Agriculture, Forestry, and Waste Management (AFW) Technical Work Group

Summary List of Pending Priority Policy Options for Analysis

Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total (2010–2025)			
AFW-1	Expanded Utilization of Biomass Feedstocks for Electricity, Heat, or Steam Production	*Not Yet Quantified*					Pending
AFW-2	In-State Liquid Biofuels Production	*Not Yet Quantified*					Pending
AFW-3	Promotion of Agricultural Practices That Achieve GHG Benefits	*Not Yet Quantified*					Pending
AFW-4	Manure Management and Waste Energy Utilization	*Not Yet Quantified*					Pending
AFW-5	Forest and Rangeland Carbon Protection and Management	*Not Yet Quantified*					Pending
AFW-6	Methane and Biogas Energy Programs	*Not Yet Quantified*					Pending

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Note: The numbering used to denote the above pending priority policy options is for reference purposes only; it does not reflect prioritization among these important draft policy options.

AFW-1. Expanded Utilization of Biomass Feedstocks for Electricity, Heat, or Steam Production

Policy Description

This policy option is intended to increase the amount of biomass available from agriculture (including forestry, row-crop agriculture, and rangeland) and from the municipal solid waste (MSW) stream for displacing the use of fossil energy sources and generating heat, steam, and/or electricity. Local energy production and utilization yields the greatest net energy payoff, as it reduces or eliminates transportation and/or transmission costs.

The biomass should be used in a sustainable, environmentally acceptable manner, considering proper facility siting and feedstock use (e.g., proximity of users to biomass, impact on water supply and quality, control of air emissions, solid waste management, cropping management, nutrient management, soil and non-soil carbon management, and impact on biodiversity and wildlife habitat). The objective is to create concurrent reduction of carbon dioxide (CO_2) due to the displacement of fossil fuel, while considering life-cycle greenhouse gas (GHG) emissions associated with viable collection, hauling, energy conversion, and energy distribution systems.

Additional investment in research and development will be needed to enhance production efficiency, increase utilization of food processing residues and by-products, produce sustainable feedstocks, and improve collection, processing, and transport systems.

In addition, this policy would improve the rate of technology development and market deployment of biomass conversion technologies, including biomass gasification combined-cycle, pyrolysis, and plasma arc technologies. These technologies expand the application of renewable fuels derived from biomass. Other types of technology development might include cellulosic ethanol, anaerobic digestion to produce methane, and refuse-derived and wood-fuel pellets.

Policy Design

Goal(s):

- *Agricultural Residues*—Increase the use of agricultural residues for electricity, steam, and heat generation to utilize 5% of available in-state agricultural residue biomass by 2015 and 10% of available biomass by 2025.
- *Energy From Livestock Manure and Poultry Litter*—By 2025, utilize 10% of available energy from livestock manure and poultry litter for renewable electricity, heat, and steam generation. *Note potential overlap with AFW-2.*
- *Energy Crops*—Increase the production of energy crops to produce biomass feedstock for electricity, steam, and heat generation to 10% by 2025. *Note potential overlap with AFW-2.*
- *Energy From the Municipal Solid Waste Stream*—By 2025, utilize XX% of MSW to produce electricity, heat, and steam. This could be accomplished using a variety of methods, from combusting MSW directly as fuel (or supplemental fuel) for generating electricity, steam, or heat, or indirectly as a means to make fuel, as by pyrolysis or gasification.

- *Cogeneration*—By 2025, ensure that facilities using biomass for electricity, heat, and steam production are capturing and utilizing 10% of waste heat (co-generation).

Timing: As described above.

Parties Involved: Agriculture landowners, rangeland and forest owners and managers, utilities, and energy-using industries. MSW will include waste generators, haulers, processors, and landfills, in addition to utilities and energy-consuming industries. Research and technology development include the Kansas Bioscience Authority and academic institutions.

