Chapter 7
Agriculture, Forestry, and Waste Management Sectors

Overview of Greenhouse Gas Emissions

The agriculture, forestry, and waste management (AFW) sectors are directly responsible for moderate amounts of South Carolina's current greenhouse gas (GHG) emissions. However, it is important to note that emissions from fossil fuel combustion in the AFW sectors are included in the industrial fossil fuel combustion and transportation sectors; hence, the emissions included here are *primarily* noncombustion GHG emissions (with the exception of some combustion in the waste management sector).

The total agriculture sector contribution to carbon dioxide-equivalent (CO_2e) gross emissions in 2005 was 3.0 million metric tons (MMt), or about 3% of the state's total. Agricultural emissions include methane (CH_4) and nitrous oxide (N_2O) emissions from enteric fermentation, manure management, agriculture soils, and agriculture residue burning. As shown in Figure 7-1, CH_4 emissions from manure management and enteric fermentation both make significant contributions to the sector totals. Agriculture sector emissions shown in the chart also include N_2O emissions resulting from activities that increase nitrogen in the soil, including fertilizer (synthetic, organic, and livestock) application, crop residues, and production of nitrogen-fixing crops (legumes). Not shown in the chart are CO_2 emissions from oxidized soil carbon (0.18 $MMtCO_2$ for all years based on a single 1997 estimate).

There is a very small amount of agricultural burning activity in South Carolina; however, the emissions are too small to be seen in Figure 6-1. Overall, emissions from the agriculture sector have declined slightly through the inventory period, and are estimated to remain fairly constant through the 2020 forecast period.

Forestland emissions refer primarily to the net CO_2 flux[1] from forested lands and urban forests in South Carolina (forests account for about 66% of the state's land area). As shown in Table 7-1, data suggest that South Carolina forests are net sinks of CO_2 and sequestered an average of over 30 $MMtCO_2e$ per year from 1990 to 2005. Hence, during this period in the forested landscape, carbon losses due to forest conversion, wildfire, and disease were estimated to be smaller than the CO_2 sequestered in forest carbon pools, such as live trees, debris on the forest floor, and forest soils, as well as in harvested wood products (e.g., furniture and lumber) and the landfilling of forest products.

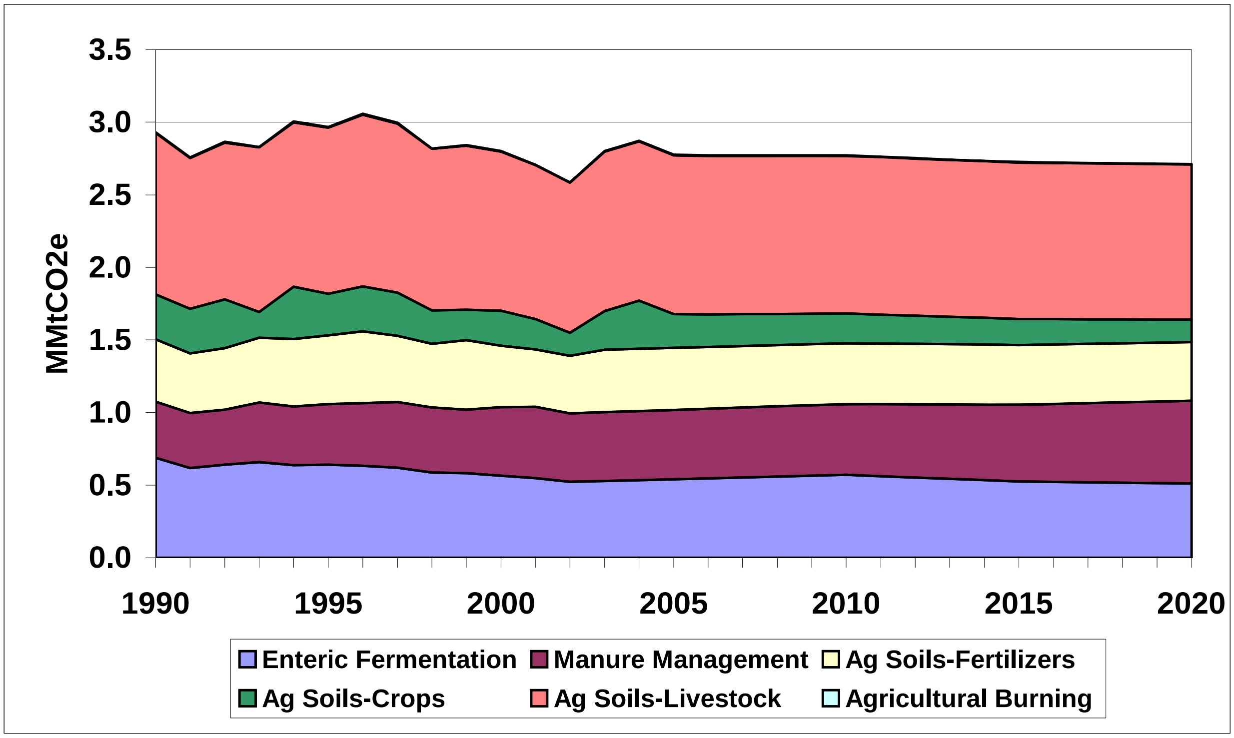
Note that, in keeping with U.S. Environmental Protection Agency (EPA) methods and international reporting conventions, the South Carolina inventory and forecast (I&F) report covers anthropogenic sources of GHGs.[2] There could be some natural sources of GHGs that are not represented in the I&F; however, these are not addressed in the Climate, Energy, and

[1] "Flux" refers to both emissions of CO_2 to the atmosphere and removal (sinks) of CO_2 from the atmosphere.

