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## Catalog of State GHG Reduction Policy Actions Agriculture, Forestry, Waste Management (AFW)

A catalog of state-level, greenhouse gas (GHG)–reducing actions and policy options prepared by the Center for Climate Strategies (CCS) and the Kentucky Climate Action Plan Council, based on actions undertaken or considered in state-wide climate change action plans by multi-stakeholder groups in a wide cross-section of U.S. states and by state, local, and private participants.

### Key to Future Rankings of Options in the Tables That Follow:

Potential GHG Emission Reductions <sup>1</sup>	Potential Cost or Cost Savings <sup>1, 2</sup>
<b>High (H):</b> At least 1.0 million metric tons (MMt) carbon dioxide equivalent (CO <sub>2</sub> e) per year by 2020	<b>High (H):</b> \$50 per metric ton CO <sub>2</sub> e (tCO <sub>2</sub> e) or above
<b>Medium (M):</b> From 0.1 to 1.0 MMtCO <sub>2</sub> e per year by 2020	<b>Medium (M):</b> \$5 to \$50/tCO <sub>2</sub> e
<b>Low (L):</b> Less than 0.1 MMtCO <sub>2</sub> e per year by 2020, or 1 MMtCO <sub>2</sub> e by 2050	<b>Low (L):</b> Less than \$5/tCO <sub>2</sub> e
<b>Uncertain (U):</b> Not able to estimate at this time	<b>Uncertain (U):</b> Not able to estimate at this time
<sup>1</sup> Several measures may overlap in terms of emissions reductions and/or cost impacts. Estimates assume measures would be implemented independently of other measures. <sup>2</sup> Costs are denoted by a positive number. Cost savings (i.e., “negative costs”) are denoted by a negative number.	

**Definition of “Priorities for Analysis”:**

- **High:** High-priority options will be analyzed first.
- **Medium:** Medium-priority options will be analyzed next, time and resources permitting.
- **Low:** Low-priority options will be analyzed last, time and resources permitting.

***Important Note: The state actions are numbered in this catalog solely for convenience in referencing them. Their numbers do NOT reflect a ranking or prioritization of the actions.***

**Table-4 Agriculture, Forestry, Waste Management (AFW)**

*Note that this listing will be developed more fully during the CCI TWG process. TWG members are encouraged to provide input on policies and programs in place in Kentucky to assist in defining baselines. The “Notes” column should be used to record recently enacted policies and programs in Kentucky relevant to state actions in the catalog.*

Option No.	Greenhouse Gas (GHG) Reduction Policy Option	Potential GHG Emissions Reduction	Cost per Ton	Externalities, Feasibility Considerations	Priority for Analysis	Notes / Related Actions in Kentucky
<b>AFW-1 AGRICULTURE &amp; FORESTRY—PRODUCTION OF FUELS AND ELECTRICITY</b>						
1.1	Expanded Use of Biomass Feedstocks for Electricity, Heat, and Steam Production			<ul style="list-style-type: none"> <li>• Need to identify viable feedstocks and volumes.</li> <li>• Conventional and emerging/advanced technologies.</li> </ul>		KY Energy Strategy – Renewable Energy Strategy.
1.2	In-state Liquid/Gaseous Biofuels Production			<ul style="list-style-type: none"> <li>• Production of biodiesel from both virgin and waste vegetable oils.</li> <li>• Starch- (e.g., corn-) and cellulosic production processes for ethanol. Includes Municipal Solid Waste as feedstock.</li> <li>• Bio-oils from biomass.</li> </ul>		KY Energy Strategy – Biofuels Production Strategy (meet 20% of current demand by 2025 or 775 million gallons of use); also Gas Production Strategy.
1.3	Improved Energy Capture from Wood Waste and Biomass Combustion					KY Energy Strategy – Renewable Energy Strategy.

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1.4	Improved Commercialization of Biomass Conversion Technologies					KY Energy Strategy – Renewable Energy Strategy.
1.5	Integrated Bioenergy Research and Production			Integrates electricity from anaerobic methane (CH <sub>4</sub> ) digestion of manure, with production of by-products, e.g. biodiesel and ethanol.		KY Energy Strategy – Renewable Energy Strategy.
1.6	Expanded Production/Use of Bio-based Materials and Chemicals			Corn-based plastics, etc.		
1.7	Manure Digesters/Other Waste Energy Utilization			Costs dependent on livestock type and manure management methods.		KY Energy Strategy – Renewable Energy Strategy.
<b>AFW-2</b>	<b>AGRICULTURE—LIVESTOCK AND RANGE MANAGEMENT</b>					
2.1	Manure Management			Includes handling, storage, and improved application methods such as manure/ methane capture, biofilters to control CAFO emissions, increase pasturing, lower densities.		

