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Brief Description of Catalog of State Actions Agriculture, Forestry, and Waste Management Options

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(Note that this listing is incomplete and will be developed further during the Technical Work Group [TWG] process. Recently enacted policies and programs in Minnesota are listed in the policy options catalog notes. Additional details will be added to this document under each of the option descriptions, as they are developed.)

AFW-1 PRODUCTION OF FUELS AND ELECTRICITY

1.1 Expanded Use of Biomass Feedstocks for Electricity or Steam Production

Increase the amount of biomass available for generating electricity and displacing the use of fossil energy sources. Local electricity or steam production yields greatest net energy payoff.

Recent Actions in MN:

1.2 In-State Liquid Biofuels Production

Increase production of ethanol and/or biodiesel fuel from agriculture and/or forestry feedstocks (raw materials) to displace the use of fossil diesel. Promote the development of cellulosic ethanol technologies and ethanol production systems that use renewable fuels to improve the embedded energy content of ethanol. Increased production and consumption in state give the highest benefits.

Recent Actions in MN:

1.3 Manure Digesters/Other Waste Energy Utilization

Reduce the amount of methane emissions from livestock manure by installing manure digesters on livestock operations. Energy from the manure digesters is used to create heat or power, which offsets fossil fuel-based energy production and the associated greenhouse gas (GHG) emissions.

Recent Actions in MN:

AFW-2 AGRICULTURE – Livestock

2.1.a Manure Management: Manure Utilization

2.1.b Manure Management: Manure/Methane Capture

Implement manure management practices that reduce GHG emissions associated with manure handling and storage. Potential practices include but are not limited to manure composting (to reduce methane emissions) and improved methods for application to fields (for reduced nitrous oxide emissions). Application improvements include incorporation into soil, instead of surface spray/spreading.

Recent Actions in MN:

2.2 Changes in Animal Feed

Livestock emit methane directly as a result of digestive processes (enteric fermentation). Research suggests that changes in the energy content of feed and other dietary changes can reduce methane emissions from enteric fermentation. By optimizing nitrogen (protein) utilization in the feed, nitrogen levels in the manure can be reduced, which in turn reduce the potential for nitrous oxide emissions.

Recent Actions in MN:

2.3 Rotational Grazing/Improve Grazing Crops and/or Management

Heavy grazing can cause significant soil disturbance and result in carbon losses from soils. Rotational grazing where animals are moved from field-to-field on a regular basis reduces soil disturbance and maintains soil carbon levels. Rotational grazing also can improve plant vigor and enhances soil carbon levels.

Recent Actions in MN:

2.4 Utilize Biofilters to Control CAFO Emissions

The utilization of collection and control equipment such as biofilters at confined animal feeding operations (CAFOs) can reduce methane emissions.

Recent Actions in MN:

2.5 Increase Pasturing and Lower Densities

Increasing the area over which manure is deposited has the potential to reduce emissions of methane, since the manure is more likely to be decomposed aerobically versus anaerobically.

Recent Actions in MN:

AFW-3 AGRICULTURE – CROP PRODUCTION

3.1 Soil Carbon Management

The amount of carbon stored in the soil can be increased by the adoption of practices such as conservation and no till cultivation. Reducing summer fallow and increasing winter cover crops are complimentary practices that reduce the need for conventional tillage. In addition, the application of biochar (i.e., charcoal) may also increase soil carbon content and stabilize soil carbon. By reducing mechanical soil disturbance, these practices reduce the oxidation of soil carbon compounds and allow more stable aggregates to form. Other benefits include reduced wind and water erosion, reduced fuel consumption, and improved wildlife habitat.

Recent Actions in MN: Blue Earth River Basin Initiative ran a project called the Third Crop Initiative. This initiative aims to replace annual crops with perennial crops.

3.2 Nutrient and Water Management

Improve the efficiency of fertilizer use and other nitrogen-based soil amendments through implementation of management practices. Excess nitrogen not metabolized by plants can leach into groundwater and/or be emitted to the atmosphere as N₂O. By managing and improving water consumption and nutrients spread on crops, there will be a minimal loss of carbon from the soil. Reduced water consumption can result in lower energy use for water pumping. Better nutrient utilization can lead to lower nitrous oxide emissions from run-off.

Recent Actions in MN:

3.3 Technology Improvements to Increase Efficiency

New technologies and cultivation methods have the potential to reduce GHG emissions when fossil fuel or electricity consumption can be reduced. Auto-steer guidance systems are an example of technologies that can increase efficiency and reduce fuel use. Note that this option has a similar counter-part in Option 5.1.