[2] Center for Climate Strategies. *Final South Carolina Greenhouse Gas Inventory and Reference Case Projections: 1990–2020*. Prepared for the Climate, Energy, and Commerce Advisory Committee of the Office of the Governor of South Carolina. June 2008. Available at: http://www.scclimatechange.us/Inventory_Forecast_Report.cfm.

Commerce Advisory Committee (CECAC) process. In the forestry sector, all emissions are treated as anthropogenic, since all of the state's forests are managed in some way (GHG reporting conventions are to treat all managed forests as anthropogenic sources). Such sources as CO_2 from forest fires and decomposing biomass are captured within the I&F (as part of the carbon stock modeling performed by the U.S. Forest Service [USFS]). However, CH_4 emissions from anaerobic decomposition of biomass in forests are not currently captured due to a lack of data. Emissions of CH_4 and N_2O from fires are estimated separately from CO_2 emissions. As noted in the I&F report, these emissions were not estimated for South Carolina; however, they are expected to be small relative to the estimated carbon sequestration rates.

Figure 7-1. Historical and projected emissions from the Agriculture Sector, 1990–2020



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; LF = landfill; WW = wastewater; LFGTE = landfill gas to energy.

Source: Calculations based on the approach described in *Final South Carolina Greenhouse Gas Inventory and Reference Case Projections: 1990–2020*. This chart does not show an additional 0.18 $MMtCO_2e$ in emissions due to soil carbon losses for each year based on available data.

Notes: Ag Soils–Crops category includes: incorporation of crop residues and nitrogen-fixing crops; Ag Soils–Fertilizers category includes emissions from commercial fertilizer application; Ag Soils–Livestock category includes emissions from manure application. Emissions for agricultural residue burning are too small to be seen in this chart.

Table 7-1. GHG emissions (sinks) from the forestry sector

Subsector	1990	1995	2000	2005	2010	2020
Forested landscape (excluding soil carbon)	–28.8	–28.8	–28.8	–28.8	–28.8	–28.8
Urban forestry and land use	–4.38	–2.88	–2.24	–2.46	–2.46	–2.46
Sector total	–33.2	–31.7	–31.0	–31.2	–31.2	–31.2

Note: Negative numbers indicate net sequestration. Based on USFS input, emissions from soil organic carbon are left out of the forestry sector summary due to a high level of uncertainty.

Carbon is also estimated to be sequestered in South Carolina’s urban forests. For the urban forestry and land-use sector, these include the net CO_2e emissions from carbon stored in urban trees, carbon stored in landfilled yard and food wastes, and N_2O emissions from fertilizer application. These rates of sequestration in the forestry sector (both urban and forested landscape) are assumed to remain constant through 2020. By including forestry sector sequestration in the inventory, total South Carolina gross GHG emissions in 2005 of 93.5 $MMtCO_2e$ are lowered to 62.3 $MMtCO_2e$ on a net basis.

