AFW-9. Advanced/Expanded Recycling and Composting

Policy Option Description

Increase the quantity of materials recovered for recycling with specific attention given to materials with the greatest ability to reduce energy consumption during the manufacturing process and to materials that may be used as a fuel source (e.g., clean wood waste).[35] Reducing the quantity of materials being landfilled reduces future landfill methane emissions potential, while recycling reduces emissions associated with the manufacturing of products from raw materials. Use of waste materials as a fuel source can further reduce emissions by offsetting fossil-based energy sources.

Policy Option Design

Goals: Increase per capita diversion to 50% (2005 actual diversion rate is 30%).[36]

Timing: 25% of the goal reached by 2012 (35% diversion rate); 50% diversion by 2028.

Parties Involved: Federal, state and municipal government, private solid waste and recycling service providers, commercial, industrial and institutional waste generators, Vermont Agency of Natural Resources Solid Waste Division.

Other: Per capita diversion as calculated by ANR Solid Waste Division.

Implementation Mechanisms

Working together in further defining, developing, implementing, and promoting sustainable recycling practices will require an in depth understanding of the cost-effectiveness and environmental benefits of recycling.

- Develop advanced recycling infrastructure so that the entire state is able to participate in single stream recycling. Currently, only the Chittenden County area is served by single stream recycling.
- Develop an incentive/rewards based recycling infrastructure, coupled with single-stream hardware infrastructure (including material recovery centers), to encourage all Vermont residents and businesses to divert recyclable materials from the waste stream (Vermont's diversion rate is essentially unchanged in the last several years (2002: 30%, 2003: 31%,

[35] It is important to note that VT ANR does not include the use of solid waste to produce energy or fuel products in its definition of recycling. Therefore, any wood waste diverted to the production of fuels (solid or liquid) would not be included in their calculations of the State's diversion rate. The potential for using municipal solid waste fiber as a feedstock for energy production is maintained in the description of this policy option to allow for the widest range of utilization of these materials (e.g. composted fiber often has limitations for use in the market place).

[36] Vermont, Agency of Natural Resources, *2005 Solid Waste Generation Report*, Table 2, retrieved from www.anr.state.vt.us/dec/wastediv/solid/DandD.htm. Note that the VT Solid Waste Plan calls for a 50% diversion to be achieved by 2011, so the goals stated in this option appear to be easily attainable.

2004: 29%, 2005: 30%[37]). This incentive/reward system could be expanded to include end of life electronics and promote the recovery, reuse and recycling of all obsolete electronic equipment.

- Develop additional processing capacity across the state for processing organic wastes (e.g., composting facilities) and expand the collection of commercially-generated organic waste materials.
- Develop a used clothing recycling program (curb-side and rural drop off model) for used clothing. Approximately 6% of the municipal solid waste stream is used clothing.[38]
- Develop an incentive/rewards based recycling infrastructure specifically for construction and demolition material to encourage all Vermont residents and businesses to divert recyclable construction materials from the waste stream (2005 C&D disposed of 99,654 tons).[39]
- Where the incentive-based methods mentioned above do not achieve progress toward the 2012 and 2028 goals, develop and implement appropriate mandates to achieve the goals (e.g., source-separated organics programs, disallow landfilling of organic wastes).

Related Policies/Programs in Place

- Vermont Environmental Assistance Division – Business Environmental Partnership Program
- Vermont Food Rescue/Waste Division Grants for Organic Diversion
- Vermont Technology and Information Transfer and Exchange Program
- Vermont Construction & Demolition Waste Reduction Assistance Program
- Vermont ANR has just proposed the Center for Climate Change and Waste Reduction (CCWR). The document at the following link provides an overview of the goals of the CCWR – www.anr.state.vt.us/site/cfm/tvwf/CCWR.pdf.

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.
- **Methane:** Diverting biodegradable wastes from landfills will result in a decrease in methane gas releases from landfills.

