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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
		2020	2030	Total 2010–2030			
AFW-1	Forestry Management for Carbon Sequestration	*Not Yet Quantified*					*Pending*
AFW-2	Expanded Use of Biomass Feedstocks for Electricity, Heat, and Steam Production	*Not Yet Quantified*					*Pending*
AFW-3	On-Farm Energy Production and Efficiency Improvements	*Not Yet Quantified*					*Pending*
AFW-4	In-state Liquid/Gaseous Biofuels Production	*Not Yet Quantified*					*Pending*
AFW-5	Soil Carbon Management	*Not Yet Quantified*					*Pending*
AFW-6	Increase Productivity of Abandoned and Reclaimed Lands	*Not Yet Quantified*					*Pending*
AFW-7	Reforestation, Afforestation, and Restoration of Mined Lands and Other Non-forested Lands	*Not Yet Quantified*					*Pending*
AFW-8	Advanced MSW Reuse, Recycling, and Organic Waste Management Programs	*Not Yet Quantified*					*Pending*
AFW-9	Landfill Methane Energy Programs	*Not Yet Quantified*					*Pending*
	Sector Total After Adjusting for Overlaps						
	Reductions From Recent Actions						
	Sector Total Plus Recent Actions						

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

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings.

The numbering used to denote the above policy recommendations is for reference purposes only; it does not reflect prioritization among these important policy recommendations.

AFW-1. Forestry Management for Carbon Sequestration

Policy Description

Carbon dioxide (CO_2) is captured and stored in trees, soil, and other forest biomass. Forest management activities that promote forest production have the potential to increase net CO_2 sequestration rates and enhance greenhouse gas (GHG) benefits. Retaining forest management where it is currently practiced and expanding the area covered by management plans would stimulate the rate of production, in terms of both forest growth and the amount of biomass harvested.

From the history of Kentucky's forests, we can see that there is no single statement regarding the value of Kentucky's forests. Value, like beauty, is in the eye of the beholder. Attitudes toward Kentucky's forests have changed, diversified, and shifted throughout Kentucky's history and will continue to do so as the concerns of our culture, the status of the resource, and the desired end uses fluctuate in the future. Will the concerns over climate change and carbon credits persist?

Economic incentives are often the easiest way to promote new ideas. Due to the financial significance of forest-related products, Kentucky stands to benefit greatly from sustainable management. Traditionally, wood products have stimulated forest management, and practices such as agroforestry provide alternative ways to produce revenue on forestland. Currently, many policies are being discussed and developed nationally with regard to carbon sequestration and biofuels for energy.

Policy Design

Goals:

1. Increase net carbon sequestration in Kentucky's forests by completing forest management plans on one million acres of currently forested lands by 2025.
2. Promote carbon marketing opportunities to increase interest in forest management.
    a. Carbon sequestration represents an avenue to assist with afforestation and reforestation programs, since trading on the Chicago Climate Exchange represents an additional revenue stream.
    b. Promote opportunities for landowners and businesses to participate in the various certification systems

Timing: See above.

Parties Involved: Kentucky Division of Forestry, Kentucky Woodland Owners Association, United States Forest Service (U.S. Department of Agriculture [USDA]), Farm Services Agency (USDA), Mountain Association for Community Economic Development, University of Kentucky, nongovernment organizations, Kentucky Department of Fish and Wildlife Resources.

Other: None.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-2. Expanded Use of Biomass Feedstocks for Electricity, Heat, and Steam Production

Policy Description

This policy dedicates a sustainable quantity of biomass from agricultural lands, land restoration activity, land clearing for roads and strip mines, agricultural residues (crop residues, waste land grass and weeds, animal bedding, etc.), wood industry residues (slabs, sawdust, trimmings, etc.), urban waste, managed agriculture crops (wood from woodlands, switchgrass, etc.) grown for profit from the biomass industry, for efficient conversion to energy and economical production of heat, steam and electricity. This biomass should be used in an environmentally friendly and acceptable manner, considering proper facility siting and feedstock use (e.g., proximity of users to biomass, impacts on water supply and quality, control of air emissions, solid waste management, cropping management, nutrient management, soil and non-soil carbon management, and impacts on biodiversity and wildlife habitat). The objective is to create concurrent reduction of CO_2 due to displacement of fossil fuels considering life-cycle GHG emissions associated with viable collection, hauling, and energy conversion and distribution systems. These biomass products would be processed into a product that can be used in electrical and heating boilers throughout the state.