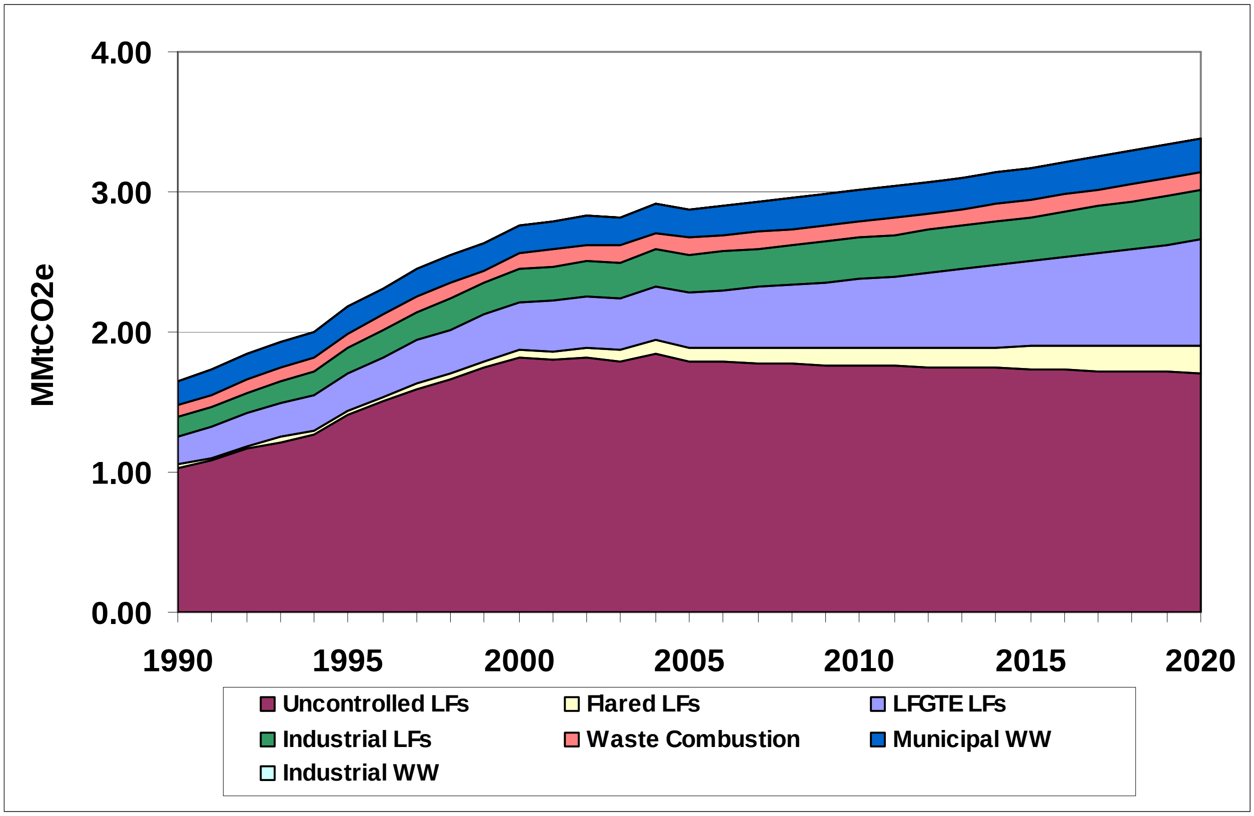
Figure 7-2 shows estimated historical and projected emissions from the management and treatment of solid waste and wastewater. Emissions from waste management consist largely of CH_4 emitted from landfills, while emissions from wastewater treatment include both CH_4 and N_2O. Smaller amounts of GHGs are also emitted during the combustion of solid waste. As shown in Figure 7-2, the largest contributions in the waste management sector come from uncontrolled landfills (about 64% in 2005), although these sites are projected to contribute lower levels in the future as more of the state’s wastes are directed to controlled sites. Overall, the waste management sector accounts for about 3% of South Carolina’s total gross emissions per year from 1990 through 2020.

The CECAC acknowledges that there are higher levels of uncertainty in the GHG emissions and forecasts in the AFW sectors compared to those in other GHG sectors (e.g., those where emissions are tied directly to energy consumption). There is a need for continued investment in research and measurement to refine the AFW I&F (details on key uncertainties are presented in the appendices of the I&F report).

Opportunities for GHG mitigation in the AFW sectors involve measures that can reduce emissions within the sector or reduce emissions in other sectors. For example, within the agriculture sector, changes in crop management practices can reduce GHG emissions by building soil carbon (indirectly sequestering carbon from the atmosphere). Similarly, additional collection and control of landfill methane can reduce emissions from the waste management sector, and reforestation projects can achieve GHG reductions by increasing the carbon sequestration capacity of the state’s forests.

For GHG reductions outside of the AFW sector, actions taken within the sector, such as production of liquid biofuels, can offset fossil fuel emissions in the transportation sector, while biomass energy can reduce fossil fuel emissions in the energy supply (ES) or residential, commercial, and industrial (RCI) sectors. Similarly, actions that promote solid waste reduction or recycling can reduce emissions within the sector (future landfill CH_4), as well as emissions associated with the production of recycled products (recycled products often require less energy to produce than similar products from virgin materials). Finally, urban forestry projects can reduce energy consumption within buildings through shading and wind protection. Many of the mitigation actions in the AFW sectors can achieve reductions both within and outside of both the AFW sector and state boundaries.

Figure 7-2. Estimated historical and projected emissions from waste and wastewater management



$MMtCO_2e$ = million metric tons of carbon dioxide equivalent; LF = landfill; WW = wastewater; LFGTE = landfill gas to energy.

Following are primary opportunities for GHG mitigation identified by the CECAC.

- **Agricultural crop cultivation:** Implement programs that incentivize growers to utilize cultivation practices that build soil carbon and indirectly sequester CO_2 from the atmosphere. These practices, such as no-till cultivation, also often offer opportunities to reduce fossil fuel consumption.
- **Production of liquid biofuels:** Production of renewable fuels, such as ethanol from crop residue, forestry residue, or municipal solid waste, and biodiesel from crop seed oils can produce significant reductions, when they are used to offset consumption of fossil fuels (e.g., gasoline and diesel in the transportation and land use [TLU] and RCI sectors). This is particularly true when these fuels are produced using processes and/or feedstocks that emit much lower GHG emissions than those from conventional sources on a life-cycle basis.

Production incentives could position the state's future biofuels industry to supply states with low-carbon fuel standards, including potentially South Carolina (see TLU-12).