Estimated GHG Savings and Costs per $MtCO_2e$

- **Estimated GHG Savings in 2012 and 2028:** 0.16, 0.88.
- **Cost-Effectiveness:** $4

[37] Vermont, Agency of Natural Resources, 2005 Solid Waste Generation Report, Table 2, retrieved from www.anr.state.vt.us/dec/wastediv/solid/DandD.htm

[38] U.S. EPA "Waste Wise" retrieved from www.epa.gov/epaoswer/non-hw/reduce/wstewise/pubs/overview.pdf

[39] Vermont, Agency of Natural Resources, 2005 Solid Waste Generation Report, Summary, retrieved from www.anr.state.vt.us/dec/wastediv/solid/DandD.htm

It should be noted that emissions associated with the production, packaging, and transport of products consumed in Vermont (e.g., embedded energy in product manufacturing occurring out of state) are not included in the Vermont GHG Inventory & Forecast. As a result, the PG might not include the reductions shown in this option in the calculation of progress towards meeting State GHG reduction goals.

- **Data Sources:** Municipal solid waste (MSW) diversion data for 2005 is from the VT Agency of Natural Resources (ANR).[40] These data are shown in Table H-19.

Table H-19. Municipal solid waste diversion data for 2005

	SOURCE OF MATERIAL						
MATERIAL	Recycling Facilities	Soft Drink and Beer Distributors(1)(2) (Broker Direct)	Economic Recycling(2) (Direct to Market)	Scrap Metal Facilities	Organics Composting	Reuse Facilities & Programs(2)	TOTAL
FIBERS	49,694	386	33,495			137	83,712
CONTAINERS	10,867	13,260	117			19	24,263
SCRAP METAL			251	34,830		159	35,240
ORGANIC WASTES					32,726	0	32,726
MISCELLANEOUS	5,167		14			2,167	7,348
Total:	65,728	13,646	33,877	34,830	32,726	2,482	183,289

2005 MSW DISPOSED (tons): 431,230

2005 MSW DIVERSION RATE: 30%

- **Quantification Methods:** GHG Reductions:

Non-Organics Recycling

EPA's Waste Reduction Model (WARM) was used to estimate GHG reductions achieved via recycling.[41] The wastes in Table H-19 were aggregated into the applicable WARM material categories: mixed paper waste (fibers in Table H-19), mixed metals (scrap metals in Table H-19), and mixed recyclables (containers and miscellaneous in Table H-19). A baseline estimate of waste diversion and associated GHG reductions for 2005 (representing a 30% MSW diversion rate) was established by inputting the diverted quantities for each waste material.

The incremental benefit for 2012 and 2028 was then determined by inputting the additional quantities of waste that would be diverted in each year (35% overall in 2012 and 50% in 2028). These additional quantities of diverted waste also included organic

[40] C. Grodinsky, VT ANR, personal communication with S. Roe, CCS, April 24, 2007. Data were taken from the report: *Vermont Solid Waste Generation, Diversion & Disposal, 2005 Report*, Agency of Natural Resources, Department of Environmental Conservation, December 1, 2006.

[41] The WARM model and associated documentation can be downloaded from: www.yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteWARM.html. Assumptions used in the WARM modeling included: landfill gas recovery for energy; 75% landfill gas collection efficiency; and default distances to landfill, recycling facility, and composting facility (20 miles each).

materials (addressed below). CCS assumed that the fractions of materials diverted remained the same as in 2005: mixed paper (0.56); mixed metals (0.23); and mixed recyclables (0.21). CCS also grew the waste generation in each future year using the 0.6%/years population growth as used in the GHG inventory and forecast. Table H-20 shows the resulting waste recycling amounts and rates in each year.

Table H-20. Projected waste diversion rates for 2005–2028

	2005	2010	2012	2028
MSW Disposed	431,230	444,323	449,671	494,837
MSW Diversion (minus organics)	150,563	178,405	199,393	406,012
Organics Composted	32,726	38,778	43,339	88,250
Diversion Rate	30%	33%	35%	50%
Incremental Recycle Tons	0	3,270	42,391	233,241
Incremental Organics Composted Tons	0	5,058	9,214	50,697

For the incremental tons recycled, WARM provided the results shown in Table H-21.