Policy Design

Goals: A 500-megawatt (MW) unit would require about 75,000 tons of biomass annually to facilitate a 5% reduction in the amount of fossil fuel used. With the production of approximately 97 terawatt-hours of electricity production (93% coal-fired) in Kentucky, it would take 15 million tons (MT) of biomass with a 4,500 British thermal units per pound (Btu/lb) of to obtain a 12% reduction co-fired with coal.

- *Agriculture/Bioenergy Crops*—Increase production of native grasses and tree production for biomass use to 25% of the biomass needed by 2020.
- *Agricultural Residues*—Increase use of agricultural residues for electricity, steam, and heat generation to utilize 10% of available in-state agricultural residue biomass by 2015 and 15% of available biomass by 2020.
- *Forestry and Wood Industry Residues*—Increase use of forest residues for electricity, steam, and heat generation to utilize 10% of available biomass by 2015 and 25% of available in-state forest residue by 2020.
- *Energy Crop*—Increase the use of energy crop to utilize 50% of available in-state energy crop biomass for electricity, steam, and heat generation by 2020.
- *Methane (CH_4) from Livestock Manure*—Utilize 20% of available CH_4 from livestock manure for renewable electricity, heat, and steam generation by 2020.

Timing: Linear implementation through 2020.

Parties Involved: This requirement would apply to all new electric generating units and all existing electric generating units having 25 MW capacity or greater. Implementation of this

policy will require the enactment of enabling legislation and subsequent regulation by the Kentucky Public Service Commission (PSC). Affected parties include utilities, power producers, renewable energy providers, ratepayers, and financial institutions that will be needed to support future capital investments and may experience a decline in returns on past investments in conventional technologies.

An analysis of power-sector industry restructuring issues must include consultation with affected and interested parties, including representatives of area land planners, rural and other energy consumers, major utility companies, investor-owned cooperatives, municipal utilities, local units of government, state and local environmental agencies, renewable energy developers and providers, community action agencies, natural gas distribution utilities, the Kentucky PSC, forest product industries with waste products, conservation groups, the Kentucky Division of Forestry, Kentucky's Natural Resources Conservation Service (NRCS), and state universities.

Other:

- Harvest all biomass products sustainably without depriving soils of important organic components for reducing erosion. Maintain soil nutrients and structure, and do not deplete wildlife habitat or jeopardize future feedstocks in quantity or quality.
- Promote all biomass to be harvested from marginal production acres without taking acres from food production. Support all production acres in the establishment and production with monies from the Kentucky Agricultural Development Fund, the NRCS Environmental Quality Incentives Program (EQIP), and state cost share through NRCS. Establish these acres with the support and development guidelines of NRCS. Encourage organic fertilizer (manure) on these acres.
- Install manure digesters and energy recovery projects in hog, dairy, and poultry operations.
- Use community and multi-facility digesters, as they are far more cost-efficient than units on individual operations.
- Evaluate the life-cycle energy costs and carbon emissions for each feedstock.
- Use the manpower used in the preparation of the raw biomass to offset the decrease in employment due to decreased coal production.
- Locate the preparation facilities in feasible areas to decrease transportation costs, and decrease GHG from the transportation source, for both the raw products and the location at which the product would be used.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-3. On-Farm Energy Production and Efficiency Improvements

Policy Description

Renewable energy may be produced and used on site at individual agricultural operations or regionally through various businesses to achieve better economies of scale. For example, on-farm production of grains and oilseeds for ethanol and biodiesel, biomass for new generation biofuels and electric generation, and the use of solar heating and power will reduce CO_2 emissions by displacing the use of fossil-based fuels. Energy conservation for agricultural operations will result in increased efficiency. For example, improved grain-drying systems; livestock facility upgrades to ventilation, lighting, heating, and cooling components; and expanded use of precision agriculture systems will also reduce fossil fuel use.

Policy Design

Goals: Achieve a 25% improvement in the energy efficiency of agricultural operations, while increasing the productivity and conversion of crops, residues, and other farm resources into 25% of Kentucky's energy requirements by 2025.

