Minnesota Pollution Control Agency

2008 Metro Area Construction and Demolition Waste Recycling Report

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METRO AREA CONSTRUCTION AND DEMOLITION WASTE RECYCLING REPORT

INTRODUCTION

In 2008, the Minnesota Legislature passed legislation that requires the Minnesota Pollution Control Agency (MPCA) to develop and submit a report to the legislature by December 1, 2008, analyzing:

- The availability of collection and processing capacity in the seven-county metropolitan area for the recycling of construction and demolition waste.
- The report must recommend a percentage of the total weight of construction and demolition waste generated in the seven-county metro area that represents an achievable but aggressive recycling goal that can be reached by 2012.
- An analysis of the economic and environmental costs and benefits of reaching that goal.

The following represents, in summary form, the analysis of those tasks to include tables containing factors that may influence the decision on the appropriateness of each recovery alternative or option.

Waste Generation, Composition & Recovery Potential

The September *2007 Minnesota Construction Demolition and Industrial (CD&I) Waste Study (2007 Study)* completed by the MPCA and the Solid Waste Management Coordinating Board (SWMCB), estimated that approximately 1,500,000 tons of construction and demolition (C&D) waste is disposed of each year in Minnesota. Of that total, approximately 73% or 1,100,000 tons is collected and delivered to 19 transfer stations and 10 landfills serving the metropolitan area.

Table 1 is a spreadsheet that lists the composition of the Minnesota C&D waste stream as determined in the 2007 Study. It lists each of the material types; percent composition; Metro area quantity; preliminary estimates for recycling, biomass fuel, and landfill; type of use; and finally projected quantities for each use by 2012. This is a comprehensive table that includes all C&D materials and includes aggressive recovery projections for several materials. This table was also developed for the purpose of conducting a follow-up analysis of the greenhouse gas (GHG) and potential energy savings associated with the recycling and recovery of C&D materials. This analysis is anticipated to be completed by early 2009.

Current Barriers to Increased C&D Recycling

C&D waste has not received the same level of attention under the Minnesota Waste Management Act as waste defined as mixed municipal solid waste (MMSW). Historically, funding for solid waste programs, research initiatives, composition studies, and market development efforts have focused primarily on MMSW and have resulted in a Minnesota MMSW recycling rate of nearly 42%, one of the best recycling rates in the country.

An equal level of effort will have to be developed and implemented to achieve similar results for the recycling of C&D wastes.

Economics

Similar to the challenges encountered with the recovery of MMSW, the primary barrier that limits the amount of recovery of C&D materials is economics. The net costs of source separation, collection, sorting, processing, and marketing potentially recoverable materials in many instances is higher than the comparable cost of simply collecting the materials at a construction or demolition site and hauling to a landfill for disposal. Inherent in the cost differential are labor rates for workers at job sites (contractors want workers doing productive activities, not sorting minor quantities of scrap), labor rates for sorting, capital costs for processing equipment, relatively low cost tipping fees at landfills, and relatively low values received for marketing most of the recovered materials.

Lack of Markets

The lack of viable markets for C&D materials limits recovery potential. Two examples of C&D wastes that could be targeted and recovered are asphalt shingles and wallboard. Together, these two materials were projected to make up 26.8% of the C&D waste stream that is currently disposed in landfills. These materials are relatively easy to identify, are generated at a site over a relatively short period of time, and could fairly easily be targeted at the job site or at a mixed C&D recycling facility. Nevertheless, without viable markets for these materials, the majority will continue to be buried in landfills.

Lack of markets is also a concern for C&D based biomass fuels. Much of the wood that could be recovered from the C&D wastes is classified as "Other Woods (18.3%)." This may include composites, furniture, plywood, etc. that will make a fuel with high Btu content. Solid fuel boilers exist in Minnesota that could burn this wood for fuel, but require additional air pollution control equipment.

