

**STRATEGIC DIRECTIONS AND POLICY RECOMMENDATIONS
FOR SOLID WASTE MANAGEMENT IN THE BISTATE KANSAS CITY
METROPOLITAN REGION**

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OVERVIEW

Environmentally sound solid waste management is a key element of the MARC Region's environmental health. This report addresses the current status and recommended strategic directions in solid waste management for the Region.

Over the past 12 years, the Mid-America Council Solid Waste Management District (MARC SWMD) has made significant contributions to improving solid waste management in the five member Missouri counties. At this juncture, the district is experiencing declining revenues and below average waste diversion rates. The findings of this study send a strong message that it is time to reshape the strategic direction and policies for solid waste management in the MARC SWMD Region. There is no imminent solid waste management crisis unless the basic strategy and policy direction of the district remain unchanged.

There are several issues that the MARC SWMD needs to deal with. For example, almost 87 percent of solid waste disposal in the MARC region is in Kansas landfills. Diversion of solid waste for recycling is below the national average across the entire eight county region.

Perhaps most compelling is the fact that many cities and counties on both sides of the state line have not acted to establish more cost-effective collection and recycling of materials from solid waste, especially where individual households contract for collection and recycling services. The private sector, with some notable exceptions, provides most of the collection, disposal, and diversion in the region, including residential services. This will and should continue into the foreseeable future.

A fundamental and active examination of strategic direction is necessary *now* as well as shaping of policies to make solid waste management more cost-effective and environmentally beneficial to the citizens, businesses/institutions, and governments of the region.

Here are the key strategic policies for MARC SWMD, as the principal planning agency, to pursue now.

- Regionalization means bringing Kansas counties and cities into the MARC Solid Waste Management District. To do so, MARC SWMD will have to provide services to attract Kansas counties and cities. This is essential and will require involvement of the full MARC Board. The SWMD's role will be to take the first step to establish stronger working relationships with state, county, and city governments and agencies outside the MARC SWMD. Also, other stakeholders such as private sector solid waste management companies, local recyclers, and not-for-profit organizations will need to be involved. In this way, the services that will attract participation in the SWMD can be defined clearly. Then, true regionalization can be developed.

- Good data provides the foundation on which good planning and policy is grounded. To overcome some significant deficiencies MARC SWMD should establish and provide an ongoing regional database on solid waste management as one of its key services.
- Proactive government policies, programs, and practices must be stimulated, especially for residential waste collection and curbside recycling. Local governments should contract with private haulers where individual services are dominant. MARC SWMD should provide assistance.
- MARC SWMD should encourage all cities and counties to be more active in solid waste management and recycling of residential wastes.
- Recovery of materials such as lumber and concrete from C&D landfills is almost nonexistent in the region. MARC SWMD must provide leadership if diversion is to grow.
- Landfill capacity will decline significantly in the next decade and will need to increase over the next ten years, especially in Missouri. There are only two options: encourage new landfill capacity in the region; or move it out of the region by establishing transfer stations, mindful that siting new landfills is no more popular out of the region than in.
- Partnerships in solid waste management education are vital, and MARC SWMD already has invested in a number of successful partnerships. The SWMD should continue to explore new and innovative educational possibilities.
- Funding is essential. Current programs, e.g., grants, need to be curtailed somewhat, while establishing a joint power agreement across state lines. A small per capita fee appears to be the most effective at the county level. A fee of 30¢ per person per year would generate over \$520,000 per year, if all counties participated.
- MARC SWMD should explore the development of a regional Solid Waste Management Authority that provides bistate oversight of solid waste management. The study should include various models that are already in place, with the ultimate goal of more diversion and lesser dependence on disposal facilities.

**EXECUTIVE SUMMARY
OBSERVATIONS AND POLICY RECOMMENDATIONS**

The observations and policy recommendations in this document are derived from a report prepared for the Mid-America Regional Council Solid Waste Management District (SWMD) by Franklin Associates, a Division of ERG. The full report includes extensive data and analyses of current and projected solid waste management in the Region, as well as information on emerging markets for recovered materials, emerging technologies, and funding strategies.

In this summary document, the findings and observations of the report are presented in a condensed format. Franklin Associates developed policy recommendations based on these findings for consideration by the SWMD.

Current Solid Waste Management and Facilities in the Region

Observations

Transfer and Disposal Facilities. Transfer and disposal facilities in the MARC region are summarized in Table ES-1. Municipal solid waste landfills dispose of most of the

**TABLE ES-1
REGIONAL SOLID WASTE TRANSFER AND DISPOSAL FACILITIES
(Number of facilities and tons managed, 2002)**

	<u>Missouri (1)</u>		<u>Kansas</u>		<u>Managed in the Region</u>	
	No.	Tons	No.	Tons	No.	Tons
Transfer stations (2)	3	100	4	110,130	7	110,230
MSW landfills	2	371,520	2	1,988,500	4	2,360,020
C&D landfills (3)	1		12	377,650	13	377,650
Industrial waste landfills (4)	4	na	4	14,570	8	14,570
Waste tire facilities			5	7,640	5	7,640
Medical waste incinerator			1	3,320	1	3,320
HHW facilities (5)	2	570	5	360	7	930

na = not available

(1) Number of Missouri facilities includes proposed facilities. Tonnage data incomplete for Missouri.

(2) One Missouri transfer station is proposed. Missouri transfer station tonnage only includes waste crossing state lines.

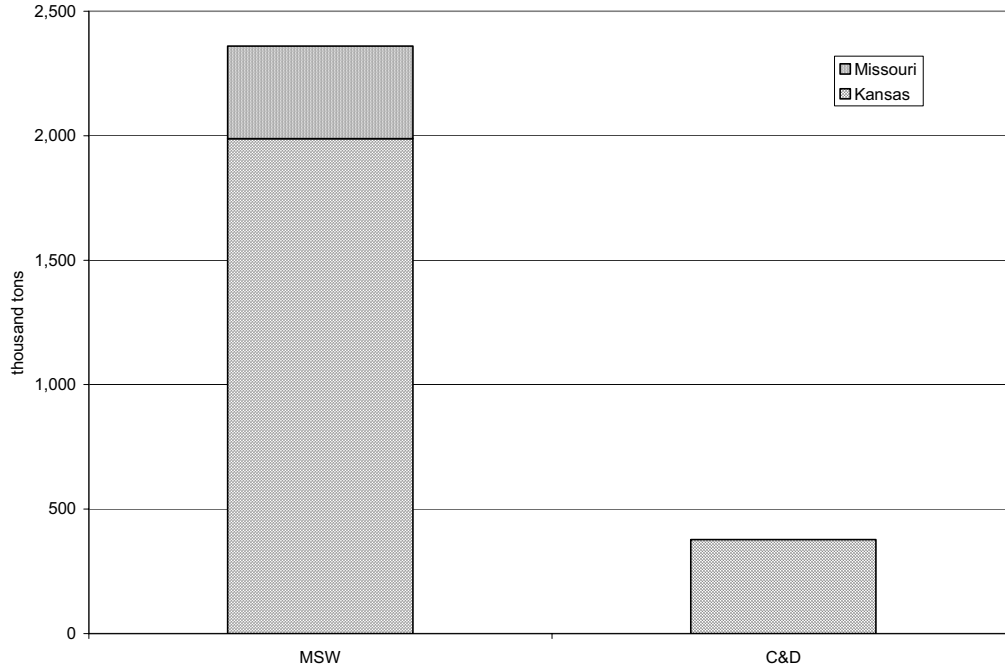
(3) Missouri C&D landfill is proposed.

(4) Industrial landfills or special use landfills. Two industrial landfills are proposed in Missouri.

(5) HHW - household hazardous waste

solid waste tonnage in the region. Solid waste disposed in MSW and construction and demolition (C&D) landfills – the landfills that dispose of most of the tonnage in the region – is shown graphically in Figure ES-1. Kansas dominates in both number of facilities and tons disposed.

Figure ES-1. Solid waste disposed in MSW and C&D landfills, 2002



Because of the large disparity in Kansas and Missouri disposal facilities, over 630,000 tons of Missouri wastes were disposed in Kansas in 2002 (Table ES-2).

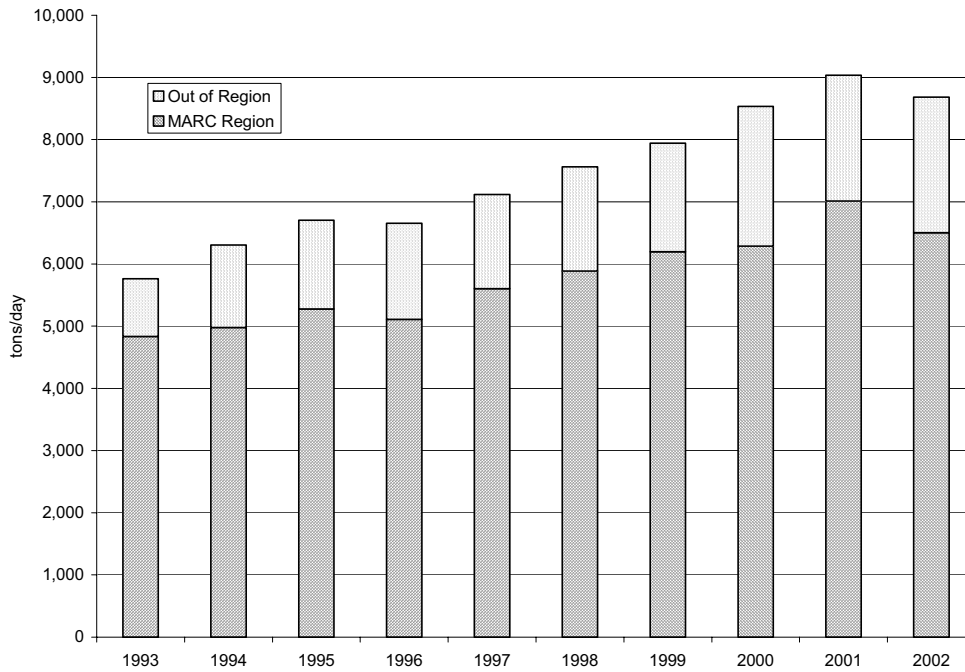
**TABLE ES-2
MISSOURI WASTE DISPOSED IN KANSAS FACILITIES
In 2002 tons**

	From MARC SWMD	From Outside SWMD	Total
Municipal solid waste	384,440	92,800	477,240
Construction & demolition waste	53,420	590	54,010
Special wastes	63,910	970	64,880
Tires	11,750	22,210	33,960
Industrial wastes*	90	90	90
Total	513,520	116,660	630,180

*Some industrial wastes are included in the special waste category and not reported separately.

Historical tonnage of MSW landfilled in the MARC region plus four facilities not far from the region is shown in Figure ES-2. Tonnage disposed has grown steadily, except for a decrease in 2002.

Figure ES-2. Historical landfill tonnage



Data on projected lifespans of landfills in the region are shown in Table 3. It is apparent that landfill capacity will be limited in the future, especially on the Missouri side.

**TABLE ES-3
LIFESPANS OF MSW LANDFILLS IN AND AROUND THE MARC REGION**

Landfill	State	MARC Region	Life Span
City of Lee's Summit	MO	In	2014
Courtney Ridge	MO	In	2026
Show Me Regional	MO	Out	2043
St. Joseph	MO	Out	2028
Forest View	KS	In	< 2 years
Hamm	KS	Out	2141
Johnson County	KS	In	2027

Diversion Facilities. Diversion facilities identified for this report include reuse, recycling, composting, and end users of recovered materials. Collectors and brokers/dealers for recovered materials may or may not have facilities where the materials are taken, but they were included when identified.

Diversion facilities identified in the Region are shown in Table ES-4. The majority of the facilities are in Missouri.

**TABLE ES-4
REGIONAL SOLID WASTE DIVERSION FACILITIES**

	Missouri	Kansas	Total
Collectors	19	11	30
Dealers/Processors/Packers	23	16	39
Composters	7	2	9
End Users	6	1	7
Reusers	15	2	17
Other	1	2	3
Total	<u>71</u>	<u>34</u>	<u>105</u>

The facilities accept a wide range of materials, including paper and paperboard, plastics, glass, metals, wood, textiles, yard waste, tires, appliances, and others.

Data Gaps

Several instances of incomplete data on solid waste management facilities in the Region were identified:

- Since Kansas counties and cities are not members of the SWMD, details on their collection and recycling is incomplete.
- Sixteen hauling companies did not respond to the data gathering effort.
- Tonnage data for all Missouri facilities are not available through a state agency.
- No data were available for Kansas waste tire and transfer facilities.
- There is lack of detail on waste origin for Missouri facilities. For Kansas, detail is available on the state of origin, but not the community.
- Data on special waste disposed at landfills is not available in Missouri.
- Kansas and Missouri state agencies do not track diversion facilities, except for those requiring permits; therefore it is likely that all facilities were not identified.

Policy Recommendations

- Proactive government policies, programs, and practices must be stimulated, especially for residential waste collection and curbside recycling. Local governments should contract with private haulers where individual services are dominant. MARC SWMD should provide assistance.
- MARC SWMD should support the location of transfer station(s) as landfill capacity reaches its limits, especially in Missouri. This suggests that landfill capacity will move out of the region in the next decade.
- MARC SWMD should support siting of environmentally sound disposal sites, including construction and demolition landfill sites, by the private sector in Missouri. This is not a popular subject to promote, but reality is that much of the solid waste generated will continue to be disposed in landfills, and without an alternative, more and more Missouri solid waste will go to Kansas landfills.
- MARC SWMD should establish and provide an on-going regional database as a service to the region. Assistance can be derived from Missouri DNR, Kansas DHE, Kansas counties in the region, and perhaps others.

Municipal Solid Waste Generation, Recovery, Source Reduction, and Disposal in the Region

Observations

For this report, diversion is defined as source reduction, recycling, and composting. Reuse is a temporary diversion option. Generation equals diversion plus discards (e.g., disposal). Generation, recovery, and discards of municipal solid waste (MSW) and construction and demolition (C&D) debris in the Region in 2002 are shown in Table ES-5. The recovery rate for municipal solid waste in the region – including source reduction of yard wastes – was estimated at 28 percent in 2002.

Details on generation and recovery of individual items in the waste streams (e.g., newspapers) are included in the full report.

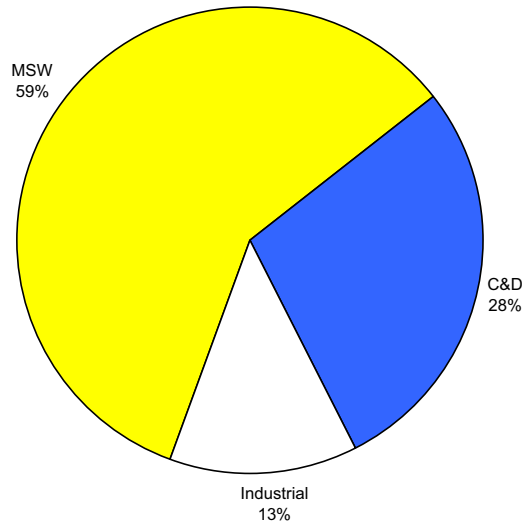
Generation of industrial process wastes in the Region was estimated to be 373, 240 tons in 2001, although data are incomplete. Figure ES-3 shows the relative importance of MSW, C&D debris, and industrial process wastes in the Region. Recovery of industrial wastes was not identified.

**TABLE ES-5
GENERATION, RECOVERY, AND DISCARDS OF MSW AND C&D DEBRIS
IN THE MARC REGION, 2002**

	tons/%	lb/person/day
Municipal Solid Waste		
Generation	1,701,430	5.35
Recovery*	468,070	1.47
Recovery percentage	28%	
Discards	1,233,360	3.88
Construction & Demolition Debris		
Generation	812,360	2.55
Recovery	380	0.00
Discards	811,980	2.55
Totals		
Generation	2,513,790	7.90
Recovery	468,450	1.47
Discards	2,045,340	6.43

* Includes source reduction (yard waste). Excluding yard waste, recovery equals 19%.

Figure ES-3. Generation of wastes in the region



Data Gaps

A number of data gaps were identified when collecting these data:

- Durable good (e.g., tires, appliances) were not identified as separate line items.
- Construction and demolition debris is not specified by source, e.g., residential or commercial.
- Available data on disposal of industrial wastes are not broken down by type of industry.
- Separate generation data for wastes from wastewater treatment plants, drinking water treatment plants, or electrical power generators were not available.

Policy Recommendation

- MARC SWMD should establish and provide an on-going regional solid waste database as a service to the region. This database would make possible better analysis of the status of waste management in the region. Assistance can be derived from Missouri DNR, Kansas DHE, Kansas counties in the region, and perhaps others.

Projections of Solid Waste Quantities in the Region

Regional municipal solid waste generation was projected to 2013 – a ten-year planning frame. The results are summarized in Table 6. Projections by product (e.g., plastic bottles) are shown in the detailed report.

**TABLE ES-6
PROJECTED WASTE GENERATION IN THE MARC REGION, 2002 AND 2013**

	2002		2013	
	tons	lb/person/ day	tons	lb/person/ day
Municipal Solid Waste	1,701,430	5.35	2,036,350	5.74
Construction & Demolition Debris	812,360	2.55	948,010	2.67
Industrial Waste*	373,240	22.94	468,130	22.94
Total	2,513,790		2,984,360	

* lb/employee/day

Generation of MSW and C&D debris are projected to increase both in tonnage and in pounds per person per day. Not enough data were available to project an increase in industrial waste in pounds per employee per day.

Waste Management, Markets, Technologies, and Funding Strategies

Observations

Waste Management Trends. Nationally, two important trends for ***collection*** of wastes were identified:

- Single-stream collection of recyclables. In this method, recyclables are generally collected commingled in a single container. There is a trend toward eliminating glass from this collection.
- Pay-as-You-Throw (PAYT). Also called unit-based pricing, this means that users pay based on the amount of waste picked up. There are a number of variations on this method.

For ***diversion*** (source reduction or recycling/composting), the following trends were identified and discussed:

- Increased collection and diversion of electronics. Programs for diverting electronics from disposal keeps potentially harmful components out of landfills.
- Decline in collection and diversion of glass. Collection of glass containers is being made more difficult by the trend toward single-stream collection, eliminating glass.
- Increased diversion of C&D debris from disposal. A number of programs for diverting the many materials in C&D debris were identified. Some of the significant components of C&D such as lumber and concrete are growing in recovery in other areas. There is a significant amount of regional diversion ahead of delivery of C&D materials to disposal sites, for example, bricks, doors, windows, and fixtures.

Detailed discussions of these trends, along with their pros and cons, are included in the full report.

Market Trends. Markets for the following recovered materials were analyzed:

- Glass. The traditional market for recovered glass containers has been manufacture of new containers. For this region, the drawback to this market has been long transportation distances for collected containers. Fiberglass manufacture was identified as an alternative.
- C&D Debris. Some emerging trends were identified for marketing the various components of C&D debris. Many are still in the experimental stage.

Detailed discussions of these trends, along with their pros and cons, are included in the full report.

Processing Technologies. The following innovative and alternative processing technologies were identified and discussed:

- MSW composting
- Gasification
- Waste-to-ethanol
- Depolymerization

These technologies apply to the organic portions of the waste streams. Detailed descriptions are included in the full report and its appendices. Of these technologies, gasification is in the most advanced stages of development. The conclusion was that at this time, the risk to a public entity in pursuing a large-scale, innovative project is unreasonably high.

Funding Strategies. A survey of other regional organizations was conducted to develop a list of funding strategies used by others. The most common funding mechanisms identified were:

- User fees from solid waste facilities owned by the organization
- Disposal fees on solid waste disposed in member cities/counties' solid waste facilities
- Generation (origination) fees on solid waste disposed in regional and nonregional facilities receiving solid waste that originated within the organizations' boundaries
- Member cities/counties association fees
- State grants

Detailed descriptions of the funding mechanisms as practiced by the identified organization are included in the full report.

Policy Recommendations

Waste Management Trends

- MARC SWMD should encourage all cities and counties to be more involved in solid waste management, especially diversion, not only of residential waste, but of other sources as well.

Market Trends

- MARC SWMD should be more aggressive in encouraging the private sector to develop:

- Reuse and recycling of wood wastes (lumber, trees, etc.) and concrete
 - Composting of organics such as food wastes
 - Co-composting of wastewater treatment sludge (biosolids) and yard waste
- MARC SWMD should continue to encourage a limited feasibility study of recycling glass in the region, with focus on how to collect glass containers in the absence of sufficient curbside collection programs and the presence of single-stream collection that excludes glass.

Emerging Technologies

- MARC SWMD should monitor emerging technologies, but wait for the private sector to demonstrate commercial development and cost effectiveness

Funding Strategies

- The first policy approach to be explored should be the per capita fee in conjunction with an intergovernmental agreement approach.
- An intergovernmental agreement should be explored as a funding mechanism.
- MARC SWMD should explore origination fees only if other options are not feasible.

Broad Policy Recommendations

Certain policy recommendations based on the data in this report are broad in scope. They are:

- Regionalization means bringing Kansas counties and cities into the MARC Solid Waste Management District. To do so, MARC SWMD will have to provide services to attract Kansas counties and cities. This is essential and will require involvement of the full MARC Board. The SWMD's role will be to take the first step to establish stronger working relationships with state, county, and city governments and agencies outside the MARC SWMD. Also, other stakeholders such as private sector solid waste management companies, local recyclers, and not-for-profit organizations will need to be involved. In this way, the services that will attract participation in the SWMD can be defined clearly. Then, true regionalization can be developed.

- MARC SWMD should explore the development of a regional Solid Waste Management Authority that provides bistate oversight of solid waste management. The study should include various models that are already in place, with the ultimate goal of more diversion and lesser dependence on disposal facilities.

- Partnerships in solid waste management education are vital, and MARC SWMD already has invested in a number of successful partnerships. The SWMD should continue to explore new and innovative educational possibilities.

INTRODUCTION

Purpose of the Study. The purpose of the solid waste management report is to provide a working document for the Mid-America Regional Council Solid Waste Management District (MARC SWMD). The report tasks include:

Task 1. Project Initiation

Task 2. Current solid waste management in the MARC region

- Regional services, collection, processing and disposal facilities
- Quantity estimates of solid wastes generated, diverted and disposed in 2002

Task 3. Estimated projections of solid waste quantities to 2013

Task 4. Emerging solid waste management trends, markets and technologies

Task 5. Policy recommendations to guide future planning and decision-making over a ten-year planning horizon.

This solid waste management report will provide data analyses and recommendations that the SWMD may utilize in developing an updated regional solid waste management plan.

Geographical Area. The MARC SWMD serves as a regional solid waste planning agency for the local governments in Cass, Clay, Jackson, Platte and Ray counties on the Missouri side of the Kansas City metropolitan area. The district encourages the development of local and regional waste reduction, reuse and recycling programs.¹ This report addresses solid waste management in the five SWMD counties as well as Johnson, Leavenworth and Wyandotte counties on the Kansas side of the Kansas City metropolitan area.

TASK 1. PROJECT INITIATION

MARC SWMD contracted with Franklin Associates, A Division of Eastern Research Group (ERG) in June 2003. The MARC SWMD and ERG held a project initiation meeting to determine the final scope of work and discuss available information resources and data. Alternative Resources, Inc. (ARI), as a subcontractor to ERG, assisted with Task 4 Emerging solid waste management trends. ARI addressed emerging solid waste process technologies.

¹ <http://www.marc.org/environment/swmd.htm>

DEFINITION OF TERMS

Municipal solid waste (MSW) includes durable goods (excluding vehicles and other moving equipment), nondurable goods, containers and packaging, food scraps, yard waste and miscellaneous inorganic wastes from **residential** (single- and multi-family households) and **non-residential** (commercial, institutional and industrial) sources. MSW does not include construction and demolition debris, vehicle bodies, municipal biosolids, combustion ash, industrial process wastes, and trees and brush from parks, streets or power line trimmings that might also be disposed in municipal waste landfills or combustion units.

Solid Waste includes MSW and non-MSW wastes. Some examples of non-MSW include construction and demolition debris (C&D), municipal wastewater treatment plant biosolids, and industrial process solid wastes.

Household Hazardous Waste (HHW) is unwanted household products labeled as flammable, toxic, corrosive, or reactive. Some common HHW products include antifreeze, fertilizers, poisons, grease and rust solvents, and latex and oil based paints.

Integrated Solid Waste Management is the complementary use of a variety of practices to handle municipal solid waste safely and effectively. Integrated waste management techniques include source reduction, recycling, composting, combustion, and landfilling.

Diversion of materials from disposal may be accomplished through source reduction and recycling (including composting).

Source reduction activities reduce the amount or toxicity of wastes before they enter the solid waste management system. Reuse of products such as refillable glass bottles, reusable plastic food storage containers, or refurbished wood pallets are examples of source reduction. Management of yard waste at home is another example that has a substantial effect on reducing the amount of waste generated.

Reuse involves the use of a product more than once in its same form for the same purpose or for different purposes, such as reusing a coffee can as a storage container.

Generation refers to the amount of materials and products that enters the solid waste stream before recycling (including composting), landfilling, or combustion takes place.

Recovery of materials, as referred to in this report, means removing certain materials/products from the waste stream for the purpose of recycling (including composting).

Discards include the solid wastes remaining after recycling and composting. These discards are usually combusted or disposed of in landfills, although some solid waste is littered, stored, or disposed on site.

TASK 2. CURRENT SOLID WASTE MANAGEMENT IN THE MARC REGION

2.1. Regional Services, Collection, Processing and Disposal Facilities

2.1.1. City Services

The following city services information was compiled by MARC SWMD staff from the MARC SWMD 2002 Assessment Inventory. The biannual assessment inventory is required by the Missouri Department of Natural Resources (DNR) to evaluate the district's progress in meeting the goals of the district's solid waste management plan. Each member county and city provides current information on residential and commercial solid waste collection services, recycling services, yard waste management, and the management of banned items. The SWMD grant funding is contingent on the submission of the updated assessment inventory. The latest inventory compiled information for the calendar year 2002.

Of the 49 Missouri communities listed in Table 1, 65 percent have access to recycling (curbside and/or drop-off) and 85 percent have access to some type of yard waste recovery program. The Kansas community data is less complete. Twelve of the 27 communities, or 44 percent, have no data listed. Ninety-three percent of the communities with data (14 of 15 communities) have access to some sort of recycling program. Only five of the 15 have yard waste collection or drop-off service. (Access does not imply participation).

Incomplete Data-Table 1. Since Kansas counties and cities are not SWMD members, they are not required to complete assessment inventories. All Kansas counties and cities, in the Kansas City metro area, have solid waste collection service and most have recycling options. The detail of these services has been identified as a data gap.

The assessment inventory tool could be expanded to query counties and cities on the quantities of solid waste collected for disposal, processing, and recovery. The flow of solid wastes collected should also be recorded to allow for cross checking of data and to avoid double counting.

There are 5 additional Missouri communities that MARC has identified as having reached the 500 population mark that need to be formally invited to join the SWMD.