Timing: Progress is already underway, as evidenced by growth in ethanol and biodiesel production and increased utilization of federal and state programs to improve on-farm energy efficiency.

- Current biomass production capabilities are estimated at 12–15 MT per year with minimal land-use changes. Approximately 30% of this volume is expected from forestry and woody biomass production, 30% from energy crop production, 20% from waste forest products, and 20% from agricultural waste.
- Potential biomass production capabilities by 2025 are estimated at 25 MT/yr, but could involve land-use changes of approximately 2 million acres, or 15% of Kentucky's farmland. Approximately 20% of this volume is expected from forestry and woody biomass production, 60% from energy crop production, 10% from waste forest products, and 10% from agricultural waste.
- Increase biomass feedstock utilization from 3–5 MT/yr to an estimated 25 MT/yr.

Parties Involved: Leadership is being shown on multiple fronts from governmental, educational, agricultural, and other business entities. The Kentucky Energy and Environment Cabinet (EEC) is working closely with the Governor's Office of Agricultural Policy to develop strategies for improved on-farm energy efficiency and increased biomass and biofuel production and utilization. Continued funding for the Kentucky Agricultural Development Fund will provide financial resources for research, demonstration, and capitalization in this area. The Kentucky Agricultural Council has over 60 member agricultural, educational, and governmental organizations that have identified agri-energy investments, education, and awareness as a priority area. The Kentucky Rural Energy Consortium has provided leadership in developing and

advancing a 25x'25 initiative.[1] These networks are promoting dialogue, research, funding, and policy development to advance these activities.

Other: None.

Implementation Mechanisms

- Identify a single agency to coordinate biomass development efforts.
- Develop policies to mitigate demand risks.
- Develop policies to mitigate supply risks.
- Define and develop a sustainable biomass industry.
- Develop capitalization mechanisms.
- Expand applied research and development (R&D) of biomass production in Kentucky.
- Educate farmers about production opportunities as well as the species of crops, specific varieties and production techniques that maximize net farm income, while protecting natural resources.
- Encourage farmer investment in renewable energy production facilities.
- Initiate applied R&D and implementation of more efficient byproduct utilization in Kentucky.
- Increase educational opportunities and material for agricultural producers in the area of on-farm energy efficiency.
- Explore and develop agreements with bordering states to cooperate in the production of biofuels and byproduct utilization.
- Advance state support to develop an adequate infrastructure for the delivery of biofuels within the Commonwealth by examining the needs for infrastructure development that matches the future supply of biofuels with the potential demand.
- Work with the Kentucky Petroleum Marketers Association, the Kentucky Clean Fuels Coalition, and others to locate biofuel suppliers and promote their availability to all farmers in those markets.
- Identify current biofuel promotion programs and coordinate with those organizations to develop new programs as part of a comprehensive promotion campaign.
- Identify and develop incentives to upgrade the material handling capabilities at a coal-fired power plant to allow co-firing of biomass at a rate up to 10%.
- Produce herbaceous energy crops (switchgrass, Indian grass, big bluestem, and *Miscanthus giganteus*) on underutilized pasture land, abandoned or reclaimed mine land, and abandoned agricultural land.

[1] "25x'25" is an initiative to get 25% of Kentucky's energy from renewable resources ,such as wind, solar, and biofuels by the year 2025.

- Produce woody energy crops (cottonwood, hybrid poplar, and black locust) on underutilized pasture land, abandoned or reclaimed mine land, and abandoned agricultural land, and investigate the removal of woody residues from forestry operations.
- Implement a system to co-fire a range of feedstocks available in Kentucky at a coal power plant:
  - Develop incentives to allow farms and forests to produce feedstocks for energy production on non-cropland.
  - Demonstrate techniques for establishing energy crops on abandoned or reclaimed mine land and other land that requires additional considerations (e.g., deep ripping, rocky, steep slopes, or transplanting).
  - Establish and demonstrate effective harvest, storage, and transportation practices for herbaceous and woody biomass.
  - Document the range in fossil energy, labor, productivity, and cost required to grow, transport, and produce electricity from biomass.
- Co-fire material for a period of five days to evaluate electric power production, emissions, and other operational changes due to co-firing biomass.
- Evaluate alternative practices to improve the sustainability of energy crop production:
  - Track changes in soil properties, adaptability to wildlife improvements, and environmental impacts.
  - Evaluate the potential of Terra Preta (biochar) for improving and sequestering carbon in energy crop plantations.
- Determine the overall change in GHG emissions and the cost of electric power from biomass.
- Develop a pilot-scale project to focus on producing biomass on underutilized marginal land in eastern and central Kentucky.
- Convert 2 million acres, or 15% of Kentucky's farmland, from low-valued forage and hay production to higher-valued energy crops.
- Establish significant levels of public–private partnerships to design, build, and operate new farm-to-market processes.
- Increase statewide education, workforce development, and economic development activities to support a fast-growing biomass and biofuels industry and infrastructure.
- Contribute to evolving economic benefits from carbon offset credits as a result of using more biomass-based fuels and less carbon-based fuels in both the power production and the transportation sectors.

