

## Catalog of State Actions Agriculture, Forestry, and Waste Management Subcommittee

A catalog of state-level, GHG-reducing actions and policy options based on actions undertaken or considered by state, local, and private actors.

### Key to Future Rankings of Options in the Following Tables

| Potential GHG Emission Reductions*                                                                                      | Potential Cost or Cost Savings* <sup>†</sup>            |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| <b>High (H):</b> At least 1.0 million metric tons of carbon dioxide equivalents (MMtCO <sub>2</sub> e) per year by 2020 | <b>High (H):</b> \$40 per MtCO <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> \$15–\$40/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 \$15/tCO <sub>2</sub> e       |
| <b>Uncertain (U):</b> Not able to estimate at this time                                                                 | <b>Negative (Neg):</b> Net cost savings                 |
|                                                                                                                         | <b>Uncertain (U):</b> Not able to estimate at this time |

\* Several measures may overlap in terms of emissions reductions and/or cost impacts. Estimates assume measures would be implemented independently from other measures.

<sup>†</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.

| Option No.   | GHG Reduction Policy Option                                                                          | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility                                                                                  | Priority for Analysis | Notes/Related Actions in Iowa                                                                                                                               |
|--------------|------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AFW-1</b> | <b>AGRICULTURE—PRODUCTION OF FUELS AND ELECTRICITY</b>                                               |                                   |              |                                                                                                                                                       |                       |                                                                                                                                                             |
| 1.1          | Expanded use of biomass feedstocks for electricity or steam production                               | H                                 | L            |                                                                                                                                                       |                       |                                                                                                                                                             |
| 1.2          | In-state liquid biofuels production                                                                  | H                                 | L-M          | Elevated corn prices; Reduction in soil erosion and improvement in water quality if produced from switchgrass.                                        |                       | Lignocellulosic conversion – H; Corn grain remains less optimistic;                                                                                         |
| 1.3          | On-farm manure digesters/other waste energy utilization                                              | M                                 | M-H          | Reduce runoff into surface waters from land application. Reduction of ammonia and odor emissions.                                                     |                       | Most cost effective for large operations separating solids. AFW-1.3, AFW-1.4, and AFW1-5 can also be related to AFW-2.1, AFW-10.2, AFW-10.3, and AFW-11.3.  |
| 1.4          | Community manure and organic waste digesters for commercial gas production and electrical generation | M                                 | H            |                                                                                                                                                       |                       | AFW-1.3, AFW-1.4, and AFW1-5 can also be related to AFW-2.1, AFW-10.2, AFW-10.3, and AFW-11.3.                                                              |
| 1.5          | Lagoon covers for methane capture and utilization or destruction                                     | M                                 | M            | Also captures nitrogen oxides. Reduction in transport of toxic bioaerosols, gases and odors. Potential improvements in neighbor and community health. |                       | Relates to AFW 2.1 Impermeable covers last 10 years or more. AFW-1.3, AFW-1.4, and AFW1-5 can also be related to AFW-2.1, AFW-10.2, AFW-10.3, and AFW-11.3. |
| 1.6          | Biomass energy crop production and utilization                                                       | H                                 | L            | Improved water quality, wildlife habitat (depending on management), and reduced soil loss                                                             |                       | Depend on crop used. If corn stalks, less efficient than if perennial materials. Relates to AFW 1.2                                                         |