System to Measure Progress in Meeting Goals

Although some reporting and documentation of C&D recovery efforts presently exist within the Metro Area, a lot of recovered tonnages are not reported because the materials are not processed at public or private disposal facilities, but rather at the point of generation. For example, contractors may opt to process concrete and asphalt materials on site for reuse into their project or a site nearby, thus reducing time, disposal and fuel costs. As such, a variety of potential strategies will need to be examined to determine the best combination of approaches to use in measuring progress in meeting C&D recovery goals.

Some Collection and Processing Capacity for Mixed C&D Does Exist

Overall collection capacity for C&D materials is adequate, although some source-separated operations may need to be expanded to meet volume and market requirements for specific materials.

At this time, some Metro Area C&D companies have or are considering upgrading equipment and their transfer stations into C&D processing facilities in order to reduce trucking costs, avoiding landfill disposal costs and marketing their hauling/recycling services to customers who also may want to encourage more recycling. Those companies that have made these investments include DemCon, Shamrock, Veit, and Broadway Resource & Recovery (Atomic).

Despite some mixed C&D processing capacity in existence in the Metro Area, it is not adequate to handle the total volume of 1.1 million tons of mixed C&D waste available each year in the Metro Area.

Targets and Opportunities for Specific C&D Materials

The 2007 Study, determined that four (4) materials consisting of shingles, wallboard, clean and mixed wood biomass fuels presented the greatest recycling opportunity in terms of both tonnage and market development potential. Table 1 illustrates these and other C&D materials with projected recycling and recovery goals for the Metro Area by 2012.

The remainder of this report will address each of the four (4) materials, noted above, that have the greatest recycling or recovery potential in terms of tons generated, recycling and recovery potential, collection and processing capacity and available markets.

Asphalt Shingles

Asphalt shingles are the most common type of roofing material used in new home construction and re-roofing projects. The 2007 Study found that tear-off shingles made up 15.2 % of the C&D waste stream or 228,000 tons. In the Metro Area, 167,200 tons of asphalt shingles are projected to be landfilled each year.

Collection and Processing Capacity

At this time, the Metro Area has in place adequate collection and processing facilities capable of handling most, if not all, tear-off shingles generated each year. There has been a recent increase in processing capacity due to investments made by the private sector. There will likely be a need for additional sorting and grinding capacity to meet anticipated market specifications in the future.

Recycling and Recovery Goal

The *Shingles Recycling White Paper* developed by SWMCB, MPCA and other stake holders in 2008 initially recommended a 75% recycling goal for asphalt shingles or 125,000 tons by 2012. But, that goal has been recently raised to 90% or 150,000 tons because of greater interest and investment demonstrated by asphalt pavers and C&D contractors in the Metro Area.

This goal will only be achieved if the Minnesota Department of Transportation issues a permissive specification for tear-off shingle use in hot mix asphalt (HMA).