Table H-21. Incremental tons recycled

Scenario	$MtCO_2e$
Baseline WARM GHG Reduction	556,520
2012 Incremental GHG Reduction	155,893
2028 Incremental GHG Reduction	857,738

Composting of Organic Material

By composting organic material, the CH_4 emissions that would have been generated via anaerobic decomposition in a landfill are avoided. Landfill methane avoided for the baseline (2005) organics material diversion was estimated using an estimate of the degradable organic carbon (DOC) content from the United Nations Framework Convention on Climate Change (UNFCC).[42] Since, landfill gas generated at operating landfills in Vermont is largely collected and controlled, the EPA default methane collection efficiency of 75% is applied. Also, the default assumption of 10% oxidation of CH_4 as it diffuses through the landfill soil cover is applied. The baseline landfill methane avoided is (see footnote for additional details):

$$\textbf{Baseline } CH_4 = (32{,}726 \text{ ton organics}) \times (0.21) \times (0.50) \times (0.907 \text{ Mt/ton}) \times (16/12) \times 21 \times (1-0.75) \times (1-0.10)$$

$$= 19{,}635 \text{ } MtCO_2e$$

Using this method for calculating the GHG reductions and the incremental tons of organics to be recycled in 2012 (9,214) and in 2028 (50,697) as shown in Table H-20, the benefit of organic material recycling in 2012 is 5,528 $MtCO_2e$ and 30,417 $MtCO_2e$ in 2028.

[42] UNFCC, CDM – Executive Board, "Approved baseline and monitoring methodology AM0039," September 29, 2006. The average DOC content for lawn & garden, food, and wood/straw waste is 21%. Default CH_4 content of landfill gas is 50%. 16/12 is the ratio of molecular weights of carbon and methane. 21 is the global warming potential of methane.

Because GHG emissions also occur as a result of composting, these emissions need to be factored in to obtain a net GHG benefit for organics recycling. CCS used an average CH_4 emission factor of 1.12 lb/ton material from tests conducted by the South Coast Air Quality Management District in California.[43] CH_4 emissions from the incremental composting in 2012 are estimated to be 99 $MtCO_2e$ and in 2028 to be 540 $MtCO_2e$. Nitrous oxide emissions were estimated from tests done on composting of cattle manure[44] (no data on MSW organic materials were identified). The average N_2O emission factor was 0.94 lb/ton of manure. Applying this emission factor to the incremental organic materials composted in 2012 and 2028 yielded: 731 $MtCO_2e$ and 4,020 $MtCO_2e$, respectively. The net GHG benefits for the incremental organics composting are shown in Table H-22:

Table H-22. Net GHG benefits for incremental organics composting

Estimate	2012 $MtCO_2e$	2028 $MtCO_2e$
Landfill methane avoided	5,528	30,417
Composting methane	99	540
Composting nitrous oxide	731	4,020
Net GHG Benefit	4,699	25,856

Therefore, the overall emission reductions for the policy option are 0.16 $MMtCO_2e$ in 2012 and 0.88 $MMtCO_2e$ in 2028.

Costs:

Non-organics recycling. CCS assumed that the policy would be applied to households in Rutland County (26,007 households), Bennington (15,061 households), and Windham County (18,760 households). Single-stream recycling service would cost $3–$4 per pick-up with each pick-up occurring every two weeks.[45] Further, households would fill a 96-gallon container with mixed recyclables. This resulted in an annual average cost per household of $91. The total annual operating cost for all households is $5.4 million.

The estimate for annual capital cost is based on an effective size plant that has a maximum throughput of 70,000 tons per year of single-stream waste. This plant would have the capacity to serve more than twice the current output from Vermont's three largest counties and cost an estimated $7.7 million. The capital cost analysis assumes that since initial recycling volumes are less than 50%, that a 50% cost share of the total capital costs is needed from the state. Therefore, the annual capital cost is equal the product of half the capital cost and a annualizing multiplier. The resulting capital cost is $0.4 million per year.