| Option No.   | GHG Reduction Policy Option                                                                                                                                       | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility                                                                                                                                                                                                          | Priority for Analysis | Notes/Related Actions in Iowa                                                                                                                                                                          |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.7          | Renewable liquid fuel tax (based on a combination of energy and carbon balance for the fuel produced)                                                             | H                                 | M?           | If increased production of perennials resulted, a higher level of soil carbon sequestration would be likely                                                                                                                                                                   |                       | If designed to encourage high energy return/low carbon footprint, could be H<br>Think this is not a new idea. Could be used to promote lignocellulosic conversion.                                     |
| 1.8          | Reduction of fossil-derived products and energy in the production of biofuels                                                                                     | M                                 | M?           | Biofuel production using perennial grasses requires less fertilizer and pesticide (energy-intensive products) and less fossil fuel since fewer passes with the tractor are required compared to corn. Further development of lignocellulosic production processes are needed. |                       | Need more detail; does this refer to use of corn cobs for example to replace natural gas for heating in ethanol production. It likely refers to use of perennial grasses instead of corn for biofuels. |
| 1.9          | Methane management for greenhouse gas (GHG) reduction and for energy production                                                                                   | M                                 | M-H          | Reduces emission of other pollutants as well.                                                                                                                                                                                                                                 |                       | Relates to AFW 1.5                                                                                                                                                                                     |
| <b>AFW-2</b> | <b>AGRICULTURE—LIVESTOCK</b>                                                                                                                                      |                                   |              |                                                                                                                                                                                                                                                                               |                       |                                                                                                                                                                                                        |
| 2.1          | Manure/methane management capture utilization                                                                                                                     | M                                 | L            | Reduces emission of other pollutants as well.                                                                                                                                                                                                                                 |                       | Relates to AFW 1.3, 1.4, 1.5                                                                                                                                                                           |
| 2.2          | Changes in animal feed (including establishing low-methane-producing feed ration demonstration programs or sales tax exemption for low-methane-producing rations) | L-M                               | ?            |                                                                                                                                                                                                                                                                               |                       |                                                                                                                                                                                                        |

| Option No. | GHG Reduction Policy Option                                                      | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility                                                                                                                                                                    | Priority for Analysis | Notes/Related Actions in Iowa                                                                                                                                                                             |
|------------|----------------------------------------------------------------------------------|-----------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.3        | Rotational grazing (improve grazing crops and/or management)                     | M                                 | N            |                                                                                                                                                                                                                                         |                       | Impact will depend on what system it is replacing. If replacing row cropping, emission reduction is much greater than if replacing CRP. 3.5 million acres in Iowa of continuous grazing.                  |
| 2.4        | Utilize biofilters to control confined animal feeding operation (CAFO) emissions | M-H                               | L-M          | This will reduce emissions of hydrogen sulfide, ammonia, odors and bioaerosols by 90%. Cost is low for operations that use active ventilation.                                                                                          |                       | Question if there is enough land that would/could be converted to biofilters to make much of an impact wetted-wall cellulose biofilters require little space. Wood chip biofilters can last 3 to 5 years. |
| 2.5        | Increase pasturing and lower densities                                           | M                                 | H            |                                                                                                                                                                                                                                         |                       | Not likely; land is too expensive; would require LARGE financial support                                                                                                                                  |
| 2.6        | Manure injection                                                                 | H                                 | L?           | This is already part of best management practices for operations using slurry systems. Injecting manure improves incorporation and reduces need for anhydrous ammonia. Injection reduces release of ammonia, hydrogen sulfide and odor. |                       | Many operations outsource manure application.                                                                                                                                                             |

| Option No.   | GHG Reduction Policy Option                                                                                                                                                 | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility | Priority for Analysis | Notes/Related Actions in Iowa                                                                                                                                                                          |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AFW-3</b> | <b>AGRICULTURE—CROP PRODUCTION / WATER, NUTRIENTS, AND SOILS</b>                                                                                                            |                                   |              |                                                                      |                       |                                                                                                                                                                                                        |
| 3.1          | Soil carbon management (including establishing no-till deep-rooting low-N <sub>2</sub> O carbon sequestering programs and a moldboard plow buy-back and retirement program) | M-H                               | L-M          |                                                                      |                       | Some studies are suggesting no-till's net CO <sub>2</sub> sequestering ability is lower than previously thought. From McKinsey Report: Conservation Tillage: -\$7/ton<br>Winter Cover Crops: \$27/ton  |
| 3.2          | Nutrient and water management (including nitrogen conservation practices)                                                                                                   | M-H                               | Neg-L        |                                                                      |                       |                                                                                                                                                                                                        |
| 3.3          | Technology improvements to increase efficiency                                                                                                                              | L-M                               | M            |                                                                      |                       | similar to option 3.7                                                                                                                                                                                  |
| 3.4          | Water management                                                                                                                                                            | L                                 | ?            |                                                                      |                       | Little irrigation in Iowa                                                                                                                                                                              |
| 3.5          | Drainage management                                                                                                                                                         | M-H                               | L            |                                                                      |                       | If integrated with wetlands, could be a very good means of sequestering C; Plans are developing on replacing existing drainage infrastructure integrating wetlands; increased crop yields are expected |
| 3.6          | Biochar production and utilization                                                                                                                                          | H                                 | L-H          | Is technically feasible, but yet cost prohibitive.                   |                       | Cost is dependent on development of the t-chemical conversion technology – there in lies the cost. Could be the largest contributor to C sequestration in the state.                                   |

