

# Addendum

## Agriculture, Forestry, and Waste Management (AFW)

### Summary List of Draft Priority Options for Analysis—2017 and 2025

| Option No. | Policy Option  | GHG Reductions (MMtCO <sub>2</sub> e) |      |                 | Net Present Value 2009–2025 (Million \$) | Cost-Effectiveness (\$/tCO <sub>2</sub> e) | Level of Support |
|------------|--|---------------------------------------|------|-----------------|--|--|------------------|
|            |  | 2017                                  | 2025 | Total 2009–2025 |  |  |                  |
| AFW-1      | Forest Retention—Reduced Conversion of Forested to Non-Forested Land Uses  | 1.6                                   | 2.1  | 24              | 615                                      | 36   | Pending          |
| AFW-2      | Afforestation and Restoration of Non-Forested Lands  |                                       |      |                 |  |  | Pending          |
|            | A. Forest Landscape  | 13                                    | 25   | 226             | 1,624                                    | 7  |                  |
|            | B. Urban Forestry  | TBD                                   |      |                 |  |  |                  |
| AFW-3      | Forest Management for Carbon Sequestration   | TBD                                   |      |                 |  |  | Pending          |
| AFW-4      | Expanded Use of Agriculture, Forestry, and Waste Management (AFW) Biomass Feedstocks for Electricity, Heat, and Steam Production |                                       |      |                 |  |  | Pending          |
|            | A. Agriculture and Forest Biomass  | 19                                    | 34   | 323             | 2,388                                    | 7  |                  |
|            | B. Municipal Solid Waste (MSW) Biomass   | 1.1                                   | 5.6  | 31              | TBD                                      | TBD  |                  |
| AFW-5      | Promotion of Farming Practices That Achieve GHG Benefits   |                                       |      |                 |  |  | Pending          |
|            | A. Soil Carbon Management  | 0.8                                   | 1.5  | 14              | -102                                     | -7   |                  |
|            | B. Land-Use Management That Promotes Permanent Cover   | TBD                                   |      |                 |  |  |                  |
|            | C. Nutrient Management   | 0.2                                   | 0.3  | 2.6             | -69                                      | -27  |                  |
|            | D. Improved Harvesting Methods to Achieve GHG Benefits   | TBD                                   |      |                 |  |  |                  |
| AFW-6      | Reduce the Rate of Agricultural Land and Open Green Space Conversion To Development  | TBD                                   |      |                 |  |  | Pending          |
| AFW-7      | In-State Liquid/Gaseous Biofuels Production  | 4.3                                   | 8.2  | 76              | -551                                     | -7   | Pending          |
| AFW-8      | Promotion of Advanced Municipal Solid Waste (MSW) Management Technologies (Including Bioreactor Technology)                      | TBD                                   |      |                 |  |  | Pending          |
| AFW-9      | Improved Commercialization of Biomass to Energy Conversion and Bio-Products Technologies   |                                       |      |                 |  |  | Pending          |
|            | A. Manure Digestion/Other Waste Energy Utilization   | 0.02                                  | 0.04 | 0.32            | -1                                       | -4   |                  |

|        |   |                |      |      |   |   |         |
|--------|---|----------------|------|------|---|---|---------|
|        | B. WWTP Biosolids Energy Production               | TBD            |      |      |   |   |         |
|        | C. Other Biomass Conversion Technologies          | 0.02           | 0.04 | 0.33 | 0 | 0 |         |
|        | D. Bio-Products Technologies & Use                | TBD            |      |      |   |   |         |
| AFW-10 | Programs to Support Local Farming/Buy Local       | Not quantified |      |      |   |   | Pending |
|        | <b>Sector Totals</b>                              |                |      |      |   |   |         |
|        | <b>Sector Total After Adjusting for Overlaps*</b> |                |      |      |   |   |         |
|        | <b>Reductions From Recent Actions</b>             | —              | —    | —    | — | — |         |
|        | <b>Sector Total Plus Recent Actions</b>           | —              | —    | —    | — | — |         |

GHG = greenhouse gas; MMtCO<sub>2</sub>e = million metric tons of carbon dioxide equivalent; \$/tCO<sub>2</sub>e = dollars per metric ton of carbon dioxide equivalent; TBD = to be determined.

\* See below for discussion of overlap adjustments

Note that negative costs represent a monetary savings.

