSU	North Carolina State University
NEEA	Northwest Energy Efficiency Alliance
NEV	neighborhood electric vehicles
NGCC	natural gas combined cycle
NO_x	nitrogen oxides
NPV	net present value
NRC	National Research Council
NRCS	Natural Resources Conservation Service [USDA]
NREL	National Renewable Energy Laboratory
NWE	NorthWestern Energy
NWPPC	Northwest Power Planning Council
O&M	operation and maintenance
ODS	ozone-depleting substance
OPS	U.S. Office of Pipeline Safety
ORNL	Oak Ridge National Laboratory [US DOE]

PC	pulverized coal
PET	polyethylene terephthalate
PFC	perfluorocarbon
PIRG	Public Interest Research Group
PM	particulate matter
PPL	PPL Montana [power company]
PRC	Public Regulatory Commission
PRO	partnership reduction opportunities
PSC	[MT] Public Service Commission
PSW	Pacific Southwest Research Station [USFS]
PTC	[federal] Production Tax Credit
PURPA	Public Utility Regulatory Policy Act
PV	photovoltaics
QF	qualifying facilities
R&D	research and development
RCI	Residential, Commercial, and Industrial
RCII	Residential, Commercial, Institutional, and Industrial [TWG]
RCW	Revised Code of Washington
REC	renewable-energy credits
RGGI	Regional Greenhouse Gas Initiative
RNP	Required Navigation Performance [aircraft]
RPS	renewable portfolio standard
RVSM	Reduced Vertical Separation Minimums [aircraft]
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SAGE	System for Assessing Aviation's Global Emissions
SED	state energy data
SF_6	sulfur hexafluoride
SO_x	sulfur oxides
SUV	sport utility vehicle
SWEEP	Southwest Energy Efficiency Project
TCRP	Transit Cooperative Research Program [Transportation Research Board]
TEU	trailer equivalent units
TLU	Transportation and Land Use [TWG]
TOD	transit-oriented development
TSE	truck stop electrification
TWG	Technical Work Group
TWh	terawatt-hours

U&CF	Urban & Community Forestry [USFS program]
UM	University of Montana
UNFCCC	United Nations Framework Convention on Climate Change
US DOE	U.S. Department of Energy
US EPA	U.S. Environmental Protection Agency
USB	Universal System Benefits
USBP	Universal System Benefits Program
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
VALE	Voluntary Airport Low Emissions
VMT	vehicle miles traveled
WARM	WAste Reduction Model
WCI	Western Climate Initiative
WECC	Western Electric Coordinating Council
WGA	Western Governors' Association
WIRED	Work Force Innovation and Rural Economic Development
WREGIS	Western Renewable Energy Generation Information System
WW	wastewater
ZERT	Zero Emission Research and Technology [Center]

Executive Summary

Background

Recognizing the profound consequences that global warming could have on the economy, environment, and quality of life in Montana, Governor Brian Schweitzer issued a letter on December 13, 2005, directing the Montana Department of Environmental Quality (MDEQ) to establish a Climate Change Advisory Committee (CCAC). Under this initiative, the CCAC evaluated state-level greenhouse gas (GHG) reduction opportunities in various sectors of Montana's economy while taking into consideration the Governor's charge to develop policy recommendations that would "save money, conserve energy, and bolster the Montana economy."

The Climate Change Advisory Committee

MDEQ Director Richard Opper appointed a broad-based group of 18 Montana citizens to the CCAC. The CCAC was supported by a panel of scientific experts, public and private sector technical and policy specialists, and staff from MDEQ. These individuals evaluated options and made recommendations on existing programs in Montana, policies to reduce GHG emissions, and the potential cost of those policies. The CCAC met six times from July 2006 through July 2007 to evaluate the recommendations from technical work groups (TWGs) representing four sectors of Montana's economy:

1. Energy Supply (ES)
2. Residential, Commercial, Institutional, and Industrial (RCII)
3. Transportation and Land Use (TLU)
4. Agricultural, Forestry, and Waste Management (AFW)

A fifth TWG, Cross-Cutting Issues (CC), developed strategies that cut across many sectors of Montana's economy and evaluated the issues of inventorying, forecasting, reporting, and registering Montana's GHG emissions.

The CCAC followed a process designed and implemented by the nonprofit Center for Climate Strategies (CCS). Staff from the CCS provided facilitation services and technical expertise to the CCAC as it formulated its recommendations. The MDEQ provided coordination and oversight to the process.

Inventory of Montana's Greenhouse Gas Emissions

Montana's GHG emissions were last inventoried in 1990. The inventory was updated to the present, and a forecast was made of expected GHG emissions through 2020. The inventory shows that Montana's electricity generation, heating needs, commerce, agricultural practices, and transportation needs accounted for 0.6% of the GHG emissions in the United States in 2005. The state's forests, cropland, and rangeland provide a vast terrestrial carbon sink that helps balance the state's emissions. A 14% increase in GHG emissions from 1990 to 2005 moved Montana from a net carbon sink to a net carbon emitter, and the state now averages net emissions of approximately 12 million metric tons of carbon dioxide equivalents ($MMtCO_2e$) per year.

Montana also has a higher rate of GHG emissions per capita—nearly double the national average. The reasons for this are varied but include the state's large fossil fuel production industry, substantial agricultural industry, large distances for transportation, cooler climate, and low population base.

Climate Change Advisory Committee Recommendations

The CCAC agreed upon 54 policy recommendations that are designed to help reduce Montana's emissions of GHGs to 1990 levels by the year 2020. Some of the recommendations can be implemented immediately, and some will require the support of the Montana State Legislature. Some will cost money to implement, and many will save money by reducing energy needs and costs. Others will require technological advances to fully implement. Most of these recommendations will have additional benefits beyond reducing GHG emissions, including reduced reliance on imported fossil fuels, reduction in air pollution, increased opportunity for Montana agriculture to provide renewable fuels, healthier forests, and the opportunity for Montana to be a leader in developing new technologies to produce cleaner burning fuels while sequestering GHGs.

The CCAC advised that the overall results of its recommended policy options be compared using two GHG emissions calculation approaches to identify which long-term emissions reduction goals could be met. The first is a "consumption-based" approach based on a projection of the amount of energy consumed by Montana residents, businesses, industries, and institutions. This includes emissions that result from all electricity, natural gas, and transportation fuel use in Montana as well as emissions from all non-energy sectors of the economy (e.g., agricultural and industrial processes). This approach shows how the actions of Montanans can affect the amount of GHGs emitted for the energy needed in-state. The second approach is "production-based." It includes everything in the consumption-based calculation plus GHG emissions from electricity produced in Montana for export to other states. The difference in emissions is significant, because Montana exports, on average, more than 40% of the electricity it produces each year. More information on these approaches can be found in Chapter 4 and Appendix G. In this document, unless otherwise noted, all GHG emission reductions are reported in terms of $MMtCO_2e$, costs reflect net present values (NPVs), and cost-effectiveness (cost-per-ton) is reported as $/$MtCO_2e$ reduced or removed.

Figure EX-1 shows the projected growth in Montana's GHG emissions under a no-action scenario (business as usual) for the energy that is consumed in Montana only (i.e., calculating GHG emissions using the consumption-based approach). It also shows the projected emissions if all of the CCAC's recommendations are implemented as well as the CCAC's recommended GHG emission target for Montana in 2020. Figure EX-1 indicates that the CCAC's goal of reducing GHG emissions to 1990 levels by the year 2020 can be met and exceeded if all recommendations are implemented.

Figure EX-1. Reference case Montana consumption-based gross GHG emissions

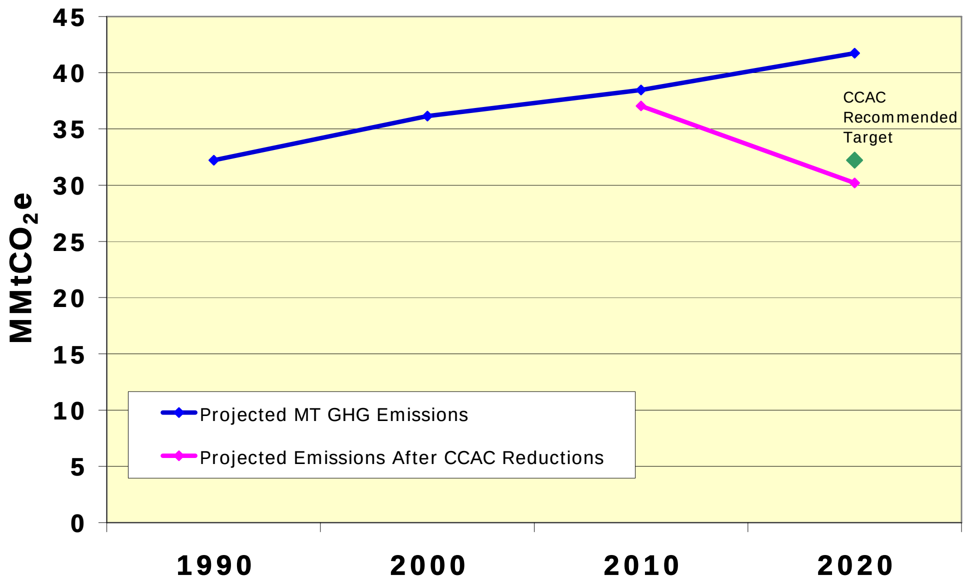
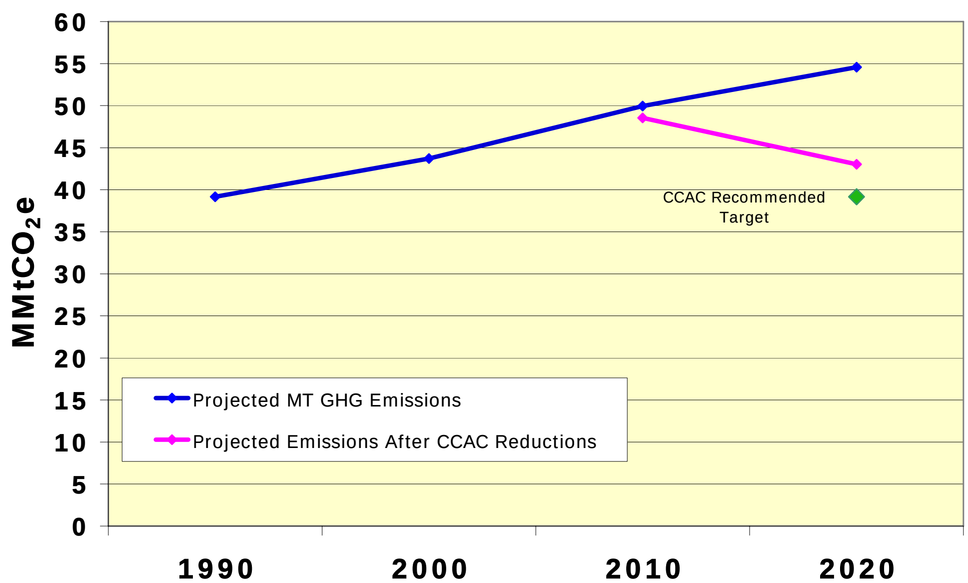


Figure EX-2 shows the projected growth in Montana's GHG emissions under a no-action scenario (business as usual) for both the energy that is consumed in Montana and the electricity that is produced and exported from Montana (i.e., calculating GHG emissions using the production-based approach). As in Figure EX-1, this graph shows the projected GHG emissions if all the CCAC's recommendations are implemented as well as the CCAC's recommended GHG emissions target for Montana in 2020. Figure EX-2 indicates that the CCAC's goal of reducing emissions to 1990 levels by the year 2020 will not be fully met under the production-based approach. This is because the 54 recommended policy options do not significantly reduce emissions from the electricity that is currently produced in Montana and exported out of state.

Figure EX-2. Reference case Montana production-based gross GHG emissions



Under the consumption-based approach with the GHG reductions from the policy options, the four sectors of Montana's economy (as defined in the CCAC process) would provide the following reductions as shown in Figure EX-3:

- 29.0% of the reductions (18.4 $MMtCO_2e$) would come from the RCII sector,
- 34.5% (21.9 $MMtCO_2e$) would come from the ES sector,
- 9.6% (6.1 $MMtCO_2e$) would come from the TLU sector, and
- 26.9% (17.1 $MMtCO_2e$) would come from the AFW sector.

Figure EX-3. Sector shares of recommended GHG reductions

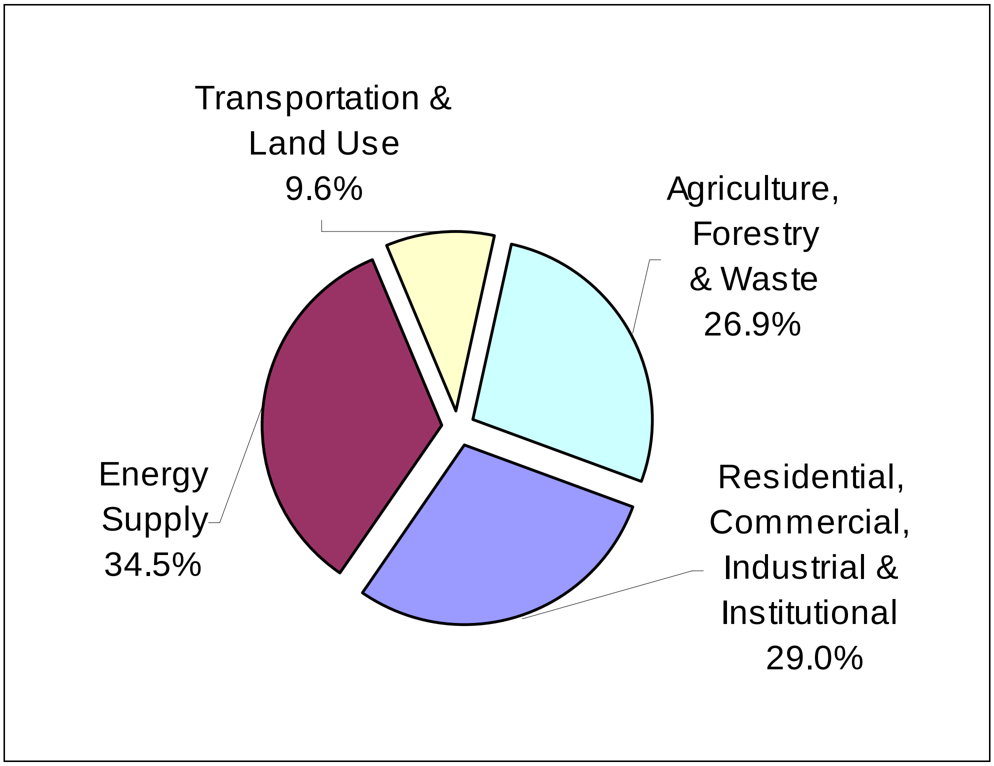
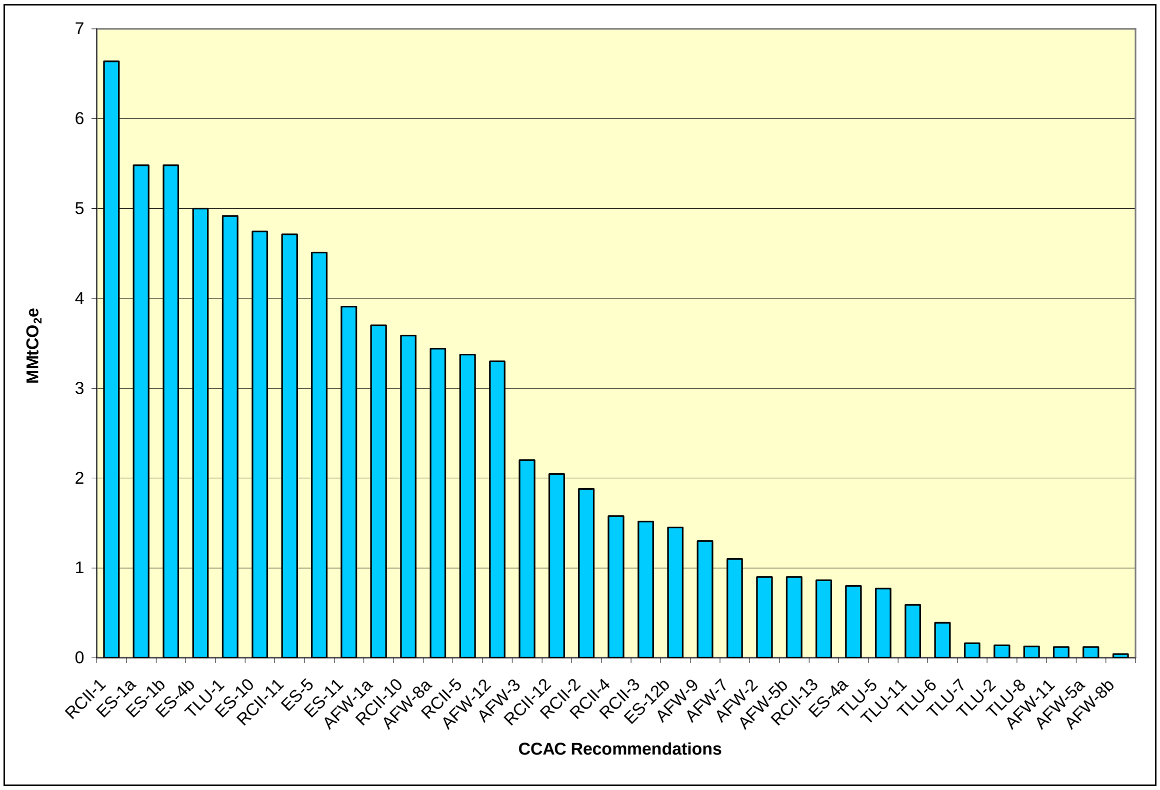


Figure EX-4 illustrates the range of GHG emission reductions that would result from implementing the individual recommendations of the CCAC as listed in Table EX-1. It is important to note that in Figure EX-4, each policy recommendation is illustrated as though it were a stand-alone option. Individual policy recommendations sometimes address the same GHG emissions, however, so the results of Figure EX-4 cannot be summed to produce total GHG emission reductions. Such overlaps have been accounted for in cumulative assessments of the CCAC's recommendations (e.g., in Figures EX-1 through EX-3).

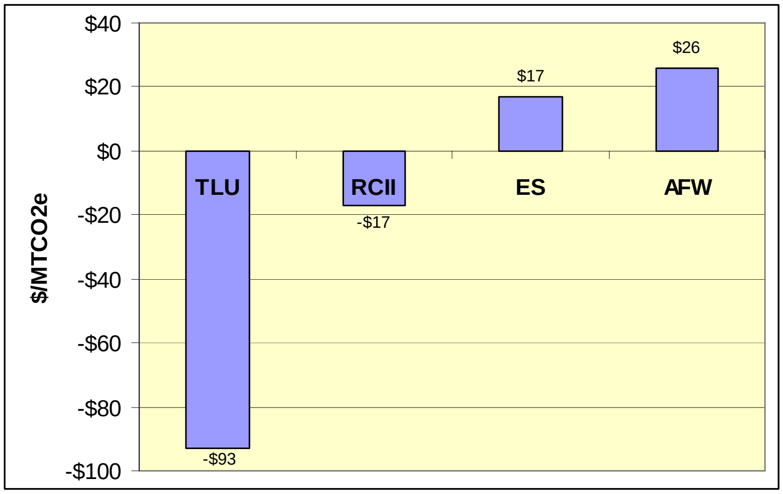
Figure EX-4. Policy recommendations ranked by GHG emission reductions



Costs of Implementation

There is considerable variation in the net costs or benefits of implementing the CCAC's recommendations as shown in Figure EX-5.

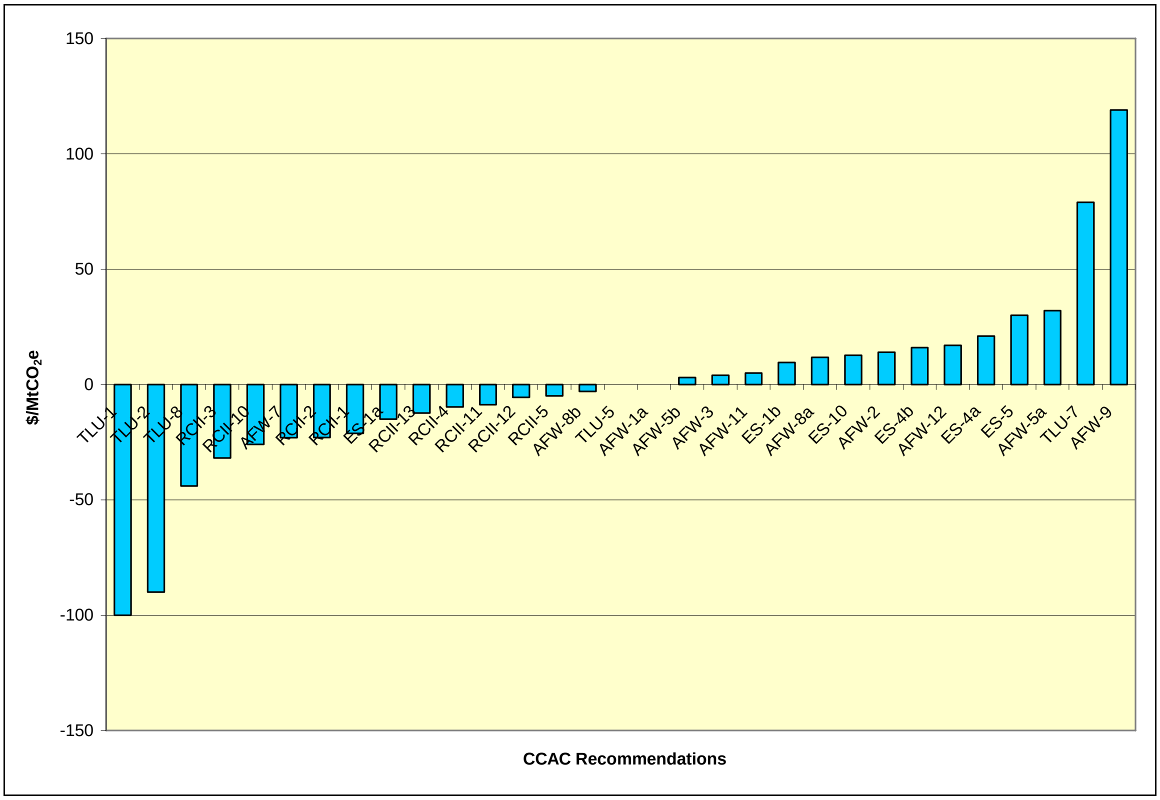
Figure EX-5. Overall cost-per-ton-reduced by sector



As Figure EX-5 illustrates, there are net costs to reducing a ton of carbon emissions from the ES and the AFW sectors. Conversely, there are net economic benefits to reducing emissions from the TLU and the RCII sectors. Most of the savings for these latter two sectors comes from reduced energy costs due to more efficient energy usage. Cumulatively, there is a slight economic benefit from implementing all of the CCAC's recommendations.

Figure EX-6 provides a ranking of individual policy recommendations based on their respective costs per $MtCO_2e$.

Figure EX-6. Policy recommendations ranked by cost-per-ton reduced



List of Recommendations

Table EX-1 lists all of the CCAC's individual policy recommendations. The recommendations are grouped by sector, and the table provides information on the amount of GHG reduction each recommendation would provide over the period 2007–2020 and their respective net costs or benefits on a cost-effectiveness (i.e., cost-per-ton-reduced) basis. Some recommendations are not quantified but are important to the success of the overall effort to reduce GHG emissions. For example, consumer education is not quantified by itself but is important to many of the policy recommendations.

Table EX-1. Policy options recommended by the CCAC

	Policy Option		GHG Reductions ($MMtCO_2e$) Total 2007–2020	Cost Effectiveness ($/t$CO_2e$)
	RESIDENTIAL, COMMERCIAL, INSTITUTIONAL, AND INDUSTRIAL			
RCII-1	Demand-Side Management Programs, Efficiency Funds and Requirements (and Financial Incentives)		6.6	–$21
RCII-2	Market Transformation and Technology Development Programs		1.9	–$23
RCII-3	State-Level Appliance Efficiency Standards and State Support for Improved Federal Standards		1.5	–$36
RCII-4	Building Energy Codes		1.6	–$10
RCII-5	“Beyond Code” Building Design Incentives and Mandatory Programs		3.4	–$5
RCII-6	Consumer Education Programs		*Not quantified*	
RCII-10	Industrial Energy Audits and Recommended Measure Implementation		3.6	–$26
RCII-11	Low-Income and Rental Housing Energy Efficiency Programs		4.7	–$9
RCII-12	State Lead by Example		2.0	–$6
RCII-13	Metering Technologies With Opportunity for Load Management and Choice		0.9	–$12
	Sector Total After Adjusting for Overlaps		**18.4**	**–$17**
	Reductions From Recent Actions			
RCII-1	Expand Energy Efficiency Funds		6.5	
RCII-11	Low-Income Energy Efficiency Programs		0.4	
	Sector Total Plus Recent Actions		**25.3**	
	ENERGY SUPPLY			
ES-1	Environmental Portfolio Standard (Renewables and Energy Efficiency)	Efficiency / Conservation	5.4	–$15
		Renewable Energy	5.5	$10
ES-2	Renewable Energy Incentives (Biomass, Wind, Solar, Geothermal)		*Not quantified separately (see ES-1 and ES-4)*	
ES-3	Research and Development (R&D), Including R&D for Energy Storage and Advanced Fossil Fuel Technologies		*Not quantified*	
ES-4	Incentives and Barrier Removal (Including Interconnection Rules and Net Metering Arrangements) for Combined Heat and Power (CHP) and Clean Distributed Generation (DG)	Distributed Renewables	0.8	$21
		Combined Heat and Power	5.0	$16
ES-5	Incentives for Advanced Fossil Fuel Generation and Carbon Capture and Storage (CCS), Including Combined Hydrogen and Electricity Production with Carbon Sequestration	Reference Case	4.5	$30
		High Fossil Fuel Scenario	24.4	$30
ES-6	Efficiency Improvements and Repowering of Existing Plants		*Not quantified*	
ES-7	Demand-Side Management		*Not quantified separately (see ES-1 and RCII-1)*	
ES-8/9	Market-Based Mechanisms to Establish a Price Signal for GHG Emissions (GHG Cap-and-Trade or Tax)		*Not quantified*	

ES-10	Generation Performance Standards or GHG Mitigation Requirements for New (and/or Existing) Generation Facilities, With/Without GHG Offsets		4.7	$13
ES-11	Methane and CO_2 Reduction in Oil and Gas Operations, Including Fuel Use and Emissions Reduction in Venting and Flaring	Reference Case	3.9	*Likely net benefit*
		High Fossil Fuel Case	6.6	*Likely net benefit*
ES-12	GHG Reduction in Refinery Operations, Including in Future Coal-to-Liquids Refineries	Coal-to-Liquids High Fossil Fuel Case	35	*Not estimated*
		Petroleum Refining – Reference Case	1.5	*Not estimated*
		Petroleum Refining – High Fossil Fuel Case	2.2	*Not estimated*
	Sector Total After Adjusting for Overlaps (Among ES Options and After Demand Reductions From RCI Options)	**Reference Case**	**21.9**	**$17**
		High Fossil Fuel Case	**79.4**	**$24**
	TRANSPORTATION AND LAND USE			
TLU-1	Light-Duty Vehicle Clean Car Standards		4.92	–$100
TLU-2	Fuel Efficient Replacement Tires Program		0.14	–$90
TLU-3	Consumer Information on Vehicle Miles Per Gallon		*Included in TLU-1 and TLU-2*	
TLU-4	Financial and Market Incentives for Low GHG Vehicle Ownership and Use		*Included in TLU-1*	
TLU-5	Growth and Development Bundle		0.77	<$0
TLU-6	Low-Carbon Fuels		0.39	N/A
TLU-7	Heavy-Duty Vehicle Emissions Standards and Retrofit Incentives		0.16	$79
TLU-8	Heavy-Duty Vehicle and Locomotive Idle Reduction		0.13	–$44
TLU-9	Procurement of Efficient Fleet Vehicles		*Included in TLU-1, TLU-6 through TLU-8, and TLU-11*	
TLU-10	Transportation System Management		*Not quantified*	
TLU-11	Intermodal Freight Transportation		0.59	N/A
TLU-12	Off-Road Engines and Vehicles GHG Emissions Reductions		*Not quantified*	
TLU-13	Reduced GHG Emissions From Aviation		*Not quantified*	
	Sector Total After Adjusting for Overlaps		**6.1**	**–$93**
	AGRICULTURE, FORESTRY, AND WASTE MANAGEMENT			
AFW-1	Agricultural Soil Carbon Management – Conservation/No-Till		3.7	$0
	Agricultural Soil Carbon Management – Organic Farming		*Not quantified*	
AFW-2	Biodiesel Production (Incentives for Feedstocks and Production Plants)		0.9	$14
AFW-3	Ethanol Production		2.2	$4
AFW-4*	Incentives for Enhancing GHG Benefits of Conservation Provisions of Farm Bill Programs		15	$12
AFW-5	Preserve Open Space and Working Lands – Agriculture		0.12	$32
	Preserve Open Space and Working Lands – Forests		0.9	$3
AFW-7	Expanded Use of Biomass Feedstocks for Energy Use		1.1	–$23
AFW-8	Afforestation/Reforestation Programs – Restocking		3.4	$12
	Afforestation/Reforestation Programs – Urban Trees		0.04	–$3
AFW-9	Improved Management and Restoration of Existing Stands		1.3	$119
AFW-10	Expanded Use of Wood Products for Building Materials		*Not quantified*	
AFW-11	Programs to Promote Local Food and Fiber		0.12	$5

AFW-12	Enhanced Solid Waste Recovery and Recycling	3.3	$17
	Reductions From Recent Actions	**0**	**$0**
	Sector Total Plus Recent Actions	**17**	**$26**
	CROSS CUTTING ISSUES		
CC-1	GHG Inventories and Forecasts	*Not quantified*	
CC-2	State GHG Reporting	*Not quantified*	
CC-3	State GHG Registry	*Not quantified*	
CC-4	State Climate Public Education and Outreach	*Not quantified*	
CC-6	Options for State GHG Goals or Targets	*Not quantified*	
CC-7	The State's Own GHG Emissions	*Not quantified*	

N/A = not applicable

* AFW-4 reductions were left out of the totals because they were not counted in the inventory.

