Agriculture, Forestry, and Waste Management (AFW) Subcommittee

Summary List of Draft Priority Policy Options for Analysis

Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2020 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Status of Option
		2012	2020	Total 2009–2020			
AFW-1	Nutrient Management	*Not Quantified*					Pending
AFW-2	Wetlands and Drainage	*Not Quantified*					Pending
AFW-3	Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat or Steam Production	*Not Quantified*					Pending
AFW-4	Encourage Large-Scale Manure/Methane Management Capture Utilization	*Not Quantified*					Pending
AFW-5	Land Management to Promote Sequestration Benefits	*Not Quantified*					Pending
AFW-6	Cellulosic Fuel Incentives	*Not Quantified*					Pending
AFW-7	Improved On-Farm (or First Point of Purchase) Energy Use and Efficiency	*Not Quantified*					Pending
AFW-8	Waste Management Strategies	*Not Quantified*					Pending
AFW-9	Landfill Methane Energy Programs	*Not Quantified*					Pending

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO2e = dollars per metric ton of carbon dioxide equivalent.

ICCAC policies: biomass supply and demand assessment

Biomass Resource	**Annual Biomass Supply (dry tons)**	**Notes**
Forest Residue	396,000	2005 NREL Report[1]. Estimated using USDA Forest Service's Timber Product Output database for 2002, includes logging residues and other removals.
Primary Mill Residue (Unused)	2,000	2005 NREL Report. Derived from the USDA Forest Service's Timber Product Output database for 2002, includes mill residues burned as waste or landfilled.
Secondary Mill Residue	32,000	2005 NREL Report. Includes wood scraps and sawdust from woodworking shops— furniture factories, wood container and pallet mills, and wholesale lumberyards. Estimated using number of businesses from the U.S. Census Bureau, 2002 County Business Patterns and assumptions on the wood waste generated.
Urban Wood Waste	353,000	2005 NREL Report. Includes MSW wood—wood chips, pallets, and yard waste; utility tree trimming and/or private tree companies; and construction/demolition wood. Data on the collected urban wood waste are not available; thus numerous assumptions were applied for estimation.
Agricultural Residue	26,003,000	2005 NREL Report. Estimated using 2002 total grain production, crop to residue ratio, moisture content, and taking into consideration the amount of residue left on the field for soil protection, grazing, and other agricultural activities.
Switchgrass		2005 NREL Report estimates a potential 11,297,000 tons of switchgrass could be grown on CRP lands.
Willow or Hybrid Poplar		2005 NREL Report estimates a potential 9,413,000 tons of willow or hybrid poplar could be grown on CRP lands.
Poultry Litter		
Municipal Solid Waste (MSW) Fiber		
Wood Pulp		
Yard & Landscape Waste Debris		
Total Annual Biomass Supply		
Policy Requiring Biomass	**2020 Annual Biomass Demand (dry tons)**	**Notes**
AFW-3	16,000,000	From goals: Annually harvest at least 5 million dry tons of dedicated energy crop production, 10 million tons of annual crop residue, and 1 million tons of forest products or wood residues.
AFW-6	10,000,000	From goals: Increase in-state cellulosic feedstock production by 10 million dry tons by 2020.

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[1] *A Geographic Perspective On The Current Biomass Resource Availability In The United States*, A. Milbrandt, Technical Report NREL/TP-560-39181, December 2005, Prepared under Task No. HY55.2200.

AFW-1. Nutrient Management

Policy Description

Demonstrate and encourage the implementation of GHG-beneficial management practices including: nutrient and soil management techniques to lower N2O emissions and increase soil carbon retention[2]; limit or restrict nitrogen fertilizer application on seasonally flooded field areas; and increase use of cover crops[3].

Improve the efficiency of fertilizer use and other nitrogen-based soil amendment use through implementation of improved management practices; development and use of crops and crop hybrids/varieties capable of improved nutrient uptake efficiency; and full accounting of nutrient applications through manure and other organic based nutrient sources.

Support research critical for identifying GHG emissions associated with different nutrient management practices and research identifying those practices leading to reduced net GHG emissions.

Policy Design

Goals:

Efficiency—Increase fertilizer use efficiency (in terms of N applied per crop yield) by 10% by 2020.

Seasonally Flooded Areas—Reduction of N application by 50% on 50% of seasonally flooded areas by 2020.

Improved Nutrient Distribution—Provide more of the state's cropland nitrogen requirements through improved distribution of natural and organic nitrogen sources (manures). Replace 10 percent of manufactured nitrogen sources through better manure distribution by 2020.

Timing: Most of these are currently being considered and implemented for economic reasons, i.e. nutrient credit for manure (however all operators do not yet credit suitably). Restricting application from seasonally flooded areas will require additional technology capable of site specific applications based on land form in addition to that from soil test maps.

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[2] The dilemma relative to nutrient management, nitrogen in particular, involves balances. The Subcommittee is confident, for example, that mandating nitrogen application reductions would reduce N2O emissions and GHG emissions associated with nitrogen manufacture. However, reduced rates would very likely result in lower yields, lower plant biomass production, and net loss of soil organic matter and CO2 emissions. We have the science to understand direction of change, but do not have the scientific capability to quantify these input/output values on a highly variable landscape in a variable climate and thus determine whether or not a given recommendations would make us consistently winners or losers.

[3] Cover crops have been studied for decades with marginal advances and at this time seem somewhat risky as a required target mandate for this group. Research investment is needed to develop cropping systems in which cover crops are complimentary to rather than competitive with the primary crop.

Parties Involved: Industry, scientists, and producers

Other:

Implementation Mechanisms

To be determined (TBD).

Related Policies/Programs in Place

TBD.

Type(s) of GHG Reductions

N_2O: reductions occur when nitrogen run-off and leaching are reduced, which leads to the formation and emission of N_2O.

CO_2: reductions occur as soil carbon levels in crop soils are increased above business as usual levels. Increasing the levels of carbon in soils indirectly sequesters carbon from the atmosphere.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Efficiency— Annual N_2O emissions from synthetic fertilizer and manure applications (Table H-5) were taken from the Iowa Inventory & Forecast. The average reduction in fertilizer usage resulting from implementation of nutrient management practices (15%) was taken from an EPA guidance document.[4] Cost information for synthetic fertilizers was taken from the USDA ERS.[5] The average cost of synthetic nitrogen fertilizers in the United States in 2007 was $370/ton.

Seasonally Flooded Areas—

Improved Nutrient Distribution—

Quantification Methods:

Efficiency GHG Benefits

A variety of programs can be used to improve nitrogen efficiency, such as soil testing and educational efforts. The potential benefits of a fertilizer efficiency program can be estimated based on the reduced costs of fertilizer not applied, and the GHG benefits of such a reduction in Nitrogen application (both from leaching and production).

Efficiency Costs

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[4] "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters," http://www.epa.gov/owow/nps/MMGI/Chapter2/ch2-2c.html#Practices, Table 2-14.

[5] http://www.ers.usda.gov/Data/FertilizerUse/Tables/Table7.xls.

The costs of such a program include the preparation of educational materials, as well as staffing and testing costs to help encourage reduced fertilizer useage. If the SC could provide estimates of the nitrogen fertilizer use in Iowa, that would be helpful.

Seasonally Flooded Areas—Does N application result in significantly greater N_2O formation? If the SC is aware of any particular studies on this phenomenon or its scope in Iowa, that would be very useful. Different possible approaches to quantify reductions in N2O would include: restriction on the use of nitrogen fertilizers in seasonally flooded areas (other fertilizer alternatives exist) or education programs to encourage best management practices, so as to avoid N2O formation as much as possible in seasonally flooded areas.

Improved Nutrient Distribution— Replacing 10% of manufactured nitrogen sources with locally produced manure will require estimates of the amount of locally produced manure available in the state. What is the current impediment to using more manure as opposed to commercial fertilizer? If fertilizer is less expensive, then financial incentives might provide the boost needed to make locally produced manure more economically viable. If farmers do not realize the benefits of manure as opposed to fertilizer use, then a government best practices educational programs would likely be effective. If manure is available but not in the proper locations, then government collection and distribution could the best possible approach. More input from the SC is needed to determine the best way of approaching and quantifying issue.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Subcommittee Suggestion:

Feasibility Issues

TBD – [as needed and approved by the subcommittees]

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

AFW-2. Wetlands and Drainage

Policy Description

Research: Research is needed to identify and quantify the greenhouse gas (GHG) implications, both from N_2O and CO_2, of

- Sub-surface drainage in agricultural croplands,
- Strategically located and designed nitrogen removal wetlands
- Denitrification in receiving streams and rivers.

Subsurface drainage: Improve subsurface drainage in poorly drained cropped lands to reduce denitrification and N_2O emissions.

Wetlands: Utilize strategically-located and designed nitrogen-removal wetlands to reduce N_2O emissions from nitrogen transported to receiving streams through subsurface drainage.

Integrated Drainage—Wetland Systems Initiative: Support policy development and public costs of this voluntary, market-driven private/public partnership which combines nitrogen-removal wetlands with improved subsurface drainage for enhanced crop production.

Policy Design

Goals:

By 2015—Support research needed to identify and quantify GHG implications of subsurface drainage, strategically-located and designed nitrate removal wetlands, and denitrification in receiving streams and rivers.

