

Agriculture, Forestry, and Waste Management Technical Work Group

Summary List of Mitigation Options

	Mitigation Option	GHG Reductions (MMtCO ₂ e)			Net Present Value	Cost-Effectiveness (\$/tCO ₂ e)	Status of Option
		2010	2020	Total 2007-2020	2007-2020 (Million \$)		
AFW-1	Agricultural Soil Carbon Management	<i>Not Quantified</i>					Pending
AFW-2	Biodiesel Production (Incentives for Feedstocks and Production Plants)	<i>Not Quantified</i>					Pending
AFW-3	Ethanol Production	<i>Not Quantified</i>					Pending
AFW-4	Incentives for Enhancing GHG Benefits of Conservation Provisions of Farm Bill Programs	<i>Not Quantified</i>					Pending
AFW-5	Preserve Open Space and Working Lands	<i>Not Quantified</i>					Pending
AFW-6	Forest Health Programs for Carbon Management	<i>Not Quantified</i>					Pending
AFW-7	Expanded Use of Biomass Feedstocks for Energy Use	<i>Not Quantified</i>					Pending
AFW-8	Afforestation and Reforestation Programs	<i>Not Quantified</i>					Pending
AFW-9	Improved Management and Restoration of Existing Stands	<i>Not Quantified</i>					Pending
AFW-10	Expanded Use of Wood Products for Building Materials	<i>Not Quantified</i>					Pending

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		2010	2020	Total 2007-2020			
AFW-11	Programs to Promote Local Food and Fiber	<i>Not Quantified</i>					Pending
AFW-12	Enhanced Solid Waste Recovery and Recycling	<i>Not Quantified</i>					Pending

Note: Italicized text reflects questions for or items still under consideration by the TWG as it continues its work on elaborating option descriptions.

AFW-1 Agricultural Soil Carbon Management Programs

Policy Option Description

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. 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.

Policy Option Design

Goals: Montana should adopt programs to increase the acres of cropland managed using best management practices, including conservation/no tillage practices, by 50%. Currently there are approximately 18 million acres of cropland in Montana. Three million acres are in the Conservation Reserve Program (CRP), 7.9 million acres are in tillage, and the remaining 7.1 million acres are in summer fallow. A total of 5.5 million acres are in no-till (1.9 million acres) and chemfallow (3.6 million acres). The acreage that could be used to sequester atmospheric carbon dioxide would be the remaining 9.5 million acres, including the 1.7 million acres currently managed by mulch-till practices that sequester a lesser fraction of carbon from the atmosphere.

An organic component is also included in this policy design pending an assessment of the GHG benefits. Compared to no tillage systems, organic farming uses extensive tillage to manage weeds and to terminate cover crops (leading to GHG dis-benefits). However, organic farming also does not use pesticides/herbicides and synthetic fertilizers (leading to GHG benefits). Organic farming acreage is increasing at the following projected rates: 126,450 acres in 2005; 215,768 acres in 2010; 305,086 acres in 2015; and, 394,404 acres in 2020. The initial goal will be to increase the organic acreage 15% above projected levels in 2015 and to 50% above 2025 projected levels.

Timing: The policy seeks a 15% increase in acres of cropland brought into no-till management practices from 2007-2015, or an additional 0.9 million acres, and an additional 35% increase in acres by 2025, or 1.9 million acres, for a total increase of 2.8 million acres in no-till/conservation tillage. This seems to be a reasonable goal considering that 1.7 million acres already in mulch-till practice could be brought into the no-till practices with incentives.

The policy also seeks an increase in organic farming acreage of 15% above the projected acreage in 2015 and 50% above the levels projected for 2025.

Parties Involved: Local Agricultural Extension Offices, Montana Conservation District Offices, USDA-NRCS field offices, Montana Salinity Control Program (Jane Holzer, who is interested in carbon credit development), National Carbon Offset Coalition (NCOC), Montana Chapter of Soil

and Water Conservation Society (Tom Pick, USDA-NRCS, Bozeman), MSU Land Resource & Environmental Sciences (LRES) program, certified crop consultants, Montana Grain Growers Association, among others.

Other: None Cited.

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

Policy Option Description

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. This option covers incentives needed to increase biodiesel production in Montana.