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-4. In-state Liquid/Gaseous Biofuels Production

Policy Description

Increase the sustainable in-state production and use of liquid and gaseous biofuels from agriculture, forestry and municipal waste sources to displace the use of fossil fuel. Displacement of traditional fossil fuels with biofuel usually results in a net reduction in greenhouse gases.

This policy promotes the use of sustainable practices in production of biomass from crop residues and dedicated biomass crops that take advantage of underutilized land resources without detrimental effect to human food resources. Additionally, this policy would encourage the use of agriculture and forestry crops that sequester carbon or are at least carbon neutral as necessary for an overall reduction in green house gases.

Biofuel technologies and production systems can take advantage of solar energy stored in biomass from agricultural and forestry resources for liquid and gaseous biofuel production. Biofuel systems can also capture discarded energy available in the waste stream. Emerging biofuel technologies such as pyrolysis, Fischer-Tropsch synthesis, utilization of microorganisms, and other novel technologies can improve utilization of feedstocks.

Policy Design

Goals: See Table 4-1.

Table 4-1. Target goals for liquid fuel production from biomass and waste systems in Kentucky

Source of Liquid Fuels	2015	2020	2030
Biomass Generated (Tons Biomass, % Biomass Used)[1]	270 million gallons (4 million tons, 8%)	900 million gallons (13 million tons, 28%)	1.35 billion gallons (19 million tons, 42%)
Waste Generated[2]	30 million gal.	100 million gallons	150 million gallons
Total	**300 million gallons**	**1 billion gallons**	**1.5 billion gallons**

[1]Target goals are based on an estimated biomass potential of Kentucky producing 46 million tons of biomass per year from native species on marginal, abandoned, and mined lands (DeBolt, et al, G*CB Bioenergy* 2009(1):308-316). Conversion estimates of 70 gallons of liquid fuel per ton of biomass for liquid fuels.

[2]Additional liquid fuel equivalents of 10% would come from municipal and private waste systems.

Timing: See goal above.

Parties Involved: Private waste industry, biofuel producers, farmers and feedstock producers, forest and agricultural landowners, municipal solid waste managers, researchers, venture capitalists.

Other: None.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-5. Soil Carbon Management

Policy Description

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. This policy option would encourage soil productivity and carbon sequestration through the use of biochar, winter overcrops, and such practices as crimping/rolling.[2]

Note that Kentucky may lead the country in no-till agriculture. Kentucky farmers have made a considerable shift to no-till agriculture in the last decade. Consequently, this option may have limited potential in Kentucky compared to other states.

Policy Design

Goals: Increase the number of acres using tillage practices that increase the amount of soil carbon and reduce GHG emissions, including:

- Plant winter cover crops on 50% of the currently winter-fallow land by 2030.
- Convert 25% of the currently conventionally tilled land to no-till or reduced-tillage by 2030.
- Encourage development and production of nitrogen-fixing crops that return nitrogen to the soil.

Timing: Linear rate of implementation through 2030.

Parties Involved: Kentucky Department of Agriculture, USDA, private farmers.

Other: None.

Implementation Mechanisms

[2] "Cover crop rolling" is an advanced no-till technique. It involves flattening a high-biomass cover crop to produce a thick, uniform mat of mulch. A cash crop is then no-tilled into the mulch. If the right kind of roller is used on the right cover crop at the right time, the rolling process itself will kill or partially kill the cover crop." From Introduction to cover crop rolling and the Virginia-USDA Crimper Roller Demonstration Project, 2006, United States Department of Agriculture. Available at ftp://ftp-fc.sc.egov.usda.gov/VA/Technical/conservation_planning/Crop_Agr/VA.Roller.FS.Sept.06.III.pdf.