By 2050—Have fully supported the needed policy development and public sector costs for the voluntary Integrated Drainage-Wetland Systems Initiative and deployment of nitrogen-removal wetlands in Iowa's subsurface-drained row-cropped landscape.

Timing: As stated above.

Parties Involved: Involved parties include public conservation agencies, research institutions, existing Iowa drainage districts, and private landowners.

Other: While the research foundation is not adequate to quantify, improved subsurface drainage of row-cropped lands is felt to reduce N2O emissions by, reducing nitrogen losses through enhanced nitrogen uptake by plants as result of earlier crop planting, reducing in-field denitrification, and increasing feasibility of no-till cropping.

Permanent wetlands not being cropped are already protected under federal/state regulations and programs. Restoration of wetlands without significant nitrogen loadings have minimal GHG implications, with reductions primarily from surrounding grassed buffers that provide GHG reductions in linear relationship to land area converted from row-crop to grassed buffer.

Strategically located and designed wetlands for nitrogen removal – technology developed and adapted to row-cropped landscapes in the corn belt by Iowa State University, and currently being implemented through the Iowa Conservation Reserve Enhancement Program (CREP). Wetland pools of 0.5–2.0% of the contributing watershed area receive predominantly subsurface drainage from watersheds 500–4000 acres, and will remove 40-90% of nitrate through denitrification, primarily as elemental N_2 rather than N_2O. Nitrate-removal wetlands will significantly reduce GHG emissions over that of de-nitrification in receiving watercourses and the Gulf of Mexico.

Combining nitrate-removal wetlands through this voluntary Iowa initiative will reduce nitrate transport to water resources, protect drinking water supplies, reduce hypoxia in the Gulf of Mexico, and reduce emissions of GHG.

Implementation Mechanisms

TBD –

Related Policies/Programs in Place

TBD –

Type(s) of GHG Reductions

CO_2: Conservation of wetlands helps maintain the ability of the land to sequester carbon in soil and biomass.

CH_4: Improved drainage reduces anaerobic decomposition, thereby preventing methane creation.

Estimated GHG Reductions and Net Costs or Cost Savings

TBD

Data Sources: [TBD by CCS on subcommittee approval]

Quantification Methods:

Does the subcommittee want to estimate GHG benefits and costs of this option? If so the goal will need to be refined.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

TBD – [as needed and approved by the subcommittees]

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

AFW-3. Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production

Policy Description

Increase the amount of biomass (including biomass from forest sources) available for co-generation of electricity or for use in combined heat and power applications to displace the use of fossil energy sources recognizing that local electricity or heat production yields greatest net energy and carbon displacement payoff. Increase both the acreage and the yield of energy crop production and utilization through the planning of energy purpose

Note that this option is focused on the supply-side aspects of promoting biomass fuel, with an emphasis on the development of feedstocks, collection, processing and transport technologies. The demand-side aspects of renewable fuels (including biomass use) are being addressed through options in the CRE Subcommittee (Generation Portfolio Standards; Technology-Focused Initiatives).

Policy Design

Goals:

Energy Crop—Annually harvest at least 5 million dry tons of dedicated energy crop production materials by 2020, which includes

- Establishing 1 million acres of identified energy crop production by 2020; and
- Transitioning 50 percent of expiring CRP contracts to energy crop production.

Agriculture Crop Residue—Annually harvest at least 10 million tons of annual crop residue biomass for energy production by 2020.

Forest Biomass—Annually harvest at least 1 million tons of forest products or wood residues for biomass energy production by 2020.

Biomass Plant—Have at least one major industrial operation contracting with producers to use biomass as the primary energy source for plant operations by 2015.

Biofuels—Have at least one biofuels production plant contracting with producers to use biomass as the primary energy source by 2015.

Timing:

Parties Involved: Farmers and landowners.

Other: Energy conversion facilities.

Implementation Mechanisms

Voluntary Incentive programs:

- Section 476C tax incentives
- State and/or federal cost-share programs for energy crop establishment
- USDA value-added agriculture development grants

Federal Renewable Fuel Standard

Cellulosic fuel requirement standards and incentives

Research funding

State fuel standards and incentives

Related Policies/Programs in Place

Section 476C of the Iowa code provides for a renewable energy tax credit for biomass and other qualifying renewable energy sources that are used to generate electricity or heat for a commercial purpose.

A producer or purchaser of renewable energy may receive renewable energy tax credits under this chapter in an amount equal to one and one-half cents per kilowatt-hour of electricity, or four dollars and fifty cents per million British thermal units of heat for a commercial purpose, or four dollars and fifty cents per million British thermal units of methane gas or other biogas used to generate electricity, or one dollar and forty-four cents per one thousand standard cubic feet of hydrogen fuel generated by and purchased from an eligible renewable energy facility.

Alternative Energy Law (Iowa's Renewable Portfolio Standard)—Iowa requires its two investor-owned utilities—MidAmerican Energy and Alliant Energy Interstate Power and Light—to contract for a combined total of 105 megawatts (MW) of their generation from renewable-energy resources.

Fuel Mix Disclosure—Iowa's rate-regulated electric utilities must report annually to customers the percentage mix of fuel and energy used to produce electricity. The percentages for renewables must further be broken down into percentages of electricity generated by wind, solar, hydropower, biomass, and other resources. Each utility's annual report must also include an estimate of sulfur dioxide, nitrogen oxides, and carbon dioxide emissions for each fuel and resource.

Energy Research Grants—The Iowa Energy Center provides grants for energy research on topics that have strong relevance to Iowa.

Type(s) of GHG Reductions

CO_2, N_2O, CH_4: Displaces emissions from fossil fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

TBD – [CCS should provide a worksheet and other reference material as needed for transparency]

Data Sources:

- *A Geographic Perspective on the Current Biomass Resource Availability in the United States*, A. Milbrandt, Technical Report NREL/TP-560-39181, December 2005. Prepared under Task No. HY55.2200.
- Maryland DNR "The Potential for Biomass Cofiring in Maryland", March 2006. Prepared by Princeton Energy Resources International, LLC and Exeter Associates INC for the DNR Maryland Power Plant Research Program.

Quantification Methods:

GHG Benefit

This analysis focuses on the incremental GHG benefits associated with the utilization of additional biomass to offset the consumption of fossil fuels. The analysis assumes that biomass will replace coal. This is based on the assumption that biomass will be used to replace coal in the RCI and electricity sector (where coal represents about 82% of electricity generated in Iowa).[6] Co-firing will be used as a technology to provide an estimate of possible capital costs required to enable the utilization of biomass, recognizing that other technologies, such as gasification, potentially offer more significant opportunities but have higher associated costs.

The GHG benefits are calculated by the difference in emissions associated with each of the input fuels (0.0959 tCO_2e/MMBtu for sub-bituminous coal, 0.0539 tCO_2e/MMBtu for natural gas, and 0.0019 tCO_2e/MMBtu for biomass, including non-CH_4 and non-N_2O emissions).[7]

Costs

There are two main components to the cost calculation, the fuel costs and capital costs. The fuel component is based on the difference in costs between supply of biomass fuel and the assumed fossil fuel that it is replacing (i.e. coal). As an example, costs are identified in Table 3-1 below and have been taken from *The Potential for Biomass Co-firing in Maryland*.[8]

Table 3-1. Assumed costs of feedstocks

Fuel Type	Cost $/Ton Delivered	Cost $/MMBtu Delivered
Agricultural Byproducts	$ 40.00	$4.85
Urban waste wood	$17.00	$1.70
Switchgrass	$47.00	$3.20
Mill Residue (Dry)	$27.00	$1.93

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[6] Based on eGRID data: Coal 82%, Nuclear 11%, Oil 0.3%, Natural Gas 2%, Wind 2%, Biomass 0.3%.

[7] Emission factors obtained from CCS Energy fuel emission factors.

[8] Maryland DNR "The Potential for Biomass Cofiring in Maryland", March 2006. Prepared by Princeton Energy Resources International, LLC and Exeter Associates INC for the DNR Maryland Power Plant Research Program.

Forest Residue	$35.00	$3.65
Bituminous Coal	$33.84	$1.41

The cost is calculated by assuming the replacement of coal with biomass. The difference in cost of supply between biomass and coal is calculated using the costs specific to Iowa, similar to those outlined in Table 3-1. The difference in costs (dollars per million British thermal units [$/MMBtu]) is multiplied by the amount of coal energy (MMBtu) being replaced by biomass. The assumed incremental capital costs are based on the capital costs associated with retrofitting an existing 300-700 MW capacity coal-fired boiler. An average capital cost of $180 per kW will be assumed, based on the range ($150–$200 per kilowatt [kW]) provided in *The Potential for Biomass Co-firing in Maryland*. While use of biomass may be pursued through other technology types (e.g. gasification) or end uses (e.g. heat or steam), the capital costs of co-firing will be used to provide an estimate of possible capital costs required to enable the utilization of biomass.[9]

The capital infrastructure lifespan is assumed to be 30 years, and the interest rate of is assumed to be 5%, giving a Capital Recovery Factor of 0.065 (i.e. $1 million plant is assumed to cost approximately $65,000 per year over the life of the project). For the purposes of this analysis, it is assumed that biomass plants do not require additional operating and maintenance costs (e.g. no additional emission control measures and ash disposal required).

