



## Brief Description of Catalog Items Agriculture, Forestry, and Waste Management Technical Work Group

*(Note: This listing is incomplete and will be fleshed out during the Technical Work Group (TWG) process. TWG members are encouraged to provide input to the TWG facilitators on existing policies and programs, where relevant. Recently enacted policies and programs in Kansas are listed where relevant in the policy options catalog notes. Additional details will be added to this document under each of the option descriptions, as they are provided.)*

### AFW-1. AGRICULTURE – PRODUCTION OF ENERGY AND MATERIALS

#### 1.1 Expanded Utilization of Biomass Feedstocks for Electricity, Heat, 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 the greatest net energy payoff. Note: This is related to AFW-6.1 (forest biomass) and AFW-9.1 (waste biomass).

**Recent actions in Kansas:** The state’s largest utility, Topeka-based Westar, announced on February 26, 2007, a request for proposals (RFP) for 500 megawatts (MW) of renewable energy. While this target may be largely comprised of wind energy, the RFP is not specific to wind and may include biomass resources.

With Executive Order 08-04, the Governor instructed the Kansas Energy Council to “collect and compile information pertaining to energy resources, including wind and biomass, in the state, as well as the availability, production and use of energy in the state.”

The Sunflower Integrated Bioenergy Center, originally planned to break ground in 2007, is a joint venture between the Sunflower Electric Power Corporation and the National Institute for Strategic Technology Acquisition and Commercialization (NISTAC). This project is expected to include a coal-fired power plant, an anaerobic digester, an algae reactor, a biodiesel plant, an ethanol plant, and a dairy farm. The intention of the Sunflower Integrated Bioenergy Center is to concentrate many renewable energy facilities in order to facilitate the reuse of by-products, reduce transportation costs, and improve cost-effectiveness. This facility will produce various energy commodities, including methane, electricity, ethanol, biodiesel, and electricity. More information may be found at: <http://www.sunflower.net/pub/BioEnergyNewsletter070710.pdf>.

#### 1.2 In-state Liquid Biofuels Production

Increase production of ethanol and/or biodiesel fuel from agriculture feedstocks and/or municipal solid and other waste (raw materials) to displace the use of fossil fuel. 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

gives the highest benefits. Note: This is related to AFW-6.2 (forestry biofuels) and AFW-9.2 (waste biofuels).

**Recent actions in Kansas:** On January 14, 2008, in her State of the State address, the Governor recommended the creation of a Bioenergy Research Grant Program to spur development of innovative technologies producing the most cost-efficient renewable fuels. She also charged the Kansas Bioscience Authority with developing an aggressive plan for bioenergy technology and production, aimed at producing 20% of the nation's alternative fuel needs.

The Sunflower Integrated Bioenergy Center, originally planned to break ground in 2007, is a joint venture between the Sunflower Electric Power Corporation and the NISTAC. This project is expected to include a coal-fired power plant, an anaerobic digester, an algae reactor, a biodiesel plant, an ethanol plant, and a dairy farm. The intention of the Sunflower Integrated Bioenergy Center is to concentrate many renewable energy facilities in order to facilitate the reuse of by-products, reduce transportation costs, and improve cost-effectiveness. This facility will produce various energy commodities, including methane, electricity, ethanol, biodiesel, and electricity. More information may be found at:

<http://www.sunflower.net/pub/BioEnergyNewsletter070710.pdf>.

### 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. May consider new technologies as well, such as plasma arc technology. The joint U.S. Department of Agriculture/U.S. Environmental Protection Agency AgSTAR program maintains extensive information on manure management technologies, including anaerobic digestion. More information may be found at: <http://www.epa.gov/agstar/>.

**Recent actions in Kansas:** The Sunflower Integrated Bioenergy Center, originally planned to break ground in 2007, is a joint venture between the Sunflower Electric Power Corporation and the NISTAC. This project is expected to include a coal-fired power plant, an anaerobic digester, an algae reactor, a biodiesel plant, an ethanol plant, and a dairy farm. The intention of the Sunflower Integrated Bioenergy Center is to concentrate many renewable energy facilities in order to facilitate the reuse of by-products, reduce transportation costs, and improve cost-effectiveness. This facility will produce various energy commodities, including methane, electricity, ethanol, biodiesel, and electricity. More information may be found at: <http://www.sunflower.net/pub/BioEnergyNewsletter070710.pdf>.