Policy Option Design

Goals: Produce sufficient biodiesel from Montana feedstocks, to meet 2%, 10%, and 20% of 2004 Montana petroleum diesel consumption by 2010, 2015, and 2020, respectively.

Timing: see above.

Parties Involved: MT DEQ, MT Department of Agriculture, MT Farmers Union, Resource Conservation and Development, MT Grain Growers, MT State University, MT Livestock Associations.

Other: None Cited.

AFW-3 Ethanol Production

Policy Option Description

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 MT Department of Agriculture

Policy Option Design

Goals: By 2010, achieve in-state production levels of 50 million gallons/year (mgy) of starch-based ethanol production capacity and 2 mgy of cellulosic production. By 2015, achieve in-state production of 110 mgy of starch-based and 20 mgy of cellulosic production. By 2020, achieve in-state production levels of 250 mgy starch-based and 40 mgy of cellulosic production.

Timing: see above.

Parties Involved: DEQ, Dept. of Ag, MT Farmers Union, MT Association of Ethanol Producers, Farm Bureau, Conservation Districts, MT extension service, MT Stock Growers and Wool Growers Associations, MT Grain Growers Association and MT Co-op Development Center.

Other: None Cited.

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

Policy Option Description

Agricultural lands that have been placed into conservation programs such as those in the US Farm Bill may sequester carbon dioxide as a result of implementing practices that build soil carbon over time. For example, land in the Conservation Reserve Program (CRP) is taken out of production and in the absence of tillage practices, soil carbon is sequestered over time. This policy 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.

Policy Option Design

Goals: For acreage that is being retired from conservation programs, retain these crop acres in some type of management program that protects the soil carbon.

Timing: Achieve no net conversion of acreage in conservation programs to conventional tillage by 2010. Retain no net conversion through 2020.

Parties Involved: Implementation of this option would require Governor's Office leadership in directing state conservation programs administered by the Conservation Districts Division of the Montana Department of Natural Resources and Conservation, to include USDA approved carbon sequestration planning criteria in their program literature and training of staff in order to provide technical assistance to landowners desiring to develop a carbon sequestration project for entry into the NCOC portfolio.

Additionally, the Governor's Office should seek the cooperation of federal agency staff from USDA agencies such as the Natural Resources Conservation Service, the Farm Services Agency, and the Forest Service state and private forest staff.

Other: This strategy would be a low cost option which would bring to bear the existing federal and state staff and programs in a focused approach unlike any other in the US.

AFW-5 Preserve Open Space & Working Lands

Policy Option Description

Reduce the rate at which existing crop/pasture, rangeland, and forests are converted to developed uses. The carbon sequestered in the soils and aboveground 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 vehicle miles traveled that would otherwise occur from unwise or unplanned development.

Policy Option Design

Goals: By 2020, reduce the rate that forest and agricultural lands are converted to developed use by 50% from current levels.

Timing: By 2015, reduce the rate of conversion by 25%; achieve full 50% by 2020.

Parties Involved: Montana Department of Natural Resources, Montana Fish, Wildlife, and Parks (FWP), USDA Forest Service, USDA Natural Resources Conservation Service; county governments and other political subdivisions of the state, private non-profit land trusts, non-profit organizations; AERO; MT Farmers Union and other farm groups.

Other: NRCS National Resource Inventory data (1987-2003) shows that Montana is losing (on average) over 2,000 acres of forest land and over 34,000 acres of rangeland on an annual basis. While some of that rangeland is turning into pastureland, over 13,000 acres a year (on average) are being developed or becoming other rural lands. There is potential for divestiture of over 1 million acres of industrial forestland and loss of over 5 million acres of ranchlands, with some proportion of those lands being converted to development. There were over 14,500 new subdivisions approved by local governments over the past 10 years, resulting in over 1.1 million acres of new development. Many of these (e.g., Yellowstone Mountain Club in Madison County) occur on former forest and agricultural lands. Projections are 200,000 more people in the next 20 years, with over 100,000 more homes in western Montana by 2025.

