www.akclimatechange.us

Forestry, Agriculture, and Waste Management (FAW) Technical Work Group

Summary List of Pending Priority Options

Option No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2010–2025 (Million 2005$)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2010–2025			
FAW-1	Forest Management Strategies for Carbon Sequestration	TBD	TBD	TBD	TBD	TBD	Pending
FAW-2	Expanded Use of Biomass Feedstocks for Energy Production	TBD	TBD	TBD	TBD	TBD	Pending
FAW-3	Advanced Waste Reduction and Recycling	0.2	0.5	4.0	-$7.3	-$29	Pending

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; TBD = to be determined; NQ = not quantified; N/A = not applicable

Note that negative costs represent a monetary savings.

Biomass Resource Supply and Demand Assessment

The table below is a preliminary table that has been developed for AK on biomass availability. The source/reference for the value is indicated in the notes section. CCS will work with the FAW TWG to continue development of this table for AK, which will be needed to address not only FAW policy options, but biomass related options in other TWGs as well.

An assessment of biomass resources available to meet the feedstock requirements of the CCMAG policies is presented in Table 1 below. The table presents a total estimated potential availability of biomass in dry tons based on business as usual in AK across the forestry , agriculture, and waste management sectors. Potential availability is defined as the amount available if the resource were managed according to its current demonstrated productive capacity; and social, ecological, administrative and technical constraints were managed to minimize their impact on utilization.[1] For the purpose of defining a reference point, the stated potential assumes all constraints can be lifted and does not consider economic considerations limiting supply (e.g. distance to end user). The only items that are not based on business as usual are MSW Fiber and Yard and Landscape Waste Debris, which assume that the diversion goals of FAW-3 will be met.

After the analysis of recommendations from all TWGs is complete, the annual biomass demand for 2025 will be calculated in order to assess whether or not sufficient biomass supply exists to achieve the goals set forth in the policy recommendations made by the CCMAG.

Table 1. Potential Annual Biomass Resource Supply and Demand

Biomass Resource	Annual Biomass Supply (dry short tons)	2025 Annual Biomass Demand (dry short tons)	Notes
Logging Residue	738,000	TBD	2005 NREL Report.[2] Derived from the USDA Forest Service's Timber Product Output database for 2002.
Primary Mill Residue (Unused)	131,000	TBD	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	2,000	TBD	2005 NREL Report. Derived from data on the number of businesses that was gathered from the U.S. Census Bureau, 2002 County Business Patterns. Includes woods scraps and sawdust from woodworking shops – furniture factories, container and pallet mills, and wholesale lumberyards.

[1] Robert Froese, Version 1.0 - 18 August 2008. Biomass for Bioenergy in Michigan: Actual Versus Potential Availability, Unpublished.

[2] A. Milbrandt. *A Geographic Perspective on the Current Biomass Resource Availability in the United States.* Technical Report NREL/TP-560-39181. Golden, CO: U.S. Department of Energy, National Renewable Energy Laboratory, December 2005. Available at: www.nrel.gov/docs/fy06osti/39181.pdf.

Biomass Resource	Annual Biomass Supply (dry short tons)	2025 Annual Biomass Demand (dry short tons)	Notes
Urban Wood Waste	65,000	TBD	2005 NREL Report. Includes MSW wood, utility tree trimming and/or private tree companies, and construction/demolition wood.
Municipal Solid Waste (MSW) Fiber	315,653	TBD	Other than Urban Wood Waste. Will be forecast to 2025 based on input from TWG and DEC
Yard and Landscape Waste Debris	106,605	TBD	Other than Urban Wood Waste. Will be forecast to 2025 based on input from TWG and DEC
Total Annual Biomass Supply	**1,357,958**	**TBD**	

FAW-1 Forest Management for Carbon Sequestration

Policy Description

Alaska forests can play a unique role in both preventing and reducing GHG emissions while providing for a wide range of social and environmental benefits. These benefits include clean air and water, wildlife habitat, recreation, subsistence activities, forest products and a host of other uses and values. Carbon is stored in the above ground biomass and in the organic and mineral soil components of the soil. Permafrost soils add an additional dimension and complication to the role soils play in the boreal, sub-arctic and arctic ecosystems and the potential impacts of increased wildland fire in these regions has wide ranging implications. Additionally the state has two distinct forest ecosystems, the boreal and coastal forests and the types of forest management activities that may apply to each from a carbon management perspective may also differ.

Coastal Forest Options:

- Increase the amount of carbon durable products produced from managed forests. Examples of management practices could be:
    - Extended rotations
    - Pre-commercial or commercial thinning of young growth stands of timber
    - Fertilization treatments
    - Other silvicultural treatments that would meet the intent of the policy option

Boreal Forest Options:

- Fuel reduction projects that utilize both prescribed fire and mechanical treatments to reduce fuel loads which will reduce burn intensity and overall GHG emissions in a wildland fire event.
- Complete Community Wildfire Protection Plans (CWPP) to identify fuel types and community risks to aid in prioritization of fuel treatment work.
- Rapidly reforest sites impacted by fire or insect and disease outbreaks to ensure full stocking and a quick return to forest cover.

Policy Design

Goals:

Coastal Forest Carbon Management Pre-commercial thinning:

- By 2010 thin 4,000 acres annually across all ownerships (both public and private)
- By 2015 thin 8,000 – 10,000 acres annually
- By 2025 thin 6,000 acres annually

Boreal Forest Mechanical Fuels Treatment Projects:

- By 2010 treat 1,000 acres annually across all ownerships
- By 2020 treat 2,000 acres annually
- By 2025 treat 2,500 acres annually

(Note if we include fire use and prescribed fire treatments, these numbers could be increased significantly)

Community Wildfire Protection Plans:

- By 2010 complete 15 plans
- By 2015 complete 25 additional plans
- By 2025 complete 35 additional plans

Boreal Forest Reforestation after fire or insect and disease mortality:

- By 2010 reforest 5% of high site class lands
- By 2015 reforest 15% of high site class lands
- By 2025 reforest 25% of high site class lands

Timing:

Forest Carbon Management: Increase funding levels to ramp up program to meet goals at various increments and establish a viable carbon trading program to capture revenue stream from the CO_2 sequestration perspective.

Mechanical Fuel Treatment Projects: Based on CWPP recommendations utilize village Type II fire crews and agency Type I fire crews to complete projects in their communities. Funding for these projects will be a key aspect and programs at the national level may help with this need.

Community Wildfire Protection Plans: Establish statewide coordinator by 2010, conduct training workshops for communities by 2011-2012

Reforestation: Increase seed collection efforts by 2010-2015, especially when there are good seed years, to ensure enough seed is on hand to meet goals. Funding for this item will be a critical aspect of this item.

Parties Involved: Alaska Department of Natural Resources, Division of Forestry, Alaska Native Corporations, University of Alaska, Southeast Conference, Cooperative Extension Service, Natural Resource Conservations Service, Resource Development Council, Alaska Forest Association, U.S. Forest Service, State and Private Forestry, State Board of Forestry, Soil and Water Conservation Districts.