### 1.4 Improving Energy Capture From Corn and Biomass Heat

Reduce emissions and increase heat efficiency from heat sources, such as corn and other bio feedstocks. Continue to advance the biomass heating industry. Note: May overlap with the Residential, Commercial, and Industrial (RCI) TWG policy options related to fuel sources.

**1.5 Expand Production/Use of Bio-Based Materials and Chemicals**

Increase the amount of renewable products and chemicals produced and used, including building materials that reduce GHG emissions over conventional petroleum-based products.

**1.6 Improved Commercialization of Biomass Conversion Technologies**

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

**AFW-2. AGRICULTURE—LIVESTOCK****2.1.1 Manure Management—Manure Utilization**

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), manure crusting, addition of additives to decrease the amount of nutrients lost and improve methods for application to fields (for reduced nitrous oxide [N<sub>2</sub>O] emissions). Application improvements include incorporation into soil instead of surface spraying or spreading.

**2.1.2 Manure Management—Manure/Methane Capture**

Implement digester and energy recovery projects at confined animal feeding operations (CAFOs) both to reduce methane emissions and to utilize the energy to displace fossil fuels. (To date, most of these projects have been implemented at dairies and swine operations.)

**2.1.3 Manure Management—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 enhance soil carbon levels.

**2.1.4 Manure Management—Utilize Biofilters To Control CAFO Emissions**

The utilization of collection and control equipment, such as biofilters at CAFOs, can reduce methane emissions.

**2.1.5 Manure Management—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 than anaerobically.

## 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. Optimizing nitrogen (protein) utilization in the feed can reduce nitrogen levels in the manure, which in turn reduces the potential for N<sub>2</sub>O emissions.

## 2.3 Technology Improvements to Increase Water Conservation

Encourage closed-loop systems when siting new construction.

# 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 such practices as conservation, no-till cultivation, and crop rotation. Reducing summer fallow and increasing winter cover crops are complementary 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 Kansas:** Kansas State University (KSU) professor of agronomy Chuck Rice is a well-known scientist who contributed his expertise on agricultural sequestration to the United Nations Intergovernmental Panel on Climate Change reports. KSU sponsors the Soil Carbon Center (<http://soilcarboncenter.k-state.edu/index.html>), which disseminates information regarding agricultural carbon sequestration. KSU also participates in the Consortium for Agricultural Soils Mitigation of Greenhouse Gases, sponsored by Colorado State University (<http://www.casmgs.colostate.edu/>). Many Kansas farmers are involved in no-till practices that sequester carbon and provide revenue through the generation of carbon offset credits. There is intense and widespread interest in the opportunities for Kansas in this area.

## 3.2 Nutrient Management

Improve the efficiency of fertilizer use and other nitrogen-based soil amendments through implementation of management practices and Generally Accepted Agriculture Management Practices (GAAMP). Excess nitrogen not metabolized by plants can leach into groundwater and/or be emitted to the atmosphere as N<sub>2</sub>O. Better nutrient utilization can lead to lower N<sub>2</sub>O emissions from runoff.

## 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, as is auto swath technology, which uses global positioning system (GPS)-based

technology to automatically turn the spray boom sections on or off when coming to an area of the field that has been sprayed or needs to be sprayed. Auto swath technology can be used for planting, fertilizing, and other operations. On odd-shaped fields, it can result in a 3%–5% savings. See [http://www.agleader.com/products.php?Product=directcommand\\_1](http://www.agleader.com/products.php?Product=directcommand_1).

Variable-rate fertilizing and liming are also becoming more popular among farmers. The farmer has a local co-op grid sample the field, and then variable-rate technology applies the fertilizer or lime in the areas of the field that need it. The areas of the field that do not need fertilizer or lime have none applied, which can result in a 50%–60% reduction in the amount of lime or fertilizer needed. See [http://www.agleader.com/products.php?Product=directcommand\\_g](http://www.agleader.com/products.php?Product=directcommand_g).

GreenSeeker normalized difference vegetation index (NDVI) is a new technology that is still in its early testing stages, but it looks promising. A farmer applies 50%–70% of his nitrogen at planting and then, in season, uses GreenSeeker NDVI technology to apply the amount of nitrogen the corn or wheat plant needs when it is growing—a more efficient way of applying nitrogen that will result in less nitrogen being overapplied. See <http://www.ntechindustries.com/greenseeker-RT200.html>.

Improvements may also encompass newer machines with better fuel efficiency, larger planters and combines, and genetically modified seed. Note that this option has a similar counterpart in AFW-5.1 (Increase On-Farm Energy Production and Efficiency).