AFW-6 Forest Health Programs for Carbon Management

Policy Option Description

This policy seeks to increase forest carbon stocks through changes in management practices on existing forestland. The focus for this option is to identify elements within existing forest health programs that can be enhanced to achieve carbon benefits. These program elements would increase tree density, enhance forest growth rates, alter rotation times, or decrease the chances of biomass loss from fires, pests, and disease. Existing forest health programs could include the following: Ecosystem Health Risk Reduction Programs, Drought Management Programs, Flood and Riparian Management Programs, Watershed Management Programs, Habitat Management Programs, and Fire Management and Risk Reduction Programs. Note that there is a companion policy option (AFW-9 Improved Management and Restoration of Existing Stands) which promotes new programs for enhancing the GHG benefits on existing forested lands in Montana.

Policy Option Design

Goals: *The TWG recommends that the elements of this option be incorporated into AFW-7 through AFW-9. This is due to the overlap of those options with this option. Originally, the TWG had felt that policy to enhance the GHG benefits of existing forest programs could be looked at separately from policy aimed at new forest programs. After further analysis and discussion, the TWG does not feel that it makes sense to have separate policies for existing forest programs and for new programs.*

Timing: Under Development.

Parties Involved: Under Development.

Other: None Cited.

AFW-7 Expanded Use of Biomass Feedstocks for Energy Use

Policy Option Description

This policy seeks to expand the use of biomass energy sources (from forests, agriculture, and other biomass resources). Biomass can be used to generate renewable energy in the form of liquid fuels (such as cellulosic ethanol), or through direct combustion to generate electricity, heat, or steam (through biomass combustion). Carbon in biomass is considered biogenic under sustainable systems; carbon dioxide emissions from biomass energy combustion are replaced by future carbon sequestration. 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 lifecycle of energy requirements for producing fuels does not exceed the energy content of the renewable resource. Expanded use of biomass energy can be promoted through increasing the amount of biomass produced and used for renewable energy, and providing incentives for the production and use of renewable energy supplies.

Policy Option Design

Goals: Increase usage of primary source forest biomass residue for renewable energy and heat generation by 900,000 tons/year above 2006 levels by 2020. To use 10% of agricultural waste for energy production by 2020. Voluntary, incentive based programs should be used to foster the development of the industry and associated economic markets. State lands should be managed with these goals in mind.

Timing: see above.

Parties Involved: DNRC, DEQ, MSU Cooperative Extension, Public Service Commission, Electric utilities, livestock and poultry producers, farmers, forest products manufacturers, logging companies.

Other: Explore and research biomass use and availability for all forms of energy production, either 100% biomass or in combination with other feedstocks.

AFW-8 Afforestation and Reforestation Programs

Policy Option Description

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 to pre-existing conditions. Afforestation and reforestation accomplished with stocking/planting and other practices (e.g., soil preparation, erosion control, etc.) can increase carbon stocks above baseline levels and ensure conditions that support forest growth.

Policy Option Design

Goals:

- Ensure re-stocking 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, re-stock 30% of the forest lands impacted by stand replacement fires within 5 years post-fire.
- Plant 1,300 new trees in Montana communities within 5 years through programs such as DNRC’s Urban Forestry program.

Timing: By 2010, ensure re-stocking on 15,000 acres of accessible lands impacted by stand replacement fires since year 2000. By 2020, ensure restocking on the remaining 55,000 acres. As stated in the goal above, for future fires re-stock 30% of the high severity burned forest lands within 5 years post-fire.

Parties Involved: Montana Department of Natural Resources, USDA Forest Service, Bureau of Land Management, Bureau of Indian Affairs, Confederated Salish and Kootenai Tribe, USDA Natural Resources Conservation Service; Private industry, Non-industrial private landowners.

Other: Since 2000, over 3.3 million acres have burned in Montana. It is roughly estimated that one-third of these have been forested acres and of the forested acres about one third have been high severity burns that require some level of restocking. Some of these areas have been replanted; however, there are an estimated 70,000 acres still requiring replanting. In addition, each year there are an estimated 20,000 acres of forests burned with high severity (stand replacement fires). Together, there is a need for re-stocking on about 25,000 acres/yr on federal, state, and private lands in Montana between 2007 and 2020 to meet the goals of this policy. Reforestation costs are roughly \$180 per acre.

A 2007 study (Potter et al.) estimates there are over 69 million acres of low-production rangelands in Montana that could be afforested to result in carbon gains. More realistically, only 8.9 million acres are available for afforestation due to precipitation and soil nutrient limitations. The potential results of afforesting 8.9 million acres could be the sequestration of over 15 million tons of carbon annually.