Table 1
Metro Area Aggressive C&D Material Recycling & Recovery Projections

Material Type	Comp. Percent	Metro Centroid Quantity	Metro Centroid Only Projections										
			Preliminary Estimates							Projected Quantites			
			Recycling		Fuel		Landfill		Type of Use	Recycling	Fuel	ADC	Landfill
			%	Tons	%	Tons	%	Tons					
Paper													
Corrugated/brown paper	2.6%	28,796	50%	14,398	40%	11,518	10%	2,880	Recycle to Paper & Biomass Fuel	14,398	11,518	0	2,880
Other paper	1.6%	17,909	0%	0	90%	16,118	10%	1,791	Biomass Fuel	0	16,118	0	1,791
Subtotal PAPER	4.2%	46,705		14,398		27,637		4,671		14,398	27,637	0	4,671
Plastic													
Marketable Plastics	0.6%	6,279	50%	3,139	40%	2,511	10%	628	Recycle to furniture & Biomass Fuel	3,139	2,511	0	628
Other plastics	3.8%	41,473	0%	0	90%	37,326	10%	4,147	Biomass Fuel	0	37,326	0	4,147
Subtotal PLASTICS	4.3%	47,752		3,139		39,837		4,775		3,139	39,837	0	4,775
Metal													
Ferrous scrap	2.8%	31,128	90%	28,015	0%	0	10%	3,113	Recycle to steel	28,015	0	0	3,113
Non-ferrous	0.5%	5,878	90%	5,290	0%	0	10%	588	Recycle to metals	5,290	0	0	588
Subtotal METAL	3.4%	37,006		33,306		0		3,701		33,306	0	0	3,701
Glass													
Glass	0.8%	9,303	0%	0	0%	0	100%	9,303		0	0	0	9,303
Subtotal GLASS	0.8%	9,303		0		0		9,303		0	0	0	9,303
Yard Waste													
Yard waste	0.2%	2,522	50%	1,261	40%	1,009	10%	252	Compost/Biomass Fuel	1,261	1,009	0	252
Subtotal YARD WASTE	0.2%	2,522		1,261		1,009		252		1,261	1,009	0	252
Textiles/Carpets													
Textiles/Carpets	3.7%	41,219	40%	16,487	50%	20,609	10%	4,122	Reuse/Recycle & Biomass Fuel	16,487	20,609	0	4,122
Subtotal Textiles/Carpets	3.7%	41,219		16,487		20,609		4,122		16,487	20,609	0	4,122
Electric Wastes													
Electric Wastes	0.1%	1,506	0%	0	0%	0	100%	1,506		0	0	0	1,506
Subtotal E-WASTES	0.1%	1,506		0		0		1,506		0	0	0	1,506
WOOD													
Tree Wastes	0.2%	2,339	50%	1,169	40%	936	10%	234	Mulch & Biomass Fuel	1,169	936	0	234
Non-treated Wood	3.2%	35,711	50%	17,855	40%	14,284	10%	3,571	Mulch & Biomass Fuel	17,855	14,284	0	3,571
Green-Treated Wood	0.8%	8,360	0%	0	0%	0	100%	8,360		0	0	0	8,360
Other Woods	18.3%	200,928	0%	0	90%	180,836	10%	20,093	Biomass Fuel	0	180,836	0	20,093
Subtotal WOOD	22.5%	247,338		19,025		196,055		32,258		19,025	196,055	0	32,258
Concrete													
Concrete	9.7%	106,508	90%	95,857	0%	0	10%	10,651	Recycle as aggregate	95,857	0	0	10,651
Subtotal CONCRETE	9.7%	106,508		95,857		0		10,651		95,857	0	0	10,651
Brick													
Brick	5.6%	61,464	90%	55,318	0%	0	10%	6,146	Recycle as aggregate & reuse	55,318	0	0	6,146
Subtotal BRICK	5.6%	61,464		55,318		0		6,146		55,318	0	0	6,146
Sheetrock													
Sheetrock and wallboard	11.6%	127,598	50%	63,799	0%	0	50%	63,799	Soil amendment	63,799	0	0	63,799
Subtotal SHEETROCK	11.6%	127,598		63,799		0		63,799		63,799	0	0	63,799
Roofing													
Roofing (incl. shingles & tear off)	15.2%	167,519	90%	150,767	10%	16,752	0%	0	Recycle as asphalt & Biomass Fuel	150,767	16,752	0	0
Flat roofing	1.9%	21,129	0%	0	90%	19,016	10%	2,113	Biomass Fuel	0	19,016	0	2,113
Subtotal ROOFING	17.1%	188,648		150,767		35,768		2,113		150,767	35,768	0	2,113
Dirt/Fines													
Dirt/fines	16.1%	176,893	90%	159,203	0%	0	10%	17,689	ADC/other beneficial use	0	0	159,203	17,689
Subtotal DIRT/FINES	16.1%	176,893		159,203		0		17,689		0	0	159,203	17,689
Unused Product/Haz Wastes													
Hazardous Wastes	0.3%	2,877	0%	0	0%	0	100%	2,877		0	0	0	2,877
Subtotal HW	0.3%	2,877		0		0		2,877		0	0	0	2,877
Incidental/Other													
Miscellaneous	0.2%	2,661	0%	0	0%	0	100%	2,661		0	0	0	2,661
	0.2%	2,661		0		0		2,661		0	0	0	2,661
Totals	**100.0%**	**1,100,000**								**453,357**	**320,915**	**159,203**	**166,524**
										41.2%	**29.2%**	**14.5%**	**15.1%**