### Overlap Discussion

The amount of carbon dioxide (CO<sub>2</sub>) emissions reduced or sequestered and the costs of a policy option within the Agriculture, Forestry, and Waste (AFW) sector may overlap with some of the quantified benefits and costs of policy options within other sectors.

Every effort will be made to determine where those overlaps occur and to eliminate double counting. As displayed in the chart above, the AFW sector totals will be reduced accordingly.

### Biomass Supply

Several options call for a supply of in-state biomass. The supply and demand for state biomass resources are assessed in Table 1 below to ensure there are sufficient resources to meet the policy option goals.

**Table 1. Florida Climate Action Team policies: biomass supply and demand assessment**

| Biomass Resource          | Annual Biomass Supply (Dry Tons) | Annual Biomass Supply* (MMBtu) | Notes   |
|---------------------------|----------------------------------|--------------------------------|---|
| Logging residue           | 1,775,000                        | 21,300,000                     | 2005 NREL Report. Forest residues.  |
| Urban wood waste          | 5,000,000                        | 60,000,000                     | Source: Bioenergy at UF/IFAS, Advisory Council Meetings, PowerPoint prepared by Mary Duryea, May–June 2008 (see slide 3). |
| Forest understory species | TBD                              |                                | Awaiting data from Florida TWG members  |

| <b>Biomass Resource</b>                                  | <b>Annual Biomass Supply (Dry Tons)</b> | <b>Annual Biomass Supply* (MMBtu)</b> | <b>Notes</b>  |
|--|---|---------------------------------------|---|
| Primary mill residue (unused)                            | 4,000                                   | 48,000                                | 2005 NREL Report. Derived from the USDA Forest Service's Timber Product Output database for 2002; includes mill residues burned as waste or landfilled.   |
| Agricultural residue and vegetable and fruit waste       | 3,663,000                               | 30,402,900                            | 2005 NREL Report. Estimated using 2002 total grain production, crop-to-residue ratio, and moisture content; takes into consideration the amount of residue left on the field for soil protection, grazing, and other agricultural activities. 0.4 million dry tons of vegetable/fruit waste from Bioenergy at UF/IFAS, Advisory Council Meetings, PowerPoint prepared by Mary Duryea, May–June 2008 (see slide 3).  |
| Agricultural energy crops                                | 3,450,000                               | 50,715,000                            | Secondary goal of AFW-4 calls for an additional 300,000 acres of energy crops by 2025, in addition to an increased production of 10% in sweet sorghum and sugar cane over current yields. Supply potential based only on 300,000 new acres assuming switchgrass production.   |
| Willow and hybrid poplar or other fast-growing hardwoods | Potential                               | Potential                             | 2005 NREL Report estimates a potential 389,000 tons of willow or hybrid poplar could be grown on CRP lands.   |
| Other woody energy crops                                 | Potential                               | Potential                             | Potential to grow 2,080,000 tons on marginal mining lands. Estimated based on 160,000 acres (from Southeastern Regional Biomass Energy Program 2003 Annual Report <sup>1</sup> ) and 13 dry tons/acre. <sup>‡</sup>   |
| Poultry litter   | —                                       | —                                     | TWG believes that this is a very small amount and will not provide a significant source of energy.  |
| Municipal solid waste (MSW) fiber                        | 42,662,000                              | 526,620,000                           | Estimated to be available by 2025. Biomass disposed in landfills, 2025. Projection based on average annual change between 2001 and 2006. Material breakdown based on 2005 MSW Composition from EPA Waste Characterization Fact Sheet, <sup>1</sup> consistent with ES TWG MSW characterization.<br>Yard and Landscape Waste: 8,611,000<br>Food Waste: 7,822,000<br>Paper Waste: 22,481,000<br>Wood Waste: 3,747,000 |
| <b>Total Annual Biomass Supply</b>                       | <b>56,554,000</b>                       | <b>589,085,900</b>                    |   |

<sup>1</sup> *Municipal Solid Waste in the United States, 2005 Facts and Figures*, US EPA, Office of Solid Waste, EPA530-R-06-011, October 2006. Accessed on July 20, 2008 from: <http://www.epa.gov/garbage/pubs/mswchar05.pdf>.