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-6. Increase Productivity of Abandoned and Reclaimed Lands

Policy Description

The production of crops is the best use for much of the mined land in Kentucky. Mined areas that are sloped are generally suitable for tree crops due to the substrates being less compacted and better drained than mined areas that are flat. Flat areas are generally more suitable for the production of crops of herbaceous plants. Improving the productivity of all mined lands will increase land value and foster better stewardship by landowners.

Flat areas used for the production of forage crops

The productivity of flat areas used for the production of forage crops can be improved by application of soil amendments. The most economical way to improve the productivity of herbaceous crops is to apply amendments that increase soil pH, thereby increasing the availability of nutrients to plants. Opportunity may exist for the use of fly ash and other biofuel production by products as soil amendments to improve the productivity of flat mined areas used in the production of forage crops.

Sloped areas and flat areas not used for the production of forage crops

Flat areas not used for the production of forage crops are typically dominated by herbaceous plants and smaller amounts of shrubs and trees. The productivity of these areas can be improved by converting them to complete forest cover, which will increase the rate of soil development/productivity and provide numerous ecosystem and economic benefits.

Policy Design

Goals:

- Increased area of mined and reclaimed lands that are producing crops. *[Will establish more definitive goals once more information is collected]*.
- Increased per-area yields of forage crops raised on mined areas through application of soil amendments.
- Increased area of mined land that has complete forest cover (see AFW-7). [*Will establish more definitive goals once more information is collected.]*

Timing: Linear implementation through 2030.

Parties Involved: Improving mined land productivity will involve individual landowners and groups that represent/communicate with landowners interacting with entities that provide technical information on productivity improvement practices, entities that provide information on where landowners can find vendors and materials needed to effect productivity improvement practices and entities, and institutions that provide financial incentives for landowners to become better stewards of their land.

These include private landowners, mining companies, farmers, foresters, Department of Natural Resources, Division of Mine Permits, Division of Mine Reclamation Enforcement, Kentucky Division of Forestry, Kentucky Department of Agriculture, Office of Surface Mining Reclamation and Enforcement ([OSM] U.S. Department of the Interior), NRCS, Kentucky Division of Conservation, Kentucky Division of Water, The Appalachian Regional Reforestation Initiative, the University of Kentucky.

Other: Improving mined land productivity through forest establishment involves a long-term investment by a landowner. The threat of investment loss due to wildfire is a significant disincentive for forest establishment. Risk of loss due to wildfire can be significantly reduced by reducing the rate of arson-caused wildfires. The latter can be effected by enabling the Kentucky Division of Forestry to successfully apprehend and prosecute forest arsonists.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-7. Reforestation, Afforestation, and Restoration of Mined Lands and Other Non-forested Lands

Policy Description

Re-establish trees, at appropriate spacing, on forested land that is currently understocked. Interplant stands that are currently thinner than carrying capacity to increase biomass and diversify age classes. Avoid planting monocultures to minimize the risk of insect and disease while increasing the habitat value for wildlife and overall biodiversity. Favor the planting of native trees appropriate to habitat type and local climate conditions. Consider future climate trends and plant species most able to adapt and thrive over changing conditions.

Establish forests on lands that are not currently forested (e.g., agricultural land—"afforestation"), and 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 site and soil preparation, erosion control, and stand stocking to ensure conditions that support forest growth. This policy can include forestation of previously mined surface mines as well as non-forested riparian areas.

Promote mine reforestation practices that (1) plant high-value hardwood trees on reclaimed coal-mined lands, (2) increase the survival and growth rates of planted trees, and (3) expedite the establishment of forest habitat through natural succession. The Forestry Reclamation Approach (FRA) focuses on foresting reclaimed coal-mined land under the Surface Mining Control and Reclamation Act (http://arri.osmre.gov/FRApproach.shtm). The Appalachian Regional Reforestation Initiative (ARRI) is a cooperative effort by the Appalachian states and OSM to encourage restoration of high-quality forests on reclaimed coal mines in the eastern United States and to promote the FRA. (See more details at http://arri.osmre.gov/and http://arri.osmre.gov/Partnerships/green_forest_works/gfw.htm). Note that the Kentucky Department of Natural Resources has jurisdiction of reclaimed mined lands.