Recent Actions in MN:

AFW-4 AGRICULTURE-LAND USE CHANGE

4.1 Land Use Management That Promotes Grassland Cover

Convert marginal agricultural land used for annual crops to permanent cover such as grassland/rangeland, orchard, or forest, where the soil carbon and/or carbon in biomass is higher under the new land use. Includes opportunities to keep CRP lands covered in perpetuity.

Increased demand for corn-based ethanol and biodiesel feedstocks can act as an incentive for converting grassland to cropland. Adopt mechanisms to prevent these acres from either returning to conventionally tilled production or to suburban/urban development.

Recent Actions in MN:

4.2 Preserve Open Space/Agricultural Land

Reduce the rate at which agricultural lands are converted to developed uses, while protecting private property rights and responsibilities. This retains the above- and below-ground carbon on these lands, as well as the carbon sequestration potential of these lands. Transportation emissions will be reduced indirectly through more efficient development and lower vehicle use. Agricultural land conversion may be prevented through conservation land grants and conservation easements facilitated through non-profit land preservation organizations.

Recent Actions in MN:

AFW-5 AGRICULTURE-FARMING PRACTICES

5.1 Reductions in On-Farm Energy Use

Renewable energy can be producing and used on-site at agriculture operations. For example, installation of solar or wind power, use of hydro-powered generators for irrigation, and converting diesel farm equipment to LNG/CNG or hybrid technology will reduce carbon dioxide emissions by displacing the use of fossil based fuels.

Recent Actions in MN:

5.2 Organic Farming

Provide incentives to farmers for growing organic products. Organic farming may result in reduced GHG emissions compared to conventional farming, depending on the specific practices implemented (e.g., use of no-till cultivation and fewer chemical inputs).

Recent Actions in MN:

5.3 Programs to Support Local Farming/Buy Local

Promote the production and consumption of locally produced agricultural goods, which displace the consumption of those transported from other states or countries. GHG reductions occur from reduced transportation-related emissions.

Recent Actions in MN:

AFW-6 FORESTRY – PRODUCTION OF FUELS AND ELECTRICITY IN FORESTRY

6.1 Expanded Use of Biomass Feedstocks for Electricity, Heat and Steam Production

Increase the amount of biomass available from forests for generating electricity and displacing the use of fossil energy sources.

Recent Actions in MN: The Laurentian Energy Authority Biomass Energy Project has provided \$150,000 to the Minnesota Forest Resources Council (MFRC) to establish guidelines for sustainable removal of woody biomass from forests for energy, and to the MN DNR to develop similar guidelines for brushlands and open lands. This project has produced a partnership between public utilities in the Cities of Virginia and Hibbing. Public utilities in these

cities have converted formerly coal-fired power plants to power plants that are now 75% fueled by woody biomass.

Minnesota currently does not allow roundwood timber to be used for energy generation, as this wood can be used to make long-lived wood products with long term sequestration potential.

6.2 In-State Liquid Biofuels Production

Increase production of ethanol and/or biodiesel fuel from agriculture and/or forestry feedstocks (raw materials) to displace the use of fossil diesel. Promote the development of cellulosic ethanol technologies and ethanol production systems that use renewable fuels to improve the embedded energy content of ethanol. Increased production and consumption in state give the highest benefits.

Recent Actions in MN:

6.3 Improved Energy Capture from Wood Waste Combustion

Reduce emissions and increase heat efficiency from heat sources such as wood burning stoves and furnaces.

Recent Actions in MN:

6.4 Improved Commercialization of Biomass Gasification and Combined Cycle

Improve the rate of technology development and market deployment of biomass gasification and combined cycle (BGCC) technologies. These technologies expand the application of renewable fuels derived from biomass.

Recent Actions in MN:

AFW-7 FORESTRY – BIOMASS PROTECTION AND MANAGEMENT

7.1 Forest Protection – Reduced Clearing and Conversion to Nonforest Cover

Reduce the rate at which existing forest are cleared and converted to developed uses. Much of the carbon stored in forest biomass and soils can be lost as a result of such a land use conversion.

Recent Actions in MN: The Minnesota Forest Legacy Partnership is a group of public and private business and non-profit interests engaged in promoting large-scale forest conservation easements in northern and central Minnesota. A 51,000 acre forest easement in Koochiching and Itasca County is being actively pursued, and two additional easements comprising a total of 76,000 acres have been proposed in Koochiching County (located on the Ontario border in north central MN). Most of the funding for purchasing the 51,000 easement has been obtained from private foundation, other private, and state sources, and funding for the additional easements is being sought.

7.2 Urban Forestry

Maintain and improve the health and longevity of trees in urban and residential areas to protect and enhance the carbon stored in tree biomass. Indirect emissions reductions may also occur by reducing heating and cooling needs as a result of planting shade trees.