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

TBD – [as needed and approved by the subcommittees]

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

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[9] The capital costs associated with using biomass as an alternative to fossil-based generation are dependent on many factors, including the end use (i.e. electricity, heat or steam), the design and size of the systems, the technology employed, and the configuration specifications of the system. Each system implemented under this policy would require a detailed analysis (incorporating specific engineering design and costs aspects) to provide a more accurate cost estimate of the system.

AFW-4. Encourage Large-Scale Manure/Methane Management Capture Utilization

Policy Description

Reduce methane emissions from livestock manure by installing large-scale anaerobic digester systems at locations that can service multiple concentrated animal feeding operations (CAFOs).

Reduce methane emissions from livestock manure by installing anaerobic digester systems at larger individual concentrated animal feeding operations.

Methane captured from the digesters is used to create heat or power, which offsets fossil fuel-based energy production and the associated greenhouse gas GHG emissions. This option is focused on implementing these projects at the large-scale level (e.g., community-based systems or large CAFOs).

Reduce GHG emissions associated with manure handling and storage. Potential practices include but are not limited to manure composting (to reduce methane emissions) and improved methods for application of effluent to fields (for reduced nitrous oxide emissions). Application improvements include incorporation into soil instead of surface spray/spreading.

Policy Design

Goals:

Utilization—By 2020, utilize 50% of available methane from livestock manure (primarily dairy, swine and poultry) for renewable electricity, heat and steam generation or incorporation into natural gas distribution systems.

Management—By 2020, apply improved manure handling and storage practices on 50% of manure generated.

Timing:

Parties Involved:

Other:

Implementation Mechanisms

Tax Incentives

Grants

Loan Guarantees

Related Policies/Programs in Place

Section 476C of the Iowa code provides for a renewable energy tax credit for biomass and other qualifying renewable energy sources that are used to generate electricity or heat for a commercial purpose.

A producer or purchaser of renewable energy may receive renewable energy tax credits under this chapter in an amount equal to one and one-half cents per kilowatt-hour of electricity, or four dollars and fifty cents per million British thermal units of heat for a commercial purpose, or four dollars and fifty cents per million British thermal units of methane gas or other biogas used to generate electricity, or one dollar and forty-four cents per one thousand standard cubic feet of hydrogen fuel generated by and purchased from an eligible renewable energy facility.

Alternate Energy Revolving Loan Program (AERLP)—The Iowa Energy Center provides zero-percent interest loans for up to half of the project cost, up to a maximum of $250,000. http://www.energy.iastate.edu/AERLP/index.htm

Energy Research Grants—The Iowa Energy Center provides grants for energy research on topics that have strong relevance to Iowa. http://www.energy.iastate.edu/Funding/gp-research.htm

Alternative Fuel Production Loans—The Value-Added Agricultural Products and Processes Financial Assistance Program offers a combination of forgivable and traditional low-interest loans for business projects involving the production of biomass or alternative fuels. http://www.iowalifechanging.com/business/vaapfap.html

Iowa DNR Anaerobic Digestion Outreach Program—Recognizing the enormous opportunity for the wide-scale implementation of farm-scale and community-based anaerobic digester systems in Iowa, the Iowa Department of Natural Resources Energy and Waste Management Bureau set about promoting the digester concept to Iowa Communities having large concentrations of livestock production, large volumes of organic wastes, and large energy users.

Type(s) of GHG Reductions

- **CO_2, N_2O, CH_4:** Displaces emissions from fossil fuel combustion.
- **CH_4:** Capture and utilization or preventing the creation of methane.
- **N_2O:** Reductions occur when nitrogen run-off and leaching are reduced, which leads to the formation and emission of N_2O.

Estimated GHG Reductions and Net Costs or Cost Savings

TBD

Data Sources: [TBD by CCS on subcommittee approval]

Quantification Methods:

Utilization GHG Benefits

Methane emissions (in $MMtCO_2e$) data from the Iowa Inventory and Forecast is used as the starting point to estimate the GHG benefits of utilizing the volumes of methane targeted by the policy and to add in the additional benefit of electricity generation using this captured methane (through offsetting fossil-based generation). The first portion of GHG benefit is obtained through reduced methane emissions through the capture of emissions from manure and poultry litter. An assumed collection efficiency of 75%[10] is applied to methane emissions from manure and poultry litter which is then multiplied by the assumed policy target ramping up to achieve 50% utilization by 2020.

The second portion of the GHG benefit is through the offsetting of fossil-based electricity generation. This is estimated by converting the methane captured in each year to its heat content (in BTUs) and then multiplying by an energy recovery factor of 17,100 Btu per kilowatt-hour (kWh) to estimate the electricity produced (assumes a 25% efficiency for conversion to electricity in an engine and generator set). The CO_2e associated with this amount of electricity in each year is estimated by converting the kWh to megawatt hours (MWh) and then multiplying this value by the Iowa-specific emission factor for electricity production from eGRID (1,943 lb/MWh).

The total GHG benefit is estimated as the sum of both portions of the benefit described above.

Utilization Costs

The costs for the dairy and swine components are estimated using an analysis by Natural Resources Conservation Service (NRCS), *An Analysis of Energy Production Costs from Anaerobic Digestion Systems on U.S. Livestock Production Facilities.*[11] The production costs are assumed to be $0.11 per kWh for swine anaerobic digesters and $0.05 per kWh for dairy anaerobic digesters[12]. These costs are in 2006 dollars and assume a 30% thermal efficiency. The costs include annualized capital costs for the digester, generator, and Operation and Maintenance costs[13]. The assumed costs for the poultry component will be taken from a Study in South Carolina (noting that Iowa specific data is preferable) *Availability of Poultry Manure as a Potential Bio-Fuel Feedstock for Energy Production* by Joseph R.V. Flora, Ph.D., P.E. and Cyrus Riahi-Nezhad ($0.103 per kWh in 2005 dollars using of Anaerobic Digestion).[14] The value of electricity produced is taken from the all sector average electricity price for Iowa in

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[10] The collection efficiency is an assumed value based on engineering judgment. No applicable studies were identified that provided information on methane collection efficiencies achieved using manure digesters (as it relates to collection of entire farm-level emissions).

[11] Beddoes, Bracmort, Burns and Lazarus (2007) *An Analysis of Energy Production Costs from Anaerobic Digestion Systems on U.S. Livestock Production Facilities*, NRCS, Technical Note No. 1, October 2007.

[12] It is assumed that the technology employed for both swine and dairy anaerobic digesters are covered anaerobic lagoon. Cost were obtained from table 1 of the NRCS paper sited above.

[13] The economic analysis conducted by Beddoes et al does not include feedstock and digester effluent transportation costs. The technical note does not address the economics of centralized digesters where biomass is collected from several farms and then processed in a single unit.

[14] Availability Of Poultry Manure As A Potential Bio-Fuel Feedstock For Energy Production By Joseph R.V. Flora, Ph.D., P.E. and Cyrus Riahi-Nezhad Department of Civil and Environmental Engineering University of South Carolina, August 2006.

2006 from the DOE Energy Information Administration (EIA) Table 5.6.B: *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State* (see http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html) ($0.07 per KWh in 2006 dollars). This price represents the value to the farmer for the electricity produced (to offset on-farm use) and is netted out from the production costs to estimate net costs.

Management GHG Benefits

Management of manure reduces methane emissions from a wider pool of animals than the utilization component of this option and includes manure from Dairy Cattle, Beef Cattle, Swine, poultry, Sheep, Goats and horses. Methane emissions (in $MMtCO_2e$) data from the Iowa Inventory and Forecast is used as the starting point to estimate the GHG benefits of reduced methane resulting from improved manure management through estimating the volumes of methane targeted by the policy. The GHG benefit is obtained through reduced methane emissions through the improved management of manure. An efficiency improvement of manure management is assumed to be of 25% (need reference?). This efficiency gain is applied to methane emissions from manure and poultry litter which is then multiplied by the assumed policy target ramping up to achieve improved management to 50% of manure generated by 2020.

Management Costs

Implementation Mechanisms Required – examples include: BMP programs for utilization, incentives for reduced methane and better management, penalties for non-compliance or others?

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

TBD – [as needed and approved by the subcommittees]

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

AFW-5. Land Management to Promote Sequestration Benefits

Policy Description

On cultivated lands, the amount of carbon stored in the soil can also be increased by the adoption of practices such as continuous conservation and no-till cultivation. By minimizing mechanical soil disturbance, these practices reduce the oxidation of soil carbon compounds and allow more stable aggregates to form. Other benefits include reduced wind and water erosion, reduced fuel consumption, and improved wildlife habitat.

Convert marginal agricultural land used for annual crops to permanent cover such as grassland/rangeland, orchard, or forest where the soil carbon and/or carbon in biomass is higher under the new land use. Adopt mechanisms to discourage theses acres from either returning to conventionally tilled production or to suburban/urban development.

Heavy grazing can cause significant soil disturbance and result in carbon losses from soils. Rotational grazing where animals are moved from field to field on a regular basis can reduce soil disturbance, improve plant vigor and enhance soil carbon levels.