Policy Design

Goals:

- *Encourage reforestation and afforestation*—Increase the number of conservation easements, forestland tax credits legislation, cost share funding available for reforestation, and the number of acres converted to forestland by 10 % per year over the current levels by 2020.
- *Promote abandoned and mined land reforestation*—Increase in the number of post-mined acres reforested annually by 10% by 2020.

Timing: Linear implementation of goal through 2020.

Parties Involved:

Encourage reforestation and afforestation—Kentucky Woodland Owners Association, Kentucky Division of Forestry, Kentucky Resources Council, Division of Conservation,

Kentucky Farm Bureau, Kentucky Department of Fish and Wildlife Resources, Natural Resources and Conservation Service, Kentucky Tree Farm Committee, Mountain Association for Community Economic Development, Kentucky Forest Industries Association, state senators and representatives, University of Kentucky.

Promote abandoned and mined land reforestation—Department of Natural Resources, Division of Mine Permits, Division of Mine Reclamation Enforcement, Kentucky Division of Forestry, Kentucky Department of Fish and Wildlife Resources, OSM, NRCS, Kentucky Division of Conservation, Kentucky Division of Water, ARRI, University of Kentucky.

Other: None.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-8. Advanced MSW Reuse, Recycling, and Organic Waste Management Programs

Policy Description

Increase the reuse and recycling and reduce the generation of waste in order to limit GHG emissions associated with landfill methane generation and with the production of raw materials relative to recycled materials. Increase the breadth and depth of recycling programs, provide incentives for the recycling of construction materials, enhance markets for recycled materials, and increase average participation/recovery rates for all existing programs. Encourage the reduction of the biodegradable volume of waste emplaced through recycling and composting of organic wastes (e.g., lawn and garden waste, food waste, wood, and paper). Encourage the conversion of the wastes from composting, anaerobic digestion, or other technologies from residential, commercial, and government sectors through programs that reduce the generation of wastes. Reduce waste generation at the source to reduce both landfill emissions as well as upstream production emissions, and reduce the energy needs associated with handling and disposing of the wastes.

Note the linkage to AFW-9 covering landfill methane energy programs. To the extent that this policy achieves lower levels of biodegradable waste emplacement in the future, lower levels of landfill methane will be generated.

Policy Design

Goals:

- Achieve a 40% recycling rate for common household recyclable materials by 2025.
- Achieve a 50% diversion rate for all municipal solid waste (MSW) by 2025.

Timing: In 2008, Kentuckians recycled 34.6% of common household recyclable materials (aluminum, cardboard, steel, plastic, newspaper, glass, and paper) and 39% of all MSW, including common household recyclables and sludge, concrete, compost, and asphalt. Beginning in 2004, recyclers were required to report annually to the county the amount of MSW collected for recycling. This has helped in tracking the amount of materials recycled. Kentucky's PRIDE Fund was amended, and in 2007, the first recycling grants were awarded to local governments to pay for the development and expansion of recycling programs and household hazardous waste management. Kentucky Recycling Interest Group (KRIG) joined the Kentucky Pollution Prevention Center (KPPC) in 2007 to facilitate a statewide program to enhance the recycling infrastructure in the Commonwealth. KPPC also operates the Kentucky Industrial Materials Exchange (KIME), which helps find industrial users for materials that may otherwise end up in landfills or other disposal facilities.

Parties Involved: EEC, private waste management and recycling companies, end users and transporters of recycled materials, KRIG, counties and other local units of government, environmental groups, and citizens of the Commonwealth, Kentucky Recycling and Marketing Assistance Program (KRMA), Area Development Districts (ADDs).

Other: None.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus

AFW-9. Landfill Methane Energy Programs

Policy Description

Collect and treat methane at solid waste landfill sites, including those not meeting minimum regulatory waste emplacement volumes, which would require installation of gas collection systems. Use the renewable energy (methane) created at landfills during anaerobic degradation of wastes to produce power, such as electricity, steam, space heat, or motor fuels (compressed or liquefied natural gas). Increasing use of renewable energy, including landfill gas, is noted as one of the seven strategies under Kentucky's November 2008 Energy Plan, "Intelligent Energy Choices for Kentucky's Future." Kentucky has seven active landfill gas-to-energy (LFGTE) projects, with several other potential candidate sites.