Other: For reforestation projects some work needs to be done on the recommended species mix for conifers. Should lodge pole pine or Siberian larch be considered for a portion of the mix? White spruce 75% and lodge pole pine 25% per unit area planted. (Adaptation measure)

Research Needs:

- Continue work to develop the science and process to better quantify beneficial and negative outcomes of silvicultural treatments from a carbon sequestration perspective. Opportunities in this area are currently limited by the science.
- Develop an accepted protocol for determining the "carbon life" of various forest products. This relates to the current assumption that the point of tree harvest is an emission of CO_2.

Implementation Mechanisms

TBD – [CCS drafts based on TWG 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 TWG approval]

Related Policies/Programs in Place

TBD – No recent policies or programs have been identified as of yet. The TWG and DEC can work with CCS to identify existing or planned programs that address issues raised in this option.

Types(s) of GHG Reductions

TBD

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: [**TBD by CCS on TWG approval]
- **Quantification Methods: [e.g.** Full life-cycle analysis with supply/demand equilibrium adjustments on TWG approval]
- **Key Assumptions: [**TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until CCMAG moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until CCMAG meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the CCMAG]

FAW-2 Expanded Use of Biomass Feedstocks for Energy Production

Policy Description

Increase the amount of biomass available from forestry, municipal solid waste, and agriculture for generating heat/electricity and liquid/gaseous biofuels to displace the use of fossil energy sources. Foster the development of the following where they are compliant with environmental requirements:

- wood biomass alternative fuel products or heat and electric generation from sawmill by-products;
- methods to economically utilize that portion of harvested trees not being used to make conventional forest products to make wood biomass alternative fuel products or heat and electric generation;
- methods to economically utilize biomass generated from silvicultural treatments and wildland fire fuel reduction treatments in the production of biomass alternative fuel products or heat and electric generation;
- methods to economically utilize feedstocks from municipal solid waste (e.g. urban wood waste, waste vegetable oil) and agricultural sources (e.g. manure management);
- large and small scale technologies that generate heat and electricity and the production of synthetic fuels from biomass;
- both conventional and emerging technologies (e.g. cellulosic ethanol/other liquid fuel; pyrolisis; gasification) for biomass utilization; and
- opportunities for industry, communities and individuals to use biomass alternative fuel products to substitute for fossil fuels for heat or transportation. This should be done either using 100% biomass or through co-firing with other fuels.

Policy Design

Goals:

- By 2025, utilize biomass feedstocks to produce 5% of the state's electricity.
- By 2025, utilize biomass feedstocks to offset 10% of the state's heating oil use.
- By 2025, utilize biomass feedstocks to offset 5% of the state's fossil transportation fuels.

Timing:

- By 2010, establish a demonstration pilot facility to produce biomass electricity, heat generation, synthetic fuels or biomass alternate fuel products.

- By 2015, utilize 50% of practical and available resource.
- By 2025, achieve the full policy goals.

Coverage of Parties:

Executive and Legislative Branches of State Government, Alaska Department of Natural Resources, Alaska Department of Environmental Conservation, Alaska Energy Authority, Alaska Native Corporations, University of Alaska, Southeast Conference, Alaska Industrial Development Authority, Cooperative Extension Service and Agencies, Natural Resource Conservation Service, Alaska State Chamber of Commerce, Resource Development Council, Alaska Forest Association, Alaska Public Service Commission, Alaska Department of Revenue, Alaska electric utilities and electric cooperatives, crop producers, and timberland owners.

Other: Not Provided.

Implementation Mechanisms

TBD – [CCS drafts based on TWG 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 TWG approval]

Related Policies/Programs in Place

TBD – No recent policies or programs have been identified as of yet. The TWG and DEC can work with CCS to identify existing or planned programs that address issues raised in this option.

Types(s) of GHG Reductions

TBD

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: [**TBD by CCS on TWG approval]
- **Quantification Methods: [e.g.** Full life-cycle analysis with supply/demand equilibrium adjustments on TWG approval]
- **Key Assumptions: [**TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until CCMAG moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until CCMAG meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the CCMAG]

FAW-3 Advanced Waste Reduction and Recycling

Policy Description

Reduce waste generation and increase recycling and organics management and in order to limit GHG emissions upstream from material production, through transportation and on the downstream end associated with landfill methane generation. Reduction of generation at the source reduces both landfill emissions and upstream production and transportation emissions. Increase economically-sustainable recycling programs, create new recycling programs, provide incentives for the recycling of construction materials, develop markets for recycled materials, and increase average participation and recovery rates for all existing recycling programs.

Policy Design

Goals: Quantify current waste generation rates (pounds per capita per day) for rural and urban areas. Reduce waste stream, including diverted waste, 10% in 2012, 15% by 2015, and 25% by 2025.

Timing: Startup in 2010 and ramp up to higher levels in 2012 and 2015, consistent with goals

Parties Involved: Consumers, manufacturers, relevant trade associations, consumer's associations, all state and local agencies, retail outlets, non-profit organizations, shippers, waste management industry

Other: Urban areas are considered to be Anchorage, Mat-Su Valley, Fairbanks, and Juneau. Rural areas are all other communities in the state.

Implementation Mechanisms

TBD – [CCS drafts based on TWG 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 TWG approval]

Related Policies/Programs in Place

The four largest communities in Alaska are embarking on new recycling programs. In Anchorage, the Municipality has dedicated a fund for recycling and is planning to build on private efforts by expansion of drop-off sites, school district recycling and public outreach. The Municipal collection utility, which serves approximately 20% of Anchorage residences, has implemented a Pay As You Throw (PAYT) and curbside recycling program beginning in October 2008. The residential waste hauler, Alaska Waste, is offering curbside recycling service to a third of Anchorage and Eagle River residences.

The Fairbanks North Star Borough (FNSB) is soliciting proposals for optimizing the Municipal Solid Waste (MSW) stream. The FNSB is seeking a long-term partnership to implement a method for economical disposal of the community's municipal solid waste while returning energy savings to the Borough; with a particular emphasis on waste reduction, recycling and waste to energy options.

The City and Borough of Juneau has just completed an evaluation by a consultant for a long range solid waste management strategy and analysis. Alaska's capital city is targeting the implementation of a curbside recycling program in 2009.

In the Matanuska-Susitna Valley, Valley Community for Recycling Solutions is securing funds and moving forward for the construction and operation of a Community Recycling Center. The site is located adjacent to the Matanuska-Susitna Borough's Central Landfill.

The Municipality of Anchorage refuse collection utility has implemented a Pay As You Throw (PAYT) and curbside recycling program beginning in October 2008. The PAYT system promotes waste reduction through lower rates for smaller refuse containers. The utility is discontinuing flat-rate refuse collection service.

Alaskans for Litter Prevention and Recycling (ALPAR) has an in-store plastic bag recycling, reuse and conservation toolkit available on their website www.alparalaska.com.

Types(s) of GHG Reductions

CO_2: Upstream energy use reductions—The energy and GHG intensity of manufacturing a product is generally less when using recycled feedstocks than when 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

GHG Reduction Potential in 2015, 2025 ($MMtCO_2e$): 0.17 and 0.51, respectively.