### **3.4 Water Management**

Improve the efficiency of water use through implementation of Best Management Practices (BMPs) and Generally Accepted Agricultural and Management Practices (GAAMP). Excess water can lead to nitrogen runoff, with subsequent emission to the atmosphere as N<sub>2</sub>O. Managing and improving water consumption and nutrients spread on crops will result in a minimal loss of carbon from the soil. Reduced water consumption can result in lower energy use for water pumping.

### **3.5 Drainage Management**

Improve drainage on agricultural lands to prevent ponding, which can lead to anaerobic soils and GHG emissions (methane).

### **3.6 Biotechnology Applications for GHG Mitigation**

Use biotechnology advances to increase yield per acre and reduce the amount of fertilizer and other inputs needed to produce crops important to Kansas.

## **AFW-4. AGRICULTURE—LAND-USE CHANGE**

### **4.1 Land-Use Management That Promotes Permanent 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 Conservation Reserve Program (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 returning either to conventionally tilled production or to suburban/urban development.

#### 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 belowground carbon on these lands, as well as their carbon sequestration potential. 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 nonprofit land preservation organizations.

**Recent actions in Kansas:** Eleven Kansas mayors have joined the U.S. Conference of Mayors Climate Protection Agreement. One of the measures among the mayors acceding to this partnership is to adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walkable urban communities.

### AFW-5. AGRICULTURE—FARMING PRACTICES

#### 5.1 Increase On-Farm Energy Production and Efficiency

Renewable energy can be produced and used on site at agriculture operations. For example, installing solar or wind power; using hydro-powered generators for irrigation; converting diesel farm equipment to liquefied natural gas, compressed natural gas, or hybrid technology; increasing on-farm use of biofuels and other renewables; expanding farm energy audit programs; and updating machinery, equipment, and engines will reduce carbon dioxide (CO<sub>2</sub>) emissions by displacing the use of fossil-based fuels.

**Recent actions in Kansas:** The Kansas Facility Conservation Improvement Program (FCIP) is in its second generation at the Kansas Energy Office. The new contract for the FCIP includes 10 prequalified energy service companies, and a strong focus on environmental design and responsibility, integrating such factors as the United States Green Building Council's LEED (Leadership in Energy and Environmental Design™) certification. To date, the FCIP has completed over \$138.7 million in energy efficiency improvements in nearly 30 million square feet of public building space, avoiding nearly \$11 million in utility costs annually. Using energy savings performance contracting, the FCIP has allowed many public-sector customers the opportunity to fund capital improvement projects and save millions of dollars in utility costs.

Eleven Kansas mayors have joined the U.S. Conference of Mayors Climate Protection Agreement. One of the measures among the mayors acceding to this partnership is to make energy efficiency a priority through building code improvements.

## 5.2 Promotion of Farming Practices That Achieve GHG Benefits

Provide incentives to farmers for using production processes that achieve net GHG benefits. For example, use biotech crops or some organic farming practices that could achieve reduced GHG emissions compared to conventional farming, depending on the specific practices implemented (e.g., use of no-till cultivation and fewer chemical inputs).

## 5.3 Programs To Support Local Farming/Buy Local

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

## 5.4 Promotion of Urban Agriculture, Community Gardens, and Green Roofs

Promote participation in urban agriculture programs that reduce GHGs by sequestering carbon, and reduce cooling costs by mitigating urban heat islands. Programs also reduce transportation-related emissions by reducing food miles for urban consumers. Promote urban agriculture on vacant or abandoned lands. Need to be sensitive to greenbelt taxing issues.

## AFW-6. FORESTRY—PRODUCTION OF ENERGY AND MATERIALS

### 6.1 Expanded Use of Forest 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. Note: This is related to AFW-1.1 (agricultural biomass) and AFW-9.1 (waste biomass).

**Recent actions in Kansas:** The state's largest utility, Topeka-based Westar, announced on February 26, 2007, an (RFP) for 500 MW of renewable energy. While this target may be largely comprised of wind energy, the RFP is not specific to wind and may include biomass resources.

With Executive Order 08-04, the Governor instructed the Kansas Energy Council to “collect and compile information pertaining to energy resources, including wind and biomass, in the state, as well as the availability, production and use of energy in the state.”

### 6.2 In-State Liquid Biofuels Production

Increase production of ethanol and/or biodiesel fuel from forestry feedstocks (raw materials) to displace the use of fossil fuel. Promote the development of cellulosic ethanol technologies and ethanol production systems that use renewable fuels to improve the embedded energy content of ethanol. Increased in-state production and consumption give the highest benefits. Note: This is related to AFW-1.2 (agricultural biofuels) and AFW-9.2 (waste biofuels).