Statewide Tonnage 2006 1,500,000
Metro Tonnage 2006* 1,100,000
(*Includes Burnsville SLF, Dawnway, both Dem-Con LFs, Demolition Landfill Services, Elk River SLF, Rich Valley, SKB Rosemount, Spruce Ridge, Veit Northwood, & Vonco II)

Economic and Environmental Cost and Benefits

The primary economic driver for tear-off shingle recycling is the virgin asphalt cost (i.e. asphalt binder oil) savings derived by HMA producers. For example, if 156,000 tons of tear-off shingles were recycled, with oil content of 20%, it would yield approximately 31,200 tons of asphalt binder each year with an estimated value of about $12 million at recent virgin oil prices.

Equally important, the 156,000 tons of asphalt shingles diverted from landfills would also net a savings of about $5 million in tipping fees each year. A summary of the strengths and weaknesses of using tear-off recycled asphalt shingles is found in Table 2.

Finally, there is a potentially significant energy savings of 30 million KWH per year and GHG reduction of 22 tons of CO_2 per year.

TABLE 2

USE OF RECYCLED ASPHALT SHINGLES IN HOT MIX ASPHALT

Strengths	Weakness
Proven and well documented use in other states	No Mn/DOT Permissive Specification in existence for Tear-off Shingles
Potential to increase new jobs	Reduced economy of scale in Greater Minnesota
Potential significant energy (30 million KWH/yr.) and GHG savings (22 tons of $C0_2$/yr)	Lower tipping fees in Greater Minnesota
Substantial demand or market exists per the Minnesota Asphalt Pavers Association	
Some collection and processing infrastructure exists through private sector investments	
High return on investment, if recycled asphalt shingles (RAS) is incorporated appropriately	
Meets MPCA "standing beneficial use determination"	
Potential recycling level high: (Metro: 150,000 tons or 90% by 2012) (Greater Minnesota: 31,000 tons or 50% by 2012)	
Significant disposal costs avoided each year at $4.8 million.	
Synergies with LEED certification	

Wallboard

Commonly referred to as "drywall or sheet rock," wallboard comprises 11.6% of the C&D waste stream or 174,000 tons. The Metro Area generates for disposal 127,600 tons of wallboard each year while Greater Minnesota disposes of 46,400 tons.

Collection and Processing Capacity

As to the collection of wallboard, it appears that adequate capacity exists at this time. However, there will be a need to coordinate the timing of wallboard collection at each construction project to ensure optimum recovery rates and contaminate free material. Currently in Minnesota, the capacity to separate sheetrock exists. However, an economically viable market for wallboard does not exist, so separation of this material is currently not being done.

Recycling and Recovery Goals

Unlike shingles, the greatest amount and opportunity for recovery of wallboard is found during the construction of buildings rather than their demolition (22.5% in construction waste versus 4.1% in demolition debris). Equally important, the promotion of sustainable building initiatives, such as Leadership in Energy & Environmental Design (LEED™) should provide an excellent opportunity to increase the recovery of wallboard and other C&D materials during the remodeling and construction of buildings

The 2012 projected recovery goal for the Metro Area is 50% or 63,799 tons. At this time, the type of use anticipated for this material is as a soil amendment only.

Economic and Environmental Cost and Benefits

The environmental benefits of recycling wallboard will be developed as part of the life-cycle assessment to be conducted in early 2009. The economics of recycling wallboard in Minnesota have not been addressed due to the lack of any significant end market availability. If this analysis shows that there are or can be environmental benefits, the recovery projections will be adjusted and a recovery strategy developed accordingly

There is substantial interest in convening a forum of stakeholders to discuss wallboard recycling and other beneficial uses options. This forum could help identify barriers and opportunities for market development. One strategy under discussion is to develop a product stewardship initiative with wallboard manufacturers. The MPCA will continue to work with other adjacent states and stakeholders in planning a forum with manufacturers to discuss product stewardship options. A summary of strengths and weaknesses related to the recovery of wallboard are listed in Table 3.