Net Cost per tCO_2e: –$29.

Data Sources: Data on current waste disposal and recycling were provided by AK DEC.[3] Where AK-specific data was not available, CCS utilized national defaults derived from the U.S. EPA 2007 Waste Characterization Report.[4] GHG emission reductions were modeled using EPA's WAste Reduction Model (WARM).[5] Input informing the cost parameters was also provided by AK DEC.

[3] D. Buteyn (AK DEC), personal communication with H. Lindquist (CCS) December 11, 2008. D. Buteyn personal communication with B. Strode (CCS) December 2008 and January 2009.

[4] U.S. EPA. (2008). "Municipal Solid Waste in the United States: 2007 Facts and Figures." Available at: http://www.epa.gov/osw/nonhaz/municipal/pubs/msw07-rpt.pdf.

[5] U.S. Environmental Protection Agency. "WAste Reduction Model (WARM)." Version 8, May 2006. Available at: http://www.epa.gov/climatechange//wycd/waste/calculators/WARM_home.html. EPA created WARM to help solid waste planners and organizations track and voluntarily report GHG emission reductions from several different waste management practices. WARM is available as a Web-based calculator and as a Microsoft Excel spreadsheet. WARM calculates and totals GHG emissions of baseline and alternative waste management practices—source

Quantification Methods:

Business-as-usual Waste Management Forecast

The business-as-usual (BAU) waste management profile in Alaska was developed using input from AK DEC.[6] MSW landfills are classified according to the average daily tonnage received. Class I landfills accept greater than 20 tons/day, Class II accept between 5 and 20 tons/day, and Class III landfills accept less than 5 tons/day. Population projections are from an Alaska Department of Labor report were used to develop the waste generation projections for the state, as well as the four key Alaska population centers (Anchorage, Fairbanks, Mat-su Borough, and Juneau).[7] See Table 3-1 for the total Alaska waste management projection. The remainder of this section will describe the methods for developing the BAU waste management forecast for distinct communities and community groups in Alaska.

Table 3-1. Total Alaska BAU Waste Management Projection, 2005-2025.

	2005	2010	2012	2015	2020	2025
Total Alaska						
MSW Generated (tons)	739,684	779,542	795,793	820,168	861,140	900,298
MSW Landfilled (tons)	634,848	669,620	683,863	705,208	740,777	774,414
MSW Incinerated (tons)	29,604	30,658	31,118	31,821	32,987	34,169
MSW Diverted (tons)[8]	75,232	79,264	80,812	83,140	87,376	91,716
Total Alaska Diversion %	10.2%	10.2%	10.2%	10.1%	10.1%	10.2%

According to data provided by AK DEC, there are 310 communities in Alaska that deposit waste in 222 Class III landfills. The waste generation from these communities is assumed to be 6.6 lbs/person/day, with waste collected 5 days per week (260 days per year). The population depositing waste in Class III landfills was assumed to be the remainder of the state's population after the populations of Class I and Class II communities were considered. AK DEC reported that there are about t10 tons per year of aluminum cans shipped from Class III communities to be recycled. The quantity and growth rate of waste incinerated in Class III landfill communities is consistent with inputs used for the AK Inventory and Forecast (I&F), less the waste that was reported to be incinerated in the North Slope Borough (within the Class II community

reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in tons of carbon equivalent (tCe), tCO_2e, and energy units (MMBtu) across a wide range of material types commonly found in MSW. For an explanation of the methodology, see the EPA report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*, EPA530-R-02-006, May 2002. Available at http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html.

[6] D. Buteyn (AK DEC), personal communication with H. Lindquist (CCS) December 11, 2008. D. Buteyn personal communication with B. Strode (CCS) December 2008 and January 2009.

[7] Alaska Department of Labor and Workforce Development. 2007. "Alaska Population Projections: 2007-2030." Available at: http://www.labor.state.ak.us/research/pop/projections/AlaskaPopProj.pdf.

[8] "Waste Diverted" includes waste recycled and waste composted.

classification). The amount of waste landfilled is the difference between the waste generated and the waste incinerated and diverted. Table 3-2 depicts the BAU waste management projections for the Class III landfill communities.

Table 3-2. Class III Landfill Communities BAU Waste Management Projection, 2005-2025.

	2005	2010	2012	2015	2020	2025
Class III Landfill Communities						
MSW Generated (tons)	63,406	63,619	63,401	63,073	62,153	60,930
MSW Landfilled (tons)	37,401	36,705	36,114	35,218	33,323	31,092
MSW Incinerated (tons)	25,995	26,904	27,277	27,845	28,819	29,827
MSW Diverted (tons)	10	10	10	10	10	10

Similar to Class III landfill communities, Class II landfill communities are assumed to deposit 6.6 lbs/person/day of waste for 260 days out of the year. AK DEC estimates that Class II communities account for 7.3% of the total population of Alaska. It is assumed that no waste is diverted in these communities. The waste incinerated is based on the estimated amount incinerated in the North Slope Borough. The total waste landfilled is therefore the difference between the waste generated and the waste incinerated. Table 3-3 shows the BAU waste management scenario for Class II landfill communities.

Table 3-3. Class II Landfill Communities BAU Waste Management Projection, 2005-2025.

	2005	2010	2012	2015	2020	2025
Class II Landfill Communities						
MSW Generated (tons)	41,522	43,754	44,667	46,036	48,320	50,490
MSW Landfilled (tons)	37,913	40,001	40,826	42,061	44,153	46,149
MSW Incinerated (tons)	3609	3753	3841	3975	4167	4341
MSW Diverted (tons)	0	0	0	0	0	0

Included in the consideration of the Class I landfill communities were the four large population centers of Anchorage, Fairbanks, Mat-su Borough, and Juneau. Additional communities served by Class I landfills are grouped into the "Non-Metro Class I Landfill Communities" category. The average per-capita waste generation rate for each community was based on input from AK DEC. The generation rate for the Non-Metro group was estimated by taking the weighted average of the generation rates from the communities in that group. Class I facilities are assumed to accept deposits for 312 days per year. Recycling rates for Anchorage, Mat-su Borough, and Juneau were provided by AK DEC. The baseline recycling rate for Anchorage is 19%, the baseline recycling rate for the Mat-su Borough is 1.2%, and the recycling rate for Juneau and Fairbanks is 5.7%.[9] It was assumed that Fairbanks had a recycling rate equal to that of Juneau.

[9] D. Buteyn (AK DEC), personal communication with H. Lindquist (CCS) December 11, 2008. D. Buteyn personal communication with B. Strode (CCS) December 2008 and January 2009. Anchorage recycling information from a data sheet compiled by Alaskans for Litter Prevention and Recycling (ALPAR), provided by D. Buteyn of AK DEC.

Recycling attributed to the Non-Metro Class I Landfill Communities is based on reported recycling from the Kenai Peninsula Borough.[10] It was also assumed that no MSW combustion took place in Class I landfill communities. Table 3.4 outlines the waste management projections for Class I landfill communities.