Chapter 1
Background and Overview

The Governor's Initiative

Concerned about the profound implications that global warming could have on the economy, environment, and quality of life in Montana, Governor Brian Schweitzer on December 13, 2005, directed the Montana Department of Environment Quality (MDEQ) to establish a Climate Change Advisory Committee (CCAC).[1] The Governor asked the CCAC to "prepare a Climate Change Action Plan that includes recommendations for reducing greenhouse gas emissions in Montana and conserving energy in various sectors of our economy." Under this initiative, the CCAC took on the responsibility of identifying greenhouse gas (GHG) reduction opportunities in all economic sectors in Montana while at the same time seeking to save money, conserve energy, and bolster the Montana economy.

Governor Schweitzer noted the scientific consensus on this issue as embodied by reports issued by the Intergovernmental Panel on Climate Change (IPCC) and the National Academy of Sciences. Climate models indicate that global average temperatures could rise from 3 to 10 degrees Fahrenheit by the end of this century. The IPCC predicts that such a warming will result in rising sea levels, increased rainfall rates, heavy precipitation events (especially over the higher latitudes), and higher evaporation rates that would accelerate the drying of soils following rain events. Other studies of the effects of climate change on the Rocky Mountain West cite the potential for prolonged drought, earlier snowmelt, reduced snow pack, more severe forest fires, and other harmful effects.[2]

The CCAC presents this report covering:

- An inventory of historical, current, and forecasted GHG emissions in Montana,
- A description and analysis of existing policies and programs that currently reduce GHG emissions in Montana,
- Long-term GHG emission reduction goals for Montana and recommended policies to achieve these goals,
- Recommended mechanisms for implementing these goals and policies across all sectors of Montana's economy,
- Estimated GHG emissions reductions from the recommended policies, expressed in tons of carbon dioxide equivalents (tCO_2e),
- Consideration of the costs and benefits of the recommendations, and
- Challenges inherent in each recommendation as well as feasibility issues.

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[1] Appendix A is a copy of the Governor's letter.

[2] Agency Technical Work Group, State of New Mexico, Potential Effects of Climate Change on New Mexico, December 30, 2005. http://www.nmenv.state.nm.us/aqb/cc/Potential_Effects_Climate_Change_NM.pdf

The report is organized into six areas:

1. Inventory and Projections;
2. Residential, Commercial, Institutional, and Industrial;
3. Energy Supply;
4. Transportation and Land Use;
5. Agriculture, Forestry, and Waste Management; and
6. Cross-Cutting Issues.

The inventory and projections provide a forecast of Montana's GHG emissions under current practices. Goals and recommended policies in many sectors include assumptions, methods, and data used to quantify emissions reductions.

Greenhouse Gas Reduction Policies Already in Place

Currently in Montana there are a number of policies and programs designed to conserve energy, encourage the use of renewable energy, support replanting and growth of forests, and protect agricultural and range lands. These programs and policies include tax incentives and financing mechanisms for conservation and renewable energy, a renewable portfolio standard, and the opportunity for consumers to purchase "green power" from utility companies. Governor Schweitzer was the first governor in the nation to sign on to the 25 × 25 Initiative recommending that 25% of the nation's energy should come from renewable resources by 2025. The 2007 Montana Legislature also endorsed this policy. Montana participated in the Western Governors' Association Clean and Diversified Energy Initiative and is a member of *The Climate Registry*, a group of 39 states and 3 Canadian provinces working to track and reduce GHG emissions.

The CCAC Process

The CCAC was selected to represent a broad base of Montana citizens with diverse expertise and perspectives on climate change and GHG emissions. MDEQ Director Richard Opper appointed 18 stakeholders representing a broad range of backgrounds and interests. Montana's CCAC held its first meeting on July 13, 2006, followed by more than a year of intensive fact finding and consensus building. The CCAC met six times from July 2006 to July 2007.

A Scientific Advisory Panel drawn from agencies and Montana universities assisted the group. This panel included representatives from the Big Sky Carbon Sequestration Partnership, National Carbon Offset Coalition, United States Geological Survey, Montana State University, and The University of Montana. The representative from the University of Montana is also a member of the IPCC. The IPCC was recently awarded the 2007 Nobel Peace Prize.

Additional technical and policy expertise was provided by members of the public and private sectors who joined CCAC and Scientific Advisory Panel members on five Technical Work Groups (TWGs). The work groups developed initial recommendations and completed further analysis of options in five areas: Energy Supply (ES); Residential, Commercial, Institutional, and Industrial (RCII); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste

Management (AFW); and Cross-Cutting Issues (CC). These five TWGs met more than 60 times via teleconference, beginning in August 2006 and concluding in September 2007.

The MDEQ organized the process and provided technical expertise to the sector-based TWGs. The CCAC followed a consensus-building process designed and implemented by the nonprofit Center for Climate Strategies (CCS). The CCS applied a design similar to those used in other successful state climate planning initiatives (i.e., Arizona and New Mexico). The CCS provided both facilitation services and technical analysis on emission reductions and costs to the CCAC in formulating its recommendations.

During the course of the process, the CCAC prepared a reference case inventory and projections of future Montana GHG emissions and then evaluated specific mitigation options to reduce GHG emissions including benefits, costs, and feasibility issues associated with the various options. The CCAC process sought but did not mandate consensus, and it explicitly documented the level of CCAC support for individual policy recommendations and key findings established through a voting process, including barriers to consensus where they existed.

The recommendations adopted by the CCAC and presented in this report underwent two levels of screening by the CCAC. First, a potential policy option being considered by a TWG was not accepted as a priority for analysis and developed for full analysis unless it had a super-majority of support from CCAC members (with a *super-majority* defined as five or fewer “no” votes or objections). Second, after the analyses were conducted, only policy options that received at least majority support from CCAC members were adopted as recommendations by the CCAC and included in this report. In total, of the 54 policy recommendations adopted by the CCAC, all received unanimous consent except for one, and that one had only one dissenting member for a portion of the recommendation.

Analysis of Options

With CCS providing facilitation and technical analysis, the TWGs prepared policy options for CCAC consideration using a “policy template” conveying the following key information:

- Policy description,
- Policy design (goals, timing, parties involved),
- Implementation mechanisms,
- Related policies/programs in place,
- Estimated GHG reductions and costs,
- Key uncertainties,
- Contributing issues,
- Feasibility issues,
- Status of group approval,
- Level of group support, and
- Barriers to consensus.

Over the course of its deliberations, the CCAC modified and embraced various policy options. The final versions, conforming to the original policy templates, appear in Appendixes F through J and constitute the most detailed record of decisions of the CCAC. Appendix E presents a description of the methods used for quantification of policy options. Three key methods are summarized here:

- **Estimates of GHG Reductions.** Using the projection of future GHG emissions (see below) as a starting point, analysis of the impact of policy recommendations produced estimates of the GHG reductions attributable to each option in the years 2010 and 2020, and cumulative over the time period 2007–2020. Many reductions occurred as a result of the quantity or type of fossil fuel combusted; others occurred as a result of methane, or carbon dioxide (CO_2) sequestered. Among the many assumptions involved in this task was selection of the appropriate GHG accounting framework, particularly the choice between a "production-based" approach vs. a "consumption-based" approach to calculating GHG emissions from certain sectors of the economy.[3]

  The consumption-based approach is based on estimates of the amount of energy consumed by Montana residents, businesses, industry, and institutions. This includes emissions that result from all of the electricity, natural gas, and transportation fuel use in Montana, plus direct emissions from all non-energy sectors of the economy (e.g., agriculture and industrial processes). The consumption-based approach does not include emissions associated with electricity generated in Montana for use in other states.

  The production-based approach includes everything in the consumption-based scenario plus those emissions associated with electricity that is produced in Montana for export to other states. This difference is significant, because Montana exports more than 40% of the electricity it produces on average each year. The CCAC looked at both the consumption-based and production-based approaches. The recommended policy options are identical under both approaches; however, the impact is different because projected GHG emissions are greater under the production-based approach.

  There are advantages and disadvantages to utilizing either approach as a framework for decision making. This report does not endorse one approach over the other but presents both sets of values for electricity in the energy supply sector. For all other sectors, the report applies the consumption-based approach only. The consumption and production-based approaches, along with other GHG estimation issues (e.g., analysis of overlapping or interacting policy impacts), are discussed below and in detail in Chapter 2, Appendix D (GHG Emissions Inventory and Reference Case Projections), and Appendix E (Methods for Quantification). In addition, the application of the consumption-based approach for the electricity sector receives additional treatment in Chapter 4 and Appendix G (Energy Supply).

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[3] In brief, 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 far more or far less electricity than they consume (with the remainder attributable to power exports or imports). Montana is an example of a high production energy exporting state.

- **Estimates of Cost.** CCS and the TWGs produced estimates of the cost of various policy options, both in terms of a net present value (NPV) from 2007 to 2020 and a dollars-per-ton-reduction cost (i.e., cost-effectiveness).[4] The costing approach used was similar to a conventional cost-benefit framework but had some important differences:
  - *Benefits vs. Costs*—The principal benefit of the CCAC options is reduced GHG emissions, and this benefit was quantified simply as tons of emissions reduced. Many options resulted in easily monetized economic benefits such as fuel savings and electricity savings. In such cases, monetized benefits were subtracted from monetized costs resulting in lower costs and even cost savings for some recommendations. There was no attempt to quantify or monetize other possible benefits associated with policy options such as health benefits from less air pollution.
  - *Direct vs. Indirect Effects*—Cost estimates were primarily based on "direct effects," i.e., those borne by the entities implementing the options.[5] 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.
  - *Montana vs. National/Global Perspective*—Costs estimates were based on implementing entities in Montana, not on a broader societal perspective (national or global). One implication of this is that national taxes or subsidies that affect actions in Montana were not part of the analysis.
  - *Discounted and "Levelized" Costs*— The NPVs of costs were calculated by applying a real discount rate of 5%. Dollars-per-ton estimates were derived as a levelized cost per ton (i.e., by dividing the present value cost by the cumulative GHG reduction measured in tons). As was the case with GHG reductions, the period 2007–2020 was analyzed.

Montana GHG Emissions Inventory and Reference Case Projections

In cooperation with MDEQ, CCS prepared a draft document, titled *Montana GHG Emissions Inventory and Reference Case Projections, 1990–2020* (hereafter *Inventory and Projections*). The projection of future emissions aimed to capture as accurately as possible the trajectory of emissions, given policies currently in place as of 2007 and recognizing the likely increase in fossil fuel production that will occur in Montana. The draft *Inventory and Projections* was presented to the CCAC at its first meeting and approved by unanimous consent at the CCAC's third meeting following technical review and revision.[6] The *Inventory and Projections* included detailed coverage of all economic sectors and GHGs in Montana, including future emissions trends and assessment issues related to energy and economic and population growth. The assessment provided discrete perspectives on total state emissions in two key areas:

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[4] The analysis addressed cost and did not attempt to estimate specific price changes or utility rate changes that might result from implementation of a policy option.

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

[6] With final technical corrections performed for this final CCAC report. The final *Montana GHG Emissions Inventory and Reference Case Projections, 1990–2020* report is available on the web at: www.mtclimatechange.us/CCAC.cfm.

1. The distinction between *gross* emissions (leaving aside carbon sinks such as forests and cropland) or *net* emissions (in which lowered emissions due to carbon sinks are subtracted from gross emissions).

2. The differences between production-based and consumption-based accounting (see earlier discussion).

These two key factors resulted in the following perspectives for measuring Montana GHG emissions:

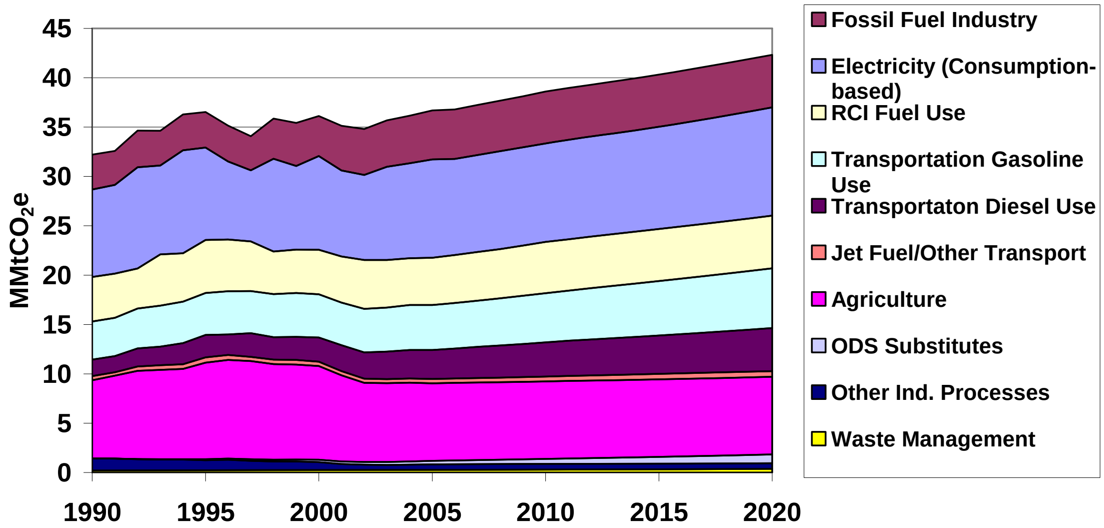
- Gross GHG emissions using the production-based approach in all sectors,
- Net GHG emissions (including carbon sinks) using the production-based approach in all sectors,
- An alternative using an expected higher rate of in-state fossil fuel production in the future,
- Gross GHG emissions using the consumption-based approach in the electricity sector, and
- Net GHG emissions using the consumption-based approach in the electricity sector.

After considering the relative merits of these perspectives, the CCAC decided that net emissions in all sectors using the consumption-based approach would be the basis for the report except in the electricity sector where both the consumption-based and production-based approaches needed to be considered. A detailed discussion of the issues involved appears in Chapter 2 and the final report is referenced Appendix D and available on the web at: www.mtclimatechange.us/CCAC.cfm.

The *Inventory and Projections* revealed substantial emissions growth rates and related policy challenges. Figure 1-1 shows the reference projections for Montana's gross GHG emissions (not counting sequestration) steadily climbing to 42 million metric tons of carbon dioxide equivalents ($MMtCO_2e$)[7] by 2020, 30% above 1990 levels. Most of this growth in emissions is projected to come from the transportation sector. Accounting for carbon sequestration or carbon sinks, Montana's forests and soil would decrease the gross estimates by about 25.4 $MMtCO_2e$ annually, resulting in net emissions of about 16.3 $MMtCO_2e$ in 2020. Figure 1-1 also illustrates the breakdown of forecasted GHG emissions by sector.

[7] Carbon dioxide equivalency is a method used to compare the emissions from various GHGs based upon their global warming potential (GWP) and their comparative ability to trap radiation and increase warming. It is commonly expressed as million metric tons of carbon dioxide equivalents ($MMtCO_2e$). For example, the GWP for methane is 24.5, meaning that emissions of one million metric tons of methane is equivalent to emissions of 24.5 million metric tons of carbon dioxide.

Figure 1-1. Gross GHG emissions by sector, 1990–2020: historical and projected (consumption-based approach)



The inventory and projection of Montana's GHG emissions provided several critical findings:

- The electricity and transportation sectors are two of the sectors with the largest emissions (26% and 20%, respectively) and are expected to continue to grow.
- Agriculture, with 26% of Montana's gross GHG emissions, is the second largest GHG source (after electricity) and is expected to remain reasonably constant over time.
- Montana has a significant fossil fuel production sector that produces natural gas (by both conventional production and coal bed methane extraction), oil, and coal for export out-of - state. In 2000, the fossil fuel industries' emissions accounted for 11% of gross GHG emissions.

While Montana's emissions growth rate presents challenges, it also provides major opportunities. Key choices on technologies and infrastructure can have a significant impact on emissions growth. The CCAC's recommendations document the opportunities for the state to reduce its GHG emissions while continuing strong economic growth by being more energy efficient, using more renewable energy sources, and increasing the use of cleaner transportation modes, technologies, and fuels. New approaches to sequestering the carbon from fossil fuel extraction and processing can offset growth in emissions from the energy supply sector. The inventory and reference case projections are discussed in more detail in Chapter 2; the full study, provided as a companion document to this report, is referenced in Appendix D.

Overview of CCAC Policy Recommendations

The CCAC is making 54 policy recommendations to the Governor to help reduce the state's GHG emissions. If implemented, the recommendations are projected to reduce the state's GHG emissions by 11.5 $MMtCO_2e$ by 2020 below what emissions would be in 2020 without the recommendations. Figure 1-2 illustrates the level of reductions that these recommendations would achieve compared with the projected growth in Montana's GHG emissions (the "reference case" forecast of emissions) using a consumption-based approach. Table 1-1 provides the numeric estimates underlying Figure 1-2. Figure 1-3 and Table 1-2 illustrate the level of reductions these recommendations would achieve compared with the projected growth in Montana's GHG emissions using a production-based approach. The CCAC recommendations reach and exceed their reduction target for the consumption-based case but fall short for the production-based case. This is largely because the 54 recommended policy options do not significantly reduce emissions from the electricity that is currently produced in Montana and exported out of state.

Figure 1-2. Reference case Montana gross GHG emissions (consumption basis)

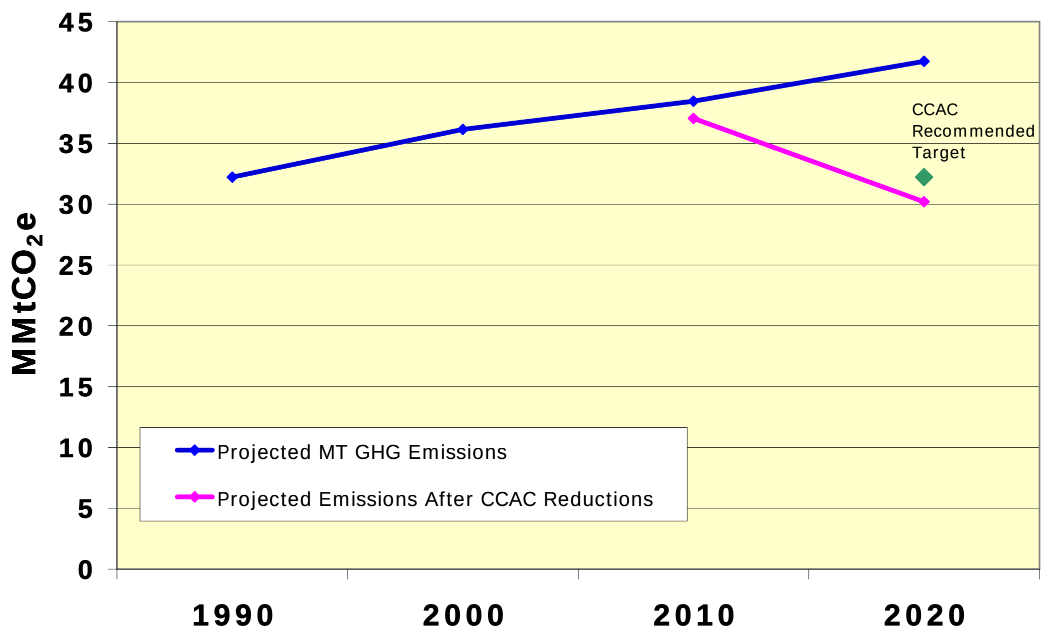


Table 1-1. Annual gross emissions (consumption basis): reference case projections and CCAC recommendations

Annual Gross Emissions–Consumption Basis ($MMtCO_2e$)	1990	2000	2010	2020
Reference Case Projections	32.2	36.1	38.5	41.7
CCAC Recommended Target*				32.2
GHG Reductions From CCAC Recommendations			–1.4	–11.5
Annual Emissions With CCAC Recommendations			37.1	30.2

* This target aims to reduce Montana GHG emissions to 1990 levels by 2020.

Figure 1-3. Reference case Montana gross GHG emissions (production basis)

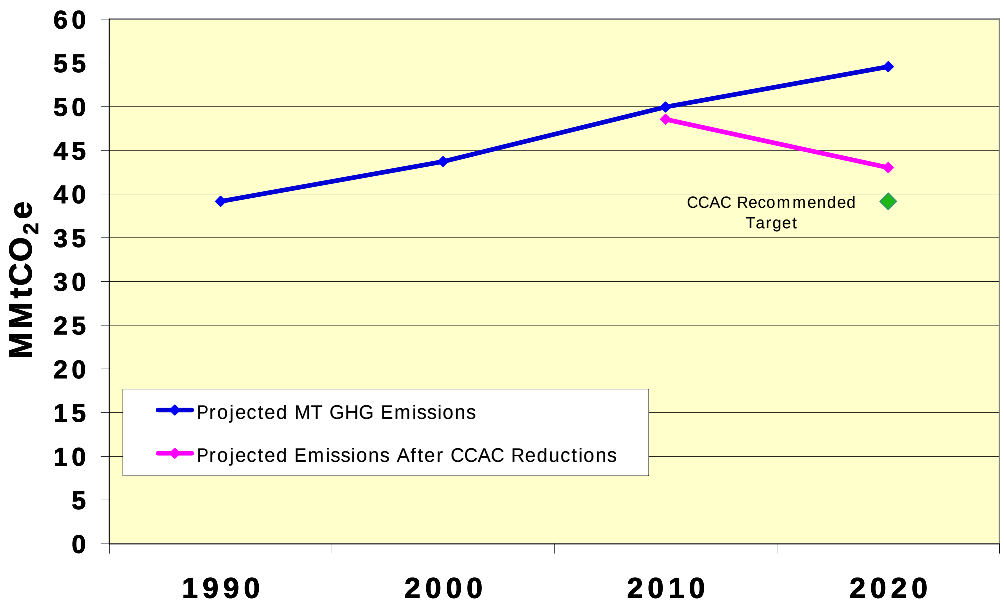


Table 1-2. Annual gross emissions (production basis): reference case projections and CCAC recommendations

Annual Gross Emissions–Production Basis ($MMtCO_2e$)	1990	2000	2010	2020
Reference Case Projections	39.2	43.7	50.0	54.6
CCAC Recommended Target*				39.2
GHG Reductions From CCAC Recommendations			–1.4	–11.5
Annual Emissions With CCAC Recommendations			48.6	43.0

* This target aims to reduce Montana GHG emissions to 1990 levels by 2020.

The CCAC recommends that Montana establish a statewide, economy-wide GHG reduction goal to reduce gross GHG emissions to 1990 levels by 2020, for both consumption-based and production-based emissions, and to further reduce emissions to 80% below 1990 levels by 2050. In lieu of establishing a specific target sooner than 2020, the CCAC also strongly recommends early and aggressive implementation of its comprehensive recommendations, along with a corresponding set of incentives to promote early adoption of needed changes. These goals are consistent with the levels and framework of goals set by other states, including those in the West, that are implementing GHG reduction strategies.

Table 1-3. Comparison of state GHG reduction goals and timelines

State	GHG Reduction Goals and Timelines
AZ	2000 levels by 2020; 50% below 2000 levels by 2040
CA	2000 levels by 2010; 10% below by 2020; 80% below by 2050
CT	1990 levels by 2010; 10% below by 2020; 75% below by 2050
MA	1990 levels by 2010; 10% below by 2020; 75% below by 2050
ME	1990 levels by 2010; 10% below by 2020; 75% below by 2050
MT	**1990 levels by 2020, 80% below by 2050**
NJ	5% below 1990 levels by 2005
NM	2000 levels by 2012; 10% below by 2020; 75% below 2050
NY	5% below 1990 levels by 2010
OR	1990 levels by 2010; 10% below by 2020; 75% by 2100
RI	1990 levels by 2010; 10% below by 2020; 75% by 2050
VT	25% below 1990 levels by 2012; 50% below 2028; 75% below by 2050
WA (Puget Sound)	1990 levels by 2010; 10% below by 2020; 75% by 2100

For Montana, as for any state, meeting a near-term reduction goal will require prompt and energetic implementation of the required GHG reduction policies by state government and all stakeholders. Meeting longer-term goals will require a consistent commitment by successive governors and legislatures, aided by an equal commitment by those same stakeholders.