| Option No.   | GHG Reduction Policy Option                                                                                                      | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility | Priority for Analysis | Notes/Related Actions in Iowa                                                                                    |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------|
| 3.7          | Precision nutrient application                                                                                                   | M                                 | L            | Probably reduce net fertilizer application and associated costs      |                       | Seems largely dependent on N management<br>Related to AFW 2.6                                                    |
| 3.8          | Establish low N <sub>2</sub> O emission, high-carbon-retention demonstration fields                                              | L                                 | ?            |                                                                      |                       |                                                                                                                  |
| 3.9          | Promote periodic carbon mapping of fields                                                                                        | L                                 | ?            | Could also map N and P to optimize soil nutrient management          |                       |                                                                                                                  |
| 3.10         | Organic farming                                                                                                                  | M                                 | L            |                                                                      |                       | Related to AFW 2.3                                                                                               |
| 3.11         | Reduction of fossil-based products and energy in agricultural activities including using wind power to produce anhydrous ammonia | ?                                 | ?            |                                                                      |                       |                                                                                                                  |
| <b>AFW-4</b> | <b>AGRICULTURE—LAND USE CHANGE</b>                                                                                               |                                   |              |                                                                      |                       |                                                                                                                  |
| 4.1          | Land use management that promotes grassland cover                                                                                | H                                 | M            |                                                                      |                       | Limitations if not linked to biomass for energy.                                                                 |
| 4.2          | Preserve open space/agricultural land                                                                                            | L                                 | H            |                                                                      |                       |                                                                                                                  |
| 4.3          | Develop land cover maps identifying marginal lands including wetlands (where permanent cover should be targeted)                 | L                                 | M            |                                                                      |                       | Policy must be developed to utilize these lands; the maps are only a tool allowing targeting of permanent cover; |

| Option No.   | GHG Reduction Policy Option                                                                                                           | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility                                                                                                                                                                                                                                                                 | Priority for Analysis | Notes/Related Actions in Iowa                                                                                                                                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4.4          | Reduce incentives for absentee land ownership and develop incentives for farm owner operators                                         | M                                 | L            | Assumption: land owner/operators manage differently than short term renters or absentee investors and that these practices favor C sequestration and sustaining the soil resource. Land owner/operators more likely to engage in practices to reduce emissions of GHG in the course of limiting hydrogen sulfide and odor emissions. |                       | Would improve efficiency of policy in creating behavior change related to C management activities. Short term leases make establishing and managing perennials very difficult. Suggested that this option is difficult to estimate as this is an “indirect” option – GHG reductions from this would be seen in other options. |
| 4.5          | Wetlands protection/conservation                                                                                                      | H                                 | H            |                                                                                                                                                                                                                                                                                                                                      |                       | If coupled with improved drainage systems, the cost could be L;                                                                                                                                                                                                                                                               |
| <b>AFW-5</b> | <b>AGRICULTURE—FARMING PRACTICES</b>                                                                                                  |                                   |              |                                                                                                                                                                                                                                                                                                                                      |                       |                                                                                                                                                                                                                                                                                                                               |
| 5.1          | Reductions in on-farm energy use (including establishing renewable fuels demonstration farms or a fossil fuel tax for off-road use)   | M                                 | NEG-L        |                                                                                                                                                                                                                                                                                                                                      |                       |                                                                                                                                                                                                                                                                                                                               |
| 5.2          | On-farm energy efficiency including improved grain dryers, heat exchangers (dairy), electric motors, energy efficient building design | L                                 | L            |                                                                                                                                                                                                                                                                                                                                      |                       | On-farm and local wind energy production feasible in north central Iowa.                                                                                                                                                                                                                                                      |
| 5.3          | Promotion of farming practices that achieve GHG benefits                                                                              | L                                 | L            |                                                                                                                                                                                                                                                                                                                                      |                       | Establish and promote a new set of Best Management Practices based upon reducing GHG emissions                                                                                                                                                                                                                                |