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				Application improvements include incorporation into soil, instead of surface spraying/spreading. Co-benefits include reduction of ammonia and VOC emissions.		
2.2	Changes in Animal Feed (Optimize Nitrogen for N <sub>2</sub> O Reduction)			Includes supplements to reduce CH <sub>4</sub> from enteric fermentation, and N efficiency to reduce downstream N <sub>2</sub> O. Co-benefits include reduction in ammonia emissions.		
2.3	Rotational Grazing/Improve Grazing Crops and/or Management					
2.4	Mitigation of Carbon Sequestration Loss and Emissions from Rangeland Wildfires					New.
<b>AFW-3</b>	<b>AGRICULTURE—CROP PRODUCTION</b>					
3.1	Soil Carbon Management			Can include: Conservation Tillage/No-Till; Reduced Fallow; Increase Winter Cover; Application of Biochar.		

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				Potential based on opportunities beyond current practice		
3.2	Nutrient and Water Management			Includes drainage management. Potential based on whether there are significant opportunities beyond current practice.		
3.3	Technology Improvements to Increase Efficiency			Improved soil sampling to optimize fertilizer application, machinery systems, etc.		
3.4	Biotechnology Application for GHG Mitigation			Improved research in and utilization of drought-resistant, flood-resistant, pest-resistant crop varieties, etc.		
3.5	Perennial Crop Production			Save on planting, tillage, etc.		
<b>AFW-4</b>	<b>AGRICULTURE – LAND USE CHANGE</b>					
4.1	Land-Use Management That Promotes Grassland Cover (includes opportunities to keep CRP lands in permanent cover—i.e., convert cropland to grassland or prevent conversion of grassland to croplands)			Demand for corn-based ethanol can convert grassland to crop production. (Relates to ethanol/biofuel options.) Need estimates of marginal agricultural land with the potential		•

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				for conversion.		
4.2	Preserve Open Space/Agricultural Land (Promoting “No Net Loss” of Agricultural Land) is a stringent application of this option.)			GHG reductions occur both from higher retention of carbon in soil and from lower transportation activity.		
4.3	Prioritize Environmental Remediation Actions for GHG Benefits			A relevant example is the revegetation of disturbed lands to improve carbon sequestration.		
4.4	Preserve and Expand Wetlands for Carbon Sequestration			Anaerobic decomposition in wetlands creates methane emissions.		
<b>AFW-5</b>	<b>AGRICULTURE—FARMING PRACTICES</b>					
5.1	Increase On-Farm Energy Production and Efficiency			Includes installation of solar or wind power; hydro-powered generators for irrigation; converting diesel farm equipment to LNG/CNG or hybrid technology.		Demand-Side Management Programs coming from KY Energy Strategy Energy Efficiency Resource Standard (EERS).
5.2	Organic Farming			Reductions occur via lower-intensity agricultural practices (nutrient/pesticide application, reduced		

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				tillage) and higher soil carbon.		
5.3	Programs to Support Local Farming/Buy Local Programs			Reductions occur through lower transport-related emissions. Locally sourced foods for residential and institutional use.		NM, MT
5.4	Promotion of Urban Agriculture			Community gardens, green roofs. Need to be sensitive to greenbelt taxing issues.		
5.5	Promotion of Farming Practices That Achieve GHG Benefits					
<b>AFW-6</b>	<b>FORESTRY—BIOMASS PROTECTION AND MANAGEMENT</b>					
6.1	Forest Protection—Reduced Clearing and Conversion to Non-Forest Cover			Reductions depend on current rates of clearing. Relatively large amount of carbon can be protected per acre.		
6.2	Urban Forestry			Cost savings are possible if thinnings are directed to products and energy.		
6.3	Reforestation of Understocked Forest Land			Can also be found in 6.5.		
6.4	Afforestation and/or Restoration			Reductions depend on		

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	of Non-Forested Land			available land. Relatively high rate of C-sequestration/acre.		
6.5	Forestry Management for Carbon Sequestration			Increased Stocking of Poorly Stocked Lands, Age Extension of Managed Stands, Thinning and Density Management of Managed Stands, Fertilization and Waste Recycling, Expanded Short-Rotation Woody Crops (for fiber and energy), Expanded Use of Genetically Preferred Species, Modified Biomass Removal Practices, Fire Management and Risk Reduction, Pest and Disease Management, Reforestation.		
6.6	Mitigation of Forest Carbon Sequestration Loss and Emissions Due to Wildfire					