*Strategic Directions and Policy Recommendations for
Solid Waste Management In The Bistate Kansas City Metropolitan Region*

**TABLE 1
RESIDENTIAL MUNICIPAL SOLID WASTE SERVICES (1)**

Regional Missouri Communities	Residential MSW Services		Facilities used (2)	Recycling Services		Yard waste		HHW Program
	Private	City Contract		drop-off (3)	curbside	drop-off	curbside	
Unincorp. Cass Co.	X		LS, CR, OTS, MC					
Archie		X	LS		contracts	year round		
Belton	X		LS, CR, D, W		available	2 x year	available	X
Cleveland		X	D		contracts		bi monthly	X
Drexel	X		LS, CR, W, OTS, MC				weekly	
Garden City	X		LS, W			frequent		X
Harrisonville		X	LS, CC		contracts		weekly	
Lake Winnebago		X	LS		contracts		weekly	X
Peculiar		X	D			2 x year	available	
Pleasant Hill	X		LS, CR, D, W	X			available	X
Raymore	X		CR, FV, D, LS		available		available	X
Unincorp. Clay Co.	X		D, CR, FV			1 x year		X
Avondale	X		D					
Claycomo		X	CR		available		available	
Excelsior Springs		X	FV, CR	X			2 x year	X
Gladstone	X		CR, FV, D		available	2 x year	available	
Glenaire	X		CR, D			1 x year		X
Kearney		X	D	X	contracts	every weekend		X
Liberty		X	CR, FV	X	contracts		2 x year	X
North Kansas City		X	FV		contracts		Fall only	X
Pleasant Valley	X		FV, D, CR				1 x year?	
Smithville		X	D	X			2 x year	X
Unincorp. Jackson Co.	X		D, CR, W	X	available		available	X
Blue Springs	X		CR, LS, D		available		available	X
Buckner	X		LS, CR				available	
Grain Valley	X		CR, LS, W	X		1 x year		X
Grandview	X		CR, LS, D		available	6 x year	available	
Greenwood	X		D, W, LS				available	X
Independence	X		CR, LS, D	X	available	9 x year	available	X
Kansas City		X	CR, D, FV	X		every weekend	available	X
Lake Lotawana	X		LS, CR, RQ		available	periodically	available	X
Lake Tapawingo		X	D		available		available	X
Lee's Summit	X		CR, LS, D	X	available	daily	available	X
Oak Grove	X		CR, W					X
Raytown	X		LS, CR, D	X	available		available	
Sugar Creek		X	CR		city	12 x year	bi-weekly	X
Unincorp. Platte Co.	X		D			2 x year	available	
Edgerton		X	CR	X				
Lake Waukomis	X		FV, CR		available		available	X

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**TABLE 1 (continued)
RESIDENTIAL MUNICIPAL SOLID WASTE SERVICES (1)**

Regional Missouri Communities	Residential MSW Services		Facilities used (2)	Recycling Services		Yard waste		HHW Program
	Private	City Contract		drop-off (3)	curbside	drop-off	curbside	
Parkville	X		FV, D		available	2 x year	available	X
Platte City		X	LTS	X	city	weekly	weekly	X
Riverside		X	D		contracts	2 x year		X
Weatherby Lake		X	D			1 x year	available	X
Weston		X	D	X		daily		
Unincorp. Ray Co.	X		CR, D, W					
Hardin	X		W			periodically		
Lawson		X	D					
Orrick	X		W					X
Richmond	X		W			weekly		X

Regional Kansas Communities	Residential MSW Services		Facilities used (2)	Recycling Services		Yard waste		HHW Program
	Private	City Contract		drop-off (3)	curbside	drop-off	curbside	
Unincorp. Johnson Co.								JO Co.
De Soto		X				X		JO Co.
Edgerton								JO Co.
Fairway	Homeowners Association's do the contracts, includes curbside yard waste and recycling							JO Co.
Gardner	X				available		available	JO Co.
Lake Quivira								JO Co.
Leawood	Homeowners Association's do the contracts, includes curbside recycling							JO Co.
Lenexa	Individuals or Homeowners Association's do the contracts, includes curbside recycling							JO Co.
Merriam								JO Co.
Mission								JO Co.
Mission Hills								JO Co.
Olathe		City owned	H	X	City provides		City provide	JO Co.
Overland Park	Individuals or Homeowners Association's do the contracts, includes curbside recycling							JO Co.
Prairie Village		X			contracts		contracts	JO Co.
Roeland Park								JO Co.
Shawnee					contracts			JO Co.
Spring Hill			D, H					JO Co.
Westwood								JO Co.
Unincorp. Leavenworth Co.								LV Co.
Basehor								LV Co.
Lansing								LV Co.
Leavenworth				X				LV Co.
Tonganoxie				X				LV Co.
Wyandotte County								WY Co.
Bonner Springs				X				WY Co.
Edwardsville				X				WY Co.
Kansas City				X				WY Co.

(1) MARC SWMD 2002 Inventory Assessments. Provided by MARC SWMD staff.

(2) FACILITIES

LS = Lee's Summit

W = Warrensburg

CR = Courtney Ridge

CC = Cass Co. Transfer Station

FV = Forest View

OTS = Olathe Transfer Station

LTS = Leavenworth Transfer Station

D = Deffenbaugh

RQ = Reno Quarry

H = Hamm Landfill

MC = Miami County

(3) An X in "Drop -off" recycling indicates city or county manages the center.

2.1.2. Solid Waste Haulers

As shown in Table 2, sixty-three solid waste haulers serve the MARC region. This information was compiled from the MARC 2002 Assessment Inventories, and the Southwestern Bell Yellow Pages. The service classifications are residential, commercial,

and special handling. Examples of special handling include roll off containers and yard waste collection.

Based on the haulers that provided data, at least four collect in all three service areas (residential, commercial and special handling). Twelve haulers (19 percent of the respondents) collect residential and commercial. Five haulers serve commercial and special handling markets, two haulers serve the commercial sector, and 21 haulers only serve the special handling market. This latter group of haulers represents one-third of the haulers that responded. No service data is known for 16 hauling companies.

Incomplete Data-Table 2. Sixteen hauling companies did not respond to the data gathering effort. This represents 25 percent of the solid waste haulers. In addition to this missing hauler service data, individual hauling company market share is unknown. This confidential information, which would be difficult for MARC to obtain, would provide insight into any consolidation within the solid waste hauling industry. Consolidation is a result of economic pressure to be more cost effective. Finally, it is likely that some consolidation already exists because ownerships may have changed but the original company name retained.

**TABLE 2
RESIDENTIAL, COMMERCIAL AND SPECIAL WASTE HAULERS (1)**

Company	Service (2)		
	Residential	Commercial	Special Handling
Teds Trash Service	x	x	x
Thomas Disposal	x	x	x
AAA Disposal Service	x	x	
BFI	x	x	x
Deffenbaugh	x	x	x
Envirostar Waste Services	x	x	
Hyden Hauling	x	x	
Mr. Trash	x	x	
Steve Haller Disposal	x	x	
Summit Disposal	x	x	
Town and Country Disposal	x	x	
Waste Corporation of America	x	x	
Bill Corum Trash Service	x		
City of Kansas City - municipal services	x		
City of Olathe - municipal services	x		
City of Platte City - municipal services	x		
City of Sugar Creek - municipal services	x		
Countryside Disposal	x		
Flynn's Raytown Disposal	x		
L & K Disposal	x		
Lawn-Corps Curbside Recycling	x		
Matthy's Hauling	x		
North Kansas City Hauling	x		

**TABLE 2 (continued)
RESIDENTIAL, COMMERCIAL AND SPECIAL WASTE HAULERS (1)**

Company	Service (2)		
	Residential	Commercial	Special Handling
Willey Disposal		x	x
Blackshear		x	
Roll Off Service		x	
A Quik Dump			x
Al's Hauling and Cleanup			x
Bambi Container Service			x
Bill & Son Hauling and Cleanup			x
Buck and Sons Hauling and Cleanup			x
Chris & Sons Hauling			x
Clarks General Hauling			x
Constable Harry Trash Service			x
Constable Roll-off Container Service			x
Contractors Recycling			x
D & S Hauling			x
David's Hauling & Cleanup			x
Dependable Hauling			x
Harvey Environmental			x
Haul & Clean			x
Joe's Box Midsize Roll off Containers			x
Kansas City Disposal			x
KC Waste Containers Inc			x
King's Disposal and Container Service			x
Steve's General Hauling			x
Todd Parker's Hauling and Moving			x
Countryside Recycling (3)			
Environmental Specialists (3)			
GW Trash (3)			
Hickman Disposal Service (3)			
J & F Disposal (3)			
Jim's Disposal Service (3)			
KC Hook (3)			
Liberty Services (3)			
Premier Equipment Inc. (3)			
RC Sanitation (3)			
Recycled Wood Products (3)			
Refuse Service (3)			
Rex Constable Trash Hauling (3)			
Robert's Hauling (3)			
Stewart Hauling (3)			
Sunshine Disposal (3)			

(1) MARC staff, 2002 Assesment Inventories, Southwestern Bell Yellow Pages

(2) Examples of special hauling services include roll off containers and yard waste collection service.

(3) Information not available.

2.1.3. Regional Facilities

Transfer and Disposal Facilities

After collection, the haulers take MSW to a transfer facility or directly to a processing or disposal facility. Tables 3 through 6 summarize the transfer and disposal facilities in the MARC region. Table 3 is a tabulation of these facilities. Table 4 shows the quantities, where available, passing through or being disposed of in 2002 in these same facilities. Appendix tables A-1 through A-5 show the detail summarized in Tables 3 and 4. Tables 5 and 6 provide additional detail on Kansas disposal facilities.

Through state permitting processes, both Missouri and Kansas track the solid waste facilities in the region. Missouri DNR and KDHE publish the list of permitted facilities on their department websites.² There are seven transfer stations in the region and 4 MSW Landfills. Twelve of the 13 construction and demolition landfills (C&D) are on the Kansas side of the state line. The thirteenth C&D landfill is a proposed site in Missouri. The only permitted incinerator in the region is a medical waste incinerator in Kansas City, Kansas. Five of the seven household hazardous waste (HHW) facilities are located in Kansas. The largest HHW facility is a regional facility located in Kansas City Missouri that serves residential customers from member counties and law enforcement customers from both sides of the state line.

Household hazardous waste (HHW) facilities have historically been considered collection points for disposal, but recently there have been increased efforts to reuse or recover as much HHW as possible. Details on the HHW programs in the region are discussed separately in this section.

MARC SWMD staff compiled the tonnage data shown for the Missouri facilities in Table 4 by contacting the individual facilities. Missouri DNR does not track this information for all permitted facilities. The Kansas facility tonnage data were obtained from the KDHE solid waste facilities database³ with the exception of the HHW facility data. A KDHE annual report⁴ provided the tons collected by the Kansas HHW facilities. This report is available in hard copy from KDHE.

A small portion of the discarded regional MSW passes through transfer stations. The MSW shown at Kansas transfer stations is being disposed of in the Hamm Landfill located in Jefferson County, Kansas. Most MSW is direct hauled to the regional MSW landfills. The quantity of MSW shown disposed in regional landfills also includes non-MSW waste streams. MSW landfills accept C&D debris, industrial waste, and other special wastes. Kansas has one regional tire monofill in Leavenworth County.

² <http://dnr.state.mo.us/alpd/swmp/homeswmp.htm>; <http://www.kdhe.state.ks.us/waste/index.html>

³ <http://www.kdhe.state.ks.us/waste/index.html>

⁴ Kansas Household Hazardous Waste Program. Report to the Legislature. SFY-2002.

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**TABLE 3
REGIONAL SOLID WASTE TRANSFER AND DISPOSAL FACILITIES (1)**

State	County	Transfer Station (number)	MSW Landfill (number)	C&D Landfill (number)	Industrial Landfill (2) (number)	Waste Tire Facility (3) (number)	Incinerator (4) (number)	HHW Facility (number)
Missouri								
	Cass	2						
	Jackson (5)(6)	1	2	1	4			2
Kansas								
	Johnson	2	1	6	1	1		2
	Leavenworth (7)	1		6		3		2
	Wyandotte (8)	1	1		3	1	1	1
Regional Total		7	4	13	8	5	1	7

C&D = Construction and demolition.

HHW = Household hazardous waste.

(1) Missouri DNR website and KDHE solid waste facilities database.

(2) Industrial landfills or special use landfills.

(3) Tire transport, processing, or disposal.

(4) Medical waste incinerator.

(5) One C&D landfill is proposed. One transfer station is proposed.

(6) Two of the industrial landfills are proposed.

(7) Transfer station and composting facility are combined.

(8) An active permit is maintained on the transfer station. Currently this facility is not being used.

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**TABLE 4
REGIONAL SOLID WASTE TRANSFER AND DISPOSAL FACILITIES 2002 QUANTITIES (1)**

State	County	Transfer Station (tons)	MSW Landfill (tons)	C&D Landfill (tons)	Industrial Landfill (2) (tons)	Waste Tire Facility (3) (tons)	Incinerator (4) (tons)	HHW Facility (tons)
Missouri								
	Cass	100						
	Jackson (5)(6)		371,520		na			566
Kansas								
	Johnson	83,120	1,611,130	371,639				189
	Leavenworth (7)	27,013		6,013		7,638		68
	Wyandotte (8)		377,374		14,569		3,321	103
Regional Total		110,233	2,360,024	377,652	14,569	7,638	3,321	926

na = not available

C&D = Construction and demolition.

HHW = Household hazardous waste.

(1) MARC data. KDHE solid waste facilities database and Kansas Household Hazardous Waste Program. Report to the Legislature. SFY - 2002. Data not available for some facilities. Missouri transfer station data only represent waste transferring across state lines.

(2) Industrial landfills or special use landfills.

(3) Tire transport, processing, or disposal. Tonnage data = tons disposed in a monofill.

(4) Medical waste incinerator.

(5) One C&D landfill is proposed. One transfer station is proposed.

(6) Two of the industrial landfills are proposed.

(7) Transfer station and composting facility are combined.

(8) An active permit is maintained on the transfer station. Currently this facility is not being used.

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Incomplete Data-Tables 3 and 4. Missouri solid waste facility tonnage data are not available through a single source. To obtain information, individual facilities have to be contacted. Although KDHE tracks waste disposed in most types of facilities listed in Table 4, no data were available for Kansas waste tire transfer and processing facilities.

The KDHE solid waste facility database includes detail on waste origin by state and waste type of waste disposed in Kansas landfills. Table 5 shows this detail for Missouri waste disposed in Kansas facilities. The database does not distinguish between waste coming from inside the MARC region and waste coming from outside of the region. The Kansas facilities accepting Missouri waste were contacted to determine the waste origin by county. The tons received from Missouri are shown in the table as well as the tons from all sources (Kansas, Missouri, and other states).

An estimated 21 percent of the total waste disposed in the Kansas facilities (shown in Table 5 part A) was from within the MARC region. By weight, the Johnson County Landfill accepts the most MARC regional MSW. Although the waste classification is MSW, this quantity also includes C&D, industrial/special waste, and tires.

The waste entering the other three Kansas facilities shown on Table 5 part B originated from Missouri outside of the MARC region. The Oak Grove facility accepts MSW from southwest Missouri.

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TABLE 5
KANSAS DISPOSAL FACILITIES ACCEPTING MISSOURI SOLD WASTE

Region	Type	Missouri					Total (tons)	All Sources Total (tons)	% Missouri
		MSW (tons)	C&D (tons)	Special (tons)	Tires (tons)	Industrial (tons)			
A. Facilities that Accept Missouri Waste From MARC SWMD									
Forest View in MSW									
	Total 2002	83,184	0	1,555	0	0	84,738	377,374	22%
	Year-to-Date 2003	16,261	0	765	0	0	17,026	94,274	18%
Johnson County Landfill in MSW									
	Total 2002	290,281	53,424	62,353	0	0	406,058	1,611,130	25%
	Year-to-Date 2003	231,515	38,926	41,800	3	0	312,244	778,715	40%
N.R. Hamm out MSW									
	Total 2002	10,975	0	0	0	0	10,975	455,968	2%
	Year-to-Date 2003	3,526	0	0	0	0	3,526	118,546	3%
Holland Corporation in C&D									
	Total 2002	0	0	0	0	0	0	0	0%
	Year-to-Date 2003	0	1,476	0	0	0	1,476	5,205	28%
Duane Becker/Tire Town in									
	Total 2002	0	0	0	4,508	0	4,508	7,638	59%
	1st Qtr 2003	0	0	0	1,045	0	1,045	1,650	63%
Champlin Tire Recycling out									
	Total 2002	0	0	0	7,244	0	7,244	25,170	29%
	1st Qtr 2003	0	0	0	0	0	0	2,261	0%
Missouri Waste from MARC SWMD Disposed in Kansas Facilities 2002		384,440	53,424	63,908	11,752	0	513,524	2,477,280	21%
B. Facilities that Accept Missouri Waste From Outside Of The MARC SWMD									
Oak Grove out MSW									
	Total 2002	92,799	0	973	0	0	93,772	131,459	71%
	Year-to-Date 2003	32,098	0	395	0	0	32,493	44,357	73%
B-3 Construction out									
	Total 2002	0	588	0	22,209	0	22,797	45,775	50%
	Year-to-Date 2003	0	87	0	6,878	93	7,058	9,767	72%
Blixt Construction out C&D									
	Total 2002	0	0	0	66	0	66	12,362	1%
	Year-to-Date 2003	0	0	0	0	0	0	2,218	0%

Source: KDHE Solid Waste Facilities Database. <http://www.kdhe.state.ks.us/waste/index.html>
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Incomplete Data-Table 5. Missouri DNR does not require similar detail from the Missouri facilities. Missouri facilities do not have to submit records on waste origin or waste stream type. The only identified data gap in the information shown in Table 5 is the lack of detail on waste origin. KDHE requires that the facilities record the state of origin but not the county, city, or region of the state. For example, the waste shown being disposed from the MARC region into the Johnson County Landfill may be overstated because some of the Missouri waste is probably coming from outside of the region.

Combining data from the KDHE database and data required by Johnson County Environmental, an additional analysis was completed of special waste disposed in the Johnson County Landfill. KDHE requires reporting of total tons special waste disposed in Kansas landfills (detail is not required). Special waste includes a variety of wastes such as industrial waste, contaminated soils and wastewater treatment plant (WWTP) biosolids. Johnson County Environmental requires the Johnson County Landfill to report, in detail, the special waste category. Table 6 combines these two data sources.

Over 34,000 tons WWTP biosolids were estimated landfilled in the Johnson County Landfill in 2002. Twenty-two percent of the WWTP biosolids came from Missouri wastewater treatment plants in the MARC region. A large amount of contaminated soils were also landfilled in Johnson County Landfill. The origin of these soils could not be determined. The Johnson County Environmental report recorded the company disposing of the soil, but the site of soil excavation was not required. The remainder of the special waste came from commercial, industrial, and public sources. This category was too varied to classify by specific waste type.

TABLE 6
ESTIMATED SPECIAL WASTE DISPOSED IN JOHNSON COUNTY LANDFILL

<u>Facility</u>	<u>2002 Tons</u>	<u>Special Waste %</u>	<u>Missouri %</u>
Johnson County Landfill			
WWTP Biosolids (1)(2)	34,076	13%	22%
Contaminated Soil (1)(2)	51,920	20%	unknown
Other Special Waste (3)	173,022	67%	unknown
<i>Total Special Waste</i>	259,017	100%	24%

(1) Johnson County Environmental. 2002 Special Waste Report - JCL.
(2) Assume 1,615 pounds/cu yd dewatered sludge and 2,600 pounds/cu yd contaminated loose soil. Handbook of Solid Waste Properties. CalRecovery, Inc. 1993.
(3) KDHE Solid Waste Facilities Database special waste category for Johnson County Landfill minus estimates from (1)

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Incomplete Data-Table 6. The Johnson County Landfill is the only regional landfill with this level of special waste detail available. The Missouri DNR does not require landfills to report special waste data. The KDHE database only requires total tons special waste disposed per year and the state of origin. The Johnson County Environmental supplemental report addresses special waste disposed in the Johnson County Landfill only.

The KDHE database reports quantities in tons per year. The Johnson County Environmental report lists tons or cubic yards per disposal or per month. Since neither source provided conversion factors, combining the two data sources required assumptions to convert cubic yards to tons.

Disposal Facilities – Historical Tonnage

Table 7 shows landfilled amounts, on a tons/day basis, from 1990 to 2002. The data, provided by Missouri DNR and KDHE, were placed on a 365-day basis to be consistent

with other data presented in this report. It should be noted that landfills may accept waste 5, 5.5 or 6 days per week and are typically closed for some holidays.

The Missouri and Kansas landfills listed are both in as well as out of the MARC region. The tons disposed include all waste types such as MSW, C&D, industrial, special wastes, and WWTP biosolids. The tons also include waste that originated outside of the region.

**TABLE 7
MSW LANDFILL HISTORICAL TONNAGE ALL WASTE TYPES (1)
(tons/day)(2)**

MSW Landfill	MARC		2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
	State	Region													
Central Missouri	MO	Out	330	361	462	297	233	201	211	180	153	130	143	187	68
City of Lee's Summit	MO	In	217	329	306	286	221	208	294	292	245	183	94	85	30
Courtney Ridge	MO	In	801	557	963	1,245	1,147	866	163						
Rumble II	MO	In							464	615	615	753	679	78	2
Show Me Regional	MO	Out	332	339	349	258	195	192	246	287	166				
St. Joseph	MO	Out	271	251	273	308	329	272	277	286	407	387	359	335	86
Southeast	MO	In	36	203	0	225	954	840	955	1,008	1,080	916	923	899	247
Forest View	KS	In	1,034	1,233	881	725	662	542	705	823	621	963	na	na	na
Hamm	KS	Out	1,249	1,071	1,160	883	921	850	813	671	598	411	na	na	na
Johnson County	KS	In	4,414	4,690	4,141	3,716	2,899	3,146	2,530	2,542	2,418	2,022	na	na	na
TOTAL			8,685	9,034	8,534	7,943	7,562	7,117	6,657	6,703	6,304	5,763			

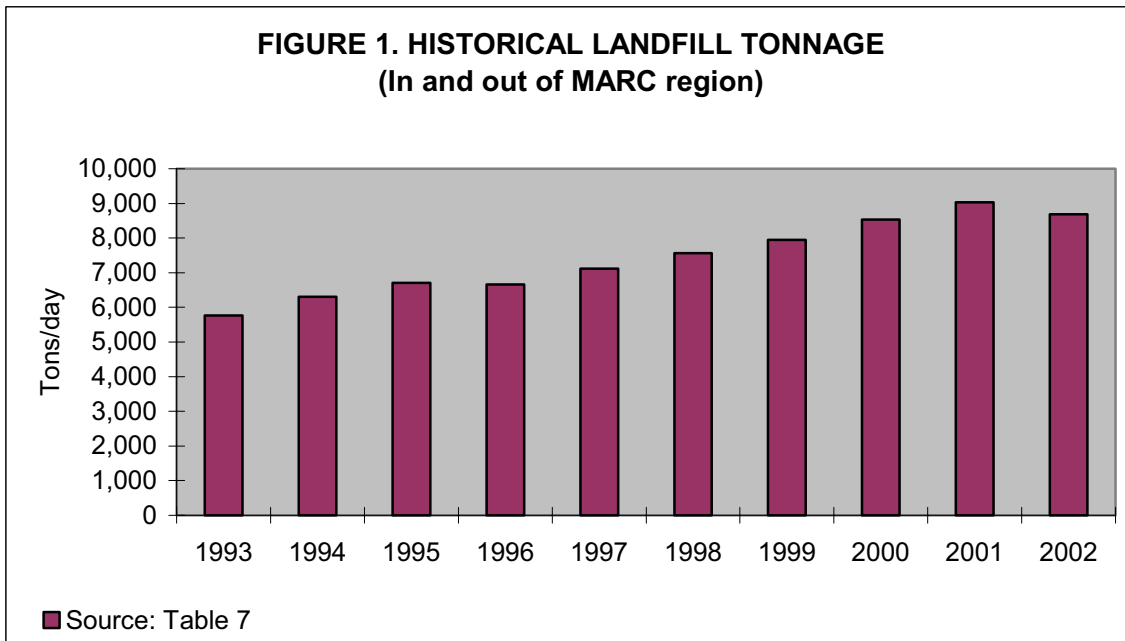
(1) Missouri DNR and KDHE data.

(2) 365 days/year

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In 2002, the total quantity disposed in the landfills listed is over 8,600 tons per day compared to about 5,800 tons per day in 1993. The three largest landfills (approximately 6,700 tons per day disposed in 2002) are in Kansas. Two of these landfills are within the MARC region. The total tons landfilled have increased every year since 1990 except for a decrease in 2002. Individual landfill tons disposed have varied from year to year. In general, tonnage has increased in most of the landfills listed in Table 7. Figure 1 illustrates the data shown in Table 7.

Incomplete Data-Table 7. The data in Table 7 represents all wastes disposed in the listed facilities. It is not possible to estimate, from this data, the origin of the waste or the type of waste disposed. Therefore the tons shown in Table 7 and Figure 1 include waste from both inside and outside of the MARC region.



Disposal Facilities – Life span

It is important for solid waste management planners to know the estimated life span of area solid waste facilities. This is especially true for MSW landfills, since siting new landfills is difficult. Expanding existing landfills has even become more difficult in the past decade.

The Lee’s Summit, Courtney Ridge, Show Me Regional and St Joseph landfill operators provided Missouri data to the MARC staff. The Kansas data were provided directly by KDHE and are not available on the department’s website. Since the estimated life span is based on current disposal rates, 2003 first and second quarters disposal quantities are also shown.

Incomplete Data-Table 8. The landfill lifespans, estimated by facility operators, reflect current conditions. Therefore the data in Table 8 does not reflect changes in the quantity of solid waste a facility may accept or any possible landfill site expansions.

**TABLE 8
MSW LANDFILL ESTIMATED LIFESPAN AND 2003 TONNAGE
ALL WASTE TYPES (1)
(tons/day)(2)**

MSW Landfill	State	MARC Region	Life span (3)	2003 2nd Qtr	2003 1st Qtr
City of Lee's Summit	MO	In	2014	252	184
Courtney Ridge	MO	In	2026	1,585	781
Show Me Regional	MO	Out	2043	352	291
St. Joseph	MO	Out	2028	318	244
Forest View	KS	In	<2 years	967	728
Hamm	KS	Out	2141	1,170	927
Johnson County	KS	In	2027	4,699	3,858

(1) MARC staff and KDHE data.

(2) 365 days/year

(3) Lifespan at current rates of disposal.

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Household Hazardous Waste (HHW) Facilities

The MARC region is served by seven HHW facilities. The largest is a regional facility in Kansas City, Missouri that accepts HHW from residential customers from member counties (currently all member counties are located in Missouri). The facility will accept law enforcement HHW from both sides of the state line for a fee.

As shown in Tables 9 and 10, the HHW facilities in the region collected over 1.8 million pounds in 2002 (926 tons). This includes over 1 million pounds (530 tons) collected at the KCMO regional facility.

Seventy-five percent of the pounds collected were diverted for recycling or energy recovery. Nineteen percent was safely landfilled and six percent was sent out of the region for destruction by incineration.

Table 10 combines the data from all of the facilities by waste category. Ninety-seven percent of the bulk used oil was diverted by recycling or energy recovery. Lead acid and nickel cadmium batteries, mercury, and waste tires were diverted 100 percent.

Incomplete data-Tables 9 and 10. The data provided by KDHE and the Missouri facilities are complete.

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**TABLE 9
HAZARDOUS WASTES MANAGED BY MARC REGIONAL HHW FACILITIES**

Regional Total 2002

Facility	State	Hazardous Wastes Managed					Total Pounds Collected
		Recycled	Energy Recovery	Treatment	Landfilled (1)	Incineration	
Kansas City	Missouri	583,400	391,150	1,288	60,000	25,302	1,061,140
Lee's Summit	Missouri	2,179	21,736	988	40,773	5,918	71,594
Johnson County	Kansas	37,492	88,900	7,900	128,000	17,338	279,630
Leavenworth County (2)	Kansas	24,000	35,160	0	48,180	28,535	135,875
Olathe	Kansas	30,550	0	1,584	46,440	18,698	97,272
Wyandotte County	Kansas	783	173,476	1,395	20,191	10,900	206,745
<i>Total Hazardous Wastes Managed</i>		678,404 37%	710,422 38%	13,155 1%	343,584 19%	106,691 6%	1,852,256 100%

(1) Hazardous waste and Non-hazardous waste landfills.