Table 3-4. Class I Landfill Communities BAU Waste Management Projection, 2005-2025.

	2005	2010	2012	2015	2020	2025
Non-metro Class I Landfill Communities						
MSW Generated (tons)	90,636	94,822	95,932	97,597	99,717	101,074
MSW Landfilled (tons)	90,002	93,853	94,904	96,474	98,416	99,565
MSW Incinerated (tons)	0	0	0	0	0	0
MSW Diverted (tons)	634	968	1027	1122	1301	1508
Anchorage						
MSW Generated (tons)	350,751	367,197	373,996	384,196	403,205	422,758
MSW Landfilled (tons)	284,108	297,430	302,937	311,199	326,596	342,434
MSW Incinerated (tons)	0	0	0	0	0	0
MSW Diverted (tons)	66,643	69,767	71,059	72,997	76,609	80,324
Fairbanks						
MSW Generated (tons)	91,974	98,638	100,693	103,776	108,308	112,698
MSW Landfilled (tons)	86,456	92,719	94,652	97,550	101,810	105,936
MSW Incinerated (tons)	0	0	0	0	0	0
MSW Diverted (tons)	5,518	5,918	6,042	6,227	6,499	6,762
Mat-su Borough						
MSW Generated (tons)	76,179	85,216	90,679	98,873	112,675	125,607
MSW Landfilled (tons)	75,265	84,193	89,590	97,686	111,323	124,100
MSW Incinerated (tons)	0	0	0	0	0	0
MSW Diverted (tons)	914	1,023	1,088	1,186	1,352	1,507
Juneau						
MSW Generated (tons)	25,217	26,297	26,425	26,618	26,762	26,742
MSW Landfilled (tons)	23,704	24,719	24,840	25,021	25,157	25,137
MSW Incinerated (tons)	0	0	0	0	0	0
MSW Diverted (tons)	1,513	1,578	1,586	1,597	1,606	1,604

GHG Benefit Analysis

CCS applied the goals set forth by the TWG in the "Policy Design" section to the Alaska BAU waste management scenario in Table 3-1. As the TWG did not prescribe a specific ratio of diversion that will be met through recycling/composting to that which will be met through source reduction, CCS assumed the ratio of the two diversion strategies needed to meet the goal. Tables

[10] Kenai Peninsula Borough Solid Waste Office. (2008). "Recycling and Solid Waste Programs." Data collected for the Homer Bailing Facility and Central Peninsula Landfill. Available at: http://www.borough.kenai.ak.us/SolidWaste/Informational%20Pages/recyclewaste.htm

3-5, 3-6, and 3-7 display the assumed annual diversion targets, the policy waste management scenario, and the incremental waste diversion, respectively. As the annual target for waste diversion does not exceed the BAU diversion level until the year 2013, it is assumed that there is zero incremental diversion in these years.

Table 3-5. Yearly Waste Management Targets, 2010-2025.

	2010	2012	2015	2020	2025
Diversion	5.0%	10.0%	15.0%	20.0%	25.0%
Recycling / Composting	5.0%	10.0%	13.0%	16.5%	20.0%
Source Reduction	0.0%	0.0%	2.0%	3.5%	5.0%

Table 3-6. Total Alaska Policy Waste Management Scenario, 2010-2025.

	2010	2012	2015	2020	2025
Total Alaska					
MSW Generated (including SR, tons)	779,542	795,793	820,168	861,140	900,298
MSW Landfilled (tons)	669,620	683,863	665,322	655,925	641,055
MSW Incinerated (tons)	30,658	31,118	31,821	32,987	34,169
MSW Diverted (tons)	79,264	80,812	123,025	172,228	225,075
MSW Recycled /Composted (tons)	79,264	80,812	106,622	142,088	180,060
MSW Source Reduced (tons)	-	-	16,403	30,140	45,015

Table 3-6. Total Alaska Incremental Waste Diversion, 2010-2025.

	2010	2012	*2013*	2015	2020	2025
Total Alaska						
MSW Diverted (tons)	-	-	12,204	39,886	84,852	133,359
MSW Recycled /Composted (tons)	-	-	6,844	23,482	54,712	88,344
MSW Source Reduced (tons)	-	-	5,359	16,403	30,140	45,015

The incremental waste diversion was allocated amongst the four large metro areas based on the proportion of waste diverted – and in the case of source reduction, waste generated – in each metro area under the BAU scenario. Any remaining incremental diversion needed to meet the goal was allocated to Anchorage. Table 3-7 portrays the assumed incremental waste diversion for each of the major population centers in Alaska.

Table 3-7. Class I Metro Landfill Communities Incremental Waste Diversion, 2010-2025.

	2010	2012	*2013*	2015	2020	2025
Anchorage						
MSW Diverted (tons)	-	-	10,100	33,158	71,236	112,200
MSW Recycled /Composted (tons)	-	-	6,218	21,340	49,767	80,437
MSW Source Reduced (tons)	-	-	3,882	11,818	21,469	31,763
Fairbanks						
MSW Diverted (tons)	-	-	1,089	3,484	7,073	10,936
MSW Recycled /Composted (tons)	-	-	411	1,409	3,283	5,301
MSW Source Reduced (tons)	-	-	678	2,076	3,791	5,635
Mat-su Borough						
MSW Diverted (tons)	-	-	705	2,259	4,600	7,340
MSW Recycled /Composted (tons)	-	-	82	282	657	1,060
MSW Source Reduced (tons)	-	-	623	1,977	3,944	6,280
Juneau						
MSW Diverted (tons)	-	-	310	983	1,942	2,883
MSW Recycled /Composted (tons)	-	-	133	451	1,005	1,545
MSW Source Reduced (tons)	-	-	177	532	937	1,337

GHG benefits were determined by using WARM,[11] which uses information for specific material inputs and disposal/diversion methods to estimate GHG emission reductions based on BAU and policy scenarios. Avoided emission of CO_2 and associated GHGs from the reduction of the amount virgin materials and energy consumption necessary for the production of products and packaging, as the total mass produced of these items would be reduced. WARM accounts for the origin of carbon sequestered in raw materials. Therefore, CO_2 emissions from the combustion or decomposition of biogenic waste are not counted towards the total emissions, CH_4 and N_2O emissions due to landfilling or combustion of biogenic waste, as well as avoided future CO_2

[11] U.S. Environmental Protection Agency. WAste Reduction Model (WARM)." Version 8, May 2006. Available at: http://www.epa.gov/climatechange//wycd/waste/calculators/WARM_home.html. EPA created WARM to help solid waste planners and organizations track and voluntarily report GHG emission reductions from several different waste management practices. WARM is available as a Web-based calculator and as a Microsoft Excel spreadsheet. WARM calculates and totals GHG emissions of baseline and alternative waste management practices—source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in tCe, tCO_2e, and energy units (MMBtu) across a wide range of material types commonly found in MSW. For an explanation of the methodology, see the EPA report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*, EPA530-R-02-006, May 2002. Available at: http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html

sequestration are counted towards the net life-cycle emissions of each waste management practice.