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[43] Average of three facilities conducting composting of a variety of organic materials – digested biosolids, manure, wood waste, rice hulls, and green waste. Documented in Roe et al, 2004, *Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources*, Final Report, prepared for the U.S. EPA, Emission Inventory Improvement Program, April 2004.

[44] X. Hao, C. Chang, F.J. Larney, and G.R. Travis, "Greenhouse Gas Emissions during Cattle Feedlot Manure Composting," *Journal of Environmental Quality*, 30:376–386 (2001).

[45] P. Calabrese, Cassella Waste Management, personal communication with S. Roe, CCS, April 26, 2007. Provided information on pick-up service costs, tipping fees, and additional information to derive assumptions for this analysis.

There are also societal cost savings associated with this option in that landfill tipping fees are avoided for the waste that is diverted. Tipping fees in Vermont are currently $103 per ton.[46] Using an EPA estimate of waste density (0.05 ton/yd^3), the volume of the recycle container, the number of annual pick-ups, and the number of households, the total waste to be diverted was estimated to be 37,333 tons/years. Using the tipping fee of $103 per ton, the avoided landfill cost is $3.8 million/years. The net cost for the non-organics recycling is $2.0 million/years. Using the GHG reduction estimates derived above, the cost-effectiveness for non-organics recycling in 2028 is $2.0 million/ 857,738 $MtCO_2e$ = $2.33/$MtCO_2e$.

Organics Composting. The cost of organics composting is based on the total quantity of organic material composted under the business as usual (BAU) scenario, less the total quantity of organics composted after the adoption of the targets imposed by this action. The per-ton cost was largely derived from capital and operation and maintenance (O&M) cost estimates provided via personal communication.[47] The cost estimates used in this analysis are provided in the Table H-23.

Table H-23. Cost estimates used for analysis

Annual Volume (tons)	Capital Cost (2007$,000)	Operating Cost ($/ton)
<1,500	75	25
1,500–9,999	200	50
10,000–29,999	2,000	40
30,000–50,000+	8,000	30

The capital costs were annualized using the cost recovery factor method. This method takes the product of the total annual capital cost and a factor that includes assumptions of a 15 year project life and a 5% interest rate. The annualized capital cost is added to the annual O&M cost and the tipping fee is subtracted to determine the total annualized composting costs. This value does not take into account any revenue raised from the sale of compost.

As reported above, the current tipping fee in Vermont is $103 per ton. Therefore, since the total annual cost-per-ton is greater than the tipping fee, composting projects are expected to have a net cost. The net present value of costs—assuming a constant $103 tipping fee—related to composting is $11.77 million.

- **Key Assumptions:** Assumptions used in the EPA WARM modeling include the use of the "current mix" of recycled and virgin material inputs to production (i.e., new products are not produced with 100% virgin materials); landfill gas is recovered for energy purposes; 75% collection efficiency for LFG; default distance to the landfill and recycling facilities (20 miles). Another key assumption is the ability of the N_2O composting emission factor to represent emissions from MSW organic materials composting.

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[46] Taylor, Holly, Intervale Compost Project, Personal Communication with B. Strode, CCS, May 29, 2007.

[47] P. Calabrese, Cassella Waste Management, personal communication with S. Roe, CCS, June 5, 2007. Transmitted via e-mail to B. Strode by S. Roe.

It can be assumed that one ton of organic compost input is equal to about one cubic yard of finished compost. This compost may net $4–6 per cubic yard after transport. However, if trucking costs are high due to remote location of compost facility, the net profit from compost sales may equal zero.[48]

Key Uncertainties

While Chittenden County is the only solid waste district with a single stream material recovery facility (MRF), many of the solid waste districts bring their recyclables to this MRF. Most of the other districts do not have the population base to support a more expensive all in one MRF. Additionally, at least one hauler in another county brings single stream materials to a MRF in Canada. A full accounting of benefits and costs would need to take these details into account; however a sub-State- (e.g., county-) level analysis was beyond the scope of the assessment conducted here.

There is also an overlap between this option and AFW-10 (Programs to Reduce Waste Generation). To the extent that AFW-10 achieves source reduction during the policy period, there could be less material available for recycling under this option. The extent of this overlap was beyond the scope of the analysis conducted for this option.