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6.7	Mitigation of Forest Loss Due to Insects and Disease					
6.8	Silvicultural and Technology Improvements			Improving techniques and technologies to save energy and water.		
6.9	Wildlife Management to Encourage Vegetative Regeneration and Growth					New.
<b>AFW-7</b>	<b>FORESTRY—WOOD PRODUCTS AND WASTE</b>					
7.1	Improved Mill Waste Recovery—Utilization of Sawmill Residues and Emissions			Reductions depend on current levels of efficiency, which tend to be high. (Can be part of biomass to energy option 1.1.)		KY Energy Strategy – Renewable Energy Strategy.
7.2	Improved Logging and Other Residue Recovery			Reductions depend on energy recovery and current levels of efficiency (e.g., removal of insect-damaged wood from managed areas).		
7.3	Expanded Use of New, Reused, and Recycled Wood Products for Building Materials			Cost depends on relative prices of materials. Expanded use of state and locally grown wood products and GHG reductions depend on current levels of wood		

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				product imports and potential for reducing transport emissions.		
7.4	Promotion of In-State Forestry Products					
<b>AFW-8</b>	<b>WASTE MANAGEMENT—WASTE MANAGEMENT STRATEGIES</b>					
8.1	Advanced Recycling and Composting			Use waste oils as energy feedstocks. (Can overlap with RCI options.)		
8.2	Expanded Use of MSW Waste and Yard Waste Biomass Feedstocks for Electricity, Heat, and Steam Production					KY Energy Strategy – Renewable Energy Strategy.
8.3	Promotion of Bioreactor Technology			Bioreactors can be landfills managed to maximize methane generation over a short period of time (e.g., via leachate recycling).		KY Energy Strategy – Renewable Energy Strategy.
8.4	Source Reduction Strategies			Reduction of generation at the source cuts both landfill emissions and upstream production emissions.		

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8.5	Resource Management Contracting			Programs that compensate waste contractors based on performance in achieving waste-reduction goals, rather than the volume of waste disposed.		
8.6	Waste Coal Recapture			Limited to states with waste coal resources.		KY Energy Strategy – Coal to Liquids Goal (8 CTL facilities by 2025)
8.7	Prevent Landfilling of Unprocessed Organic Material  (Often combined with advanced recycling)			Reduces methane emissions from landfills via composting or shredding/using biodegradable fraction of waste.		
8.8	Waste Management Feedstocks for Liquid/Gaseous Fuels Production			e.g., use of MSW fiber for cellulosic ethanol production.		KY Energy Strategy – Biofuels Production Strategy (meet 20% of current demand by 2025 or 775 million gallons of use); also Gas Supply Strategy
<b>AFW-9</b>	<b>WASTE MANAGEMENT—LANDFILL GAS STRATEGIES</b>					
9.1	Flare Landfill Methane at non-NSPS (smaller) Sites			Federal New Source Performance Standards and emission guidelines require methane capture at larger landfills. (Need		

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				to consider economics & energy needed to collect CH <sub>4</sub> .)		
9.2	Methane and Biogas Energy Programs (Linked to Options 1.1 [Manure Digesters] but directed at municipal/industrial waste streams)			Look at opportunities for digesters/energy utilization outside of the municipal solid waste sector.		KY Energy Strategy – Renewable Energy Strategy.
9.3	Landfill Methane Energy Programs			Examples include methane conversion to motor fuels (LNG), electricity, steam, or space heat..		KY Energy Strategy – Renewable Energy Strategy.
<b>AFW-10 WASTE MANAGEMENT—WASTEWATER ACTIVITIES</b>						
10.1	Energy Efficiency Improvements					Demand-Side Management Programs coming from KY Energy Strategy Energy Efficiency Resource Standard (EERS).
10.2	Lower Waste Water Processing Needs			Lower water use & waste production lead to lower GHG emissions.		
10.3	Install Digesters and Turbines or Fuel Cells			Reductions occur via methane control and offsetting fossil energy use.		KY Energy Strategy – Renewable Energy Strategy.
10.4	Wastewater Treatment Plant Biosolids for Energy Production					KY Energy Strategy – Renewable Energy Strategy.

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10.5	Algae in Effluent and Bio-oils as Energy Source					KY Energy Strategy – Biofuels Production Strategy (meet 20% of current demand by 2025 or 775 million gallons of use).
10.6	Utilization of Biosolids as a Fertilizer Substitute			May not be suitable for food crops. Public perceptions tend to be negative.		

C = carbon; CAFO = concentrated animal feeding operation; CCI = Cross-Cutting Issues; CH<sub>4</sub>= methane; CNG = compressed natural gas; GHG = greenhouse gas; LNG = liquefied natural gas; MSW = municipal solid waste; N<sub>2</sub>O = nitrous oxide; NSPS = new source performance standard; RCI = Residential, Commercial, and Industrial; TWG = Technical Work Group.