(2) There are two HHW facilities in Leavenworth County.

Kansas Household Hazardous Waste Program - Annual Report Form. Fiscal Year 2002 (July 1, 2001 to June 30, 2002)

City of Lee's Summit Resource Recovery Park Household Hazardous Waste Collection Center.

Waste Summary for 2002. Manifest #'s: 00015-00025

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**TABLE 10
HAZARDOUS WASTES MANAGED BY MARC REGIONAL HHW FACILITIES BY WASTE CATEGORY**

Regional Total 2002

Waste Category Class Description	Hazardous Wastes Managed					Total Pounds Collected
	Recycled	Energy Recovery	Treatment	Landfilled	Incineration	
Bulk Latex Paints	283,606	0	0	151,175	0	434,781
Bulk Used Oil	41,000	162,125	0	0	5,261	208,386
Sorted Aerosols, Lab/Loose Pack	150	5,725	1,165	0	7,709	14,749
Bulk Oil Based Paint	0	327,699	0	0	27,720	355,419
Bulk Fuels/Fuel Blends	0	50,012	0	0	16,700	66,712
Flammable Solids	0	0	0	0	565	565
Spontaneously Combustible	0	0	0	0	2	2
Dangerous When Wet	0	0	0	0	217	217
Oxidizers	0	0	1,288	0	1,325	2,613
Organic Peroxides	0	0	0	0	1	1
Poisons	52	0	0	0	42,531	42,583
Dioxin	0	0	0	0	120	120
Corrosives, Acids and Bases	47	0	5,402	0	0	5,449
Batteries - Lead Acid	131,925	0	0	0	0	131,925
Sorted Batteries - NiCd	1,507	0	0	0	0	1,507
Batteries - Dry Cell	18,252	0	0	1,497	0	19,749
Antifreeze	13,160	1,605	5,300	0	0	20,065
Non-Hazardous	1,930	2,877	0	130,890	302	135,999
Mercury	312	0	0	0	0	312
Asphalt/Metal	0	0	0	0	4,203	4,203
Waste Tires	0	141,520	0	0	0	141,520
Other	186,463	18,859	0	60,022	35	265,379
Total Pounds Managed:	678,404	710,422	13,155	343,584	106,691	1,852,256
<i>Percent of Total Managed</i>	37%	38%	1%	19%	6%	100%

Hazardous waste and Non-hazardous waste landfills.

Kansas Household Hazardous Waste Program - Annual Report Form. Fiscal Year 2002 (July 1, 2001 to June 30, 2002)

City of Lee's Summit Resource Recovery Park Household Hazardous Waste Collection Center.

Waste Summary for 2002. Manifest #'s: 00015-00025

Franklin Associates, A Division of ERG

Diversion Facilities

Diversion facilities, as used in this report, include reuse, recycling, composting, and end use facilities. Also included are companies that may or may not have a facility where materials are taken. Examples of these companies are collectors and broker/dealers. Tables 11 and 12 summarize the data shown in appendix tables A-6 and A-7. In addition to the appendix tables, an electronic database of the facilities, contact information, addresses, and materials collected is being provided to the MARC SWMD separate from this solid waste management report.

The data sources included information from MARC SWMD staff, the American Recycling Markets Annual Directory,⁵ and the Southwestern Bell Yellow Pages.

Table 11 tabulates the diversion facilities by primary activity and by county where the company is located. Jackson and Wyandotte counties have the most diversion facilities. Twice the number of facilities are located on the Missouri side of the MARC region as are on the Kansas side of the state line. Thirty of the companies identified themselves as collectors. Thirty-nine of the 105 facilities are classified as dealers/processors/packers. Standard definitions of primary activities do not exist. The dealer/processor/packer category shown in Table 11 includes a variety of functions. In general, this category includes some sort of processing and/or movement of collected recyclable materials.

Table 12 is a tabulation of the materials that the diversion facilities accept. Since some facilities accept more than one material, the numbers in Table 12 do not add to the same values as Table 11. Metals, ferrous and non-ferrous, are the most common materials accepted, followed by paper. Only one facility reported accepting glass.

Incomplete Data-Tables 11 and 12. There are likely additional diversion facilities within the MARC region that were not identified in this report. Neither Missouri DNR nor KDHE track diversion facilities. Exceptions to this are the composting facilities and tire facilities that are required to have a permit, but the other categories are typically not permitted. Therefore this report has not identified 100 percent of the diversion facilities in the MARC region.

⁵ The American Recycling Markets Annual Directory is an online service subscribed to by Franklin Associates, A Division of ERG.

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**TABLE 11
IDENTIFIED REGIONAL SOLID WASTE DIVERSION FACILITIES (1)**

State	County	Prime Activity					Other (2)	Total
		Collector (number)	Dealer/ Processor/ Packer (number)	Composter (number)	End User (number)	Reuse (number)		
Missouri								
	Cass		2					2
	Clay	2	3	1	1	1		8
	Jackson	14	16	6	3	12	1	52
	Platte					1		1
	Ray				1			1
	Out of region	3	2		1	1		7
	Total Missouri	19	23	7	6	15	1	71
Kansas								
	Johnson	2	3	1	0	1		7
	Leavenworth	2	3					5
	Wyandotte	5	10	1	1	1	2	20
	Out of region	2						2
	Total Kansas	11	16	2	1	2	2	34
Total Diversion Facilities		30	39	9	7	17	3	105

(1) Appendix Tables A-6 and A-7.

(2) Other = transportation/storage/disposal, reconditioner

Tables 11 and 12 do not show the tonnages collected by the diversion facilities. Currently, this data can only be obtained by contacting each facility individually. It is beyond the scope of this study to contact every diversion facility identified.

**TABLE 12
IDENTIFIED REGIONAL SOLID WASTE DIVERSION FACILITIES - MATERIALS ACCEPTED (1)**

State	County	Number of Facilities Accepting Materials									
		Paper (number)	Plastic (number)	Glass (number)	Metals (number)	Wood (number)	Textile (number)	Yard Waste (number)	Tires (number)	Appliances (number)	Other (2) (number)
Missouri											
	Cass	1	1		2						
	Clay	2			3		1	1	1		
	Jackson	5	2	1	18	7	2	5	3	1	7
	Platte										1
	Ray	1									
	Out of region	2	2		2		1		1		1
Kansas											
	Johnson	1	1		3			1			
	Leavenworth	2			4				1		
	Wyandotte	4	3		14			1		1	
	Out of region				2						

(1) Appendix Tables A-6 and A-7.

(2) Other = C&D, industrial byproducts, landfill gas, used oil, antifreeze, consumer goods

2.2. Regional Municipal Solid Waste Generation, Recovery, Source Reduction, Disposal

2.2.1. Solid Waste Generation

Generation equals diversion plus discards. Diversion includes source reduction, recycling and composting.⁶ Reuse, a type of source reduction, is a temporary diversion option. For example, clothes given to Good Will are diverted in the year given, but clothes given in previous years that are entering the waste stream offset this. A benefit of reuse is that it most likely reduces the quantity of new consumer goods produced. In addition, there is a growing reuse of industrial packaging, such as pallets and crates, which reduces the quantity of new packaging produced.

Municipal Solid Waste (MSW) and Construction and Demolition Debris (C&D) Generation

As shown in Section 2.1.3, Regional Facilities, the data available from disposal facilities includes all waste streams (MSW, C&D, industrial process waste, etc.) and the data are sometimes incomplete. Additionally, the solid waste disposal facilities do not record waste by regional boundary lines. These issues decrease the reliability of an estimation of the MSW or C&D disposed by residential and commercial customers in the MARC region based on disposal facility records only.

Diversion, another component of the generation formula, is even more difficult to obtain under current data collection methods. There is no central tracking of existing facilities, the materials accepted, or the quantities diverted.

The MSW and C&D generation methodology used in this report combined national estimates with the available regional data. The data sources used include:

- Franklin Associates internal worksheets for *Municipal Solid Waste in The United States: 2001 Facts and Figures*. U.S. EPA publication expected winter 2003
- Characterization of Building-Related Construction and Demolition Debris in the United States. U.S. EPA June 1998
- The MARC Integrated Solid Waste Management Plan 1994
- The Missouri Solid Waste Composition Study 1999
- Johnson County Solid Waste Management Plan 1992
- KDHE Solid Waste Composition Study 2002
- Regional 2002 data (Olathe, KCMO, Franklin County).

Table 13 shows estimated 2002 MSW and C&D generation in the MARC region. The regional population was separated into small city/rural, suburban, and urban classifications. The classifications are similar to those used in the MARC Integrated Solid

⁶ The U.S. EPA definition of generation equals recycling, including composting, plus disposal. Source reduction occurs before generation and therefore is not part of EPA's definition of generation.

Waste Management Plan 1994. Appendix tables B-1 and B-2 provide population detail by city.

An estimated 1.7 million tons of MSW and 0.8 million tons of C&D (total of 2.5 million tons) were generated within the MARC region in 2002. Fifty percent was generated from the urban sector, 42 percent from the suburban sector and the remaining eight percent from the small city/rural areas.

Thirty-nine percent of total regional MSW generation was estimated to be paper, ten percent plastic and over 13 percent yard waste. The other materials accounted for 37 percent of total MSW. Durable goods, sometimes referred to as bulky waste, are not shown as a separate line item but rather distributed among the different materials (Other Plastic, Other Ferrous, etc.). This was determined by the material components specified in the 1994 MARC plan.

Not included in this estimate are Other Wastes, Fines and HHW, which were categories in the MARC Integrated Solid Waste Management Plan 1994. These materials are considered non-MSW and not included in the analysis. Household hazardous waste (HHW) quantified in the previous section is considered separately from MSW. Some HHW does become mixed with residential and commercial MSW during collection for disposal.

The regional per person MSW generation rate is 5.35 pounds per person per day compared to 5.03 pounds per person per day nationally in 2000.⁷ Small city/rural has the smallest per capita rate at 3.71 pounds per person per day and the urban sector is highest at 6.05. The MSW generation rate for the suburban sector is in between the other two at 5.16 pounds per person per day.

The C&D per capita rate is estimated to be the same in the suburban and urban sectors (2.8 pounds per person per day). The small city/rural factor is estimated to be lower at 1.05 pounds per person per day. C&D, as estimated in this report, does not include road and bridge debris.

The composition of C&D was estimated from two published studies. The composition and the study references are shown in Table 14. Wood is approximately 30 percent of both construction and demolition debris. Drywall is estimated at 18 percent of construction waste and 15 percent of demolition waste. Roofing waste and metals are large components of demolition debris, at nearly ten percent and slightly over eight percent, respectively.

⁷ Municipal Solid Waste In The United States: 2000 Facts and Figures. U.S. EPA. Published national value of 4.5 pounds per person per day was adjusted upward to account for added moisture included in MARC generation estimate. This was done for comparison purposes in this study only.

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**TABLE 13
ESTIMATED MUNICIPAL SOLID WASTE (MSW) AND CONSTRUCTION & DEMOLITION (C&D)
GENERATION IN THE MARC REGION**

Material	MARC Region 2002 Generation				
	Small City/Rural (1)	Suburban (2)	Urban (3)	Total MARC Region Generation (4)	
	(tons)	(tons)	(tons)	(tons)	(%)
Paper:					
OCC/Kraft	27,720	114,670	154,840	297,230	17.5%
Office	14,580	60,310	74,900	149,790	8.8%
Magazines	2,100	8,700	10,800	21,600	1.3%
Newsprint	8,810	36,460	45,280	90,550	5.3%
Non-recyclable	5,880	26,490	72,360	104,730	6.2%
<i>Total Paper</i>	<u>59,090</u>	<u>246,630</u>	<u>358,180</u>	<u>663,900</u>	<u>39.0%</u>
Plastics:					
HDPE	530	2,210	2,750	5,490	0.3%
PETE	630	2,600	3,230	6,460	0.4%
Other Plastic	16,890	63,020	79,120	159,030	9.3%
<i>Total Plastic</i>	<u>18,050</u>	<u>67,830</u>	<u>85,100</u>	<u>170,980</u>	<u>10.0%</u>
Yard Waste	20,210	114,100	96,560	230,870	13.6%
Glass:					
Amber					
Green					
Clear					
<i>Total Glass</i>	<u>9,080</u>	<u>34,940</u>	<u>35,590</u>	<u>79,610</u>	<u>4.7%</u>
Non-Ferrous Metal:					
Alum. Beverage	1,090	4,510	5,600	11,200	0.7%
Other Alum.	1,220	5,030	6,270	12,520	0.7%
Other	1,030	4,240	5,270	10,540	0.6%
<i>Total Non-Ferrous</i>	<u>3,340</u>	<u>13,780</u>	<u>17,140</u>	<u>34,260</u>	<u>2.0%</u>
Ferrous Metal:					
Food Containers	1,700	7,060	8,760	17,520	1.0%
Other Ferrous	8,050	28,520	35,420	71,990	4.2%
<i>Total Ferrous</i>	<u>9,750</u>	<u>35,580</u>	<u>44,180</u>	<u>89,510</u>	<u>5.3%</u>
Other Materials:					
Food Wastes	18,930	67,820	84,230	170,980	10.0%
Textiles	7,040	21,920	27,390	56,350	3.3%
Diapers	2,480	9,590	11,910	23,980	1.4%
Misc. Organics	14,220	58,820	73,040	146,080	8.6%
Misc. Inorganics	3,390	14,060	17,460	34,910	2.1%
Other Waste					
Fines					
HHW					
<i>Total Other Materials</i>	<u>46,060</u>	<u>172,210</u>	<u>214,030</u>	<u>432,300</u>	<u>25.4%</u>
TOTAL MSW	<u>165,580</u>	<u>685,070</u>	<u>850,780</u>	<u>1,701,430</u>	<u>100.0%</u>
pounds/person/day (5)	3.71	5.16	6.05	5.35	
C&D (5)	46,860	371,740	393,760	812,360	
pounds/person/day (5)	1.05	2.80	2.80	2.55	
TOTAL MSW and C&D	<u>212,440</u>	<u>1,056,810</u>	<u>1,244,540</u>	<u>2,513,790</u>	
pounds/person/day (5)	4.76	7.96	8.85	7.90	

(1) Small city/rural generation model developed from Franklin County Kansas and national average data.

(2) Suburban generation model developed from Olathe Kansas and national average data.

(3) Urban generation model developed from Kansas City Missouri and national average data.

(4) Summation of (1)(2)(3).

(5) 365 days/year

2002 Regional small city/rural population	
Missouri	168,288
Kansas	76,261
Total	<u>244,549</u>
2002 Regional suburban population	
Missouri	245,673
Kansas	481,811
Total	<u>727,484</u>
2002 Regional Urban population	
Missouri	623,582
Kansas	146,978
Total	<u>770,560</u>

**TABLE 14
ESTIMATED COMPOSITION
C&D DEBRIS**

Construction Waste	
Wood	30%
Dry Wall	18%
Metal	2%
Plastic	4%
Other	47%
	100%

Demolition Waste	
Wood	29%
Dry Wall	15%
Roofing	10%
Metal	8%
Other	38%
	100.0%

Source: Brickner, Robert. "Identifying C&D Debris Markets." Scrap Processing. March/April 1995. "Construction and Demolition Debris Reduction and Recycling: A Regional Approach." Research Triangle Park, NC. June 1993.

Incomplete Data-Tables 13 and 14. Although the quantity of durable goods is included in the total MSW on Table 13, durable goods are not shown as separate line items. For example, tires (a durable good) and wood are shown together as Miscellaneous Organics. The data could possibly be reworked to display the individual categories separately. This would make the data series non-comparable to the MARC Integrated Solid Waste Management Plan 1994.

The 2002 household hazardous waste data shown on Tables 9 and 10 could be included on Table 13. This data would need to be adjusted with any previous SWMD estimates.

The construction and demolition debris composition estimate in Table 14 is not specific. The estimate detail does not specify if the construction and demolition debris is from residential or commercial construction/demolition or a combined average of both.

Generation Methodology Comparison. The 2002 MSW generation shown in Table 13 was compared to the Missouri DNR solid waste generation formula.⁸ Three other MSW estimation methods are included on the table (Table 15).

- U.S. national average generation estimate for the MARC region for 2000, 2001 and 2002
- Missouri DNR generation estimate for the MARC region for 2000, 2001 and 2002 calculated with the pre-1999 methodology
- Missouri DNR generation estimate for the MARC region for 2000, 2001 and 2002 calculated with the current methodology

The Missouri formula includes both MSW and non-MSW. Table 15 has been adjusted (with Missouri DNR factors) to show MSW generation only.

In 1999, Missouri DNR changed the methodology for estimating solid waste generation. At that time, they factored in the economic statistic Personal Consumption Expenditures (PCE). This escalator plus a population growth factor were applied to 1990 base year data. Prior to 1999 the only escalator used was population growth.

As the region grows in population and more consumer goods are purchased, more MSW is generated. This rationale appears to be valid for population growth. The PCE, although a good indicator of an increase in MSW associated with consumer goods consumption, may not be a good indicator of all MSW waste components. For example, an increase in spending probably will not affect the quantity of yard waste generated. Since both escalators are applied to 1990 data, all components of the waste stream are moving in an upward direction equally. This probably is overstating the quantity of MSW generated in the MARC region.⁹

⁸ Missouri Solid Waste Diversion and Recycling Status Report For Calendar Year – 2001 and previous years.

⁹ It should be noted that Missouri DNR applies the escalators to the entire solid waste stream (MSW and non-MSW). There are likely other portions of the waste stream that are being escalated by PCE that are not necessarily affected by growth in PCE.

**TABLE 15
MISSOURI DEPARTMENT OF NATURAL RESOURCES AND FRANKLIN ASSOCIATES MSW
GENERATION COMPARISON**

MARC Region	2000	2001	2002
<hr/>			
Total MSW			
Generation (tons) (1)			1,701,430
MSW Report rate - pounds/person/day			5.35
Generation (tons) (2)	1,562,200	1,581,810	1,599,230
National rate - pounds/person/day	5.03	5.03	5.03
Generation (tons) (3)	1,491,380	1,510,090	1,526,720
MO DNR pre-1999 methodology rate - pounds/person/day	4.80	4.80	4.80
Generation (tons) (4)	1,866,760	1,931,270	1,994,080
MO DNR 1999 methodology rate - pounds/person/day	6.01	6.14	6.27
<hr/>			

365 days/year

- (1) Generation estimate developed by Franklin Associates for MARC MSW Report For Calendar Year 2002. Table 13.
- (2) Generation estimate using national generation rates. Municipal Solid Waste in The United States: 2000 Facts and Figures. U.S. EPA. Estimate adjusted upward 11.5% to account for moisture. (Franklin original estimate is as generated not disposed)
- (3) Generation estimate using pre-1999 Missouri DNR MSW diversion formula. 1.47 tons/capita/year residential, commercial, and industrial. 59.6% MSW and 40.4% non-MSW
- (4) Generation estimate using 1999 Missouri DNR MSW diversion formula. Per capita factor - 1.47 tons/capita/year residential, commercial, and industrial; 59.6% MSW and 40.4% non-MSW adjusted for U.S. Personal Consumption Expenditures (PCE). (2000 per capita factor = 1.84; 2001 = 1.88; 2002 = 1.92)

Source: Franklin Associates, A Division of ERG

Industrial Process Waste Generation

Industrial wastes include process waste such as trimmings, shavings, sludges, ashes, out-of-date product, or product that doesn't meet production specifications. Packaging waste such as corrugated containers and pallets are considered MSW and accounted for in the MSW generation estimates.

Industrial process waste generation was estimated from generation factors developed by Franklin Associates, Ltd. for the 1993 Johnson County Solid Waste Management Plan Phase I. Employment statistics were obtained from the U.S. Census Bureau, County Business Pattern. Employment in 2001 was the most recent data available. Table 16 shows 2001 industrial process waste generation by county and Table 17 shows the same data by North American Industrial Classification System (NAICS). NAICS replaced the Standard Industrial Classification (SIC) code system in 1998.

**TABLE 16
ESTIMATED TOTAL INDUSTRIAL PROCESS WASTE BY COUNTY, 2001**

	<u>2001 Companies (number)(1)</u>	<u>2001 Employees (number)(1)</u>	<u>2001 Generation tons/yr(2)</u>
Missouri County Totals			
Cass County	72	1,540	9,290
Clay County	214	15,666	60,080
Jackson County	834	34,680	160,460
Platte County	54	2,035	7,160
Ray County	19	675	4,300
<i>Missouri County Totals</i>	<u>1,193</u>	<u>54,595</u>	<u>241,290</u>
Kansas County Totals			
Johnson County	531	19,622	75,620
Leavenworth County	35	752	3,740
Wyandotte County	236	14,185	52,590
<i>Kansas County Totals</i>	<u>802</u>	<u>34,558</u>	<u>131,950</u>
MARC Region Total	1,995	89,153	373,240

(1) County Business Patterns. www.census.gov

(2) Solid Waste Management Plan Revision for Johnson County, Kansas. Phase I. Franklin Associates, Ltd. February 1993. Generation factors.

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An estimated 373,000 tons of industrial process waste was generated in the MARC region in 2001. The 2002 industrial process waste generation is expected to be similar. Jackson County generates 43 percent of the industrial waste. Together the five Missouri counties generate 65 percent of the total. The three Kansas counties account for 35 percent of the total.

Table 17, industrial process waste by NAICS, shows the industries in the MARC region, the number of companies and the number of employees in each code. The industries generating the most waste are furniture and fixtures, printing and publishing, chemicals and allied products, and transportation equipment.

Incomplete Data-Tables 16 and 17. The industries listed on these two tables do not include utility industries such as wastewater treatment plants (WWTP), drinking water plants, or electrical power generation plants. These facilities are known to produce large quantities of waste. Waste generation factors could not be identified for these industries.

**TABLE 17
ESTIMATED INDUSTRIAL PROCESS WASTE
BY NAICS CODES FOR THE MARC REGION, 2001**

NAICS		2001	2001	2001
		Companies (number)(1)	Employees (number)(1)	Generation tons/yr(2)
311 & 312	Food & Kindred	158	7,898	4,900
313, 314, & 315	Apparel & Other Textile	79	1,122	11,320
321	Lumber & Wood	39	637	17,500
337	Furniture & Fixtures	121	2,208	67,950
322	Paper & Allied Products	51	5,507	36,820
323	Printing & Publishing	342	10,378	51,290
325	Chemicals & Allied Products	105	7,720	84,240
316 & 326	Rubber, Leather	120	5,643	2,030
327	Stone, Clay, & Glass	101	3,572	830
331	Primary Metal Products	36	1,773	1,200
332	Fabricated Metal Products	312	8,985	6,100
333	Industrial Machinery	172	10,134	31,920
335	Electronic & Electric Equip.	34	1,816	1,130
336	Transportation Equipment	71	13,575	48,420
334	Instruments & Related	90	4,972	2,860
339	Misc. Manufacturing	164	3,216	4,730
<i>Total Industrial Waste</i>		1,995	89,153	373,240

(1) County Business Patterns. www.census.gov

(2) Solid Waste Management Plan Revision for Johnson County, Kansas. Phase I. Franklin Associates, Ltd. February 1993. Generation factors.

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MSW and C&D Generation Historical Comparison

MARC Integrated Solid Waste Management Plan 1994. The 2002 generation estimates are shown in Table 18 with the estimates from the MARC Integrated Solid Waste Management Plan 1994, Tables II-6, II-7, and II-8. These tables divide the regional population by three city classifications: small city/rural, suburban, and urban. Appendix tables C-1, C-2, and C-3 provide the same information as Table 18 except by the three city classifications.

The material categories were matched to the extent possible to allow for a side-by-side comparison. The percent columns show the individual line items as a percent of total generation. The table also shows the individual line items on a pounds per person per year basis. This improves the ability to compare the two years.

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**TABLE 18
ESTIMATED MUNICIPAL SOLID WASTE (MSW)
AND CONSTRUCTION & DEMOLITION (C&D) GENERATION
REGIONAL COMPARISON 1993 and 2002**

MSW Material	MARC SWMD 1993 Regional SWMP Generation (1)			MARC SWMD 2002 Regional Model Generation (2)		
	(tons)	lb/c/yr	(%)	(tons)	lb/c/yr	(%)
OCC/Kraft	187,539	412	17%	297,230	341	17%
Office	25,775	57	2%	149,790	172	9%
Magazines	22,102	49	2%	21,600	25	1%
Newsprint	63,208	139	6%	90,550	104	5%
Non-recyclable	159,825	351	14%	104,730	120	6%
<i>Total Paper</i>	<u>458,450</u>	<u>1,007</u>	<u>41%</u>	<u>663,900</u>	<u>762</u>	<u>39%</u>
Plastics:						
HDPE	3,510	8	0%	5,490	6	0%
PETE	3,690	8	0%	6,460	7	0%
Other Plastic	78,932	173	7%	159,030	183	9%
<i>Total Plastic</i>	<u>86,132</u>	<u>189</u>	<u>8%</u>	<u>170,980</u>	<u>196</u>	<u>10%</u>
<i>Yard Waste</i>	<u>114,437</u>	<u>251</u>	<u>10%</u>	<u>230,870</u>	<u>265</u>	<u>14%</u>
Glass:						
Amber	7,152	16	1%			
Green	7,290	16	1%			
Clear	28,061	62	3%			
<i>Total Glass</i>	<u>42,504</u>	<u>93</u>	<u>4%</u>	<u>79,610</u>	<u>91</u>	<u>5%</u>
Non-Ferrous Metal:						
Alum. Beverage	8,792	19	1%	11,200	13	1%
Other Alum.	3,824	8	0%	12,520	14	1%
Other	560	1	0%	10,540	12	1%
<i>Total Non-Ferrous</i>	<u>13,176</u>	<u>29</u>	<u>1%</u>	<u>34,260</u>	<u>39</u>	<u>2%</u>
Ferrous Metal:						
Food Containers	24,625	54	2%	17,520	20	1%
Other Ferrous	34,439	76	3%	71,990	83	4%
<i>Total Ferrous</i>	<u>59,065</u>	<u>130</u>	<u>5%</u>	<u>89,510</u>	<u>103</u>	<u>5%</u>
Other Materials:						
Food Wastes	85,168	187	8%	170,980	196	10%
Textiles	42,222	93	4%	56,350	65	3%
Diapers	11,648	26	1%	23,980	28	1%
Misc. Organics	147,773	325	13%	146,080	168	9%
Misc. Inorganics	24,843	55	2%	34,910	40	2%
Other Waste	11,598	25	1%			
Fines	20,577	45	2%			
HHW	2,889	6	0%			
<i>Total Other Materials</i>	<u>346,718</u>	<u>762</u>	<u>31%</u>	<u>432,300</u>	<u>496</u>	<u>25%</u>
<i>TOTAL MSW</i>				<u>1,701,430</u>	<u>1,953</u>	<u>100%</u>
				pounds/person/day	5.35	
C&D				812,360	932	
				pounds/person/day	2.55	
<i>TOTAL MSW and C&D</i>	<u>1,120,482</u>	<u>2,462</u>	<u>100%</u>	<u>2,513,790</u>	<u>2,885</u>	
				pounds/person/day	6.7	7.90

(1) MARC SWMD Integrated Solid Waste Management Plan April 1994. Tables II-6, II-7, II-8. Urban industrial waste is included from Table II-6.