| <b>Biomass Resource</b>   | <b>Annual Biomass Supply (Dry Tons)</b> | <b>Annual Biomass Supply* (MMBtu)</b> | <b>Notes</b>  |
|---|---|---------------------------------------|---|
| AFW-4. Expanded Use of Agriculture, Forestry, and Waste Management (AFW) Biomass Feedstocks for Electricity, Heat, and Steam Production | 41,448,702                              | 483,103,135                           | Utilize biomass feedstocks in proportion to their availability.   |
| AFW-7. In-State Liquid/Gaseous Biofuels Production  | 7,300,000                               | 87,600,000                            | Utilize 20% of available biomass by 2025. Includes potential fast-growing hardwoods and other woody energy crops. |
| AFW-9. Improved Commercialization of Biomass to Energy Conversion and Bio-Products Technologies   | To be quantified                        | To be quantified                      |   |
| <b>Total Annual Biomass Demand</b>  | <b>48,748,702</b>                       | <b>570,703,135</b>                    |   |

MMBtu = million British thermal units; NREL = National Renewable Energy Laboratory; UF/IFAS = University of Florida/Institute of Food and Agricultural Sciences; USDA = U.S. Department of Agriculture; CRP = Conservation Reserve Program.

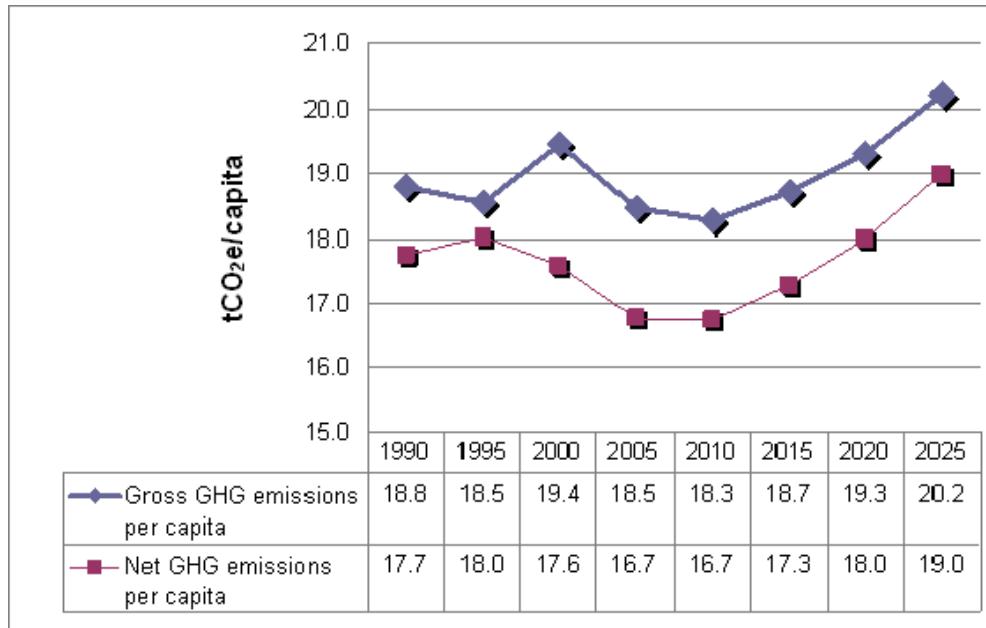
\* Assuming the following values for average heat content in MMBtu/dry ton:

- agricultural residues = 8.3 (Average Heat Content of Selected Biomass Fuels Table 10 EIA (2008) Annual Electric Generator, <http://www.eia.doe.gov/cneaf/solar.renewables/page/trends/table10.html>);
- energy crops = 14.7 (Heat Content of Selected fuels ORNL (7,341 BTU per pound), [http://cta.ornl.gov/bedb/appendix\\_a/Approximate\\_Heat\\_Content\\_of\\_Selected\\_Fuels\\_for\\_Electric\\_Power\\_Generation.xls](http://cta.ornl.gov/bedb/appendix_a/Approximate_Heat_Content_of_Selected_Fuels_for_Electric_Power_Generation.xls));
- forest feedstocks = 12 (Heat Content of Selected fuels ORNL (6,000 to 8,000 BTU per pound for solid wood products), [http://cta.ornl.gov/bedb/appendix\\_a/Approximate\\_Heat\\_Content\\_of\\_Selected\\_Fuels\\_for\\_Electric\\_Power\\_Generation.xls](http://cta.ornl.gov/bedb/appendix_a/Approximate_Heat_Content_of_Selected_Fuels_for_Electric_Power_Generation.xls));
- municipal solid waste feedstocks = 10 (From Electricity Supply Inventory & Forecast)

† Southern States Energy Board, Southeastern Regional Biomass Energy Program. 2003 (Oct.). 3<sup>rd</sup> year field operations & maintenance support for Central Florida short rotation woody crop (SRWC) tree farm. Available at: <http://www.treepower.org/papers/annualreport-2003.doc>

‡ Midpoint between high (16 dry tons/acre) and low (10 dry tons/acre), estimates from University of Florida (UF), <http://www.treepower.org/yields/main.html>.