The key requirement for inputting data into WARM is that the amount of waste generated for each waste type must be the same under the policy and BAU scenarios. Therefore, although waste that is source reduced is not actually generated, it is considered as a part of the total generated under the policy scenario as that waste has the potential to be generated without incremental diversion efforts. A second requirement for an accurate result from WARM is that the MSW managed should be broken up by waste type. There are six categories and 34 distinct waste types accepted by WARM. Based on available Alaska data, 18 of those waste types were utilized. Table 3-8 and 3-9 show the baseline waste generation, disposal, and diversion characterization. In cases where, due to data selection from multiple sources, there was more waste projected to be diverted than generated for a given waste type, it was assumed that the maximum diversion percentage for any waste type is 90%.

Table 3-8. Assumed Baseline Alaska Waste Characteristics – Waste Categories

Category	Baseline Generation Composition (BAU)	Baseline Anchorage, Juneau, Fairbanks Recycling Composition (BAU)	Baseline Mat-Su Valley Recycling Compostition (BAU)	Baseline non-Metro Recycling Composition (BAU)
Paper	32.7%	45.9%	87.9%	9.7%
Organics	25.3%	1.6%	0.0%	0.0%
Mixed Plastic	12.1%	0.7%	7.3%	0.5%
Metals	8.2%	46.4%	4.8%	3.4%
Glass	5.3%	1.5%	0.0%	0.0%
Other	16.4%	3.8%	0.0%	0.0%

Table 3-9. Assumed Baseline Alaska Waste Characteristics – Waste Types

Waste Category Waste Type	Alaska Waste Generation Composition (% of waste Generated)[12]	Anchorage, Juneau, Fairbanks Baseline Recycling Composition (% of Waste Recycled)[13]	Mat-su Baseline Recycling Composition (% of Waste Recycled)[14]	ROS Baseline Recycling Composition (% of Waste Recycled)[15]	Total Baseline Recycling Composition (% of Waste Recycled)
Paper	**32.7%**	**45.9%**	**87.9%**	**96.1%**	**47.0%**
Corrugated Cardboard	12.3%	25.8%	27.7%	47.1%	26.1%
Magazines/Third-class Mail	3.3%	2.5%			2.4%

[12] U.S. EPA. (2008). "Municipal Solid Waste in the United States: 2007 Facts and Figures." Available at: http://www.epa.gov/osw/nonhaz/municipal/pubs/msw07-rpt.pdf.

[13] D. Buteyn (AK DEC), personal communication with H. Lindquist (CCS) December 11, 2008. D. Buteyn personal communication with B. Strode (CCS) December 2008 and January 2009.

[14] *Ibid.*

[15] *Ibid.*

Waste Category Waste Type	**Alaska Waste Generation Composition (% of waste Generated)[12]**	**Anchorage, Juneau, Fairbanks Baseline Recycling Composition (% of Waste Recycled)[13]**	**Mat-su Baseline Recycling Composition (% of Waste Recycled)[14]**	**ROS Baseline Recycling Composition (% of Waste Recycled)[15]**	**Total Baseline Recycling Composition (% of Waste Recycled)**
Newspaper	4.3%	8.5%		39.4%	8.8%
Office Paper	2.4%	0.2%			0.2%
Phonebooks	0.3%	0.4%			0.4%
Textbooks	0.5%	0.0%			0.0%
Mixed - Residential	7.1%	8.5%	60.2%	9.7%	9.1%
Mixed - Office	2.5%	0.0%			0.0%
Glass	**5.3%**	**1.5%**		**0.0%**	**1.5%**
Metals	**8.2%**	**46.4%**	**4.8%**	**3.4%**	**45.4%**
Aluminum Cans	0.6%	0.2%	2.2%	3.4%	0.3%
Steel Cans	1.0%	0.0%			0.0%
Mixed Metals	6.6%	46.2%	2.6%		45.1%
Plastics	**12.1%**	**0.7%**	**7.3%**	**0.5%**	**0.8%**
HDPE	2.2%	0.0%			0.0%
LDPE	2.5%	0.0%			0.0%
PET	1.5%	0.0%			0.0%
Mixed Plastics	5.9%	0.7%	7.3%	0.5%	0.8%
Organics	**25.3%**	**1.6%**	**0.0%**	**0.0%**	**1.5%**
Food Scraps	12.5%	0.0%			0.0%
Yard Trimmings	12.8%	1.6%			1.5%
Other	**16.4%**	**3.8%**	**0.0%**	**0.0%**	**3.8%**

The BAU and Policy waste management projections were multiplied by the percentages in Table 3-9 to provide WARM inputs for the years 2015 and 2025. Again, it was assumed that the maximum diversion rate for any given waste type is 90%. It was also assumed that only biogenic waste (i.e. paper and organics) could be combusted. The amount of each biogenic waste type combusted is in proportion to that waste type's generation quantity. The amount of waste source reduced for each waste type for which this diversion method is an accepted WARM input was also proportional to each waste type's generation quantity. The amount of waste landfilled was estimated by subtracting the amount of waste diverted and combusted from the total waste generated. Tables 3-10 and 3-11 display the BAU and policy WARM modeling for 2025.

Table 3-10. 2025 BAU WARM Inputs

Material	Tons Generated	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum cans	5,172	278	4,894	-	NA
Steel cans	8,644	-	8,644	-	NA
Copper wire				-	NA
Glass	48,108	1,336	46,772	-	NA
HDPE	20,015	-	20,015	-	NA
LDPE	22,672	-	22,672	-	NA
PET	13,320	-	13,320	-	NA
Corrugated cardboard	110,633	23,951	79,437	7,245	NA
Magazines/third-class mail	29,970	2,224	25,783	1,963	NA
Newspaper	38,897	8,061	28,289	2,547	NA
Office paper	21,255	180	19,683	1,392	NA
Phonebooks	2,480	339	1,979	162	NA
Textbooks	4,747	-	4,436	311	NA
Dimensional lumber					NA
Medium-density fiberboard					NA
Food scraps	112,121	NA	104,779	7,342	-
Yard trimmings	115,593	NA	106,605	7,570	1,419
Grass		NA			
Leaves		NA			
Branches		NA			
Mixed paper (general)					NA
Mixed paper (primarily residential)	63,907	8,379	51,343	4,185	NA
Mixed paper (primarily from offices)	22,176	-	20,724	1,452	NA
Mixed metals	59,692	41,393	18,298	-	NA
Mixed plastics	52,855	711	52,144	-	NA
Mixed recyclables	148,042	3,446	144,597	-	NA
Mixed organics		NA			
Mixed MSW		NA			NA
Carpet					NA
Personal computers					NA
Clay bricks		NA		NA	NA
Concrete				NA	NA
Fly ash				NA	NA
Tires					NA
Totals	**900,298**	**91,716***	**774,414**	**34,169**	

N/A = not applicable; HDPE = high-density polyethylene; LDPE = low-density polyethylene; PET = polyethylene terephthalate; MSW = municipal solid waste. *Includes waste composted