(2) Table 13. Regional industrial waste estimate *not* included.

1993 Regional population (1) 910,341

2002 Regional population 1,742,593

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On a per person basis, paper generation has decreased and plastic has increased. Yard waste is estimated at a slightly higher rate in 2002. Ferrous metals show a decrease of about 21 percent from 1993 to 2002. Total MSW and C&D are estimated at 2,460 pounds per person per year in 1993 and 2,900 pounds per person per year in 2000. This represents an 18 percent increase in generation.

Incomplete Data-Table 18. The 1994 report tables (II-6, II-7, II-8) had inconsistencies in the display of construction and demolition debris as well as industrial wastes. For example, Table II-6 Urban included MSW and industrial, Table II-7 Suburban included MSW and C&D, and Table II-8 included MSW only. The total shown on Table 18 for the 1993 regional SWMP generation includes industrial waste from urban areas. The total shown for the 2002 regional model generation does not include industrial process waste. Due to lack of documentation, it was impossible to subtract the industrial waste from the 1993 analysis. This inconsistency does not affect the MSW comparison.

2.2.2. Solid Waste Recovery and Source Reduction

Solid waste recovery and source reduction estimates were developed from local and national data. The larger regional recyclers provided data for 2002. Where recovery data was known to be missing, regional data was supplemented with national recovery data.

For example, aluminum cans are purchased from individuals by buy-back centers. These centers, typically scrap metal dealers, were too numerous to contact. Additionally, previous work has shown that scrap metal dealers track tonnage data by material, not by product or source. Therefore aluminum cans would be included with all aluminum or possibly all non-ferrous metals and not estimated separately.

Table 19 shows estimated MARC recovery by tons and as a percent of generation. Composting is included in the recovery estimates. U.S. recovery as a percent of U.S. generation is also shown for comparison purposes. The reason for displaying source reduction of yard waste separately from recovery estimates is that the U.S. average recovery percentages do not take source reduction into account. Due to this difference, certain percentages on Table 19 are not comparable between the MARC region and the U.S. average.

Paper products have the highest recovery rate. The MARC region, at 33 percent, is still below the national average of 42 percent. Yard waste recovery, including source reduction, is estimated at 81 percent of generation. Miscellaneous organics, which include tires and wood, are recovered at a rate similar to national average. Food waste composting is also close to national average. Anticipated growth in food waste composting will most certainly increase MARC food waste recovery above national recovery estimates.

MSW recovery, excluding yard waste, is estimated at 19 percent for the MARC region. This compares to 26 percent on a national basis. The MARC *Total MSW* recovery estimate (which includes yard waste composting plus source reduction) is 28 percent. There is no comparable national statistic available.

As mentioned above, Table 19 shows that MARC is recovering MSW (excluding yard waste) at 19 percent, which is below national levels of 26 percent. Although paper is slightly below national levels, containers and packaging are significantly below national recovery estimates, which reflect the low level of curbside collection in the MARC region.

There is no detectable recovery from C&D waste, which affects the overall recovery level in the MARC region. There is diversion ahead of delivery of C&D materials to disposal sites for reuse e.g. bricks, door, window, fixtures, etc. The tonnage shown on Table 19 reflects activity at Habitat ReStore.

The principal conclusion from this analysis is that recovery of recyclable materials within the MARC region is well below the national average. There is sufficient infrastructure in place to support higher recovery rates. Both Kansas and Missouri have sufficient collection infrastructure and Kansas has excess processing capacity.

Incomplete Data-Table 19. Due to budget constraints, 100 percent of the MARC regional recycling industry was not surveyed. Also, some of the recyclers that were surveyed did not track tonnage data. In some cases, recovery estimates were provided as total tons and not material specific estimates. For example, sometimes all grades of paper were combined or paper and containers were combined. Distribution of some of the data collected to the specific materials was made on a best judgment basis. Most of the major recyclers provided data and there is no indication that recovery would increase significantly if a complete survey were carried out.

2.2.3. Solid Waste Disposal

Table 20 shows MSW and C&D disposal estimates for the MARC region at over 2 million tons in 2002. Disposal equals generation minus recovery minus source reduction of yard waste. Disposal is estimated at 72 percent of MSW generation. If C&D is considered, then 81 percent of MSW plus C&D is disposed.

Since MARC regional generation is higher than national average (on a per person basis) and recovery is below national average, it is not surprising that the MARC regional disposal levels are higher than national average. MARC regional disposal of 3.88 pounds of MSW per person per day compares to a national average disposal estimate of 3.46¹⁰ pounds per person per day or 12 percent higher. MSW generation shown on Table 20 at 5.35 pounds per person per day compares to 5.03 pounds per person per day on a national level or 6 percent higher.

Incomplete Data-Table 20. Since disposal is the difference between generation and recovery (including source reduction of yard waste), disposal estimates are subject to the same data gaps as generation and recovery.

¹⁰ Municipal Solid Waste In The United States: 2000 Facts and Figures. U.S. EPA. Published national value of 3.1 pounds per person per day was adjusted upward to account for added moisture included in MARC disposal estimate. This was done for comparison purposes in this study only.

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TABLE 19
ESTIMATED MARC REGIONAL MUNICIPAL SOLID WASTE (MSW) AND CONSTRUCTION & DEMOLITION (C&D)
RECOVERY AND SOURCE REDUCTION, 2002

Material	MARC Region Generation (1) (tons)	MARC Region Recovery (2) (tons)	MARC Recovery Percent of Generation (%)	US Recovery Percent of US Generation (3) (%)	MARC Region Source Reduction (4) (tons)	MARC Recovery and Source Reduction Percent of Generation (%)
MSW						
Paper:						
OCC/Kraft	297,230	136,900	46%	55%		46%
Mixed Paper	149,790	47,110	31%	37%		31%
Books & Magazines	21,600	2,750	13%	29%		13%
Newsprint	90,550	34,460	38%	60%		38%
Non-recyclable	104,730	0				0%
<i>Total Paper</i>	<u>663,900</u>	<u>221,220</u>	<u>33%</u>	<u>42%</u>		<u>33%</u>
Plastics:						
HDPE	5,490			28%		
PETE	6,460			36%		
Other Plastic	159,030			10%		
<i>Total Plastic</i>	<u>170,980</u>	<u>8,160</u>	<u>5%</u>	<u>12%</u>		<u>5%</u>
Yard Waste	230,870	51,250	percentage not comparable		136,260	81%
Glass:						
Amber						
Green						
Clear						
<i>Total Glass</i>	<u>79,610</u>	<u>5,340</u>	<u>7%</u>	<u>19%</u>		<u>7%</u>
Non-Ferrous Metal:						
Alum. Beverage	11,200	3,100	28%	49%		28%
Other Alum.	12,520			10%		
Other	10,540			65%		
<i>Total Non-Ferrous</i>	<u>34,260</u>	<u>3,100</u>	<u>9%</u>	<u>40%</u>		<u>9%</u>
Ferrous Metal:						
Food Containers	17,520	5,650	32%	58%		32%
Other Ferrous	71,990	20,300	28%	29%		28%
<i>Total Ferrous</i>	<u>89,510</u>	<u>25,950</u>	<u>29%</u>	<u>34%</u>		<u>29%</u>
Other Materials:						
Food Wastes	170,980	3,000	2%	3%		2%
Textiles	56,350					
Diapers	23,980					
Misc. Organics	146,080	13,790	9%	12%		9%
Misc. Inorganics	34,910					
<i>Total Other Materials</i>	<u>432,300</u>	<u>16,790</u>	<u>4%</u>	<u>5%</u>		<u>4%</u>
MSW excluding yard waste	<u>1,470,560</u>	<u>280,560</u>	<u>19%</u>	<u>26%</u>		
TOTAL MSW	<u>1,701,430</u>	<u>331,810</u>			<u>136,260</u>	<u>28%</u>
pounds/person/day (6)	5.35	1.04	percentage not comparable		0.43	
C&D	812,360	380	0%	25%		0%
pounds/person/day (6)	2.55	0.001				
TOTAL MSW and C&D	<u>2,513,790</u>	<u>332,190</u>				<u>19%</u>
pounds/person/day (6)	7.90	1.04				

(1) Table 13.

(2) Recovery estimated from telephone survey of regional recyclers supplemented with US national recovery rates.

(3) US EPA. Municipal Solid Waste in the United States 2001 Facts and Figures.

(4) Franklin estimate MARC region - assumed 85% source reduction of yard waste in Missouri and 30% source reduction in Kansas

(5) Recovery plus Source Reduction of yard waste.

(6) 365 days/year

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**TABLE 20
ESTIMATED MARC REGIONAL MUNICIPAL SOLID WASTE (MSW) AND
CONSTRUCTION & DEMOLITION (C&D) DISPOSAL, 2002**

Material	MARC Region Generation (1) (tons)	MARC Region Recovery and Source Reduction (1) (tons)	MARC Region Disposal (3) (tons)
Paper:			
OCC/Kraft	297,230	136,900	160,330
Mixed Paper	149,790	47,110	102,680
Books & Magazines	21,600	2,750	18,850
Newsprint	90,550	34,460	56,090
Non-recyclable	<u>104,730</u>	<u>0</u>	<u>104,730</u>
<i>Total Paper</i>	663,900	221,220	442,680
Plastics:			
HDPE	5,490		
PETE	6,460		
Other Plastic	<u>159,030</u>		
<i>Total Plastic</i>	170,980	<u>8,160</u>	<u>162,820</u>
Yard Waste	230,870	187,510	43,360
Glass:			
Amber			
Green			
Clear			
<i>Total Glass</i>	<u>79,610</u>	<u>5,340</u>	<u>74,270</u>
Non-Ferrous Metal:			
Alum. Beverage	11,200	3,100	8,100
Other Alum.	12,520		
Other	<u>10,540</u>		
<i>Total Non-Ferrous</i>	34,260	<u>3,100</u>	<u>31,160</u>
Ferrous Metal:			
Food Containers	17,520	5,650	11,870
Other Ferrous	<u>71,990</u>	<u>20,300</u>	<u>51,690</u>
<i>Total Ferrous</i>	89,510	25,950	63,560
Other Materials:			
Food Wastes	170,980	3,000	167,980
Textiles	56,350		56,350
Diapers	23,980		23,980
Misc. Organics	146,080	13,790	132,290
Misc. Inorganics	<u>34,910</u>		<u>34,910</u>
<i>Total Other Materials</i>	432,300	<u>16,790</u>	<u>415,510</u>
TOTAL MSW	<u>1,701,430</u>	<u>468,070</u>	<u>1,233,360</u>
pounds/person/day (4)	5.35	1.47	3.88
C&D	812,360	380	811,980
pounds/person/day (4)	2.55	0.001	2.55
TOTAL MSW and C&D	<u>2,513,790</u>	<u>468,450</u>	<u>2,045,340</u>
pounds/person/day (4)	7.90	1.47	6.43

(1) Table 19.

(2) Disposal equals generation minus diversion.

(4) US EPA. Municipal Solid Waste in the United States 2001 Facts and Figures.

(4) 365 days/year

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TASK 3. PROJECTIONS OF ESTIMATED SOLID WASTE QUANTITIES TO 2013

3.1. Municipal Solid Waste (MSW)

Projections of MARC Region municipal solid waste generation in 2013 compared to estimated generation in 2002 are shown in Table 21. The projection methodology relied on unpublished projections of MSW generation to 2010 done recently for the U.S. EPA. It was assumed that the growth for U.S. MSW would be the same from 2010 to 2013 as that from 2001 to 2010, as projected for EPA. Using the U.S. 2001 to 2010 growth rates, U.S. generation in 2002 was also projected.

Since the MSW categories used for EPA are more detailed than those used for MARC, the 2002 and 2013 U.S. projections were allocated to the MARC categories used previously. Then, annual per capita generation rates by category for the MARC region and the U.S. were compared and adjustment factors were developed. It was found that in nearly every category, the MARC per capita rates were higher than the U.S. rates. This can be explained by the fact that the MARC region population is mostly suburban and urban, while the U.S. as a whole has large regions that are mostly rural or small towns.

Finally, the MARC/U.S. category factors developed above were used to adjust U.S. per capita generation by category to achieve the MARC generation projections in Table 21.

Comparing the MARC region 2002 and projected 2013 generation, the following observations can be made:

- Paper, plastics, non-ferrous metals, food wastes, textiles, and miscellaneous inorganics will increase in terms of pounds per person generated. Their percentages in MSW will increase or stay about the same.
- Glass generation will decrease both in pounds per person and in percentage of total MSW.
- Yard waste, ferrous metals, diapers, and miscellaneous organics will stay about constant in terms of generation per person and will decrease or stay about the same in percentage of total MSW.

3.2. Construction and Demolition Debris (C&D)

For purposes of the projections methodology, C&D debris was divided into residential and commercial categories. (Debris from road, highway, and bridge construction was not included.) According to a report¹¹ prepared for the U.S. EPA, C&D is 43 percent residential and 57 percent commercial in the U.S. In the absence of local data, it was assumed that C&D in the MARC region would be in the same percentages.

¹¹ Franklin Associates, Ltd. *Characterization of Building-Related Construction and Demolition Debris in the United States*. U.S. EPA Report No. EPA530-R-98-010. June 1998.

C&D generation in 2002 was divided into residential and commercial categories using the U.S. percentages above. Then, the residential portion was projected to 2013 using household growth rates calculated from a MARC report.¹² (It was assumed that growth from 2002 to 2013 would be at the same rate as the 2000 to 2010 rate calculated from the MARC long-range forecast report.)

In a similar manner, the commercial portion of C&D in the MARC region was projected to grow at the same rate as employment, using data from the same report. Residential and commercial projections were added together to yield the result shown in Table 21, or growth from about 812,000 tons in 2002 to about 948,000 tons in 2013. Generation per capita is also projected to grow between 2002 and 2013, mostly on the basis on increased employment.

3.2. Industrial Waste

There was no good information to allow projections of industrial process waste as shown in Table 17. Therefore, it was assumed that employment in each of those industries would remain at a constant percentage of total employment as projected in the MARC report cited above. The generation factors developed for 2001 were applied to projected employment in each industry to arrive at a projected industrial process waste generation of 468, 130 tons in 2013 (Table 21). This is a projected increase in generation in terms of pounds per person, but the basis for this increase is not at all certain.

¹² Mid-America Regional Council. *2002 Kansas City Metropolitan Area Long-Range Forecast*. October 2002.

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**TABLE 21
MUNICIPAL SOLID WASTE (MSW), CONSTRUCTION & DEMOLITION DEBRIS (C&D), AND
INDUSTRIAL SOLID WASTE GENERATION IN THE MARC REGION, 2002 AND 2013**

Material MSW	2002 Generation (1)			2013 Generation (3)		
	(tons)	(lbs/ person)	(%)	(tons)	(lbs/ person)	(%)
Paper:						
OCC/Kraft	297,230	341	17.5%	367,920	378	18.1%
Office	149,790	172	8.8%	200,290	206	9.8%
Magazines	21,600	25	1.3%	27,690	28	1.4%
Newsprint	90,550	104	5.3%	101,990	105	5.0%
Non-recyclable	104,730	120	6.2%	126,640	130	6.2%
Total Paper	663,900	762	39.0%	824,530	848	40.5%
Plastics:						
HDPE	5,490	6	0.3%	7,620	8	0.4%
PETE	6,460	7	0.4%	9,290	10	0.5%
Other Plastic	159,030	183	9.3%	207,610	213	10.2%
Total Plastic	170,980	196	10.0%	224,520	231	11.0%
Yard Waste	230,870	266	13.6%	259,110	266	12.7%
Glass:						
Amber						
Green						
Clear						
Total Glass	79,610	91	4.7%	78,350	81	3.8%
Non-Ferrous Metal:						
Alum. Beverage	11,200	13	0.7%	11,380	12	0.6%
Other Alum.	12,520	14	0.7%	15,600	16	0.8%
Other	10,540	12	0.6%	12,470	13	0.6%
Total Non-Ferrous	34,260	39	2.0%	39,450	41	1.9%
Ferrous Metal:						
Food Containers	17,520	20	1.0%	18,270	19	0.9%
Other Ferrous	71,990	83	4.2%	83,240	86	4.1%
Total Ferrous	89,510	103	5.3%	101,510	104	5.0%
Other Materials:						
Food Wastes	170,980	196	10.0%	201,910	208	9.9%
Textiles	56,350	65	3.3%	72,360	74	3.6%
Diapers	23,980	28	1.4%	26,210	27	1.3%
Misc. Organics	146,080	168	8.6%	163,220	168	8.0%
Misc. Inorganics	34,910	40	2.1%	45,180	46	2.2%
Total Other Materials	432,300	496	25.4%	508,880	523	25.0%
TOTAL MSW	1,701,430	1,954	100.0%	2,036,350	2,093	100.0%
pounds/person/day (2)	5.35			5.74		
C&D	812,360	932		948,010	975	
pounds/person/day (2)	2.55			2.67		
TOTAL MSW and C&D	2,513,790	2,885		2,984,360	3,068	
pounds/person/day (2)	7.90			8.41		
Industrial Waste	373,240	428		468,130	481	
pounds/employee/day (2)	22.94			22.94		

(1) From Tables 13 and 17. Industrial waste generation is for 2001.

(2) 365 days/year

(3) MSW projections by Franklin Associates based on previous work for the U.S. EPA. C&D projections based on Franklin Associates work for the U.S. EPA and MARC projections of household and employment growth.

Industrial waste projections based on 2001 generation factors and MARC projections of employment.

2002 Population 1,742,593

2013 Population 1,945,541

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TASK 4. EMERGING SOLID WASTE MANAGEMENT TRENDS, MARKETS, TECHNOLOGIES, AND FUNDING STRATEGIES

4.1. Waste Management Trends

4.1.1. Collection

*Single-stream collection of recyclables.*¹³ A quick survey of publications in the solid waste management field shows that single-stream collection of recyclable materials is a “hot” topic nationally, with many communities moving to this system. This is a trend in the MARC region also.

Generally, single-stream collection means that recyclable materials are collected commingled in a single container. (Yard waste is almost always collected separately in this method.) Communities or haulers using single-stream collection frequently replace collection trucks that provided separate bins for curbside sorting by collectors with noncompartmentalized vehicles. There is a trend toward dropping glass containers from single-stream collection, both nationally and in the MARC region. The reason given is usually that glass breaks, contaminating other recyclables, especially paper. Lack of good markets for glass may also be given as a reason for dropping glass.

Pros and Cons. According to proponents, advantages of single-stream collection are:

- Single-stream collection of recyclables along with organics can maximize diversion from disposal. More paper is recovered in a single-stream system.
- Economic efficiency can be obtained, e.g., by reducing labor costs.

Disadvantages cited for single-stream collection are:

- Materials processing costs may increase.
- Recyclables may be contaminated, resulting in lower market prices. This is especially true for contamination of paper by broken glass.
- There may be a higher residue rate going to landfill at the MRF.
- If glass is collected unsorted by color, there may be no traditional market for the material.
- There is expense involved in switching from multistream to single-stream.

Clearly, these advantages and disadvantages must be balanced on a case-by-case basis. However, the trend is toward single-stream.

¹³ Sources for this section include:
Snow, Darlene. “Single-Stream Versus Multistream Recycling.” *MSW Management*. September/October 2003.
Farrell, Molly. “Single Stream MRF Comes to New England.” *BioCycle*. July 2003.
Eureka Recycling. “Downstream of Single-Stream.” *Resource Recycling*. November 2002.

Pay-as-You-Throw (PAYT).¹⁴ Pay-as-you-throw, or unit based-pricing, has been a favorite program of the U.S. EPA for at least 10 years. It has been widely adopted across the U.S.

According to EPA, over 4,000 communities use unit-based pricing. About 60 of these communities have populations greater than 100,000. Generally, the goals of unit-based pricing are to encourage waste prevention and recycling (reduce volume disposed) and/or raising sufficient revenue to cover municipal solid waste management costs. SERI estimates that PAYT can reduce residential disposal at the landfill by 16 to 17 percent through source reduction, recycling, and yard waste diversion.

There are many variations of PAYT or unit-based pricing, e.g.:

- Volume-based vs. weight-based
- Cans vs. bags
- Prepaid tags or stickers
- A variety of rate systems
- Linking recycling/composting with PAYT, e.g., providing “free” collection of recyclables.

Pros and Cons. Potential benefits of unit-based pricing include:

- Waste reduction/prevention
- Reduced waste disposal costs
- Increased participation in composting and recycling programs
- More equitable waste management fee structure.

Some potential disadvantages or barriers to unit-based pricing include:

- Illegal dumping
- Increased administrative costs
- Perception of increased cost to residents
- Difficulty implementing at multi-family housing
- Challenge of setting prices correctly.

Nationwide, there is considerable experience with PAYT or unit-based pricing, with generally positive results.

¹⁴ Sources for this section include:
U.S. EPA. “Unit-Based Pricing in the United States: A Tally of Communities.”
<http://www.epa.gov/epaoswer/non-hw/payt/comminfo.htm>. Downloaded August 26, 2003.
Skumatz, Lisa A., SERI. “Measuring Source Reduction: Pay as You Throw/Variable Rates as an Example.” May 13, 2000. <http://www.epa.gov/epaoswer/non-hw/payt/comminfo.htm>. Downloaded August 26, 2003.
Canterbury, Janice L., U.S. EPA. “Pay-As-You-Throw: Lessons Learned About Unit Pricing.” EPA530-R-94-004. April 1994.

4.1.2. Diversion

Diversion can include both source reduction and recycling and composting. The purpose may be to reduce quantities of waste to be disposed, or the focus may be on removing hazardous materials from disposal.

*Electronics.*¹⁵ Both nationally and in the MARC region, there has been increasing emphasis on diverting waste electronics (e-scrap) from disposal. For EPA, Franklin Associates has estimated that consumer electronics in MSW comprise only about one percent of total generation (but growing rapidly). It is, however, the presence of heavy metals, primarily lead, that cause the greatest environmental concern with disposal of electronics. EPA and some states have been devoting particular attention to this issue.

Consumer electronics include personal computers, printers, monitors, modems, telephones, fax machines, televisions, VCRs, disc players, radios, and many other products. Some of these products that are no longer wanted may be given away for reuse, but eventually they must be recycled or discarded. The recycling process for electronics generally involves demanufacturers. These facilities salvage some components for repair and attempt to recycle the rest. In the MARC region, Surplus Exchange exemplifies this process. Computers and related information products make up most of the electronic products recycled.

In 2003, more than 1,000 U.S. communities provide electronics recycling services of some kind. Collection methods include periodic events, drop-off sites, or door-to-door collection. Some communities provide this service free of charge, but many are charging a fee. Most domestic computer manufacturers and other electronics companies will take back their equipment – usually for a fee. At least one electronics retailer provides a similar service. Electronics recycling is growing nationally, with some major players such as Waste Management entering the field.

Pros and Cons. The benefits of remanufacturing/recycling of e-scrap are obvious:

- Diverting a small, but growing, segment of the waste stream from disposal
- Keeping hazardous substances out of landfill and other disposal facilities.

¹⁵ Sources for this section include:
Franklin Associates. “Characterization of Municipal Solid Waste in the United States: 2000 Update.” Included in *Municipal Solid Waste in the United States: 2000 Facts and Figures*. EPA530-R-02-001. June 2002.
Powell, Jerry. “The heated world of electronics recycling: trends and issues.” *Resource Recycling*. August 2003.
Powell, Jerry. “The e-scrap map now can be seen.” *Resource Recycling*. May 2003.
“9 key questions in electronics recycling.” *Resource Recycling*. February 2003.
<http://www.restorekc.org>
Mueller, Thomas. “Building Deconstruction & Salvaged Materials Reuse.” Presented at the SWANA Pacific Northwest Regional Solid Waste Symposium. Burnaby, BC. April 14, 2000.

The disadvantages/barriers to increased recycling include:

- Lack of markets for CRT (cathode-ray tube) glass
- Difficulty in recycling plastics from electronics because of the wide range of plastic resins used
- Reuse suffers from price competition for new electronics
- The presence of heavy metals can make recycling dangerous.

Some experts contend that increased public/private efforts at the state and federal levels will be needed to resolve some issues that hold back electronics recycling. Since manufacturers are national or international companies, widely varying state regulations could be problem.

Glass. Diversion of glass from the waste stream is closely tied to the trend toward single-stream collection (4.1.1) and to markets for recovered glass (4.2.1). As discussed above, both contamination of other materials by broken glass and lack of good markets are given as reasons for excluding glass from single-stream collection.

Glass containers (the only readily recyclable part of glass in the waste stream) make up less than 5 percent of the municipal solid waste stream, both nationally and in the MARC region. Because of substitution of lighter materials, especially plastic containers for food and beverages, glass containers have been a declining part of the waste stream since the 1980s, both in tonnage and percentage. This trend is projected to continue, so it could be argued that there is some diversion by source reduction already going on.

Pros and Cons. Advantages of putting extra effort into diverting glass from the MSW stream include:

- While declining, glass containers are still a significant part of the waste stream
- Glass is very recyclable.

Some disadvantages/barriers of increased glass recycling (contamination of other materials and finding cost-effective markets) are addressed in other sections. Another observation is:

- If landfilled, glass containers are inert and do not contribute to potentially harmful leachate. Therefore, there is no strong national emphasis on keeping glass out of landfills.

*Construction and demolition (C&D) debris.*¹⁶ C&D tends to be managed separately from other wastes and has been largely ignored by the public sector until recent years. With the increasing realization that C&D debris is an important part of the waste stream, this has been changing. For the U.S., building-related C&D may be as much as 40 percent of the combined total of C&D and MSW. For the MARC region, the percentage is estimated at about 32 percent. Thus, this is a very significant waste stream and diversion is an important issue. Diversion of C&D can be by conventional recovery and recycling, or by deconstruction and reuse. Major components of C&D include concrete, yard and land-clearing debris, and wood. Other important components include metals, asphalt, drywall, and shingles. In the MARC region, there is a significant amount of diversion ahead of delivery of C&D materials to disposal sites e.g. bricks, doors, windows, fixtures, etc.

In some regions of the country, state or local agencies are taking action to reduce disposal of C&D. Portland, Oregon and some California communities have ordinances requiring contractors to recycle at least part of the C&D debris they create. Massachusetts has a new ban on unprocessed C&D in landfills. One industry expert comments, however, that recycling C&D is not always profitable and tends to be done on the east and west coasts where landfill costs are high.

The methods used to recover the materials in C&D vary by type. The first step is always separation of the materials.

Metals. Metals (e.g., copper and aluminum) have the highest recycling rate among building-related C&D materials. Recovered metals are generally taken directly to a scrap dealer.

Wood. Wood from construction sites is cleaner and more desirable for recycling than wood from demolition sites. Wood is processed by grinding, usually in a tub grinder. Magnetic separation may be used to remove metals, e.g., nails. Screening may also be done. Equipment to move the products around is also needed. Products of the recycling include mulch and fuel (the most prevalent), and also compost bulking agents and animal bedding. (Markets for the products are discussed below.)