However, a question remains on the efficacy of afforestation in Montana. The best possible means for afforestation could remain with the development of wind break and shelter belts. As currently envision, this policy only covers reforestation efforts on high severity burned areas and some urban forestry goals.

AFW-9 Improved Management and Restoration of Existing Stands

Policy Option Description

This policy seeks to increase forest carbon stocks through changes in management practices on existing forestland. In contrast to the companion policy AFW-6, 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 to serve as nutrient inputs to the forest. Practices may include management of rotation length, biomass density, biomass energy use, and sustainable use of wood products.

Policy Option Design

Goals: Initiate programs to increase forest productivity by XX% on 1 million acres of private and state forest lands by 2020.

Timing: Accelerate private forest landowner education programs by 2010. Implement forest improvement projects on 77,000 acres of state and private forest lands per year.

Parties Involved: Montana Department of Natural Resources, Montana Fish, Wildlife, and Parks, USDA Forest Service, USDA Natural Resources Conservation Service; Bureau of Land Management, Bureau of Indian Affairs and Tribal Governments, county governments and other political subdivisions of the state, private non-profit land trusts, non-profit organizations.

Other: A 2001 study (Fiedler et al.) estimated that 7.5 million acres of Montana's forestlands should be considered for treatment because they are in the moderate or high fire hazard condition in short-term fire-adapted ecosystems. Treating these stands would reduce fire hazard potential, improve forest health and diversity, and restore stand conditions. In 2005, over 1.2 million acres of Montana's forestlands (all ownerships) were affected by insect and diseases.

AFW-10 Expanded Use of Wood Products for Building Materials

Policy Option Description

This policy seeks to enhance the use and lifetime of durable wood products. 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 last for 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 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 lifecycle for wood products enhances greenhouse gas benefits.

Policy Option Design

Goals: The CCAC recommends that Montana adopt programs to expand use of wood products by 5% over current levels.

Timing: Increase usage by 2% by 2010 and 5% by 2020, above current trends.

Parties Involved: Building material suppliers, wood product industries, recycled building materials sellers, etc. All state agencies lead through example.

Other: As needed, identify incentives that encourage expanded usage of wood products for building, such as giving state tax credits for the use of wood product in building “good sense” homes. Conduct an inventory of needs for durable wood product utilization in Montana. [Add data on current levels]

AFW-11 Programs to Promote Local Food and Fiber

Policy Option Description

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 US 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.

Policy Option Design

Goals: 30% of food consumed in Montana is grown, harvested and processed in Montana.

Timing: For food, 20% by 2010, 30% by 2020.

Parties Involved: Promotion by MT Dept of Ag, Farm Bureau, Stock Growers, Montana Cattlemen's Association, Grow Montana, AERO, NCAT, sheep producers, wool growers, grain growers, etc.

Tracking by MT Dept of Ag.

Other: Montana-based food systems are a realistic vision.

- In 1950, 70% of the food Montanans ate was grown in Montana.
- Through the 1930s, food processing was Montana's number one employer.
- In the spring of 2003, The University of Montana-Missoula responded to student demand by launching the Farm to College Program, purchasing safflower oil, beef, bread, dairy products, and fruits and vegetables from Montana producers. In the past two years, the program bought more than \$500,000 from in the state. In the same period, the University's overall food costs – as a percentage of its food service budget – decreased.
- Notes to reviewers: I am suggesting a food goal based on historic information. In 1950, 70% of the food Montanans ate was grown in Montana. Today it is 15%. If we sourced 30% instead of 15% of our food in-state, an additional \$450 million would go directly to our food producers and the associated carbon dioxide burned as a result of transportation of these products would be saved.

AFW-12 Enhanced Solid Waste Recovery & Recycling

Policy Option Description

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.

Policy Option Design

Goals: Increase Montana solid waste recycling rates to 17% by 2008, 19% by 2011, 22% by 2015, (targets from the Montana Integrated Waste Management Plan) and 25% by 2020 using a variety of methods including source reduction, reuse, recycling, and composting.

Timing: see above.

Parties Involved: DEQ, MACO, MSU Extension, local governments, other landfill operators (private), recycling firms.

Other: None Cited.