The CCAC's recommendations are summarized in the Executive Summary, along with rankings of the options in terms of total GHG reductions and cost (or cost savings). Chapters 3 through 7 and the Appendixes provide detailed descriptions and analysis of GHG reductions, costs, additional impacts, and feasibility for individual options developed by the five TWGs:

- Residential, Commercial, Institutional, and Industrial (RCII);
- Energy Supply (ES);
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste Management (AFW); and
- Cross-Cutting Issues (CC).

Although not prepared in coordination with other state and regional actions, the recommendations adopted by the CCAC are consistent with and supportive of resolutions adopted by the Western Governors' Association (WGA), including those adopted at its June 2006 annual meeting in Sedona, Arizona, pertaining to "Regional and National Policies Regarding Global Climate Change,"[8] "Clean and Diversified Energy for the West,"[9] and "Transportation Fuels for the Future,"[10] as well as the recommendations of the WGA's Clean and Diversified Energy Advisory Committee.[11]

[8] Resolution 06-3 http://www.westgov.org/wga/policy/06/climate-change.pdf

[9] Resolution 06-10 http://www.westgov.org/wga/policy/06/clean-energy.pdf

[10] Resolution 06-20 http://www.westgov.org/wga/policy/06/futurefuels.pdf

[11] http://www.westgov.org/wga/meetings/am2006/CDEAC06.pdf

The CCAC's recommendations also complement other efforts underway in Montana, outlined at the beginning of this chapter. This underscores the potential co-benefits of the CCAC's recommended policy options.

Chapter 2
Inventory and Projections of GHG Emissions

Introduction

This chapter presents a summary of the full study, *Montana Greenhouse Gas Inventory and Reference Case Projections 1990–2020* (hereafter, the *Inventory and Projections*, Appendix D to this report) and includes the emission estimates (historical and projected) along with key methodological issues and uncertainties. These estimates are intended to help the state and stakeholders understand past, current, and possible future greenhouse gas (GHG) emissions in Montana and thereby inform the policymaking process.

Historical GHG emissions estimates (1990 through 2005)[1] were developed using a set of generally accepted principles and guidelines for state GHG emissions inventories, relying to the extent possible on Montana-specific data and inputs. The reference case projections (2006–2020) are based on a compilation of various existing Montana and regional projections of electricity generation, fuel use, and other GHG-emitting activities, along with a set of simple, transparent assumptions described later in this chapter. Developing a "reference case" projection for the most likely development of Montana's electricity and fossil fuel production sectors is particularly challenging, given the many factors impacting energy production-related emissions. The principal uncertainty of interest is on the high side, given the many plans and initiatives to increase coal utilization locally and nationally. As a result, an alternative scenario of future energy supply development—the high fossil fuel production scenario—is also included.

Inventory and Projections covers the six types of gases included in the U.S. 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 equivalents (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.

It is important to note that the preliminary emissions estimates reflect the *GHG emissions associated with the electricity sources used to meet Montana'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. For many years, Montana power plants have tended to produce considerably more electricity than is consumed in the state—emissions associated with exported electricity are excluded from the consumption-based emissions. This report covers both methods of accounting for emissions, but for consistency, all total results are reported as *consumption-based.*

Montana GHG Emissions: Sources and Trends

Table 2-1 provides a summary of GHG emissions estimated for Montana by sector for the years 1990, 2000, 2005, 2010, and 2020. As shown in this table, Montana is estimated to be a net

[1] The last year of available historical data varies by sector from 2000 to 2005.

source of GHG emissions, but with significant sinks of GHG emissions due to the forestry sector and agricultural soils. We note that there are significant uncertainties associated with estimating forest carbon sinks. In the sections below, we discuss GHG emission sources (positive, or *gross*, emissions) and sinks (negative emissions) separately in order to clearly identify trends, projections, and uncertainties.

The next section of the report provides a summary of the historical emissions (1990 through 2005) followed by a summary of the forecasted reference case projection year emissions (2006 through 2020), key uncertainties, and next steps. We also provide an overview of the general methodology, principles, and guidelines followed for preparing the inventory.

Table 2-1. Montana historical and reference case GHG emissions, consumption-based by sector*

$MMtCO_2e$	1990	2000	2005	2010	2020
Energy	**22.9**	**25.3**	**27.7**	**29.2**	**32.0**
Electricity use	8.9	9.5	10.0	10.0	11.0
Transportation fuel use	5.9	7.3	8.0	8.8	10.4
Fossil fuel industry	3.5	4.1	5.0	5.2	5.3
Residential/commercial/other industrial fuel use	4.5	4.5	4.8	5.2	5.3
Other	**9.3**	**10.9**	**9.1**	**9.3**	**9.8**
Industrial processes	1.2	1.0	0.9	1.1	1.5
Agriculture	7.9	9.5	7.9	7.9	7.9
Waste management	0.2	0.2	0.3	0.3	0.4
Gross emissions	**32.2**	**36.1**	**36.8**	**38.5**	**41.7**
Change relative to 1990		*12%*	*14%*	*19%*	*30%*
Change relative to 2000			*2%*	*6%*	*15%*
Forestry	**–23.1**	**–23.1**	**–23.1**	**–23.1**	**–23.1**
Agricultural soils sink	**–2.3**	**–2.3**	**–2.3**	**–2.3**	**–2.3**
Net emissions (including sinks)	**6.8**	**10.7**	**11.4**	**13.1**	**16.3**
Change relative to 1990		*57%*	*67%*	*92%*	*139%*
Change relative to 2000			*7%*	*22%*	*52%*
Per capita gross emissions	**40.3**	**40.1**	**39.4**	**39.7**	**40.8**
Per capita net emissions	**8.5**	**11.9**	**12.2**	**13.5**	**15.9**

*Totals may not equal exact sum of subtotals shown in this table due to independent rounding.
$MMtCO_2e$ = million metric tons carbon dioxide equivalent

Historical Emissions

Overview

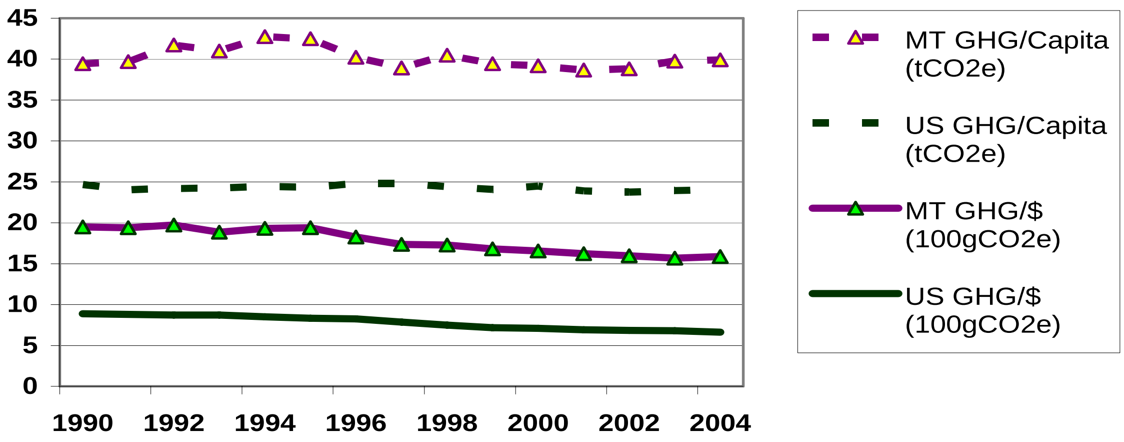
Preliminary analyses suggest that in 2005, activities in Montana accounted for approximately 37 million metric tons (MMt) of CO_2e gross emissions, an amount equal to 0.6% of total U.S. GHG emissions.[2] Montana's gross GHG emissions are rising at about the same rate as those of

[2] United States emissions estimates are drawn from US EPA 2006. *Inventory of US Greenhouse Gas Emissions and Sinks:1990–2004*.

the nation as a whole.[3] Montana's gross GHG emissions were up 11% from 1990 to 2004, while national emissions rose by 15% during this period.

Although Montana's GHG emissions are low on an absolute scale compared with the total national output on a per capita basis during the period from 1990 to 2004, Montanans emit about 40 $MtCO_2e$, much higher than the national average of 25 $MtCO_2e$ over this same time period. The reasons for the higher per capita intensity in Montana are varied, but they include the state's strong fossil fuel production industry, large agricultural industry, large distances for transportation, and low population base. Figure 2-1 illustrates the state's emissions per capita and per unit of economic output. It also shows that, like the nation as a whole, per capita emissions have remained fairly flat, while economic growth exceeded emissions growth throughout the 1990–2004 period. From 1990 to 2004, emissions per unit of gross product dropped by 25% nationally and by 18% in Montana.

Figure 2-1. Montana and U.S. gross GHG emissions, per capita and per unit gross product



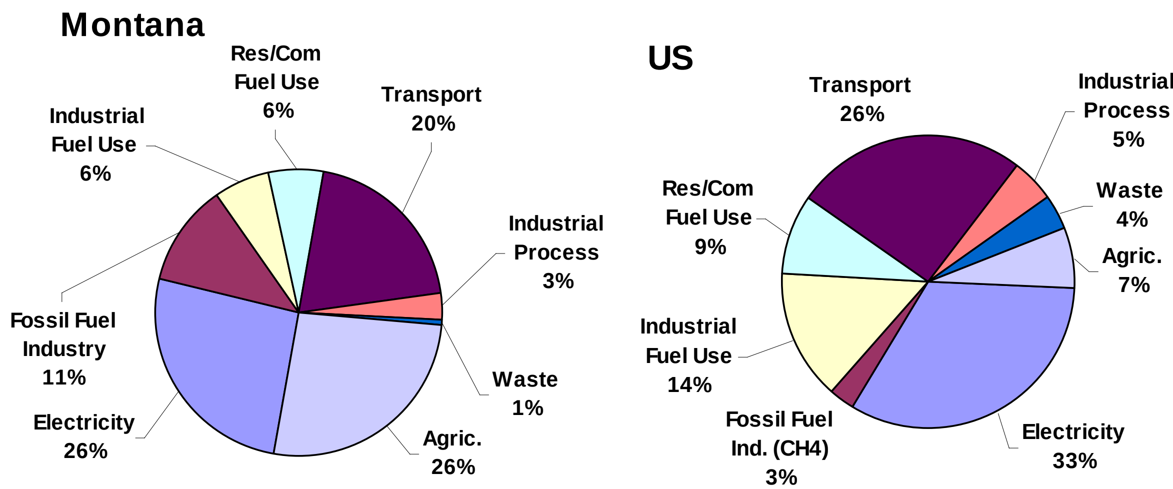
tCO_2e = tons carbon dioxide equivalent gCO_2e = grams carbon dioxide equivalent

Electricity use, agriculture, and transportation are the state's principal GHG emissions sources. Together, the combustion of fossil fuels for electricity generation used in-state and in the transportation sector account for about 46% of Montana's gross GHG emissions, as shown in Figure 2-2. The relative contribution of agricultural emissions (methane and N_2O emissions from manure management, fertilizer use, and livestock) is much higher in Montana (26%) than in the nation as a whole (7%). This is a result of more agricultural activity per capita in Montana compared with that in the United States as a whole. The state also has higher levels of emissions (methane) from the fossil fuels industry—natural gas, oil products, and coal—than the national average (11% of the state's emissions). The remaining use of fossil fuels in the residential,

[3] *Gross* emissions estimates include only those sources with positive emissions. Carbon sequestration in soils and vegetation is included in *net* emissions estimates. All emissions reported in this section for Montana reflect consumption-based accounting (excluding emissions from electricity exports). On a national basis, little difference exists between *production-based* and *consumption-based* accounting for GHG emissions because net electricity imports are less than 1% of national electricity generation.

commercial, institutional, and industrial (RCII) sectors constitutes another 12% of state emissions.

Figure 2-2. Gross GHG emissions by sector, 2000, Montana and US



Industrial process emissions comprised only about 3% of state GHG emissions in 2000, but these emissions are expected to rise in the future due to the increasing use of HFCs as substitutes for ozone-depleting chlorofluorocarbons.[4] Other industrial process emissions result from CO_2 released during aluminum and cement production and soda ash, limestone, and dolomite use. Landfills and wastewater management facilities produce CH_4 and N_2O emissions accounting for the remaining 1% of the state's emissions in 2000.

Based on data from 1989 to 2004, Montana's forests are estimated to be net sinks, accounting for –23.1 $MMtCO_2$ of GHG emissions (the negative value indicates a net sequestration of carbon dioxide from the atmosphere). Also, agricultural soils are estimated to sequester an additional 2.3 $MMtCO_2$. With these GHG sinks, Montana's net emissions were 6.8 $MMtCO_2$ in 1990. Because of a lack of information for estimating future trends, these sinks were estimated to remain constant throughout the forecast period from 2005 through 2020. Thus, with the increase in GHG emission sources, by 2020, the net emissions in Montana are estimated to increase to about 16.3 $MMtCO_2e$/year.

The Center for Climate Strategies (CCS) also prepared emission estimates for black carbon (BC), which is an aerosol species (component of particulate matter) that has positive climate forcing potential. The 2002 estimates for BC were 2.6 $MMtCO_2e$ across all source sectors. This is about 7% of the total emissions for the six GHGs shown in Table 2-1 during this period. Important sources of BC are diesel combustion, non-road engines (31%), rail (29%), and on-road vehicles (24%). An assessment of these sources using available data for a 2018 projection from the Western Regional Air Partnership showed a decrease in the on-road and non-road diesel sectors because of the new federal engine and fuel standards for particulate matter. Rail emissions rose

[4] Chlorofluorocarbons (CFCs) are also potent GHGs; however, they are not included in GHG estimates because of concerns related to implementation of the Montreal Protocol. See Appendix J.

only slightly. Overall, future BC emissions are expected to drop as a result of the new federal standards.

A Closer Look at the Three Major Sources: Electricity, Agriculture, and Transportation

As shown in Figure 2-2, the electricity, agriculture, and transportation sectors are the largest contributors to Montana's gross consumption-based emissions. These sectors accounted for 26%, 26%, and 20%, respectively, of total GHG emissions in 2000.

It is important to note that the electricity emissions estimates reflect the *GHG emissions associated with the electricity sources used to meet Montana 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. For many years, Montana power plants produced almost twice the electricity that was consumed in the state. In the year 2000, for example, Montana exported 41% of the electricity produced in the state. As a result, in 2000, emissions associated with electricity consumption (9.5 $MMtCO_2e$) were much lower than those associated with electricity production (17.1 $MMtCO_2e$).[5]

While we estimate both the emissions from electricity production and consumption, unless otherwise indicated, tables, figures, and totals in this report reflect electricity consumption emissions. The consumption-based approach can better reflect the emissions (and emissions reductions) associated with activities occurring in the state, particularly with respect to electricity use (and efficiency improvements), and is particularly useful for policy making. Under this approach, emissions associated with electricity exported to other states would need to be covered in those states' accounts in order to avoid double counting or exclusions. (Indeed, Arizona, California, Oregon, New Mexico, and Washington are currently considering such an approach.)

Emissions from agricultural sources (CH_4 and N_2O emissions from enteric fermentation, manure management, agricultural soils and crop residue burning) ranged from about 8 to 10 $MMtCO_2e$ during the period 1990 to 2005. Total GHG emissions increased from 8 $MMtCO_2e$ in 1990 to a high of 10 $MMtCO_2e$ in 1996 before dropping back to 8 $MMtCO_2e$ in 2002 and remaining at this level. Except for emissions from agricultural soils, emissions in each subsector were fairly static. For agricultural soils, emissions grew through the mid-1990s but then began to fall during the late 1990s. Emissions from agricultural soils are N_2O emissions from the use of synthetic fertilizers, crop residue, nitrogen fixing crops, and manure application. Manure application is the largest contributor to the emissions from agricultural soils.

Like electricity emissions, GHG emissions from transportation fuel use have risen steadily since 1990 at an average rate of slightly over 2% annually. Gasoline-powered vehicles account for about 54% of transportation GHG emissions in 2005. Diesel consumption accounts for another 39%, air travel for roughly 6%, and the remainder of transportation emissions come from natural gas and liquefied petroleum gas (LPG) vehicles and lubricants. As the result of Montana's

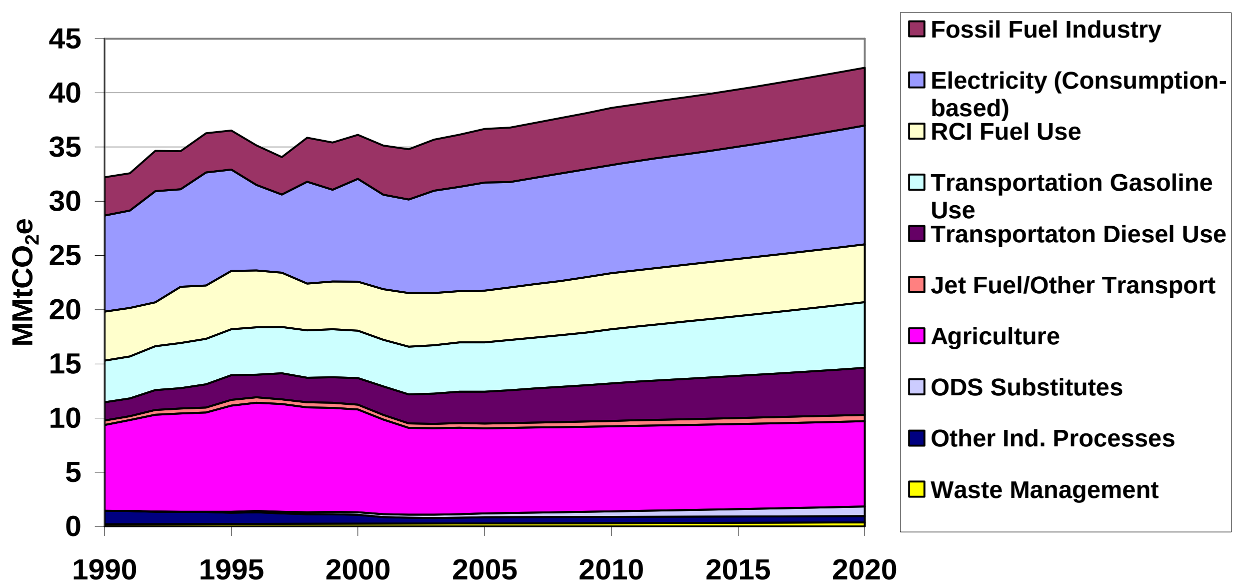
[5] Estimating the emissions associated with electricity use requires an understanding of the electricity sources (both in-state and out-of-state) used by utilities to meet consumer demand. The current estimate reflects some very simple assumptions described in Appendix A of *Inventory and Projections*.

population and economic expansion and an increase in miles traveled during the 1990s, gasoline use has grown at rate of 0.9% annually from 1990 to 2005. Meanwhile, over the same period, on-road diesel fuel use has risen 4% annually, suggesting an even more rapid growth in freight movement within the State.

Reference Case Projections

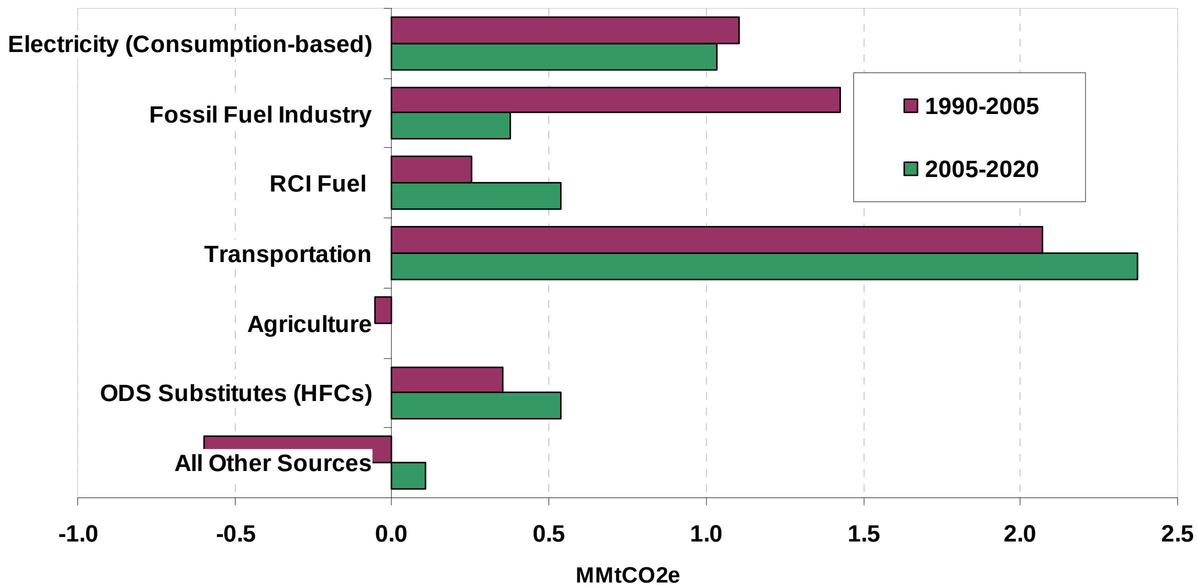
Relying on a variety of sources for projections of electricity and fuel use, as noted below and in *Inventory and Projections*, we developed a simple reference case projection of GHG emissions through 2020. As illustrated in Figure 2-3 and shown numerically in Table 2-1 under the reference case projections, Montana gross GHG emissions continue to grow steadily, climbing to 42 $MMtCO_2e$ by 2020, 30% above 1990 levels. Transportation is projected to be the largest contributor to future emissions growth, followed by the electricity sector, as shown in Figure 2-4. Other major sources of emissions growth include the fossil fuel industry and RCII fuel use. The decrease in GHG emissions from *All Other Sources* in Figure 2-4 is driven by the drop in aluminum production from 1990 to 2005.

Figure 2-3. Montana gross GHG emissions by sector, 1990–2020: historical and projected under reference case assumptions



*RCI = direct fuel use in residential, commercial, and industrial sectors (excluding the fossil fuel production industry); ODS = ozone-depleting substance. Other Ind. Processes includes process-related GHG emissions from aluminum production, cement production, and soda ash, limestone, and dolomite use.

Figure 2-4. Sector contributions to emissions growth in Montana, 1990–2020: historic and reference case projections



*RCI = direct fuel use in residential, commercial, and industrial sectors (excluding the fossil fuel production industry); ODS = ozone-depleting substance; HFC = hydrofluorocarbon.

High Fossil Fuel Production Scenario

Given the many factors impacting energy production-related emissions and a diversity of assumptions by stakeholders within the energy sector, developing a “reference case” projection for the most likely development of Montana’s electricity and fossil fuel production sectors is particularly challenging. The principal uncertainty of interest is on the high side, given the many plans and initiatives to increase coal utilization locally and nationally. As a result, we explore an alternative scenario of future energy supply development—the high fossil fuel production scenario. The high fossil fuel scenario assumes that

- Additional new transmission lines will be built to export power from Montana. The total additional transmission lines in this case would have a capacity of 2,500 additional MW over the reference case addition of 500 MW, or 3,000 total additional MW capacity, relative to current levels. The new power plants built in Montana to use the capacity of the additional transmission lines are assumed to be a mix of 67% fluidized bed coal and 33% wind.
- Total natural gas production triples between 2005 and 2010 and increases an additional 74% above 2010 levels by 2020. Much of this increase is driven by increased coal bed methane development. To support this production, the scenario assumes two new natural gas transmission lines cross the state.
- Montana refining capacity increases, through both expansion of existing refineries and the addition of a new refinery, for refining of Athabasca crude from Alberta’s oil sands.
- Two commercial coal-to-liquids plants are assumed to begin operation in Montana, and coal mining increases modestly to support these plants.

The above assumptions reflect the high end of estimates for future fossil fuel development, under favorable conditions.

Table 2-2 presents a summary of GHG emissions from the electricity sector in Montana on a production basis for both the reference case and the high fossil fuel scenario and on a consumption basis, which has the same estimated emissions for each case. Though the GHG emissions are significantly different from each other, each set of estimates is valid depending on circumstances. The difference between the emissions in the reference case and the high fossil fuel scenario estimates reflects the uncertainty in future energy development in Montana. The consumption-based emissions represent a focus on the emissions associated with electricity consumption in Montana. This focus is important when evaluating the effects of actions directed at in-state electricity conservation.

Table 2-2. Summary GHG emissions for Montana electric sector

($MMtCO_2e$)	1990	2000	2005	2010	2020
Production-based					
Reference case	15.8	17.1	19.3	21.5	23.8
High fossil fuel scenario	15.8	17.1	19.3	21.5	34.2
Consumption-based	**8.9**	**9.5**	**10.0**	**10.0**	**11.0**

Note: Consumption-based emissions are the same for both the reference case and the high fossil fuel scenario because electricity consumption in Montana is the same for both cases.

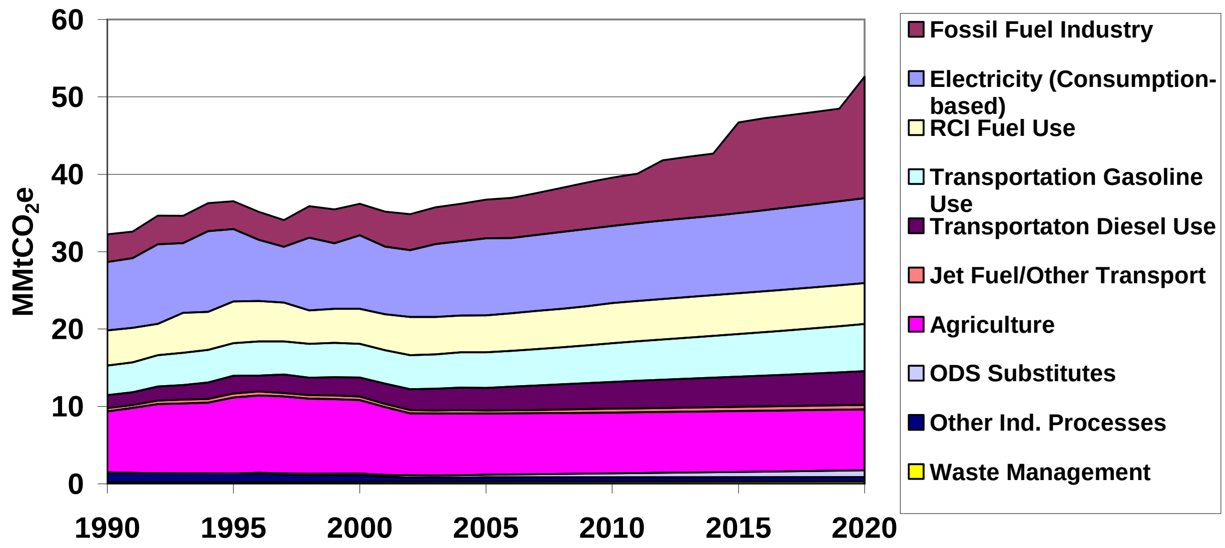
Table 2-3 presents a summary of GHG emissions from the Montana fossil fuel sector for both the reference case and the high fossil fuel scenario. The projected growth between 2005 and 2020 is only 7% in the reference case and 216% in the high fossil fuel case, in which a number of unconventional technologies are assumed to reach commercial scale production. Under the high fossil fuel scenario, GHG emissions in 2020 are 10 $MMtCO_2e$ higher than in the reference case, adding approximately 19% to the state's production-based emissions in that year.

