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## AGRICULTURE & FORESTRY (AF) SECTOR GHG REDUCTION POLICY OPTIONS

PREPARED FOR TWG CALL #6, JANUARY 10, 2006

Potential Emission Reductions <u>1/</u>	Potential Cost or Cost Savings <u>1/ 2/</u>
<b>High (H):</b> At least 1 Million Metric Tons (MMT) carbon dioxide equivalent (CO <sub>2</sub> e) per year by 2020 (~1% of current NM emissions), at least 10 MMT CO <sub>2</sub> e by 2050	<b>High (H):</b> \$50 per Metric Ton CO <sub>2</sub> e (MTCO <sub>2</sub> e) or above
<b>Medium (M):</b> From 0.1 to 1 MMT CO <sub>2</sub> e per year by 2020, or 1-10 MMT CO <sub>2</sub> e by 2050	<b>Medium (M):</b> \$5-50/MTCO <sub>2</sub> e
<b>Low (L):</b> Less than 0.1 MMT CO <sub>2</sub> e per year by 2020, or 1 MMT CO <sub>2</sub> e by 2050	<b>Low (L):</b> Less than \$5/MTCO <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
<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.

\*Changes discussed during Call #5 are highlighted in yellow.

Option No.	GHG Reduction Policy Option	Priority for Analysis	Potential GHG Emissions Reduction	Potential Cost or Cost Savings	Ancillary Impacts, Feasibility Considerations	Notes
<b>Agriculture, Production of Fuels and Electricity</b>						
1.1	Manure Digesters (methane recovery and electricity production)	High	Medium	Cost Savings to Low	<ul style="list-style-type: none"> <li>Co-reductions in other air pollutants (ammonia, VOC)</li> </ul>	<ul style="list-style-type: none"> <li>Linked with Option 2.2 below</li> </ul>
1.2	Biodiesel Production (incentives for feedstocks and production plants)	Medium	Medium	Med to High	<ul style="list-style-type: none"> <li>Seed oil production in NM feasible (e.g. soy and rapeseed)?</li> </ul>	<ul style="list-style-type: none"> <li>Production from both virgin and waste vegetable oils</li> </ul>
1.3	Biomass Feedstocks for Electricity or Steam Production	Low	Low	?	<ul style="list-style-type: none"> <li>Pecan waste has been identified as the most likely feedstock.</li> <li>Pecan waste will be considered unless too small to be considered alone, in which case, it will be included in Option 8.1</li> </ul>	<ul style="list-style-type: none"> <li>Linkage to Energy Supply TWG to determine availability of biomass plants</li> <li>Linkage to RCI TWG to identify available capacity for biomass generated steam</li> </ul>
1.4	Ethanol Production	High	Medium	Med to High	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>Note differences in energy benefits between cellulosic ethanol versus starch-based (e.g. corn) ethanol production</li> </ul>
1.5	Convert Diesel Farm Equipment to LNG/CNG or Hybrid Technology	Low	Low	Med to High	<ul style="list-style-type: none"> <li>LNG/CNG engines or engine conversions reduce BC emissions</li> <li>Availability of diesel hybrid equipment for farm applications?</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
1.6	(Additional option, if/as suggested)				<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
1.7	(Additional option, if/as suggested)				<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
<b>Agriculture, Fertilizer and Manure Management</b>						
2.1	Nutrient Management (improve efficiency of fertilizer use)	High	Medium	Low	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>Linked to Option 3.4 below.</li> </ul>
2.2	Manure Management (practices to reduce methane emissions)	High	Medium	?	<ul style="list-style-type: none"> <li>Could include composting and other measures.</li> <li>Co-benefits include reduction of ammonia and VOC emissions.</li> </ul>	<ul style="list-style-type: none"> <li>Linked with Option 1.1 above.</li> <li>Most of the benefit achieved at dairies.</li> </ul>
2.3	Change Feedstocks (optimize nitrogen for N <sub>2</sub> O reduction)	Low	Low	Low	<ul style="list-style-type: none"> <li>Co-benefits include reduction in ammonia emissions.</li> </ul>	<ul style="list-style-type: none"> <li>Most of the benefit achieved at feedlots.</li> </ul>