Other: Data needs:

- Acres/volumes of feedstock crops—corn, switchgrass;
- Volumes of manure;
- Volumes of waste:
    - crop residue;
    - wood mill waste;
    - wood solid wastes (e.g., pallets);
    - mixed combustible MSW.

AFW-2. In-State Liquid Biofuels Production

Policy Description

Kansas plants currently produce nearly 500 million gallons of ethanol and 1.2 million gallons of biodiesel per year. To reduce U.S. consumption of foreign oil, to displace fossil fuels, and decrease CO_2 emissions, an increase is needed in U.S. production of ethanol and/or biodiesel fuel from agriculture and forestry feedstocks, as well as from MSW and other waste (raw materials). The development of cellulosic ethanol technologies and ethanol production systems that use renewable fuels will improve the embedded energy content of ethanol. Increased in-state production and consumption of biofuels will achieve the greatest benefits.

Bioenergy feedstocks and biofuel production processes need to be integrated to serve multiple GHG-beneficial objectives. For example, manure from confined animal feeding operations can be used as a methane energy source to fuel starch-based and cellulosic ethanol production (lowering the embedded GHGs of the ethanol), and wet distillers' grains from the ethanol production process can be used as feed for livestock (thereby reducing transport and drying-related GHG emissions). Other integrated bioenergy production facilities are practical, where multiple agricultural or energy production systems are linked to provide a large net GHG reduction. Biomass is found throughout the United States, not just in the Midwest, and can be used to provide energy in different forms. In Kansas, various feedstocks are available at various times of the year to lower the deterioration of biomass. The state also has several regions that receive little rainfall, which can help maintain biomass quality.

Utilization of biomass from agriculture may be enhanced (1) by increasing production efficiency, (2) planting more acres, (3) using excess residue from crop production and improving utilization of food processing residues and by-products, and/or (4) taller plants producing more removable residue per acre. New drought-technology crops will help reduce water needs in the drier regions of Kansas.

The ethanol industry has utilized several technologies to improve the efficiency and productivity of the plants, thus reducing the industry's carbon footprint and making better use of natural resources. For example, an ethanol production facility is utilizing corn amylase, which has been shown to help reduce water and energy needs at a Kansas ethanol plant. By 2011, Abengoa Bioenergy will have a commercial facility to produce ethanol from lignocellulosic biomass. The plant will be located in Hugoton, Kansas, and will provide 110 million gallons of ethanol per year.

Policy Design

Goals:

- *Renewable Fuels*—Achieve 12% use of renewable fuels by 2012 and by 30% by 2025.
- *Biodiesel*—Use 1% of biodiesel by 2012 and 10% by 2025. Conduct further research to find adequate biodiesel by-products (e.g., soaps, degreasers, and oil seed crops, such as canola).

- *Agricultural Residues*—Conduct research to not only increase the yields of crops, but also to look at ways to produce an adequate supply of biomass. Using excess crop residues could eliminate the need for burning or strip-tillage practices.
- *Biorefineries*—Attract and remodel existing ethanol facilities into biorefineries that are able to create chemical products and transportation fuels and to provide electricity for the facility.
- *Energy Crops*—Dedicate 5% of the crops in the state to energy crops by 2012, and 20% by 2025.

Timing: As described above.

Parties Involved: Agricultural interests, food processing industries, auto industries, fuel industries, environmental/sustainability interests, relevant state regulatory authorities (Kansas Departments of Health and Environment, Agriculture, Revenue, and Commerce and the Kansas Bioscience Authority).

Other: Growth in the used of biomass fuels needs to be linked to the health of Kansas' agricultural and food processing industries, and to the state's sustainable agricultural and forest management practices.