- **Expanded use of forest and agricultural biomass:** Expanded use of biomass energy from residue removed from forested areas during treatments to reduce fire risk, crop residues, or purpose-grown crops can achieve GHG benefits by offsetting fossil fuel consumption (to produce either electricity or heat/steam). Programs to expand sustainably procured biomass fuel production will most likely be needed to supply a portion of the fuel mix for the renewable energy goals of ES-1.
- **Enhancement/protection of forest carbon sinks:** Through a variety of programs, enhanced levels of CO_2 sequestration can be achieved and carbon can be stored in the state's forest biomass. These include reforestation programs, management programs directed at increased sequestration and forest carbon protection, and urban tree programs. Programs aimed at reducing the conversion of forested lands to nonforest cover will also be important to maintain the sequestration capacity of these lands.
- **Changes in municipal solid waste management practices and wastewater treatment efficiency programs:** By concentrating on enhancing the recycling and composting practices in the state, significant GHG emission reductions can be achieved. Also, for waste remaining after full implementation of these "front-end" practices, additional projects are needed to collect and capture methane from biodegradable wastes that are still to be emplaced within the state's landfills. Beneficial use of this methane could achieve additional benefits by offsetting fossil fuel sources. Since wastewater treatment is an energy-intensive process, efficiency programs at wastewater treatment plants can achieve significant GHG reductions by lowering electricity consumption at these sites.

Key Challenges and Opportunities

In the agriculture sector, the CECAC found significant opportunity in promoting biofuel production using feedstocks and production methods with superior GHG benefits (e.g., current conventional corn-based ethanol). When biofuels are used to displace fossil fuels with higher life-cycle carbon contents, net GHG benefits can be achieved. The combined benefits of AFW-4a (ethanol production) and 4b (biodiesel production) are cumulative reductions of more than 1.6 $MMtCO_2e$ annually by 2020.

It should be noted that the estimated GHG benefits did not include any indirect impacts associated with emissions resulting from land-use change.[3] For ethanol production, the recommendations include incentives only for cellulosic ethanol from biomass, not for starch-based ethanol production. Hence, the indirect impacts associated with potential land-use change don't appear to be an issue. For biodiesel production, some of the feedstocks are likely to come from crop oils that also serve as food (e.g., soybean oil, other vegetable oils), especially during

[3] Recent research has indicated that incorporating land conversion impacts into GHG analysis may remove any GHG benefits from biofuels production from crops (e.g., corn to ethanol in the United States leading to land conversion for planting crops in developing countries to make up for the loss of available export food crops). See: T. Searchinger et al. "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change." *Science* February 2008;319(5867):1238-1240. Available at: http://www.sciencemag.org/cgi/content/abstract/1151861.

the early years of implementation. To limit these potential impacts, incentives for research and development, pilot plants, and commercial-scale production will be needed to establish in-state production capacity from new and emerging technologies (cellulosic ethanol, algal biodiesel, gasification, etc.). For the purposes of estimating GHG benefits, it was assumed that these technologies are commercially viable during the policy period.

Future work on the biofuels recommendations should assess the potential for significant impacts on the availability of land, biomass, and water, as well as the consequences for food production, economic feasibility, and changes in overall fuel costs. These issues should be studied in coordination with the recommendations under TLU-12 on the low-GHG fuel standard.

It should be noted that there is significant overlap in benefits of AFW-4a and 4b with the TLU-12 low-GHG fuel standard. However, the CECAC recognizes the need for programs to promote in-state biofuels production (TLU-12 focuses more on the demand side of biofuels).[4] Examples of biofuels that could be produced with much better GHG impacts include ethanol from cellulosic hydrolysis of biomass. Feedstocks for the fiber needed for this recommendation could come from crop residue, energy crops, forestry residue, municipal solid waste biomass, or other sources. A major challenge for the success of AFW-3 is the production of a viable commercial-scale cellulosic ethanol and biodiesel industry by 2015.

CECAC recommendation AFW-5 promotes the expanded use of biomass as an energy source for producing electricity, heat, or steam. Use of biomass to supplant fossil fuels was estimated to reduce almost 5 $MMtCO_2e$ annually by 2020. The CECAC conducted a limited assessment of the available biomass resources in the state, which indicated that sufficient resources were available through 2020 to achieve the goals for both the liquid biofuels recommendation above and this biomass for energy recommendation. Research on sustainable harvest standards is also needed with resulting yields potentially affecting the estimated available quantities. Although the initial assessments show sufficient resources to meet the CECAC's biomass policies, a number of variables are not taken into consideration, including the assumption that all land currently available for biomass production will still be available in 2012 and 2020, the assumption that all available biomass can actually collected feasibly, and the impact of future climate conditions. It will also be necessary to analyze the impact of biomass harvest on plant nutrient removal in both agricultural and forest systems.

Within both the agriculture and forestry sectors, the CECAC also recommends programs to promote terrestrial carbon sequestration (AFW-6). These recommendations cover soil carbon management programs in agriculture to increase soil carbon levels, thereby indirectly sequestering carbon from the atmosphere. Within the forestry sector, there are three separate recommendations covering forest management programs for carbon sequestration, afforestation/reforestation programs, and urban forestry. Combined with the agriculture soil carbon recommendation, these three forestry sector recommendations are estimated to deliver over 4.8 $MMtCO_2e$ in GHG reductions annually by 2020.