Table 2-3. Comparison of total fossil fuel industry GHG emissions for reference and high fossil fuel scenario

($MMtCO_2e$)	1990	2000	2005	2010	2015	2020
Fossil fuel industry						
Reference case	**3.5**	**4.1**	**5.0**	**5.2**	**5.3**	**5.3**
Natural gas industry	1.4	1.7	2.0	2.3	2.3	2.4
Oil industry	2.0	2.2	2.7	2.8	2.8	2.8
Coal mining	0.2	0.2	0.2	0.2	0.2	0.2
Coal-to-liquids	0.0	0.0	0.0	0.0	0.0	0.0
High fossil fuel scenario	**3.5**	**4.1**	**5.0**	**6.2**	**11.7**	**15.7**
Natural gas industry	1.4	1.7	2.1	2.9	3.4	3.6
Oil industry	2.0	2.2	2.7	3.1	4.4	4.4
Coal mining	0.2	0.2	0.2	0.2	0.2	0.3
Coal-to-liquids	0.0	0.0	0.0	0.0	3.7	7.3

Figure 2-5 illustrates the Montana gross GHG emissions under the high fossil fuel scenario assumptions. In this case, gross GHG emissions are projected to grow to 52 $MMtCO_2e$ by 2020, 61% above 1990 levels.

Figure 2-5. Montana gross GHG emissions by sector, 1990–2020: historical and projected under high fossil fuel scenario assumptions



RCI = residential, commercial, and industrial; ODS = ozone-depleting substance.

Key Uncertainties

Some data uncertainties exist in this inventory, and particularly in the reference case projections. Potential improvements to this work include developing a better understanding of the electricity generation sources currently used to meet Montana loads (in collaboration with state utilities), and review and revision of key drivers such as the electricity and transportation fuel use growth rates that will be major determinants of Montana's future GHG emissions (See Table 2-4). These growth rates are driven by uncertain economic, demographic, and land use trends (including growth patterns and transportation system impacts), all of which could be refined further.

Perhaps the variable with the most important implications for GHG emissions is the type and number of power plants built in Montana between now and 2020. The assumptions related to vehicle miles traveled (VMT) and air travel growth also have large impacts on the GHG emission growth in the state. Finally, uncertainty remains on estimates for historic GHG sinks from forestry and agriculture, and projections for these emissions will greatly impact the net GHG emissions attributed to Montana.

Table 2-4. Key annual growth rates for Montana, historical and projected

	1990–2005	2005–2020	Sources
Population	1.0%	0.6%	U.S. Bureau of Census
Employment			Montana Department of Labor Web site, based on analysis by the US Bureau of Labor and Statistics
Goods	2.5%	0.9%	
Services	2.3%	1.7%	
Electricity sales	0.0%	1.6%	EIA (USDA's Energy Information Administration) data for 1990–2004 (0% growth is a mix of increased residential and commercial electricity sales countered by a large decrease in industrial sales), projections based on plans from Montana utilities (all sectors projected to have increased sales)
Vehicle miles traveled	1.7%	1.9%	Federal Highway Administration, Highway Statistics; projections from Montana Department of Transportation

* Population and employment projections for Montana were used together with US DOE's Annual Energy Outlook 2006 projections of changes in fuel use on a per capita and per employee basis, as relevant for each sector. For instance, growth in Montana's residential natural gas use is calculated as the Montana population growth times the change in per capita natural gas use for the Mountain region. Montana population growth is also used as the driver of growth in cement production, soda ash consumption, and dolomite and limestone use.

Chapter 3
Residential, Commercial, Institutional, and Industrial Sectors

Overview of Sectoral Greenhouse Gas Emissions

The residential, commercial, institutional, and industrial (RCII) sectors were directly responsible for just over 15% of Montana's gross greenhouse gas (GHG) emissions as of 2005—a total of 5.7 MMtCO_2e (million metric tons of CO_2 equivalent). Direct emissions from these sectors result principally from the on-site combustion of natural gas, oil, coal, and wood, as well as the release of CO_2 and fluorinated gases (hydrofluorocarbons, or HFCs, and perfluorocarbons, or PFCs) during industrial processing (largely cement and, to a significantly lesser extent, the aluminum industry), the leakage of HFCs from refrigeration and related equipment, and to a smaller, and recently declining degree, from the use of sulfur hexafluoride (SF_6) in the utility industry.[1]

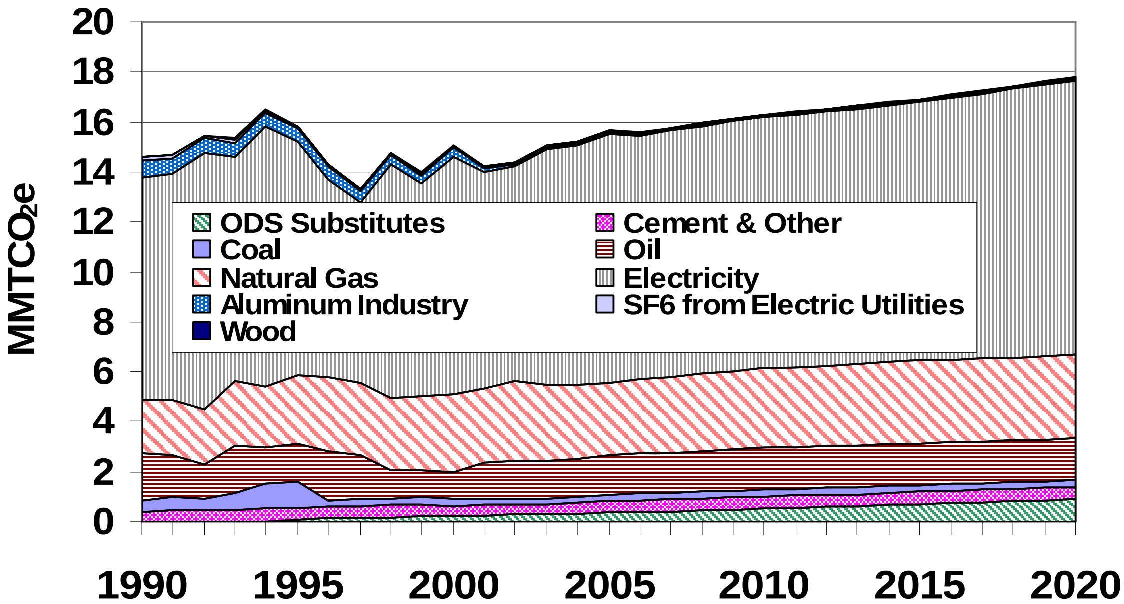
In addition to direct emissions from combustion of fuels and industrial processes in the RCII sectors, nearly all of the electricity sold in the Montana is consumed as the result of residential, commercial, institutional, and industrial activity. If the emissions associated with producing the electricity consumed in Montana are considered, RCII activities are associated with about 43% (15.7 MMtCO_2e) of the state's gross GHG emissions.[2] Montana's future GHG emissions therefore will depend significantly on future trends in the consumption of electricity and other fuels in the RCII sectors.

Historical and projected GHG emissions for the RCII sectors by fuel and source are provided in Figure 3-1 for the Reference Case forecast scenario. This figure illustrates the large fraction of RCII emissions (just under two-thirds) associated with electricity use. RCII emissions associated with electricity and natural gas use are expected to rise by about 11% between 2005 and 2020, and are projected to account for a quarter of the state's growth in gross GHG emissions during this period. Projected growth in industrial process emissions (essentially all from assumed growth in the use of HFC refrigerants) accounts for roughly another tenth of statewide growth in gross emissions through 2020.

[1] RCII direct fuel use accounted for 4.8 MMtCO_2e in GHG emissions in 2005, and industrial process emissions, largely from cement production and the use of substitutes (such as HFCs) for ozone depleting substances (ODSs) accounted for 0.9 MMtCO_2e.

[2] Gross emissions here denote GHG emissions from activities in Montana, adjusted for exports of electricity, oil, and gas, but not including consideration of estimated "sinks" of GHGs in the forestry and land-use sectors.

Figure 3-1: Historical and projected residential, commercial, institutional, and industrial GHG emissions in Montana, 1990 to 2020



ODS = ozone-depleting substance.

Overall GHG emissions associated with industrial energy use in Montana were nearly twice as high as those in the residential sector in 1990, with commercial/institutional emissions about 20% lower than residential emissions. Due to a significant decline in industrial energy use and non-CO_2 emissions between 1995 and 2002, and gradually increasing emissions in the other sectors, industrial-sector emissions from energy use were only about 35% higher than residential sector emissions by 2005 and were about 39% of total RCII emissions. Industrial emissions from energy use are projected to grow, on average, at just below the rate of overall RCII emissions through 2020, constituting just over 38% of RCII emissions by 2020. As a result of the combination of slowing population growth and increasing commercial/institutional sector activity over the coming decades, commercial/institutional sector emissions are projected to grow somewhat faster than emissions from the residential sector so that by 2020, residential sector emissions are less than commercial/institutional sector emissions (at 26% and 27.5% of total RCII emissions, respectively). Manufacturing activity is expected to continue to grow at a rate of about 0.9% per year after 2005, though this growth is offset for all fuels except electricity by continuing declines in overall energy intensity due to energy efficiency gains and structural shifts to less energy-intensive industries.[3] Figure 3-2 shows RCII emissions by sector and source from 1990 through 2020.

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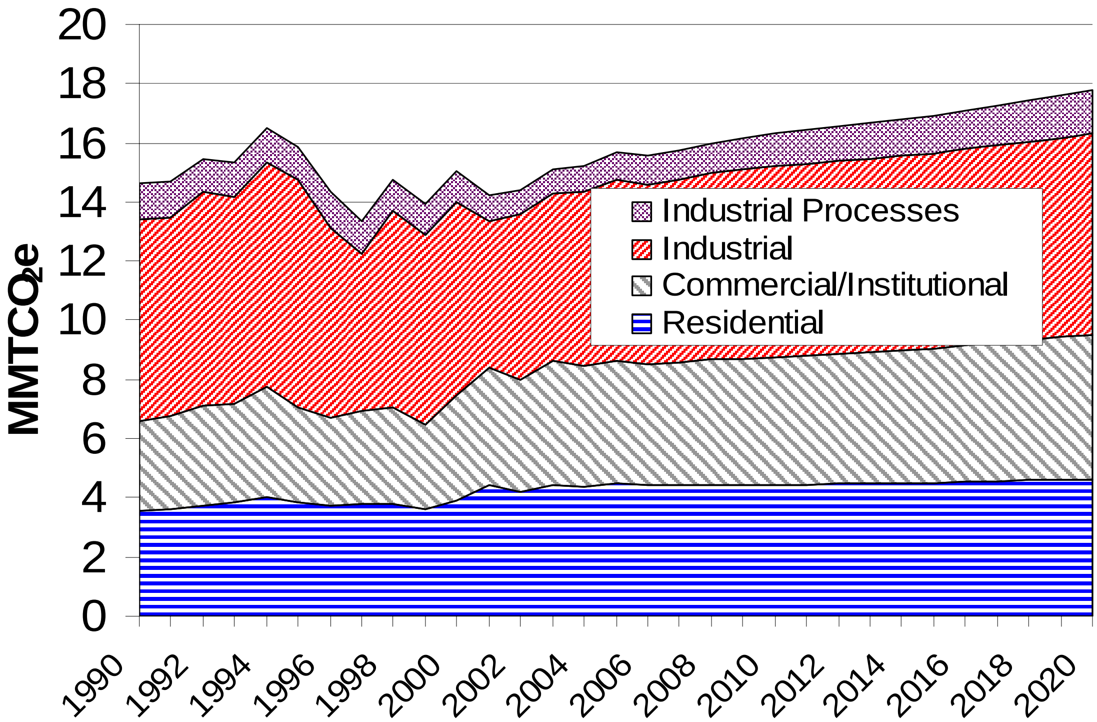
[3] Projections of manufacturing and nonmanufacturing activity (employment growth) are based on estimates from the Montana Department of Labor. Declines in energy intensity are based on projections by the U.S. Department of Energy (Annual Energy Outlook 2005).

Figure 3-2. 1990–2020 GHG emissions by source



Key Challenges and Opportunities

The principal means of reducing RCII sector GHG emissions include improving energy efficiency; substituting electricity, natural gas, and (in more limited instances) other fossil fuels with lower-emission energy resources (such as solar water heating and biofuels); reducing industrial process emissions; and promoting consumer-sited electricity generation using renewable fuels and combined heat and power systems. A universal systems benefits (USB) charge for some of the state's electric and gas utilities has been in place since 1997 and collected since 1999. It has provided funding for significant energy efficiency programs, but many opportunities remain to reduce emissions through programs and initiatives to improve the efficiency of buildings, appliances, and industrial practices. Though overall population growth in the state is projected to be modest, the strong growth of a number of Montana's communities places pressure on communities and businesses to make swift decisions before lower efficiency building energy performance becomes "locked in." Another challenge before the state is the desire to ensure that low-income residents are able to reap the benefits of—and not be adversely affected by—efforts to increase the efficiency of energy use and reduce emissions.

A number of ongoing and recently enacted Montana programs and initiatives have already taken important steps in providing the means to reduced RCII emissions. The USB charge noted above remains in effect for investor-owned electric and gas utilities, though some USB funds are currently used for purposes other than supporting energy efficiency or renewable energy programs. Additional energy efficiency programs have been provided to customers of cooperative utilities through the costs of power purchases from the Bonneville Power Administration. Tax credit programs are available to help fund consumers' investments in energy efficiency and renewable energy systems, and low-income weatherization programs have been operated for a number of years by state agencies and other service providers. Technical assistance services for energy efficiency and renewable energy have been provided by the Montana Department of Environmental Quality (DEQ) and others. A number of Montana organizations provide education on energy and environmental topics. The Montana State Buildings Energy Program provides funding for energy efficiency improvements in state buildings. While an indication of the growing momentum for improving efficiency and reducing GHG emissions, these actions only begin to tap the overall potential of the state to slow its growth of energy use and GHG emissions in the RCII sectors.

Overview of Policy Recommendations and Estimated Impacts

The Montana Climate Change Advisory Committee (CCAC) recommends a set of 13 policy options for the residential, commercial, institutional, and industrial sectors that offer the potential for major economic benefits and significant GHG emissions savings. Of these 13 options, 3 (RCII-7 through RCII-9) span both the RCII and Energy Supply (ES) sectors; those options are discussed in more detail in Chapter 5. As summarized in Figure 3-3, these RCII policy recommendations—not including those shared with ES—could lead to emissions savings from reference case projections by just under 3 $MMtCO_2e$ per year by 2020 and provide cumulative savings of over 18 $MMtCO_2e$ from 2007 through 2020.[4] These RCII policy options could result in an estimated net cost *savings* of more than $300 million through the year 2020 on a net present value (NPV) basis.[5] Most emissions savings from the RCII options are in the form of reduced carbon dioxide emissions, with relatively minor reductions of emissions of other GHGs (principally methane and nitrous oxide) produced via leakage and/or combustion of fuels.

The estimated impacts of the RCII policies recommended by the CCAC are shown in Figure 3-3. Figure 3-4 shows the results of several policies that have been recently implemented in Montana. These savings are not accounted for in the reference inventory and forecast, but they do contribute to overall emissions reduction along with savings from the CCAC-recommended measures. The combination of savings from recent actions and from CCAC policies is, in the RCII sectors, estimated to be significantly greater than the projected reference case growth in emissions from 2007 through 2020 and, as shown by the trend in the dark area in Figure 3-3, actually reduces RCII emissions below estimated 1990 emissions levels.[6]

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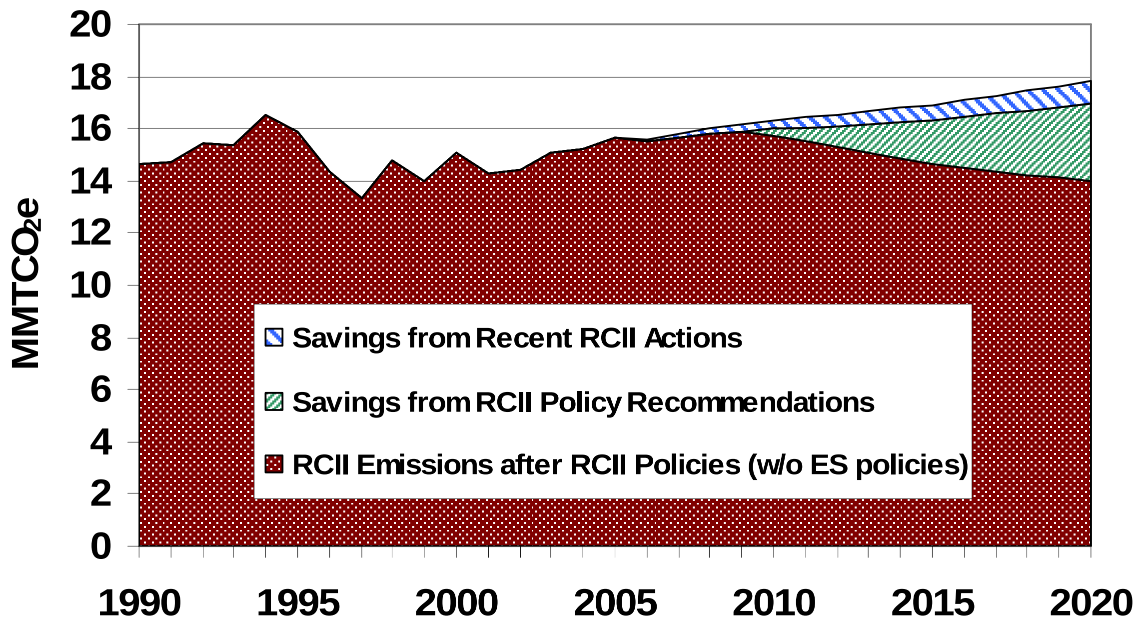
[4] Note that these figures do not include additional emission savings from recent actions not included in the reference case forecast; see below for a summary of savings from these recent actions. Note also that the emissions savings and costs of option RCII-6 were not quantified, because this education option is designed to support other policies and thus has largely indirect impacts on GHG emissions. See Appendix F for more detailed information. Of the total 18 $MMtCO_2e$ in cumulative emissions savings from the RCII policies, about 15 $MMtCO_2e$ are from reduced electricity consumption, with the remaining 3 $MMtCO_2e$ from reduction in on-site use of fossil fuels.

[5] The net cost savings are based on fuel expenditures, operations, maintenance, and administrative costs, and on amortized, incremental equipment costs. All NPV values shown here are calculated using a 5% per year real discount rate.

[6] Note, however, that Montana RCII emissions grew relatively little, in aggregate, between 1990 and 2003, due primarily to a reduction in output of key industrial sectors.

Figure 3-3. Impact of policy recommendations on RCII emissions



The CCAC policy recommendations described briefly here, and in more detail in Appendix F, not only result in significant emissions and costs savings but also offer a host of additional benefits. These benefits include, but are by no means limited to, reduction in spending on energy by homeowners and businesses, contributions to local economic development, reduced local and regional air pollution and related human health impacts, improvements in business efficiency and productivity, electricity system generation, transmission and distribution benefits, reduction in water use and in related water supply impacts, and improvements in comfort, convenience and indoor air quality as a result of building improvement measures.

In order for the RCII policy options recommended by the CCAC to yield the levels of savings described here, the options must be implemented in a timely, aggressive, and thorough manner. This means, for example, not only putting the policies themselves in place, but also attending to the development of supporting policies that are needed to help make the recommended options effective. Many of these supporting policies are part of the package of RCII options and many are included among the policies recommended as "cross-cutting" policies (see Chapter 7). Elements of some ES policies (for example, those related to utility rates and cost recovery) and those from other groups may also bear upon the ultimate effectiveness of RCII options. For example, improved building codes and "beyond-code" building improvements (RCII-4 and RCII-5) will not be optimally effective without training contractors, builders, architects, financial institutions, building inspectors and others in the methods and benefits of efficient building design (as recommended in RCII-6). Regulatory policies that provide better incentives and lower disincentives for the adoption of consumer-sited combined heat and power and renewable electricity generation, as included in ES options, are also among the supporting policies crucial to the success of the shared ES/RCII options. Some of these policies are already in the formative stages (or beyond) in Montana. The CCAC's work indicates that there are considerable benefits to both the environment and to consumers from adoption of the policy options offered. 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.

Table 3-1. CCAC-recommended policy options and results for the residential, commercial, institutional, and industrial sectors

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/t$CO_2$e)	Level of Support
		2010	2020	Total 2007–2020			
	Residential, Commercial, Institutional, and Industrial						
RCII-1	Demand-Side Management Programs, Efficiency Funds and Requirements (and Financial Incentives)	0.04	1.15	6.6	–$141	–$21	UC
RCII-2	Market Transformation and Technology Development Programs	0.03	0.30	1.9	–$43	–$23	UC
RCII-3	State-Level Appliance Efficiency Standards and State Support for Improved Federal Standards	0.05	0.20	1.5	–$55	–$36	UC
RCII-4	Building Energy Codes	0.03	0.25	1.6	–$15	–$10	UC
RCII-5	"Beyond Code" Building Design Incentives and Mandatory Programs	0.07	0.52	3.4	–$17	–$5	UC
RCII-6	Consumer Education Programs	*Not quantified*					UC
RCII-7	Support for Implementation of Clean Combined Heat and Power	*Quantified in Coordination with the Energy Supply TWG (as a part of ES-4)*					UC
RCII-8	Support for Renewable Energy Applications	*Quantified in Coordination with the Energy Supply TWG (as a part of ES-4)*					UC
RCII-9	Carbon Tax	*Not Quantified; Considered in Coordination with the Energy Supply TWG (as ES-8/9)*					UC
RCII-10	Industrial Energy Audits and Recommended Measure Implementation	0.07	0.56	3.6	–$93	–$26	UC
RCII-11	Low-Income and Rental Housing Energy Efficiency Programs	0.05	0.75	4.7	–$41	–$9	UC
RCII-12	State Lead by Example	0.03	0.33	2.0	–$11	–$6	UC
RCII-13	Metering Technologies With Opportunity for Load Management and Choice	0.02	0.12	0.9	–$11	–$12	UC
	Sector Total After Adjusting For Overlaps	0.28	2.95	18.4	–$304	–$17	N/A
	Reductions From Recent Policy Actions (see table below)	**0.32**	**0.84**	**6.9**	N/A	N/A	N/A
	Sector Total Plus Recent Policy Actions	0.59	3.79	25.3	N/A	N/A	N/A

Table 3-2: Emissions reductions associated with recently enacted policies (not included in baseline projections) related to RCII policy options

	Policy Option	Estimated 2010 GHG Reduction ($MMtCO_2e$)	Estimated 2020 GHG Reduction ($MMtCO_2e$)	Cumulative 2007–2020 GHG Reduction ($MMtCO_2e$)
RCII-1	Expand Energy Efficiency Funds	0.30	0.79	6.5
RCII-11	Low-Income Energy Efficiency Programs	0.02	0.05	0.4

Residential, Commercial, Institutional, and Industrial (RCII) Policy Descriptions

Policy options suggested by the CCAC for residential, commercial, institutional, and industrial sectors include those that address emissions reduction opportunities related to improving energy use efficiency, that support energy-efficiency efforts with education and new electricity metering strategies and, in coordination with options in the energy supply sector, promote using lower GHG energy sources for customer-sited generation.

RCII-1 Demand-Side Management Programs, Efficiency Funds and Requirements (and Financial Incentives)

The CCAC recommends that Montana increase the efficiency of electricity and natural gas use through demand-side management (DSM) programs, funds, and/or requirements. This option focuses on what are typically termed DSM activities—programs, usually delivered by utilities or government-designated agencies, designed to reduce energy consumption and/or change the timing of energy use. Examples of DSM programs include technical assistance for and implementation of energy efficiency and renewable energy measures, electrical and natural gas demand response, alternative rate schedules, and research activities. Note that the activities described for this option may also support implementation of other options recommended by the CCAC, such as RCII-11 and RCII-12.

This policy design is focused on increasing energy-efficiency programs offered through investor-owned and cooperative utilities and is linked with the energy-efficiency element of Energy Supply option ES-1, "Environmental Portfolio Standard." RCII-1 and ES-1 require that each utility implement a plan to obtain 100% of the achievable cost-effective energy efficiency in its service territory by 2025. Intermediate steps for each utility include identifying, by 2010, the achievable cost-effective energy efficiency (or energy conservation) in its service territory for the subsequent 10 years and updating its energy-efficiency assessment and plan regularly, possibly every 2 years. Implementation of energy-efficiency programs under this option could be through an independent, nonprofit, statewide provider of energy-efficiency services to support, in particular, the provision of energy-efficiency/conservation programs in the service territories of smaller utilities, including cooperatives, with other utilities providing their own efficiency programs as appropriate. Revolving loan programs and new or expanded state tax credits to fund energy-efficiency/conservation investments are potentially key implementation elements for this policy, as are expanded information and education for consumers and energy-efficiency service providers.

RCII-2 Market Transformation and Technology Development Programs

Market transformation programs focus on voluntary efforts implemented by non-utility organizations to encourage greater uptake by consumers (residential, commercial, institutional, and industrial, as well as the professionals that service energy-using equipment) of cost-effective energy-efficiency practices. Market transformation also seeks to ensure sufficient supplies of technologies and practitioners to meet the subsequent increased demand for energy efficiency. The goal of a market transformation and technology development program is to put energy-efficiency technologies and practices into a position where they will be demanded by the public, chosen by builders and manufacturers, and provided by retailers and contractors. Methods of transformation can be different for each technology or practice, but often revolve around public and private review of quality and effectiveness, including partnerships between government agencies, retailers, manufacturers, and nongovernmental agencies. Market transformation programs can be statewide or regional.

Recognizing that Montana constitutes a limited market, by itself, for energy-efficient products, the CCAC recommends that Montana focus its efforts on joining, supporting, or increasing its participation in regional market transformation alliances that develop and implement technologies for reduction of energy use and GHG emissions. Market transformation and technology development efforts should stress addressing technologies of particular significance to Montana. One example is the testing and monitoring of residential and commercial high-efficiency structures to determine their performance under Montana conditions and to identify barriers to implementation of energy-efficient building practices.