The Kansas Bioscience Authority (KBA) awarded $4.1 million to Kansas State University (KSU) and the University of Kansas (KU) to create the Kansas Bioenergy and Biorefining Center of Innovation. The center will use commercial biorefining to develop alternative fuels and chemicals, commercialize efficient biomass resources for cost-effective quality power, and improve carbon capture. KBA, along with Archer Daniels Midland, provided KU with funding to design new processes for plant material to be converted to 1,4-butanediol, a product in the application of engineering plastics. The project will also look at ways to convert vegetable oils and biodiesel into industrial chemicals, as well as finding new substitutes for Bisphenol-A.

Many areas of Kansas are prime locations for the production of cellulosic ethanol. The three major crops grown in the state that can provide residues are corn (3.3 tons/acre/year), sorghum (1.4 tons/acre/year), and wheat (1.9 tons/acre/year). Some examples of locations in the state that could produce cellulosic ethanol based on total available residue (dry) and transportation availability within a 50-mile radius are: Newton (3,394,000 tons), Great Bend (2,976,000 tons), Kinsley (3,563,000 tons), Holcomb (3,564,000 tons), and Cimarron (3,721,000 tons).

AFW-3. Promotion of Agricultural Practices That Achieve GHG Benefits

Policy Description

An estimated 20%-40% of targeted emission reductions can be met by agricultural soil carbon sequestration and by a reduction in other GHGs. The amount of carbon stored in soil can be increased by the adoption of specific agricultural practices, including no-till or strip-till farming, crop rotation, and planting of perennial vegetation. Reducing tillage decreases the loss of soil carbon and promotes formation of stable aggregates that protect soil carbon. Crop rotation and cover crops can increase the amount of plant material added to the soil that forms soil carbon. Increasing soil carbon through soil carbon sequestration improves agricultural soil quality, fertility, and productivity; reduces soil erosion and nutrient runoff; improves soil water retention and drought resistance; reduces nutrient leaching; improves surface- and ground-water quality; and can help reduce fuel use and inputs (diesel and gasoline for operation of farm equipment), and GHG concentrations.

In addition, improved nitrogen management can reduce nitrous oxide (N_2O) emissions. Improved nitrogen management practices include soil testing to reduce the amount of nitrogen fertilizer applied to crops, improved timing and placement of nitrogen fertilizer, and the use of legumes for biological nitrogen fixation. Many of these practices increase the efficiency of nitrogen and, thus, producers' profitability.

Restoration of perennial vegetation on marginal or degraded soils also increases the carbon stored in soils. Permanent vegetation or semi-permanent vegetation, like grasses, trees, forbs, shrubs, or other perennial crops, can still be used for agriculture production, but also has the secondary benefit of building carbon stocks in the soil. Examples include planting cool- and warm-season grasses for forage, managed and harvested timber stands, orchards, vineyards, or riparian area restoration.

Policy Design

Goal(s): By 2025, increase the number of acres in conservation tillage to 50% statewide and no-tillage to 25% of the acres.

Timing: As stated above.

Parties Involved: Landowners, state and federal agencies, state universities, KSU Extension Service, county conservation districts, commodity and agriculture advocacy organizations, and nonprofit agriculture educational organizations.

Other: None identified.

AFW-4. Manure Management and Waste Energy Utilization

Policy Description

Agriculture provides the key link in human population survival through the efficient production of food. Increasing regulatory pressures challenge food producers to continue efficient and profitable production. Regulations requiring reduction of GHGs may challenge the ability of producers to be profitable even more. However, when implemented, current production practices for handling and storing manure can reduce GHG emissions.

Methane (CH_4), a natural by-product of manure, is released during the biological process of manure degradation. However, methane is an intense GHG that can be captured or destroyed from certain animal feeding operations. A methane digestion system for animal production facilities captures the CH_4, CO_2, and other trace gases in the covered digester (tank or lagoon) and uses those gases for on-farm energy production. If on-farm energy production is not an option, then the gases can be combusted and flared prior to release to the atmosphere. The typical CH_4 digester is a large and irreversible capital investment characterized by value uncertainty; therefore, cost assistance will be required for large-scale adoption within the industry.