| Option No.   | GHG Reduction Policy Option                                                           | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility                                                                       | Priority for Analysis | Notes/Related Actions in Iowa                |
|--------------|---------------------------------------------------------------------------------------|-----------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------------------|
| 5.4          | Programs to support local farming/buy local                                           | L-M                               | L            | Local foods promote diversified production.                                                                                                |                       |                                              |
| 5.5          | Reduction of fossil-based products and energy in agricultural activities              | ?                                 | ?            | Switchgrass uses less fossil fuel inputs than corn for ethanol production. Promote use of biofuels for tractors, combines and farm trucks. |                       | Related to AFW 1.8                           |
| <b>AFW-6</b> | <b>FORESTRY—PRODUCTION OF FUELS AND ELECTRICITY</b>                                   |                                   |              |                                                                                                                                            |                       |                                              |
| 6.1          | Expanded use of forest biomass feedstocks for electricity, heat, and steam production | M                                 | L-H          |                                                                                                                                            |                       |                                              |
| 6.2          | In-state liquid biofuels production                                                   | M                                 | L-M          |                                                                                                                                            |                       |                                              |
| 6.3          | Improved energy capture from wood waste combustion                                    | L                                 | ?            |                                                                                                                                            |                       |                                              |
| 6.4          | Improved commercialization of biomass gasification and combined cycle                 | L                                 | U            |                                                                                                                                            |                       |                                              |
| <b>AFW-7</b> | <b>FORESTRY—BIOMASS PROTECTION AND MANAGEMENT</b>                                     |                                   |              |                                                                                                                                            |                       |                                              |
| 7.1          | Forest protection—reduced clearing and conversion to non-forest cover                 | M-H                               | M            | Clean water, reduced soil erosion, strengthens Iowa Wood Industries, improves wildlife habitat                                             |                       | McKinsey Report: Forest Management: \$23/ton |
| 7.2          | Urban forestry                                                                        | M                                 | M-H          | Improve quality of life, save energy.                                                                                                      |                       |                                              |

| Option No.   | GHG Reduction Policy Option                                                                                                                                                                       | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility                           | Priority for Analysis | Notes/Related Actions in Iowa                                                             |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------|
| 7.3          | Afforestation and/or restoration of non-forested lands                                                                                                                                            | M-H                               | M            | Clean water, reduced soil erosion, strengthens Iowa Wood Industries, improves wildlife habitat |                       | McKinsey Report: Afforestation pastureland: \$18/ton and Afforestation cropland: \$39/ton |
| 7.4          | Forest management for carbon sequestration                                                                                                                                                        | M                                 | M            | Clean water, reduced soil erosion, strengthens Iowa Wood Industries, improves wildlife habitat |                       |                                                                                           |
| 7.5          | Mitigation of forest carbon sequestration loss and emissions due to wildfire                                                                                                                      | L                                 | ?            |                                                                                                |                       |                                                                                           |
| 7.6          | Mitigation of forest loss due to insects/disease                                                                                                                                                  | H                                 | L            |                                                                                                |                       |                                                                                           |
| 7.7          | Management of wetlands to improve sequestration and/or reduce associated methane emissions                                                                                                        | ?                                 | ?            |                                                                                                |                       |                                                                                           |
| <b>AFW-8</b> | <b>FORESTRY—WOOD PRODUCTS AND WASTE</b>                                                                                                                                                           |                                   |              |                                                                                                |                       |                                                                                           |
| 8.1          | Improved mill waste recovery                                                                                                                                                                      | L                                 | L            |                                                                                                |                       |                                                                                           |
| 8.2          | Improved logging residue recovery                                                                                                                                                                 | L                                 | U            |                                                                                                |                       |                                                                                           |
| 8.3          | Expanded use of wood products for building materials (emphasizing the benefits associated with durable wood products: less energy intensive than steel and concrete and additional sequestration) | M                                 | ?            |                                                                                                |                       |                                                                                           |