[4] The overlap in GHG benefits between AFW recommendations and recommendations in other sectors has been removed in the sector-level totals used to estimate the overall reductions for the CECAC process.

The forest management recommendation to promote terrestrial carbon sequestration seeks to increase the rates of carbon sequestration in the state's forests through a variety of management approaches. These could include increased stocking of poorly stocked lands, age extension of managed stands, thinning and density management, 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, and pest and disease management. The afforestation/reforestation recommendation targets establishing forests on 1.4 million acres of land suitable for these projects. The key challenge with this recommendation is the identification of land both suitable and available for these projects. This recommendation along with the urban forestry recommendation will expand the state's forest base, leading to higher levels of future carbon sequestration. The urban forestry component also has the potential to reduce fossil fuel consumption through shading and wind protection of homes and commercial buildings.

Land use management approaches to carbon management in the agriculture and forestry sectors are also recommended to protect existing above- and below-ground carbon stocks (AFW-7a and b). By preserving agricultural and forested lands, the CECAC estimates GHG savings in 2020 of 3.3 $MMtCO_2e$. To achieve these reductions, the state will need to work closely with local planning agencies, land owners, and nongovernmental organizations to identify lands suitable for acquisition/conservation easements and funding mechanisms. Another benefit from these policies, which was not quantified, is the reduction in vehicle miles traveled (VMT) due to more efficient development patterns that should result as the lands around the urban fringe are protected (see TLU-4).

AFW-8 and AFW-9 provide an integrated set of recommendations for future management of municipal solid waste in South Carolina. AFW-8 focuses on "front-end" waste management technologies: recycling and composting. AFW-8 focuses on reducing landfill methane emissions. The recommendations for AFW-8 represent a significant change from business-as-usual (BAU) waste management in the state: for recycling, a 35% recycling rate should be achieved by 2020, compared to current levels of about 25%; and for composting, a rate of 10% by 2020, compared to current levels of about 6%. The recycling and composting elements of AFW-7 are estimated to reduce GHGs by 3.0 $MMtCO_2e$ annually by 2020. These reductions include avoided landfill GHG emissions, as well as avoided product and packaging life-cycle GHG emissions from the use of recycled products and packaging versus those created from virgin materials. The landfill gas recommendations under AFW-8 are estimated to reduce GHGs by 1.0 $MMtCO_2e$ by 2020.

Although AFW-8 is estimated to achieve a net cost savings, successful implementation will require waste management infrastructure investment by communities in the form of material recovery facilities and composting operations. Cost savings result from avoided landfill fees and the addition of the value of recycled or composted materials. New markets for recycled commodities will need to be established.

Additional CECAC recommendations cover energy efficiency programs covering on-farm operations and wastewater treatment plants (AFW-1 and AFW-10). These recommendations will require sources of up-front capital for implementation, but are also estimated to result in a net cost savings, once energy reductions are taken into account. Combined GHG reductions for these energy efficiency options are estimated to be over 0.3 $MMtCO_2e$ annually by 2020. A final set of recommendations covers energy recovery projects on swine, dairy, and poultry operations (AFW-2a and b). These recommendations are estimated to produce GHG reductions of 0.05 $MMtCO_2e$, with low to negative societal costs.

Overview of Policy Recommendations and Estimated Impacts

As noted above, the 10 policy recommendations for the AFW sector address a diverse array of activities. Taken as a whole, they offer significant cost-effective emission reductions, as shown in Table 7-2.

Table 7-2. Summary list of policy recommendations

No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2020 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Level of Support
		2012	2020	Total 2008–2020			
AFW-1*	On-Farm Energy Efficiency	0.052	0.16	1.0	–$43	–$41	Unanimous
AFW-2a	On-Farm Waste Energy Recovery—Swine/Dairy	0.006	0.019	0.13	$0.58	$5	Unanimous
AFW-2b[†]	On-Farm Waste Energy Recovery—Poultry Litter	0.010	0.031	0.20	–$3.2	–$16	Unanimous
AFW-3	Expanded Use of Local Agricultural Products	0.012	0.030	0.21	Not Quantified	Not Quantified	Unanimous
AFW-4a[†,‡]	In-State Liquid Biofuels Production—Biodiesel	0.12	0.13	1.5	$26	$17	Unanimous
AFW-4b[†]	In-State Liquid Biofuels Production—Ethanol	0.86	1.5	13	$281	$22	Unanimous
AFW-5[‖]	Expanded Use of Biomass Feedstocks for Electricity, Heat, or Steam Production	2.7	4.9	41	$156	$4	Unanimous
AFW-6a	Terrestrial Carbon Sequestration—Agriculture	0.21	0.39	3.1	–$191	–$62	Unanimous
AFW-6bi	Terrestrial Carbon Sequestration—Forestry: Forest Management	0.33	0.85	5.8	$53	$9	Unanimous
AFW-6bii	Terrestrial Carbon Sequestration—Forestry: Afforestation/Reforestation	0.81	2.4	16	$158	$10	Unanimous
AFW-6biii[¶]	Terrestrial Carbon Sequestration—Forestry: Urban Forestry	0.37	1.2	7.5	$456	$60	Unanimous
AFW-7a	Conservation and Restoration of Agriculture Lands for Enhanced Carbon Sequestration	0.080	0.21	1.5	$54	$37	Unanimous
AFW-7b	Conservation and Restoration of Forestlands for Enhanced Carbon Sequestration	0.42	3.1	16	$117	$7	Unanimous
AFW-8	Advanced Recycling and Composting	1.18	3.0	20	–$44	–$2	Unanimous
AFW-9[‖]	Waste-to-Energy Reclamation	0.41	1.0	7.2	$0.23	$0.03	Unanimous
AFW-10*	Water and Wastewater Energy Efficiency Improvements	0.16	0.18	1.6	–$33	–$21	Unanimous
	Sector Total After Adjusting for Overlaps[**]	**7.8**	**19.2**	**135**	**$987**	**$7**	
	Reductions From Recent Actions	**—**	**—**	**—**	**—**	**—**	
	Sector Total Plus Recent Actions[**]	**7.8**	**19.2**	**135**	**$987**	**$7**	