Asphalt and Concrete. Crushed concrete, after metals have been removed, is commonly used as a replacement for road-base gravel or as aggregate. Asphalt can be recycled into

¹⁶ References for this section include:
Franklin Associates. *Characterization of Building-Related Construction and Demolition Debris in the United States*. EPA530-R-98-010. June 1998.
Cochran, Kim, et al. "Taking aim at C&D." *Resource Recycling*. September 2002.
Krause, Timothy. "When recycling comes out of the woodwork." *Resource Recycling*. March 2003.
Kraus, Timothy. "Roofing shingles and roads." *Resource Recycling*. April 2003.
Gordon, Susie, et al. "Capturing Wood from Construction Stream." *BioCycle*. August 2003.
Jenna, Kunde, and Sonya Newenhouse. "Leading the way to new C&D markets." *Resource Recycling*. January 2002.
Aquino, John T. "C&D Waste: A Sometimes Bumpy Road to More Attention." *MSW Management*. July/August 2003.
Gertman, Richard. "Portola Valley Pushing Waste Diversion Beyond 50%." *MSW Management*. July/August 2003.

road use. It should be noted that recycling of asphalt and concrete in road and highway construction is routine. However, road materials are not included with building-related C&D for this report.

Drywall. Some recovery of drywall has been going on in the Pacific Northwest and Wisconsin. One motive is that drywall – in addition to being a large component of C&D – decomposes in landfills, producing hydrogen sulfide. Recovered drywall is processed by on-site or off-site grinding.

Asphalt Shingles. Some experimentation with recycling asphalt shingle byproducts into hot-mix asphalt for road construction has been going on in Minnesota, with some success. (The cooperation of the Minnesota Department of Transportation was necessary.) The University of New Hampshire has been looking at the feasibility of recycling asphalt shingles from C&D. This process requires that the recovered material be free of contaminants such as metals.

Additional Diversion. In addition to recovery of materials, an innovative diversion method is cited in the literature. That is grinding materials such as untreated wood and gypsum drywall on-site and placing them on the ground before sod is laid. This is being tried in Indiana and Georgia.

Pros and Cons. The advantages of recycling/diverting C&D debris are obvious:

- C&D debris is a very large portion of solid waste generated, so diversion can have a large impact.
- Contractors can save money on disposal if materials are diverted.

Some problems encountered in recovery/recycling of C&D debris include:

- Meeting end-use specifications may be difficult due to contamination, especially from demolition sites, and extensive processing may be required
- Specifications may be a problem, e.g., state DOTs may not permit use of asphalt shingles in roadways
- The virgin materials replaced (e.g., gypsum) may be very inexpensive, so recycled materials may not be able to compete economically
- Some materials, e.g., pressure-treated wood made with chromated copper arsenate, may be hazardous to handle.

Deconstruction. In deconstruction, a structure is removed by taking it apart; preserving the materials, e.g., lumber, intact for reuse.

Deconstruction is not an entirely new idea. For years demolition contractors have been removing valuable materials, most commonly metals, for recycling. However, this has often done after the building has been knocked down. Other components commonly recovered include windows, doors, hardware and lumber.

Careful deconstruction to recover more materials, such as wood, without contaminating them has had considerable interest in the past few years, although the trend cannot be quantified nationally. In the MARC region, Habitat for Humanity offers deconstruction services and operates ReStore, where salvaged and donated new materials are sold at bargain prices.

Pros and Cons. The advantages of deconstruction are similar for those listed for C&D recycling. Other advantages include:

- Reducing the environmental impact of building demolition
- Providing jobs
- Conserving resources.

Disadvantages/barriers for deconstruction include:

- Possible regulatory barriers to use of recovered materials
- Deconstruction requires more time than demolition
- Costs/benefits are not well established.

4.2. Emerging Market Trends

4.2.1. Glass Market Trends¹⁷

The traditional market for cullet (crushed glass containers) has been manufacture of new bottles and jars. Another fairly prevalent market has been fiberglass manufacture. This section will discuss these along with some newer applications for recovered glass.

Glass containers. As discussed above, production of glass containers has been in a decline for a number of years. This fact, along with relatively low value for cullet and expensive shipping due to its heavy weight, has dampened this market. The trend toward single-stream collection, excluding glass, was noted above. The process of glass recycling in containers is well established and will not be discussed further here.

Fiberglass. Production of fiberglass can use up to about 10 percent postconsumer container cullet. (More preconsumer cullet can be used.) Colored glass as well as flint glass can be used, but the color mix must be consistent. The range can be 0 – 100 percent flint and green glass, while amber glass must be less than 50 percent. There also are strict limitations on contaminants such as food wastes, labels, lids, ceramics, etc. As with glass container manufacture, shipping costs can be a problem if the fiberglass manufacturer is some distance away.

¹⁷ Sources for this section include:

Powell, Jerry. "Is glass recycling soon to become passé?" *Resource Recycling*. May 2002.

Powell, Jerry. "Breaking glass markets." *Resource Recycling*. September 2002.

Franklin Associates. *Environmental and Economic Analysis of Glass Container Recycling from Portland's Curbside Collection Program*. July 23, 1998.

Emerging markets for glass. To avoid shipping costs, research has been done to identify alternative local uses for recovered glass, discussed below. Pulverizing glass into aggregate (pulverized glass aggregate – PGA) is the first step in most of these applications.

Road/street uses. Use of glass in asphalt paving (glasphalt) is not a new application, and is one that can use large volumes. Iowa and New Jersey are among the states pursuing this alternative. Glass has also been used in road base in Indiana, for example. Use as a sand substitute for icy conditions has occurred in Washington State and New Mexico.

Landscaping uses. Glass “sand” has been used as a turf or soil amendment. Tumbled glass “rocks” or “sand” have been used in landscaping in New Mexico.

Landfill applications. Use as landfill cover has occurred in a number of states.

Other infrastructure applications. PGA has been used in concrete products, e.g., drainage pipes, as septic sand filters, bedding for concrete walkways, pipe/sewer bedding material, filter media for swimming pools, filling sandbags, sandblasting media, and the like.

Decorative uses. Recovered glass has been used to make decorative tile. Tumbled glass has been used in fishbowls and floral displays. Recycled glass chips have been used for a terrazzo effect in concrete floors.

Pros and cons. The advantages of markets for recovered glass are obvious:

- Glass is still a substantial part of the waste stream, so markets for recovered glass can result in substantial diversion.

Some disadvantages are:

- Shipping glass cullet to a manufacturer, e.g., of glass containers or fiberglass, is quite costly due to its relatively heavy weight
- Use of recovered glass in large-scale applications such as road construction and other infrastructure uses means that glass is replacing sand and gravel, relatively low-cost materials. It probably would be necessary for local or state ordinances or regulations to specify use of recovered glass in order to achieve widespread use.

4.2.2. Construction and Demolition (C&D) Debris Market Trends¹⁸

Since C&D composition is extremely diverse, various materials in C&D will be discussed separately.

Asphalt and Concrete. As mentioned earlier, asphalt and concrete are routinely recycled as road construction material, but the sources are mostly the roads themselves.

*Wood.*¹⁹ Well-known markets for wood include mulch, compost and soil conditioner, animal bedding, playground covering, and fuel for wood-burning plants. Paper making and board manufacture are less common markets for recovered wood. Coloring mulch for landscape use is a trend that adds market value.

Drywall. A good deal of research is going into finding markets for recovered drywall (also called gypsum board, wallboard, etc.). Potential markets include land application, on-site grinding, and drywall-to-drywall recycling.

Ground drywall contains calcium and sulfur, which can be beneficial when applied to crop land as a substitute for gypsum fertilizer. In Wisconsin, there was some investigation into the safety of land application of Type X drywall, which includes a small amount of fiberglass as a fire retardant. Wisconsin DNR did eventually give a permit for land application of Type X drywall – perhaps the first such permit in the country. The study cited suggests that farmers charge a tipping fee that would be less than a landfill tipping fee.

In Georgia, on-site grinding and diversion of drywall is being tested. The process grinds the drywall on a construction site and places it on the ground before sod is laid. In Indiana, ground untreated wood, cardboard, and gypsum drywall can be placed at the job site. No detrimental environmental effects were found in a study by the Research Center of the National Association of Home Builders.

For drywall to be recycled back into drywall, the paper must be removed, because paper affects its fire rating. This does not appear to be a large market at present.

¹⁸ Sources for this section include:
Emerson, Dan. "Building Strong Markets for Mulch and Compost Products." *BioCycle*. July 2003.
Ennis, Kent. "Evolution of a Mulch Marketer." *BioCycle*. July 2003.
Cochran, Kim, et al. "Taking aim at C&D." *Resource Recycling*. September 2002.
Kunde, Jenna, and Sonya Newenhouse. Leading the way to new C&D markets." *Resource Recycling*. January 2002.
"Drywall Recycling." www.ciwmb.ca.gov/ConDemo/FactSheets/Drywall.htm. Downloaded August 29, 2003.
"Asphalt Roofing Shingles in Asphalt Paving." www.ciwmb.ca.gov. Downloaded August 29, 2003.
"Drywall Recycling." www.ciwmb.ca.gov/ConDemo/FactSheets/Drywall.htm. Downloaded August 29, 2003.

¹⁹ Note that wood to be diverted includes not only wood from C&D, but also wood pallets and landscaping waste.

Potential markets for drywall waste include cement production, addition to stucco, sludge drying, water treatment, salty soil treatment (e.g., along treated roads), manure treatment, animal bedding (combined with other materials), flea powder, grease absorption, and athletic field marking. These uses are at the test or idea stage; the crushed drywall would substitute for gypsum in these uses.

Asphalt shingles. Potential markets for asphalt shingles include hot mix asphalt, cold patch, dust control on rural roads, temporary roads or driveways, aggregate road base, new shingles, and perhaps fuel. The most interest currently seems to be with hot-mix asphalt, or asphalt concrete. A few states have allowed a percentage of asphalt shingles in asphalt pavement.

Pros and Cons. The advantages of recycling/diverting C&D debris have already been discussed.

Some disadvantages and barriers to marketing recovered C&D materials are:

- Most products derived from C&D debris must compete with relatively low-cost alternatives, e.g., gypsum
- A tipping fee for processors/users may be required to make recycling economical
- Many recovered C&D materials are contaminated with objects such as nails, or the materials themselves may be hazardous, e.g., pressure-treated wood.
- Rewriting specifications may be required, e.g., for use of asphalt shingles in road use.

4.3. Processing Technology Advances

The MARC SWMD, with assistance from ERG, identified the following emerging processing technologies to be of interest:

- Composting - MSW composting is an alternative, commercially demonstrated technology. Of particular interest is co-composting for management of food waste and biosolids.
- Waste-to-energy Technologies - The private sector has expressed an interest in development of waste-to-energy projects in and around the Kansas City region. Technologies of interest include gasification; waste-to-ethanol; thermal depolymerization; and "reculturing," an alternative refuse derived fuel processing technology that may be compatible with alternative, non-burn conversion technologies.
- Mixed Waste Processing - The private sector is also exploring the possibility of a mixed waste processing facility, also called a "dirty MRF," coupled with a transfer station, to serve the Kansas City region.

MARC SWMD also has an interest in advances that may exist for management of the following wastes:

- Construction and Demolition Debris
- Commercial and Industrial Food Waste
- Wastewater Treatment Plant Biosolids
- Commingled Residential Plastics.

This section²⁰ provides a summary of the innovative and alternative processing technologies identified above (composting, waste-to-energy, and mixed waste processing). The purpose of the summary is to describe the technology, its potential benefits, commercial status and economics, if available. This section also discusses certain management options for the other wastes of interest identified by MARC SWMD. The intent of this section is an educational overview, to assist in the consideration by the MARC SWMD of whether any of these technologies or management options can help the Kansas City region in the next ten years.

4.3.1. Innovative Process Technologies

Introduction

Over the past three decades, many innovative and alternative technologies have been proposed for municipal solid waste (MSW) management. Innovative technologies are often developed in response to technical and social issues to find a more efficient and effective waste management solution, or perhaps to develop a process that will be accepted by the public above other, mainstream solutions. Frequently, innovative solutions are pursued to manage challenging waste streams, or manage separate waste streams that may be amenable to discrete solutions: construction and demolition debris, food waste, biosolids, and specific recyclable materials. However, innovative technologies are often costly, particularly in the early stages of development.

This review provides an introduction to select innovative and alternative processing technologies:

- MSW Composting
- Gasification
- Waste-to-Ethanol
- Depolymerization.

A brief review is also provided of methods for handling waste in support of these technologies: front-end processing through a mixed waste processing facility (i.e., dirty MRF), and use of reculturing to create feedstock for thermal treatment or conversion using non-burn methods.

Table 22 presents an overall summary of the technologies reviewed. Supporting text follows the table. In summary, innovative and alternative processing technologies may offer certain advantages over conventional processing technologies (e.g., mass-burn

²⁰ Alternative Resources, Inc. (ARI) prepared this section.

waste-to-energy and landfill), such as greater public acceptance and reduced air emissions.

Of the technologies reviewed, gasification is in the most advanced stages of development, having been commercially demonstrated overseas at large-scale by at least one gasification vendor (Thermostelect). However, the other innovative technologies have not been sufficiently demonstrated on a commercial basis; claims made regarding the benefits of the technologies are largely untested and costs are uncertain.

At this time, the risk to a public entity in pursuing a large-scale, innovative project may be unreasonably high. Further development and demonstration of these technologies by the private sector is recommended prior to public-sector involvement and risk-taking.

**TABLE 22.
SUMMARY OF ALTERNATIVE AND INNOVATIVE WASTE PROCESSING TECHNOLOGIES**

Technology	Description	Highlights
Composting	MSW is processed to recover recyclables and remove inerts, then processed using any of a variety of commercially available composting technologies: windrow, aerated static pile, agitated bed, in-vessel digester. Yard waste and biosolids (sewage sludge) can be co-composted with MSW.	<ul style="list-style-type: none"> • MSW composting has not been commercially successful in the U.S. on a large scale. • Requires establishment of a consistent market for the compost product. • Renewed interest is developing for tailored or small-scale projects, such as food waste composting. • Location-specific opportunities may be viable for source-separated organics, depending on local costs and compost markets.
Gasification	Industrial chemical process that combines proven technologies to process waste: generally compaction, pyrolysis, gasification and gas cleaning. This conversion technology uses high temperature to break down and transform waste into clean synthesis gas to make electricity and other commercially useful products.	<ul style="list-style-type: none"> • Combines proven technologies in an innovative fashion. • Commercially demonstrated overseas, however, there are no facilities operating in the United States. • Comprehensive solution - processes all types of waste. • Reduced air emissions compared to incineration. • Produces no ash and generates no wastewater requiring disposal. • Costs are uncertain, but may be competitive with traditional mass-burn waste-to-energy systems.
Waste-to-Ethanol	Industrial chemical process converts the cellulose present in MSW to sugar, which is then fermented to ethanol. The ethanol is distilled, and sold as a gasoline additive. This conversion technology typically requires up-front processing to separate recyclable materials, followed by mechanical processing to prepare the waste as a feedstock.	<ul style="list-style-type: none"> • Combines proven technologies in an innovative fashion. • Not commercially demonstrated for MSW. • Comprehensive solution - processes all types of waste. • Costs are uncertain, but may be competitive with traditional mass-burn waste-to-energy systems.
Depolymerization	Depolymerization, or more specifically thermo-depolymerization (TDP) patented and developed by Changing World Technologies (CWT), is a chemical conversion process that uses pressure and heat to decompose long chain polymers of hydrogen, oxygen and carbon into short chain petroleum hydrocarbons. Using TDP, which mimics natural geologic processes, a variety of waste products can be converted into usable products, including oils, fuels, gases and carbon.	<ul style="list-style-type: none"> • Accepts wide range of carbon-based feedstock including MSW, medical waste, food industry waste, plastics, and other materials. • Pilot plant operated in Pennsylvania. • Development of first, full-scale commercial facility nearing completion in Carthage MO. • Produces marketable byproducts. • Costs are uncertain.

Technologies of Interest Review

MSW Composting. In a typical MSW composting facility, MSW may first be processed to separate traditionally recycled materials. The remaining MSW is then shredded to a uniform size, and glass shards and other inert materials are screened out. The processed MSW is composted, using any of a variety of composting technologies that are commercially available: turned windrow, aerated static pile, agitated bed, and in-vessel digester. As an alternative, MSW may receive some form of pre-composting, followed by separation of recyclables and inert materials and then final composting. Yard waste and biosolids (sewage sludge) can be co-composted with MSW.

Approximately three-dozen MSW composting facilities were constructed in the U.S. between the early 1970s and very early 1990s. Most of these had processing capacities under 300 TPD; however, several were of large design capacity – 600 TPD to 1,350 TPD. Significantly, most MSW composting facilities built in the U.S. have been commercial failures, and have been shut down. All of the large facilities have failed. Reasons given for those failures include technical problems, economics (high cost, compared with landfill), environmental problems (inadequate odor control), and lack of consistent market for the compost product. In any case, MSW composting has been moribund in the U.S. for over a decade now, except for a limited number of small-scale projects.

While MSW composting *per se* has largely failed in the U.S., there may be location-specific opportunities for composting source-separated organic components of MSW, such as food waste. The economic feasibility depends on local costs for competing disposal methods, and on the availability of compost markets locally.

Gasification Waste-to-Energy. In traditional waste-to-energy, MSW is burned as a solid fuel in a boiler (in the presence of oxygen), to produce steam and electric power. In gasification waste-to-energy, MSW is first converted to a synthetic gas in a high-temperature pyrolysis process (oxygen-free). The gas is cleaned (e.g., sulfur is removed and recovered), and then used to fuel a conventional engine-generator to produce electric power, or a boiler to produce steam and electric power. By-products produced in the gasification process include a construction aggregate, elemental sulfur, a metal alloy, and others. These recyclable byproducts can potentially be marketed, reducing or eliminating the need for process residue disposal. Acid gases generated in the process can be recovered and made into industrial grade salts. Process water can be treated and recycled.

Gasification is amenable to processing MSW along with other solid wastes (e.g., bulky waste, tires, C&D waste, sewage sludge, medical waste, and industrial waste). Therefore, the technology can offer a comprehensive solution for managing many waste types.

The primary advantage claimed for gasification waste-to-energy is lower emissions of air pollutants than with traditional waste-to-energy. As the gasification process is closed-loop, it has no emissions to the air. Air emissions are produced when the synthesis gas is subsequently used in fueling engines, gas turbines, or boilers to produce electricity. However, the synthesis gas is cleaned of most air pollutants prior to the gas being used as

a fuel. This advantage of lower air emissions can potentially facilitate siting and public acceptance of gasification facilities.

There are no gasification waste-to-energy facilities in the U.S. at present, although, there are several developers promoting this technology. The lack of operating facilities makes vendor claims regarding cost and technological advances difficult to evaluate. In general, gasification may be similar in cost with traditional, mass-burn waste-to-energy facilities (i.e., in the range of \$60 to \$70 per ton of waste).

One developer of gasification waste-to-energy, Thermosteel, currently has reference plants in commercial operation in Germany and Japan. Thermosteel continues to actively pursue development of MSW gasification projects worldwide, including in the United States. Another vendor offering gasification technology is Thermogenics, Inc. While Thermogenics is generally known as a gasification vendor, the company also offers their gasification systems in conjunction with alcohol processing equipment from Power Energy Fuels, Inc. to produce liquid alcohol fuels (i.e., a form of waste-to-ethanol, as discussed below).

A detailed description of the Thermosteel gasification technology is provided in Appendix D. Although there are patented differences in the gasification technologies offered by different vendors, review of the Thermosteel technology is useful in understanding the gasification process, in general, and its status as an MSW processing technology.

Waste-To-Ethanol. Ethanol is a liquid alcohol fuel, most commonly used as a blending component with gasoline. At high-concentration blends, ethanol is considered an alternative fuel. Ethanol is generally made from corn, but can be made from other biomass feedstock, including agricultural crops, waste from agriculture and forestry, waste paper, and MSW.

Waste-to-ethanol technology is distinguished from traditional waste-to-energy, because a significant fraction of the energy in MSW is recovered in a different form; i.e., as ethanol, and this is done by means of chemical processes, not through waste combustion. While this distinction exists, the process still makes use of a significant degree of thermal energy recovery.

In waste-to-ethanol, MSW is first processed to separate the traditionally recycled materials. The remaining MSW is further mechanically processed into feedstock for a chemical process. That chemical process converts the cellulose present in MSW to sugar, which is then fermented to ethanol. The ethanol is distilled, and sold as a gasoline additive. The solid residue from the process becomes a fuel for energy recovery, using a conventional boiler or a gasification system.

A potential advantage of waste-to-ethanol is that it does not produce MSW combustion ash (the disposal of such ash may be controversial and is a significant cost for traditional waste-to-energy). Another potential advantage is that the public may perceive waste-to-

ethanol to be more environmentally friendly than traditional waste-to-energy, making waste-to-ethanol plants easier to site.

One developer of waste-to-ethanol facilities, Masada, is proceeding with plans to develop the country's first, full-scale waste-to-ethanol facility in New York State. Masada's waste-to-ethanol technology is further described in Appendix D, to provide a greater understanding of the waste-to-ethanol technology. A second developer, Power Energy Fuels, Inc., has a patented process to convert carbon based waste materials into a trademarked product Ecalene™. Ecalene™ is described by the company to be a superior, ethanol-based product that includes higher alcohols. It is a clean-burning fuel that can be used as a gasoline-blending additive or directly as a fuel; it can also be blended with diesel.

Depolymerization. Polymerization is the process of combining groups of molecules to form a giant molecule called a polymer (e.g., rubber, plastics). Depolymerization is the reverse process - the reduction of complex organic materials into smaller ones. Thermo-depolymerization (TDP) is a patented depolymerization process developed by Changing World Technologies (CWT). TDP is a chemical conversion process that uses pressure and heat to decompose long chain polymers of hydrogen, oxygen and carbon into short chain petroleum hydrocarbons. Using this process, which mimics natural geologic processes, a variety of waste products can be converted into usable products, including oils, fuels, gases, carbon and minerals.

The TDP process could be applied to almost any carbon-based feedstock, including: MSW; medical waste; hazardous waste; food industry waste; and specific waste streams such as tires, rubber, plastics and paper. According to CWT, their TDP process differs from other depolymerization processes in that it does not expend energy trying to remove water from the waste materials at the start of the process. Instead, the TDP process uses water to improve the process.

TDP works by mixing waste with water to form a slurry. The slurry is pumped to a reactor where it is heated and pressurized, beginning the depolymerization process. Next, the slurry is rapidly depressurized in a flash vessel, which releases about 90% of the free water in the slurry. At this same stage, minerals settle out and are recovered. The remaining organic material is pumped to a second reactor, where heat is used to continue the depolymerization process. As the material is heated, it vaporizes and resultant products are separated and recovered in vertical distillation columns: high value crude oil; fuel gas (methane, propane and butane), which can be burned to create electricity or steam; solid minerals which can be used as fertilizers; solid carbon, which can be used as a filter or fuel source; and from certain feedstock (e.g., agriculture), fatty acid oils which can be used for soap, lubricants and rubber products.

CWT developed a pilot plant in Philadelphia, which has been used to test the process on a variety of waste feedstocks. In July 2001, they initiated construction of a \$20 million, 200 ton per day TDP facility in Carthage, Missouri, in partnership with ConAgra Foods. The Carthage plant will be the first, commercial-scale TDP facility, designed to process

turkey waste from ConAgra's Butterball Turkey Plant. The facility is reportedly in the startup phase.

MSW Processing – General. Some of the alternative processing technologies described above require (or, at least, are improved by) pre-processing of MSW, to recover recyclables and obtain a more homogeneous feedstock. Typically, this could be achieved with front-end processing integrated into the process. This processing could be simple or elaborate, depending on project-specific needs and objectives. Two alternatives are briefly described, based on interest expressed by MARC SWMD: mixed waste processing ("Dirty MRF"), and reculturing.

- **Mixed Waste Processing.** A mixed waste processing facility, commonly referred to as a dirty MRF, is a technology that processes raw municipal solid waste to recover recyclables. Facility designs can vary from manual sorting to highly automated processes; most facilities are designed with a combination of the two. Mixed waste processing facilities can also be constructed as hybrid facilities, which allow for separation of clean recyclables alongside recovery of additional recyclables from mixed waste. Compared to MRFs that process source-separated recyclables, dirty MRFs may have higher capital and operating costs, and the recyclables recovered are of lower quality. Other disadvantages include worker health and safety concerns and potential odor problems.
- **Reculturing.** The reCulture process is a waste processing technology described by the developer to be a wet chemical process for converting municipal solid waste into biofuel. Based on available technical information, the process appears to be comparable to a refuse derived fuel process. Conventional RDF technology uses shredders and other mechanical separation techniques to remove non-combustibles from MSW and create a shredded, combustible fuel. The reCulture process uses a wet system, which the developer compares to the fiber recovery process used for recycling newsprint, paper and paperboard. The use of the reCulture process would result in pelletized or "fluffed" waste (i.e., RDF), which could be combusted to produce electricity or steam. The reCulture RDF could also be further processed in a gasification or waste-to-ethanol process. Limited information is available on the reCulture process; there is no indication that the technology has been commercially demonstrated, and no cost information was available for review.

4.3.2 Management Considerations for Wastes of Interest

Wastes of interest identified by MARC SWMD include:

- Construction and Demolition Debris
- Commercial and Industrial Food Waste
- Wastewater Treatment Plant Biosolids
- Commingled Residential Plastics.

The innovative technologies described above may be capable of handling these wastes. For example, food waste is particularly suitable for source-separated composting, and the conversion technologies (gasification, waste-to-ethanol, depolymerization) reportedly handle a wide range of waste materials, including the wastes of interest.

Absent the development of a large-scale, innovative project that could provide a regional solid waste management solution, consideration can be given to focused efforts to recycle, or otherwise manage, specific waste streams. In this case, the consideration focuses more on the viability of local end markets than on the processing itself. A study of the presence and viability of local markets for these wastes of interest is beyond the scope of this report. A brief review of readily available information regarding management of the waste streams identified above in the MARC region follows.

Construction and Demolition Debris

Construction and demolition (C&D) debris such as wood waste, gypsum drywall and asphalt shingles are a waste of concern in the MARC region. The recycling of C&D debris is a growing industry in the United States, while at the same time limited by the use of recycled materials (i.e., the presence of a stable end market). The success of C&D recycling is also affected by the degree of contamination present in the waste stream. Strategies can be followed during design, construction and demolition phases of municipal building projects to reduce C&D waste. Specifically, deconstruction techniques can be employed to enhance material separation (i.e., less contamination) and promote reuse.

- **Wood Waste.** A sizable amount of C&D debris is wood waste, including wood from land clearing debris at construction sites. Markets generally exist for non-treated, recycled wood waste, particularly land clearing debris. Wood fuel is the most common reuse option for recycled wood waste. Wood fuel has been used at a number of cogeneration plants and industrial boilers. Wood recovered from C&D recycling can also be manufactured into mulches for horticulture and agricultural applications, or chipped and used as a bulking agent in biosolids and compost. Through deconstruction techniques, some wood waste can be recycled through reuse of lumber as a building supply.

- Gypsum Drywall. Wallboard is also a main component in the composition of C&D debris, but it is not as commonly recovered for reuse as wood waste. Gypsum drywall is composed of calcium sulfate dihydrate, and contains a paper backing. When disposed of in a landfill, gypsum may produce hydrogen sulfide, a noxious smelling gas.

Gypsum can be recycled in the manufacture of new drywall at plants with the ability to accept and process recovered drywall. The paper backing must be substantially removed from the drywall to facilitate reuse. New West Gypsum Recycling (NWGR) is an established company that operates several large gypsum recycling facilities, including one in Seattle. The company also offers portable recycling units to process smaller amounts of waste drywall. NWGR has developed an innovative process that removes the paper backing from the wallboard and pulverizes the gypsum, leaving recycled gypsum ready for reuse.