Establish forests on land that has not historically been forested (e.g., afforestation of agricultural land) and promote forest cover and associated carbon stocks by regenerating or establishing forests in areas with little or no present forest cover (“reforestation”). Maintain and improve the health and longevity of trees in urban and residential areas to protect and enhance the carbon stored in tree biomass. Indirect emissions reductions may also occur by reducing heating and cooling needs as a result of planting shade trees.

Apply biochar to crop production fields to increase soil productivity and increase soil carbon levels.

Policy Design

Goals:

Conservation Tillage—By 2020, 75 percent of annual cropland will be managed with continuous no-till or low-till production practices

Agriculture Land Conversion—By 2020, convert 1 million acres of marginal agricultural land to higher sequestration permanent cover (including grassland, rangeland, orchard, or forest).

Conservation Grazing—By 2020, apply conservation grazing practices including rotational grazing to 50 percent of Iowa grazing lands.

Reforestation—By 2020, establish 250,000 acres of new forest lands and 500,000 acres of reforestation.

Urban Forestry—By 2020, increase the canopy cover of urban forest in Iowa communities by 25%.

Biochar—By 2020, apply biochar to 5 million acres of Iowa land annually.

Timing:

Parties Involved:

Other:

Implementation Mechanisms

TBD – [CCS drafts based on subcommittee inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on subcommittee approval]

Related Policies/Programs in Place

Type(s) of GHG Reductions

CO_2: Increase the sequestration of carbon, as well as preventing carbon currently stored in Iowa's forests and farm land from being released. Reductions also occur as soil carbon levels in crop soils are increased above business as usual levels. Increasing the levels of carbon in soils indirectly sequesters carbon from the atmosphere.

Estimated GHG Reductions and Net Costs or Cost Savings

TBD

Data Sources:

Reforestation and Afforestation:

- USDA Forest Service (USFS) Methods for Calculating Forest Ecosystem and Harvested Carbon with Standards Estimates for Forest Types of the US, General Technical Report NE-343 (also published as part of the Department of Energy Voluntary GHG Reporting Program).
- USFS Forest Inventory Analysis data, provided by the USFS.
- Walker et al. 2007. Terrestrial carbon sequestration in the Northeast: Opportunities and Costs, Part 3A: Opportunities for Improving Carbon Storage through Afforestation of Agricultural Lands.

Urban Forestry:

- McPherson and Simpson (1999), Carbon Dioxide Reduction Through Urban Forestry, USFS PSW-GTR-171. E. Gregory McPherson and James R. Simpson, Carbon Dioxide Reduction Through Urban Forestry: Guidelines for Professional and *Volunteer Tree Planters*, Gen. Tech. Rep. PSW-GTR-171, Washington, DC: U.S. Department of

Agriculture, U.S. Forest Service, 1999. Available at: http://www.treesearch.fs.fed.us/pubs/6779

Quantification Methods:

Conservation Tillage GHG Benefits

Total cropland in Iowa is estimated at about 23 million acres[15] in 1998. For the purposes of this analysis, conservation tillage is defined as any system that leaves 50% or more of the soil covered with residue.[16]

Based on the policy design parameters, the schedule for acres to be put into conservation tillage/no-till cultivation will be developed. This will represent the percentage of cropland required by the policy, less the area currently implementing conservation tillage. For the policy period, the mid-point of the estimated range for carbon sequestration (1 MtC/acre) in agricultural soils will be used to estimate the amount of carbon to be sequestered.[17] Based on the Naderman et al. study,[18] it is further assumed that this additional carbon would be sequestered in the soil over 10 years (after 10 years, the crop acres that entered the program are assumed to not store additional carbon). The resulting annual carbon accumulation rate is converted into its CO_2 equivalent, yielding 0.333 $MtCO_2$/acre/year. To estimate carbon stored each year, the annual accumulation rate is multiplied by the number of acres in the policy program each year.

Conservation Tillage Costs

The estimated cost savings related to the adoption of no-till farming is derived from the low end of the range provided in a North Carolina Study "Economic Comparison of Three Cotton Tillage Systems in Three NC Regions," by S. Walton and G. Bullen ($2.75/acre).[19] The reduction in

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[15] 1998 Iowa total crop land from the Conservation Technology Information Center Iowa Crop Residue Management Survey (see http://www.conservationinformation.org/index.asp?site=1&action=crm_results)

[16] The definitions of tillage practices from Conservation Technology Information Center are used under this policy. However, only no-till/strip-till and ridge-till are considered “conservation tillage” practices. No-till means leaving the residue from last year’s crop undisturbed until planting. Strip-till means no more than a third of the row width is disturbed with a coulter, residue manager, or specialized shank that creates a strip. If shanks are used, nutrients may be injected at the same time. Ridge-till means that 4–6-inch-high ridges are formed at cultivation. Planters using specialized attachments scrape off the top 2 inches of the ridge before placing the seed in the ground.

[17] Mid-point of the range provided by G. Naderman, B.G. Brock, G.B. Reddy, C.W. Raczkowski, “Long Term No-Tillage: Effects on Soil Carbon and Soil Density Within the Prime Crop Root Zone,” Project Report, January 2006.

[18] G. Naderman, B.G. Brock, G.B. Reddy, and C.W. Raczkowski, “Long Term No-Tillage: Effects on Soil Carbon and Soil Density Within the Prime Crop Root Zone,” Project Report, January 2006.

[19] See www.ces.ncsu.edu/depts/agecon/Cotton_Econ/production/Economic_Comparison.ppt, accessed February 2000.

fossil diesel fuel use from the adoption of conservation tillage methods is 3.5 gallons/acre.[20] The life cycle fossil diesel GHG emission factor is assumed to be 12.31 $MtCO_2e$/1,000 gallons.[21]

Additional GHG savings from reduced fossil fuel consumption are estimated by multiplying the fossil diesel emission factor and diesel fuel reduction per acre estimate provided above. Results are shown in Table 3, along with a total estimated benefit from both carbon sequestration and fossil fuel reductions.

Costs savings are estimated by multiplying the estimated savings per acre cited above ($2.75/acre) by the number of acres in the program each year. This savings estimate takes into account budget changes for the cost of fuel, labor, chemicals, and equipment.

The costs of adopting soil management practices (e.g., conservation tillage/no-till practices) are based on the financial incentives provided through the Minnesota] Agriculture Best Management Practices (AgBMP) program.[22] This program provides farmers a low-interest loan as an incentive to initiate or improve their current tillage practices. The equipment funded is generally specialized tillage or planting implements that leave crop residues covering at least 15%–30% of the ground after planting. The average total cost for this equipment is $23,000, though the average loan for tillage equipment is $16,000. The average-size farm using an AgBMP loan to purchase conservation tillage equipment is 984 acres. Based on the average loan size ($16,000) and the average size of the farm utilizing the loan (984 acres), it is assumed that a once-off loan of $16.26/acre is required to incentivize the adoption of conservation tillage practices. This loan payment is applied to each new acre entering the program to determine an approximate cost of encouraging the use of soil management practices.

Agriculture Land Conversion GHG Benefits

The number of acres of marginal crop land (1 million acres by 2020) will be multiplied by the carbon change between conventional crop production and higher sequestration activities.

Agriculture Land Conversion Costs

Costs will estimated by applying the cumulative number of acres being converted by the annual rental payment (based on conservation easement costs or other sources).

Conservation Grazing GHG Benefits

The GHG benefits of rotational grazing will be compared to BAU practices. Fore example, in Montana the soil sequestration rates currently established for sustainable grazing systems range from 0.12 $MtCO_2$/acre to 0.40 $MtCO_2$/acre. The sequestration rate depends on the determination

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[20] Reduction associated with conservation tillage compared with conventional tillage, at http://www.ctic.purdue.edu/Core4/CT/CRM/Benefits.html, accessed August 2006.

[21] Life cycle emissions factor for fossil diesel from J. Hill et. al., *Proceedings of the National Academy of Sciences*, 103(30):11206–11210. From the assessment used to evaluate U.S. soybean-based biodiesel life cycle impacts.

[22] Minnesota Department of Agriculture (2006), Agricultural Best Management Practices Loan Program State Revolving Fund Status Report, February 28, 2006.

of whether the range is in a non-degraded or degraded condition. The NRCS has established indicators of degraded rangeland that are published in the 2005 "Interpreting Indicators of Rangeland Health." NRCS Field Office Technical Guides publish guidelines for managing the controlled harvest of vegetation with grazing animals. Stocking rates and livestock distribution criteria are defined according to county and state in the NRCS "Prescribed Grazing Specification" code.

Conservation Grazing Costs

Implementation Mechanisms required: E.g. Payments to Farmers, BMPs, Education programs, Penalties, others??

Reforestation and Afforestation GHG Benefits
Forests grown or planted on land not currently in forest cover will likely accumulate carbon at a rate consistent with the accumulation rates of average forest in the region. Therefore, C sequestered by afforestation and reforestation activities can be assumed to occur at the same rate as C sequestration in average IA forests.

Average C storage will be found based on USFS GTR-NE-343, assuming reforestation and afforestation activity with a forest type distribution determined for Iowa by USDA Forest Service Forest Inventory and Analysis data. A 25-year project period will be assumed. For each forest type group for which carbon stock data are available, annual carbon sequestration rates will be calculated by subtracting carbon stocks in new stands (0 years) from carbon stocks in 25-year old stands and dividing by 25 years. An average rate will be calculated, weighted by area of each forest type to take into account variation in carbon sequestration across forest types. A 25-year rate will be used to reflect the average age of forested stands during the time frame of analysis. Young stands typically sequester carbon at faster rates than older stands.