Recent Actions in MN:

7.3 Afforestation/Reforestation

Establish forests on land that has not historically been forested (“afforestation”), for example, on agricultural lands. Promote forest cover and associated carbon stocks by regenerating or establishing forests in areas with little or no present forest cover (“reforestation”). In addition, implement practices such as soil preparation, erosion control, and stand stocking to ensure conditions that support forest growth.

Recent Actions in MN: The Board of Soil and Water Resources (BSWR) has been directed by the 2007 MN legislature to administer \$500k in grants to conduct site level ecological research and assessments, a clean energy program, and technical teams for native seed harvesting and working lands initiatives.

7.4 Forest Management for Carbon Sequestration

Forest management activities that promote forest productivity and increase the rate of carbon dioxide sequestration in forest biomass and soils and in harvested wood products. Practices may include: increased stocking of poorly stocked lands, age extension of managed stands, thinning and density management, fertilization and waste recycling, expand short rotation woody crops (for fiber and energy), expanded use of genetically preferred species, modified biomass removal practices, fire management and risk reduction, pest and disease management.

Recent Actions in MN:

7.5 Mitigation of Forest Loss and GHG Emissions Due to Wildfire

Programs that reduce the potential for and severity of wildfires also reduce GHG emissions by lowering the forest carbon lost during the fire in addition to the subsequent losses of carbon sequestration potential in the area impacted by wildfire.

Recent Actions in MN:

7.6 Mitigation of Forest Loss Due to Insect Blight

Programs that reduce insect damage to forests also reduce GHG emissions by maintaining the carbon sequestration achieved in healthy forests.

Recent Actions in MN:

AFW-8 FORESTRY – WOOD PRODUCTS AND WASTE

8.1 Improved Mill Waste Recovery – Utilization of Sawmill Residues

Improve treatment and cleaning of waste materials from paper mills, which can then be re-used to manufacture additional wood products. Ensure that sawmill byproducts are recycled or beneficially used for energy.

Recent Actions in MN:

8.2 Improved Logging Residue Recovery

Use more efficient logging methods to fully utilize harvested trees, which will minimize carbon losses from wood damaged during harvesting and maximize the potential for carbon sequestration in harvested wood products. Process the logging remains efficiently.

Recent Actions in MN:

8.3 Expanded Use of Wood Products for Building Materials

Increase the amount of renewable wood products used for residential and commercial building. The use of wood products in place of other building materials can increase carbon sequestration in wood products and displace GHG emissions associated with processing high-energy input materials such as steel, plastic and concrete. Reduction potential is enhanced by promoting the use of locally grown wood due to lower transport-associated emissions.

Recent Actions in MN:

AFW-9 WASTE MANAGEMENT – WASTE MANAGEMENT STRATEGIES

9.1 Advanced Recycling and Composting

Increase recycling and reduce waste generation in order to limit greenhouse gas emissions associated with landfill methane generation and with the production of raw materials. Recently, an area of focus in the solid waste industry has been in increase recycling of organic wastes (lawn and garden waste, food waste, wood, paper, etc.) using different conversion technologies, including composting, anaerobic digestion, or hybrids of these technologies.

Increase recycling programs, create new recycling programs, provide incentives for the recycling of construction materials, develop markets for recycled materials, and increase average participation/recovery rates for all existing recycling programs.

Recent Actions in MN:

9.2 Promotion of Bioreactor Technology

A bioreactor landfills is essentially in-landfill composting activity at a Subtitle D sanitary landfill in which liquid, temperature, and air (for aerobic processes), are managed in a controlled manner to achieve rapid stabilization of the food, greenwaste, and paper-waste constituents. To optimize the rapid waste stabilization of these wastes, moisture, gas composition, gas flow, and

temperature must be carefully maintained and monitored. Bioreactor technology is used to accelerate waste stabilization, enhance gas production and collection, control leaching, reduce volume, and minimize long-term liability of waste.

Recent Actions in MN:

9.3 Source Reduction Strategies

Reduce the volume of waste from residential, commercial, and government sectors through programs that reduce the generation of wastes. Reduction of generation at the source reduces both landfill emissions as well as upstream production emissions.

Recent Actions in MN:

9.4 Resource Management Contracting

Unlike traditional solid waste service contracts, resource management (RM) compensates waste contractors based on performance in achieving an organization's waste reduction goals rather than the volume of waste disposed. As a result, RM aligns waste contractor incentives with the goals to explore innovative approaches that foster cost-effective resource efficiency through prevention, recycling, and recovery.