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

All costs are reported in 2005 U.S. dollars, net present value as of January 1, 2009. Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

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

* AFW-1 and AFW-10 may overlap with RCI-6 (Residential, Commercial, and Industrial). However, for reasons stated in the documentation of AFW-1 and AFW-10, no overlap will be counted.

† AFW-4 overlaps with TLU-12 (Transportation and Land Use). This overlap will be accounted for in the cumulative analysis of the TLU options.

‡ AFW-4 biodiesel targets were unachievable with in-state feedstock supplies. These reductions and costs refer to modified goals based on in-state feedstock. See text under AFW-4.

|| AFW-2, AFW-5, and AFW-9 overlap with ES-1 (Energy Supply). These overlaps will be accounted for in the cumulative analysis of the ES options.

¶ AFW-6biii represents the combined costs and benefits of two elements of urban forestry: tree planting and avoided deforestation. The net cost of avoided deforestation was not quantified because of insufficient information regarding the costs of such programs.

** The totals may not equal the sum of rows because of independent rounding. The cost-effectiveness totals represent the total net present value divided by the cumulative (2008–2020) GHG reductions for those options for which quantitative cost analyses were performed (i.e., excludes AFW-3).

Agriculture, Forestry, and Waste Management Sector Policy Descriptions

The agriculture, forestry, and waste management sectors include emission mitigation opportunities related to the use of biomass energy, protection and enhancement of forest and agricultural carbon sinks, production of renewable liquid fuels, production of additional biomass energy, forestation on nonforested lands, and an increase in municipal solid waste recycling, composting, and landfill gas collection.

AFW-1. On-Farm Energy Efficiency

Renewable energy may be produced and used on site at individual agricultural operations or regionally through farm cooperatives to achieve better economies of scale. For example, on-farm production and use of solar heating and biofuels 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 irrigation systems save both water and energy, and expanded use of precision-agriculture systems will also reduce fossil fuel use.

GHG benefits can also be achieved indirectly through better use of organic fertilizers (manure) to offset commercial fertilizers, which require intensive energy inputs for production, transportation, and application. These indirect (life-cycle) benefits are covered within recommendation AFW-6a (Soil Carbon Management—Agriculture).

Note: This AFW policy recommendation is related to RCI-6 (Incentives and Policies for Improving Building Efficiency, Including Building Energy Codes). However, as the AFW-1 mechanism is not prescriptive as to where the electricity reductions must come from, no overlap between these two options is counted.

AFW-2. Farm By-Products Energy Recovery

This policy would reduce both methane emissions from livestock manure by installing manure digesters on livestock operations, and the amount of excess nitrogen applied to crops from poultry litter by promoting gasification, pyrolysis, and other thermochemical conversion methods for energy recovery.

Energy from manure digesters is used to create heat or power, which offsets fossil fuel-based energy production and the associated GHG emissions. Thermochemical conversion and other methods of waste-to-energy conversion may be more advantageous than anaerobic digestion. Energy from these processes will also reduce GHG emissions and may be used to produce synthesis gas and hydrocarbon fuels. As with AFW-1, these energy-recovery projects can be implemented at individual livestock operations or collectively at groups of operations to achieve better economies of scale.

Note: This policy is related to ES-1 (Efficiency and Renewable Portfolio Standard and Statement of Support for New Nuclear Energy). Any overlap with the ES policy is addressed in the ES cumulative analysis. No GHG benefits have been subtracted from the AFW cumulative analysis.

AFW-3. Expanded Use of Local Farm Products

This policy promotes the production and consumption of locally produced agricultural commodities, which displace the consumption of commodities transported from other states or countries. GHG reductions occur from reduced transportation-related emissions and from local farms that utilize GHG reduction practices that may not be instituted in other states or countries.

AFW-4. In-State Liquid Biofuels Production

The ultimate goal of South Carolina is to take full advantage of resources available in the state through agriculture, forestry, or other biomass feedstocks to displace the use of fossil fuels. South Carolina is in an excellent position to develop an in-state alternative fuels industry that will provide economic opportunities for rural communities looking for alternatives to fading tobacco and cotton industries. Policies must be developed in South Carolina that will attract farmers, investors, retailers, and purchasers to produce and use the fuels in the state. The focus of this policy should be in-state biofuels production based on in-state feedstocks.