Specific composting methods also may reduce GHG emissions. CO_2, CH_4, and N_2O are all by-products of the composting process. While composting manures inside sealed vessels greatly reduces GHG emissions, the practicality of sealed vessels on farms is questionable. A more feasible approach is a composting method that minimizes the development of anaerobic processes, generally by frequently aerating wind-rowed manure piles and storing manure on cement pads.

Specific methods and timing of land-applied manure can also reduce GHG emissions. In liquid form, injecting manure into the soil in the upper root zone reduces the volatilization potential of manure. Applying solid manure uniformly to the surface, minimizing clumping, incorporating it into the soil promptly after application, and avoiding application just before or after precipitation will minimize GHG emissions.

Policy Design

Goal(s):

- Capture 20% of available CH_4 from confined animal operations by 2025 for use in on-farm energy projects and for sale to utilities.
- Increase by 20% of the available manure composted to aerobic composting methods.
- Increase by 20% the volume of liquid manure that is land-applied through soil-injection methods.

Timing: Implement projects to capture 5% of available methane energy at hog farms and dairies by 2015, and 20% by 2025.

Parties Involved: Landowners, state and federal agencies, universities, county conservation districts, commodity and agriculture advocacy organizations, grazing associations, nonprofit agriculture education organizations.

Other: None identified.

AFW-5. Forest and Rangeland Carbon Protection and Management

Policy Description

An estimated that 20%-40% of targeted emission reductions can be met by sequestering agricultural soil carbon and reducing other GHGs.

Specific rangeland management practices can also have the net effect of storing additional carbon in the soil. Maintaining good stands of native rangeland and allowing recovery of areas that have poor vegetative cover enables greater root mass to develop, increasing carbon stocks in soils and sequester that carbon permanently. Some of the principles that are applied to increase carbon are appropriate stocking rates, good distribution of livestock across grazing areas, and adequate recovery time for grazed vegetation. Management practices, such as rotational grazing, variable and multiple water sources, frequent relocation of supplements, and drought contingency plans, can enhance the ability of grasses to sequester additional carbon. Optimally grazed lands often have greater soil carbon than on ungrazed or overgrazed lands. As for croplands, carbon storage in grazing lands can be improved by a variety of measures that promote productivity. For instance, alleviating nutrient deficiencies by fertilizer or organic amendments increases plant productivity and, hence, soil carbon storage. Introducing grass species with higher productivity, or carbon allocation to deeper roots, has been shown to increase soil carbon.

Policy Design

Goal(s): By 2025, increase the number of acres with improved grazing practices by 15% on Kansas grazing lands.

Timing: As stated above.

Parties Involved: Landowners, state and federal agencies, state universities, KSU Extension Service, county conservation districts, commodity and agriculture advocacy organizations, and nonprofit agriculture educational organizations.

Other: None identified.

AFW-6. Methane and Biogas Energy Programs

Policy Description

Reductions in GHGs occur from landfill gas (LFG) collection and destruction, LFG used to offset fossil-based fuels, and the oxidation of CH_4 in cover soil systems. This policy option encourages and promotes controls or waste management options at MSW landfills, to reduce GHGs from landfills that do not currently utilize a gas collection and control system (GCCS).

Policy Design

Landfills that currently have a GCCS in place, such as new source performance standard (NSPS) landfills, will continue current LFG collection and control activities. By adopting policies that encourage and incentivize LFG use, Kansas will dramatically decrease GHG emissions through reduced GHG emissions and offset other GHG producers, such as coal-fired electric plants.

Goal(s): By 2025, implement LFG controls at 5% of currently uncontrolled landfills.

Timing: As stated above.

Parties Involved: Municipal governments, landfill operators, landfill gas-to-energy project developers.

Other: This policy is intended for sites that would not be expected to trigger federal NSPS or emission guidelines for landfills.