With limitations, gypsum can be applied in agriculture as a soil amendment, but consideration needs to be given to potential problems associated with the sulfate present in the drywall. In limited applications, gypsum has been reused as a raw ingredient in cement manufacturing and has been considered for use as a bulking agent in composting processes.

- Asphalt Shingles. Currently, limited recovery and recycling of asphalt shingles is occurring nationwide, primarily due to the concern that contaminants (i.e., asbestos) may be present in the shingles. The Construction Materials Recycling Association, together with the EPA, is working to encourage and facilitate asphalt shingle recycling. The largest market for asphalt shingle recycling is in hot mix asphalt. Other potential markets, though not yet well developed, include: temporary roads, parking lots and driveways; as a road base, when blended with other materials; as patch material for roads; in the manufacture of molded products, such as parking blocks; in the production of new shingles; and, with controversy, as a fuel.

Commercial and Industrial Food Waste

Source-separated food waste can be effectively managed through composting. Because food waste has a high moisture content and low physical structure, food waste should be mixed with a bulking agent, such as yard waste. Co-composting with yard waste will add structure to the mix and absorb excess moisture. Barriers to food waste composting typically include the lack of processing capacity, potential odor problems during the composting process, and absence of a stable market for the final compost product. Compost from source-separated food waste, particularly pre-consumer food waste, is likely to have higher nutrient value and lower contamination than other compost products, which may make it more valuable in the market.

An example of large-scale efforts to promote food waste recycling is occurring in the Commonwealth of Massachusetts. In its Beyond 2000 Master Plan, the Massachusetts DEP has proposed banning food residuals from landfills in 2010, beginning with the commercial sector. Massachusetts DEP has identified the greatest barrier to food waste recycling to be local processing capacity. Their ongoing efforts to promote food waste recycling include research to identify generators (density mapping); establishment of partnerships to increase processing capacity and waste diversion, including development of a program to assist supermarkets in setting up organic diversion programs; and anticipated use of regulations to remove road blocks to end-product marketing.

Significant study has also taken place in Wisconsin. WasteCap Wisconsin, in partnership with public and private parties, has conducted several food waste recovery projects including: co-composting food waste and duck manure, recovery of food scraps for vermicomposting and windrow composting, feeding of unprocessed food wastes and pelletized food wastes to swine, and piloting of a project to recover food waste from grocery stores and co-compost with yard waste and chicken manure. The co-composting pilot was reported to be successful; however, WasteCap concluded that there is a need to develop end markets for the compost for economically sustainable food waste recovery efforts. See Appendix D for full article.

Management Considerations for Biosolids

Biosolids, nutrient-rich organic matter, are generated as a result of the treatment (stabilization) of sludge at a wastewater treatment facility. Biosolids may be incinerated, but can also be recycled as a fertilizer and soil amendment. Biosolids can be used for a variety of purposes: as a fertilizer for agricultural uses; to reclaim disturbed soils (replace lost topsoil), such as for surface strip mines, large construction sites, and landfills; and to improve forest productivity (e.g., promote rapid timber growth and enhance the aesthetic value of Christmas trees). In addition, biosolids may be composted for beneficial use. For example, biosolids composted with sawdust, wood chips or yard waste can be marketed as mulch or topsoil for horticultural and landscaping purposes.

Land application of biosolids is subject to federal and state standards. The federal biosolids rule is contained in 40 CFR Part 503, which provides general requirements, quality standards (e.g., metals content, pathogen standards) and management practices for land application.

Case studies demonstrating success in the beneficial use of biosolids have been published. According to a nationwide survey conducted by Biocycle in 2000,²¹ the majority of biosolids are now managed by beneficial use practices, rather than by landfilling or incineration. However, project failures are also documented. Odors, concerns about pathogens, and establishment of stable markets for product end-use are the most common hurdles in successful beneficial use projects.

²¹ Goldstein, Nora. The State Of Biosolids In America. *BioCycle*. December 2000.

Further evaluation of opportunities for beneficial use of biosolids in the MARC region may be warranted. Consideration of beneficial use of biosolids requires consideration of local conditions: quantity and quality of biosolids generated; availability of suitable farmland/forest areas for land application; regulatory framework for project development and implementation; availability of suitable materials (bulking agents) to co-compost with biosolids; market conditions for composted biosolids, and other economic considerations.

A viable source for comprehensive, up-to-date information on biosolids is the National Biosolids Partnership (NBP), a not-for-profit alliance formed in 1997 with the Association of Metropolitan Sewerage Agencies (AMSA), Water Environment Federation (WEF), and U.S. Environmental Protection Agency (EPA). NBP's website is located at <http://biosolids.policy.net>.

Commingled Residential Plastics

In conventional recycling, sorted plastics are chopped, washed and converted into flakes or pellets that are then processed into new products. If viable markets for the recycling of *commingled* residential plastics are not available, research supports the technical and economic feasibility of using the plastic in process engineered fuels (PEF), where collected plastics are processed with paper into fuel pellets and then used in conjunction with coal and other fuels in industrial boilers and utility plants. Since 1994, the American Plastics Council has been working to promote and facilitate the manufacturing and use of PEF. Hurdles, however, include lack of processing capacity, cost, and regulatory acceptability.

4.4. Funding Strategies

The purpose of the following review is to provide MARC SWMD with information on the funding strategies used by other regional organizations. Seven regional organizations were reviewed. The information sources for this section include the organizational websites and follow-up telephone calls for clarification. Table 23 summarizes the following points:

- Name of the organization, website and contact information
- Year the organization was created
- The structure of the organization
- The area served
- Taxing and regulatory authority
- Funding sources.

All of the solid waste regional organizations surveyed had funding concerns and most were searching for ways to insure that their future funding needs were met. All of the organizations currently obtained funding through more than one funding mechanism. The most common funding mechanisms identified were:

- User fees from solid waste facilities owned by the organization

- Disposal fees on solid waste disposed in member cities/counties solid waste facilities
- Generation (origination) fees on solid waste disposed in regional and nonregional facilities receiving solid waste that originated within the organizations boundaries
- Member cities/counties association fees
- State grants.

Following Table 23 is additional information on each organization.

**TABLE 23
SELECTED SOLID WASTE MANAGEMENT REGIONAL ORGANIZATIONS SUMMARY**

Name	Created	Organization	Area Served	Authority	Funding Sources
Tri-County Solid Waste District www.4county.com 888-426-9278	1991	Arkansas Act 699 of 1979 – nine counties Reorganization in 2002 To Tri-County	Arkansas – three counties	No taxing authority Regulatory authority	1. Generation fee of \$1.50 per ton solid waste generated in the District 2. Member contributions of \$0.50 per capita per year 3. State grants
East Central Iowa Council of Governments www.ia.net/~ecicog/ 319-365-9941	1972; 1990 first solid waste planning staff hired	Intergovernmental Council; Elected and non elected representatives from each county	Iowa – eight counties	No taxing authority No regulatory authority	1. Member counties fund solid waste staff with a \$0.30 per capita per year fee 2. State grants Counties or cities own their own landfills
Solid Waste Management Coordinating Board www.swmcb.org 651-222-7227	1989	Joint powers board; 2 county commissioners from each county plus office of Environmental Assistance and Minnesota Pollution Control Agency representatives	Minnesota – six counties (Minneapolis/St. Paul area)	No taxing authority No regulatory authority	1. Member counties are equal contributors 2. Metropolitan Landfill Abatement Fund. State collects a surcharge of \$6.66/ton MSW. Monies come back to the board

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Solid Waste Authority of Central Ohio www.swaco.org 614-871-5100	1989	Ohio General Assembly HB 592 Nine-member Board of Trustees	Ohio – Franklin County plus parts of five surrounding counties (that portion of each county where city boundaries cross county lines) Columbus area	Taxing authority Regulatory authority	1. Authority owns a landfill and three transfer stations 2. Fee assessed on solid waste generated within the District and disposed at the SWACO landfill or other public or privately-owned landfills located outside of Franklin County 3. State grants
Hamilton County Department of Environmental Services Solid Waste Management District www.hcdoes.org 513-946-7719	1989	Ohio General Assembly HB 592	Cincinnati, Ohio	No taxing authority No regulatory authority	1. Disposal fee assessed at the privately owned Hamilton County Landfill 2. State grants
Metro www.metro-region.org 503-797-170	1992 – existing structure	Elected regional government	Oregon – three counties Portland area	Taxing authority Regulatory authority	1. Enterprise revenue 2. Taxes 3. State grants
Southeastern Public Service Authority of Virginia www.spsa.com 757-420-4700	1976	Intergovernmental agreement	Southampton County and municipalities >1 million population	No taxing authority No regulatory authority	1. Initial funding of \$3 million from bond anticipation notes 2. Authority owns a landfill, 8 transfer stations, a refuse derived fuel plant, and a power plant

Tri-County Solid Waste District. The counties in the Tri-County District originally were part of a nine county district. In 1991, the District included four counties and in 2002 the district was reduced to three counties. The county leaving the District in 2002 was more rural in nature and decided a more rural district would better serve their needs.

The generation fee was originally a disposal fee. The District collected \$1.50 per ton solid waste disposed in facilities located in the member counties. Arkansas state law allowed the fee to be changed to a generation fee. This type of fee provides an assessment

on waste that is transferred out-of- state or out-of-county as well as waste disposed within the District. Arkansas assesses a \$1.50 per ton fee on solid waste leaving the state. The Tri-County District has been allowed to attach an additional \$1.50 to the state's fee on solid waste generated within the District.

ECICOG. East Central Iowa Council of Governments is a planning agency serving approximately 380,000 people. Most of the members own their disposal facilities and provide for the collection of residential and, in some cases, a portion of the commercial solid waste. The members are losing revenue at their disposal facilities to private haulers that collect commercial waste and do truck-to-truck transfer of the waste for transport to landfills in Illinois. The Council is promoting the solution that cities contract for commercial collection of solid waste much like they do for residential.

SWMCB. Minnesota's Solid Waste Management Coordinating Board contracts with Richardson Richter Associates for administration, policy and management functions. The Board does not have its own staff or office space. Member counties provide county staff time as needed. Through a funding agreement with the state, the Board receives funding from a landfill surcharge at area disposal facilities. In addition to this funding source, member counties are equal contributors at the level necessary to maintain the functions of the Board.

SWACO (Solid Waste Authority of Central Ohio). Ohio law requires that landfills document origin of solid waste and reimburse the authority (or district) with jurisdiction over the county where the waste originated. The authorities set the fee amount. SWACO has set a five-dollar generation fee that is included in the landfill tipping fee at their landfill and any other Ohio landfill accepting SWACO regional waste. Waste disposed out-of-state avoids the generation fee.

In 1994, SWACO closed an authority owned waste-to-energy facility due to an inability to implement flow control measures resulting in insufficient waste quantities being delivered to the facility. The volatility of waste flow into the remaining facilities continues to be a challenge.

HCDOES. Hamilton County Solid Waste Management District assesses a disposal fee on solid waste entering the privately owned Hamilton County Landfill. The fee structure is \$1 per ton on Hamilton County generated solid waste, \$2 per ton on out-of-county solid waste and \$1 per ton for out-of-state generated solid waste disposed in the Hamilton County Landfill. HB 592 authorized disposal fees, which are similar to the generation fees.

The District, located on the Kentucky border, is impacted by solid waste from the district going to out-of-state landfills. The district is evaluating their options to capture lost revenue from out-of-state transfer.

One option, successfully implemented in the Van Wert County District, utilized the District's power to designate disposal facilities. The District required designated disposal facilities to enter into a contract with the county (county had the power to contract). The

contracts specified a certain amount of reimbursement that would flow back to the District. This funding mechanism has been challenged and upheld in the Ohio courts.

Metro. In 1979, the Columbia Region Association of Governments (CRAG) combined with the Metropolitan Service District to form Metro. The Metro's functions include solid waste and transportation planning, management of the Washington Park Zoo and managing the urban growth boundary. Management of the local landfill was added to the Metro functions in 1980. Voters approved the existing organizational structure in 1992.

The Metro funds the solid waste management functions from the general budget. The general budget revenue sources shown in Table 23 represent 77 percent of the Metro's total budget. The remaining 23 percent comes from interest earned, intergovernmental sources, and interfund transfers. The taxes levied by the Metro include both property taxes and excise taxes.

SPSA (Southeastern Public Service Authority of Virginia). The authority's facilities are sized to handle all of the areas MSW (residential and commercial). To attract waste collected by private haulers, SPSA contracts favorable hauler rates guaranteed over a period of years not to exceed those tipping fees paid by the member communities. This is particularly challenging since two of the largest haulers also own large landfills in the area. The contracts make it attractive for the private haulers to use the authority's facilities and import out-of-state waste into their own landfills.

The host community receives free disposal of MSW collected within its borders. This represents an annual savings of \$2.75 million to the city. In addition, private haulers collecting commercial waste within the city receive discounted rates of one-third normal tipping fees.²²

²² 2003 Solid Waste Management System Excellence Award Gold Medal: Southeastern Public Service Authority. John Trotti. MSW Management. September/October 2003.

TASK 5. POLICY RECOMMENDATIONS TO GUIDE FUTURE PLANNING AND DECISION-MAKING OVER A TEN-YEAR PLANNING HORIZON

5.1. Observations

To shape the policy recommendations that follow in Section 5.2, some general observations derived from previous sections of the report are made here. Several of these observations revolve around the nature of solid waste management in the MARC region.

5.1.1. Solid Waste Management in the Region

Solid waste management is essentially a private sector activity in the entire region. For example, there are only four landfills in the region, three of which are privately owned (Lee's Summit is the exception). Significantly, 87 percent of solid waste disposal takes place in Kansas. Also, private haulers provide most of the collection services in the region with some notable exceptions for residential solid waste collection, e.g., Kansas City, Missouri; Olathe, Kansas.

Also, city and county governments are involved to a limited extent in the management of solid waste. However, 21 cities in Missouri provide for residential solid waste collection by contract; only three cities in Johnson County contract for residential collection. As a consequence, oversight by cities and counties is limited.

Residential waste collection other than by cities or city contract is carried out via homeowner associations or by individual contracts with haulers. Many of these have curbside collection of recyclables, or the option to provide curbside collection at an additional cost.

5.1.2. Diversion of Recyclable Materials

Another factor important to the structure of solid waste management has meant that diversion of recyclable materials, including composting, is well below the national average. For residential collection access to curbside recycling is relatively high (65 percent) however, city contracted curbside programs exist in the following communities: Harrisonville, North Kansas City, Liberty, Missouri plus Prairie Village, Mission, and Roeland Park in Kansas. In addition to these cities, there are a few smaller communities that also contract for curbside recycling service. It does appear that Kansas City, Missouri will move into curbside collection of recyclable materials in 2004.

Most of the diversion that takes place is via the commercial sector and is principally paper products such as corrugated boxes and office paper. Other materials such as metals and plastics are also diverted, but in relatively small quantities. Most diversion of yard wastes is through source reduction on-site.

5.1.3. MARC SWMD Diversion Activities

There are some very effective diversion programs that the MARC SWMD has stimulated. For example, household hazardous waste collection, support of Surplus Exchange, and support of pilot programs have all led to diversion successes. Bridging The Gap has management responsibilities over the drop-off sites provided by local governments on the Missouri side. Nonetheless, disposal of solid waste continues to increase in the SWMD.

5.1.4. Data Collection Systems

The data collection system(s) are fragmented and incomplete. As a result, planning and policy considerations are hampered by lack of comprehensive information on solid waste disposal and diversion. However, most private sector recycling companies have been cooperative in providing data that will support the planning process.

5.2. Policy Recommendations

5.2.1. Introduction

The observations developed in Section 5.1 are background for the policy recommendations. However, the policy issues are presented in a sequence that starts with data collection needs and progresses to broader regional options.

5.2.2. Data Collection

Good data provides the foundation on which analysis of trends and opportunities is based. Data also provides the basis on which policy evolves. Thus, a coordinated and continuing development of data such as required for this report would be a key service that the MARC SWMD could provide.

Landfill data on the Missouri side is not available in sufficient detail. Missouri DNR should be urged to collect disposal data broken down as MSW (residential and commercial), industrial waste, and construction and demolition (C&D) debris, plus special wastes such as contaminated soils. That will make Missouri landfill data comparable to Kansas data collected now.

The solid waste role of Kansas cities and counties is not documented as well as that for the MARC SWMD members. This information should be collected for the Kansas side. The number of households and the number actually serviced by curbside collection of recyclables should be included.

Also, MARC SWMD should identify and collect data on diversion of solid waste with special emphasis on private recyclers. (Most were cooperative during this study.)

- Policy Recommendation: MARC SWMD should establish and provide an on-going regional database as a service to the region. Assistance can be derived from Missouri DNR, Kansas DHE, Kansas counties in the region, and perhaps others.

5.2.3. Local Government Activism

As noted earlier, cities and counties in the MARC region are involved in a wide spectrum of residential collection services. The most cost effective for citizens are city-provided services via contract, often including curbside collection of recyclables. Homeowner associations also provide similar cost-effective contract collection. However, where individuals contract separately, they typically pay \$14 to \$18 per month, including curbside recycling as an option. For comparable services by city contract, the costs are \$9 to \$12 per month per home, with curbside recyclables collection included.

- Policy Recommendation: Proactive government policies, programs, and practices must be stimulated, especially for residential waste collection and curbside recycling. Local communities should provide carefully developed contracts with private haulers where individual services are dominant. This approach will save citizens significant amounts of fees and will expand curbside collection of recyclables. MARC SWMD should provide assistance to the communities as appropriate.

5.2.4. Diversion of Solid Waste

Cost effective curbside collection for recycling should be further encouraged. With commingled (single-stream) collection of all but glass, this technique will divert greater quantities of paper from homes, e.g., corrugated boxes, mail, cartons, etc. A modified pay-as-you-throw system can also be effective. However, the cities and counties in both Missouri and Kansas will need to be more actively involved for this to happen.

- Policy Recommendation: MARC SWMD should encourage all cities and counties to be more involved in solid waste management, especially diversion, not only of residential waste, but of other sources as well.

The greatest potential for diversion lies with industrial wastes, commercial wastes, and C&D debris.

- Policy Recommendation: MARC SWMD should be more aggressive in encouraging the private sector to develop:
 - Reuse and recycling of wood wastes (lumber, trees, etc.) and concrete
 - Composting of organics such as food wastes
 - Co-composting of wastewater treatment plant biosolids and yard waste

Deconstruction of buildings will grow slowly, but should continue to be encouraged by MARC via such organizations as Habitat for Humanity.

The prospects for stimulating glass recovery and recycling seem quite limited for a number of reasons.

- Policy Recommendation: MARC SWMD should continue to encourage a limited feasibility study of recycling glass in the region, with focus on how to collect glass containers in the absence of sufficient curbside collection programs and the presence of single-stream collection that excludes glass.

5.2.5. Emerging Technologies

The emerging technologies examined are not proven at a commercial level and have uncertain economic value.

- Policy Recommendation: MARC SWMD should monitor emerging technologies, but wait for the private sector to demonstrate commercial development and cost effectiveness.

5.2.6. Landfill Capacity

If current trends continue, toward the end of the 10-year planning period landfill capacity on the Missouri and Kansas sides will be more limited than it is today.

- Policy Recommendation: MARC SWMD should support the location of transfer station(s) as landfill capacity reaches its limits, especially in Missouri. This suggests that landfill capacity will move out of the region in the next decade.
- Policy Recommendation: MARC SWMD should support the siting of environmentally sound disposal sites, including C&D landfills, by the private sector in Missouri. This is not a popular subject to promote, but reality is that much of the solid waste generated will continue to be disposed in landfills, and without an alternative, more and more Missouri solid waste will go to Kansas landfills.

5.2.7. Regional Management of Solid Waste

The MARC SWMD promotes diversion and sound SWM practices in Missouri. The Kansas agencies are cooperative, especially on regional issues such as illegal dumping. Kansas landfills take a growing percentage of Missouri-generated wastes. MARC should explore ways to involve the Kansas counties more directly in the planning process. In addition, EPA Region VII is a resource of value and should be included in MARC's planning activity.

In order to attract Kansas counties into the district, MARC SWMD will have to provide more services that bring value to cities and counties. Some of the recommendations that follow will encourage bringing Kansas counties into the SWMD in a more proactive way.

- Policy Recommendation: MARC SWMD should pursue expanding to include Kansas counties, perhaps as a separate organization until true regionalization is recognized as valuable.

5.2.8. Education that Leads to Action

The linkage that stimulates action is education on solid waste. Solid waste is nearly off the radar screen now because of other pressures, e.g., national security, new public education requirements, declining funds, tax pressures, etc. Nonetheless, the number one priority of MARC SWMD should be to provide education to stakeholders, especially public officials, school age children, private sector firms (including the solid waste and recycling community), public sector agencies, and community leaders. The whole idea is to re-energize the stakeholders to become more cost effective and to benefit the environment at the same time.

- Policy Recommendation: Partnerships in solid waste management education are vital, and MARC SWMD already has invested in a number of successful partnerships. The SWMD should continue to explore new and innovative educational possibilities.

5.2.9. Funding Strategies

The SWMD depends on Missouri DNR and landfill surcharges for funding. It is likely that the current structure of funding will lead to declines as waste destinations move more to Kansas in the near term. Obviously, reviewing how the SWMD allocates funding should be carefully reviewed, in case funding is restricted. There are a few alternative funding strategies that are worthwhile to explore from a policy standpoint.

Solid Waste Origination Fees. One of the techniques used to keep funding at a level rate would be to set the fee at the point of origination rather than disposal. This is done in some districts where solid waste crosses district and state lines. The mechanism would have to be established.

One immediate issue is that the MARC regional solid waste going to Kansas would be subject to two surcharges, one to support the SWMD and one already in place in Kansas.

- Policy Recommendation: MARC SWMD should explore origination fees only if other options are not feasible.

Joint Powers Board or Intergovernmental Agreement. Bringing several jurisdictions together is a common approach to all sorts of intergovernmental activities. The SWMD already exists in this way. However, the SWMD could be a mechanism to expand the district to Kansas counties.

- Policy Recommendation: MARC SWMD should explore this approach to bring one or more Kansas counties into the SWMD. (The funding arrangements could be a sticking point, of course.)

Per Capita Fee. We believe that the member communities need to be more directly involved in solid waste management and diversion activities. In fact, if more cities contracted for residential and commercial waste management there could be benefit to both residential and commercial customers.

One method of funding is to apply a modest annual per capita fee to fund the SWMD. For example, one organization cited in Section 4.4 collects \$0.30 per person per year to help fund regional solid waste management activities.

- Policy Recommendation: The first policy approach to be explored should be the per capita fee in conjunction with the intergovernmental agreement approach.

As shown in the previous discussion, there are other ways that communities have funded their operations, but the ones listed above seem to hold the most promise for the SWMD.

5.2.10. Regional Authority

All analysis of trends and practices in the MARC region leads to the conclusion that MARC SWMD needs to examine its role in solid waste management in depth. This includes its role in the region from the viewpoint of services it can provide to attract more participation and partnership with the private sector as well as local governments at the county, city, and state level.

Funding mechanisms will not enhance the MARC SWMD via a view that perpetuates the status quo. Thus, a broader approach and strategic view should be given priority attention. In this context, a regional Solid Waste Management Authority may be the ultimate strategic objective.

As long as the strengths of the private sector can be the guiding philosophy, the citizens of the MARC region will be well served. Moving toward a regional Solid Waste Management Authority is worthy of in-depth exploration. Such an Authority would provide a basis on which local governments could coordinate their efforts. Regional Authorities work in several regions of the U.S.

- Policy Recommendation: MARC should explore the development of a regional Solid Waste Management Authority that provides bistate oversight of solid waste management. The study should include various models that are already in place, with the ultimate goal of more diversion and lesser dependence on disposal facilities.

- Regionalization means bringing Kansas counties and cities into the MARC Solid Waste Management District. To do so, MARC SWMD will have to provide services to attract Kansas counties and cities. This is essential and will require involvement of the full MARC Board. The SWMD's role will be to take the first step to establish stronger working relationships with state, county, and city governments and agencies outside the MARC SWMD. Also, other stakeholders such as private sector solid waste management companies, local recyclers, and not-for-profit organizations will need to be involved. In this way, the services that will attract participation in the SWMD can be defined clearly. Then, true regionalization can be developed.

APPENDIX A – REGIONAL FACILITIES

**TABLE A-1
SOLID WASTE FACILITIES
CASS COUNTY MISSOURI**

<u>Facility</u>	<u>Type</u>	<u>All Sources (1)</u>	
		<u>tons/2002</u>	<u>tons/day (2)</u>
Cass County Disposal	Transfer Station	na	
Roll-Off Service	Transfer Station	100	0.27

na = not available

(1) MARC data; does not include intrastate transfer of waste

(2) 365 days/year

Franklin Associates, A Division of ERG.

**TABLE A-2
SOLID WASTE FACILITIES
JACKSON COUNTY MISSOURI**

<u>Facility</u>	<u>Type</u>	<u>All Sources (1)</u>	
		tons/2002	tons/day (2)
Pink Hill Acres Demolition Landfill	C&D Landfill	proposed	
City of Lee's Summit	HHW	36	0.1
Kansas City Regional Facility	HHW	530	1.5
Courtney Ridge	MSW Landfill	292,202	801
City of Lee's Summit	MSW Landfill	79,318	217
Sibley Fly Ash Landfill	Special Use	na	
Amoco Oily Dirt Land Treatment Facility	Special Use	na	
Hawthorn Station Utility Waste Landfill	Special Use	proposed	
Galamet Special Waste Landfill	Special Use	proposed	
Material Recovery & Transfer	Transfer Station	proposed	

na = not available

e = estimated by Franklin Associates

(1) MARC data

(2) 365 days/year

Franklin Associates, A Division of ERG.

**TABLE A-3
SOLID WASTE FACILITIES
JOHNSON COUNTY KANSAS**

Facility	Type	All Sources (1)		Missouri (1)
		tons/2002	tons/day (2)	%
Asphalt Sales	C&D	43,463	119	0%
City of Olathe	C&D	6,625	18	0%
City of Overland Park	C&D	1,851	5	0%
Holland Corporation(3)	C&D	0	0	0%
O'Donnell and Sons Construction Co.	C&D	136,252	373	0%
Reno Construction, Inc.	C&D	183,448	503	0%
City of Spring Hill	Composting	na		0%
Signature Landscape	Composting	na		0%
City of Olathe	HHW	49	0	0%
Johnson County HHW	HHW	140	0	0%
City of Olathe(4)	Industrial	na		0%
Johnson County Landfill	MSW	1,611,130	4,414	25%
Deffenbaugh Industries(5)	Tire Processing			
City of Lenexa	Transfer Station	552	2	0%
City of Olathe	Transfer Station	82,568	226	0%

na = not available

(1) KDHE Solid Waste Facilities Database. www.kdhe.state.ks.us/waste/index.html

(2) 365 days/year

(3) Holland Corporation accepted 5,205 tons of C&D the first quarter of 2003
(28% or 1,476 tons were from Missouri).

(4) Lime sludge from water production.

(5) Tire quantities included with Johnson County Landfill data.