Soil C will be assumed to remain constant, as there is no change in soil C with time in the USFS NE-GTR-343 methodology. Forests planted in one year continue to sequester carbon in subsequent years. Thus C storage in a given year will be calculated as the sum of annual C sequestration on cumulative planted acreage.

<u>Potential Land Areas Available for Afforestation and Reforestation</u>: For each of the vegetation types analyzed, a scaled implementation of growth/planting on 25%, 50%, and 100% of the land use category will be considered. A gradual ramp-up will be assumed, such that full implementation of each Scenario would be achieved in 2020.

Abandoned Minelands (AMLs): Restoring abandoned minelands can be challenging and very costly due to the need for site preparation because of uneven terrain and the legacy of their prior use. Afforestation with a typical IA forest cover mix could be analyzed.

Brownfields: Although many brownfields are remediated and used as commercial or industrial sites, they also offer potential space for C sequestration. Afforestation with a typical IA forest cover mix could be analyzed.

Oil And Gas Well Sites: These sites are widely scattered and quite small. Afforestation could be explored for these sites.

Marginal and Abandoned Agricultural Land: Marginal agricultural land is restricted by various soil physical/chemical properties, or environmental factors, for crop production. Land can be placed in this category because of its combination of soil and land cover characteristics, and includes land with high water table, steep slopes (high erodibility), shallow soils, stoniness, and low fertility. Both afforestation and reforestation with a typical IA forest cover mix could be analyzed.

Riparian Buffers: Afforestation and reforestation in riparian buffers with a typical IA riparian species forest cover mix could be analyzed.

Other land types will also be considered if they are found to represent significant areas in IA.

Reforestation and Afforestation Costs

Cost analyses of vegetation planting costs typically employ four categories: opportunity cost (of planting forest rather than another, potentially more lucrative land use), conversion cost, maintenance cost, and measuring/monitoring costs (Walker et al. 2007). For this analysis, opportunity cost will be assumed to be zero because the land considered in each of the Scenarios is currently underutilized.

One-time costs of vegetation establishment include site preparation and vegetation planting. These costs are incurred in the year of planting, one time only. Ongoing costs of maintenance and monitoring are incurred annually on all acreage planted in all years of policy implementation. Costs will vary, depending on the specific goals of the tree-planting project, species planted, and site conditions. If natural growth rather than planting occurs on a site, many of these costs may not be incurred.

For each of the combinations of vegetation and land use category, a phased implementation of planting vegetation on 25%, 50% and 100% of the available land in that category by 2020 will analyzed. Discounted costs to 2020 will be calculated using a 5% discount rate. Net present value (NPV) is the sum of the discounted costs—in other words, the economic cost or benefit of implementing the option between 2008 and 2020, calculated in today's dollars. Levelized cost-effectiveness is the NPV of a scenario divided by the cumulative GHG benefit of that scenario. This will be expressed in $/tCO_2e$ sequestered or avoided, and is intended to give a sense for the cost of each scenario standardized for its actual GHG benefit across numerous scenarios and options that vary in terms of overall cost and cumulative GHG benefit.

Urban Forestry GHG Benefit

Carbon Sequestration in Urban Trees

Annual carbon sequestration per urban tree will be calculated based on statewide average data reported by the USDA Forest Service. The average annual per-tree carbon sequestration value will be found by dividing the total estimated annual carbon sequestration in IA urban trees by the total number of urban trees. Since trees planted in one year continue to accumulate carbon in subsequent years, annual carbon sequestration in any given year will be calculated as the sum of carbon stored in trees planted in that year, plus the sequestration by trees that were planted in prior years. Because it takes the difference between total live C stocks at two points in time, this stock change approach will account for normal tree mortality.

Avoided Fossil Fuel Emissions

GHG reductions from avoided fossil fuel use for heating and cooling can occur as a result of planting trees that provide additional shade and wind protection to buildings. The total benefits are a function of three different types of impacts: reduced cooling demand, reduced demand for heating due to wind reduction, and increased demand for heating due to wintertime shading. McPherson et al. will be used to calculate an average annual per-tree GHG reduction factor. The estimate will assume that the trees planted are split among residential settings with pre-1950, 1950–1980, and post-1980 homes using the default distribution provided by McPherson et al.

To calculate total avoided GHG emissions due to increased shading, it will be assumed that 50% of the new urban trees are planted where they can have shading effects. Medium-sized evergreen trees planted and average tree distribution around buildings will also be assumed (i.e., these fossil fuel reduction factors are average for existing buildings, and do not necessarily assume that trees are optimally placed around buildings to maximize energy efficiency). These factors are also dependent on the fuel mix (coal, hydroelectric, nuclear, etc.) in the regions of interest, and are thus likely to change if the electricity mix changes.

The shading benefits occur in the year a tree is planted and every year thereafter. Thus, the GHG emissions reduction factor will be multiplied by the cumulative number of trees planted each year to estimate annual avoided fossil fuel emissions.

Total GHG benefit will be calculated as the sum of direct C sequestration plus fossil fuel offset from reduced cooling demand and wind reduction.

Urban Forestry Costs

The economic costs included in this analysis will be the costs of planting and annual maintenance, including the costs of program administration and waste disposal. The economic benefits of tree planting will include the cost avoided from reduced energy use. Data are available on the estimated economic benefits of such services as provision of clean air, hydrologic benefits (e.g., stormwater control), and aesthetic enhancement, but these indirect co-benefits will not explicitly quantified.

Costs and cost savings will be estimated from average annual costs and cost savings over 40 years for a range of tree sizes. The cost estimate used in this analysis will be calculated as the average of small, medium, and large trees under public and private management. The cost savings will also be calculated as the average of small, medium, and large trees under public and private management. The cost savings will be estimated using 40-year averages; thus, it will represent lifetime costs applicable in the year planted and every year thereafter during the time frame of the analysis. To estimate total cost savings, cost per tree will be multiplied by the cumulative number of trees planted each year.

Biochar GHG Benefits

Need information and data sources for GHG benefits of biochar.

Biochar Costs

Need information and data sources for GHG benefits of biochar.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

TBD – [as needed and approved by the subcommittees]

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

AFW-6. Cellulosic Fuel Incentives

Policy Description

Promote research and production of sustainable in-state fuels derived from cellulose (biomass) to displace the use of conventional petroleum-based fuels. Promote the in-state development of cellulosic feedstocks (including perennials) that are able to be utilized for the production of cellulosic fuels. Promote research into conversion technologies, such as thermo-chemical Fischer-Tropsch processes and enzymatic conversion, to facilitate their development.

Promote cellulosic biofuel production systems that improve the embedded energy content, life-cycle, and carbon profile of biofuels. Focus on plant material feedstocks that favor energy production and are carbon neutral or negative and have multiple other positive environmental benefits, such as maintaining carbon sequestration potential and soil productivity, and decreasing water and fossil fuel inputs in their production. This could help provide a strong economic market within the state and reduce GHG emissions through avoided fossil fuel consumption.

Note that this option is focused on the supply-side aspects of promoting biofuels, with an emphasis on the development of feedstocks and production technologies. The demand-side aspects of renewable fuels (including cellulosic biofuels) are being addressed through the Transportation and Land Use subcommittee through TLU-8.

Policy Design

Goals:

Increase in-state cellulosic feedstock production by 10 million dry tons by 2020.

Timing:

Parties Involved:

State of Iowa, farmers, biofuels producers, distributors, fuel retailers, fuel wholesalers, business owners, and relevant agriculture and trade associations.

Other:

Implementation Mechanisms

TBD – [CCS drafts based on subcommittee inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on subcommittee approval]

Related Policies/Programs in Place

Question for Sub-committee: Are there plans currently in place for any cellulosic ethanol facilities in the state of Iowa? If so, what is their planned capacity, estimated time of opening, etc.?

Type(s) of GHG Reductions

CO_2: Lifecycle emissions are reduced to the extent that biofuels are produced with lower embedded fossil-based carbon than conventional (fossil) fuel. Feedstocks used for producing biofuels can be made from crops or other biomass, which contain carbon sequestered during photosynthesis (e.g., biogenic or short-term carbon).

Estimated GHG Reductions and Net Costs or Cost Savings

TBD

Data Sources:

What feedstock sources would be used – Switchgrass and energy crops? Residue from current agricultural production? Wood residue? Will energy crops be grown on CRP or marginal land?

Quantification Methods:

Biofuel GHG Reductions

For ethanol the benefits for this option are dependent on developing in-state production capacity that achieves benefits beyond petroleum fuels.

Based on the emission factors listed above, the incremental benefit of cellulosic production targeted by this policy over gasoline is 8.46 Mt CO_2 reduced/1,000 gallons. This value is based on the difference between the lifecycle CO_2e emission factor of gasoline (11.74 metric tons/1,000 gallons) and the lifecycle CO_2e emission factor of cellulosic ethanol (3.28 metric tons/1,000 gallons).[23] The cellulosic benefit value will be used along with the production in each year to estimate GHG reductions.