RCII-3 State-Level Appliance Efficiency Standards and State Support for Improved Federal Standards

Appliance efficiency standards reduce the market cost of energy-efficiency improvements by incorporating technological advances into base appliance models, thereby creating economies of scale. In recognition of the fact that Montana represents, on its own, a relatively limited market for appliances and equipment, the CCAC recommends that the state work with other states and with regional entities, as applicable, to review federal appliance standards; work with federal agencies and others toward raising federal appliance and equipment energy-efficiency standards where applicable; and to implement, in concert with other states, higher-than-federal energy-efficiency standards for appliances where technological advances allow. It is anticipated that the process of setting higher energy-efficiency standards in Montana, in concert with other states, will encourage higher federal standards and higher-volume manufacturing of higher-efficiency appliances and equipment, resulting in wider distribution and likely lower prices for these devices.

RCII-4 Building Energy Codes

Building energy codes specify minimum energy-efficiency requirements for new buildings or for existing buildings undergoing a major renovation. Given the long lifetime of most buildings, amending state and/or local building codes to include minimum energy-efficiency requirements and periodically updating energy-efficiency codes could provide long-term GHG savings. The CCAC recommends that the energy-efficiency–related elements of building codes in Montana be improved to reduce the amount of fossil energy input needed for operating buildings in the state. Key elements of a policy to enhance Montana's building energy codes, and their effectiveness, include

- Undertaking a comprehensive review of existing building codes in Montana to determine where increased energy efficiency can be achieved;
- Increasing standards so that the minimum performance of new and substantially renovated buildings, both commercial and residential, is at least 15% higher by 2010 than that required by today's building codes (International Energy Conservation Codes [IECC] 2003), and 30% higher by 2020;
- Encouraging and working toward achieving the goal of "carbon-neutral" status for new buildings;
- Encouraging the use of recycled and local building materials;
- Expressing energy-efficiency standards on a per-unit-floor-space basis for commercial buildings and on a per-dwelling-unit basis for residential buildings;
- Periodically and regularly reviewing building codes, including energy-efficiency requirements of building codes, to ensure that they stay up-to-date;
- Offering, and requiring as appropriate, education to equip building code officials, builders, designers, and others to effectively implement building energy code improvements; and
- Exploring new mechanisms, such as working with financial institutions and the use of spot checks, to improve code implementation in rural areas.

RCII-5 "Beyond Code" Building Design Incentives and Mandatory Programs

The CCAC recommends that incentives and targets be provided to induce the owners and developers of new and existing buildings to improve the efficiency with which energy and other resources are used in those buildings, along with provisions for raising targets periodically and providing resources to help achieve the desired building performance. This policy includes elements to encourage improving and reviewing energy use goals over time and using flexibility in contracting arrangements to encourage integrated energy- and resource-efficient design and construction. The goals of this option are to induce one-quarter of new and existing homes and commercial/institutional buildings in Montana to reduce per-unit-floor-area consumption of grid electricity and natural gas by 20% by 2020 in existing buildings and by 50% in new buildings by 2020. A combination of financial incentives and regulatory policies—including, for example, fee adjustments, that is, adjustment of "impact fees" or "connection fees," permitting advantages (expedited review processing of applications), rewards programs for "beyond code" energy-efficiency/emissions reduction improvements, property tax adjustment, and increased tax incentives for energy-efficiency improvements and installation of renewable energy systems.

RCII-6 Consumer Education Programs

Noting that public education and outreach and training people to implement GHG emissions reduction strategies will be the foundation for the long-term success of all of the mitigation actions proposed by the CCAC, as well as those that may evolve in the future. The CCAC recommends the implementation of a package of consumer, primary/secondary school, and professional education initiatives, including

- Providing consumer education, through public broadcasting and other delivery systems, related to energy efficiency and the environmental consequences of energy and other choices;
- Directing the Office of Public Instruction and others to develop and implement curricula for primary and (particularly) secondary schools that teach students to evaluate the implications of consumption choices;
- Implementing and enhancing professional education and certification programs for teachers and for those involved in providing products and services related to energy use and GHG emissions to build the statewide pool of individuals trained to support RCII and other policy options;
- Educating businesses and retailers about the GHG emissions associated with products and supply chains and exploring regional efforts to rate the GHG emissions of products; and
- Discouraging use of excessive lighting in outdoor RCII applications, including yard lights and unneeded street lights, and use of lighting control systems when applicable.

The goals of the CCAC-recommended initiatives are to educate consumers, businesses, retailers, and children so they can make informed choices to reduce energy use, improve efficiency, and reduce environmental consequences of their actions, and to educate professionals working in energy efficiency so they can better inform consumers and make wise decisions.

RCII-7 Support for Implementation of Clean Combined Heat and Power

Distributed generation with clean combined heat and power (CHP) systems reduces fossil fuel use and GHG emissions both through the improved efficiency of the CHP systems, relative to separate heat and power technologies and by avoiding transmission and distribution losses associated with central power stations that are located far away from where the electricity is used. The CCAC recommends that implementation of these systems by residential, commercial, institutional, and industrial energy consumers be encouraged through a combination of regulatory changes and incentive programs. Further details on this recommended policy are provided in Chapter 5 as a part of ES-4, "Incentives and Barrier Removal (Including Interconnection Rules and Net Metering Arrangements) for Combined Heat and Power (CHP) and Clean Distributed Generation (DG)" and in Appendix G.

RCII-8 Support for Renewable Energy Applications

Distributed electricity generation sited at residences, commercial, industrial, and institutional facilities and powered by renewable energy sources (typically solar but also wind and hydro) displaces fossil-fueled generation and avoids electricity transmission and distribution losses, thus reducing GHG emissions. The CCAC recommends that regulatory changes and incentives be provided to encourage implementation of distributed (consumer-sited) renewable electricity generation; to encourage consumers to switch from using fossil fuels to using renewable fuels in applications such as water, process, and space heating; and to supply new energy services using fuels that produce low or no GHG emissions. Increasing the use of renewable energy applications in homes, businesses, and institutions in Montana can be achieved through a combination of regulatory changes and incentives. Further details on this recommended policy are provided in Chapter 5 as part of ES-4, "Incentives and Barrier Removal (Including Interconnection Rules and Net Metering Arrangements) for Combined Heat and Power (CHP) and Clean Distributed Generation (DG)" and in Appendix G.

RCII-9 Carbon Tax

A CO_2 tax would be a tax on each ton of CO_2 or CO_2-equivalent emitted from an emissions source covered by the tax. A CO_2 tax could be imposed upstream of final consumption based on the carbon content of fuels (for example, on fossil fuel suppliers) or at the point of combustion and emission (typically large point sources such as power plants or refineries). Taxed entities would pass some or all of the cost on to consumers, change production to lower emissions, or a combination of the two. As the suppliers respond to the tax, consumers would see the implicit cost of CO_2 emissions in products and services and would adjust their behavior to purchasing substitute goods and services that result in lower CO_2 emissions, thus allowing a market response to reduce emissions. CO_2 tax revenue could be used in a variety of ways, including for assisting households and businesses in reducing carbon emissions. Recognizing that a CO_2 tax is best implemented on a national level, the CCAC recommends that the state should investigate and advocate for a national GHG cap-and-trade or tax system, and should participate fully in the Western Regional Climate Action Initiative, which will consider development of regional market-based mechanisms for GHG emissions reduction.

The CO_2 tax option was considered by the CCAC as part of the overall ES-8/9 option "Market-Based Mechanisms to Establish a Price Signal for GHG Emissions (GHG Cap-and-Trade or Tax)." Further details of this recommended policy are provided in Chapter 5 and Appendix G.

RCII-10 Industrial Energy Audits and Recommended Measure Implementation

The CCAC recommends providing industrial-sector energy technical assistance (energy audits) to identify and recommend options for reducing fossil energy and electricity use and for reducing emissions of GHGs not related directly to electricity or fuels use. For example, an agency could hire experts who will visit industrial sites to assess current practices and equipment and provide recommendations for reducing GHG emissions and could be set up or housed in an existing post-secondary institution. A combination of incentives—for example, a program of low- or no-interest loans designed to encourage industrial customers to take up energy-efficiency measures that reduce both electricity and natural gas consumption—plus expertise and information to implement recommended options are included in the policy to encourage the operators of industrial-sector facilities to follow up on audit recommendations.

RCII-11 Low-Income and Rental Housing Energy Efficiency Programs

Though residential-sector energy-efficiency improvements are a key goal of several RCII policies recommended by the CCAC, low-income and rental consumers are frequently unable to participate in energy-efficiency programs because they lack funds to pay for improvements or, in the case of renters, are unable either to make changes to their residences or to fully benefit from any cost savings. In recognition of this barrier, and building on existing (and popular) Montana programs, the CCAC recommends the implementation of programs specifically targeted to the needs of low-income residents for services such as home weatherization, updating or repairing inefficient appliances, and providing funds for renewable energy systems. These programs could be designed to offer low-income residents energy-efficiency services with a minimum of up-front costs and should be marketed through an aggressive campaign of outreach to low-income households and communities, including communities with a high incidence of rental housing. A key goal of this policy is to substantially upgrade the efficiency of the majority of homes occupied by low-income Montana residents and a majority of rental homes by 2020.

RCII-12 State Lead by Example

The CCAC recommends that Montana state government provide leadership by moving the state toward a stock of buildings that has much higher energy efficiency and by improving efficiency in the operations of state buildings. This policy provides energy-efficiency and renewable energy targets that are much higher than code standards for new state-funded buildings and recommends their application to state-leased buildings and to other government buildings (e.g., county and municipal government buildings and schools). The policy also includes elements to encourage the improvement and review of efficiency goals over time and to encourage flexibility in contracting arrangements to facilitate integrated energy-efficient design and construction. Goals and targets are also provided for upgrading energy efficiency in existing state government facilities and for considering the overall environmental impacts of state operations (including increased waste reduction and recycling and purchasing of Energy Star–certified appliances and equipment or appliances and equipment with higher-than-standard energy efficiency). One suggested mechanism for this policy is climate neutral bonding, meaning that there is no net increase in GHG emissions within the bond-issuing agency’s geographical jurisdiction after a project becomes operational.

RCII-13 Metering Technologies With Opportunity for Load Management and Choice

Providing Montana energy consumers with price and other information via metering that allows them to more clearly identify the outcomes of their choices is a potentially useful tool in improving energy efficiency, reducing GHG emissions, and saving consumers money. The CCAC recommends that Montana utilities implement systems for metering electricity demand

and consumption, building on successful initiatives in other jurisdictions, which reflect the real-time cost and GHG emissions implications of the resources that must be used to provide power. At the same time, rate structures should be implemented that allow utilities and consumers to take advantage of the information provided by the metering systems to lower emissions and costs. Doing so will provide consumers with incentives to manage their energy consumption so as to reduce both costs and GHG emissions. This policy option recommends the implementation of a pilot program of installation of “smart meters” at approximately 45,000 residential and some nonresidential customers’ sites, followed by a program resulting in the installation of smart meters for an additional 30% of residences by 2020.

Chapter 4
Energy Supply

Overview of GHG Emissions

Greenhouse gas (GHG) emissions from the energy supply (ES) sector in Montana include emissions from electricity generation and the fossil fuel industry (i.e., oil, natural gas, and coal production) and comprise a significant portion of the state's overall GHG emissions. In 2005, emissions associated with energy supply were approximately 24 million metric tons of carbon dioxide equivalents ($MMtCO_2e$) on a production basis and 15 $MMtCO_2e$ if only the emissions associated with electricity consumed in-state are accounted for (consumption basis).[1] Fossil fuel production accounted for about 5 $MMtCO_2e$ of these emissions, with electricity production accounting for the remainder.

By 2020, energy supply emissions under the reference case are projected to increase from 1990 levels by approximately 32% on a consumption basis, with the majority of the increase from electricity generation. Emissions reflecting energy produced in Montana (including electricity exported to other states) are anticipated to rise approximately 51% over 1990 levels by 2020, as the increase in electricity generation is projected to outpace electricity consumption in the state. Figure 4-1 depicts the historical and projected growth in electricity emissions for in-state use, for net electricity exports, and for fossil fuel production.

Given the many factors impacting energy production–related emissions and a diversity of assumptions by stakeholders within the energy sector—developing a "reference case" projection for the most likely development of Montana's electricity and fossil fuel production sectors is particularly challenging. The principal uncertainty of interest is on the high side, given the many plans and initiatives to increase coal utilization locally and nationally. As a result, an alternative scenario of future energy supply development was created—the high fossil fuel production scenario. The high fossil fuel production scenario assumes more rapid development of transmission lines for electricity exports and increased fossil fuel production, including the start-up of two commercial plants to produce liquid fossil fuels from coal. Under the high fossil fuel production scenario, production basis GHG emissions are projected to more than double compared with 1990 levels. The emission increase is split evenly between electricity generation (including exports) and fossil fuel production, as illustrated in Figure 4-2.

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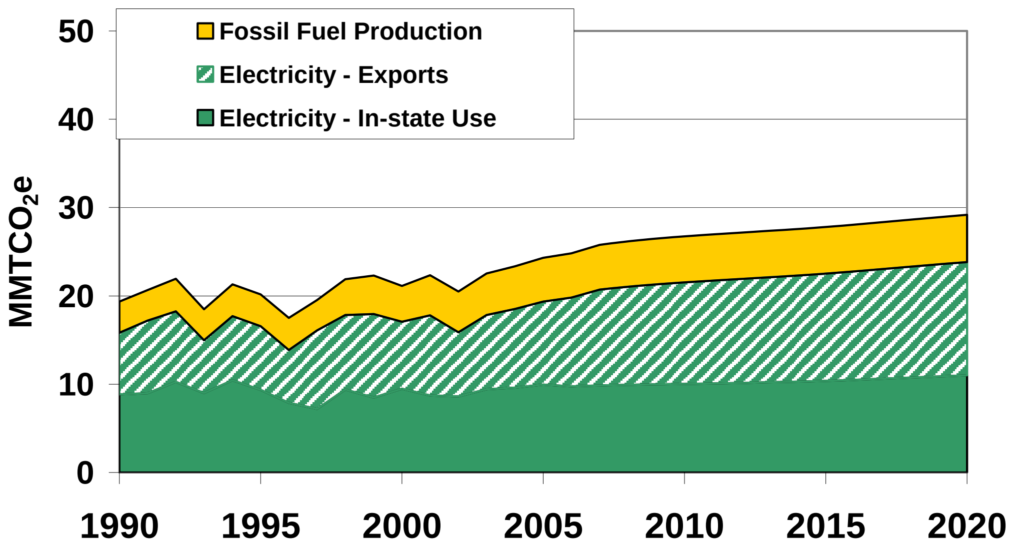
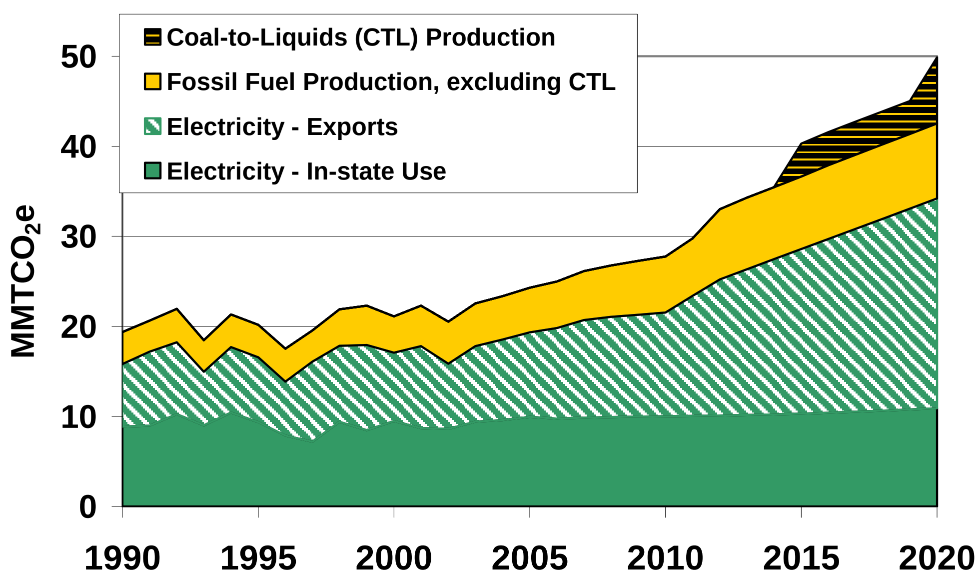
[1] Reporting emissions from a state's electricity sector is not unambiguous, especially for states with large amounts of electricity imports or exports. For many years, Montana power plants have produced almost twice the electricity that is consumed in the state. In general, the emission reporting for Montana used here reflects the *GHG emissions associated with the electricity sources used to meet Montana demands*, corresponding to a consumption-based approach to emissions accounting. This accounting method can better reflect the benefit of actions that reduce electricity consumption or affect the sources of electricity used to meet in-state demands. The *GHG emissions produced by all electricity generation facilities in the state* are reported separately. This production-based accounting can better reflect the effect of actions that impact all electricity generation, regardless of whether the electricity generated is for in-state or out-of-state consumption.

Figure 4-1. Historical and projected GHG emissions from the energy supply sector, Montana, 1990 to 2020, reference case



Note: The reference case assumes that commercial coal-to-liquids (CTL) production will not begin before 2020.

Figure 4-2. Historical and projected GHG emissions from the energy supply sector, Montana, 1990 to 2020, high fossil fuel production case



Key Challenges and Opportunities

Two major challenges in addressing GHG emissions from Montana's energy supply sector are the uncertainty in future amounts of electricity and fossil fuel production within the state and the uncertainty of future costs and commercial readiness of lower GHG emission technologies. The uncertainty in future production is driven by factors such as the resource availability of conventional and unconventional natural gas, the nature of export markets plus cost and timing of transmission infrastructure needed to transport Montana's products, and policies enacted in other jurisdictions that seek to reduce GHG emissions associated with energy production (such as limits that California, Washington, and Oregon have implemented or discussed that limit GHG emissions for both electricity and transportation fuels). The differences in total emissions between Figures 4-1 and 4-2 indicate the potential range for Montana's future emissions based on uncertainty in production. The uncertainty in future costs and commercial readiness of energy production technologies overlaps strongly with the uncertainty in future production. This uncertainty is most obvious in the case of coal-to-liquids (CTL) production. Proponents are pursuing a CTL plant in Montana, though decisions on permits and timing for such a plant are not final. As noted in Figure 4-2, the GHG emissions associated with two commercial CTL plants in Montana are the same order of magnitude as GHG emissions associated with all of Montana's electricity sales. If these plants are built, Montana will have both greater growth in GHG emissions and different opportunities to install new technologies for GHG emission control.

Fortunately, there are significant opportunities to reduce GHG emissions growth attributable to energy production and supply. The GHG emissions of electricity generation can be addressed through: greater use of renewable energy; recapture of waste energy through combined heat and power; carbon capture and storage; and other technologies. For example, Montana has some of the nation's best wind locations, yet the remoteness and the intermittency of wind resources will require careful planning to enable their development. Electricity and fuel production facilities in Montana could be pioneers in the commercial use of carbon capture and storage, as well as in the substitution of biomass for coal (co-firing). Where actions are both technically and economically feasible, the producers and processors of natural gas can benefit from actions that reduce methane venting and leakage as well as on-site fuel use, which could also enable more natural gas to come to the market, producing a genuine win-win situation. In addition, there are significant opportunities to reduce GHG emissions through policies that result in both energy and cost savings, as the Climate Change Advisory Committee (CCAC) has identified for the residential, commercial, institutional, and industrial sectors in Chapter 3.

Overview of Policy Recommendations and Estimated Impacts

The CCAC recommends a set of 13 policy options for the energy supply sector as listed in Table 4-1, along with their projected emissions savings and costs (or cost savings). These recommendations can be grouped into those affecting electricity supply (ES-1, ES-2, ES-4 through ES-7, and ES-10), those affecting fossil fuel production (ES-11 and ES-12), and those with overarching impacts (ES-3, ES-8, and ES-9, which are not quantified).

Table 4-1. CCAC-recommended policy options and results for the energy supply sector

	Policy Option	GHG Reductions ($MMtCO_2e$) 2012	2020	Total 2007–2020	Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($\$/tCO_2e$)	Level of Support
	Energy Supply						
ES-1	Environmental Portfolio Standard (Renewables and Energy Efficiency)						UC
	Efficiency/Conservation	0.03	0.92	5.4	–$79	–$15	UC
	Renewable Energy	0.0	1.6	5.5	$53	$10	UC
ES-2	Renewable Energy Incentives and Barrier Removal	*Not quantified separately (see ES-1 and ES-4)*					UC
ES-3	Research and Development (R&D), Including R&D for Energy Storage and Advanced Fossil Fuel Technologies	*Not quantified*					UC
ES-4	Incentives and Barrier Removal for Combined Heat and Power (CHP) and Clean Distributed Generation (DG)						UC
	Distributed Renewables	0.03	0.10	0.8	$16	$21	UC
	Combined Heat and Power	0.2	0.7	5.0	$81	$16	UC
ES-5	Incentives for Advanced Fossil Fuel Generation and Carbon Capture and Storage or Reuse (CCSR)						UC
	Reference Case	0	1.0	4.5	$135	$30	UC
	High Fossil Fuel Scenario	0	5.2	24.4	$733	$30	UC
ES-6	Efficiency Improvements and Repowering of Existing Plants	*Not quantified*					UC
ES-7	Demand-Side Management	*Not quantified separately (see ES-1 and RCII-1)*					UC
ES-8/9	Market-Based Mechanisms to Establish a Price Signal for GHG Emissions (GHG Cap-and-Trade or Tax)	*Not quantified*					UC
ES-10	Generation Performance Standards or GHG Mitigation Requirements for New (and/or Existing) Generation Facilities, With/Without GHG Offsets	0.1	0.8	4.7	$60	$13	UC
ES-11	Methane and CO_2 Reduction in Oil and Gas Operations, Including Fuel Use and Emissions Reduction in Venting and Flaring						UC
	Reference Case	0.1	0.5	3.9	*Not estimated*	*Likely net benefit*	UC
	High Fossil Fuel Case	0.3	0.8	6.6			UC
ES-12	GHG Reduction in Refinery Operations, Including in Future Coal-to-Liquids Refineries						UC
	Coal-to-Liquids – High Fossil Fuel Case	0	9.9	35	*Not estimated*	*Not estimated*	UC
	Petroleum Refining - Reference Case	0.02	0.24	1.5	*Not estimated*	*Not estimated*	UC
	Petroleum Refining - High Fossil Fuel Case	0.03	0.38	2.2	Not estimated	Not estimated	UC

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of Support
		2012	**2020**	**Total 2007–2020**			
ES-13	CO_2 Capture and Storage or Reuse (CCSR) in Oil & Gas Operations, Including Refineries and Coal-to-Liquids Operations	*Incorporated in ES-5 and ES-12*					UC
	Sector Total After Adjusting for Overlaps (Among ES Options and After Demand Reductions From RCI Options)						
	Reference Case	**0.4**	**4.2**	**21.9**	**$272**	**$17**	
	High Fossil Fuel Case	**0.4**	**18.7**	**79.4**	**$870**	**$24**	

UC – Unanimous Consent

The electricity supply recommendations include efforts to increase the supply of renewable energy (ES-1 and ES-2), decrease the emission intensity of fossil-fuel–generated electricity (ES-5), reduce the average emissions of new utility resource acquisitions (ES-10), increase distributed generation (ES-4), and reduce demand. When taken together in a combined scenario that assumes all of the CCAC's recommendations are fully implemented, these electricity supply recommendations could result in cumulative GHG emissions reductions of about 16 $MMtCO_2e$ through 2020 at a cumulative net present value (NPV) cost of about $270 million.[2,3,4]

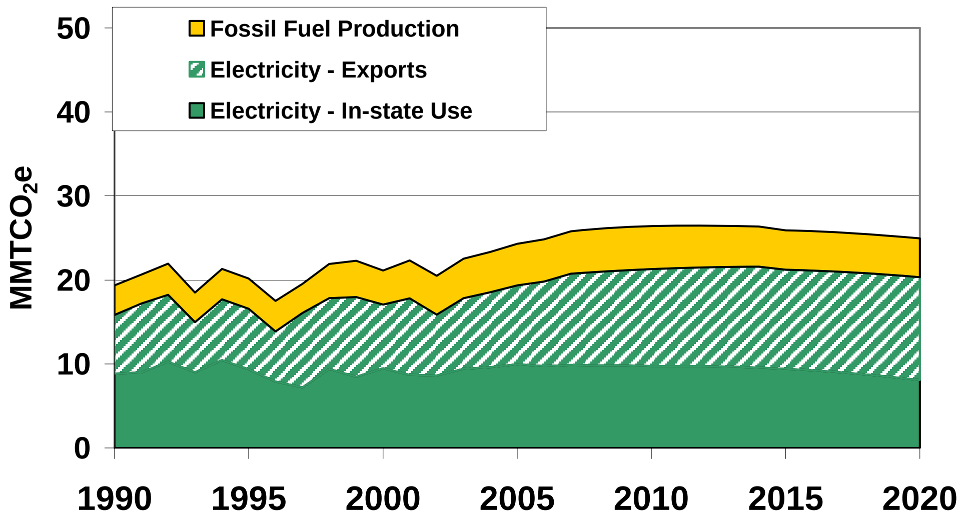
Recommendations to reduce emissions from oil and gas operations, oil refineries, and CTL facilities (ES-11 through ES-13) could yield another 5 $MMtCO_2e$ in cumulative emissions savings through 2020; there was insufficient information to estimate their cost impacts. Taken together, the energy supply recommendations could lead to cumulative reductions of almost 22 $MMtCO_2e$ from 2007 through 2020 and reductions of about 4.2 $MMtCO_2e$ per year by 2020. These results are shown in Figure 4-3.

[2] A glance at the numbers in Table 4-1 suggests that if simply added together, cumulative emission reductions of these policies under the reference case could exceed 30 $MMtCO_2e$ in 2020, assuming all options are implemented in isolation from each other. However, these options are *not* additive. In fact, they tend to overlap heavily, so simply adding them would introduce significant double-counting. These options essentially target—through different means—the avoidance of the same or similar emissions sources (e.g., the emissions from fossil-fuel power plants existing and yet to be built).

[3] Note also that the CCAC's policy recommendations concerning GHG emissions from electric generation are highly interactive with its residential, commercial, institutional, and industrial (RCII) policy recommendations that concern electricity use, because reducing electricity demand can offset the need for new generation, often at a lower cost or even with a savings. The combined results reported here take into account the many overlaps among energy supply and RCII policy options that reduce the demand for power.

