



North Carolina
Climate Action Plan Advisory Group

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Agriculture, Forestry, and Waste Management Sectors GHG Reduction Policy Options

Prepared for Technical Working Group (TWG) Call #1, April 13, 2006 9:00-10:30 AM

Potential Emission Reductions <u>1/</u>	Potential Cost or Cost Savings <u>1/ 2/</u>
High (H): At least 1 Million Metric Tons (MMT) carbon dioxide equivalent (CO ₂ e) per year by 2020 (~1% of current NC emissions)	High (H): \$50 per Metric Ton CO ₂ e (MTCO ₂ e) or above
Medium (M): From 0.1 to 1 MMT CO ₂ e per year by 2020	Medium (M): \$5-50/MTCO ₂ e
Low (L): Less than 0.1 MMT CO ₂ e per year by 2020, or 1 MMT CO ₂ e by 2050	Low (L): Less than \$5/MTCO ₂ e
Uncertain (U): Not able to estimate at this time	Uncertain (U): Not able to estimate at this time
<u>1/</u> Several measures may overlap in terms of emissions reductions and/or cost impacts. Estimates assume measures would be implemented independently from other measures.	
<u>2/</u> 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.

* Options marked with an asterisk (*) indicate options that are at least partially “base case” policies, i.e., that have been considered or undertaken at some level in North Carolina.

** Options marked with a double asterisk (**) indicate options that are included as recommendations in the September 1, 2005 NC DENR Report under the Clean Smokestacks Act of 2002.

AFW

Option No.	GHG Reduction Policy Option	Priority for Analysis	Potential GHG Emissions Reduction	Potential Cost or Cost Savings	Ancillary Impacts, Feasibility Considerations	Notes
AFW-1 Agriculture – Production of Fuels and Electricity						
1.1	Manure Digesters/Other Waste Energy Utilization		Medium	Neg to Low	<ul style="list-style-type: none"> • Linked with Option AFW2.2 below 	<ul style="list-style-type: none"> • Hog farms a likely focus in NC • Recent proposed projects to incorporate this option with ethanol production (e.g. beef feedlots) in other states.
1.2	Biodiesel Production (incentives for feedstocks and production plants)		Medium	Med to High	<ul style="list-style-type: none"> • Production from both virgin and waste vegetable oils 	
1.3	Biomass Feedstocks for Electricity or Steam Production		Medium	Neg to Low	<ul style="list-style-type: none"> • Need to identify viable feedstocks and volumes [e.g., crop residue (wheat straw, corn stover) or energy crops (switchgrass)] 	<ul style="list-style-type: none"> • Linkage to Energy Supply TWG to determine availability of biomass plants • Linkage to RCI TWG to identify available capacity for biomass generated steam

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1.4	Ethanol Production (incentives for production plants)		Medium	Med to High	<ul style="list-style-type: none"> Starch- (e.g. corn-) and cellulosic production processes. 	<ul style="list-style-type: none"> Starch-based ethanol has small GHG benefits, while cellulosic ethanol has much higher benefits due to the energy required for ethanol production
AFW-2 Agriculture – Fertilizer and Manure Management						
2.1	Nutrient Management (improve efficiency of fertilizer use)		Medium	Low		
2.2	Manure Management (improve application methods)		Medium	?	<ul style="list-style-type: none"> Linked with Option AFW1.1 above and 2.1, 2.3 below. Co-benefits include reduction of ammonia and VOC emissions. 	<ul style="list-style-type: none"> Application improvement includes incorporation into soil, instead of surface spray/spreading.
2.3	Manure Composting		Low	?	<ul style="list-style-type: none"> Potentially most feasible in the poultry, dairy or beef cattle sectors. 	<ul style="list-style-type: none"> Potential for reduction in CH4 emissions.
2.4	Change Feedstocks (optimize nitrogen for N ₂ O reduction)		Low to Medium	Low	<ul style="list-style-type: none"> Co-benefits include reduction in ammonia emissions. 	<ul style="list-style-type: none"> Option includes supplements to reduce CH4 from enteric fermentation, as well as nitrogen efficiency to reduce downstream N2O.
2.5	Reduce Non-Farm (Residential and Commercial) Fertilizer Use		Low	?	<ul style="list-style-type: none"> Emissions from non-farm application are not currently in the inventory; unclear what the reductions and costs would be. 	<ul style="list-style-type: none"> Additional research needed on the levels of N2O emissions from lawns, golf courses, etc.
2.6	Using Bio-char as Soil Amendment		?	?	<ul style="list-style-type: none"> Increase soil productivity and soil carbon storage 	<ul style="list-style-type: none"> Need information on the sources of bio-char and its impacts.