TABLE 3

WALLBOARD RECOVERY

Strengths	Weaknesses
174,000 tons available statewide, 127,000 tons exist in the Metro Area for recovery.	No sustainable market(s) exist at this time.
Greater opportunity exists to recover greater tonnage of clean materials during the construction of buildings rather than demolition (22.5% vs. 4.1%)	Gypsum is readily available, including that created at coal-fired utility plants.
Potential significant energy and GHG savings	
Synergies with LEED certification	No dedicated public or private funding to explore market opportunities for the creation of value-added products from wallboard
Great interest among both public and private landfill operators in its potential recovery	No incentive(s) exist at this time creating manufacturer interest in wallboard product stewardship
Product research and development infrastructure (labs and engineers) exist at public universities such as the Natural Resources Research Institute at the University of Minnesota Duluth.	Wallboard found in mixed C&D loads are generally highly contaminated
Potential to create new jobs	Potential contamination in ground alternative daily cover (ADC) that causes hydrogen sulfide odors – Limits ADC to only screened material

Clean Biomass Fuel:

Potential biomass fuel markets identified in the 2007 Study were separated into "clean fuel" and "mixed fuel" with a preliminary assumption that potential end users would be different based on need for more comprehensive air emission controls for the mixed fuel users. The clean fuels are considered tree waste and "non-treated wood" consisting of dimensional lumber, pallets, etc. and do not include any manufactured wood products such as plywood, painted wood, or furniture. The composition of clean wood sources was a total of 3.4 % or 51,000 tons statewide. The available tonnage in the Metro Area and Greater Minnesota were estimated at 37,400 and 13,600 tons, respectively. The ranges of potential target recovery goals from 25% to 90% yield a tonnage range of 12,750 to 45,900 tons.

Recovery of the "clean biomass fuels" already occurs, but goes undocumented. This is reflected in the relatively low percentage of material in the C&D waste composition analysis done in the 2007 Study. It may be difficult to track the additional recovery of clean biomass fuel that generators separate and deliver to end users. Like other materials, a combination of reporting strategies may be needed to monitor source separated wood recovery efforts occurring at job sites rather than at the disposal facilities.

Based upon the fact that the majority of clean biomass fuel is currently being utilized, the **Collection & Processing Capacity, Recycling & Recovery Goals, and the Economic and Environmental Costs and Benefits** issues will not be addressed in this report.

Mixed Biomass Fuel

The composition of mixed biomass fuel represents 23.9 % of the C&D waste stream. These materials consist of other paper, other plastic, yard waste and other wood. Other wood makes up the majority of the mixed biomass waste stream and consists of plywood, particle board, painted wood, wood furniture, and composite furniture. The potential tons available in Greater Minnesota are projected to be 95,000 tons, the Metro Area projection is 262,900 tons, for a total projected tonnage of 358,500 tons. The range of potential target recovery goals of 25% to 90% yields a tonnage range of 86,625 to 322, 650 tons per year.

Collection and Processing Capacity

As with the collection of wallboard, it appears that capacity to initially start collecting material is adequate. However, source separation at the generation point would greatly improve upon the recovery of this material.

Recycling and Recovery Goals

The MPCA and other stake holders in 2008 determined that a 90 % recycling goal for mixed biomass fuel may be possible by 2012. It should be noted that MMSW combustors are capable of combusting mixed biomass fuel. However, current Metro area capacity to burn this material in MMSW combustors does not exist at this time.

Economic and Environmental Costs and Benefits

In order to reach a 90 % recycling rate, solid fuel boilers that currently exist in Minnesota, and are capable of combusting mixed biomass fuels, would have to absorb higher capital costs. The higher costs would be associated with additional permitting requirements and air pollution control equipment expenses should these facilities choose to burn mixed biomass fuel.

The environmental costs and benefits of using mixed biomass fuel will be developed as part of a life-cycle assessment to be conducted in early 2009. If this analysis shows that there are or can be environmental benefits from the transporting, sorting, and burning of mixed biomass fuel, then recycling and recovery goals will be re-evaluated.