Table 3-11. 2025 Policy WARM Inputs

Material	Baseline Generation	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum cans	5,172	714	546	3,911	-	NA
Steel cans	8,644	1,194	-	7,450	-	NA
Copper wire						NA
Glass	48,108	6,645	2,622	38,841	-	NA
HDPE	20,015	2,765	-	17,251	-	NA
LDPE	22,672	3,131	-	19,541	-	NA
PET	13,320	1,840	-	11,480	-	NA
Corrugated cardboard	110,633	15,281	47,021	41,086	7,245	NA
Magazines/third-class mail	29,970	4,139	4,366	19,502	1,963	NA
Newspaper	38,897	5,372	15,826	15,152	2,547	NA
Office paper	21,255	2,936	354	16,574	1,392	NA
Phonebooks	2,480	343	665	1,310	162	NA
Textbooks	4,747	656	-	3,780	311	NA
Dimensional lumber						NA
Medium–density fiberboard						NA
Food scraps	112,121	NA	NA	104,779	7,342	-
Yard trimmings	115,593	NA	NA	105,238	7,570	2,785
Grass		NA	NA			
Leaves		NA	NA			
Branches		NA	NA			
Mixed paper, broad		NA				NA
Mixed paper, residential	63,907	NA	16,450	43,272	4,185	NA
Mixed paper, office	22,176	NA	-	20,724	1,452	NA
Mixed metals	59,692	NA	53,722	5,969	-	NA
Mixed plastics	52,855	NA	1,396	51,459	-	NA
Mixed recyclables	148,042	NA	34,306	113,736	-	NA
Mixed organics		NA	NA			
Mixed MSW		NA	NA			NA
Carpet						NA
Personal computers						NA
Clay bricks			NA		NA	NA
Concrete		NA			NA	NA
Fly ash		NA			NA	NA
Tires						NA
Totals	**900,298**	**45,015**	**180,060***	**641,055**	**34,169**	

HDPE = high-density polyethylene; LDPE = low-density polyethylene; PET = polyethylene terephthalate; MSW = municipal solid waste. *Includes waste composted

The resulting output for the 2015 and 2025 WARM runs predict the GHG reductions for these years to be 0.17 and 0.51 $MMtCO_2e$, respectively. The cumulative GHG reductions are calculated to be 3.96 $MMtCO_2e$. Table 3-12 displays a summary of the waste diversion, reduction, and GHG benefits of this recommendation.

Table 3-12. Overall Policy Results—GHG Benefits

Year	Avoided Emissions (MMtCO2e)	Incremental Waste Diversion (tons)	Source Reduction (tons)	Incremental Recycling (tons)	Incremental Composting (tons)
2010	-	-	-	-	-
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	0.06	12,204	5,359	6,723	121
2014	0.12	25,910	10,827	14,840	242
2015	0.17	39,886	16,403	23,119	363
2016	0.21	48,553	19,052	29,037	464
2017	0.24	57,383	21,750	35,069	564
2018	0.28	66,377	24,498	41,215	664
2019	0.31	75,533	27,294	47,474	765
2020	0.34	84,852	30,140	53,847	865
2021	0.38	94,242	33,021	60,256	965
2022	0.41	103,788	35,949	66,774	1,065
2023	0.45	113,490	38,924	73,400	1,166
2024	0.48	123,346	41,946	80,134	1,266
2025	0.51	133,359	45,015	86,977	1,366
Totals	**3.96**	**978,921**	**350,180**	**618,865**	**9,876**

$MMtCO_2e$ = million metric tons of carbon dioxide equivalent.

Cost-Effectiveness

Source reduction—The amount of waste managed in Alaska under the policy scenario is reduced according to CCS's best judgment that 5% of the 25% goal would be feasible by 2025. The cost-effectiveness estimate for source reduction in Alaska comprises three elements: the cost of program implementation, the avoided costs of waste collection and disposal.

The cost of program implementation is assumed to be $1.00 per capita per year.[16] This cost applies only to the populations of the four largest metro areas. The cost figure uses a population projection from AK Department of Labor.[17] These funds are assumed to cover any education and marketing programs necessary to implement the source reduction goal.

---

[16] The source reduction program cost is a preliminary estimate consistent with costs assumed in similar options considered by CCS projects in Washington and Colorado.

[17] Alaska Department of Labor and Workforce Development. 2007. "Alaska Population Projections: 2007-2030." Available at: http://www.labor.state.ak.us/research/pop/projections/AlaskaPopProj.pdf.

Source reduction is expected to save money by reducing the amount of waste that has to be collected and disposed of in landfills. The avoided collection cost is assumed to be \$2.50 per household per month (calculations based on total households in these areas yields a per-ton collection cost of \$9.72).[18] The landfill tip fees that are offset vary by municipality. The landfill tipping fees used for this analysis are; \$60 for Anchorage, \$61 for Fairbanks, \$50 for Mat-su Borough, and \$140 for Juneau.[19]

The analysis assumes that costs begin to be incurred in 2012. The estimated cost savings result in an NPV of –\$4.1 million. Cumulative GHG reductions attributed to source reduction are 1.7 $MMtCO_2e$, and the estimated cost-effectiveness is –\$2/tCO_2e, as shown in Table 3-14.

Recycling—The net cost of increased recycling rates in Alaska was estimated by adding the increased costs of collection for two-stream recycling, revenue obtained for the value of recycled materials, and avoided landfill tipping fees. The additional cost for separate curbside collection of recyclables is \$9.72 per ton. The capital cost of additional recycling facilities in Alaska is \$5.6 million.[20] Annualized over the 10-year policy period at 5% interest, the capital cost is \$0.4 million/year. The avoided cost for landfill tipping is the same as in the source reduction calculations. CCS assumed the value of recycled materials to be zero, based on recent volatility in recycling markets. Table 3-15 provides the results of the cost analysis. The analysis assumes that costs begin to be incurred in 2012. The estimated cost savings result in an NPV of –\$33.1 million. Cumulative GHG reductions attributed to recycling are 1.0 $MMtCO_2e$, and the estimated cost-effectiveness is –\$8/tCO_2e.

Composting—As WARM considers the sole form of diversion for yard trimmings and food waste to be composting, the tons of these items that are "recycled" are assumed to be composted. The net costs for increased composting in Alaska were estimated by adding the additional costs for collection (same calculation as recycling) and the net cost for composting operations. The net cost for composting operations is the sum of the annualized capital and operating costs of composting, increased collection fees, revenue generated through the sale of compost, and the avoided tipping fees for landfilling. Information on the capital and operating costs of composting facilities was received from Cassella Waste Management during the analysis of a similar option in Vermont.[21] These data are summarized in Table 3-13.

[18] U.S. Census Bureau. "State & County QuickFacts. Accessed on January 9, 2009, at: http://quickfacts.census.gov/qfd/states/02/0203000.html, http://quickfacts.census.gov/qfd/states/02/0224230.html, http://quickfacts.census.gov/qfd/states/02/02170.html, and http://quickfacts.census.gov/qfd/states/02/0236400.html.