Biofuel Costs

For ethanol, costs for the incentives needed by this policy option are based on the estimated production costs of cellulosic ethanol. Estimates taken from an NREL-sponsored industry forum estimate a production cost $1.97 per gallon for cellulose-based, resulting in a differential of $0.66 per gallon (for more information on these costs, please see the Key Uncertainties section below).[24] These estimates include capitals costs so additional incentives for capital and R&D are not included in this analysis. These incentives are considered necessary in the near term to help commercialize technologies that produce ethanol from cellulose. The incentives should also help to establish the infrastructure to deliver biomass to biorefineries, since producers will seek the local feedstocks or renewable fuels for their operations.

By 2015, it is assumed that advances in cellulosic ethanol production (e.g., enzyme costs, production processes) will make cellulosic ethanol production cost competitive with starch-based production. Hence, the incentives could be discontinued beginning in 2015. Note that federal legislation has been proposed to offer cellulose an incentive of $0.765/gallon compared to the $0.51/gallon currently offered for ethanol production.[25] If enacted, this $0.255/gallon premium could cover the additional incentives that are assumed to be needed by the State of Iowa. The federal incentives do not assure, however, that production facilities would locate in Iowa, hence these federal incentives have not been factored into the cost estimates for this option.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

Cost competitiveness of biofuels will depend on cost of oil.

Cost of cellulosic ethanol production: The Energy Information Administration (EIA) has stated "Capital costs for a first-of-a-kind cellulosic ethanol plant with a capacity of 50 million gallon per year are estimated by one leading producer to be $375 million (2005 dollars), as compared with $67 million for a corn-based plant of similar size, and investment risk is high for a large-

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[23] DOE/EIA, http://www.eia.doe.gov/oiaf/analysispaper/biomass.html, accessed January 9, 2008. ANLGreet model emission factor in g/mi x GREET model average fuel economy (100 mi/4.7 gal).

[24] http://www.nrel.gov/technologytransfer/entrepreneurs/pdfs/19_forum/braemar_cellulosic.pdf, slide 21, accessed December 2007

[25] D. Morris, *Making Cellulosic Ethanol Happen: Good and Not So Good Public Policy*, Institute for Local Self-Reliance, January 2007, at www.newrules.org/agri/cellulosicethanol.pdf, accessed January 2007.

scale cellulosic ethanol production facility. Other studies have provided lower cost estimates. A detailed study by the National Renewable Energy Laboratory in 2002 estimated total capital costs for a cellulosic ethanol plant with a capacity of 69.3 million gallons per year at $200 million."[26]

In June 2006, a U.S. Senate hearing was told that the current cost of producing cellulosic ethanol is US $2.25 per US gallon (US $0.59/litre). This is primarily due to the current poor conversion efficiency. At that price it would cost about $120 to substitute a barrel of oil (42 gallons), taking into account the lower energy content of ethanol. However, the Department of Energy is optimistic and has requested a doubling of research funding. The same Senate hearing was told that the research target was to reduce the cost of production to US $1.07 per US gallon (US $0.28/litre) by 2012.

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

Implementation of this option requires additional research and development in cellulosic ethanol production methods, development of feedstock collection and delivery infrastructure, successful negotiations with cellulosic technology leaders to establish pilot and commercial-scale plants in the state. Sourcing of feedstocks and the size and location of facilities (both crushing and biodiesel production) must be addressed for optimization and planning. Trade-offs between food and fuel crops will be an important issue.

There may be an overlap among agricultural options that seek to increase/maintain crop acreage in no-till production or in conservation management programs. This could be in conflict with the higher levels of crop production proposed in this option.

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

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[26] http://www.eia.doe.gov/oiaf/analysispaper/biomass.html, accessed December 2007

AFW-7. Improved On-Farm (or First Point of Purchase) Energy Use and Efficiency

Policy Description

Renewable energy can be produced and used on-site at agriculture operations. For example, installation of solar or wind power, use of hydro-powered generators for irrigation, and converting diesel farm equipment to more efficient or renewable energy technology will reduce carbon dioxide emissions. The use of energy efficient products should also be promoted. This could include improved grain dryers, heat exchangers (dairy), electric motors, and energy efficient building design.

Policy Design

Goals:

Renewable Energy—Increase renewable energy use at agriculture operations by 10% by 2020.

Energy Efficiency—Increase energy efficiency of on-farm operations by 30% by 2020.

Timing:

Parties Involved:

Other:

Implementation Mechanisms

TBD – [CCS drafts based on subcommittee inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on subcommittee approval]

Related Policies/Programs in Place

TBD

Type(s) of GHG Reductions

CO_2: Improved efficiency can reduce electricity and fuel consumption and the associated GHGs.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

Renewable Energy: Iowa Renewable Energy Guide[27] may be valuable in estimating costs of various renewable energy technologies on a small scale. If this policy is more intended to install on-farm renewable energy on a large scale, then different cost estimates will be used, such as the

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[27] http://www.iowadnr.gov/energy/renewable/files/renewableguide.pdf

Energy Information Agency Report entitled: "Assumptions for the Annual Energy Outlook 2006: with projections to 2025", 2006.

Energy Efficiency: Consumption of distillate fuel by the agriculture sector in Iowa was projected from historical data provided by the Energy Information Administration (EIA).[28] The petro-diesel emissions factor used is consistent with the California Climate Action Registry (10.05 $MtCO_2e$/1,000 gal)[29]. The agricultural sector electricity consumption was derived from the National Agriculture Statistics Service (NASS)[30] and historical electricity prices from the EIA.[31]

Quantification Methods:

Renewable Energy GHG Benefits

Potential renewable energy options available for Iowa farmers include wind, solar photovoltaics, solar thermal heating and geothermal. Methane utilization is considered under AFW-4 and will not be covered here. A reasonable mix of these technologies will be provided for the state of Iowa based on previous state analyses. An example from Colorado is provided below in Tables 7-1 and 7-2. These numbers will be updated for Iowa after consultation with the Energy Supply Subcommittee.

Table 7-1. Annualized cost of renewable generation

Year	Annualized Wind Cost (2005$/MW-hr)	Annualized PV Cost (2005$/MW-hr)	Annualized Solar Thermal Cost (2005$/MW-hr)	Annualized Geothermal Cost (2005$/MW-hr)
2010	50	576	254	–
2011	49	543	252	–
2012	48	509	250	–
2013	47	476	247	–
2014	46	442	245	–
2015	45	409	243	78
2016	45	409	243	77
2017	45	409	243	76
2018	45	409	243	76
2019	45	409	243	75
2020	45	409	243	74

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[28] Energy Information Administration. “Colorado Total Distillate Sales/Deliveries to Farm Consumers.” 1984–2006. Accessed on 4/25/08, at http://tonto.eia.doe.gov/dnav/pet/hist/kd0vfmsia1a.htm

[29] California Climate Action Registry. “General Reporting Protocol” March 2007.

[30] National Agricultural Statistics Service. “Iowa Agriculture: A Profile.” 2005 data. Accessed on April 25, 2008, at http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/

[31] Energy Information Administration. “Current and Historical Monthly Retail Sales, Revenues, and Average Retail Price by State and by Sector (Form EIA-826).” Table accessed on 4/25/08, at www.eia.doe.gov/cneaf/electricity/page/sales_revenue.xls.

Table 7-2. Assumed mix of generation

Year	Share of Wind	Share of Solar PV	Share of Solar Thermal	Share of Geothermal
2007	83%	0%	1%	0%
2008	86%	0%	1%	0%
2009	88%	1%	1%	0%
2010	91%	1%	1%	0%
2011	90%	1%	1%	0%
2012	90%	2%	2%	1%
2013	89%	2%	2%	1%
2014	89%	3%	3%	2%
2015	88%	3%	3%	2%
2016	87%	3%	3%	2%
2017	87%	3%	3%	2%
2018	86%	3%	3%	3%
2019	86%	3%	3%	3%
2020	85%	3%	3%	3%

If the on-farm mix in Iowa is likely to be different from that provided by the ES SC, then the AFW subcommittee should provide information on reasonable percentages of each technology to use. The GHG benefits will be quantified based on the emission differences between the renewable portfolio and the grid electricity that it is replacing.

Renewable Energy Costs

The costs/benefits of incentivizing each technology will be considered. If the SC wants the analysis to pursue renewable energy in any manner other than state incentivizing, they should be clear on how that is meant to be implemented. Costs will be based on the portfolio of technologies considered, and the different costs of each, as seen in Table 7.1.

Energy Efficiency GHG Benefits

This analysis will also consider various technology possibilities available to reduce on-farm energy consumption. Potential options include: education programs to optimize tire inflation, improving efficiency of water pumps, more efficient lighting, and incentives for more efficient tractors. If other technologies are to be considered in the analysis, subcommittee members should provide examples of information on how these technologies could be used in Iowa. Could the subcommittee provide estimates on the amount of energy used by these various technologies and what efficiency improvements might be possible, given the technologies available. The GHG benefits will then be calculated based on the emissions that have been avoided because of the new technologies. This can come in the form of fuel savings or reduced electricity consumption. We will calculate the total GHG benefit based on the emissions factors of the various fuels (CO2e/BTU or gallon) or electricity (CO2e/kWh).