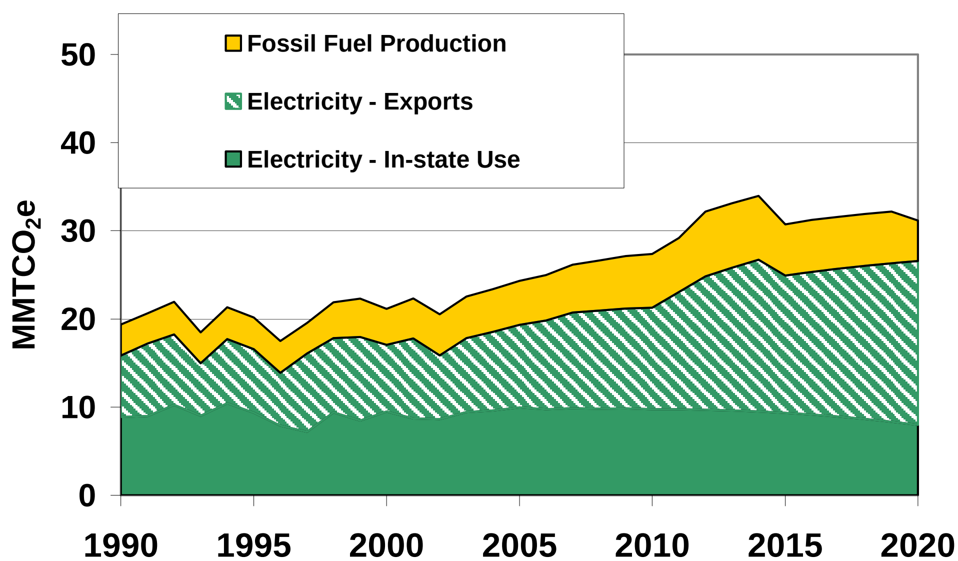
[4] The net cost savings are based on fuel expenditures, operation, maintenance, and administrative costs and amortized, incremental equipment costs. All NPV analyses here use a 5% real discount rate.

Figure 4-3. Impact of policy recommendations on energy supply sector emissions, reference case



Note: It is important to emphasize that these results assume moderate growth in energy production as outlined in the Reference Case projections. If, instead, energy production grows rapidly—particularly in terms of new coal-to-liquid facilities and coal-fired power plants—as described in the High Fossil Fuel Case, the electricity supply policy could lead to more significant impacts. As shown in Figure 4-4, (in comparison with Figure 4-2), the CCAC energy supply recommendations could reduce GHG emissions in the high fossil fuel case by 84 MMtCO$_2$e cumulatively from 2007 through 2020 and by almost 19 MMtCO$_2$e per year by 2020. The NPV costs of the options for which costs were estimated (electricity options only) are projected to add to $870 million through the year 2020.

Figure 4-4. Impact of policy recommendations on energy supply sector emissions, high fossil fuel production case



Note: Figures 4-2 and 4-4 show CTL emissions on a life cycle basis, over and above those of the traditional petroleum fuels they would displace. Because policy option ES-12 would require that coal liquids produce fewer life cycle emissions than their petroleum-based counterparts, CTL emissions are not visible in this chart.

The CCAC policy recommendations described in more detail in Appendix G not only offer GHG emissions savings but also offer significant additional benefits. Development and demonstration of carbon storage in Montana, for instance, may be accompanied by a corresponding increase in expertise and related jobs in the state. Leadership in commercializing these technologies would also contribute to the growth and influence of Montana-based companies serving markets elsewhere. Energy reliability and security could be enhanced by greater penetration of distributed and renewable energy resources, as would experience in transmission system management. These co-benefits, including improved air quality and other environmental benefits, are indeed important drivers for many of the CCAC's recommendations.

Energy Supply Sector
Policy Descriptions

The energy supply sector includes emissions mitigation opportunities related to electricity generation and oil and gas production. Electrical energy options include mitigation activities associated with the generation, transmission, and distribution of electricity, whether generated through the combustion of fossil fuels or by renewable energy sources; in a centralized power station supplying the grid or by distributed generation facilities; or in the case of some options, for consumption within Montana or exported from the state. Oil and gas mitigation options include mitigation activities associated with the extraction, transportation, and processing of oil and natural gas, including processing of liquid fuels from coal. Carbon capture and storage options can apply to both electrical generation and fossil fuel production, while market-based mechanisms apply to all activities.

ES-1 Environmental Portfolio Standard (Renewables and Energy Efficiency)

A renewable portfolio standard (RPS) is a requirement that utilities must supply a certain percentage of electricity from an eligible renewable energy source(s). An environmental portfolio standard (EPS) expands that notion to include energy efficiency as an eligible resource as well. In some cases (as in Montana), utilities can also meet their RPS (or EPS) requirements by purchasing certificates from eligible energy projects, typically referred to as Renewable Energy Certificates in the case of RPS policies.

The CCAC unanimously recommends that Montana extend the existing RPS to include renewable energy requirements for 2020 and 2025 and require utilities to pursue cost-effective end-use energy conservation (both electricity and natural gas). Each investor-owned and public utility (including member-owned electric cooperatives) should a) meet 20% of its load using renewable energy resources by 2020, increasing to 25% by 2025 and b) implement a plan to obtain 100% of achievable cost-effective energy conservation by 2025. By 2010, each utility must identify its achievable cost-effective energy conservation for the subsequent 10 years. Utilities must update their energy efficiency assessments and plans regularly, possibly every 2 years.

ES-2 Renewable Energy Incentives and Barrier Removal

This policy option reflects financial incentives and other efforts, such as improving the ability to integrate intermittent wind resources and to encourage investment in renewable energy sources by businesses that sell power commercially (smaller scale renewable sources are covered in ES-4). This option provides additional support to the renewable portion of the EPS in ES-1 with the goal of increasing the supply of renewable energy and reducing its cost.

The CCAC recommends that Montana offer incentives that could include some of the following aspects:

- The state, including the Montana Public Service Commission (PSC) and Montana's representatives on the Northwest Power and Conservation Council, should work with other regional actors to utilize to the greatest possible extent the region's vast hydroelectric resources for the provision of integration services necessary to accommodate significant increases in generation from wind power in Montana and regionally.
- Carbon markets, whether current voluntary offsets markets or future compliance markets (allowances and/or offsets), could provide an important mechanism for promoting renewable energy projects. At present, there is uncertainty regarding the shape of these markets and the best strategies for the state to pursue.
- Financial incentives through tax policies, production tax credits (federal), and Public Utility Regulatory Policy Act (PURPA) requirements.
- Recent change in property tax specification for wind projects could be expanded to other renewable forms of generation as appropriate.
- Incentives for locating manufacturing plants in the state for renewable generation, with potential sunset provisions as industries mature in Montana.
- Incentives for technologies that support improved integration of intermittent (e.g., wind) resources, including but not limited to advanced energy storage technologies.
- Target incentives to community wind projects.
- Tax incentives for transmission lines that carry wind power (which were included in the recently passed House Bill 3 [HB 3] from the 2007 Montana Legislative Special Session).
- A planning process that, among other things, will evaluate potential wind power sites and associated transmission infrastructure in order to develop a priority list of transmission system upgrades that will enable development of those wind power sites.
- Develop a system that certifies and recognizes new wind projects that have implemented measures in project construction and operation so as to minimize impacts to wildlife, critical wildlife habitat, national and state parks, and other areas of special concern. The Montana Department of Environmental Quality (DEQ) should work collaboratively with stakeholders to establish the criteria for such a system in order to formalize the best management practices that Montanans agree make sense for active but low-impact wind power development.

ES-3 Research and Development (R&D), Including R&D for Energy Storage and Advanced Fossil Fuel Technologies

R&D funding can be targeted toward a particular technology or group of technologies as part of a state program with a mission to build an industry around that technology in the state and/or to set the stage for adoption of the technology for use in the state. For example, an agency can be established with a mission to help develop and deploy energy storage technologies. R&D funding can also be made available to any renewable or other advanced technology through an open bidding procedure (i.e., driven by bids received rather than by a focused strategy to develop a particular technology). Funding can also be given for demonstration projects to help commercialize technologies that have already been developed but are not yet in widespread use. Funding could be provided to increase collaboration between existing institutions for R&D on technologies.

The CCAC recommends that Montana, potentially working with other partners, pursue an R&D program that targets, among other technologies, carbon sequestration technologies, compressed air, and other storage technologies to increase penetration of intermittent renewable energy (including wind power) and direct carbon fuel cells. Funding sources could include federal R&D funding for a high-altitude advanced fossil demonstration project(s) in Montana as authorized by the Energy Policy Act of 2005, a small pool of state funding for R&D efforts, industry contributions (e.g., licensing fees), and the coal severance tax (e.g., for clean coal, sequestration, and compressed air storage, among others). The program could establish an energy technology program in the Montana university system, attract federal R&D funding, grow technology expertise, issue advanced degrees, and aim for resulting "multiplier" benefits. It could also include industrial participation and make available the results of R&D and pilot programs to inform industrial development.

ES-4 Incentives and Barrier Removal (Including Interconnection Rules and Net Metering Arrangements) for Combined Heat and Power (CHP) and Clean Distributed Generation (DG)

This option focuses on CHP and clean distributed generation (DG) located on-site at consumer facilities that do not sell power commercially. There are numerous barriers to CHP and clean DG, including inadequate information, institutional barriers, high transaction costs because of small projects, high financing costs because of lender unfamiliarity and perceived risk, "split incentives" between building owners and tenants, and utility-related policies such as interconnection requirements, high standby rates, and exit fees. The lack of standard offer or long-term contracts, payment at avoided cost levels, and lack of recognition for emissions reduction value provided also create obstacles.

The CCAC recommends that Montana take several steps to increase incentives and decrease barriers for CHP and DG. These steps could include increasing incentives for installation and development of CHP and DG systems, including small distributed wind and solar hot water. These incentives could be funded in part through improving or expanding the Alternative Energy Revolving Loan Program (AELRP). Existing interconnection rules can be a barrier, and the CCAC recommends creating standardized interconnection and net metering rules for CHP and

DG systems, while considering needs of smaller systems and the potential impact that net metering may have on cross-subsidies between consumers. The CCAC also recommends considering a DG effort—similar to the establishment of the Rural Electrification Administration in the 1930s—in order to use grants, loans, and the initiation of green co-ops to overcome many of the road blocks to DG implementation. The CCAC encourages the development of a set of state-issued licenses for renewable energy system technicians and installers.

ES-5 Incentives for Advanced Fossil Fuel Generation and Carbon Capture and Storage or Reuse (CCSR), Including Combined Hydrogen and Electricity Production with Geological Carbon Sequestration

Advanced fossil technologies produce fewer carbon dioxide (CO_2) emissions per kilowatt-hour (kWh) as the result of more efficient generating technologies (e.g., supercritical coal and integrated gasification combined cycle [IGCC]) and/or carbon capture and storage or reuse (CCSR). Differing technologies may apply either before or after fuel combustion.

The CCAC recommends that Montana direct DEQ or direct the state to enter into a regional collaborative effort to develop standards and protocols for CCSR. It also recommends that Montana strengthen the Major Facility Siting Act to enable eminent domain for pipelines to transport CO_2 and protect landowners with appropriate siting requirements and address liability issues associated with carbon capture and storage. Finally, it recommends that Montana create a requirement that all fossil-fuel–fired electric generation facilities must meet a technology/fuel-neutral emissions level expressed in tCO_2/MWh (megawatt-hour). Facilities must file a plan with the DEQ Air Permitting Section that details the facility's commitment to capture and/or sequester (by geological or terrestrial means) CO_2 emissions, as an attribute of operating plans and permits and as needed to achieve this level. CCAC recommends that DEQ petition the Montana Board of Environmental Review for such a rule with specific suggested language. CCAC also suggests that the legislature approve supporting legislation. The CCAC recommends an emissions goal of 0.5 tCO_2/MWh (or 1,100 lbs/MWh), decreasing over time commensurate with best available control technology.

ES-6 Efficiency Improvements and Repowering of Existing Plants

Efficiency improvements refer to increasing generation efficiency at power stations through incremental improvements at existing plants (e.g., more efficient boilers and turbines, improved control systems, or combined cycle technology). Repowering existing power plants refers to switching to lower or zero emitting fuels at existing plants or to new capacity additions. This includes co-firing biomass at coal burning plants or the use of natural gas in place of coal or oil.

The CCAC recommends that the state investigate and implement policies that encourage the reduction of GHG emissions per MWh produced or, in the case of renewable energy facilities, encourage an increase of output at existing facilities. The co-firing of biomass at coal and other fossil fuel plants and advanced technologies, such as oxyfuel combustion, deserve particular attention. Policies to encourage efficiency improvements and repowering of existing plants could include incentives or regulations as described in ES-5 above, with adjustments for financing opportunities and emission rates of existing plants.

ES-7 Demand-Side Management

CCAC recommendations for demand-side management, meaning the provision of energy efficiency programs for electricity and natural gas conservation, is included in options ES-1 (above) and RCII-1 (discussed in Chapter 3).

ES-8/9 Market-Based Mechanisms to Establish a Price Signal for GHG Emissions (GHG Cap-and-Trade or Tax)

Market-based mechanisms are used to establish a price on GHG emissions (or CO_2 specifically). Presently, the cost of emitting CO_2 into the atmosphere is free. With a cost attached to carbon emissions, emitters would have a strong incentive to modify their practices, and economic inefficiencies inherent in the present system would be addressed, leading to a reduction in GHG emissions.

There are two principal ways to place a value on carbon: a carbon tax or a cap-and-trade system. Among the important considerations with respect to either implementation mechanism are the sources and sectors to which it would apply, the level and timing, how "leakage" is addressed, and how potential revenues are invested.

Some CCAC members believe that a national carbon tax is the preferred strategy. Other CCAC members believe that a national cap-and-trade system is not only preferred but stands a more realistic chance of being adopted than a national carbon tax. Collectively, however, the CCAC determined not to take a position on these competing mechanisms because we recognize that our ability to influence national policy is limited. The CCAC underscores that one of these mechanisms, or some other mechanism, needs to be adopted by the federal government in the near future if the nation is to achieve significant reductions in GHG emissions.

Overall, the CCAC recommends that Montana investigate and advocate for a national GHG cap-and-trade or tax system. In addition, the state should participate fully in the Western Regional Climate Action Initiative, which will consider development of a regional market-based mechanism.

ES-10 Generation Performance Standards or GHG Mitigation Requirements for New (and/or Existing) Generation Facilities, With/Without GHG Offsets

A generation performance standard (GPS) could take several forms. In the case of a GHG Emissions Performance Standard, as enacted in California and in Washington State, it is a mandate requiring load-serving entities (LSEs) to acquire electricity with an emissions rate below a specified mandatory standard. In the case of power plant GHG performance standards, as are in place in Oregon and Washington, it can be a requirement that power plant developers build and operate new electrical generation with an emission rate (e.g., X lbs CO_2/MWh) below a specified mandatory standard. In some cases (as in Oregon and Washington), GHG offsets or credits can be used for compliance. GHG offsets are GHG emission savings from project-based activities in sectors or regions not covered by the standard or regulations, which typically need to meet specific criteria laid out in the regulation.

The CCAC recommends that the state implement GHG Emission Performance Standards and align these standards to the extent possible with those adopted in California and Washington State. These standards would establish a maximum GHG emission rate that is equal to or less than that of a new, natural gas combined cycle (NGCC) power plant for new, long-term financial commitments to baseload electrical generating resources by LSEs; it would apply to both in-state and imported electricity. In doing so, the state should consider a longer term phase-in to account for the availability of technological options and to ensure no reduction in electricity supply reliability. The standard is based on net emissions from electricity production and does not count CO_2 stored in geologic formations as emissions from the power plant (e.g., sequestration would count as emissions savings within a GPS standard). Note that this option should complement and work with any future cap-and-trade or carbon tax system (ES-8/9).

ES-11 Methane and CO_2 Reduction in Oil and Gas Operations, Including Fuel Use and Emissions Reduction in Venting and Flaring

Methane (CH_4) and CO_2 emissions in the oil and gas industry can be reduced by a number of means. Natural gas consists primarily of methane, a very potent GHG; therefore, any leaks during production, processing, and transportation/distribution should be addressed. Among the practices recommended are preventive maintenance (improving the overall efficiency of the gas production and distribution system), reducing flashing losses (releases when pressure drops at storage tanks, wells, compressor stations, or gas plants), and changing and replacing parts and devices to reduce leaks and improve efficiency. CO_2 emissions in the oil and gas industry can also be reduced by improving energy efficiency by a) using new efficient compressors, b) optimizing gas flow to improve compressor efficiency, c) improving performance of compressor cylinder ends, d) capturing compressor waste heat, e) replacing compressor driver engines, and f) using waste heat recovery boilers.

The CCAC recommends that Montana adopt a policy to encourage natural gas companies in the state to participate in EPA’s Natural Gas STAR Program and provide enforcement and verification of participation. This is especially helpful for a state like Montana where many of the operators are smaller companies that probably have not considered the leak prevention and other methods available through the Natural Gas STAR Program. The CCAC recommends that the state consider whether participation by smaller companies would be a significant burden and possibly provide incentives if needed. The CCAC suggests a goal of reducing methane emissions by 30% below business as usual (BAU) levels by 2020.

ES-12 GHG Reduction in Refinery Operations, Including in Future Coal-to-Liquids Refineries

Methane and CO_2 emissions can be reduced in the production of liquid fuels at oil refineries or at CTL plants through various energy efficiency and process options, including enhanced combined heat and power along with carbon capture and storage. CTL plants are energy-intensive and emit 10 times more CO_2 than conventional oil refineries in order to produce liquid fuels. Emissions reductions from CTL production can be achieved through polygeneration, biomass blending, and most significantly through carbon capture and storage. CTL fuels production is especially amenable to CO_2 capture and sequestration, because emissions are largely generated from a single source and are already concentrated because the syngas produced from the feedstock fuel must be cleansed of excess CO_2 before entering the Fischer-Tropsch reactor.

The CCAC has serious concerns about the high GHG emissions associated with the production of coal liquids and recommends that the state require that all CTL facilities located in Montana meet a performance-based standard, reflecting a best available control technology approach. A suggested goal is that CTL plants must produce fuels with life cycle GHG emissions [at least] 20%–30% below petroleum-based fuels. This could imply that CTL facilities would capture and store CO_2 from the start of operations, assuming this technology is considered commercially available, producing fuels with 20% to 30% lower life cycle emissions relative to standard petroleum-based fuels. Any CTL plant would likely also be a poly-generation plant and would produce electricity along with fuel and other products.

The CCAC recommends that this policy option aim to improve maintenance at oil refineries as well as CTL plants and ensure that best practices are being followed (cross-cut with safety issues).

ES-13 CO_2 Capture and Storage or Reuse (CCSR) in Oil & Gas Operations, Including Refineries and Coal-to-Liquids Operations

Due to overlaps with other options, CCSR is incorporated within ES-5 and ES-12.

Chapter 5
Transportation and Land Use

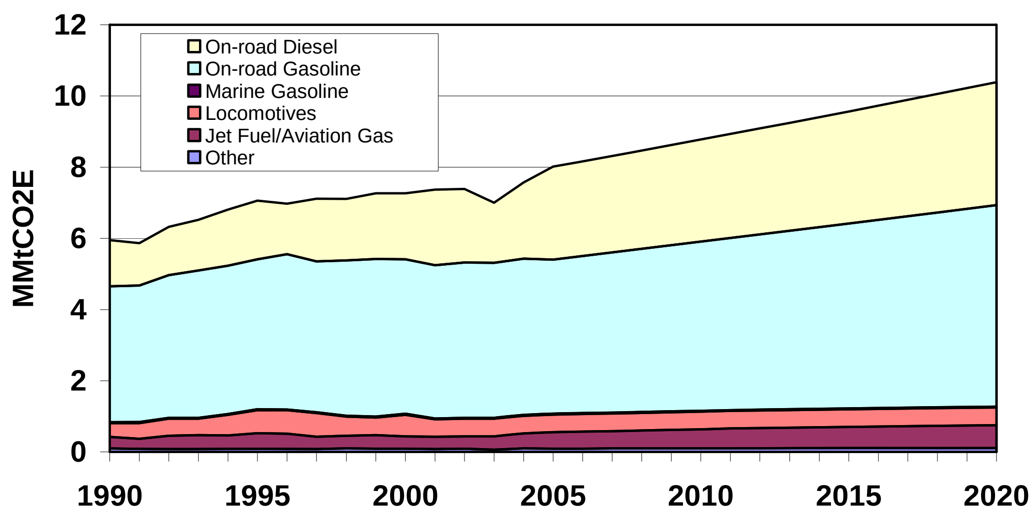
Overview of GHG Emissions

The transportation sector is a major source of greenhouse gas (GHG) emissions in Montana—currently accounting for about 20% of the state's gross GHG emissions. The transportation technologies and fuels used are key determinants of those emissions, along with population, economic growth, and various land use policies that all affect the demand for transportation services. GHG emissions from the transportation sector totaled about 7.3 million metric tons of carbon dioxide equivalents ($MMtCO_2e$) in 2000.

Figure 5-1 shows historical and projected transportation and land use (TLU) GHG emissions by fuel and source and illustrates their rapid growth. TLU emissions are expected to grow significantly from 1990 to 2020. Montana state projections suggest on-road vehicle miles traveled (VMT) will continue to increase at an estimated rate of 1.92% annually, with relatively higher growth in freight VMT also expected.

In 2005 Congress enacted the Energy Policy Act which contained a provision for a national renewable fuel standard that will likely increase the use of alternative fuels in Montana. This was classified as a "recent action" and was accounted for in the TLU Technical Work Group (TWG) analysis.

Figure 5-1. Historical and projected GHG emissions from the transportation and land use sector, Montana, 1990 to 2020



$MMtCO_2e$ = million metric tons of carbon dioxide equivalents

Key Challenges and Opportunities

The principal means of reducing TLU emissions includes improving vehicle fuel efficiency, substituting gasoline and diesel with lower emission fuels, modal switches to lower emission means of travel, and various strategies to decrease the growth in fuel use and VMT.

In Montana and in the nation as a whole, vehicle fuel efficiency has improved little since the late 1980s, yet many studies have documented the potential for substantial increases consistent with maintaining vehicle size and performance. The use of alternative fuels with lower GHG emissions is growing in Montana, and larger market penetration is possible. Montana also has taken some steps to increase transit options and encourage alternative growth and development patterns.

Overview of Policy Recommendations and Estimated Impacts

The Climate Change Advisory Committee (CCAC) recommends a set of 13 policy options for the transportation and land use sector that offer the potential for major economic benefits and emissions savings. These policy recommendations could lead to emissions reductions from reference case projections of 1.01 $MMtCO_2e$ for the year 2020, cumulative savings of nearly 5.54 $MMtCO_2e$ from 2006 through 2020, and net cost *savings* of more than $321 million to the Montana economy through the year 2020 on a net present value (NPV) basis.[1] The weighted average cost of saved carbon from the policy options for which quantitative estimates of both costs and savings were prepared was –$67/$MtCO_2e$.

The estimated impacts of the individual policies are shown in Table 5-1 below. The CCAC policy recommendations described briefly here (and in more detail in Appendix H) not only result in significant emissions and costs savings but also offer a host of additional benefits as well. These benefits include (but are by no means limited to) reduced local air pollution, more livable, healthy communities, and economic development and job growth from in-state alternative fuel production.

In order for the TLU policy options recommended by the CCAC to yield the levels of savings described here, the options should be implemented in a timely, aggressive, and thorough manner. Notably, the state Clean Car Program must clear several hurdles before Montana or any other state can adopt it, including EPA approval of the original California Clean Car Program (that other states can then opt into) and a court challenge to the underlying notion of regulation of GHG emissions from vehicles. If, for any reason, Montana is not able to implement the Clean Car Program, other options could play a larger role. For example, the policies to be studied under the Financial and Market Incentives for Low GHG Vehicle Ownership and Use (TLU-4) could improve fuel efficiency through some combination of "feebates," vehicle excise taxes that vary with fuel economy, and other programs. Feebate proposals usually have two parts: 1) a fee on relatively high emissions/lower fuel economy vehicles and 2) a rebate or tax credit on low emissions/higher fuel economy vehicles. A multistate approach to feebates is recommended here because of the drawbacks of Montana (or any state) acting alone in this area.

Greater use of lower carbon fuels (TLU-6) can be accomplished through a combination of voluntary and mandatory measures. The Low Carbon Fuel Standard recommended as part of TLU-6 can increase the use of ethanol and biodiesel.

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[1] The net cost savings are based on fuel expenditures, operations, maintenance, and administrative costs, and amortized, incremental equipment costs. All NPV analyses here use a 5% real discount rate.

To be most effective, the group of policies aimed at Growth and Development (TLU-5) will require change at every level of government, and as such will be most effective with focused leadership by the state, including training, outreach, and technical assistance to local governments.

Table 5-1. CCAC-recommended policy options and results for the TLU sector

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2006–2020 (Million $)	Cost-Effective-ness ($/t$CO_2$e)	Level of Support
		2010	2020	Total 2007–2020			
TLU-1	Light-Duty Vehicle Clean Car Standards	0.00	0.95	4.92	–$492	–$100	UC
TLU-2	Fuel Efficient Replacement Tires Program	0.00	0.03	0.14	–$86	–$90	UC
TLU-3	Consumer Information on Vehicle Miles Per Gallon (MPG)	*Included in TLU–1 and TLU–2*					UC
TLU-4	Financial and Market Incentives for Low GHG Vehicle Ownership and Use	*Included in TLU–1*					UC
TLU-5	Growth and Development Bundle	0.00	0.14	0.77	<$0	<$0	UC
TLU-6	Low Carbon Fuels	0.00	0.04	0.39	N/A	N/A	UC
TLU-7	Heavy-Duty Vehicle Emissions Standards and Retrofit Incentives	0.00	0.02	0.16	$12.8	$79	UC
TLU-8	Heavy-Duty Vehicle and Locomotive Idle Reduction	0.01	0.02	0.13	–$5.6	–$44	UC
TLU-9	Procurement of Efficient Fleet Vehicles	*Included in TLU-1, TLU-6 through TLU-8, and TLU–11*					UC
TLU-10	Transportation System Management	*Not quantified*					UC
TLU-11	Intermodal Freight Transportation	0.02	0.09	0.59	N/A	N/A	UC
TLU-12	Off-Road Engines and Vehicles GHG Emissions Reductions	*Not quantified*					UC
TLU-13	Reduced GHG Emissions from Aviation	*Not quantified*					UC
	Sector Total After Adjusting For Overlaps	0.02	0.96	6.1	–$492	–$93	

Transportation and Land Use Sector Policy Descriptions

The TLU sector includes emissions and mitigation opportunities related to vehicle technologies, fuel choices, transit options, and demand for transportation services.

TLU-1 Light-Duty Vehicle Clean Car Standards

The CCAC recommends that Montana adopt the Light-Duty Vehicle Clean Car Standards (also known as the "Pavley" standards or California GHG Emission Standards) in order to reduce GHG emissions from new light-duty vehicles (LDVs). The standards, which must still be approved by the United States Environmental Protection Agency (US EPA), would take effect in model year 2011 (calendar year 2010). Other Clean Car Program elements include standards requiring reductions in smog- and soot-forming pollutants and promoting introduction of very low-emitting technologies into new vehicles.