Efforts on the part of farmers in growing and processing biocrops into biodiesel fuel for on-farm use should be encouraged, and the farmers and/or those who make biodiesel on their behalf should qualify for available state fuel-making incentives.

In 2006 and 2007, South Carolina passed attractive incentives to promote and expand this industry. To date, the incentives have been effective, and have generated a great deal of interest within the alternative-fuels industry. Other potential incentives for alternative-fuel producers include expanding existing tax credits for biodiesel and ethanol to include other low-GHG future fuels, such as butanol and hydrogen.

Note: This policy is related to TLU-12 (Low-GHG Fuel Standard) and TLU-6 (Alternative-Fuel Infrastructure), which promote public consumption of alternative fuels. This policy seeks to achieve incremental GHG benefits beyond the TLU policies by promoting in-state production of biofuels using feedstocks with greater GHG benefits than the likely BAU national production methods. Any overlap with the TLU policies is addressed in the TLU cumulative analysis. No GHG benefits have been subtracted from the AFW cumulative analysis for AFW-4.

AFW-5. Expanded Production of In-State Biomass for Electricity, Heat, or Steam Production

This policy proposes to offset fossil fuel use with production of electricity, steam, and heat from biomass resources, and to provide incentives for the development of new biomass production and collection infrastructure, as well as incentives for energy end users that are equitable throughout the economy. Local electricity, heat, or steam production yields the greatest net energy payoff. According to a recent study for the Central Electric Power Cooperative, South Carolina currently has 360 MW of installed capacity for woody biomass.[5] Based on available wood and agriculture residue inventories, as well as energy crop production potential, South Carolina has the ability to more than double its current level of biomass production.

The focus of this policy is on programs needed to increase the availability of biomass feedstocks for in-state use. Policies to encourage use of this resource are addressed within the ES recommendations.

Note: This policy is related to ES-1 (Study the Energy Options for Portfolio Standards). Any overlap with the ES recommendation is addressed in the ES cumulative analysis. No GHG benefits have been subtracted from the AFW cumulative analysis.

AFW-6. Terrestrial Carbon Sequestration

AFW-6a. Terrestrial Carbon Sequestration—Agriculture

This policy considers four components of improved soil carbon management: alternative cultivation practices, manure management practices, crop conversion to increase sequestration potential, and rotational grazing.

The amount of carbon stored in the soil can be increased by adopting such practices as conservation-till and no-till cultivation, cover cropping, and application of biochar (i.e., charcoal) and compost. Reducing summer fallow and increasing winter cover crops are complementary practices that reduce the need for conventional tillage. The application of biochar and compost increases soil carbon content, stabilizes soil carbon, enhances drought resistance, and may improve production by boosting soil dynamics. 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.

Additionally, manure management practices may reduce GHG emissions associated with manure handling and storage. Potential practices may include composting of manure (to reduce methane emissions) and improved methods of field application (for reduced nitrous oxide emissions). Application improvements include incorporating manure into the soil, instead of surface spraying or spreading it, spreader calibration, and manure management planning.

Another management practice involves converting marginal agricultural land used for annual crops to permanent cover, such as grassland/rangeland, orchard, perennial biocrops, or forest, where the soil carbon and/or carbon in biomass is higher under the new land use. This policy includes opportunities to keep U.S. Department of Agriculture Conservation Reserve Program lands covered in perpetuity. Increased demand for corn-based ethanol and biodiesel feedstocks can act as an incentive for converting grassland to cropland. Incentives could be offered to reduce returning acreage to conventionally tilled production or to suburban/urban development.

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[5] GDS Associates, Inc., and La Capra Associates, Inc. "Analysis of Renewable Energy Potential in South Carolina: Renewable Resource Potential—Final Report." Prepared for Central Electric Power Cooperative, Inc. September 12, 2007. Available at: http://www.ecsc.org/newsroom/RenewablesStudy.ppt.

Heavy grazing can cause significant soil disturbance and result in carbon losses from soils. Practicing rotational grazing, where animals are regularly moved from field to field, reduces soil disturbance, improves soil carbon levels, and can improve plant vigor.

AFW 6b. Terrestrial Carbon Sequestration—Forestry

This policy establishes forests on land that has not historically been forested (e.g., agricultural land) ("afforestation"). It also promotes forest cover and associated carbon stocks by regenerating or establishing forests in areas with little or no present forest cover ("reforestation").

Forest management has significant potential to sequester CO_2. Southern forests are capable of sequestering more than 1 tCO_2/acre/year, and there are 12.9 million acres of forestland in South Carolina. Since 73% of South Carolina forestland is privately owned, the management decisions made by private landowners will ultimately determine carbon impacts.

Promoting forest management for carbon sequestration also has many additional benefits, such as wildlife habitat, clean air and water, recreational opportunities, and scenic beauty. Timber is South Carolina's highest-valued agricultural crop, and the forest industry leads the manufacturing sector in South Carolina with regard to employment and wages paid. Forest-based jobs, payroll, and capital investment are an important part of the state's economy.