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2.4	Reduce Non-Farm (Residential and Commercial) Fertilizer Use	Low	?	?	<ul style="list-style-type: none"> <li>Emissions from non-farm application are not currently in the inventory; unclear what the reductions and costs would be.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
2.5	(Additional option, if/as suggested)				<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
2.6	(Additional option, if/as suggested)				<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
<b>Agriculture, Soil Carbon Management</b>						
3.1	Conservation Tillage/No-Till (carbon sequestration and reduced energy use)	High	Medium	Low	<ul style="list-style-type: none"> <li>Boll Weevil eradication program requires cotton residue to be plowed under (conservation tillage not applicable to cotton)</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
3.2	Reduce Summer Fallow (increase soil C content, reduce N <sub>2</sub> O emissions)	Medium	?	?	<ul style="list-style-type: none"> <li>Applicability to NM agricultural lands?</li> </ul>	<ul style="list-style-type: none"> <li>Need estimates of fallow summer acreage for cover crops</li> </ul>
3.3	Increase Winter Cover Crops (increase soil C content, increase soil N content)	Low	?	?	<ul style="list-style-type: none"> <li>Applicability to NM agricultural lands?</li> </ul>	<ul style="list-style-type: none"> <li>Need estimates of winter acreage available for cover crops</li> </ul>
3.4	Improve Water and Nutrient Use (to minimize soil C loss)	Medium	Low	Low	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>Linked to Option 2.1 above; These two could be combined.</li> </ul>
3.5	Rotational Grazing/Improve Grazing Crops and/or Management	Medium	Low	Low	<ul style="list-style-type: none"> <li>Applicability to NM grazing lands?</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
3.6	(Additional option, if/as suggested)				<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
<b>Agriculture, Land Use Change</b>						
4.1	Convert Land to Grassland or Orchards	High	Medium	?	<ul style="list-style-type: none"> <li>Opportunities for conversion in NM?</li> <li>Potential natural vegetation should guide any conversions so as to ensure a healthy viable ecosystem.</li> <li>Conversion should be from annual crops to perennial crops or permanent cover.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>

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4.2	Reduce Permanent Conversion of Farm and Rangelands to Developed Uses	High	High	?	•	<ul style="list-style-type: none"> <li>• Reductions occur both from higher retention of carbon in soil and lower transportation activity.</li> <li>• Linked to Option 4.3.</li> <li>• Linked to Smart Growth Options in the TLU TWG.</li> </ul>
4.3	(Additional option, if/as suggested)				•	•
4.4	(Additional option, if/as suggested)				•	•
<b>Agriculture, Farming Practices</b>						
5.1	Organic Farming	High	Medium	Low	•	<ul style="list-style-type: none"> <li>• Reductions occur via lower intensity agricultural practices (nutrient/pesticide application, reduced tillage)</li> <li>• <a href="#">Link to Option 3.1</a></li> </ul>
5.2	Programs to Support Local Farming/Buy Local	High	Medium	?	•	• Reductions occur through lower transport related emissions.
5.3	(Additional option, if/as suggested)				•	•
5.4	(Additional option, if/as suggested)				•	•
<b>Forestry, Biomass Protection and Management</b>						
6.1	Forest Protection – Reduced Clearing And Conversion to Nonforest Cover for Developed Use	High	High	Low	•	• reductions and costs depend on business as usual rates of land clearing and viable alternatives
6.2	Increase Maintenance of Urban and Residential Trees	Medium	Low	Low to High	• Increased maintenance will result in more over mature and hazard trees being removed.	•

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6.3	Afforestation of Nonforested Rural Lands	Medium	Low to High	Low	<ul style="list-style-type: none"> <li>Afforestation might not be economically feasible in the Southwest or successful over large areas. Most tree plantings in the state require a minimum of two years supplemental watering to get established.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
6.4	Afforestation of Nonforested Urban Lands	Medium	Low to High	Low	<ul style="list-style-type: none"> <li>Urban plantings can have necessary supplemental watering provided via drip irrigation and could use gray water as a co-benefit.</li> </ul>	<ul style="list-style-type: none"> <li>Reductions and costs depend on available acreage and risk</li> </ul>
6.5	Reforestation/Restoration of Forested Lands	Medium	Low to High	Low	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>Reductions and costs depend on available acreage and risk</li> </ul>
6.6	Reforestation or Increased Stocking of Stands	Medium	Low to High	Low	<ul style="list-style-type: none"> <li>Increased stocking by planting may not be economically feasible in the Southwest or successful over large areas. Natural regeneration in the stands might be more than sufficient. In most cases, the stands are over-stocked, resulting in stagnant stands more susceptible to insect and disease outbreaks and catastrophic fires.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
6.7	Age Extension of Managed Stands	Low	Low	Low to high	<ul style="list-style-type: none"> <li>Involves significant tradeoffs with carbon savings from harvested wood products, as well as ecological risk;</li> <li>The rate of sequestration in over mature trees tends to be negative, as biomass is breaking down faster than accumulating.</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
6.8	Thinning and Density Management of Managed Stands	High	High	Low to high	<ul style="list-style-type: none"> <li>Cost and technology barriers to market use of harvested biomass may be high; supply potential is high</li> </ul>	<ul style="list-style-type: none"> <li>Link to Forest Health and Restoration</li> </ul>