New cars and light trucks in all states must comply with federal emission standards and, generally speaking, states have the choice of adopting the stronger set of standards applicable in California. In 2005, California finalized a set of standards that would require reductions of GHG emissions of about 30% from new vehicles, phased in from 2009 to 2016, through a variety of means. Eleven states have already adopted the California Clean Car Program standards: California, Connecticut, Maine, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington.

TLU-2 Fuel Efficient Replacement Tires Program

The CCAC recommends that Montana improve the fuel economy of the LDV fleet by setting minimum energy efficiency standards for replacement tires and requiring that greater information about low-rolling resistance (LRR) replacement tires be made available to consumers at the point of sale.

Manufacturers currently use LRR tires on new vehicles, but they are not readily available to consumers as replacement tires. When installing original equipment tires, carmakers use LRR tires as a way to contribute to meeting the federal corporate automobile fuel economy (CAFE) standards. When replacing the original tires, consumers often purchase less efficient tires. Currently, tire manufacturers and retailers are not required to provide information about the fuel efficiency of replacement tires. An appropriate state agency would initiate a fuel efficient tire replacement program. The program could include consumer education, product labeling, and minimum standards elements. These programs would be developed under a rule development process that would incorporate the best scientific information, including the results from tests of tires conducted by the tire manufacturers, data from the California Energy Commission, and other data reviewed by the National Academy of Sciences.

TLU-3 Consumer Information on Vehicle Miles Per Gallon (MPG)

The CCAC recommends that Montana work to provide consumers with information about the fuel efficiency and cost in relation to the purchase, maintenance, and operation of their vehicles. Consumers would receive real-time information on the miles per gallon (MPG) while their vehicles are in operation and alerts when their tire pressure is too low (i.e., devices like Air Alert Valve Caps). Generally, a set of four light-emitting diode (LED) tire alert self-calibrating tire pressure valve caps cost about $22.00, and MPG monitoring systems, such as ScanGauge, are about $100.00. In addition, consumers would receive public education and information relating to the impact that vehicle maintenance practices have on the operation of their vehicles. Finally, consumers would be encouraged to consider the MPG of vehicles before and at the time of vehicle purchase.

TLU-4 Financial and Market Incentives for Low GHG Vehicle Ownership and Use

The CCAC recommends that Montana further study and develop policy options that create incentives and disincentives for the purchase and operation of vehicles with varying fuel economy. The policies to be studied and developed includes the following:

1. *Feebates.* A multistate feebate program, including other western states of Arizona, California, and New Mexico. Feebate proposals usually have two parts: 1) a fee on relatively high emissions/lower fuel economy vehicles; and 2) a rebate or tax credit on low emissions/higher fuel economy vehicles. Legislation for this policy option will be needed.

2. *Excise Taxes.* A change in new vehicle excise taxes that increases taxes for relatively high-emitting vehicles and reduces taxes for relatively low-emitting vehicles. Overall, excise tax revenue would remain the same.

3. *Labeling.* A consumer labeling program that provides buyers with better information on the GHG emissions of new vehicles.

Together, these incentives could change the vehicle fleet technology mix through a combination of demand- and supply-side changes.

TLU-5 Growth and Development Bundle

The CCAC recommends that Montana pursue a bundle of options that encompass several components intended to reduce GHG emissions through promotion of multimodal transit options and land use practices and policies. These policies contribute to GHG emissions reductions by reducing vehicle trips and VMT.

Potential actions include the following programs and program elements:

1. Infill, densification, and brownfield redevelopment;

2. Mixed-use and transit-oriented development;

3. Smart Growth planning, modeling, and tools;

4. Targeted open space protection;

5. Expanding transit infrastructure and service; and

6. Expanding transportation choices.

In general, neighborhood center development/redevelopment options are recommended to reduce VMT resulting from inefficient development patterns and locations. Smart Growth principles should be implemented to manage the location, density, development pattern, and infrastructure and to meet basic human needs of new growth.

TLU-6 Low Carbon Fuels

The CCAC recommends that Montana seek to increase the use and market penetration of low carbon fuels (LCFs) to offset traditional fossil fuels such as gasoline, diesel, jet fuel, and others derived from crude oil. Additionally, the policy aims to increase production opportunities for LCFs derived from Montana crops and other low carbon transportation alternatives such as hydrogen, natural gas, and electricity. TLU-6 will evaluate the merits of LCFs based on their net carbon impact and will remain consistent with Agriculture, Forestry, and Waste Management Policy Option 2 (AFW-2), which increases biodiesel production in the state.

Various options or a combination of options to increase LCF use would include:

- Carbon fuel accounting,
- Fuel quality standards,
- LCF infrastructure development,
- LCF standard and credits for compliance,
- High carbon fuel tax,
- State government fleet ‘leadership’ programs for adoption of LCFs, and
- Carbon reduction requirements.

LCFs demonstrate tangible economic benefits to rural economies. An LCF policy provides for strong, proactive measures to address economic and environmental issues where agricultural concerns yearn for economic sustenance and higher crop prices, or new and higher paying industry jobs to sustain the existing economy.

TLU-7 Heavy-Duty Vehicle Emissions Standards and Retrofit Incentives

The CCAC recommends that Montana work with other states and the EPA to advance GHG emissions standards for on-road heavy-duty vehicles (HDVs). In addition, the state would adopt incentive programs to reduce particulate matter (PM) emissions from existing on-road HDVs. Diesel particulate matter includes black carbon aerosols, which are thought to contribute to global warming through positive radiative forcing.

Approaches to diesel engine emission reductions include vehicle scrappage and replacement, repowering (engine replacement), and retrofit with exhaust after-treatment devices. Two devices commonly used to reduce diesel PM emissions are diesel oxidation catalysts and diesel particulate filters. These devices can be used on certain model year engines of heavy-duty trucks, motor coaches, and transit and school buses.

TLU-8 Heavy-Duty Vehicle and Locomotive Idle Reduction

The CCAC recommends that Montana reduce the amount of time that trucks, buses, and locomotives idle. It would involve promoting and expanding the use of technologies that reduce long-term idling, including the use of truck stop electrification. It would also encourage development of local ordinances banning unnecessary idling by HDVs and locomotives in most situations.

Truck stop electrification involves truck plazas that are equipped with electrification systems that allow drivers to shut off their engines and draw electrical power and in some cases, heating, cooling, and communication and entertainment options from a ground source. Different systems may or may not require the purchase of an adaptor to connect to the tractor.

In addition to truck stop electrification, other available technologies that reduce HDV idling include automatic engine shut-down/start-up system controls, auxiliary power units, and direct-fired heaters. Technologies to reduce locomotive idling include automatic engine shut-down/start-up system controls and hybrid-electric switcher engines.

TLU-9 Procurement of Efficient Fleet Vehicles

The CCAC recommends that Montana state and local government agencies "lead by example" by enacting procurement policies and/or joining the EPA SmartWay program and utilizing the SmartWay Upgrade Kits that result in adoption of lower emitting vehicle fleets. There are three primary components of the EPA SmartWay program: creating partnerships, reducing all unnecessary engine idling, and increasing the efficiency of LDVs, HDVs, rail, and intermodal operations.

Targets are listed under the Policy Design section of Appendix H and will be based on the availability of energy-saving technologies and overall efficiency of the life of the vehicle.

This policy option strengthens Montana's commitment to reduce GHG emissions through fuel efficiency in vehicles owned by the state while also encouraging private and public agency fleets that have the potential to develop incentive programs for local governments to help with the initial costs of purchasing such vehicles.

TLU-10 Transportation System Management

The CCAC recommends that Montana seek to reduce GHG emissions from the transportation sector through improvements to transportation system management. These efforts would focus on the improvement, management, and operation of the transportation infrastructure, with a focus on the roads and highway systems.

TLU-11 Intermodal Freight Transportation

The CCAG recommends that Montana encourage the expansion of intermodal rail service for Montana shippers. In addition, the state would strive to increase the competitiveness of rail rates for all Montana shippers. Transportation of freight by railroad generally results in less fuel use and GHG emissions than transportation by truck. The best candidates for diversion from truck to rail are commodities that can move by intermodal rail transportation, which involves shipping containers or truck trailers placed on rail flatcars.

TLU-12 Off-Road Engines and Vehicles GHG Emissions Reductions

The CCAC recommends that Montana reduce emissions from off-road engines. Off-road (also called non-road) engines and vehicles are significant emitters of GHGs and consumers of petroleum-based fuels. Emissions from off-road engines can be reduced by adoption of GHG emissions standards and through retrofit technologies. The efforts would be expected to be consistent with efforts to reduce off-road emissions of other regulated air pollutants. In the state of Montana, these reductions would affect the following equipment categories: airport service, construction, industrial, lawn and garden, agriculture, light commercial, logging, recreational (including snowmobiles and snow coaches), and recreational marine.

TLU-13 Reduced GHG Emissions from Aviation

The CCAC recommends that Montana encourage the federal government to take actions to reduce GHG emissions from the aviation portion of the transportation sector. Those actions could include promotion and use of existing aircraft technologies and programs to reduce emissions, such as Reduced Vertical Separation Minimums (RVSM), Required Navigation Performance (RNP), System for Assessing Aviation's Global Emissions (SAGE), and Voluntary Airport Low Emissions (VALE) Program.

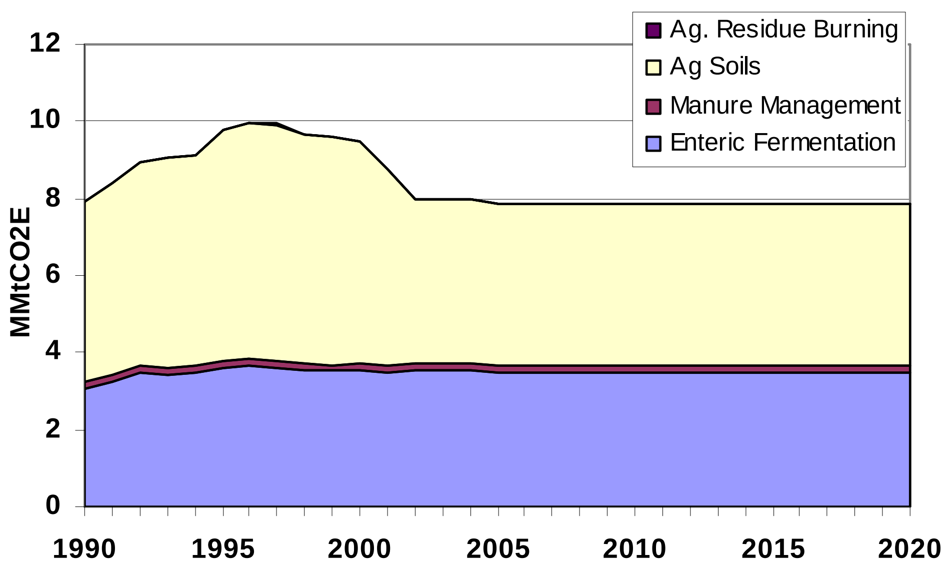
Working in cooperation with other state governments, the State of Montana would seek to develop and encourage a set of federal policies that would significantly reduce GHG emissions reductions from the in-air operation of airplanes.

Chapter 6
Agriculture, Forestry, and Waste Management

Overview of GHG Emissions

The agriculture, forestry, and waste management (AFW) sectors have a significant impact on Montana's current greenhouse gas (GHG) emissions. For agriculture, net emissions were 9.5 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) in 2000, accounting for about one-fourth of Montana's gross GHG emissions. Agricultural emissions include methane (CH_4) and nitrous oxide (N_2O) emissions from enteric fermentation, manure management, agricultural soils, and agricultural residue burning. As shown in Figure 6-1, emissions from agricultural soils account for the largest portions of agricultural emissions. The agricultural soils category includes N_2O emissions resulting from activities that increase nitrogen in the soil, such as fertilizer application (synthetic, organic, and livestock) and production of nitrogen-fixing crops.

Figure 6-1. Historical and projected GHG emissions from the agriculture sector, Montana, 1990–2020



Total gross emissions from agricultural sources fluctuated from 8 to 10 $MMtCO_2e$ from 1990 through 2005. Figure 6-1 shows that projected emissions are held constant between 2005 and 2020. This is because of a lack of information that suggests significant future change in Montana agricultural practices or activity levels. On the basis of limited data, agricultural soils are estimated to sequester about 2.3 $MMtCO_2$ per year.

Forestland emissions refers to the net carbon dioxide (CO_2) flux[1] from forested lands in Montana, which account for about 24% of the state's land area. As shown in Table 6-1,

[1] "Flux" refers to both emissions of CO_2 to the atmosphere and removal (sinks) of CO_2 from the atmosphere.

U.S. Forest Service (USFS) data suggest that Montana forests and the use of forest products sequestered, on average, 23.1 $MMtCO_2$ per year from 1989 to 2004. The data show an accumulation of carbon in each of the forest carbon pools during this period. These rates of sequestration are assumed to remain constant through 2020 (as discussed in the Inventory and Forecast [I&F] Report, the soil carbon flux is left out of the totals because of large uncertainties).

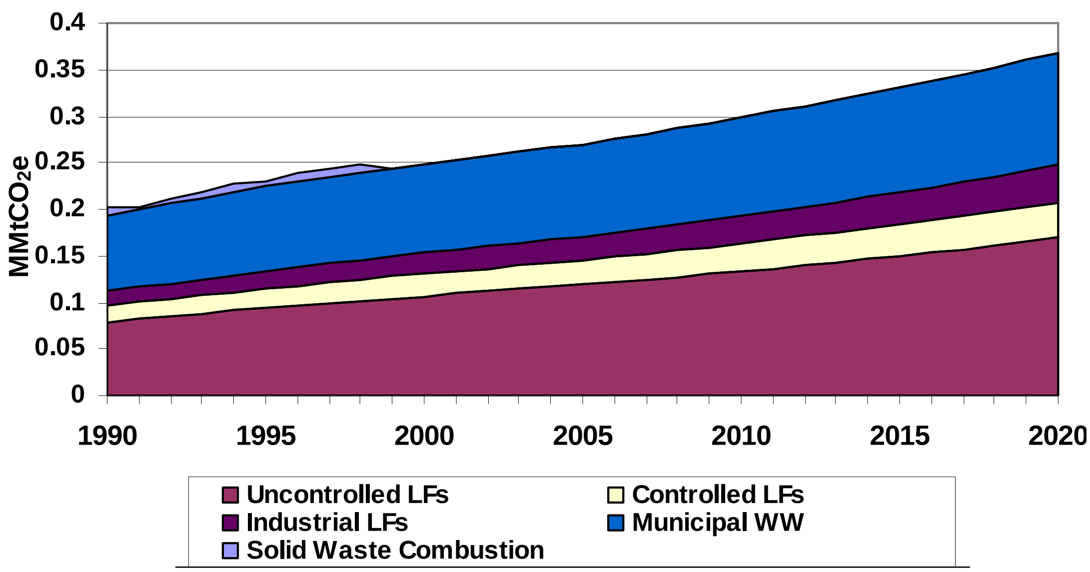
Table 6-1. GHG emissions (sinks) from the forestry sector

Forest Carbon Pool	1990–2020* $MMtCO_2e$
Live trees	–9.6
Standing dead trees	–2.04
Live understory	–0.83
Down and dead trees	–0.81
Forest floor	–7.3
Soil organic carbon	–8.7
Harvested wood products and landfilled forestry waste	–2.5
Total (excludes soil organic carbon)	**–23.1**

*Based on USFS data from 1989 to 2004.

The waste management sector includes both solid waste management and wastewater treatment. Sources include methane from solid waste landfilling. (As organic wastes decompose in landfills they generate methane.) Wastewater (WW) treatment plants produce both methane and nitrous oxide emissions. This sector contributes relatively little to Montana's GHG emissions (see Figure 6-2). In 2000, these sources produced an estimated GHG emissions of 0.3 $MMtCO_2e$, which was less than 1% of the state's gross emissions.

Figure 6-2. Montana GHG emissions from the waste management sector



LF = landfill; WW = wastewater treatment.

Opportunities for GHG mitigation in the AFW sector involve measures that can reduce emissions within the sector or reduce emissions in other sectors. For example, production of liquid biomass fuels can offset emissions in the transportation and in the residential, commercial, institutional, and industrial (RCII) sectors, while biomass energy can reduce emissions in the energy supply (ES) or RCII sectors. Similarly, actions taken to increase waste recycling in the waste management sector can reduce emissions not only in the state (e.g., landfill methane) but also outside the state (e.g., emissions associated with the energy used to produce products from recycled materials versus from virgin materials).

The primary opportunities for GHG mitigation are as follows:

- **Production of renewable fuels (in-state production from in-state feedstocks)—**renewable fuels, such as ethanol from crops, crop residue, forestry residue, or municipal solid waste, can produce significant reductions when they are used to offset consumption of fossil fuels (gasoline consumption in the transportation sector). This is particularly true when these fuels are produced using processes and/or feedstocks that emit much lower GHG emissions than those from conventional sources (e.g., starch-based ethanol).
- **Beneficial use of forest biomass—**expanded use of biomass energy from residue removed from forested areas during treatments to reduce fire risk can achieve GHG benefits by offsetting fossil fuel consumption (to produce electricity, steam, or heat).
- **Protection of forest and agricultural land from conversion to developed use—**by protecting these areas from development, the carbon in aboveground biomass and belowground soil organic carbon can be maintained, and additional emissions of CO_2e to the atmosphere can be avoided. Indirectly, these opportunities will also support the smart-growth policies in the transportation sector.
- **Increase the level of organic carbon in soil—**by using conservation tillage/no-till and other soil management practices and, potentially, through the use of organic farming techniques. These practices have been shown to result in significant increases in soil carbon compared with conventional cultivation. Additional GHG reductions are also possible to the extent that these techniques reduce fossil fuel consumption because of less intensive use of farm equipment. Also, policies aimed at protecting existing soil carbon in agricultural soils under conservation programs can avoid future GHG emissions to the extent that acres returning to active conventional cultivation are minimized.
- **Enhance solid waste recovery and recycling—**reducing the quantity of materials being landfilled reduces future landfill methane emissions potential, while recycling reduces emissions associated with the manufacturing of products from raw materials. Analysis has shown that enhanced waste recovery and recycling can produce overall life cycle GHG reductions (both within and outside of Montana) that are greater than the current levels of emissions from solid waste management (landfilling) within the state.

Additional opportunities for reducing GHGs include afforestation/reforestation of non-forested lands (in both forested and urban areas), restocking forest lands, improving management of existing forest stands, and expanding usage of wood products for building materials. The increased planting and restocking of trees in urban areas has benefits in carbon sequestration and also has other energy and environmental benefits.

Key Challenges and Opportunities

In the agricultural sector, production of ethanol and biodiesel were found to offer substantial GHG reduction potential with an estimated reduction of 0.54 $MMtCO_2e$ by 2020 (combined benefit of Policy Options AFW-2 and AFW-3). This is the benefit from in-state production using Montana-grown feedstocks and/or lower GHG production methods. These two policy options are linked with the low-carbon fuels policy in the transportation and land management (TLU) sector (TLU-6, Low Carbon Fuels). TLU-6 seeks to achieve greater consumption of lower carbon fuels in the state, while these two AFW options seek to promote lower carbon fuel production in the state (to help meet future demand). The benefits for both biodiesel and ethanol are based on production methods and feedstocks that have lower GHG emissions than conventional processes. For ethanol, this means processes that achieve much better GHG reductions than production from conventional corn-based ethanol. These processes could include cellulosic hydrolysis, biomass gasification combined with biofuels production, or alternative starch-based production (fermentation processes fueled by renewable fuels). The analysis conducted to estimate benefits assumed that the ethanol would be produced using cellulosic hydrolysis. For biodiesel, crop production should be promoted that results in significantly better vegetable oil yields than soybean oil, which is currently the most prominent feedstock in the United States. Candidates include vegetable oil crops like canola, camelina, sunflower, mustard, or safflower that have much higher yields, or emerging technologies like algal oil production.

For biofuels, the challenges in Montana will be to identify and promote appropriate feedstocks for the production of these fuels. Limited analysis by the Climate Change Advisory Committee (CCAC) suggests that sufficient feedstock for cellulosic ethanol is available to meet the increased consumption resulting from the TLU-6 (Low Carbon Fuel) policy. There is limited capacity within the state for crop production to support biodiesel production without the use of cropland that is currently used for other purposes or is part of the Conservation Reserve Program (the analysis showed a need for 1.2 million acres devoted to vegetable oil production by 2020). Hence, careful study is needed to identify available croplands and appropriate crops for vegetable oil production.

Funding and/or incentives will be needed to support the development of biofuels production capacity, including research and development (for production processes and feedstocks) and scale-up of production facilities. In addition to planning for the production of vegetable oil, sufficient planning is needed to promote in-state production for the other primary feedstock to biodiesel fuel (methanol or ethanol). The CCAC is unaware of any commercial-scale production of either of these feedstocks in Montana. Additional research and development will be needed to ensure that these alcohols are produced from renewable in-state resources (e.g., manure energy, biomass gasification, cellulosic hydrolysis) to maximize the GHG benefits.

As shown in the policy option descriptions in Appendix I, the implementation mechanisms developed for the agriculture and forestry sectors should focus on methods that avoid conflict with potential future market-based GHG reduction programs. These include GHG credits that could be generated in the agricultural sector through renewable fuels projects, soil carbon projects, and possibly other project types. New regulations that mandate emission reductions or specific agricultural practices could limit Montana agriculture from taking part in emerging carbon markets. Implementation mechanisms that are incentive and education based can avoid these conflicts.

By combining the agricultural and forestry land protection options (AFW-5), 0.12 $MMtCO_2e$/year in GHG emissions is estimated to be saved in 2020. To achieve these reductions, the state will need to work closely with local planning agencies, land owners, and nongovernmental organizations to identify lands suitable for acquisition/conservation easements and funding mechanisms. Another benefit of these options is the reduction in vehicle miles traveled (VMT) due to more efficient development patterns. More efficient development is covered under TLU-5.

Adoption of soil carbon management programs, such as conservation tillage/no-till methods (AFW-1) has been shown to result in significant benefits by 2020 (0.37 $MMtCO_2e$/year). The reductions associated with increases in soil carbon and reduced fossil fuel consumption have both been quantified. The reductions to be achieved by the organic farming element could not be quantified with available information on the net GHG reduction potential of organic farming methods on Montana crop systems. The challenges in Montana will be to identify and communicate opportunities for growers to adopt these methods to achieve the levels of participation envisioned in the policy design (394,404 acres by 2020). A strong educational and outreach program will be needed.

Option AFW-4 seeks to retain cropland in an uncultivated state from conservation programs such as those in the U.S. Farm Bill, thereby preventing the oxidation of soil carbon and subsequent CO_2 emissions. More than one million acres are expected to be retired from the Farm Bill's Conservation Reserve Program (CRP) by 2020. If these acres are returned to active cultivation, not only will already stored soil carbon be lost, but the annual sequestration of additional CO_2 by these soils will also be impaired. About 2.1 $MMtCO_2$ would be protected by maintaining these acres in some type of conservation program. The CCAC recognizes that additional work is needed to identify appropriate implementation approaches for this option. The reductions for AFW-4 were not included in the total GHG reductions for this sector. These emissions relate to the protection of agricultural soil carbon, and the potential emissions were not included in the GHG forecast for the agricultural sector.

Also in the forestry sector, the expanded use of biomass feedstocks for energy use (AFW-7) has a significant potential for GHG benefits (0.15 $MMtCO_2e$/year by 2020). These reductions are associated with the collection and use of additional woody biomass not consumed within the renewable energy options in the ES and RCII sectors. The estimated benefits focused on those obtained by utilizing biomass energy from forest treatment projects (to reduce fire risk). Success will be achieved through close cooperation between Montana, federal agencies (e.g., USFS), and private industry to identify biomass resources and effective end uses for the resources, as well as the development of a collection and distribution industry.

Overview of Policy Recommendations and Estimated Impacts

The CCAC recommends a set of 12 policy options for the AFW sector that offer the potential for major economic benefits and emissions savings. As summarized in Table 6-2, the AFW policy recommendations could lead to emissions reductions from reference case projections of

2.4 $MMtCO_2e$ per year by 2020, cumulative savings of around 17 $MMtCO_2e$ from 2007 through 2020, and a net cost of approximately $446 million through the year 2020 on a net present value (NPV) basis.[2] The weighted average cost of saved carbon from the policy options for which quantitative estimates of both costs and savings were prepared was $26/$MtCO_2e$. These reflect only the effects of the policy options in the AFW sectors, noting that the AFW policy options achieve emission reductions not only from the AFW source sectors, but also from other source sectors (e.g., transportation sector from biofuels production and ES or RCII sectors from biomass energy production).

Note that the total NPV costs for the sector include the costs for AFW-4, but that the GHG reductions have not been included in the totals (as described above, the potential emissions were not included in the inventory and forecast). Since the GHG reductions for AFW-4 were not included in the totals, the total cost-effectiveness does not include the costs of this option.

The CCAC policy recommendations described briefly here (and in more detail in Appendix I) not only result in significant emissions savings, but also offer a host of additional benefits. These benefits include 1) support of Montana agricultural producers in the production of biofuels crops, development of new markets for agricultural byproducts, production of crops to support locally consumed foods, and training/outreach covering energy production and organic farming;
2) creation of jobs in the biomass energy and liquid biofuels feedstock/production industries;
3) healthier forests with lower fire risk through the development of markets for forestry residue; and 4) research and development work to be conducted by Montana universities to support many of the policies for this sector.

Table 6-2. CCAC-recommended policy options and results for the AFW sector

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/$tCO_2e$)	Level of Support
		2010	2020	Total 2007–2020			
AFW-1	Agricultural Soil Carbon Management–Conservation/No-Till	0.15	0.37	3.7	0	0	UC
	Agricultural Soil Carbon Management–Organic Farming	*Not quantified*					
AFW-2	Biodiesel Production (Incentives for Feedstocks and Production Plants)	0.02	0.15	0.9	13	14	UC
AFW-3	Ethanol Production	0.02	0.39	2.2	10	4	UC
AFW-4*	Incentives for Enhancing GHG Benefits of Conservation Provisions of Farm Bill Programs	0.5	1.6	15	181	12	UC
AFW-5	Preserve Open Space and Working Lands–Agriculture	0.003	0.02	0.12	5	32	UC
	Preserve Open Space and Working Lands–Forests	0.03	0.1	0.9	3	3	

[2] The net cost savings are based on fuel expenditures, operations, maintenance, and administrative costs, and amortized, incremental equipment costs. All NPV analyses here use a 5% real discount rate.