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**TABLE A-4
SOLID WASTE FACILITIES
LEAVENWORTH COUNTY KANSAS**

<u>Facility</u>	<u>Type</u>	<u>All Sources (1)</u>		<u>Missouri (1)</u>
		<u>tons/2002</u>	<u>tons/day (2)</u>	<u>%</u>
American Roofing Inc.	C&D	3,150	9	0%
DDE VA Medical Center	C&D	200	1	0%
Ft. Leavenworth	C&D	1,287	4	0%
Lansing Correctional Facility	C&D	89	0	0%
Leavenworth County	C&D	801	2	0%
Leavenworth Excavating	C&D	486	1	0%
Ft. Leavenworth HHW	HHW	na		
Leavenworth HHW Program	HHW	68	0	
Duane Becker/Tire Town	Tire Monofill	7,638	21	59%
Tire Town, Inc.	Tire Processing, Transporter	na		
AAA Recycling	Tire Transporter	na		
Leavenworth County	Transfer & Composting	27,013	74	0%

na = not available

(1) KDHE Solid Waste Facilities Database. www.kdhe.state.ks.us/waste/index.html

(2) 365 days/year

Franklin Associates, A Division of ERG.

**TABLE A-5
SOLID WASTE FACILITIES
WYANDOTTE COUNTY KANSAS**

Facility	Type	All Sources (1)		Missouri (1)
		tons/2002	tons/day (2)	%
Kansas City	HHW	103	0.3	0%
Stericycle(3)	Incinerator	3,321	9.1	0%
Griffin Wheel(4)	Industrial	3,594	9.8	0%
KC KS Board of Public Utilities(5)	Industrial	10,231	28.0	0%
KC KS Board of Public Utilities(6)	Industrial	744	2.0	0%
Forest View	MSW	377,374	1033.9	22%
Tom's Tire Processing	Tire Processing	na		
BFI Waste Systems NA, Inc.(7)	Transfer Station	0	0.0	0%

na = not available

(1) KDHE Solid Waste Facilities Database. www.kdhe.state.ks.us/waste/index.html

(2) 365 days/year

(3) Medical waste incinerator

(4) Metal foundry wastes

(5) Fly ash, bottom ash

(6) Wood chips from land clearing.

(7) BFI maintains an active permit but is not currently transferring waste through the facility.

Franklin Associates, A Division of ERG.

*Strategic Directions and Policy Recommendations for
Solid Waste Management In The Bistate Kansas City Metropolitan Region*

**TABLE A-6
IDENTIFIED MISSOURI DIVERSION FACILITIES (1)(2)**

Missouri Companies	Primary Activity	Materials
Cass County		
M & M Auto Wrecking Co.	Dealer/Processor/Packer	Metals
Roll-Off Service	MRF	Metals, Paper, Plastic
Clay County		
Birmingham Auto Parts	Collector	Metals
City of North Kansas City	Composting	Yard Waste
Columbia Burlap & Bag Co.	Dealer/Processor/Packer	Textiles
Jones Iron & Metal Corp.	Dealer/Processor/Packer	Metals
Midwest Shredding Service	Dealer/Processor/Packer	Metals, Paper
Tire Recycling, Inc.	Collector	Tires
United Cerebral Palsy	Reuse	Residential
United States Gypsum Co.	Consumer (End User)	Paper
Jackson County		
12th Street Recycling Inc.	Collector	Metals
Ajax Auto Parts	Collector	Metals
American Compressed Steel Inc.	Dealer/Processor/Packer	Metals
American Lung Association	Reuse	Residential
American Textile Mills	Dealer/Processor/Packer	Paper, Textiles
Aquila	WTE (End User)	Tires
As Is Aluminum Recycling	Collector	Metals
Batliner Paper Stock Co.	Dealer/Processor/Packer	Paper, Plastics
BFI/Allied	MRF (Planning Stage)	
Central American Tire Salvage	Collector	Tires
City of Lee's Summit	Composting	Yard Waste
City Scrap Metal L.L.C.	Dealer/Processor/Packer	Metals
Cook Paper Recycling Corp.	Broker	Paper
Damon Purcell	Composting	Yard Waste
Disabled American Veterans	Reuse	Residential
Door Step Pallet Repair	Reuse	Wood Pallets
Envirostar Waste Services	Collector	Appliances, Yard Waste
F&S Pallet	Reuse	Wood Pallets
Frank Metal Co.	Dealer/Processor/Packer	Metals
Galamet Inc.	Dealer/Processor/Packer	Metals
Helping Hand of Goodwill Industries	Reuse	Residential
Habitat ReStore	Reuse	C&D, Surplus Building Materials
Homan Steel Co.	Collector/Dealer	Metals
KC Iron & Metal Co.	Collector	Metals
KCP&L	Byproduct Use	Fly Ash, Bottom Ash, Dry Scrubber Residue, Cyclone Boiler Slag
LaFarge	WTE (End User)	Landfill Methane Gas Recovery
Langley Recycling, Inc.	Dealer/Processor/Packer	Metals
Lee's OK Tire, Inc.	Collector	Tires
MARCK Industries	Broker/Dealer	Paper
MO Council of the Blind	Reuse	Residential
Mallin Brothers Co.	Dealer/Processor/Packer	Metals, Plastics
Material Recovery & Transfer	MRF	
Metal By The Foot	Collector/Dealer/Processor	Metals
Metro Recycling Inc.	Dealer/Processor/Packer	Metals
Midwest Mulch Manufacturing	Mulcher	Wood
Missouri Organic Recycling	Composting	Yard Waste, Food Waste
Paper Stock Dealers	Dealer/Processor/Packer	Paper
Philip	Dealer/Processor/Packer	Metals, Glass, Oil, Textiles, Other Materials
Philip Metals Inc.	Collector/Dealer	Metals
Pioneer Pallet Brokerage Co.	Reuse	Wood Pallets

*Strategic Directions and Policy Recommendations for
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**TABLE A-6
IDENTIFIED MISSOURI DIVERSION FACILITIES (1)(2)(Cont'd)**

Missouri Companies	Primary Activity	Materials
Jackson County (Cont'd)		
Reardon Pallet Co.	Reuse	Wood Pallets
Recycled Wood Products	Collector/Processor	Wood
Rich Industries Inc.	Collector	Metals
Salvation Army ARC	Reuse	Residential
Suburban Lawn & Garden	Composting	Yard Waste
The Surplus Exchange	Reuse	Residential, Commercial
Top Metal Recycling	Collector	Metals
Univar USA Inc.	Collector	Chemicals, HHW
Wabash Iron & Metal Co.	Dealer/Processor/Packer	Metals
Warehouse One	Reuse	C&D, Surplus Building Materials
Waste Express	Transportation/Storage/Disposal	Hazardous & Non-Hazardous
Windswept Worm Farm	Composting	Yard Waste, Manure, Sawdust, Wood Ash
Platte County		
Office Products Recycling	Reuse	Residential, Commercial
Ray County		
Ideal Industries	Consumer (End User)	Shredded Paper
Out of Region		
Alternative Fuel Sources	Collector/Processor	Tires
Antifreeze Recycling Service	Collector/Processor	Antifreeze
Education Textbook Services & Recycling	Collector/Processor/Reuse	Textbooks, Paper, Aluminum Cans, Plastic Bottles
Midwest Scrap Management	Dealer/Processor/Packer	Metals
Missouri Textile & Apparel Center		Textiles
NWMSU	WTE	Paper Pellets
St. Joseph Plastics	Dealer/Processor/Packer	Plastics

(1) MARC Staff, American Recycling Markets database, and Franklin Associates.

(2) Diversion facilities include brokers, reuse, recovery, recondition, and end use facilities.

**TABLE A-7
IDENTIFIED KANSAS DIVERSION FACILITIES (1)(2)**

Kansas Companies	Primary Activity	Materials
<u>Johnson County</u>		
I-35 Auto Parts	Collector	Metals
I.J. Cohen & Co. Inc.	Broker	Metals
City of Olathe	Composting	Yard Waste
Flooring Systems	Collector	Foam Rebound Pad
National Kidney Foundation	Reuse	Residential
Security Shred	Dealer/Processor/Packer	Paper
Wise Recycling	Dealer/Processor/Packer	Metals
<u>Leavenworth County</u>		
ABC Recycling	Collector	Metals, Paper
Dickerson Recycling Center	Collector	Metals, Paper
Stateline Recycling	Dealer/Processor/Packer	Metals
Stateline Recycling	Dealer/Processor/Packer	Metals
Tire Town, Inc.	Dealer/Processor/Packer	Tires
<u>Wyandotte County</u>		
A-1 Barrel Company	Collector	Metals
Abitibi-Consolidated (Donohue)	Collector	Paper
Asner Iron & Metal Co.	Collector	Metals
Chelsea Coalition	Reuse	Residential
Contour Products	Consumer (End User)	Polystyrene
Deffenbaugh Materials Recycling Facility	MRF	Metals, Paper, Plastics
Erman Corporation, Inc.	Dealer/Processor/Packer	Metals
Kaw River Shredding	Dealer/Processor/Packer	Metals
Muncie Auto Salvage Inc.	Collector	Metals
National Compressed Steel Corp.	Dealer/Processor/Packer	Metals
National Fiber Supply Co.	Dealer/Processor/Packer	Paper
OBN Recycling	Dealer/Processor/Packer	Metals
Olson Industries of Kansas City Inc.	Dealer/Processor/Packer	Metals
Planet Marris Recycling	Composting	Yard Waste (No Grass)
Sawyer Auto Salvage Inc.	Collector	Metals
Scott Barrel Company Inc.	Reconditioner	Metals
Shafer Salvage	Dealer/Processor/Packer	Metals
Shostak Iron & Metal Co., Inc.	Dealer/Processor/Packer	Metals
Smurfit Recycling Company	Dealer/Processor/Packer	Metals, Paper, Plastics
Supervalve Sales	Collector/Processor/Reuse	Appliances
<u>Out of Region</u>		
Atchison Iron & Metal Co.	Collector, Dealer	Metals
King Auto/Metal Recycling	Collector	Metals

(1) MARC Staff, American Recycling Markets database, and Franklin Associates.

(2) Diversion facilities include brokers, reuse, recovery, recondition, and end use facilities.

APPENDIX B – POPULATION STATISTICS

**TABLE B-1
MISSOURI POPULATION CLASSIFICATION**

Urban Area	July 1, 2002 Population	July 1, 2001 Population	July 1, 2000 Population
Grandview city	25,542	24,713	24,853
Independence city	113,027	113,194	113,298
Kansas City city	443,471	442,608	441,828
North Kansas City city	4,743	4,731	4,716
Raytown city	30,060	30,198	30,357
Riverside city	2,975	2,979	2,979
Sugar Creek city	3,764	3,797	3,832
Total	623,582	622,220	621,863

Suburban Area	July 1, 2002 Population	July 1, 2001 Population	July 1, 2000 Population
Avondale city	532	531	529
Belton city	23,214	22,485	21,877
Birmingham village	216	215	214
Blue Springs city	49,451	49,009	48,286
Claycomo village	1,276	1,272	1,268
Gladstone city	26,778	26,588	26,404
Glenaire city	586	573	557
Greenwood city	4,300	4,191	4,001
Houston Lake city	283	283	284
Lake Lotawana city	1,915	1,897	1,878
Lake Tapawingo city	839	841	843
Lake Waukomis city	919	920	918
Lake Winnebago city	984	942	910
Lee's Summit city	74,948	73,302	71,241
Liberty city	27,532	26,991	26,378
Northmoor city	410	405	400
Oaks village	137	136	136
Oakview village	388	387	386
Oakwood village	198	198	197
Oakwood Park village	184	184	183
Parkville city	4,644	4,421	4,132
Peculiar city	2,996	2,859	2,654
Platte City city	4,598	4,226	3,939
Platte Woods city	471	473	474
Pleasant Valley city	3,383	3,358	3,328
Raymore city	12,612	11,900	11,291
Weatherby Lake city	1,879	1,872	1,873
Total	245,673	240,459	234,581

**TABLE B-1
MISSOURI POPULATION CLASSIFICATION (Cont'd)**

Small City and Rural Areas	July 1, 2002 Population	July 1, 2001 Population	July 1, 2000 Population
Archie city	910	898	891
Buckner city	2,725	2,705	2,722
Cass County	25,945	26,434	26,024
Clay County	11,402	14,554	14,123
Cleveland city	627	614	596
Drexel city	1,109	1,097	1,092
Edgerton city	543	540	540
Excelsior Springs city	11,138	11,041	10,888
Garden City city	1,595	1,522	1,508
Grain Valley city	6,250	5,822	5,313
Harrisonville city	9,264	9,148	8,996
Jackson County	22,009	22,252	22,035
Kearney city	6,313	5,967	5,607
Lawson city	2,370	2,333	2,335
Oak Grove city	6,486	5,843	5,601
Platte County	22,140	22,798	22,268
Pleasant Hill city	6,019	5,776	5,622
Ray County	23,811	21,146	21,012
Smithville city	5,990	5,794	5,592
Weston city	1,642	1,640	1,634
Total	168,288	167,924	164,399

US Census Bureau.

Note - Table B-1 total population estimates differ from MARC April 14, 2003 estimates shown below

MARC Total Population	1,040,930	1,030,451	1,020,702
Table B-1 Total Population	1,037,543	1,030,603	1,020,843

**TABLE B-2
KANSAS POPULATION CLASSIFICATION**

Urban Area	July 1, 2002 Population	July 1, 2001 Population	July 1, 2000 Population
Kansas City city	146,978	147,491	146,823
Total	146,978	147,491	146,823

Suburban Area	July 1, 2002 Population	July 1, 2001 Population	July 1, 2000 Population
Countryside city	290	292	295
De Soto city	4,736	4,658	4,588
Fairway city	3,891	3,921	3,950
Lake Quivira city	926	932	933
Leavenworth city	35,410	35,308	35,424
Leawood city	28,270	28,072	27,770
Lenexa city	41,249	40,689	40,372
Merriam city	10,844	10,919	11,002
Mission city	9,578	9,642	9,720
Mission Hills city	3,553	3,568	3,592
Mission Woods city	162	163	165
Olathe city	101,413	96,312	93,765
Overland Park city	158,430	154,074	150,247
Prairie Village city	21,764	21,909	22,063
Roeland Park city	6,705	6,755	6,812
Shawnee city	52,715	50,846	48,623
Westwood city	1,505	1,518	1,532
Westwood Hills city	370	373	377
Total	481,811	469,951	461,230

Small City and Rural Areas	July 1, 2002 Population	July 1, 2001 Population	July 1, 2000 Population
Basehor city	2,513	2,311	2,252
Bonner Springs city	6,815	6,833	6,773
Easton city	373	372	369
Edgerton city	1,525	1,482	1,450
Edwardsville city	4,439	4,407	4,193
Gardner city	10,701	10,224	9,592
Johnson County	15,042	15,083	15,013
Lansing city	9,526	9,406	9,246
Leavenworth County	18,370	18,956	18,459
Linwood city	377	376	374
Spring Hill city	3,357	3,056	2,797
Tonganoxie city	3,169	3,008	2,783
Wyandotte County	54	54	54
Total	76,261	75,568	73,355

US Census Bureau.

Note - Table B-2 total population estimates differ from MARC April 14, 2003 estimates shown below

MARC Total Population	705,656	692,504	680,957
Table B-2 Total Population	705,050	693,010	681,408

**APPENDIX C – MSW AND CONSTRUCTION & DEMOLITION GENERATION
HISTORICAL COMPARISON**

*Strategic Directions and Policy Recommendations for
Solid Waste Management In The Bistate Kansas City Metropolitan Region*

**TABLE C-1
ESTIMATED MUNICIPAL SOLID WASTE (MSW)
AND CONSTRUCTION & DEMOLITION (C&D) GENERATION
SMALL CITY/RURAL COMPARISON 1993 and 2002**

MSW Material	MARC SWMD 1993 Small City/Rural SWMP Generation			MARC SWMD 2002 Small City/Rural Model Generation		
	(1) (tons)	(1) lb/c/yr	(1) (%)	(2) (tons)	(2) lb/c/yr	(2) (%)
Paper:						
OCC/Kraft	12,093	206.8	15.3%	27,720	226.7	16.7%
Office	2,330	39.8	2.9%	14,580	119.2	8.8%
Magazines	1,374	23.5	1.7%	2,100	17.2	1.3%
Newsprint	5,205	89.0	6.6%	8,810	72.1	5.3%
Non-recyclable	10,063	172.1	12.7%	5,880	48.1	3.6%
<i>Total Paper</i>	<u>31,065</u>	<u>531.1</u>	<u>39.3%</u>	<u>59,090</u>	<u>483.2</u>	<u>35.7%</u>
Plastics:						
HDPE	284	4.9	0.4%	530	4.4	0.3%
PETE	261	4.5	0.3%	630	5.1	0.4%
Other Plastic	5,569	95.2	7.1%	16,890	138.1	10.2%
<i>Total Plastic</i>	<u>6,114</u>	<u>104.5</u>	<u>7.7%</u>	<u>18,050</u>	<u>147.6</u>	<u>10.9%</u>
<i>Yard Waste</i>	6,548	112.0	8.3%	20,210	165.3	12.2%
Glass:						
Amber	624	10.7	0.8%			
Green	521	8.9	0.7%			
Clear	2,393	40.9	3.0%			
<i>Total Glass</i>	<u>3,539</u>	<u>60.5</u>	<u>4.5%</u>	<u>9,080</u>	<u>74.3</u>	<u>5.5%</u>
Non-Ferrous Metal:						
Alum. Beverage	790	13.5	1.0%	1,090	8.9	0.7%
Other Alum.	395	6.8	0.5%	1,220	10.0	0.7%
Other	39	0.7	0.0%	1,030	8.4	0.6%
<i>Total Non-Ferrous</i>	<u>1,224</u>	<u>20.9</u>	<u>1.5%</u>	<u>3,340</u>	<u>27.3</u>	<u>2.0%</u>
Ferrous Metal:						
Food Containers	1,572	26.9	2.0%	1,700	13.9	1.0%
Other Ferrous	2,725	46.6	3.4%	8,050	65.9	4.9%
<i>Total Ferrous</i>	<u>4,297</u>	<u>73.5</u>	<u>5.4%</u>	<u>9,750</u>	<u>79.8</u>	<u>5.9%</u>
Other Materials:						
Food Wastes	6,548	111.96	8.3%	18,930	154.8	11.4%
Textiles	3,065	52.41	3.9%	7,040	57.6	4.3%
Diapers	1,208	20.65	1.5%	2,480	20.3	1.5%
Misc. Organics	9,644	164.89	12.2%	14,220	116.3	8.6%
Misc. Inorganics	2,259	38.62	2.9%	<u>3,390</u>	27.8	2.1%
Other Waste	814	13.92	1.0%			
Fines	2,275	38.90	2.9%			
HHW	387	6.62	0.5%			
<i>Total Other Materials</i>	<u>26,200</u>	<u>448.0</u>	<u>33.2%</u>	<u>46,060</u>	<u>376.7</u>	<u>27.8%</u>
TOTAL MSW	<u>78,986</u>	<u>1,350.5</u>	<u>100.0%</u>	<u>165,580</u>	<u>1,354.2</u>	<u>100.0%</u>
pounds/person/day	3.70			3.71		
C&D				46,860		
pounds/person/day				1.05		
TOTAL MSW and C&D				212,440		
pounds/person/day				4.76		

(1) MARC SWMD Integrated Solid Waste Management Plan April 1994. Table II-6.

(2) Table 13

1993 Regional small city/rural population(1) 116,973

2002 Regional small city/rural population 244,549

Franklin Associates, A Division of ERG

*Strategic Directions and Policy Recommendations for
Solid Waste Management In The Bistate Kansas City Metropolitan Region*

**TABLE C-2
ESTIMATED MUNICIPAL SOLID WASTE (MSW)
AND CONSTRUCTION & DEMOLITION (C&D) GENERATION
SUBURBAN COMPARISON 1993 and 2002**

MSW Material	MARC SWMD 1993 Suburban SWMP Generation (1)			MARC SWMD 2002 Suburban Model Generation (2)		
	(tons)	lb/c/yr	(%)	(tons)	lb/c/yr	(%)
Paper:						
OCC/Kraft	22,446	250	11.0%	114,672	315	16.7%
Office	7,516	84	3.7%	60,309	166	8.8%
Magazines	3,961	44	1.9%	8,697	24	1.3%
Newsprint	18,181	203	9.0%	36,461	100	5.3%
Non-recyclable	22,751	254	11.2%	26,487	73	3.9%
<i>Total Paper</i>	<u>74,855</u>	<u>835</u>	<u>36.8%</u>	<u>246,626</u>	<u>678</u>	<u>36.0%</u>
Plastics:						
HDPE	711	8	0.4%	2,212	6	0.3%
PETE	914	10	0.4%	2,600	7	0.4%
Other Plastic	13,001	145	6.4%	63,022	173	9.2%
<i>Total Plastic</i>	<u>14,626</u>	<u>163</u>	<u>7.2%</u>	<u>67,834</u>	<u>186</u>	<u>9.9%</u>
Yard Waste	34,533	385	17.0%	114,101	314	16.7%
Glass:						
Amber	2,336	26	1.1%			
Green	1,320	15	0.6%			
Clear	6,805	76	3.3%			
<i>Total Glass</i>	<u>10,461</u>	<u>117</u>	<u>5.1%</u>	<u>34,939</u>	<u>96</u>	<u>5.1%</u>
Non-Ferrous Metal:						
Alum. Beverage	2,133	24	1.1%	4,507	12	0.7%
Other Alum.	914	10	0.4%	5,030	14	0.7%
Other	102	1	0.1%	4,244	12	0.6%
<i>Total Non-Ferrous</i>	<u>3,149</u>	<u>35</u>	<u>1.6%</u>	<u>13,780</u>	<u>38</u>	<u>2.0%</u>
Ferrous Metal:						
Food Containers	3,352	37	1.7%	7,062	19	1.0%
Other Ferrous	7,821	87	3.9%	28,518	78	4.2%
<i>Total Ferrous</i>	<u>11,173</u>	<u>125</u>	<u>5.5%</u>	<u>35,580</u>	<u>98</u>	<u>5.2%</u>
Other Materials:						
Food Wastes	15,743	176	7.8%	67,822	186	9.9%
Textiles	7,719	86	3.8%	21,922	60	3.2%
Diapers	4,571	51	2.3%	9,591	26	1.4%
Misc. Organics	19,501	218	9.6%	58,815	162	8.6%
Misc. Inorganics	1,625	18	0.8%	14,061	39	2.1%
Other Waste	305	3	0.2%			
Fines	4,469	50	2.2%			
HHW	406	5	0.2%			
<i>Total Other Materials</i>	<u>54,339</u>	<u>606</u>	<u>26.8%</u>	<u>172,212</u>	<u>473</u>	<u>25.1%</u>
TOTAL MSW				685,072	1,883	100.0%
pounds/person/day				5.16		
C&D				371,744	1,022	
pounds/person/day				2.80		
TOTAL MSW and C&D	203,135	2,267	100.0%	1,056,816	2,905	
pounds/person/day	6.21			7.96		

(1) MARC SWMD Integrated Solid Waste Management Plan April 1994. Table II-7.

(2) Table 13

1993 Regional suburban population (1) 179,231

2002 Regional suburban population 727,484

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*Strategic Directions and Policy Recommendations for
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**TABLE C-3
ESTIMATED MUNICIPAL SOLID WASTE (MSW)
AND CONSTRUCTION & DEMOLITION (C&D) GENERATION
URBAN COMPARISON 1993 and 2002**

MSW Material	MARC SWMD 1993 Urban SWMP Generation (1)			MARC SWMD 2002 Urban Model Generation (2)		
	(tons)	lb/c/yr	(%)	(tons)	lb/c/yr	(%)
OCC/Kraft	153,000	498.3	18.2%	154,840	401.9	11.0%
Office	15,929	51.9	1.9%	74,900	194.4	5.3%
Magazines	16,767	54.6	2.0%	10,800	28.0	0.8%
Newsprint	39,822	129.7	4.7%	45,280	117.5	3.2%
Non-recyclable	127,011	413.6	15.1%	72,360	187.8	5.1%
<i>Total Paper</i>	<i>352,530</i>	<i>1,148.1</i>	<i>42.1%</i>	<i>358,180</i>	<i>929.7</i>	<i>25.4%</i>
Plastics:						
HDPE	2,515	8.2	0.3%	2,750	7.1	0.2%
PETE	2,515	8.2	0.3%	3,230	8.4	0.2%
Other Plastic	60,362	196.6	7.2%	79,120	205.4	5.6%
<i>Total Plastic</i>	<i>65,392</i>	<i>213.0</i>	<i>7.8%</i>	<i>85,100</i>	<i>220.9</i>	<i>6.0%</i>
<i>Yard Waste</i>	<i>73,356</i>	<i>238.9</i>	<i>8.7%</i>	<i>96,560</i>	<i>250.6</i>	<i>6.8%</i>
Glass:						
Amber	4,192	13.7	0.5%			
Green	5,449	17.7	0.6%			
Clear	18,863	61.4	2.2%			
<i>Total Glass</i>	<i>28,504</i>	<i>92.8</i>	<i>3.4%</i>	<i>35,590</i>	<i>92.4</i>	<i>2.5%</i>
Non-Ferrous Metal:						
Alum. Beverage	5,869	19.1	0.7%	5,600	14.5	0.4%
Other Alum.	2,515	8.2	0.3%	6,270	16.3	0.4%
Other	419	1.4	0.0%	5,270	13.7	0.4%
<i>Total Non-Ferrous</i>	<i>8,803</i>	<i>28.7</i>	<i>1.1%</i>	<i>17,140</i>	<i>44.5</i>	<i>1.2%</i>
Ferrous Metal:						
Food Containers	19,701	64.2	2.3%	8,760	22.7	0.6%
Other Ferrous	23,893	77.8	2.8%	35,420	91.9	2.5%
<i>Total Ferrous</i>	<i>43,595</i>	<i>142.0</i>	<i>5.2%</i>	<i>44,180</i>	<i>114.7</i>	<i>3.1%</i>
Other Materials:						
Food Wastes	62,877	204.8	7.5%	84,230	218.6	6.0%
Textiles	31,438	102.4	3.7%	27,390	71.1	1.9%
Diapers	5,869	19.1	0.7%	11,910	30.9	0.8%
Misc. Organics	118,628	386.3	14.2%	73,040	189.6	5.2%
Misc. Inorganics	20,959	68.3	2.5%	17,460	45.3	1.2%
Other Waste	10,479	34.1	1.2%			
Fines	13,833	45.0	1.7%			
HHW	2,096	6.8	0.3%			
<i>Total Other Materials</i>	<i>266,179</i>	<i>866.8</i>	<i>31.8%</i>	<i>214,030</i>	<i>555.5</i>	<i>15.2%</i>
TOTAL MSW				850,780	2,208	60.3%
	pounds/person/day			6.05		
Industrial				167,350	434	11.9%
	pounds/person/day			1.19		
C&D				393,760		
	pounds/person/day			2.80		
TOTAL MSW, Industrial, C&D	838,359	2,730	100.0%	1,411,890	3,665	100.0%
	pounds/person/day	7.48		10.04		

(1) MARC SWMD Integrated Solid Waste Management Plan April 1994. Table II-6.

(2) Table 13. Industrial estimated added to 2002 generation estimate to make the analysis comparable.

1993 Regional Urban population (1) 614,137

2002 Regional Urban population 770,560

Franklin Associates, A Division of ERG

**APPENDIX D – PROCESSING TECHNOLOGIES AND TECHNOLOGY
REFERENCE ARTICLE**

THERMOSELECT (Gasification Waste-to-Energy)

Technology Summary

The Thermoselect technology is supplied by Thermoselect S.A., a Swiss firm. A major investor in Thermoselect is the German electric utility company, Badenwerk, which has a 25% ownership stake. Thermoselect is represented in the western hemisphere by Interstate Waste Technologies, which is a subsidiary of the U.S. firm, Interstate General Company, L.P.