In addition, Table 4 illustrates the estimate energy content of clean and mixed biomass fuel while Table 5 provides a comparison of the Btu content of other solid fuels.

TABLE 4

ESTIMATED ENERGY CONTENT

Clean Biomass Fuel

Material Type	% of Total	% of Fuel	Btu Content/lb.	Weighted Total
Non-treated Wood	3.2	94.1	7,352	6,918.2
Tree Waste	0.2	5.9	2,100	123.9
Totals	3.4	100.0	NA	7,042.1

Mixed Biomass Fuel

Material Type	% of Total	% of Fuel	Btu Content/lb.	Weighted Total
Other Paper	1.6	6.7	6,799	455.5
Other Plastic	3.8	15.9	14,101	2,242.1
Yard Waste	0.2	0.8	2,601	20.8
Other Wood	18.3	76.6	6,640	5,086.2
Totals	23.9	100.0	NA	7,804.6

TABLE 5

BTU CONTENT COMPARISONS OF SOLID FUELS

Fuel Type	Btu Content per Pound
Clean Biomass	7,040
Mixed Biomass	7,800
Coal	12,500
Shelled Corn	6,970
Seasoned Wood (20% moisture)	6,930
Freshly Cut Wood	2,000
Manure (10% moisture)	6,500
Refuse-derived Fuel (RDF)	5,750

In general, clean biomass fuels have more for recycling or beneficial use options than mixed biomass fuels. Facilities that burn only clean wood/biomass fuel range in size from small to large; such facilities often are not required to have the level of air pollution control equipment needed for facilities that combust coal or MMSW. However, there is a need to expand the collection infrastructure of source separated clean dimensional lumber from construction and building deconstruction projects.

Tables 6 and 7 provides a summary of the strengths and weaknesses of utilizing biomass fuel.

TABLE 6

CLEAN BIOMASS FUEL USE

Strengths	Weaknesses
28 facilities exist statewide who are able to combust all 45,000 tons of clean fuel each year at a 90% recovery rate.	Requires either some type of source separation at job sites or mixed C&D processing equipment investment to separate and process clean wood from mixed C&D.
Several facilities are located in the Metro Area close to fuel sources.	Low landfill tipping fees
Needed air pollution equipment are a lot less compared to mixed biomass fuel	May require the development of an MPCA wood fuel sampling/inspection protocol
Compliments on-site grinding at demolition or deconstruction projects improving load densities and saving fuel.	
Potential significant energy, GHG and other environmental benefits	
Potential to create new jobs	
Potential carbon credit revenue	
Significant disposal costs avoided each year estimated at $1.5 million (90% recovery goal)	
With the exception of coal, Btu content exceeds other solid fuels	
Some source separation processing equipment in existence to sort out clean wood from mixed C&D	
Compliments Minnesota Climate Change Advisory Group (MCCAG) 2025 GHG goal and MPCA's 2007 Policy Report strategy	
Compliments the 2007 Next Generation Energy Act and Next Generation Initiative	

TABLE 7

MIXED BIOMASS FUEL USE

Strengths	Weaknesses
Potential to create new jobs	Permit modifications and air pollution control equipment needed
Greater tonnage available from mixed biomass than clean biomass 236,610 versus 33,660 at a 90% recovery rate	Low tipping fees at landfills
If modified with proper permitting and air pollution control equipment, there are six facilities in Minnesota capable of combusting more than 1,000 tons per day	Lack of incentives to overcome landfill tipping fees
C&D recycling facilities and C&D wood/derived biomass fuel compliment each other.	May require legislative change to include C&D waste derived biomass fuels in definition of renewable fuels
Provides electric utility companies an opportunity to provide power from a renewable energy source per the Next Generation Energy Act of 2007	
Availability of Next Generation BioEnergy and BioFuels funding for projects and research	
Compliments the goals and objectives within the MPCA's 2007 Policy Report	
With the exception of coal, Btu content exceeds other solid fuels	
Significant disposal costs avoided each year estimated at $10.4 million (90% recovery goal)	
Potential carbon credit revenue	
Significant energy, GHG and environmental benefits per MCCAG 2025 GHG goal	