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AFW-3 Agriculture – Soil Carbon Management						
3.1	Conservation Tillage/No-Till (carbon sequestration and reduced energy use)		Medium	Low	•	• Need estimates on current practices/potential for increased acreage.
3.2	Reduce Summer Fallow (increase soil C content, reduce N ₂ O emissions)		?	?	•	• Need estimates of fallow summer acreage
3.3	Increase Winter Cover Crops (increase soil C content, increase soil N content)		?	?	•	• Need estimates of winter acreage available for cover crops
3.4	Improve Water and Nutrient Use (to minimize soil C loss)		Low	Low	•	
3.5	Rotational Grazing/Improve Grazing Crops and/or Management		Low	Low	•	
3.6	(Additional option, if/as suggested)					
AFW-4 Agriculture – Land Use Change						
4.1	Convert Land to Grassland or Forest		Medium	?		• Need estimates of marginal agricultural land with the potential for conversion.
4.2	Preserve Open Space/Agricultural Land		High	?	• Reductions occur both from higher retention of carbon in soil and lower transportation activity.	
4.3	Promote “No Net Loss” of Agricultural Land		High	?	• Reductions occur both from higher retention of carbon in soil and lower transportation activity.	
AFW-5 Agriculture – Farming Practices						
5.1	Convert Diesel Farm Equipment to LNG/CNG, Hybrid Technology, or Bio-diesel		Low	Med to High	• LNG/CNG engines or engine conversions reduce BC emissions • Availability of diesel hybrid equipment for farm applications?	•

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5.2	Programs to Support Organic Farming		Medium	Low	<ul style="list-style-type: none"> Reductions occur via lower intensity agricultural practices (nutrient/pesticide application, reduced tillage) 	<ul style="list-style-type: none"> Weed management Transgenic crops Integrated pest management Bed/row size or spacing Application efficiencies (low volume sprayers, etc.)
5.3	Programs to Support Local Farming/Buy Local		Medium	?	<ul style="list-style-type: none"> Reductions occur through lower transport related emissions. 	<ul style="list-style-type: none">
5.4	Programs to Encourage Local Oilseed Pressing for Bio-diesel Production and Use as Farm Equipment Fuel		Low	?	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
AFW-6 Forestry – Biomass Protection and Management						
6.1	Forest Protection – Reduced Clearing And Conversion to Nonforest Cover		High	Low	<ul style="list-style-type: none"> Depends on business as usual rates of land clearing and viable alternatives 	<ul style="list-style-type: none">
6.2	Increase Maintenance of Urban and Residential Trees		Low	Low to high	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
6.3	Afforestation and/or Restoration of Nonforested Lands		Low to high	Low	<ul style="list-style-type: none"> depends on available acreage and risk 	<ul style="list-style-type: none">
6.4	Reforestation/Restoration of Managed Stands		Low to high	Low	<ul style="list-style-type: none"> depends on available acreage and risk 	<ul style="list-style-type: none">
6.5	Increased Stocking of Poorly Stocked Lands		Low to high	Low	<ul style="list-style-type: none"> depends on available acreage and risk 	<ul style="list-style-type: none">
6.6	Age Extension of Managed Stands		Low	Low to high	<ul style="list-style-type: none"> involves significant tradeoffs with carbon savings from harvested wood products, as well as ecological risk 	<ul style="list-style-type: none">

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6.7	Thinning and Density Management of Managed Stands		High	Low to high	<ul style="list-style-type: none"> cost and technology barriers to market use of harvested biomass may be high; supply potential is high 	•
6.8	Fertilization and Waste Recycling		Low	Low to high	<ul style="list-style-type: none"> site and situation specific 	•
6.9	Expand Short Rotation Woody Crops (for fiber and energy)		Low to medium	Low to high	<ul style="list-style-type: none"> depends on available acreage and market demand 	•
6.10	Expanded Use of Genetically Preferred Species		Low	Low	<ul style="list-style-type: none"> 	•
6.11	Modified Biomass Removal Practices (reduced decay and energy use)		Low	?	<ul style="list-style-type: none"> may be opportunities to use biofuels for equipment 	•
6.12	Fire Management and Risk Reduction Programs		High	Low to high	<ul style="list-style-type: none"> implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse 	•
6.13	Ecosystem Health Risk Reduction Programs (pest/disease, invasive species)		High	Low to high	<ul style="list-style-type: none"> implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse 	•
6.14	Drought Management Programs (tree selection, placement, protection)		High	Low to high	<ul style="list-style-type: none"> implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse 	•
6.15	Flood and Riparian Management Programs (tree selection, placement, protection)		Low	Low to high	<ul style="list-style-type: none"> depends on available acreage 	•