Efficiency Costs

This analysis will be done by examining the cost of installing or optimally using various technologies (for example more efficient pumps). In order to maximize pump efficiency, they must be tested and replaced periodically, which requires a capital investment.

Using estimates of the total number of pumps potentially available in Iowa, we can determine the total costs of this project. This total cost figure will be balanced against the fuel/ electricity savings which occur with such an efficiency investment. Costs and savings for each year will be discounted back to 2005 dollars.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

Implementing renewable projects at a small scale (e.g. on-farm operations) can often be difficult and/or expensive. This may be a limiting factor in the implementation of this option.

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

AFW-8. Waste Management Strategies

Policy Description

Reduce the volume of waste from residential, commercial, and government sectors through programs that reduce the generation of wastes. Reduction of generation at the source reduces both landfill emissions and upstream production emissions.

Increase recycling or reuse of waste in order to limit GHG emissions associated with landfill methane generation and with the production and transport of products/packaging from virgin materials (noting that different recycled materials will exhibit different costs and benefits on a life cycle basis). Increase recycling programs, create new recycling programs, provide incentives for recycling construction materials, develop markets for recycled materials, and increase average participation/recovery rates for all existing recycling programs.

Increase organics management programs, such as composting, in order to reduce GHG emissions associated with land-filled organic waste.

Policy Design

Three approaches are possible: recycling approach, waste prevention approach, market driven approach, i.e., producer responsibility (voluntary systems and mandatory systems).

Goals:

Waste Prevention—Achieve a 0% per capita increase in waste production (as compared to 2005), from residential commercial, and government sectors by 2020. Achieve zero waste by 2050.

Reuse and Recycling—Increase statewide recycling rate average to 35% by 2020 as compared to the amount of waste produced. (If waste is minimized, then there will be less materials to recycle.)

Extended Producer Responsibility—Reach an agreement with manufacturers, producers, and retailers to reduce by 10 percent the quantity of packaging on the market and pursue more environmentally friendly packaging.

Work with U.S. industry to achieve life cycle product stewardship, so that products are designed for reuse, repair (not planned obsolescence), and recycling. Alternatively, shift the responsibility for managing discarded products and packaging from local government to producers of products. (non-quantified goal)

Timing:

Parties Involved:

Other:

Waste Prevention

The route to waste prevention requires a combination of initiatives by manufacturers and retailers, governmental intervention, as well as better informed consumers.

Waste prevention and recycling are at different ends of the spectrum. Recycling programs do not further the goals of waste prevention.

The incentive for manufacturers, producers, and consumers to minimize waste is greatly reduced when the emphasis is on municipal recycling programs.

There is insufficient awareness and understanding of the benefits and methodology of waste prevention. There is predominantly an emphasis in both the public and private sectors on "end-of-pipe" waste treatment rather than prevention.

With waste prevention, greenhouse gas emissions associated with waste disposal are not only avoided, but also all the emissions associated with extraction, manufacturing and transport. Waste prevention is genuinely sustainable resource management.

Manufacturing take back programs create an incentive for waste minimization.

Consumer education on waste-related purchase behavior results in little impact as consumers have a tendency to rank price, convenience and brand name as more critical than environmental considerations.

EPA estimates that for each person participating in a PAYT program, greenhouse gas emissions are reduced by an average of 0.088 metric tons of carbon equivalent. (EPA, 1999) A community of 100,000 people could potentially reduce GHG emissions by 8,800 metric tons of carbon equivalent.

Recycling

Goals of ever higher recycling targets will have higher costs. There is increasing demand for more materials to be added to recycling programs, which will further escalate costs and add to risks of being able to market the materials collected.

High recycling rates inadvertently justify high consumption rates. Statutory recycling targets do not prevent waste but force the focus on recycling.

Providing garbage collection more frequently than recycling collection encourages disposal rather than recycling.

The development of integrated waste management facilities such as commercial MRFs and biodegradable waste composting facilities are complex and expensive and siting such facilities is problematic if not impossible.

Flow control will become an issue if Iowa establishes waste rules and regulations that are more stringent, onerous, and more costly than surrounding states.

The overriding goal should be on climate change; we should evaluate the potential of source reduction or recycling to achieve the goal of reducing greenhouse gas emissions.

As the principal generator of waste, industry is a crucial stakeholder in the effective implementation of waste reduction and recycling.

Implementation Mechanisms

Assist in the creation and expansion of sustainable markets to support diversion and recycling efforts.

Introduce appropriate financial, legal and policy incentives and sanctions to induce waste generators to prevent waste and recycle.

- Focus local government efforts to require multi-family recycling.
- Focus local government efforts to require construction and demolition recycling.
- Make recycling more convenient and cost-effective when compared to waste disposal, e.g., implement curbside single stream recycling systems and food waste collection. (all organics?)
- Implement incentives for customers to reduce waste through meaningful Unit Based Pricing systems for waste disposal in all regions with combined populations above XXXXX.
- Establish composting programs for yard waste and food waste in all regions with combined populations above XXXXX.
- Pilot Commercial Material Recovery Facilities (COMM MRFs) through which all commercial waste will be processed before residuals are disposed of (not front-end).
- Require mandatory life cycle product stewardship (extended producer responsibility) which is designed, financed, and managed by manufacturers of consumer goods.
- Hold manufacturers responsible for the waste and environmental impact of their products and packaging (producer responsibility) rather than passing that responsibility to the consumer.
- Place a tax on plastic bags.
- Establish statewide landfill bans for select materials that can be reused, recycled, or otherwise recovered.
- Expand the materials collected through the Bottle Bill and increase financial incentives for collectors.

Educate the community about the consequences of generating waste and responsible consumerism.

- Clearly define waste reduction and establish as a priority.
- Distribute information on how to reduce unwanted mail and catalogues.
- Encourage use of reusable shopping bags.

- Promote "simple living," local purchasing
- Promote an economic environment that favors the use of recycled materials.

Related Policies/Programs in Place

Waste Management Programs: The State of Iowa runs several programs to promote waste reduction, recycling, and composting. These programs include Iowa DNR's Solid Waste Alternatives Program, Pollution Prevention Services Program, and Iowa Waste Exchange, as well as Iowa Waste Reduction Center at the University of Northern Iowa.

Landfill Diversion Goals: The State of Iowa adopted the goal of diverting 50% of waste from landfills by the year 2000 from year 1988 levels.

Type(s) of GHG Reductions

CO_2: Upstream Energy Use Reductions—The energy and GHG intensity of manufacturing a product is generally less using recycled feedstocks than from using virgin feedstocks.

CH_4: Diverting biodegradable wastes from landfills will result in a decrease in methane gas releases from landfills.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources: [TBD by CCS on subcommittee approval]

Quantification Methods:

Below is an outline of expected quantification methods that may be used by CCS to estimate the GHG reduction potential of this option. While some text may be left in for the final version of the Policy Options Document, this outline will be removed once the draft quantification has been completed.

GHG Benefits

GHG benefits are determined using the EPA's WAste Reduction Model (WARM). WARM uses information for specific material inputs and disposal/diversion methods to estimate GHG emission reductions based on a business-as-usual (BAU) and policy scenario. The BAU scenario will extrapolate the baseline waste management data using an average annual change in generation. This rate has yet to be identified, and more information from the Subcommittee is requested. The table below describes the 2005 Data Inputs for the WARM model.[32] These numbers will represent the baseline scenario.

Material	Tons Generated	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum Cans	28,411	21,979	6,432		NA
Steel Cans	31,418	10,516	20,902		NA

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[32] Iowa Department of Natural Resources. "Economic Impacts of Recycling in Iowa." December 2007. Accessed on March 7, 2008 from; http://www.iowadnr.com/waste/recycling/files/ecofullreport.pdf. The 2005 baseline data is estimated from Table 7.1 of the "Economic Impacts of Recycling in Iowa" report.

Material	**Tons Generated**	**Tons Recycled**	**Tons Landfilled**	**Tons Combusted**	**Tons Composted**
Copper Wire					NA
Glass	99,872	63,428	36,444		NA
HDPE	26,438	5,000	21,438		NA
LDPE	610	610			NA
PET	25,139	11,740	13,399		NA
Corrugated Cardboard	330,237	149,625	180,612		NA
Magazines/Third-class Mail	186,775		186,775		NA
Newspaper	325,214	240,000	85,214		NA
Office Paper	55,004	2,750	52,254		NA
Phonebooks					NA
Textbooks					NA
Dimensional Lumber	344,525	167,665	176,860		NA
Medium-density Fiberboard					NA
Food Scraps	225,595	NA	225,095		500
Yard Trimmings	101,573	NA	34,300		67,273
Grass		NA			
Leaves		NA			
Branches		NA			
Mixed Paper (general)	349,636	153,214	196,422		NA
Mixed Paper (primarily residential)					NA
Mixed Paper (primarily from offices)					NA
Mixed Metals	250,620	178,000	72,620		NA
Mixed Plastics	298,059	16,959	281,100		NA
Mixed Recyclables					NA
Mixed Organics	44,301	NA	31,620		12,681
Mixed MSW	1,007,566	NA	1,007,566		NA
Carpet	575	575	50,647		NA
Personal Computers	51,281	634			NA
Clay Bricks		NA		NA	NA
Concrete[1]	5,382	5,382		NA	NA

Material	Tons Generated	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Fly Ash[2]				NA	NA
Tires[3]					NA
Totals	3,788,231	1,028,077	2,679,700	-	67,773

The WARM model will be run for the years 2012 and 2020, in order to produce GHG reduction estimates for the policy target years. A linear extension in all other years is expected.
For the policy scenario, the baseline annual waste generation rate will be altered to incorporate the goals of 0% per-capita increase and 35% recycling rate of waste that is generated.
WARM considers composting of organic material differently than traditional recycling. Also, the cost of composting programs differs from that of recycling programs. Therefore, the 35% recycling goal will be referred to as "diversion" and the "recycling" and "composting" rates will add up to the total goal.