Additional Benefits and Costs

- Lower emissions of landfill gas for the decomposable waste that would be landfilled without this policy option. In addition to methane, landfill gas contains other air pollutants, such as volatile organic compounds and toxic air pollutants.
- This policy could result in lower revenue for landfill operators due to lower quantities of waste being landfilled.

Feasibility Issues

Post consumer organic waste diversion. Vermont currently composts only separated organic waste.[49] Broadening the range of wastes composted to include mixed MSW may not be feasible at small-scale facilities due to equipment requirements, higher capital costs, and poor marketability of compost residue (whereas the end product from organic composting may be sold as fertilizer).

Co-operating a landfill with an organic composting operation necessitates additional equipment for odor control. The capital costs of odor control equipment vary, depending on the size of the operation and the available buffer zone between the landfill sites and surrounding communities.[50] For some wastes—particularly heavy nitrogenous or wet wastes—bulking agents are necessary to properly manage the composting operation. These bulking agents are major factors in operations and maintenance (O&M) costs of composting facilities.[51]

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[48] Ibid

[49] Taylor, Holly, Intervale Compost Project, Personal Communication with B. Strode, CCS, May 29, 2007.

[50] P. Calabrese, Cassella Waste Management, personal communication with S. Roe, CCS, June 5, 2007. Transmitted via e-mail to B. Strode by S. Roe.

[51] Ibid.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

AFW-10. Programs to Reduce Waste Generation

Policy Option Description

Institute programs to reduce waste generation at the source to reduce downstream emissions at the waste management site and for transporting these materials to the site. Reducing waste generation can also reduce the emissions associated during manufacturing of the original products.

Policy Option Design

Goals: Reduce the rate of municipal solid waste generation to 50% below 2005 actual rate of 5.40 pounds per person per day.[52]

Timing: 25% by 2012; 50% by 2028.

Parties Involved: Residential, commercial, industrial and institutional waste generators, Vermont Agency of Natural Resources Solid Waste Division

Other: Not applicable.

Implementation Mechanisms

The policy should aim to develop accessible, cost-effective and sustainable policies, strategies and educational/media campaigns that will promulgate cultural and behavioral changes across the state with the ultimate goal of reducing the amount of waste generated. The policy should reflect the principles of the waste hierarchy and reduce the generation of all waste.

- Develop prototype residential and commercial waste prevention programs that will validate costs savings realized by the waste prevention.
- Develop a communication portal that will keep all constituents apprised of waste reduction/minimization initiatives and actively promote waste minimization efforts, including the results of prototype programs and specific case studies.
- Develop sector-specific waste minimization strategies (schools, hotels, hospitals, restaurants, retail, banks, etc.). Develop these strategies in collaboration with other organizations and the local community.
- Develop an assistance program to provide engineering support to businesses to: 1) reduce product packaging and shipping materials 2) select product packaging and shipping materials that are highly recyclable.
- Encourage manufacturers to provide end-of-life management solutions that reduce the environmental impact of waste (e.g., “cradle-to-cradle” responsibility of waste).

[52] Vermont, Agency Natural Resources, *2005 Solid Waste Generation, Diversion, and Disposal,* Table 2, retrieved from www.anr.state.vt.us/dec/wastediv/solid/DandD.htm.

- Develop and implement a green purchasing program for all state operations, and use that program as a model and encourage adoption of that model by all municipalities and businesses.

Related Policies/Programs in Place

- Vermont Department of Environmental Conservation "Beyond Disposal & Recycling Waste Prevention Stakeholders Forum" (along with Agency of Natural Resources is developing the Vermont Waste Prevention Plan).
- Vermont Agency of Natural Resources Environmental Assistance Office Partnership.
- Vermont ANR has just proposed the Center for Climate Change and Waste Reduction (CCWR). The document at the following link provides an overview of the goals of the CCWR – www.anr.state.vt.us/site/cfm/tvwf/CCWR.pdf.

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.
- **Methane:** Diverting organic wastes from landfills will result in a decrease in methane gas releases from landfills.

Estimated GHG Savings and Costs per $MtCO_2e$

- **Estimated GHG Savings in 2012 and 2028:** 0.34, 0.73
- **Cost-Effectiveness:** Not quantified. The TWG was unable to determine the costs associated with the implementation mechanisms described above (programs developed and implemented by the State and waste generators to reduce generation. These program costs would be offset to some extent by savings from reduced tipping fees; however the extent of this was not possible to quantify with existing data.

  It should be noted that emissions associated with the production, packaging, and transport of products consumed in Vermont (e.g., embedded energy in product manufacturing occurring out of state) are not included in the Vermont GHG Inventory & Forecast. As a result, the PG might not include the reductions shown in this option in the calculation of progress towards meeting State GHG reduction goals.

- **Data Sources:** These include the 2005 Vermont Solid Waste Generation, Diversion & Disposal Report,[53] data on the amounts of waste recycled in 2005,[54] and a 2002 report on

[53] *Vermont Solid Waste Generation, Diversion & Disposal, 2005 Report*, Agency of Natural Resources, Department of Environmental Conservation, December 1, 2006.

[54] C. Grodinsky, VT ANR, personal communication with S. Roe, CCS, May 16, 2007, spreadsheet provided via e-mail.

municipal solid waste (MSW) composition in Vermont,[55] and the EPA Waste Reduction Model (WARM).[56]

- **Quantification Methods:** WARM provides estimates of the life cycle GHG emissions avoided via source reduction, recycling, and composting. The 2005 Vermont waste generation rate was 614,519 tons (5.4 lb/person-day). Waste composition data from the 2002 study cited above were used to provide inputs to the WARM model, as shown in Table H-24.[57] This table shows an assumed baseline for 2012. The tons generated in 2012 are those estimated for 2005 and adjusted for population growth. The tons recycled, combusted and composted were held static from 2005.

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[55] *Final Report, Vermont Waste Composition Study,* prepared for the Vermont Department of Environmental Conservation, Solid Waste Program, prepared by DSM Environmental Services, Inc., June 2002.

[56] The WARM model and associated documentation can be downloaded from: www.yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteWARM.html. Assumptions used in the WARM modeling included: landfill gas recovery for energy; 75% landfill gas collection efficiency; and default distances to landfill, recycling facility, and composting facility (20 miles each).

[57] For all waste categories, the data in Table 7a of the 2002 waste composition study cited above were used. The August urban and rural values were averaged; then the November urban and rural values were averaged; finally the average values obtained for August and November were averaged to represent an “annual average” waste percentage by weight.

Table H-24. Waste composition data from 2002 study

Material	Tons Generated	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum Cans	5,790	1,981	3,809		NA
Steel Cans	26,379	1,404	24,975		NA
Copper Wire					NA
Glass	17,372	13,719	3,653		NA
HDPE	30,517	916	29,601		NA
LDPE	23,337	-	23,337		NA
PET	5,984	1,968	4,016		NA
Corrugated Cardboard	57,906	36,366	21,540		NA
Magazines/Third-class Mail	18,659	881	17,778		NA
Newspaper	31,526	21,281	10,245		NA
Office Paper	42,465	585	41,880		NA
Phonebooks					NA
Textbooks	4,504	18	4,486		NA
Dimensional Lumber					NA
Medium-density Fiberboard					NA
Food Scraps		NA			
Yard Trimmings		NA			
Grass		NA			
Leaves		NA			
Branches		NA			
Mixed Paper (general)	-	-	-		NA
Mixed Paper (primarily residential)					NA
Mixed Paper (primarily from offices)					NA
Mixed Metals	-		-		NA
Mixed Plastics	-	-	-		NA
Mixed Recyclables					NA
Mixed Organics	193,021	NA	160,295		32,726
Mixed MSW	174,361	NA	124,690	49,671	NA
Carpet					NA
Personal Computers	11,581	-	11,581		NA
Clay Bricks		NA		NA	NA
Aggregate				NA	NA
Fly Ash				NA	NA

* Plastics composition was estimated as follows using information in the 2005 solid waste report: high density polyethylene (HDPE) – 51%; polyethylene terephthalate (PET) 39%; other plastics, assumed to be primarily low density polyethylene (LDPE) – 10%. Steel cans includes ferrous cans and all other ferrous waste. Newspaper includes newspaper/inserts as well as half of the "dirty paper" identified in the solid waste composition study; office paper includes "mixed paper" and the other half of the "dirty paper" identified in the solid waste composition study.

Table H-25 shows an alternative solid waste management scenario for 2012 assuming that waste in all categories has been source reduced by 25%. The recycled and waste combusted amounts were held constant from 2005 levels. Composting levels were increased to reflect a 25% reduction in organics being landfilled (while this is not technically source reduction it does reduce the landfill emissions that would occur from this organic waste; also, WARM does not have the capability to model source reduction of organics). For mixed MSW, WARM also does not have the capability to estimate the benefits of source reduction. Therefore, CCS reduced the amount of waste being landfilled for that category in 2012 to reflect the waste not landfilled due to source reduction. While this captures the reduction in landfill emissions, it does not capture the rest of the life cycle emissions. Hence, the benefits are slightly underestimated as a result.

Table H-25. Alternative solid waste management scenario for 2012

Material	Baseline Generation	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted
Aluminum Cans	5,790	1,448	1,981	2,361		NA
Steel Cans	26,379	6,595	1,404	18,380		NA
Copper Wire	-					NA
Glass	17,372	3,653	13,719	-		NA
HDPE	30,517	7,629	916	21,972		NA
LDPE	23,337	5,834	-	17,503		NA
PET	5,984	1,496	1,968	2,520		NA
Corrugated Cardboard	57,906	14,477	36,366	7,063		NA
Magazines/Third-class Mail	18,659	4,665	881	13,113		NA
Newspaper	31,526	7,882	21,281	2,363		NA
Office Paper	42,465	10,616	585	31,264		NA
Phonebooks	-					NA
Textbooks	4,504	1,126	18	3,360		NA
Dimensional Lumber	-					NA
Medium-density Fiberboard	-					NA
Food Scraps	-	NA	NA			
Yard Trimmings	-	NA	NA			
Grass	-	NA	NA			
Leaves	-	NA	NA			
Branches	-	NA	NA			
Mixed Paper, Broad	-	NA	-			NA
Mixed Paper, Resid.	-	NA				NA
Mixed Paper, Office	-	NA				NA
Mixed Metals	-	NA				NA
Mixed Plastics	-	NA	-			NA
Mixed Recyclables	-	NA				NA
Mixed Organics	193,021	NA	NA	112,040		80,981
Mixed MSW	174,361	NA	NA	81,100	49,671	NA
Carpet	-					NA
Personal Computers	11,581	2,880		8,701		NA
Clay Bricks	-		NA		NA	NA
Aggregate	-	NA			NA	NA
Fly Ash	-	NA			NA	NA

WARM estimated a 0.34 $MMtCO_2e$ reduction in 2012 due to the 25% source reduction shown above. A similar assessment was done for 2028 with the goal of achieving a 50% reduction in waste generation. For 2028, a GHG reduction of 0.73 $MMtCO_2e$ was estimated.

- **Key Assumptions:** The increased wastes to be recycled as a result of this option will be recycled in the same relative quantities to those currently being recycled. Since some recycled materials have higher life-cycle GHG benefits than others, changes to the proportions of different wastes recycled could have either a positive or negative effect on the reductions estimated.

Key Uncertainties

There is an overlap between this option and AFW-9 covering enhanced recycling. To the extent that this option achieves the source reduction goals during the policy period, there could be less material available for recycling under AFW-9. The extent of this overlap was beyond the scope of the analysis conducted for this option.

Additional Benefits and Costs

These can include reduction in fossil energy use and related emissions associated with the production of new products that are avoided as a result of source reduction.

The option could potentially result in lower revenue for landfill operators due to lower quantities of landfilled waste.

Feasibility Issues

None identified.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.