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6.16	Watershed Management Programs (stand retention, enhancement and management)		Low to high	Low to high	• depends on available acreage and forest health issues	•
6.17	Habitat Management Programs (stand retention, enhancement and management)		Low to high	Low to high	• depends on available acreage and forest health issues	•
AFW-7 Forestry - Wood Products and Waste						
7.1	Improved Mill Waste Recovery		Low to high	Low to high	• technology and market dependent	•
7.2	Improved Logging Residue Recovery		High	Low to high	• technology and market dependent	•
7.3	Expanded Use of Wood Products for Building Materials		Medium to high	Low to high	• technology and market dependent	• Supplant use of non-wood products (e.g. steel, cement) with wood products, where possible.
7.4	Expanded Use of State and Locally-Grown Wood Products		Low to high	Low to high	• technology and market dependent	• Reduces transportation-related emissions and embedded energy.
7.5	(Additional option, if/as suggested)				•	•
AFW-8 Forestry – Energy Production						
8.1	Expanded Use of Forest Biomass Feedstocks for Electricity (fuel switching)		High	Low	• technology and market dependent	•
8.2	Expanded Use of Forest Biomass Feedstocks for Residential, Commercial/Institutional, or Industrial Heating		High	Low	•	•
8.3	Improved Efficiency of Wood Burning Stoves and Direct Heat		Low to Medium	?	•	•

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8.4	Improved Energy Capture from Wood Waste Combustion		Low to high	?	<ul style="list-style-type: none"> technology and market dependent 	<ul style="list-style-type: none">
8.5	Expanded Landfill Methane Recapture (wood products waste)		Low	Neg to Low	<ul style="list-style-type: none"> Federal New Source Performance Standards and Emissions Guidelines require methane capture at larger landfills. 	<ul style="list-style-type: none"> Also under Waste management (Options AFW10.1-AFW10.3)
8.6	Improved Commercialization of Biomass Gasification and Combined Cycle		Low to high	Medium to high	<ul style="list-style-type: none"> requires improved technology and market incentives 	<ul style="list-style-type: none">
AFW-9 Waste Management – Waste Management Strategies						
9.1	Advanced Recycling and Composting		Low	Low	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
9.2	Advanced Municipal Solid Waste Management Practices (e.g., bioreactors)		Low to Med	Neg to Low	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
9.3	Source Reduction Strategies		Low	Low	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
9.4	Resource Management Contracting		?	?	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
9.5	Manure Digesters		Med	Neg to Low	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Also under Agriculture (Option AFW1.1)
9.6	Waste Coal Recapture		Med	?	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> No direct CO₂e reductions – benefit is the net improvement in embedded energy content between waste coal and new coal extraction.
AFW-10 Waste Management – Landfill Gas Strategies						
10.1	Flare Landfill Methane at non-NSPS (smaller) sites		Low	Med to High	<ul style="list-style-type: none"> Federal New Source Performance Standards and Emissions Guidelines require methane capture at larger landfills. 	<ul style="list-style-type: none"> Should be limited to consideration at sites where energy can not be recovered feasibly; Need to consider energy required to collect CH₄.

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10.2	Methane and Biogas Energy Programs		Low to Med	Neg to Med	•	•
10.3	Convert Landfill Methane to Electric Power, Space Heat, or LNG		Low to Med	Neg to Low	•	•
AFW-11 Waste Management – Wastewater Activities						
11.1	Energy Efficiency Improvements		Low	Neg to Low	•	•
11.2	Lower Waste Processing Needs (lower water consumption, waste production)		Low	?	•	•
11.3	Install Digesters and Turbines		Low to Med	?	•	•
11.4	Install Fuel Cells		Low to Med	?	•	•