Cost Effectiveness
Iowa-specific information will be preferable for all of the factors listed below. For recycling and composting, the net cost will be the sum of the program cost, the tipping fee received at the diversion facility, additional capital cost, and additional operation and maintenance (O&M) cost, less any avoided landfill tipping fee and the market value of the recycled or composted product. For source reduction, the net cost will generally be any program costs required for the implementation of the program, less the value of the averted landfill tipping fees.

- Average landfill tipping fee
- Average recycling facility tipping fee (paid to either the hauler or recycler)
- Average compost facility tipping fee
- Average value of compost
- Capital and O&M cost for recycling facilities
- Capital and O&M cost for composting facilities
- Collection cost for source-separated compost and recycling programs
- Education and/or enforcement program costs.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

Sufficient political commitment?

Budget constraints

Sufficient regulatory/financial incentives?

Inconsistent enforcement

Insufficient data

Low landfill disposal costs result in less interest in waste prevention/recycling

Resistance to change

Must have sufficient local capacity for collected recyclables

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]

AFW-9. Landfill Methane Energy Programs

Policy Description

Use the renewable energy within landfills gas (methane) to make electric power, space heat, or liquefied natural gas. Methane gas generation by landfills is a GHG reduction strategy that may benefit from a cap and trade system, encouraging landfills to install flares at a minimum and possibly achieve electric generation if the economic incentives are sufficient.

Policy Design

Goals: TBD

Control—Increase the number of landfills from recovering methane as an energy source wherever it is economically feasible to do so. By 2020, ensure that all large landfills (i.e. sites accepting over XX TPD of waste) are fully controlling the release of methane, such that XX% of the landfill gas being generated is controlled by 2020. This can be done through development of additional landfill gas to energy (LFGTE) projects. For sites where LFGTE is not feasible, implement flaring controls to achieve the goal.

Technology Research and Evaluation—Since conversion technologies hold promise for environmentally managing waste and producing energy, annually examine the experience and costs of emerging technologies for waste management with a goal to determine feasibility of the technology for Iowa. (non-quantified goal)

Education—Begin to educate the public about the impact and costs of various waste to energy technologies. (non-quantified goal)

Timing:

Parties Involved:

Other:

Iowa currently has four landfill operations which are recovering methane (2 generate electricity). EPA Land-fill Methane Outreach Program (LMOP) identifies 17 facilities that may have the opportunity to recover methane.

Methane Energy Programs

The capture of one ton of methane from landfill gas (LFG) is equivalent to reducing approximately 20 tons of CO2e. (Benefits of LFG Energy, Landfill Methane Outreach Program, USEPA, www.epa.gov/lmop/benefits.htm)

According to the EPA Landfill Methane Outreach Program (WMW Review Issue 2006) landfills generate about 26% of the U.S. methane emissions. Methane is the second most important greenhouse gas (GHG).

If landfilling of organic materials is to be continued, future landfills must be fully controlled bioreactors where most of the methane generated is captured and used to produce energy. (Capture and Utilization of Landfill Gas, Nickolas Themelis and Priscilla Ulloa, Easrth Engineering Center and Department of Earth and Environmental Engineering, Columbia University, New York, NY 10027, USA).

Actual emissions of CH4 from landfills are sensitive to dozens of site-specific factors and can vary over a wide range, but we do not have either the direct measurement data or the detailed site data that would be required to conduct more than an approximate estimate of CH4 emissions from Iowa landfills. (from a North Carolina study)

Waste to Energy (WTE) Mass Burn

Incineration, the combustion of organic material such as waste, with energy recovery is the most common WTE implementation.

Other than removing oversized items and HHW, little preprocessing is necessary.

Depending on the location, size and other factors, the capital costs range from $110,000 to $140,000 per daily ton of capacity. Therefore, a plant that processes 1,000 tons of municipal solid wastes per day may cost between $110 and $140 million. In addition to the capital costs, a 1000-ton-per-day plant would engage personnel of about 60. Other costs are services, materials, and supplies and the cost of disposal of ash. (The ABC of Integrated Waste Management, Waste-to-Energy Research and Technology Council, www.seas.columbia.edu/earth/wtert/faq.html)

Tipping fees at WTE plants, based on 15 respondents, ranged from $40/ton in North Carolina (1 facility) to $98/ton (3 facilities). (Biocycle, April 2006, The State of Garbage in America)

Experts and local community groups are concerned with modern incinerators because of fine particulate emissions, metal, trace dioxins and acid gas emissions, toxic fly ash, bottom ash management as well as waste resource ethics such as valuable resource destruction and low energy efficiency.

Incineration or combustion in any form is rejected in the zero waste movement as a viable, sustainable or ethical solution to waste management. Public acceptability, or rather lack of it, remains a barrier to emerging waste management technologies.

Emerging Technologies for MSW (Gasification, plasma arc, thermal depolymerization, ethanol production from waste, anaerobic digestion)

Currently long-term experience with alternative technologies is unavailable. Waste conversion technologies have very high costs, and the vast majority have not been proven on a commercial scale or as full scale plants using municipal solid waste. More than 90% of these technologies are still in the experimental, development, small-scale, or pilot project stage, i.e., they are not mature technologies. Experts agree that they are not currently a reliable, cost-effective alternative.

Only gasification and plasma arc can handle the entire MSW waste stream with limited residuals. Most other processes require preprocessing and/or pretreatment, either by separating out incompatible and recyclable materials, homogenizing and shredding. This means that materials must either be separated at the source or processed through an MRF.

Some processes produce an ash containing constituents of lead, cadmium and mercury which need to be managed in a manner that is environmentally responsible.

Proponents for conversion technologies report them to produce not only energy but usable products and by-products, e.g., slag. The slag bonds metals, halogen and sulfur atoms with silicate to make leaching of the materials difficult. The profitability of products and by-products is dependent on viable markets and the value of the products produced. There are risks with constructing such facilities with a goal of profiting from products and by-products.

Implementation Mechanisms

TBD – [CCS drafts based on subcommittee inputs; this can be developed as they go along, and can start early or late as they prefer; the level of detail can vary on subcommittee approval]

Related Policies/Programs in Place

Methane Gas Conversion Property Tax Exemption: Under Iowa's Methane Gas Conversion Property Tax Exemption, property used for methane gas collection and conversion into energy and connected with, or in conjunction with, a publicly owned sanitary landfill, is exempt from property tax. If other fuels are burned as well, the exemption is equal to the ratio of methane in the overall fuel mix.

Type(s) of GHG Reductions

CO_2, N_2O, CH_4: Displaces emissions from fossil fuel combustion.

CH_4: Methane reductions via collection and control (via flaring, or preferentially via energy utilization).

Estimated GHG Reductions and Net Costs or Cost Savings

TBD

Data Sources:

Gasification Project in Greve (1,200 TPD of RDF) ($1,996)

- $170 million capital costs
- $35.6 million O&M costs
- $16.3 million/year in revenues

Plasma Arc – Green Power Systems

- $182 million capital costs
- $18 million/year revenue

Quantification Methods:

Below is an outline of expected quantification methods that may be used by CCS to estimate the GHG reduction potential of this option. While some text may be left in for the final version of the Policy Options Document, this outline will be removed once the draft quantification has been completed.

GHG Benefits

The first step in determining the GHG benefits for this option is to set the annual WIP threshold, above which landfills will begin instituting landfill-gas-to-energy (LFGTE) controls.

If the goal is based on a percentage reduction in emissions, the total municipal landfill emissions from the Iowa I&F will be multiplied by this percentage to determine the GHG reduction.

However, if the goal is based on a certain number of landfills, an EPA model, LandGEM, will be used to determine the GHG reductions from this option.

Cost-Effectiveness

The cost effectiveness of this option is determined using the LFGcost model. The current model inputs assume an 8% interest rate over 10 years for capital and energy prices of $4.50/MMBtu and $0.045/kWh.

Based on the current utilization of LFGTE, assumptions will be made to determine the proportion of landfill gas captured by small engines (less than 800 kW capacity), large engines, and direct use. Then, the total emissions captured by each technology will be multiplied by the respective cost effectiveness estimates from the LFGcost model to determine an overall cost effectiveness for this option.

Key Assumptions: [TBD, as needed on subcommittee approval]

Key Uncertainties

TBD – [as needed and approved by the subcommittees]

Additional Benefits and Costs

TBD – [as needed and approved by the subcommittees]

Feasibility Issues

There is a danger of over committing on infrastructure to recover value.

Status of Group Approval

Pending –

Level of Group Support

TBD – [blank until ICCAC meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the ICCAC]