| Option No.    | GHG Reduction Policy Option                                                              | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility | Priority for Analysis | Notes/Related Actions in Iowa                                                                         |
|---------------|------------------------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------|
| 8.4           | Forestry biochar                                                                         | ?                                 | ?            |                                                                      |                       |                                                                                                       |
| <b>AFW-9</b>  | <b>WASTE MANAGEMENT—WASTE MANAGEMENT STRATEGIES</b>                                      |                                   |              |                                                                      |                       |                                                                                                       |
| 9.1           | Advanced recycling and composting                                                        | M-H                               | L-M          |                                                                      |                       | Feed exhaust air from compost operations through biofilters and into greenhouses for C sequestration. |
| 9.2           | Promotion of bioreactor technology (advanced municipal solid waste management practices) | M-H                               | L            |                                                                      |                       |                                                                                                       |
| 9.3           | Source reduction strategies                                                              | M-H                               | ?            |                                                                      |                       |                                                                                                       |
| 9.4           | Resource management contracting                                                          | L                                 | ?            |                                                                      |                       |                                                                                                       |
| 9.5           | Waste coal recapture                                                                     | ?                                 | ?            |                                                                      |                       |                                                                                                       |
| 9.6           | Enhanced management of organic waste                                                     | M                                 | M            |                                                                      |                       |                                                                                                       |
| 9.7           | Promotion of new and existing technologies for waste energy conversion                   | L-H                               | ??           |                                                                      |                       |                                                                                                       |
| 9.8           | Reduce residential waste burning, including organic waste                                | L                                 | L            |                                                                      |                       | Many communities have done this already. Easily expanded to statewide.                                |
| 9.9           | Improve waste collection efficiencies                                                    | ?                                 | ?            |                                                                      |                       |                                                                                                       |
| <b>AFW-10</b> | <b>WASTE MANAGEMENT—LANDFILL GAS STRATEGIES</b>                                          |                                   |              |                                                                      |                       |                                                                                                       |

| Option No.    | GHG Reduction Policy Option                                              | Potential GHG Emissions Reduction | Cost per Ton | Other Considerations: Jobs, Fuel Imports, Externalities, Feasibility | Priority for Analysis | Notes/Related Actions in Iowa |
|---------------|--------------------------------------------------------------------------|-----------------------------------|--------------|----------------------------------------------------------------------|-----------------------|-------------------------------|
| 10.1          | Flare landfill methane at non-NSPS (smaller) sites                       | L                                 | H?           |                                                                      |                       | Costs should be low.          |
| 10.2          | Methane and biogas energy programs                                       | M                                 | M-H          |                                                                      |                       |                               |
| 10.3          | Landfill methane energy programs                                         | M-H                               | Neg-L        |                                                                      |                       |                               |
| <b>AFW-11</b> | <b>WASTE MANAGEMENT—WASTEWATER MANAGEMENT ACTIVITIES</b>                 |                                   |              |                                                                      |                       |                               |
| 11.1          | Energy efficiency improvements                                           | M                                 | Neg-L        |                                                                      |                       |                               |
| 11.2          | Lower waste processing needs (lower water consumption, waste production) | L                                 | ??           |                                                                      |                       |                               |
| 11.3          | Install digesters and turbines or engines                                | L-M                               | L            |                                                                      |                       |                               |
| 11.4          | Restoration of soil organic carbon from application of WWTP biosolids    | L-M                               | ??           |                                                                      |                       |                               |
| 11.5          | Heat recovery                                                            | L                                 | ??           |                                                                      |                       |                               |
| 11.6          | Algae and bio-oils                                                       | M-H                               | ??           |                                                                      |                       |                               |