Recent Actions in MN:

9.5 Waste Coal Recapture

Promote research and implementation of recovering waste coal. Waste coal is a usable material that is a byproduct of previous coal processing operations. Emissions are reduced relative to the mining of new coal.

Recent Actions in MN:

9.6 Prevent Landfilling of Unprocessed Organic Material

Reduces methane emissions associated with landfilling by reducing the biodegradable fraction of waste emplaced. Often included as an element of advanced recycling and composting programs.

Recent Actions in MN:

9.7 Promotion of New Technologies for Waste Energy Conversion

These processes include biomass gasification and pyrolysis. A range of renewable products can be developed from these processes, including gaseous and liquid fuels, biochar, and chemical products.

Recent Actions in MN:

AFW-10 WASTE MANAGEMENT – LANDFILL GAS STRATEGIES

10.1 Flare Landfill Methane at Non-NSPS (Smaller) Sites

Encourage smaller landfills that do not fall under environmental protection regulations to capture and flare methane gas. Flares are used to safely combust toxic and volatile gases from landfills and they convert methane gas, which has a relatively high global warming potential, to carbon dioxide.

Recent Actions in MN:

10.2 Methane and Biogas Energy Programs

Encourage and promote the use of anaerobic digesters and energy recapture for waste materials other than municipal solid waste at landfills (e.g. food processing waste). These projects will help prevent the emission of methane while producing clean energy. Anaerobic digesters make a two-fold contribution to climate protection: the usual unchecked discharge of methane into the atmosphere is prevented, and the burning of fossil fuels is replaced with renewable energy (biogas).

Recent Actions in MN:

10.3 Landfill Methane Energy Programs

Use the renewable energy created at landfills by anaerobic digesters (methane) to make electric power, space heat, or liquefied natural gas.

Recent Actions in MN:

AFW-11 WASTE MANAGEMENT – WASTEWATER MANAGEMENT ACTIVITIES

11.1 Energy Efficiency Improvements

Provide incentives for efficiency improvements. Encourage the set up of energy policies, energy audits, and energy cost tracking. Identify and implement energy improvements such as using energy efficient equipment and generating on-site power (e.g. solar power).

The term “efficiency improvements” is defined, within the scope of wastewater management activities, as:

- Conversion of secondary aeration processes to fine bubble diffusion and optimization of oxygen transfer efficiencies.
- Research and development of diffuser cleaning protocols.
- Research and development to increase removal of chemical oxygen demand (COD) in primary treatment tanks and clarifiers.
- Evaluate steam usage in plant processes and biofilters. Optimize use and find alternatives.
- Research and development of options to optimize denitrification in secondary treatment.

Financial and performance analyses that may be conducted to assist the implementation of this option include:

- Creation of a leveraged state revolving loan fund program to capitalize energy efficiency in municipal waste water treatment plants (WWTPs).
- Establish a “fair cost of service” pricing tariff for transmission and distribution of remotely sited wind power.
- Facilitate optimization of energy management by requiring all utility meter data to be available without extra charge on a monthly basis.
- Provide incentives to install interval meters to get whole load profile and make data available online and in real-time.
- Conduct benchmarking of energy use per million gallons treated in Minnesota to showcase good and deficient energy performance in this specific climate.

Recent Actions in MN: Xcel Energy operates a process efficiency program; a sub-program within the mandated conservation improvement programs.

11.2 Lower Waste Processing Needs

Develop and implement best practices for lowering water consumption and lowering waste production in the industrial, commercial, and residential sectors. Encourage and create incentives for research and development on methods/technologies to reduce water consumption and waste production. Provide education to reduce water consumption and waste production. Lower water consumption and waste production lead to lower GHG emissions.

Recent Actions in MN:

11.3 Install Digesters and Turbines or Engines

Provide incentives to install anaerobic digesters to treat municipal waste and create methane. Install turbines or reciprocating engines to generate electricity from the methane. Reductions occur via methane control and offsetting fossil energy use.

Recent Actions in MN:

11.4 Restoration of Soil Organic Carbon from Application of WWTP Biosolids

Evaluate the restoration and sequestration of carbon in soil through land application of biosolids, the organic residuals from wastewater treatment plants (WWTPs). Research and develop a mechanism to remove algae from WWTP ponds and apply solids to restore/sequester soil carbon.

Recent Actions in MN:

11.5 Heat Recovery

Provide incentives to recover heat from wastewater influent or effluent through the use of heat pumps.

Recent Actions in MN:

11.6 Algae and Bio-Oils

Provide financial incentive to research the production of bio-oils from algae grown in wastewater effluents (would reduce carbon, nitrogen and phosphorus).

Recent Actions in MN: