TELLUS INSTITUTE
Resource and Environmental Strategies

THE ROLE OF WASTE DIVERSION IN IOWA'S CLIMATE CHANGE ACTION PLAN

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Prepared by Tellus Institute in collaboration with
the Iowa Department of Natural Resources

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Opinions, findings, conclusions, and recommendations expressed herein are those of the authors and do not necessarily reflect the views of the United States Environmental Protection Agency.

EXECUTIVE SUMMARY

This report uses data and information from the state of Iowa to demonstrate specifically how greenhouse gas impacts of source reduction and recycling can be quantified and included in state Climate Change Action Plans.[1] The analysis presented is based directly on information and approaches developed by the United States Environmental Protection Agency (EPA).[2] The research was sponsored by a cooperative agreement between EPA Region VII, the Iowa Department of Natural Resources (DNR), and the Tellus Institute.

The "greenhouse effect" is a global environmental concern that has received substantial attention from scientists throughout the last decade. There is increasing scientific consonsensus that greenhouse gases (primarily water vapor, carbon dioxide, methane, and nitrous oxide) emitted through human processes, such as the burning of fossil fuels, will influence global climate patterns. Shifting climate patterns could lead to major environmental changes such as rising sea levels, diminished fresh water resources, the spread of infectious diseases, losses in biological diversity, agricultural shifts and impacts on crop yields and productivity.

In response to growing scientific consensus over the existence and potential environmental impacts resulting from the greenhouse effect, world leaders have begun to establish policies and plans to mitigate human induced emissions of GHGs. In 1993, the US established a national climate change action plan that calls for cost-effective actions and voluntary cooperation with states, local governments, industries, and citizens to reduce GHG emissions. In response, several states and a few local governments have developed or are developing climate change action plans. Like the *US Climate Change Action Plan (CCAP)*, state CCAPs identify initiatives to reduce GHG emissions.

While the Greenhouse Effect is a global environmental issue that is typically addressed by planners at the state and national levels, local issues, such as solid waste management influence it directly. When organic waste is disposed in modern sanitary landfills, methane, a potent GHG, is emitted as the waste decomposes. Waste diversion, through source reduction and recycling, can reduce GHG emissions in two ways:

- Emissions associated with waste disposal, particularly landfill methane emissions are avoided.
- Emissions associated with resource extraction are avoided altogether and those associated with manufacturing are avoided or reduced.

GHG impacts associated with landfill methane emissions are relatively well understood, however, impacts associated with resource extraction and material manufacturing have only

[1] Ney, Schnoor, Foster, Forkenbrock. 1996. *Iowa Greenhouse Gas Action Plan* (1996). Prepared by the University of Iowa for the Iowa Department of Natural Resources.

[2] See U.S. EPA. *States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions* (1998).

recently been identified and quantified in an EPA report entitled *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste*.[3] This report demonstrates how the EPA data can be used in conjunction with state diversion data to incorporate waste diversion impacts in state CCAPs. It also illustrates the relative impact of waste diversion compared to other climate change mitigation options.

As a national leader in waste reduction and GHG planning, Iowa was selected to serve as a demonstration site for this project. In 1989 Iowa established a goal to reduce 1988 waste disposal rates by 50% by year 2000 through increased waste diversion. Shortly thereafter, DNR established procedures to track communities' progress in meeting their waste management goals. In 1995, the state diverted approximately 33% of its waste stream through state and local source reduction (SR), recycling, and composting programs.

Iowa is also one of the few states that has completed a CCAP—The Iowa Greenhouse Gas Action Plan.4 As a precursor to the CCAP, Iowa developed an inventory of Iowa GHG emissions for 1990, which identifies landfills as the second largest source of methane emissions in the state.5 The inventory is used to evaluate and identify options for reducing state GHG emission in the CCAP. The CCAP identifies 16 priority options for reducing GHG emissions between 1990 and 2010. No information on the GHG impacts of waste diversion was available when the CCAP was produced in 1996. Therefore, source reduction (SR) and recycling programs promoted by the state were never considered among the priority options.

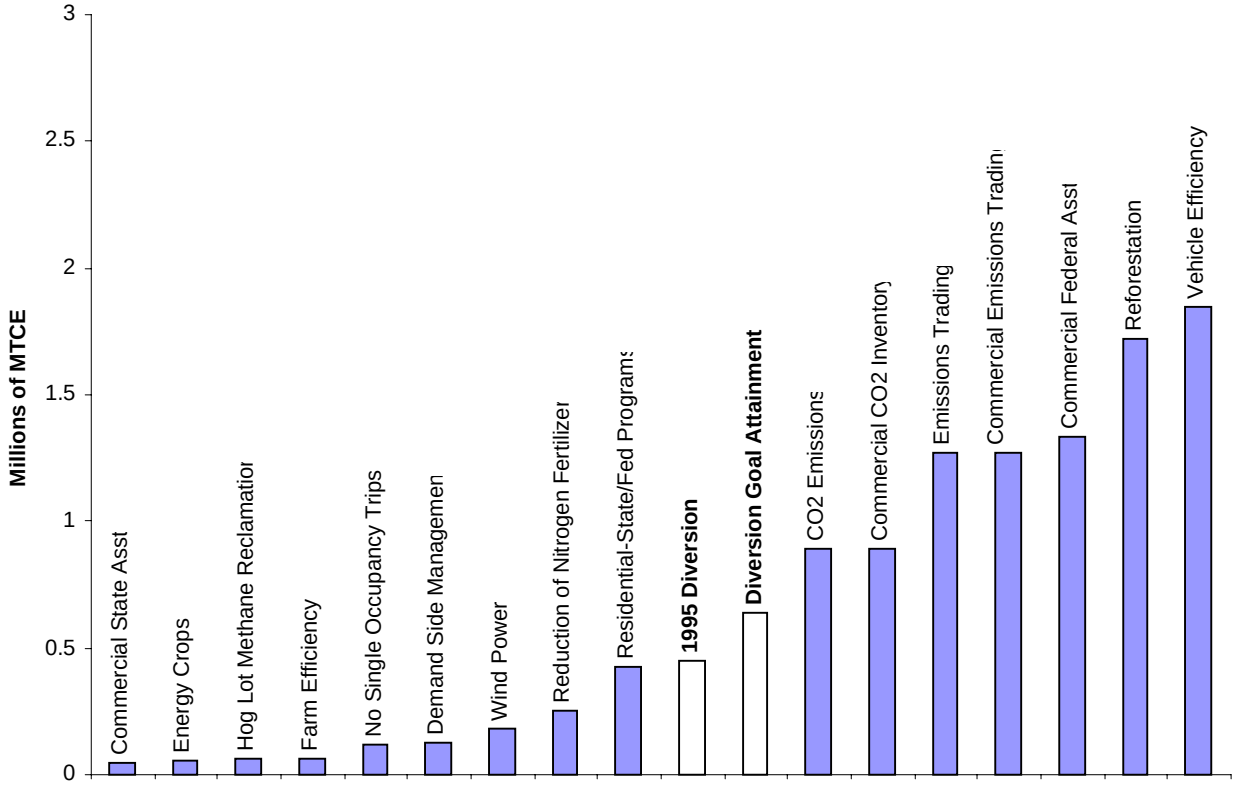
With the benefit of hindsight and additional information, this report examines GHG impacts of Iowa's source reduction and recycling diversion programs compared to the original 16 options identified in the CCAP. Results of the analysis are summarized in Figure 1, which indicates that Iowa's 1995 diversion levels resulted in GHG benefits that were larger than half of the priority options identified in the plan. This is particularly significant because these reductions have already been achieved, well in advance of the 2010 target date. The remainder of this report describes the basic information and procedures used to develop the information in Figure 1.

[3] United States Environmental Protection Agency: *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste* (1998).

[4] As of January 1999, in addition to Iowa, the following states had completed CCAPs: Illinois, Oregon, Pennsylvania, Washington, and Wisconsin.

[5] Ney and Schnoor. 1996. *Inventory of Iowa Greenhouse Gas Emissions for the Year 1990.* Published by the University of Iowa for the Iowa Department of Natural Resources. Landfills emit 173,065 tons or 25% of state methane emissions.

Figure 1.
Estimated Carbon Reduction from Iowa's CCAP Priority Options and Waste Diversion



1. QUANTIFYING IMPACTS OF WASTE DIVERSION ON GHG EMISSIONS

The procedure for quantifying impacts of Iowa's waste diversion on GHG emissions involved four steps:

- Drawing on EPA-sponsored research, GHG emissions factors from management of select materials in the waste stream were identified.
- Data on the tonnage and composition of the waste source reduced and recycled in 1995 were developed.
- The results from steps 1 and 2 were combined to produce estimates of the GHG emissions reductions achieved due to waste diversion.
- A range of potential future emissions reductions were explored through scenario analyses.

The sections that follow provide additional details on each of the four steps.

1.1 GHG Emission Factors

Recent research conducted by the United States Environmental Protection Agency (EPA) quantifies GHG emissions associated with source reducing, recycling, composting, combusting, and landfilling select materials in the waste stream.[6] For each waste management option, the research accounts for GHGs emitted in resource acquisition, manufacturing, and waste management, as well as changes in carbon sequestration resulting from increased carbon storage. The research developed unit emission factors for select materials and waste management options shown in Table 1. The emission factors expressed in terms of metric tonnes of carbon equivalent (MTCE) emitted per ton of waste managed. MTCE is a standard unit of measurement that adds together the emissions of different greenhouse gases (i.e., CO_2, methane, etc.), weighted according to their warming potential.[7] Negative values in Table 1 indicate avoided GHG emissions, while positive values indicate increased GHG emissions.

Use of the factors in Table 1 depends, in part, on how the baseline inventory forecast of GHG emissions is developed. In Iowa's baseline inventory forecast, landfill emissions decline slightly between 1990 and 2010, despite population growth, due to implementation of planned methane collection systems and waste reduction trends.[8] Thus, one can assume that Iowa's future landfill emissions would be higher in the absence of state and local diversion programs. Because Iowa's inventory forecast already accounts for reduced landfill emissions resulting from

[6] United States Environmental Protection Agency: *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste* (1998).

[7] Each GHG possesses different global warming potential. For example, methane can force warming 22 times stronger than carbon dioxide. MTCE provides a means of direct comparison of various GHGs by converting GHGs to carbon dioxide equivalent units.

[8] *Iowa Greenhouse Gas Action Plan* (1996), Table A-1, page 77.

diversion, only the resource extraction and manufacturing factors (shown under "source reduction" and "recycling" headings in Table 1) are used to calculate GHG impacts of diversion because these are not accounted for in the baseline inventory forecast. [9]

Table 1.
GHG Emission Factors by Material and Waste Management Option (MTCE/Ton)[10]

Material	Source Reduction	Recycling	Combustion	Landfilling
Newspaper	-0.91	-0.86	-0.22	-0.23
Office Paper	-1.03	-0.82	-0.19	0.53
Corrugated Cardboard	-0.78	-0.70	-0.19	0.04
Mixed Paper				
Broad Definition	NA	-0.67	-0.19	0.06
Residential Definition	NA	-0.67	-0.19	0.03
Office Paper	NA	-0.84	-0.18	0.10
Aluminum Cans	-2.98	-3.88	0.03	0.01
Steel Cans	-0.84	-0.57	-0.48	0.01
Glass	-0.14	-0.08	0.02	0.01
HDPE Containers	-0.61	-0.37	0.21	0.01
LDPE Containers	-0.89	-0.49	0.21	0.01
PET Containers	-0.98	-0.62	0.24	0.01
Food Scraps	NA	NA	-0.05	0.15
Yard Trimmings	NA	NA	-0.07	-0.11
Mixed MSW	NA	NA	-0.04	-0.02
Mixed Recyclables	NA	-0.76	-0.18	0.03

[9] If the baseline did not account for reduced landfill emissions resulting from waste reduction, it would have been necessary to subtract the landfill factors shown in Table 1 from the source reduction and/or recycling factors. For example, since Iowa's waste disposal options are limited to landfills, any newspaper that is not recycled would end up in a landfill. To account for this, one could simply subtract the newspaper recycling factor (-0.91) from the newspaper landfill factor (-0.23) to derive an estimate of the total impact of recycling newspaper compared to landfilling it (-0.68).

[10] *Greenhouse Gas Emissions from Management of Selected Materials in Municipal Solid Waste* (1998), Exhibit 8-5.

1.2 Quantity and Composition of Diverted Waste

In 1989, Iowa established a goal to reduce the amount of waste it disposed in 1988 by 50% by 2000. Local comprehensive solid waste planning agencies submit goal status reports, which the state compiles and uses to track the state's progress in reaching the 50% diversion goal.[11]

The starting point for the development of the waste diversion composition was the information submitted by local solid waste planning agencies in the goal status reports. The goal status reports provide the total tons of waste generated and disposed in landfills in 1995. The tonnage recovered as well as the composition of the waste recovered and disposed was determined based on recent Iowa studies.[12,13,14] Source reduction was calculated by taking national per capita source reduction values of the major contributors to source reduction and multiplying by the population of Iowa. The major contributors to source reduction and per capita source reduction values were obtained from a recent Tellus study[15]. Yard waste source reduction was estimated separately. It was estimated as the difference between the tonnage of yard waste disposed in 1990 and the tonnage currently composted or disposed. This captures the effect of the state's yard waste disposal ban. Once the source reduction is calculated the other recovery category was calculated by subtracting disposal, source reduction and recovery from generation. This category is meant to account for industrial waste recycling which is a contributor to the state's diversion rate. Table 2 shows the 1995 disposal and diversion.

The composition of source reduction shown in Table 2 reflects the impacts of six major contributors to source reduction ferrous metals, publications, yard waste, food waste, wood waste, and food containers. In the food container category, plastic containers are replacing metal and glass containers causing source expansion of plastic and source reduction of metal and glass. The plastic source expansion is shown in Table 2 as "negative SR".

[11] Iowa Department of Natural Resources. *Base Year Adjustment Method User's Guide* (1995).

[12] R.W. Beck. *Economic Benefits of Recycling* (1997). Prepared for RecycleIowa.

[13] Resource Conservation and Development of Northeast Iowa, Inc. *Iowa Statewide Compost Market Assessment* (1998). Prepared for Iowa Department of Natural Resources. Page 18.

[14] R.W. Beck. *Iowa Solid Waste Characterization Study* 1998. Prepared for Iowa Department of Natural Resources.

[15] Data from Tellus memo to the U.S. EPA dated April 6, 1999, entitled *Update of the National Source Reduction Report*.

Table 2.
Tons of Waste Recycled, Disposed and Source Reduced in 1995

	Recycled	Disposed	Source Reduced
Paper	**367,175**	**668,286**	**49,533**
Newspaper	88,294	77,708	31,952
OCC and Kraft Bags	225,047	183,908	NA
High Grade	31,699	46,625	NA
Other	22,135	360,046	17,581
Plastics	**23,423**	**293,994**	**(2,814)**
PET	10,307	7,771	(2,291)
HDPE	6,286	18,132	(523)
LDPE	3,442	-	NA
Other	3,388	268,092	NA
Glass	**28,908**	**44,034**	**25,829**
Metals	**141,321**	**128,218**	**27,692**
Steel Cans	29,036	20,722	2,525
Aluminum Cans	3,996	5,181	1,970
Ferrous Scrap	102,782	91,954	23,197
Non-ferrous Scrap	5,507	10,361	NA
Yard Waste	**113,858**	**33,673**	**277,858**
Food Waste	**NA**	**191,679**	**18,503**
Wood	**39,173**	**243,484**	**30,334**
Rubber, Textiles and Leather	**166,428**	**986,888**	**NA**
Total	**880,286**	**2,590,257**	**426,935**

1.3 Emissions Reductions Due to Waste Diversion

The recycling and SR tonnage data from Table 2, together with the EPA GHG emission factors from Table 1, provide all the information required to quantify GHG emissions avoided as a result of Iowa's 1995 diversion. Table 3 shows the details of the calculation.[16] The results in the table show that, Iowa's 1995 diversion activities resulted in about 450 thousand MTCE of avoided GHG emissions in resource extraction and material manufacturing processes.

Table 3.
Avoided GHG Emissions from Recycling and Source Reduction in Iowa[17]

Material	Recycling			Source Reduction			Total	
	Diverted	Emission Factor	Avoided Emissions	Diverted	Emission Factor	Avoided Emissions	Diverted	Avoided Emissions
	Tons	MTCE/Ton	MTCE	Tons	MTCE/Ton	MTCE	Tons	MTCE
Paper	**367,175**		**274,289**	**49,533**		**45,075**	**416,708**	**319,364**
Newspaper	88,294	0.86	75,933	31,952	0.91	29,076	120,246	105,009
OCC and Kraft Bags	225,047	0.7	157,533	NA	0.78	NA	225,047	157,533
High Grade	31,699	0.82	25,993	NA	1.03	NA	31,699	25,993
Other	22,135	0.67	14,830	17,581	0.91	15,999	39,716	30,829
Plastics	**23,423**		**12,167**	**(2,814)**	0.85	**(2,387)**	**20,609**	**9,780**
PET	10,307	0.62	6,390	(2,291)	0.98	(2,245)	8,016	4,145
HDPE	6,286	0.37	2,326	(523)	0.61	(319)	5,763	2,007
LDPE	3,442	0.49	1,687	NA	0.89	NA	3,442	1,687
Other	3,388	0.52	1,765	NA	NA	NA	3,388	1,765
Glass	**28,908**	**0.08**	**2,312.64**	**25,829**	**0.14**	**3,616**	**54,737**	**5,929**
Metals	**141,321**		**90,641**	**27,692**		**27,477**	**169,013**	**118,118**
Steel Cans	29,036	0.57	16,551	2,525	0.84	2,121	31,561	18,672
Aluminum Cans	3,996	3.88	15,504	1,970	2.98	5,870	5,966	21,375
Ferrous Scrap	102,782	0.57	58,586	23,197	0.84	19,485	125,979	78,071
Non-ferrous Scrap	5,507	NA	NA	NA	NA	NA	5,507	NA
Yard Waste	**113,858**	**NA**	**NA**	**277,858**	**NA**	**NA**	**391,716**	**NA**
Food Waste	**NA**	**NA**	**NA**	**18,503**	**NA**	**NA**	**18,503**	**NA**
Wood	**39,173**	**NA**	**NA**	**30,334**	**NA**	**NA**	**69,507**	**NA**
Other	**166,428**	**NA**	**NA**	**NA**	**NA**	**NA**	**166,428**	**NA**
Total	**880,286**		**379,410**	**426,935**		**73,780**	**1,307,220**	**453,190**

[16] Note that emission factors were not available for all materials, so these materials were excluded from our calculations. Also, for clarity, emission factors shown in Table 3 are the values in Table 1 multiplied by –1, thus emission reductions appear as positive values in Table 3.

[17] Includes only those GHG emissions avoided as in resource extraction and material manufacturing processes.

1.4 Scenario Analyses

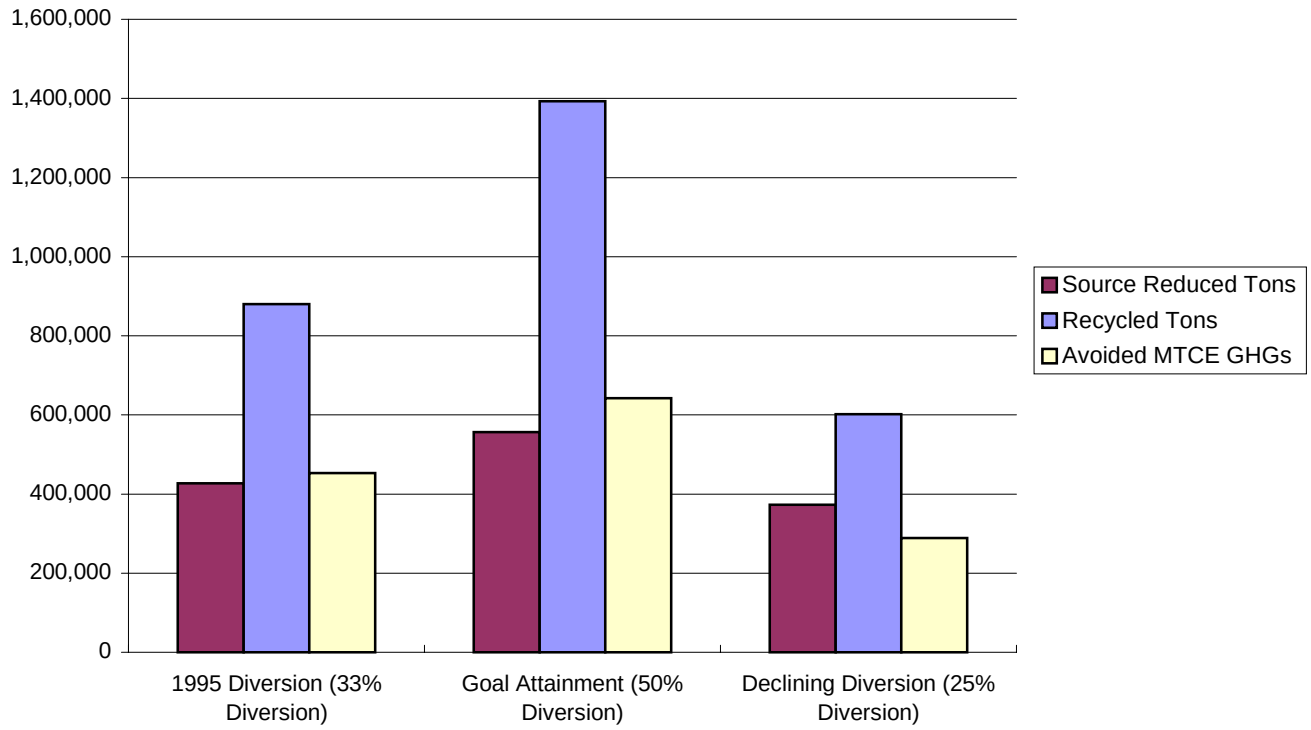
In addition to the analysis of 1995 diversion shown in Table 3, two scenarios were developed to evaluate how changes in the state's current 33.5% diversion rates would affect GHG emissions.

- **The Goal Attainment Scenario** assumes that DNR meets its 50% diversion goal in year 2000 based on linear growth in 1995 SR and recycling rates. In this scenario avoided GHG emissions increase to 641,887 MTCE (See appendix B for details).

- **The Declining Diversion Scenario** assumes that SR and recycling diversion decline linearly to a combined rate of 25%. In this case avoided GHG emissions decline to 288,423 (See Appendix B for details).

Results of the scenario analyses are summarized in Figure 2. If the state achieves its 50% diversion goals it will increase avoided GHG emissions by 42%, or 189 thousand MTCEs compared to 1995 diversion. On the other hand, if diversion declines to 25%, avoided GHG emissions will decline by about one-third (165 thousand MTCE).

Figure 2:
Summary of Tonnage Diversion and GHG Emissions Benefits by Scenario

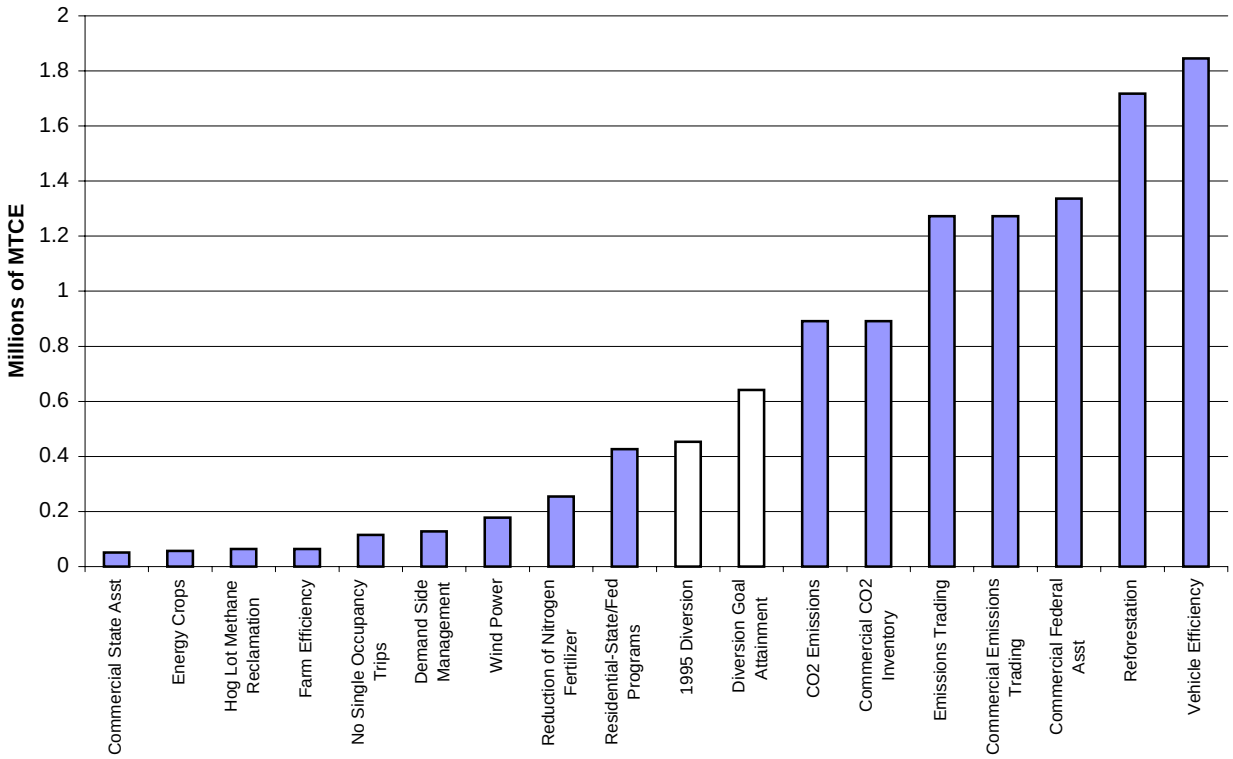


2. CONSIDERING WASTE DIVERSION IN THE CONTEXT OF CARBON REDUCTION OPTIONS

Iowa's Climate Change Action Plan (*Iowa Greenhouse Gas Action Plan)* identifies 16 priority options for reducing carbon emissions to 1990 levels by the year 2010 (See Appendix C for additional details on the priority options). Priority options are defined as "those [options] that the State should adopt…..to reach the objective of curtailing [GHG] emissions to 1990 levels by the year 2000 or soon thereafter."[18] The Plan quantifies projected carbon reduction in year 2010 for each priority option. This information is directly comparable to the data shown in Figure 1 and thus provides an excellent basis for evaluating waste diversion's value as a carbon reduction measure.

Figure 3 shows estimated carbon reduction for each priority option along with the 1995 diversion and goal attainment diversion scenarios. Note that waste diversion in 1995 resulted in more carbon reduction than half of the priority options identified in the plan. This is particularly significant because these reductions have already been achieved, well in advance of the 2010 target date for achievement of the CCAP priority options.

Figure 3.
Estimated Carbon Reduction from CCAP Priority Options and Waste Diversion



[18] *Iowa Greenhouse Gas Action Plan* (1996), page 19.

3. CONCLUSION

While the connection between waste diversion and reduced GHG emissions from landfills is relatively well understood, the same cannot be said for the connection between waste diversion and reduced GHG emissions from natural resource and material manufacturing processes. These "upstream" impacts are particularly important for materials such as aluminum cans, which emit no GHGs when disposed in local landfills, but which result in substantial GHG reductions when recycled cans are used as a substitute for bauxite in aluminum production processes, or when demand for aluminum is avoided altogether through source reduction. As this study shows, these impacts can be significant when compared to other common GHG reduction options. State CCAPs should account for these impacts since they are the direct result of state and local diversion activities and policies.

Iowa's baseline GHG inventory and forecast captures a portion of the carbon reduction resulting from state and local diversion by assuming reduced landfill methane emissions over time as a result of waste diversion. However, it does not account for the additional 450,000 MTCE of carbon reduction that occurs in resource extraction and material production processes as a result of state and local diversion programs and policies. According to EPA's *State's Guidance Document on Climate Change Action Plans*, the state can and should take credit for these reductions in its CCAP.[19]

Finally, this study illustrates the important synergy between state diversion polices and climate change initiatives by placing the state's waste diversion impacts in the context of the 16 priority carbon reduction options identified in the state's CCAP. As a carbon reduction measure, Iowa's 1995 waste diversion compares very favorably to the 16 priority options, producing more carbon reduction than 8 of the 16 strategies identified in the plan. If the state is able to achieve its 50% diversion goal, it will increase carbon reduction from waste diversion by 42% to nearly over 640 thousand MTCE.

[19] See Appendix 2 in U.S. EPA's. *States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions* (1998).