**Recent actions in Kansas:** On January 14, 2008, in her State of the State address, the Governor recommended the creation of a Bioenergy Research Grant Program to spur development of innovative technologies producing the most cost-efficient renewable fuels. She also charged the

Kansas Bioscience Authority with developing an aggressive plan for bioenergy technology and production, aimed at producing 20% of the nation's alternative fuel needs.

### 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.

### 6.4 Improved Commercialization of Biomass Conversion Technologies

Improve the rate of technology development and market deployment of biomass conversion technologies, including BGCC, pyrolysis, and plasma arc technologies. These technologies expand the application of renewable fuels derived from biomass. The U.S. Department of Energy's National Renewable Energy Laboratory is a good place to start to gain an understanding of some of these technologies ([http://www.nrel.gov/biomass/proj\\_thermochemical\\_conversion.html](http://www.nrel.gov/biomass/proj_thermochemical_conversion.html)). The California Integrated Waste Management Board also maintains information on biomass conversion technologies (<http://www.ciwmb.ca.gov/organics/conversion/>).

### 6.5 Expanded Use of New, Reused, and Recycled Wood Products for Building Materials

Increase the amount of renewable wood products used for residential and commercial building. Using 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 because it has lower transport-associated emissions. Promote utilization of recycled or reusable wood products to reduce wood waste. Encourage certification programs, such as LEED, to put wood on an equal footing with other materials.

## AFW-7. FORESTRY—BIOMASS PROTECTION AND MANAGEMENT

### 7.1 Forest Protection—Reduced Clearing and Conversion to Non-Forest Cover

Reduce the rate at which existing forests 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. Easements can be used toward this end, as well as conservation programs.

### 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 emission reductions may also occur by reducing heating and cooling needs as a result of planting shade trees. Promote use of software programs that can be used by cities and communities to track urban forestry. Need to be sensitive to greenbelt taxing issues.

**Recent actions in Kansas:** Eleven Kansas mayors have joined the U.S. Conference of Mayors Climate Protection Agreement. One of the measures among mayors acceding to the agreement is to maintain healthy urban forests, promote tree planting, and increase shading.

**7.3 Afforestation and/or Restoration of Non-Forested Land**

Establish forests on land that has not historically been forested (e.g., agricultural land; “afforestation”). 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 such practices as soil preparation, erosion control, and stand stocking to ensure conditions that support forest growth.

**7.4 Forest Management for Carbon Sequestration**

Encourage forest management activities that promote forest productivity and increase the rate of CO<sub>2</sub> 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, expansion of short-rotation woody crops (for fiber and energy), expanded use of genetically preferred species, modified biomass removal practices, fire management and risk reduction, and pest and disease management.

**7.5 Mitigation of Forest Carbon Sequestration Loss and 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 affected by wildfire. Prescribed fires may increase carbon in soil. Mechanical removal of biomass may provide sources of biomass that can be used for conversion to energy.

**7.6 Mitigation of Forest Loss Due to Insects/Disease**

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

**AFW-8. FORESTRY—WOOD PRODUCTS AND WASTE****8.1 Improved Mill Waste Recovery—Utilization of Sawmill Residues and Emissions**

Improve treatment and cleaning of waste materials from paper mills, which can then be reused to manufacture additional wood products. Ensure that sawmill by-products are recycled or beneficially used for energy. Note: this option links to AFW-6.1 (forest biomass) and AFW-6.3 (wood waste).

**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.

### 8.3 Silviculture Improvements

Adopt water conservation, improved harvesting technology such as improved equipment, and other GHG-reducing agricultural practices that can be applied to silviculture. Maximize compliance with programs.

## AFW-9. WASTE MANAGEMENT—WASTE MANAGEMENT STRATEGIES

### 9.1 Expanded Use of Yard Waste Biomass Feedstocks for Electricity, Heat, and 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 the greatest net energy payoff. Note: This is related to AFW-1.1 (agricultural biomass) and AFW-6.1 (forestry biomass).

**Recent actions in Kansas:** The state's largest utility, Topeka-based Westar, announced on February 26, 2007, an RFP for 500 MW of renewable energy. While this target may be largely comprised of wind energy, the RFP is not specific to wind and may include biomass resources.

With Executive Order 08-04, the Governor instructed the Kansas Energy Council to “collect and compile information pertaining to energy resources, including wind and biomass, in the state, as well as the availability, production and use of energy in the state.”