This policy includes a range of forest management activities that promote productivity and increase the rate of CO_2 sequestration in biomass, soils, and harvested wood products. Practices may include soil preparation, erosion control, increased stocking of poorly stocked lands, age extension of managed stands, thinning and density management, 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, and urban forestry, including urban tree planting and enhanced maintenance programs.

AFW-7. Conservation and Restoration of Forest and Agricultural Lands for Enhanced Carbon Sequestration

AFW-7a. Conservation and Restoration of Agricultural Lands for Enhanced Carbon Sequestration

In agricultural lands, soil carbon levels can be higher than those converted to developed use. By conserving agricultural lands, GHG emissions can also be reduced indirectly by influencing more efficient development patterns (leading to lower VMT). Therefore, a suitable policy for carbon sequestration is to incorporate methodologies that reduce the rate at which the existing base of South Carolina agricultural acreages is cleared and converted to developed uses.

AFW-7b. Conservation and Restoration of Forestlands for Enhanced Carbon Sequestration

Forests can play a substantial role in climate change by sequestering (or storing) carbon (by absorbing CO_2) as trees grow and releasing it as they decay. Trees are powerful, relatively low-cost concentrators of carbon. Young forests sequester carbon at a high rate, roughly proportional to forest growth in biomass. Old-growth forests have a large balance of carbon stored over time in wood and soil.

Forests set aside to promote old growth result in long-term carbon storage balance due to a negligible rate of additional carbon sequestration because of natural loss and decay at about the same rate as they are growing. Land-use changes resulting in forest conversion to other uses are generally believed to be a secondary source of net carbon release. Much of the carbon stored in forest biomass and soils can be released as a result of such land-use conversion in addition to the loss in future carbon sequestration. Therefore, a suitable policy for carbon sequestration is to incorporate methodologies that promote long-term maintenance of the existing base of South Carolina forest acreages and support public policies that encourage and enhance carbon sequestration on those lands. Another appropriate policy to sequester carbon is to encourage the manufacture and use of durable wood products sequestering carbon over the life of the products.

Conversion of cropland acreage to forest acreage can produce GHG benefits by adding above- and below-ground biomass (sequestering carbon) to the converted area. The converted area is also likely to sequester more carbon annually as forested area than as cropland. This option also covers programs aimed at protecting forested areas that were previously converted (e.g., returned to active cultivation).

AFW-8. Advanced Recycling and Composting

This policy would increase the use of recycling and composting as waste diversion methods in order to limit GHG emissions associated with landfill methane generation and to increase production efficiencies of raw materials and new products. To achieve the goals of this policy, it will be necessary to increase awareness of the value of recycling, develop consistent recycling programs across counties, promote “best practices” comparisons across counties and between other states, increase and create new recycling programs, provide incentives for the recycling of construction and demolition waste, develop markets for recycled materials and compost, and increase average participation/recovery rates for all existing recycling and composting programs.

AFW-9. Waste-to-Energy Reclamation

This policy promotes the use of anaerobic digesters and energy recapture for organic waste materials (e.g., food processing waste, yard waste, other organics). (Note the linkage to AFW-2, whereby some organics from this waste stream could be co-managed with livestock wastes, and to the AFW-8 composting goals.) For waste that is landfilled, this policy promotes the use of landfill gas-to-energy projects.

Anaerobic digesters make a two-fold contribution to climate protection: the usual unchecked discharge of methane into the atmosphere is prevented, and the burning of fossil fuels is replaced with clean, renewable energy (biogas). Under this policy, the clean, renewable energy created at landfills by anaerobic digesters is used to make electric power, space/process heat, and liquefied/compressed natural gas. Note that this policy is not promoting waste combustion-to-energy projects.

Note: This AFW policy is related to ES-1 (Efficiency and Renewable Portfolio Standard and Statement of Support for New Nuclear Energy). Any overlap with ES-1 is addressed in the ES cumulative analysis. No GHG benefits have been subtracted from the AFW cumulative analysis.

AFW-10. Water and Wastewater Energy Efficiency Improvements

The collection and treatment of wastewater and the treatment and delivery of drinking water cost around $4 billion per year and make up 3% of the nation's energy use. Achieving the goal of a 10%–25% improvement in energy efficiency would produce a savings of $400 million to $1 billion, which translates into energy savings of 5–12.5 billion kilowatt-hours. The improved energy efficiency would also help to reduce GHG emissions.

Most facilities that carry out these operations were designed during periods of lower energy costs and/or did not adequately consider the release of GHG emissions to the environment. Simple improvements, such as replacing older equipment, can produce savings. Organizations like the American Water Works Association (AWWA) Research Foundation and EPA have launched initiatives to improve energy efficiency. The AWWA Research Foundation launched the National Municipal Water and Wastewater Facility Initiative in December 2004, and EPA launched the ENERGY STAR wastewater program in 2007.

Note: This policy is related to RCI-6 (Incentives and Policies for Improving Building Efficiency, Including Building Energy Codes). However, as the AFW-1 mechanism is not prescriptive as to where the electricity reductions must come from, no overlap between these two policies is counted.