[19] D. Buteyn (AK DEC), personal communication with H. Lindquist (CCS) December 11, 2008. D. Buteyn personal communication with B. Strode (CCS) December 2008 and January 2009.

[20] Based upon the ratio of capital cost per household used in the Vermont analysis. Vermont capital cost a result of personal communication between P. Calabrese (Cassella Waste Management) and S. Roe (CCS).

[21] P. Calabrese (Cassella Waste Management), personal communication with S. Roe (CCS) June 5, 2007. Because the cost was not originally specified in terms of 2007\$, assume the cost to be valid for 2005.

Table 3-13. Capital and operating costs of composting facilities

Annual Volume (tons)	Capital Cost ($1,000)	Operating Cost ($/ton)
<1,500	$75	$25
1,500–10,000	$200	$50
10,000–30,000	$2,000	$40
30,000–60,000+	$8,000	$30

CCS assumed that the composting facilities to be built within the policy period would tend to be from the first category (a capital cost of $75,000, and an O&M cost of $25/ton) shown in Table 3-13. It is assumed that three of these facilities are needed to meet the goal. To annualize the capital costs of these facilities, CCS assumed a 15-year operating life and a 5% interest rate. Other cost assumptions include the landfill tipping fees from the source reduction and recycling sections, an additional source-separated organics collection fee of $9.72/ton (as used above in the recycling element), a compost facility tipping fee of $16.5/ton,[22] and a compost value of $16.50/ton.[23]

Table 3-16 presents the results of the cost analysis for composting. GHG reductions were assumed not to begin until 2012, and the cumulative reductions estimated were 0.0014 $MMtCO_2e$. An NPV of $0.1 million was estimated, along with a cost-effectiveness of $47/t$CO_2$e.

[22] **NOT AN ALASKA-SPECIFIC PARAMETER.** Emerson, Dan. *Latest Trends in Yard Trimmings* Composting. 2005. Accessed on May 23, 2008, from: http://hs.environmental-expert.com/resultEachArticle.aspx?cid=6042&codi=5723&idproducttype=6.

[23] D. Buteyn (AK DEC), personal communication with H. Lindquist (CCS) December 11, 2008. D. Buteyn personal communication with B. Strode (CCS) December 2008 and January 2009.

Table 3-14. Cost Analysis for Source Reduction

Year	Ancorage Tons Reduced	Fairbanks Tons Reduced	Mat-su Tons Reduced	Juneau Tons Reduced	AK Metro Population	Avoided Landfill Tipping Fee (2006$MM)	Avoided MSW Collection Costs (2006$MM)	Program Costs (2006$MM)	Net Source Reduction Costs (2006$MM)	Discounted Costs (2006$MM)	GHG Reductions (MMtCO2e)	Cost Effectiveness
2010	-	-	-	-	502,210	$0.0	$0.0	$0.0	$0.0	$0.0	0.00	
2011	-	-	-	-	508,674	$0.0	$0.0	$0.0	$0.0	$0.0	0.00	
2012	-	-	-	-	515,138	$0.0	$0.0	$0.5	$0.5	$0.5	0.00	
2013	3,882	678	623	177	521,601	$0.3	$0.1	$0.5	$0.1	$0.1	0.03	
2014	7,821	1,370	1,282	354	528,065	$0.7	$0.1	$0.5	-$0.2	-$0.2	0.05	
2015	11,818	2,076	1,977	532	534,529	$1.0	$0.2	$0.5	-$0.6	-$0.5	0.08	
2016	13,694	2,408	2,338	613	541,186	$1.2	$0.2	$0.5	-$0.8	-$0.6	0.09	
2017	15,597	2,745	2,714	694	547,843	$1.3	$0.2	$0.5	-$1.0	-$0.7	0.10	
2018	17,528	3,088	3,107	774	554,499	$1.5	$0.2	$0.6	-$1.2	-$0.8	0.12	
2019	19,485	3,437	3,517	855	561,156	$1.7	$0.3	$0.6	-$1.4	-$0.9	0.13	
2020	21,469	3,791	3,944	937	567,813	$1.8	$0.3	$0.6	-$1.6	-$1.0	0.14	
2021	23,475	4,149	4,380	1,017	574,318	$2.0	$0.3	$0.6	-$1.8	-$1.0	0.16	
2022	25,508	4,513	4,832	1,097	580,823	$2.2	$0.3	$0.6	-$2.0	-$1.1	0.17	
2023	27,566	4,881	5,299	1,177	587,328	$2.4	$0.4	$0.6	-$2.2	-$1.2	0.18	
2024	29,651	5,256	5,782	1,257	593,833	$2.6	$0.4	$0.6	-$2.4	-$1.2	0.20	
2025	31,763	5,635	6,280	1,337	600,338	$2.8	$0.4	$0.6	-$2.6	-$1.2	0.21	
Totals	**249,257**	**44,026**	**46,075**	**10,821**					**-$6.2**	**-$4.1**	**1.7**	**-$2**

2006$MM = million 2006 dollars; GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Table 3-15. Cost Analysis for Recycling

Year	Anchorage Tons Recycled	Fairbanks Tons Recycled	Mat-su Tons Recycled	Juneau Tons Recycled	Annual Collection Cost (2006$MM)	Annual Capital Cost (2006$MM)	Annual Recycled Material Revenue (2006$MM)	Landfill Tip Fees Avoided (2006$MM)	Net Policy Cost (Recycling) (2006$MM)	Discounted Costs (MM$)	GHG Reductions (MMt)	Cost Effectiveness ($/Mt)
2010	-	-	-	-	$0.0	$0	$0.0	$0.0	$0.0	$0.0	-	
2011	-	-	-	-	$0.0	$0	$0.0	$0.0	$0.0	$0.0	-	
2012	-	-	-	-	$0.0	$0.4	$0.0	$0.0	$0.4	$0.3	-	
2013	6,109	402	82	131	$0.1	$0.4	$0.0	$0.5	-$0.1	$0.0	0.0	
2014	13,486	887	181	287	$0.1	$0.4	$0.0	$1.1	-$0.6	-$0.5	0.1	
2015	21,012	1,382	282	444	$0.2	$0.4	$0.0	$1.7	-$1.1	-$0.8	0.1	
2016	26,396	1,735	354	552	$0.3	$0.4	$0.0	$2.1	-$1.4	-$1.1	0.1	
2017	31,885	2,096	428	661	$0.3	$0.4	$0.0	$2.5	-$1.8	-$1.3	0.1	
2018	37,480	2,463	503	770	$0.4	$0.4	$0.0	$2.9	-$2.2	-$1.5	0.2	
2019	43,180	2,837	579	879	$0.5	$0.4	$0.0	$3.4	-$2.6	-$1.7	0.2	
2020	48,985	3,218	657	988	$0.5	$0.4	$0.0	$3.8	-$3.0	-$1.8	0.2	
2021	54,827	3,601	735	1,094	$0.6	$0.4	$0.0	$4.3	-$3.4	-$2.0	0.2	
2022	60,769	3,990	814	1,200	$0.6	$0.4	$0.0	$4.8	-$3.8	-$2.1	0.2	
2023	66,813	4,386	895	1,306	$0.7	$0.4	$0.0	$5.2	-$4.2	-$2.2	0.3	
2024	72,957	4,789	977	1,412	$0.8	$0.4	$0.0	$5.7	-$4.6	-$2.3	0.3	
2025	79,202	5,198	1,060	1,517	$0.8	$0.4	$0.0	$6.2	-$5.0	-$2.4	0.3	
Totals	**563,099**	**36,981**	**7,545**	**11,240**					**-$33.1**	**-$8.3**	**1.0**	**-$8**