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2010	2020	Total 2007–2020			
AFW-6†							
AFW-7‡	Expanded Use of Biomass Feedstocks for Energy Use	0.04	0.15	1.1	–25	–23	UC
AFW-8	Afforestation/Reforestation Programs–Restocking	0.09	0.5	3.4	41	12	UC
	Afforestation/Reforestation Programs–Urban Trees	0.001	0.006	0.04	–0.1	–3	
AFW-9	Improved Management and Restoration of Existing Stands	0.05	0.2	1.3	159	119	UC
AFW-10	Expanded Use of Wood Products for Building Materials	*Not quantified*					UC
AFW-11	Programs to Promote Local Food and Fiber	0.01	0.02	0.12	0.5	5	UC
AFW-12	Enhanced Solid Waste Recovery and Recycling	0.05	0.55	3.3	58	17	UC
	Sector Total After Adjusting for Overlaps	**0.44**	**2.4**	**17**	**446**	**26**	
	Reductions From Recent Actions	**0**	**0**	**0**	**0**	**0**	
	Sector Total Plus Recent Actions	**0.44**	**2.4**	**17**	**446**	**26**	

UC = unanimous consent.

* The reductions for AFW-4 were not included in the total GHG reductions for this sector. These emissions relate to the protection of agricultural soil carbon for conservation program acres that are being retired and might return to active cultivation. Since these potential emissions were not included in the GHG forecast for the agricultural sector, the potential reductions have been left out of the totals. The NPV costs include the costs of AFW-4, while the calculation of cost-effectiveness does not include the costs or reductions of AFW-4.

† AFW-6 was folded into AFW-7 through AFW-9.

‡ For AFW-7, these reductions are associated with the use of additional woody biomass not consumed within the renewable energy options in the ES and RCII sectors.

Agriculture, Forestry, and Waste Management Sector Policy Descriptions

The Agriculture, Forestry, and Waste Management (AFW) sectors include emissions and mitigation opportunities related to use of biomass energy, protection and enhancement of forest and agricultural carbon sinks, programs to promote local food and organic farming, production of renewable fuels, and methods to increase soil carbon, achieve afforestation on non-forested lands, and recycling of waste material.

AFW-1 Agricultural Soil Carbon Management Programs: Conservation/No-Till and Organic Farming

Use of conservation tillage/no-till and other soil management practices can increase the level of organic carbon in the soil, which sequesters carbon dioxide from the atmosphere. In addition, some practices lower fossil fuel consumption through less intensive equipment use. Other practices, such as the application of bio-char can also increase the level of soil carbon and improve the soil. Organic farming methods may tend toward an increased use of these soil management practices. This option is designed to increase the acreage using soil management practices that lead to higher soil carbon content for both conventional and organic farming.

Montana should adopt programs to increase the acres of cropland managed using best management practices, including conservation/no-tillage practices, by 50%. An organic farming component is also included in this policy design pending an assessment of the GHG benefits. The initial goal will be to increase the organic acreage 15% above projected levels in 2015 and to 50% above 2025 levels for practices known to achieve net GHG benefits.

AFW-2 Biodiesel Production (Incentives for Feedstocks and Production Plants)

The use of biodiesel offsets the consumption of diesel fuel produced from oil (fossil diesel). Since biodiesel has a lower GHG content than fossil diesel (being derived from biogenic sources), overall GHG emissions are reduced. By producing biodiesel in the state for consumption within the state, the highest benefits can be achieved, since the fuel is transported over shorter distances to the end user (compared with importing biodiesel to Montana from other states). This option covers incentives needed to increase biodiesel production in Montana.

This policy seeks to produce sufficient biodiesel from Montana feedstocks to meet 2%, 10%, and 20% of 2004 Montana petroleum diesel consumption by 2010, 2015, and 2020, respectively.

Note that this policy option is linked with the low-carbon fuels policy in the transportation and land use sector (TLU-6). That policy option seeks to achieve greater consumption of lower carbon fuels in the state, while this option seeks to promote lower carbon fuel production in the state (to help meet future demand).

AFW-3 Ethanol Production

Offset fossil fuel use (gasoline) with production and use of starch-based and cellulosic ethanol. Offsetting gasoline use with ethanol can reduce GHGs to the extent that the ethanol is produced with lower GHG content than gasoline. Provide incentives for the production of ethanol from crops, forest sources, animal waste, and municipal solid waste. Also encourage cellulosic ethanol production research and development already initiated by the Montana Department of Agriculture.

This policy option seeks to achieve in-state production levels of 50 million gallons per year (MGY) of starch-based ethanol production capacity and 2 MGY of cellulosic production by

2010; achieve in-state production of 110 MGY of starch-based and 25 MGY of cellulosic production by 2015; and achieve in-state production levels of 250 MGY starch-based and 50 MGY of cellulosic production by 2020.

Note that this policy option is linked with the low-carbon fuels policy in the transportation and land use sector (TLU-6). That policy option seeks to achieve greater consumption of lower carbon fuels in the state, while this option seeks to promote lower carbon fuel production in the state (to help meet future demand).

AFW-4 Incentives for Enhancing GHG Benefits of Conservation Provisions of Farm Bill Programs

Agricultural lands that have been placed into conservation programs such as those in the U.S. Farm Bill may sequester carbon dioxide by implementing practices that build soil carbon over time. For example, land in the CRP is taken out of production and, in the absence of tillage practices, soil carbon is sequestered over time. This option seeks to extend the GHG benefits of current Farm Bill programs, looking particularly at land that is scheduled to retire from Farm Bill programs and potentially go back into production.

AFW-5 Preserve Open Space and Working Lands: Agriculture and Forests

Reduce the rate at which existing crop/pasture, rangeland, and forests are converted to developed uses. Specifically, reduce the rate of conversion by 50% from current levels by 2020. The carbon sequestered in the soils and above ground biomass of these open spaces and working lands is often much higher than in developed land uses. Policies that preserve open space and working lands provide additional GHG benefits by reducing the VMT that would otherwise occur from unwise or unplanned development (note relationship to growth and development under Option TLU-5).

AFW-7 Expanded Use of Biomass Feedstocks for Energy Use

This policy seeks to expand the use of biomass from forests, agriculture, and other sources for energy. Biomass can be used to produce liquid fuels, including cellulosic ethanol, or to produce energy in the form of electricity, heat, or steam. The latter is covered by this option.

Carbon in biomass is considered biogenic under sustainable systems; carbon dioxide emissions from biomass energy combustion are replaced by future carbon sequestration in new biomass. Expanded use of biomass energy in place of fossil fuels results in net emissions reductions by shifting from high to low carbon fuels (when sustainably managed), provided the full life cycle of energy requirements for producing fuels does not exceed the energy content of the renewable resource. Expanded use of biomass energy can be promoted by increasing the amount of biomass produced and used for renewable energy and by providing incentives for the production and use of renewable energy supplies.

This policy option aims to increase the usage of woody biomass residue for renewable electricity, heat, and steam generation to 450,000 tons/year by 2020. It also aims to use 540,000 dry tons of agricultural residues annually by 2020.

AFW-8 Afforestation and Reforestation Programs: Restocking and Urban Trees

Increase carbon stored in forests through expanding the forestland base. Establishing new forests, either on historically non-forested land ("afforestation") or on land that has not been managed as forest land for some time ("reforestation") increases the amount of carbon in biomass and soils compared with preexisting conditions. Afforestation and reforestation accomplished with stocking/planting and other practices (e.g., soil preparation and erosion control) can increase carbon stocks above baseline levels and ensure conditions that support forest growth.

One of the goals is to ensure restocking on 20% of the accessible forest lands impacted by stand replacement fires since year 2000 (estimated at 70,000 acres) to stocking rates of 200–400 trees/acre (depending on forest type). For future lands impacted by wildfire, this policy option aims to restock forest lands impacted by stand replacement fires (estimated at 20,000 acres/year) within 5 years post-fire. It is also recommended that Montana plant 42,250 new trees in its communities by 2020 through programs such as the Department of Natural Resources and Conservation's (DNRC's) Urban and Community Forestry Program.

AFW-9 Improved Management and Restoration of Existing Stands

This policy seeks to increase forest carbon stocks through changes in management practices on existing forestland. The goal is to initiate programs to increase forest productivity by 20% on 700,000 acres of private and state forest lands by 2020. This policy is not restricted to working through existing forest health programs to promote new practices that increase tree density, enhance forest growth rates, alter rotation times, or decrease the chances of biomass loss from fires, pests, and disease. In addition, increasing the transfer of biomass to long-term storage in wood products can increase net carbon sequestration, provided a proper balance is maintained where enough biomass remains on site as residues serving as nutrient inputs to the forest. Practices may include management of rotation length, biomass density, biomass energy use, and sustainable use of wood products.

AFW-10 Expanded Use of Wood Products for Building Materials

This policy seeks to enhance the use and lifetime of durable wood products. The CCAC recommends that Montana adopt programs to expand use of wood products by 5% over current baseline rates of use. Durable products made from wood prolong the length of time forest carbon is stored and not emitted to the atmosphere. Following their useful life (which could be measured in decades), wood products disposed of in landfills may store carbon for long periods under conditions that minimize decomposition. Additional GHG benefits can be achieved when methane gas is captured from landfills and used as an energy source (carbon originally stored in wood products becomes methane gas during decomposition). Increasing carbon stored in the wood products pool increases carbon sequestration from forests. This can be achieved through improvements in production efficiency, product substitution, expanded product lifetimes, and other practices. In addition, increasing the efficiency of the manufacturing life cycle for wood products enhances GHG benefits.

AFW-11 Programs to Promote Local Food and Fiber

Programs that promote the production, distribution, and consumption of locally grown food and fiber products reduce transportation and manufacturing emissions by offsetting the consumption of products with higher embodied energy. Food and fiber products consumed in the United States can travel thousands of miles before reaching a grocery or clothing store in the form of a final product (on average, a typical food product travels 1,500 miles and changes hands 33 times). Increasing the percentage of locally grown food and fiber consumed in Montana will significantly reduce fossil fuel use and its associated GHG emissions. The goal is to have 30% of the food consumed in Montana grown, harvested, and processed in Montana by 2020.

AFW-12 Enhanced Solid Waste Recovery and Recycling

Programs are needed to increase the quantity of materials recovered for recycling with specific attention given to materials with the greatest ability to reduce energy consumption during the manufacturing process and to materials that may be used as a fuel source (e.g., clean wood waste). Reducing the quantity of materials being landfilled reduces future landfill methane emissions potential, while recycling reduces emissions associated with the manufacturing of products from raw materials.

This policy aims to increase Montana solid waste recycling rates to 17% by 2008, 22% by 2011, 25% by 2015, and 28% by 2020 using a variety of methods, including source reduction, reuse, recycling, and composting.

Chapter 7
Cross-Cutting Issues

Overview of Cross-Cutting Issues

Some issues relating to climate policy cut across multiple or all sectors. These issues were addressed by a distinct technical work group under the Montana Climate Change Advisory Committee (CCAC). The issues include inventorying and forecasting greenhouse gas (GHG) emissions, reporting GHG emissions by entities, registering any GHG reductions achieved by entities for possible future credit and/or recognition, instituting a variety of public education and outreach initiatives, establishing goals for reducing statewide GHG emissions in Montana, and leading by example by reducing the state government's own GHG emissions. The Cross-Cutting Issues Technical Work Group (CC TWG) developed policy options for each of these issues.

Key Challenges and Opportunities

During the course of the CCAC's efforts, broad state interest in GHG reporting and registries coalesced in the establishment of *The Climate Registry*, a uniform GHG reduction registry platform suitable for all states. Building on the progress established by the California Climate Action Registry and the Eastern Climate Registry, several states developed a unified path forward that promises to meet most, if not all, of the GHG reporting and registry needs of the states, including voluntary GHG reporting, mandatory GHG reporting, and allowance reconciliation. Ultimately, this registry could serve as the foundation for trading and other transactions associated with GHG reductions. Consistent with the recommendations being prepared by the CCAC, Governor Schweitzer committed Montana as one of the first states to participate in *The Climate Registry*, which now includes all but a handful of the U.S. states, as well as many Canadian provinces and some states in Mexico. Montana's participation in the formation of *The Climate Registry* should enhance its ability to ensure that key sources and sectors (e.g., oil and gas production and biological carbon sequestration) are included as soon as possible.

Also consistent with this direction, the CCAC recognized the importance of improving Montana's ability to inventory and forecast its own GHG emissions. These are essential elements of understanding where emission reduction opportunities lie, what emission trends are evident, and the extent to which progress is being made against goals. The CCAC also noted the importance of concerted public education and outreach efforts in reducing GHG emissions. The results of public education and outreach programs may be difficult to measure, but public understanding of climate risks and solutions is ultimately the foundation upon which successful climate action policy and implementation is built.

Establishing GHG reduction goals or targets is another key cornerstone to progress. The CCAC addressed this issue in two respects: 1) establishing a statewide GHG reduction goal and 2) making recommendations by which the state government itself could lead by example in reducing its own emissions. The CCAC recommended that Montana establish a statewide, economy-wide GHG reduction goal to reduce gross GHG emissions to 1990 levels by 2020, for both consumption-based and production-based emissions and, further, to reduce emissions to

80% below 1990 levels by 2050. The CCAC also strongly recommended the early and aggressive implementation of its comprehensive set of recommendations, along with a corresponding set of incentives to promote early adoption. The CCAC further recommended that the Montana state government lead by example in reducing its own GHG emissions to 1990 levels by 2018 (2 years earlier than the statewide goal) and 5% below 1990 levels by 2020 (5% lower than the statewide goal for 2020).

Also of note regarding reduction goals are several regional and other GHG emission reduction efforts now underway across the country. Two of these, the Western Climate Initiative (WCI) and the Chicago Climate Exchange (CCX), were considered by the CCAC. The CCAC recommended that Montana join the WCI, which seeks to reduce regional GHG emissions by 15% from 2005 levels by 2020, bringing regional emissions down to nearly 1990 levels. The CCAC also recommended that Montana consider joining the CCX. Doing so would commit the state to a 6% reduction from 1998–2001 levels by 2010 and could potentially provide revenue for the state through GHG reductions achieved on state-owned grazing and forest trust lands.

Overview of Policy Recommendations

Cross-cutting issues include policies and measures that apply across the board to all sectors and activities. Cross-cutting recommendations typically encourage, enable, or otherwise support emissions mitigation activities and/or other climate actions. The CCAC recommends that six such policies be adopted and implemented by Montana. All are enabling policies that are not quantified in terms of tons of GHG reduction or costs.

First, a rigorous GHG emissions inventory program is vital to understanding GHG emissions levels, where mitigation opportunities lie, and how much progress is being made. A forecasting function is equally important to assess trends and likely emissions levels going forward. Montana's involvement in *The Climate Registry* will assist the state in measuring future progress, recognizing and sharing emission reduction accomplishments, and protecting entities' interests by rigorously recording their early GHG reduction efforts and accomplishments. Public awareness of climate change is essential to the public's acceptance of concerted climate action, so a comprehensive public education and outreach program is warranted. Finally, establishing statewide GHG reduction goals and demonstrating leadership by example toward meeting them is also essential to progress. Montana state government has set rigorous, well-defined GHG emission reduction goals for the state and identified several ways that it can lead by example, including a) an even more aggressive goal for the state's own emissions, b) consideration of climate-neutral bonding for projects that involve state funding, c) requiring evaluation of GHG emissions as part of environmental assessments and environmental impact statements, and d) joining WCI and possibly CCX.

Detailed descriptions of the individual Cross-Cutting Issues policy options as presented to and approved by the CCAC can be found in Appendix J.

Table 7-1. CCAC-recommended policy options and results for Cross-Cutting Issues

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/t$CO_2$e)	Level of Support
		2012	2020	Total 2007–2020			
	Cross-Cutting Issues						
CC-1	GHG Inventories and Forecasts	*Not quantified*					UC
CC-2	State GHG Reporting	*Not quantified*					UC
CC-3	State GHG Registry	*Not quantified*					UC
CC-4	State Climate Public Education and Outreach	*Not quantified*					UC
CC-5*							
CC-6	Options for Statewide GHG Goals or Targets	*Not quantified*					2020 Goal: UC 2050 Goal: Super-majority
CC-7	The State Government's Own GHG Emissions (Lead by Example)	*Not quantified*					UC

UC = unanimous consent.

* There is no policy option CC-5 (Adaptation), because this catalog option was determined not to be a priority for analysis by the CCAC.

Cross-Cutting Issues
Policy Descriptions

CC-1 GHG Inventories and Forecasts

GHG emissions inventories and forecasts are essential to understanding the magnitude of all emission sources and sinks (both natural and those resulting from human endeavors), the relative contribution of various types of emission sources and sinks to total emissions, and the factors that affect trends over time. Inventories and forecasts will inform state leaders and the public on statewide trends and opportunities for mitigating emissions or enhancing sinks, and will help verify GHG reductions associated with implementation of Montana's Climate Action Plan. Development of GHG emissions inventory and forecasting systems for Montana should integrate with existing Montana Department of Environmental Quality (DEQ) functions and should take advantage of expertise found in the state's colleges and universities. Opportunities for public participation by voluntary self-reporting of individual and community GHG reductions (with appropriate privacy protection) should also be made available. The inventory and forecast function will be an ongoing effort that will improve over time, based on more and better emissions data.

The CCAC recommends that Montana develop its capacity for statewide GHG emissions inventories and forecasts by conducting a periodic, consistent, and complete inventory of emission sources and sinks on a continuing basis, with forecasts covering a 20-year planning horizon. This inventory should be updated every two years and include both production- and consumption-based approaches. The forecast should project what emissions will be in future years, allowing for expected economic growth and implementation of mitigation options and provide a basis for documenting reductions and credits from year to year. This process should be implemented as soon as possible, and all emission sources and sinks (both natural and those resulting from human endeavors) should be included. It should be conducted so as to encourage awareness, understanding, and broad participation in reducing state GHG emissions by sources, citizens, and communities.

CC-2 State GHG Reporting

A GHG reporting system is designed to provide for measuring and then reporting emissions. GHG reporting can help sources identify emission reduction opportunities and manage risks associated with possible future GHG mandates by moving up the learning curve. GHG reporting is a precursor for participation in GHG reduction programs and a GHG emissions reduction registry. Tracking and reporting of GHG emissions is also useful in the construction of periodic state GHG inventories and makes it easier for sources to receive recognition and goodwill for successful emission reduction efforts. Reporting and the related inventory function will also provide valuable information for assessing the efficacy of measures implemented to reduce GHG emissions going forward. Self-reporting by individuals and communities should also be allowed to encourage awareness, understanding, and broad participation on the part of the pubic.

The CCAC recommends that Montana develop GHG reporting requirements and opportunities for its emission sources and citizens as soon as possible. Subject to consistently rigorous quantification, GHG reporting should not be constrained to particular sectors, sources, or approaches, in order to encourage GHG mitigation activities from all quarters. Mandatory GHG reporting should be established for sources holding air quality permits with the Montana DEQ and then phased in by sectors as rigorous, standardized quantification protocols, base data, and tools become available, and as responsible parties become known. Entities should be encouraged to report GHG emissions voluntarily before mandatory reporting applies to them, and the state, municipalities, and other jurisdictions should be encouraged to report emissions associated with their own activities and any programs they may implement. Every effort should be made to maximize consistency with federal, regional, and other states' GHG reporting programs, and reporting of project-based emissions reductions should be allowed when properly identified as such and quantified with equally rigorous consistency.

CC-3 State GHG Registry

A GHG registry enables measurement and recording of GHG emissions reductions in a central repository with a "transaction ledger" capacity to support tracking, management, and ownership of emission reductions as well as to encourage GHG reductions. It assists with baseline protection and/or the crediting of actions by implementing programs and parties in relation to possible emissions reduction goals. And it can also provide a mechanism for regional, multistate, and cross-border cooperation. Subject to appropriately rigorous quantification and verification, participation in a GHG registry should not be constrained to particular sectors, sources, or approaches so as to encourage GHG mitigation activities from all quarters. In particular, a GHG registry should be able to incorporate activities associated with all policy options implemented in Montana, whether reflective of reductions in emissions of GHGs or increases in biological or geological sequestration of carbon.

The CCAC notes that the State of Montana has joined 39 other U.S. states in the effort to develop a national GHG registry through *The Climate Registry*. Being a charter state in this effort should help ensure that Montana's needs and priorities are addressed in the course of developing *The Registry.* To the extent that Montana's needs may not be fully met by *The Climate Registry,* the state should consider developing supplemental or ancillary registry capacity or opportunities. Montana's participation in *The Climate Registry* should include or cover all of the activities associated with all policy options that the CCAC recommends and the Governor accepts. A mechanism should be provided whereby Montana sources and stakeholders can keep abreast of—and provide input to—state and national registry efforts as they evolve. Additional elements are detailed in Appendix J, Cross-Cutting Issues – Policy Recommendations.

CC-4 State Climate Public Education and Outreach

Explicitly articulated public education and outreach can support GHG emissions reduction efforts at all levels in the context of emissions reduction programs, policies, or goals. Public education and outreach is vital to fostering a broad awareness of climate change issues and effects (including co-benefits, such as clean air and public health) among the state's citizens. Such awareness is necessary to engage citizens in actions to reduce GHG emissions. Public education and outreach efforts should integrate with and build upon existing outreach efforts involving climate change and related issues in the state. Ultimately, public education and outreach will be the foundation for the long-term success of all the policy actions proposed by the CCAC as well as those which may evolve in the future.

The CCAC recommends that the state lead by example in its own education and outreach activities by establishing a proactive public education and outreach capability and using it to target education and outreach activities to policy makers, younger generations, community leaders and community-based organizations, the general public, and industrial and economic sectors. Specific public education and outreach suggestions are provided in the accompanying technical Appendix J. The overarching goal is a wholesale shift in public consciousness away from uninformed consumerism to a commitment to choices that enhance personal, community, and statewide health and contribute to productive, thriving natural systems. To support monitoring of this goal, it is recommended that the state conduct a voluntary survey of a cross-section of Montana residents' lifestyles to elucidate the level of awareness of sources of individual GHG emissions and steps currently being taken to reduce them. The survey will provide a baseline for a parallel, more qualitative report that will accompany the more technical reporting by nonresidential sectors. Public education and outreach efforts should begin as soon as possible, continue evolving and spreading over time, and involve all parties and sectors.

CC-6 Options for Statewide GHG Goals or Targets

The CCAC will recommend actions that can be taken in Montana to reduce the state's contribution to climate change. Consistent with this charge, the establishment of a statewide goal or target can provide vision and direction, a framework within which implementation of CCAC policy recommendations can proceed effectively, and a basis of comparison for regular periodic assessments of progress. In pursuit of similar climate progress, at least 16 other states have established GHG reduction goals or targets.

The CCAC recommends that Montana establish a statewide, economy-wide GHG reduction goal to reduce gross GHG emissions to 1990 levels by 2020, for both consumption-based and production-based emissions and, further, to reduce emissions to 80% below 1990 levels by 2050. In lieu of establishing a specific target sooner than 2020, the CCAC also strongly recommends the early and aggressive implementation of the CCAC's comprehensive recommendations, along with a corresponding set of incentives to promote early adoption.

CC-7 The State Government's Own GHG Emissions (Lead by Example)

The CCAC recommends three actions with respect to leading by example in reducing the state's own GHG emissions. (A fourth action, CC-7.2 *Climate-Neutral Bonding*, was initially considered by the CC TWG but subsequently incorporated into the design and quantification of policy option RCII-12 and is not repeated here.) The three recommendations are 1) CC-7.1 *Establish a Target for Reducing the State Government's Own GHG Emissions*, 2) CC-7.3 *Require Evaluation of GHG Emissions in Environmental Studies*, and 3) CC-7.4 *Join the Western Climate Initiative (WCI) and Consider Joining the Chicago Climate Exchange (CCX).*

CC-7.1. State government is responsible for providing a multitude of services for the public that are delivered through very diverse operations and result in wide-ranging GHG emission activities. Montana State government can take the lead in demonstrating that reductions in GHG emissions can be achieved through analysis of current operations, identification of significant GHG sources, and implementation of changes in technology, procedures, behavior, operations, and services provided. The state can also encourage local governments, school districts, universities, and other entities in implementing similar GHG reduction strategies by closely partnering with them. The CCAC recommends that the state establish a target to reduce GHG emissions from state operations to 1990 levels by 2018 (2 years earlier than the statewide goal) and to 5% below 1990 levels by 2020 (5% lower than the statewide goal for 2020).

CC-7.3. Environmental Assessments (EA) and Environmental Impact Statements (EISs) are written analyses of the potential environmental impacts of a proposed action or project. Requiring consideration of GHG emissions to be included as part of EA and EIS processes and documents would enable comparison of reference case GHG emissions levels to future GHG emissions levels as a result of proposed projects. Such information could be helpful in targeting development decisions that minimize GHG emissions or in pointing out the need for authority to regulate GHG emissions. The CCAC recommends that agencies be instructed to include data regarding reference case and estimated future GHG emissions in EA and EIS documents. This information will guide officials and developers in choosing technologies and activities resulting in development that protects the environment and reduces additional contributions of GHGs.

CC-7.4. The Western Climate Initiative (WCI) is a joint effort by the states of Washington, Oregon, California, Arizona, and New Mexico (since joined by the state of Utah and the Canadian provinces of British Columbia and Manitoba) to develop a regional GHG reduction goal and identify market-based mechanisms by which it can be achieved.[1] WCI is also seen as a precursor to a national market-based system for GHG reductions and may serve as a model for a national program. By joining WCI, Montana would commit to more broadly applicable GHG reductions—both geographically and among economic sectors—and participate in the development of mechanisms for achieving these goals. One part of the overall strategy will likely be the utilization of offsets, which often include terrestrial sequestration actions to increase the absorption of carbon dioxide (CO_2) as a result of land management activities. Joining WCI will give Montana the opportunity to help define the nature and quality of terrestrial offsets over a large region of the country, helping to ensure that terrestrial offsets play an appropriate role in achieving the GHG reduction goals established by WCI and then, subsequently, under a national regime.

The Chicago Climate Exchange (CCX) is also a market-based effort. Its membership is broad and extensive and includes three other states along with many U.S. cities and dozens of corporations. Joining CCX would require a reduction in Montana's own GHG emissions of 6% (from 1998–2001 levels) by 2010. As a condition for joining CCX, Montana would likely seek eligibility for a portion of its required reductions to be achieved from state trust lands through offsets from agricultural and forestland sequestration projects. Thus, joining CCX could provide potential revenue for the state through GHG reductions achieved on state-owned grazing and forest trust lands. By developing and utilizing such offsets and ensuring that these do, in fact, constitute actual reductions in emissions, Montana could get early experience on this learning curve, allowing it to become a ground floor player in terrestrial CO_2 offset markets while WCI's offset policies are being developed. Ultimately, joining CCX could encourage more CO_2 reductions to be made in Montana and could provide additional revenues to the state as well as to private and tribal landowners.

The CCAC recommends that the State of Montana join WCI (with respect to Montana's economy-wide GHG emissions) and consider whether to take advantage of the trading platform provided by joining CCX (with respect to state government GHG emissions) and commit to meeting their respective GHG emission reduction obligations. The aspirations and reach of the WCI, coupled with the techniques developed and applied by the CCX, may produce more effective, less costly outcomes than either entity would produce alone.

[1] After the CCAC approved this recommendation, the WCI announced agreement on a goal of reducing regional GHG emissions by 15% from 2005 levels by 2020.