APPENDIX A:
IOWA COMPREHENSIVE PLANNING AREAS' GOAL PROGRESS STATUS

Appendix C Methodology	BASELINE				MOST RECENT FISCAL YEAR			
NAME OF PLANNING AREA	Population	Tonnage	Per Capita	Year	Population	Tonnage	Per Capita	STATUS
Allamakee County Solid Waste Commission	12,638	6,726	0.5322045	95	12,508	5,013	0.4007835	24.69%
Cass County Environmental Control Agency	15,484	10,817	0.6985921	96	15,047	7,244	0.4814249	31.09%
Des Moines Co. Regional Solid Waste Comm.	58,594	91,029	1.553555	96	59,475	58,085	0.9766288	37.14%
Dickinson County Sanitary Landfill	26,830	29,534	1.1007827	95	26,067	27,425	1.0520965	22.44%
Fayette County Solid Waste Mgmt. Comm.	22,410	15,687	0.7	96	21,621	10,253	0.4742149	32.26%
Flannegan Landfill	29,790	22,603	0.7587445	95	29,174	19,944	0.6836224	9.90%
Floyd-Mitchell County Solid Waste Agency	29,325	21,294	0.7261381	96	40,520	21,669	0.534773	26.35%
Grundy County Landfill Commission	12,496	9,500	0.7602433	95	12,127	6,008	0.4954234	34.83%
Guthrie County Solid Waste & Recycling Agcy.	9,475	6,752	0.7126121	95	9,268	4,900	0.5287009	25.81%
Hamilton County Solid Waste Commission	16,930	13,467	0.7954519	95	16,116	8,725	0.5413874	31.94%
Harrison County Landfill Association	15,054	11,149	0.7406005	95	14,939	8,189	0.5481625	25.98%
Humboldt County Landfill Commission	10,997	6,940	0.6310812	94	9,513	6,298	0.6620414	-4.91%
Kossuth County	27,004	21,811	0.8076952	96	23,867	13,300	0.5572548	31.01%
Mahaska Co. Solid Waste Mgmt. Comm.	22,682	50,581	2.2300062	95	21,561	23,451	1.0876583	51.23%
Montgomery County Landfill Commission	12,343	12,489	1.0118286	97	11,908	8,229	0.691048	31.70%
Mills/Fremont/Nishna	21,704	12,717	0.5859289	94	22,698	10,292	0.453432	22.61%
Newton, City of, Sanitary Landfill	32,011	37,523	1.1721908	96	33,489	25,977	0.7756875	33.83%
North Central Iowa Reg. Solid Waste Agcy.	45,340	61,070	1.3469343	95	49,149	49,452	1.0061649	25.30%
North Dallas Regional Solid Waste Planning Commission	24,858	21,314	0.8574302	95	26,232	19,100	0.7281183	15.08%
Page Co. Landfill Assoc.	17,562	15,367	0.8750142	95	17,347	10,205	0.5882862	32.77%
PCB (Plymouth, Cherokee, & Buena Vista) Solid Waste Agency	59,473	39,097	0.6573907	96	58,560	23,542	0.402015	38.85%
Pottawattamie County	83,415	146,057	1.7509681	94	83,418	118,819	1.4243808	18.65%
Rathbun Area Solid Waste Commission	18,296	19,016	1.0393529	95	16,014	11,645	0.7271762	30.04%
Rural Iowa Waste Management Association	51,130	41,825	0.8180129	96	45,199	26,007	0.5753888	29.66%
Sac County Solid Waste Agency	12,657	6,480	0.5119697	95	12,089	4,044	0.334519	34.66%
South Central Iowa Landfill Agency	43,138	28,902	0.6699893	96	45,905	23,038	0.5018625	25.09%
Union County Landfill Commission	25,483	20,381	0.7997802	95	24,189	14,333	0.5925421	25.91%
Wayne-Ringgold-Decatur Solid Waste Management Commission	22,791	11,636	0.5105485	96	19,567	7,916	0.404574	20.76%
Winnebago Co. SLF / Central Disposal Systems	15,271	4,249	0.2782267	95	13,185	3,248	0.2463405	30.57%
Appendix C TOTALS	795,181	796,013	1.001046		790,752	576,351	0.728865	27.19%
Base-Year Adjustment Method								
Adair County Sanitary Landfill Commission	10,514	7,006	0.6663496	95	10,210	5,275	0.5166503	24.71%
Bi-State Regional Commission	282,846	398,440	1.4086818	96	286,505	253,781	0.8857821	36.31%
Central Iowa Solid Waste Mgmt. Assoc.	115,209	128,418	1.1146525	95	114,617	69,281	0.6044566	46.05%
Clarke County Landfill Commission	8,173	6,528	0.7987275	96	8,136	7,084	0.8706981	-8.52%
Delaware County Solid Waste Disposal Commission	20,005	10,244	0.512072	96	20,117	7,344	0.3650644	28.31%
Dubuque Metropolitan Area Solid Waste Agency	87,786	81,641	0.9300002	95	88,133	59,943	0.6801425	26.58%
East Central Iowa Council of Governments	335,442	498,111	1.4849404	96	361,233	317,843	0.879884	36.19%
Great River Regional Waste Authority	46,046	54,467	1.1828823	97	45,562	48,657	1.0679294	10.67%
Iowa Northland Regional Council of Governments	165,897	313,998	1.8927286	96	167,766	137,289	0.8183363	56.28%
Landfill of North Iowa	74,418	82,487	1.1084281	97	73,121	61,982	0.8476568	24.86%
Marshall Co. Sanitary Landfill Commission	39,549	36,804	0.9305924	96	39,228	23,653	0.6029622	35.73%
Metro Waste Authority	334,160	641,263	1.9190298	95	363,228	419,173	1.1540217	34.63%
Northwest Iowa Area Solid Waste Agency	82,464	68,225	0.8273326	97	82,569	53,355	0.6461928	21.79%
Ottumwa-Wapello Landfill Commission	43,107	34,475	0.7997541	95	44,585	25,391	0.5694965	26.35%
Siouxland Interstate Metropolitan Planning Council (SIMPCO)	109,162	125,414	1.1488796	95	111,252	93,853	0.8436073	25.17%
South Central Iowa Solid Waste Agency	69,049	63,339	0.9173051	95	67,783	50,094	0.7390349	20.91%
Southeast Mutli-County Solid Waste Agency (SEMCO)	46,280	28,394	0.6135201	96	47,118	20,700	0.4393226	27.10%
Van Buren County Solid Waste Mgmt. Comm.	7,866	3,130	0.3979151	95	7,767	2,653	0.3415733	15.24%
West Central Iowa Waste Mgt. Assoc.	74,693	50,819	0.6803717	96	72,078	33,978	0.471406	33.14%
Winneshiek County Solid Waste Agency	63,807	40,773	0.6390051	96	64,011	24,194	0.3779663	40.66%
Base-Year Adjustment Method TOTALS	2,016,473	2,673,976	1.326066		2,075,019	1,715,523	0.826751	35.84%
Appendix C + Base-Year Method Combined %								
Appendix C Method	2,811,654	3,469,989	1.234145		2,865,771	2,291,874	0.799741	35.20%
				Appendix C		0.251476		6.84%
				Base-Year		0.748524		26.83%
Weighted Average Percent				TOTAL		1		33.67%
Minnesota Method								
Dickinson County Sanitary Landfill		115,412		95		82,601		28.43%
Winnebago Co. SLF / Central Disposal Systems		312,077		95		215,782		30.86%
Minnesota Method TOTALS		427,489				298,383		30.20%
Appendix C + Base-Year + Minnesota		3,897,478				2,590,257		
				Appendix C		0.2225073		6.05%
				Base-Year		0.6622983		23.74%
				Minnesota		0.1151943		3.48%
Weighted Average Percent				TOTAL		1		33.27%

APPENDIX B:
SCENARIO RESULTS

Table B-1.
Avoided GHG Emissions from Waste Diversion Goal Attainment, 50% Diversion