$MM = million dollars; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Table 3-16. Cost Analysis for Composting

Year	Anchorage Tons of Waste Composted	Fairbanks Tons of Waste Composted	Mat-su Tons of Waste Composted	Juneau Tons of Waste Composted	Annual Cost O&M ($MM)	Capital Cost ($MM)	Annualized Capital Cost ($MM)	Annual Collection Cost ($MM)	Avoided Landfill Tipping Fees ($MM)	Value of Composted Material ($MM)	Total Annual Composting Cost ($MM)	Discounted Costs ($MM)	GHG Reductions (MMtCO2e)	Cost Effective ness ($/Mt)
2010	-	-	-	-	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-	
2011	-	-	-	-	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-	
2012	-	-	-	-	$0.00	$0.23	$0.02	$0.00	$0.00	$0.00	$0.02	$0.02	-	
2013	109	9	-	2	$0.00	$0.00	$0.02	$0.00	$0.01	$0.00	$0.02	$0.02	4.3E-05	
2014	219	18	-	5	$0.01	$0.00	$0.02	$0.00	$0.01	$0.00	$0.01	$0.01	8.6E-05	
2015	328	27	-	7	$0.01	$0.00	$0.02	$0.00	$0.02	$0.01	$0.01	$0.01	1.3E-04	
2016	419	35	-	10	$0.01	$0.00	$0.02	$0.00	$0.02	$0.01	$0.01	$0.01	1.6E-04	
2017	510	42	-	12	$0.01	$0.00	$0.02	$0.01	$0.03	$0.01	$0.01	$0.00	2.0E-04	
2018	601	50	-	14	$0.02	$0.00	$0.02	$0.01	$0.03	$0.01	$0.00	$0.00	2.3E-04	
2019	691	58	-	16	$0.02	$0.00	$0.02	$0.01	$0.04	$0.01	$0.00	$0.00	2.7E-04	
2020	782	65	-	18	$0.02	$0.00	$0.02	$0.01	$0.04	$0.01	$0.00	$0.00	3.0E-04	
2021	873	73	-	20	$0.02	$0.00	$0.02	$0.01	$0.05	$0.02	-$0.01	$0.00	3.3E-04	
2022	963	80	-	22	$0.03	$0.00	$0.02	$0.01	$0.05	$0.02	-$0.01	$0.00	3.7E-04	
2023	1,054	88	-	24	$0.03	$0.00	$0.02	$0.01	$0.05	$0.02	-$0.01	-$0.01	4.0E-04	
2024	1,145	95	-	26	$0.03	$0.00	$0.02	$0.01	$0.06	$0.02	-$0.01	-$0.01	4.4E-04	
2025	1,236	103	-	28	$0.03	$0.00	$0.02	$0.01	$0.06	$0.02	-$0.02	-$0.01	4.7E-04	
Totals	**8,931**	**743**	**-**	**203**							**$0.0**	**$0.1**	**1.4E-03**	**$47**

$MM = million dollars; MMtCO$_2$e = million metric tons of carbon dioxide equivalent; $/t = dollars per metric ton.

The overall cost analysis, as seen in Table 3-17, yields an NPV of –$29.1 million and a cost-effectiveness of –$7, based on the cumulative emission reductions of 3.96 $MMtCO_2e$.

Table 3-17. Overall policy results—cost-effectiveness

Year	Net Program Cost Source Reduction ($MM)	Net Program Cost Recycling ($MM)	Net Program Cost Composting ($MM)	Total Net Program Cost ($MM)	Discounted Cost (2006$MM)	Cost Effectiveness ($/MtCO2e)
2010	$0.0	$0.0	$0.00	$0.0	$0.0	
2011	$0.0	$0.0	$0.00	$0.0	$0.0	
2012	$0.5	$0.4	$0.02	$0.9	$0.8	
2013	$0.1	-$0.1	$0.02	$0.1	$0.1	
2014	-$0.2	-$0.6	$0.01	-$0.8	-$0.6	
2015	-$0.6	-$1.1	$0.01	-$1.7	-$1.3	
2016	-$0.8	-$1.4	$0.01	-$2.2	-$1.7	
2017	-$1.0	-$1.8	$0.01	-$2.8	-$2.0	
2018	-$1.2	-$2.2	$0.00	-$3.4	-$2.3	
2019	-$1.4	-$2.6	$0.00	-$3.9	-$2.5	
2020	-$1.6	-$3.0	$0.00	-$4.5	-$2.8	
2021	-$1.8	-$3.4	-$0.01	-$5.1	-$3.0	
2022	-$2.0	-$3.8	-$0.01	-$5.7	-$3.2	
2023	-$2.2	-$4.2	-$0.01	-$6.3	-$3.4	
2024	-$2.4	-$4.6	-$0.01	-$7.0	-$3.5	
2025	-$2.6	-$5.0	-$0.02	-$7.6	-$3.7	
Totals	**-$17.1**	**-$33.1**	**$0.02**	**-$50.2**	**-$29.1**	**-$7**

$MM = million dollars; $/t$CO_2$e = dollars per metric ton of carbon dioxide equivalent.

Key Assumptions:

For the MSW management input data to WARM, the key assumption is that none of the goals would be achieved via existing programs in place. To the extent that those programs will fully or partly achieve the goals of this policy, the GHG reductions estimated would be lower (no additional penetration from the current Alaska recycling and composting campaigns has been incorporated into the BAU assumptions for this analysis). Therefore, the most important assumption relates to the assumed BAU projection for solid waste management. This BAU forecast is based on current practices and does not factor in the effects of further gains in recycling or composting rates during the policy period. The BAU assumptions are needed to tie into the assumptions used to develop the GHG forecast for the waste management sector, which does not factor in these changes in waste management practices during the policy period (2010-2025). To the extent that these gains in recycling and composting would occur without this policy, the benefits and costs are overstated.

The other key assumptions relate to the use of WARM in estimating life-cycle GHG benefits and the use of the stated assumptions regarding costs for increased source reduction, recycling, and organics recovery (composting in this example) programs.

Another important assumption is that under BAU, the waste directed to landfilling would include methane recovery (75% collection efficiency) and utilization. The need for this assumption is partly based on limitations of WARM (which doesn't allow for management of landfilled waste into controlled and uncontrolled landfills).

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Pending – [until CCMAG moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until CCMAG meeting #5]

Barriers to Consensus

TBD – [blank until final vote by the CCMAG]