Option No.	GHG Reduction Policy Option	Priority for Analysis	Potential GHG Emissions Reduction	Potential Cost or Cost Savings	Ancillary Impacts, Feasibility Considerations	Notes
6.9	Fertilization and Waste Recycling	Medium	Low	Low to high	<ul style="list-style-type: none"> <li>• Site and situation specific</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
6.10	Expand Short Rotation Woody Crops (for fiber and energy)	Medium	Low to medium	Low to high	<ul style="list-style-type: none"> <li>• Probably not feasible in NM due to water requirements of these crops.</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
6.11	Expanded Use of Genetically Preferred Species	Low	Low	Low	<ul style="list-style-type: none"> <li>• Primary issues in the southwest are reductions of fuel load and restoration of native species;</li> <li>• Might have merit in urban plantings, but large scale plantings may not be economically feasible in the Southwest.</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>
6.12	Modified Biomass Removal Practices (reduced decay and energy use)	Medium	Low	?	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• There may be opportunities to use biofuels in biomass removal equipment</li> </ul>
6.13	Fire Management and Risk Reduction Programs	High	High	Low to high	<ul style="list-style-type: none"> <li>• Implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse.</li> </ul>	<ul style="list-style-type: none"> <li>• Link to Forest Health and Restoration</li> </ul>
6.14	Forest Health Risk Reduction Programs (pest/disease, invasive species)	High	High	Low to high	<ul style="list-style-type: none"> <li>• Implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse.</li> </ul>	<ul style="list-style-type: none"> <li>• Managing the forest lands to be healthy, viable and productive could incorporate many of the listed options.</li> <li>• Link to Forest Health and Restoration</li> </ul>
6.15	Drought Management Programs (tree selection, placement, protection)	Medium	High	Low to high	<ul style="list-style-type: none"> <li>• Implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse;</li> <li>• Probably limited to urban areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Link to Forest Health and Restoration</li> </ul>

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6.16	Flood and Riparian Management Programs (tree selection, placement, protection)	Medium	Low	Low to high	•	<ul style="list-style-type: none"> <li>• Related to 6.14 in broad sense. Tree selection, placement, protection items are more for small scale, perhaps municipality, park, or refuge. Riparian management across a landscape is managing for a healthy watershed which would include planting within an exclusions from cattle and wildlife in meadows and rangeland, not forests.</li> <li>• Link to Forest Health and Restoration</li> </ul>
6.17	Watershed Management Programs (stand retention, enhancement and management)	Medium	Low to high	Low to High	• Reductions and costs depend on available acreage and forest health issues.	• Link to Forest Health and Restoration
6.18	Habitat Management Programs (stand retention, enhancement and management)	Medium	Low to high	Low to High	• Reductions and costs depend on available acreage and forest health issues.	• Link to Forest Health and Restoration
6.19	(Additional option, if/as suggested)				•	•
6.20	(Additional option, if/as suggested)				•	•
<b>Forestry, Wood Products and Waste</b>						
7.1	Improved Mill Waste Recovery	Medium	Low to High	Low to High	• technology and market dependent	• Link to Forest Health and Restoration
7.2	Improved Logging Residue Recovery	Medium	High	Low to High	• technology and market dependent	• Link to Forest Health and Restoration
7.3	Expanded Use of Small Diameter Trees for Wood Products and Energy	High	High	Low to High	• technology and market dependent	• Link to Forest Health and Restoration
7.4	Expanded Use of Wood Products for Building Materials	Medium	Medium to High	Low to High	• technology and market dependent	• Link to Forest Health and Restoration
7.5	Expanded Use of State and Locally-Grown Wood Products	Medium	Low to High	Low to High	• technology and market dependent	• Link to Forest Health and Restoration
7.6	(Additional option, if/as suggested)				•	•

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7.7	(Additional option, if/as suggested)				•	•
	<b>Forestry, Energy Production</b>					
8.1	Expanded Use of Forest Biomass Feedstocks for Electricity (fuel switching)	High	High	Low	<ul style="list-style-type: none"> <li>technology and market dependent</li> <li>Pecan waste will be included in this option if not covered under Option 1.3.</li> </ul>	<ul style="list-style-type: none"> <li>Link to Forest Health and Restoration</li> </ul>
8.2	Improve Use and Efficiency of Wood for Direct Commercial Heat and Energy	High	High	Low	<ul style="list-style-type: none"> <li>technology and market dependent</li> </ul>	<ul style="list-style-type: none"> <li>Link to Forest Health and Restoration</li> </ul>
8.3	Improved Energy Capture from Wood Waste Combustion	Medium	Low to High	?	<ul style="list-style-type: none"> <li>technology and market dependent</li> </ul>	<ul style="list-style-type: none"> <li>Link to Forest Health and Restoration</li> </ul>
8.4	Expanded Landfill Methane Recapture (wood products waste)	Medium	Low	Cost Savings to Low	•	<ul style="list-style-type: none"> <li>Federal New Source Performance Standards and Emissions Guidelines require methane capture at larger landfills.</li> </ul>
8.5	Improved Commercialization of Biomass Gasification and Combined Cycle	Medium	Low to High	Medium to high	<ul style="list-style-type: none"> <li>requires improved technology and market incentives</li> </ul>	•
8.6	Expand Usage and or Efficiency of Wood Waste as Residential Fuel Source	Medium	Low to Medium	Low	•	<ul style="list-style-type: none"> <li>Overlap with RCI sector.</li> <li>Link to Forest Health and Restoration</li> </ul>
8.7	(Additional option, if/as suggested)				•	•