**Florida per capita emissions – all sectors**



**Update of Progress on Options**

**AFW-1. Forest Retention—Reduced Conversion of Forested to Non-Forested Land Uses**

**Conditionally complete.** There will be revisions to quantification based on the updated draft of the Forestry Inventory & Forecast that has just been completed.

**AFW-2. Afforestation and Restoration of Non-Forested Lands**

**Forest Landscape conditionally complete.** Quantification will be modified slightly: 4% of “protected forest acreage” will be taken out before calculating the 2.5% annual rate of forest land increase; awaiting quantification of Urban Forestry sub-option.

**AFW-3. Forest Management for Carbon Sequestration**

Needs to be quantified.

**AFW-4. Expanded Use of Agriculture, Forestry, and Waste Management (AFW) Biomass Feedstocks for Electricity, Heat, and Steam Production**

**Agriculture and forestry biomass complete. Landfill methane sub-option complete.** Awaiting cost information on MSW biomass WTE. CCS has contacted TWG members as well as experts from Wheelabrator Technologies, Inc. and Waste Management, Inc. to establish more representative cost estimate and is awaiting their feedback.

### **AFW-5. Promotion of Farming Practices That Achieve GHG Benefits**

**Soil Carbon Management and Nutrient Management sections complete.** CCS has contacted Jay Levenstein (FL DACS) to obtain information on marginal agricultural acreage so that a goal can be established for converting marginal agricultural land to higher sequestration potential. CCS has also contacted Mr. Levenstein regarding the types of improved harvesting methods available in Florida so that a goal of adopting higher efficiency harvesting methods can be established. Additionally, CCS is awaiting feedback from the TWG on appropriate easement costs.

### **AFW-6. Reduce the Rate of Agricultural Land and Open Green Space Conversion To Development**

Needs to be quantified. Received data from NRI last week. CCS is also awaiting feedback from the TWG on easement costs and a list of land stewardship programs/groups in Florida.

### **AFW-7. In-State Liquid/Gaseous Biofuels Production**

**Complete.** New additions: The Key Uncertainties section has a new paragraph about sensitivity of this option to the price of feedstock and to the wholesale price of ethanol. The AEO2008 assumes the wholesale cost of ethanol will remain below \$2 through the policy period. As of July 31, 2008, however, the state average rack price of ethanol was \$2.85 per gallon (see <http://www.ethanolmarket.com/fuelethanol.html>). If future wholesale costs of ethanol are higher than forecasted by the AEO2008, then this option has the potential to have a higher net revenue. Likewise, if feedstocks prove to be more expensive than estimated, this option will have a lower revenue and potentially a net cost.

### **AFW-8. Promotion of Advanced Municipal Solid Waste (MSW) Management Technologies (Including Bioreactor Technology)**

**Preliminary GHG quantification complete.** CCS is trying to collect more data on reduction potential or mitigation program costs from the collection, transfer, and transport processes to produce a cost-effectiveness estimate. Additionally, a brief Internet search by CCS on the GHG mitigation potential and costs of anaerobic or hybrid bioreactors did not yield enough information to establish a quantification method.

### **AFW-9. Improved Commercialization of Biomass to Energy Conversion and Bio-Products Technologies**

**Manure digestion and bio-products sub-sections complete.** For WWTP biosolids, according to *Summary of Class AA Residuals: 2007* from Florida DEP, about 83% of wastewater residuals are either distributed and marketed as Class AA residuals products to be used as soil amendment or directly land applied as Class A or Class B residuals. The TWG would like to change the WWTP sub-goal to one where current utilization levels of WWTP biosolids are maintained and requests the Action Team's feedback. The Additional Biomass sub-option will be quantified once quantification of AFW-4 and AFW-7 are complete so the surplus quantity of biomass can be determined.

**AFW-10. Programs to Support Local Farming/Buy Local  
Complete.**