This option is linked to AFW-8 covering waste reduction, use of waste management feedstocks for fuels, reuse, recycling and composting. There is also potential linkage to AFW-2 and AFW-4, which address expanding biomass utilization options to produce energy, which would divert materials from the MSW stream that would normally go into landfills. If these options result in a lower volume of biodegradable wastes for emplacement in landfills in the future, lower levels of methane will be generated for collection and use as renewable energy sources.

Policy Design

Goals:

- Implement controls or waste management options at MSW landfills, such that 50% of the methane emissions that would be generated under uncontrolled conditions are avoided by 2025.
- By 2025, utilize the maximum amount feasible of the 50% methane reduction above for LFGTE purposes.
- By 2025, increase annual renewable energy production from LFGTE projects to 88 MW/yr, which is the potential energy output equivalent of 50% of the total volume of solid waste disposed of annually. *[Depending on the outcome of the modeling for AFW-8, this goal may need to be reduced, since there would be less waste going into the landfills.]*

Timing:

- *By 2025, reduce methane emissions by 50%*—In terms of overall impacts to the environment from GHG emissions, methane is 16 times more damaging than CO_2. In accordance with the U.S. Environmental Protection Agency's (EPA's) regulations, all landfills with volumes of waste exceeding 3.2 million cubic yards (MCY) total permitted space and 50 megagrams per year (MG/yr), non-methane organic carbons (NMOCs) Tier 2 analyses must have measures in place to contain and/or flare methane. Only 27.2% of the annual MSW disposed of in landfills currently remains uncollected or flared, while 42.6% of the MSW is flared. By 2025, with improved equipment and gas collection systems, achieve a 50% reduction in methane emissions. This would be collection and flaring of 2,120,509 CY/yr X 0.5 = approx. 1 MCY/yr of MSW, or 13% of the waste stream.

- *By 2025, implement incentives by regulations or other measures*—Currently 30% of the annual MSW disposed of in landfills generates methane, which is collected and reused for LFGTE. By 2025, implement incentives by regulations or other measures to facilitate and encourage utilities and other private and public entities to use landfill gas for renewable energy production—specifically, to increase the percentage of renewable energy produced from LFGTE projects from its current rate of 30% of the annual total potential energy output equivalent from solid waste disposal to 50%. In terms of potential energy generated for electricity or natural gas usage, this would be an increase from the current 52.9 MW/yr to 88 MW/yr. Of the seven active landfill sites, six are used to generate electricity, having a combined 16.9 MW of production capacity. The seventh, by far the largest landfill in the state, provides 0.72 million cubic feet of gas per day to an industrial park for use in steam boilers—equal to 36 MW of energy generated, or approximately half of the methane collected at the landfill. Studies have shown that 80% of the methane is generated within five years following initial MSW disposal in the landfill. After the five-year period, the level of methane generated is significantly reduced.

Parties Involved: This option would apply to all private and public waste management operators of currently active Subtitle D contained landfills. It would also apply to public and private electric and gas utility entities and companies who may be consumers and end users of the renewable energy sources provided by the methane. This would also apply to those who regulate energy production, transportation, and use, including EEC, the Public Protection Cabinet, PSC, the Federal Energy Regulatory Commission and U.S. Department of Transportation, and city and county governments.

Other: It should be noted one of the main goals represented in this policy statement of increasing the recovery of methane produced by landfills in the state for conversion to LFGTE uses would be directly affected by implementation of several of the other options, including those that divert biomass and other forms of biodegradable waste from emplacement in landfills. This will reduce the amount of methane that would be produced for capture and reuse by LFGTE sites, affecting long-range supplies of methane that may be generated by landfills, and thus could impact the market and future projections of waste in place and energy potential that could be generated from the waste.

Implementation Mechanisms

Related Policies/Programs in Place

Type(s) of GHG Reductions

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Quantification Methods:

Key Assumptions:

Key Uncertainties

Additional Benefits and Costs

Feasibility Issues

Status of Group Approval

Level of Group Support

Barriers to Consensus