### 9.2 In-State Liquid Biofuels Production

Increase production of ethanol and/or biodiesel fuel from agriculture and/or forestry feedstocks and/or municipal solid and other waste (raw materials) to displace the use of fossil fuel. See AFW-1.2 above. This is related to AFW-1.2 (agricultural biofuels) and AFW-6.2 (forestry biofuels).

**Recent actions in Kansas:** On January 14, 2008, in her State of the State address, the Governor recommended the creation of a Bioenergy Research Grant Program to spur development of innovative technologies producing the most cost-efficient renewable fuels. She also charged the Kansas Bioscience Authority with developing an aggressive plan for bioenergy technology and production, aimed at producing 20% of the nation's alternative fuel needs.

### 9.3 Advanced Recycling and Composting

Increase recycling and reduce waste generation in order to limit GHG emissions associated with landfill methane generation and with the production of raw materials. Increase recycling programs, create new recycling programs, provide incentives for the recycling of construction materials, develop markets for recycled materials, and increase average participation and recovery rates for all existing recycling programs.

#### **9.4 Promotion of Bioreactor Technology (Advanced Municipal Solid Waste Management Practices)**

A bioreactor landfill is essentially an in-landfill composting activity at a Subtitle D (municipal solid waste) 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 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.

#### **9.5 Source Reduction Strategies**

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

#### **9.6 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.

#### **9.7 Enhanced Management of Organic Waste**

Reduce methane emissions associated with landfilling by reducing the biodegradable fraction of waste emplaced. Recently, an area of focus in the solid waste industry has been increasing recycling of organic wastes (e.g., lawn and garden waste, food waste, wood, paper, and bio-based plastics) using different conversion technologies, including composting, anaerobic digestion, or hybrids of these technologies.

#### **9.8 Improved Commercialization of Biomass Conversion Technologies**

Improve the rate of technology development and market deployment of biomass conversion technologies, including BGCC, pyrolysis, and plasma arc technologies. These technologies expand the application of renewable fuels derived from biomass. A range of renewable products can be developed from these processes, including gaseous and liquid fuels, biochar, chemical products, and methane to methanol. Existing processes include waste combustion and energy recovery (as electricity, steam, or both) or ethanol plants using co-products for heating and drying, rather than relying on outside energy sources.

## 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 (i.e., new-source performance standards [NSPS]) 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 CO<sub>2</sub>.

### 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 twofold 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 Kansas:** Eleven Kansas mayors have joined the U.S. Conference of Mayors Climate Protection Agreement. One of the measures among mayors acceding to this partnership is to increase the use of clean, alternative energy by, for example, investing in “green tags,” advocating for the development of renewable energy resources, recovering landfill methane for energy production, and supporting the use of waste-to energy-technology.

### 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.

## AFW-11. WASTE MANAGEMENT—WASTEWATER MANAGEMENT ACTIVITIES

### 11.1 Wastewater Treatment Plant Biosolids for Energy Production

Develop and implement methods for processing and use of biosolids as a renewable energy source—for example, as a renewable fuel to be co-fired with other fuels in existing or new combustion units for the purpose of generating electricity, heat, or steam.

**Recent actions in Kansas:** Eleven Kansas mayors have joined the U.S. Conference of Mayors Climate Protection Agreement. One of the measures among mayors acceding to this partnership is to evaluate opportunities to increase pump efficiency in water and wastewater systems and recover wastewater treatment methane for energy production.

### 11.2 Energy Efficiency Improvements

Provide incentives for efficiency improvements. Encourage the setup 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 in primary treatment tanks and clarifiers;
- Evaluation of steam use in plant processes and biofilters, optimization of use, and promotion of alternatives; and
- 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:

- Create a leveraged state revolving loan fund program to capitalize energy efficiency in municipal wastewater treatment plants.
- Conduct benchmarking of energy use per million gallons treated in Kansas to showcase good and deficient energy performance in this specific climate.

May also include researching ways to use wastewater biomass as an energy source, rather than just as a soil carbon source.

### **11.3 Lower Waste Processing Needs (Lower Water Consumption, Waste Production)**

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 or 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.

### **11.4 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. Provide incentives to recover heat from wastewater influent or effluent through the use of heat pumps. Investigate opportunities for waste heat recovery from biogas combustion units (turbines, engines, flares).

### **11.5 Algae and Bio-Oils**

Provide financial incentives to research the production of bio-oils from algae or other microorganisms grown in wastewater effluents (which would reduce carbon, nitrogen, and phosphorus). This option would most likely be developed under AFW-1.2 (In-state Liquid Biofuels Production).