Material	Recycling			Source Reduction			Total	
	Diverted	Multiplier	Benefit	Diverted	Multiplier	Benefit	Diverted	Benefit
	Tons	MTCE/Ton	MTCE	Tons	MTCE/Ton	MTCE	Tons	MTCE
Paper	**489,692**		**362,236**	**94,707**		**86,183**	**584,399**	**448,419**
Newspaper	102,612	0.86	88,246	37,133	0.91	33,791	139,745	122,037
OCC and Kraft Bags	271,195	0.7	189,836	-	0.78	-	271,195	189,836
High Grade	43,398	0.82	35,587	-	1.03	-	43,398	35,587
Other	72,487	0.67	48,567	57,574	0.91	52,392	130,062	100,959
Plastics	**98,164**		**49,285**	**(3,784)**	0.82	**(3,093)**	**94,381**	**46,192**
PET	12,814	0.62	7,945	(2,848)	0.98	(2,791)	9,966	5,154
HDPE	11,249	0.37	4,162	(936)	0.61	(571)	10,313	3,591
LDPE	3,442	0.49	1,687	-	0.89	-	3,442	1,687
Other	70,660	0.50	35,492	-	NA	NA	70,660	35,492
Glass	**34,743**	**0.08**	**2,779.48**	**31,043**	**0.14**	**4,346**	**65,787**	**7,126**
Metals	**168,401**		**107,476**	**32,786**		**32,674**	**201,186**	**140,150**
Steel Cans	33,820	0.57	19,277	2,942	0.84	2,471	36,761	21,748
Aluminum Cans	4,867	3.88	18,883	2,399	2.98	7,150	7,266	26,032
Ferrous Scrap	121,607	0.57	69,316	27,445	0.84	23,054	149,052	92,370
Non-ferrous Scrap	8,107	NA	NA	-	NA	NA	8,107	NA
Yard Waste	**113,858**	**NA**	**NA**	**277,858**	**NA**	**NA**	**391,716**	**NA**
Food Waste	**-**	**NA**	**NA**	**66,600**	**NA**	**NA**	**66,600**	**NA**
Wood	**73,606**	**NA**	**NA**	**56,998**	**NA**	**NA**	**130,604**	**NA**
Other	**414,066**	**NA**	**NA**	**-**	**NA**	**NA**	**414,066**	**NA**
Total	**1,392,531**		**521,777**	**556,208**		**120,111**	**1,948,739**	**641,887**

Table B-2.
Avoided GHG Emissions Assuming Declining Diversion
25% Diversion

Material	Recycling			Source Reduction			Total	
	Diverted	Multiplier	Benefit	Diverted	Multiplier	Benefit	Diverted	Benefit
	Tons	MTCE/Ton	MTCE	Tons	MTCE/Ton	MTCE	Tons	MTCE
Paper	**233,681**		**174,566**	**31,524**		**28,687**	**265,205**	**203,253**
Newspaper	56,193	0.86	48,326	20,335	0.91	18,505	76,528	66,831
OCC and Kraft Bags	143,226	0.7	100,259	NA	0.78	NA	143,226	100,259
High Grade	20,174	0.82	16,543	NA	1.03	NA	20,174	16,543
Other	14,087	0.67	9,439	11,189	0.91	10,182	25,276	19,621
Plastics	**14,907**		**7,744**	**(1,791)**	0.85	**(1,519)**	**13,116**	**6,224**
PET	6,560	0.62	4,067	(1,458)	0.98	(1,429)	5,102	2,638
HDPE	4,001	0.37	1,480	(333)	0.61	(203)	3,668	1,277
LDPE	2,191	0.49	1,073	NA	0.89	NA	2,191	1,073
Other	2,156	0.52	1,123	NA	NA	NA	2,156	1,123
Glass	**18,398**	**0.08**	**1,471.83**	**16,438**	**0.14**	**2,301**	**34,836**	**3,773**
Metals	**89,941**		**57,686**	**17,624**		**17,487**	**107,565**	**75,173**
Steel Cans	18,479	0.57	10,533	1,607	0.84	1,350	20,087	11,883
Aluminum Cans	2,543	3.88	9,868	1,254	2.98	3,736	3,797	13,604
Ferrous Scrap	65,413	0.57	37,286	14,763	0.84	12,401	80,176	49,687
Non-ferrous Scrap	3,505	NA	NA	NA	NA	NA	3,505	NA
Yard Waste	**113,858**	**NA**	**NA**	**277,858**	**NA**	**NA**	**391,716**	**NA**
Food Waste	**NA**	**NA**	**NA**	**11,776**	**NA**	**NA**	**11,776**	**NA**
Wood	**24,931**	**NA**	**NA**	**19,306**	**NA**	**NA**	**44,237**	**NA**
Other	**105,919**	**NA**	**NA**	**NA**	**NA**	**NA**	**105,919**	**NA**
Total	**601,635**		**241,468**	**372,735**		**46,956**	**974,369**	**288,423**

APPENDIX C:

PRIORITY OPTIONS FOR GHG REDUCTION IDENTIFIED IN IOWA'S GHG ACTION PLAN

(Millions of MTCE)

Sector	Recommended Option to Reduce Greenhouse Gas Emissions in Iowa	Priority Reduction (million MTCE)
Agricultural	Reforestation of Marginal Lands (riparian zones, native tree plantings)	1.72
	Production of Energy Crops (switchgrass and poplars)	0.06
	Reduction of Nitrogen Fertilizer Applications	0.25
	Reclamation of Methane Gas at Large Hog Lots	0.06
	Continued Improvement of Farm Efficiency	1.85
Transportation	Improve Vehicle Fleet Efficiency (revenue neutral fee/rebate)	0.11
	Discourage Single Occupancy Trips	0.89
Utility	Carbon Dioxide Emissions Inventory	0.18
	Wind Power Development	0.13
	Demand Side Management (voluntary)	1.27
	Emissions Trading (market based)	0.05
Commercial/ Industrial	State (Iowa Energy Bank, Rebuild Iowa, Total Assessment Audit, Climate Wise) Voluntary Programs	1.34
	Federal Voluntary Programs (in concert with state programs)	1.27
	Emissions Trading (market based)	0.89
	Carbon Dioxide Emissions Inventory	0.43
Residential	State and Federal Voluntary Programs	2.93
Total Priority Reductions		13.43
Waste Diversion	Status Quo (33% diversion)	.45
	Goal Attainment (50% diversion)	.64
	Declining Diversion (25% diversion)	.29