The Thermoselect technology is designed to process MSW, as well as other solid wastes (bulky municipal wastes, tires, C&D waste, sewage sludge, medical waste, and industrial waste). A Thermoselect plant is comprised of one or more processing units, each sized at 330 TPD. The Thermoselect gasification process operates at a high temperature, to convert solid waste into a synthesis gas and recyclable by-products. The synthesis gas is cleaned (e.g., sulfur is removed and recovered), then the gas is combusted in engines or a boiler to produce electricity. The recyclable by-products include a construction aggregate, elemental sulfur, a metal alloy, and others. If, as Thermoselect claims, the process by-products can be marketed, there would be no process residue or material (other than spent refractory) requiring disposal. Acid gases can be recovered and made into industrial grade salts. Process water is treated and recycled. There is no discharge of process wastewater from a Thermoselect plant.

As the gasification process is closed-loop, it has no emissions to the air. Air emissions are produced, however, when the synthesis gas is subsequently used in fueling engines or a boiler to produce electricity. Regarding emissions control, the synthesis gas is cleaned of most air pollutants prior to the gas's being used as a fuel. Nonetheless, the engines or boilers used to produce energy from the synthesis gas may require some level of add-on emissions controls, e.g. for control of nitrogen oxides, depending on the location of the project. Based on an extensive review by ARI of a large Thermoselect plant proposed in Puerto Rico in 2000, the emissions of most air pollutants from a Thermoselect plant (engines or boiler fueled with synthesis gas) would be substantially less than emissions from a modern, conventional waste-to-energy plant.

Thermoselect plants processing MSW have operated commercially in Italy and Japan at a small scale, with apparent success. A large scale Thermoselect plant for MSW processing was constructed in Germany in 1999; this plant received regulatory approval for commercial operation much later, in January 2002. Thermoselect is in the early stages of active development of plants in the U.S. Virgin Islands and Costa Rica. Another Thermoselect project in early development has been proposed in Puerto Rico.

Based on ARI's review of a large Thermoselect facility previously proposed in Puerto Rico, the costs for constructing and operating a Thermoselect facility would significantly exceed costs for a conventional waste-to-energy facility. The company has been addressing this issue, and claims to have identified technical changes to its process to bring the cost in line with other waste-to-energy technologies. In addition, the net electric

output (hence energy revenues) for a Thermoselect facility would be less than for conventional technology of the same processing capacity.

Regarding construction schedule, Thermoselect indicates that a large plant could be constructed in a 25 month period. If true, this would be 4-6 months shorter than the typical construction period for a conventional waste-to-energy plant.

In summary, the Thermoselect gasification technology is commercially available at the required scale, and there is a limited track record of commercial operation at small plants overseas. The primary advantages of the technology are significantly lower air pollutant emissions than conventional waste-to-energy technology, and the claimed ability to market all residue as beneficial by-products (rather than paying to landfill the residue). The primary disadvantages at present are significantly higher construction and operating costs than conventional waste-to-energy technology, and lower energy production efficiency.

Further detailed information follows on selected aspects of the Thermoselect gasification technology.

Process Description

The Thermoselect gasification process is depicted in the figure that follows this page. The major process steps are as follows:

- **Waste Compaction.** Using conventional presses, the MSW is compacted into packets, reducing the MSW volume by 90%. This also minimizes the residual air content of the MSW, and promotes an even moisture distribution.
- **Degassing.** The highly-compressed MSW packets are pushed into a channel to form a gas-tight “plug.” In this channel, the MSW is heated intensively (660° F) by conduction. Volatile components are liberated: water vapor, carbon monoxide, carbon dioxide, hydrogen, and hydrocarbon gases. During degassing, the organic constituents of the MSW are converted to carbon. Inorganic components of MSW are entrained in the carbon matrix. The volatilized gases and the carbon (with entrained inorganic components) then move to the next process stage.
- **High Temperature Gasification Chamber (HTC).** The volatilized gases and packets containing carbon and inorganic components are treated in the high temperature gasification chamber (HTC) at temperatures up to 2,200° F, in the presence of oxygen. This produces a raw synthesis gas, approximately 25,000 cubic feet of gas per ton of waste processed. All organic compounds; i.e., organic air pollutants present in the gas, are thermally destroyed (decomposed to atomic levels). The inorganic fraction of MSW is liquefied at these temperatures, and is refined (freed of carbon) via oxidation. The metal and mineral (glass) products are recovered.

Thermoselect indicates that these products have been shown to meet US EPA leachate toxicity testing (TCLP test).

- Water Quenching of the Gas. The raw synthesis gas is cooled rapidly to 194° F with a water quench, in the absence of oxygen. This is intended to prevent *de novo* synthesis (new formation) of dioxin and furan compounds. In addition, halogens are removed from the gas and react with the quench water to form HCL and HF, which are in turn removed from the process during wastewater treatment and recycling.
- Synthesis Gas Cleaning. The synthesis gas is then acid washed, followed by a caustic wash. This removes sulfur from the gas, and the sulfur is recovered in elemental form. The synthesis gas is then dehumidified by cooling, is rewarmed, and passed through a final, “polishing” activated-coke filter. This results in an oxygen-free synthesis gas, having a heating value of approximately 250 Btu per cubic foot.
- Electric Power Generation. The clean, dry synthesis gas is then converted to electrical energy using generators driven by either gas-fueled reciprocating engines, or by a gas-fueled steam boiler. For a typical Thermoselect processing unit that converts 330 TPD of MSW to gas, the electrical output from reciprocating engines would be approximately 11 Mw gross (7 Mw net).

Marketable By-Products

Thermoselect claims that the process has no residue or material (other than spent refractory) requiring disposal; i.e., all by-products are recyclable. The by-products and their intended markets are as follows:

- Vitriified Aggregate – sold to local asphalt and concrete suppliers
- Metal Alloy Pellets – shipped for use as scrap steel
- Mixed Salts – sold as industrial grade salts
- Metal Hydroxide Cake – sold to processors to reclaim zinc and lead, and
- Sulfur – sold for use in pharmaceutical and agricultural products

ARI has determined that to date, Thermoselect has not been able to achieve 100% recycling of process by-products at its reference plants.

Reference Plants

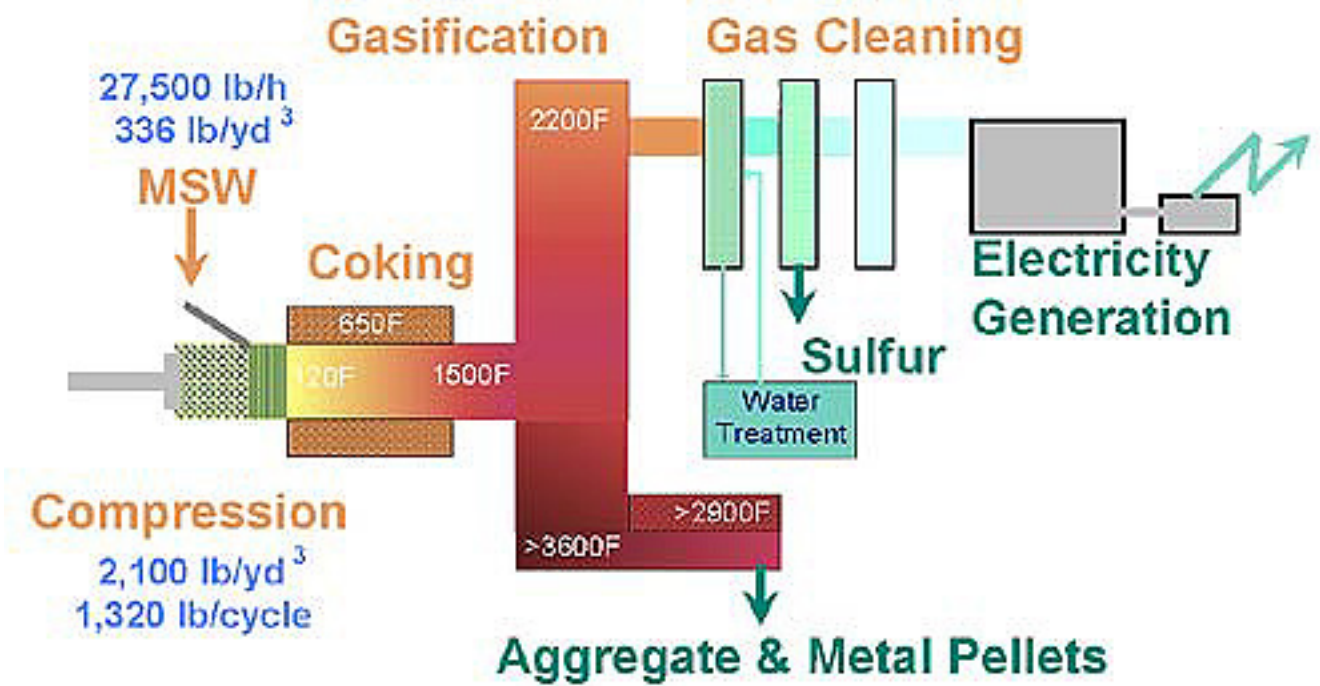
A 110 TPD, Thermoselect pilot/demonstration plant was constructed in Fondotoce, Italy, and was operated commercially, processing MSW from January 1995 to August 1998. A 330 TPD plant was constructed in Chiba, Japan. That plant, built and owned by Kawasaki, had successfully completed a demonstration period for processing MSW more than a year ago. The Chiba plant continues in commercial operation, now processing the intended waste, Kawasaki’s industrial wastes (i.e., not MSW). A 792 TPD plant

comprised of three, 264 TPD units processing MSW, was constructed in Karlsruhe, Germany, on a design-build-operate basis. The plant required extensive emissions-control upgrades for its emergency gas flaring system, to enable compliance with air emissions limits. Accordingly, although completed in 1999, this plant only recently (January 2002) received final regulatory approval for full, commercial operation.

Economics

Based on an extensive review by ARI of an 1,800 TPD Thermoselect plant proposed in 2000 for processing MSW in Puerto Rico, the costs for constructing and operating a large Thermoselect facility would significantly exceed costs for a conventional waste-to-energy facility. The installed capital cost would be substantially higher, as would the net present-value cost over a 25-year project "lifetime." Thermoselect's overall operating cost would be higher, despite a substantial advantage in avoiding one key element of operating cost; i.e., ash disposal, presuming Thermoselect succeeds in its plan to market all by-products. Contributing to the costliness of the Thermoselect process is that the net electric output (hence energy revenues) for a Thermoselect facility would be significantly less than for conventional technology of the same processing capacity. This requires higher tipping fees to be economic than would a conventional facility of the same processing capacity.

THERMOSELECT



THE MASADA “CES OXYNOL™ PROCESS” (WASTE-TO-ETHANOL)

Technology Summary

The CES OxyNol™ process for converting MSW to ethanol was developed and is supplied by Masada Resource Group, LLC, an affiliate of The Masada Companies of Birmingham, Alabama. Masada claims to have built more than \$1 billion in business assets in the U.S. and the United Kingdom, mostly in the areas of telecommunications and electronic security. Masada’s historical business experience in solid waste management, however, is very limited.

MSW contains significant amount of cellulose, e.g., in the paper, wood, and food waste components. The CES OxyNol process is designed to convert the cellulose present in MSW to ethanol, which is then sold for use as a gasoline additive (oxygenator). Biosolids (liquid and solid sewage sludge) can be co-processed, as well as certain other waste materials, e.g., industrial paper scrap.

In the CES OxyNol process, MSW is processed first through a Materials Recovery Facility, where traditionally-recycled materials are separated. The remaining MSW is shredded, and is fed to an acid hydrolysis process. There, sulfuric acid is used as a catalyst to convert the cellulose present in MSW to a slurry mixture of sugar, acid, and lignin residue. The acid is recovered from the slurry for re-use in the process. The lignin is recovered and used to fuel a fluid-bed gasifier/boiler that generates process steam. The remaining sugar-water solution is then fermented to ethanol using yeast. Following this, the ethanol is distilled to market grade strength and purity. By-products of the process, according to Masada, are commercial-grade carbon monoxide and marketable gypsum. There is a substantial amount of solid residue resulting from the acid hydrolysis process. That residue is gasified in a fluid bed system, and the gas is used to fuel a boiler to generate process steam.

The CES OxyNol process requires control of odor as well as control of air pollutant emissions. As the process would typically store and mechanically process both MSW and biosolids, active odor control is needed. This would include total enclosure of the process, and treatment of odorous air with a biofilter, scrubber, or thermal oxidizer. Dust emissions from MSW shredding may require a fabric filter or other control device. Emissions from the gasifier/boiler may require add-on controls for emissions of particulate matter, and potentially for emissions of nitrogen oxides and acid gases. Regarding wastewater, it is Masada’s stated goal for its facilities to be “zero discharge” for process wastewater; however, Masada does not currently have this as a standard design feature.

Masada does not yet have a commercial-scale reference plant for its CES OxyNol process. Extensive data reviewed in the past by ARI indicates that the CES OxyNol process was successfully operated at the pilot scale in the 1990’s at a National Renewable Energy Laboratory facility. In addition, Masada’s first, commercial-scale MSW-to-ethanol facility is under development in Orange County, New York. That facility would process 960 TPD of MSW, and large quantities of biosolids. It would yield 8 million

gallons of ethanol per year. Masada has earned the endorsement of the most prominent environmental group in Orange County. They accomplished this by successfully distinguishing their waste-to-ethanol technology, in the public's eye, from traditional waste combustion technologies.

As there are no MSW-to-ethanol facilities operating at the commercial scale as yet, there is no reliable basis for assessing capital and operating costs for such a facility, relative to traditional waste-to-energy. Masada estimates that its facility planned in Orange County, New York can be constructed in under two years, which is at least 6 months shorter than it takes to construct a traditional waste-to-energy plant. Again, however, that estimate has yet to be proven out in commercial experience.

In summary, Masada's CES OxyNol process for waste-to-ethanol is proven at the pilot scale, but not yet at the commercial scale. The technology is distinguished from traditional waste-to-energy, because a significant fraction of the energy in MSW is recovered in a different form; i.e., as ethanol, and this is done by means of chemical processes, not via waste combustion. While this distinction is clearly a legitimate one, the process still employs a significant degree of thermal energy recovery, by gasification of the process residue, and combustion of the gas for steam production. Whether waste-to-ethanol will operate reliably at full scale, and whether the economics are better or worse than traditional waste-to-energy are the key questions. These will remain highly speculative, until operating experience is gained at the commercial scale. A potential advantage of the CES OxyNol process is that it does not produce MSW combustion ash. Another potential advantage of the CES OxyNol process is that the public may perceive waste-to-ethanol to be more environmentally friendly than traditional waste-to-energy, making waste-to-ethanol plants easier to site. Perception aside, there is not sufficient information developed at this point, to demonstrate objectively whether the total environmental burden for waste-to-ethanol is less or more than for traditional waste-to-energy.

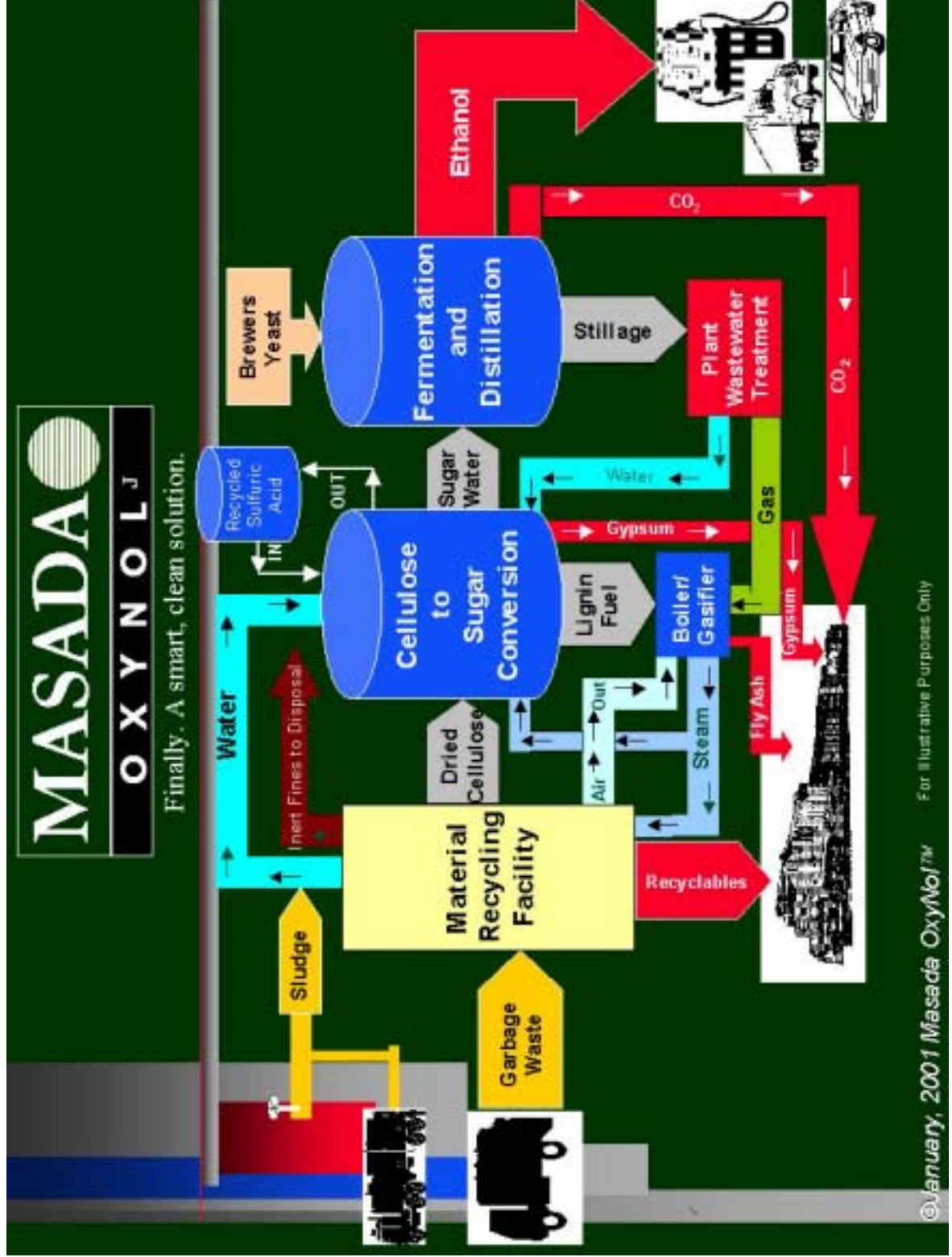
Further detailed information follows on selected aspects of the CES OxyNol waste-to-ethanol technology.

Process Description

Masada's waste-to-ethanol process is depicted in the figure that follows this page. While MSW is the principal feedstock for the CES OxyNol process, biosolids (sewage sludge) can be co-processed with MSW. In addition, treated effluent from a local, public wastewater treatment plant can be used to help meet process water requirements. The major process steps are as follows:

1. Waste Receipt and Preparation
2. Biosolids Receiving and Preparation
3. Acid Hydrolysis of Cellulose to Sugar
4. Sugar Solution Conditioning
5. Fermentation of Sugar to Ethanol
6. Distillation of Ethanol Product

7. Gasifier and Boiler for Process Steam
8. Carbon Dioxide Conditioning
9. Air Emission Controls



The steps of Masada's process are further discussed below.

- **Waste Receipt and Preparation.** In this step, MSW is received, recyclable materials are recovered, and the remaining MSW is prepared for use as a process feedstock. Delivered MSW is unloaded from collection vehicles onto the tipping floor of an enclosed, Materials Recovery Facility (MRF). There, bulky materials are removed from the waste by hand. A series of manual and mechanical and sorting steps is used to separate out the bulk of recyclable materials – metals, glass, plastics, and aluminum, as well as inorganic residue materials. Recyclable materials are marketed, and the inorganic residue is either sold as a recycled aggregate material, or disposed at a landfill. The remaining MSW is moved by conveyor to a mechanical separation system, where the MSW is sorted by size. Following this, the remaining MSW then enters a shredder and passes underneath a magnet where additional ferrous material is removed. What now remains is a cellulose-rich feedstock for the ethanol process, that is substantially free of metals, glass, plastics and other non-cellulose material. The feedstock is then shredded to a smaller size, dried and re-fluffed, and conveyed to the hydrolysis phase of the process.
- **Biosolids (Sludge) Receiving and Preparation.** The CES OxyNol process can co-process sewage sludge with MSW. Liquid sludge is received by pipeline or delivered by tank truck. Solid sludge “cake” is delivered by truck. Liquid sludge is stored in a sludge storage tank. Sludge cake is conveyed to the storage tank, where it is blended with liquid sludge. The liquid sludge is pumped to another tank, where it is mixed with acid to remove heavy metals from the sludge, to kill pathogens, and to generate CO₂ for recovery and sale. The liquid sludge is then dewatered via centrifuge. The solids become a feedstock for the ethanol process, and the centrate liquid is used for hydrolyzate washing in the ethanol process.
- *Acid Hydrolysis. Hydrolysis is a chemical reaction which breaks down the cellulose that is present in MSW, yielding a slurry which contains sugars, acid and non-hydrolyzed materials. In the hydrolysis phase, the MSW-derived feedstock is treated with hot concentrated sulfuric acid, which acts as a catalyst to convert the cellulose to glucose and the hemicellulose to xylose and mannose. After the treatment with sulfuric acid, the resulting slurry is transferred to "cook" tanks where sewage sludge and water are added to create the hydrolyzate. The hydrolyzate, now containing the proper moisture content, cooks for a prescribed period of time and then enters a separator to separate the liquid portion from the residue solids. The liquid portion of the hydrolyzate proceeds to an ion exclusion unit to separate the sulfuric acid from the sugar. The sugar solution is sent to the sugar conditioning step. The acid is recovered, reconcentrated by*

evaporation, and re-used in the process. The solid residue is composed of lignin and other non-hydrolyzed materials. The lignin is used as a fuel for energy recovery, by the plant's steam generator.

- Sugar Solution Conditioning. Lime is added to the sugar solution for pH adjustment, and to cause dissolved, heavy metals to precipitate out of the solution. The precipitate is a non-hazardous, gypsum material that is either marketed or landfilled. The sugar solution is then concentrated via evaporation, and is sent to the fermentation phase of the process.
- Fermentation to Ethanol. During fermentation, the sugar, in solution from the hydrolysis process, is converted to ethanol and carbon dioxide, via the biological action of yeast. The ethanol produced by fermentation is contained within a fermented "mash," from which the ethanol must be distilled. The carbon dioxide produced is collected and processed to commercial standards in an on-site facility, then sold. The process uses a continuous, cascade fermentation technology.
- Distillation of the Ethanol Product. Distillation is the process used to separate the ethanol from the fermented mash to produce pure ethanol. The fermented mash is distilled in a conventional two-phase process. In the first phase, the ethanol is initially dehydrated by distillation to approximately 95% concentration (190 proof); in the second phase, the ethanol is further dehydrated to 100% concentration (200 proof) by using a molecular sieve. After the ethanol is transferred to a storage tank, it is denatured with gasoline, converting it to fuel grade ethanol. The denatured product is stored until transferred for shipment.
- Gasifier and Boiler. A substantial mass-fraction of the MSW feedstock that enters the acid hydrolysis process, leaves it as a solid residue of the chemical process. The solid residue (lignin and other solid materials) is gasified in a fluidized bed system for energy recovery. The gas produced is used to fuel a boiler, that produces process steam for the facility. The char and fly ash from the gasifier may potentially be marketed, or if not, would be landfilled as a nonhazardous solid waste.
- Carbon Dioxide Conditioning. A carbon dioxide plant cleans and compresses the carbon dioxide that is produced during fermentation. The carbon dioxide is sold in liquid form.
- Control of Air Pollutant Emissions and Odors. Odor from the storage and processing of MSW and sludge is controlled (1) by designing for totally-enclosed operations, and (2) by application of odor control techniques (scrubbers, biofilters, thermal oxidation). Emissions of particulate matter from mechanical processing of MSW are controlled via fabric filter, as

necessary. Emission controls for the boiler would depend on local regulatory requirements, but could include add-on controls for emissions of particulate matter (fabric filter), acid gases (scrubber), and/or nitrogen oxides (e.g., SNCR).

Marketable By-Products

Masada claims that, besides materials separated from the MSW for traditional recycling, there will be two, marketable by-products generated by the CES OxyNol process: carbon dioxide and gypsum.

Reference Plants

The CES OxyNol process has been demonstrated successfully at the pilot scale at the National Renewable Energy Laboratory's test facility at Muscle Shoals, Alabama. Masada has not built or operated any commercial-scale facilities to date. However, Masada's first commercial facility is under development in the City of Middletown in Orange County, New York. The Orange County facility will be large, with design capacity to process 960 TPD of MSW, and to co-process 1,790 wet TPD of biosolids. The facility will use treated effluent from the City's wastewater treatment plant as process water. The ethanol yield of the plant will be 8 million gallons per year. The Orange County waste-to-ethanol facility is being built on the surface of a closed, City landfill, and will constitute part of the landfill's closure plan.

Masada indicates that it is pursuing new project development opportunities in the U.S. and abroad, including specifically, in the southeast U.S.

Economics

Since there have been no commercial-scale, MSW-to-ethanol facilities operated to date, there is no historical data on actual construction and operating costs, relative to conventional waste-to-energy plants. The installed capital cost for Masada's MSW-to-ethanol facility planned for Orange County, New York is approximately \$150 million. No projections of operating costs are publicly available; however, the waste supply contracts that Masada has negotiated carry tip fees that range to a maximum of \$65/ton, which is very competitive in Orange County.

**TECHNOLOGY REFERENCE ARTICLE
MULTI-YEAR EXPERIMENTATION WITH FOOD WASTE ALTERNATIVES²³**

ABSTRACT

Several trial projects using food wastes as animal feedstock and as compost supplements offer insights into food waste recovery at the municipal and commercial levels. From 1989 to 2002, WasteCap Wisconsin, Inc., in partnership with many private parties, advanced food waste recovery with several projects:

- Assisted commercial composting efforts in adding food wastes to recipes for composted duck manure;
- Provided the link between food waste generators, haulers and markets which resulted in recovery of food scraps for vermicomposting and windrow composting;

- Conducted experiments for feeding unprocessed food wastes and pelletized food wastes to swine;
- Completed a pilot project to assess commercial feasibility of recovering food scraps from grocery stores by utilizing a commercial hauler to haul and keep records, and a yard waste contractor to compost the food scraps.

Also during that time, the City of Wauwatosa attempted to spearhead a regional organic waste program. Results of these studies and programs are instructive to potential businesses and municipalities that may want to begin or expand organic waste recycling efforts.

²³ William Tarman-Ramcheck, Ph.D. Public Works Department
City of Wauwatosa Wauwatosa, Wisconsin
Richard Moen Executive Director
WasteCap Wisconsin, Inc., Milwaukee, Wisconsin

INTRODUCTION

Over one fourth of all food produced for human consumption goes to waste. The annual value of this excess food is estimated at around \$31 billion (USDA, 1997). There is great potential for restaurants, grocery stores, food processors and other food-related businesses to utilize food wastes and save money in the process. Local governments also can assist in this process, as evidenced by San Francisco's venture into commercial and residential food waste collection and composting (Swartz, 2002).

Food waste is the third largest portion of the U.S. waste stream, yet at a recovery rate just under 3%, it is currently the least recovered portion (EPA, 1998).

This report describes the efforts of WasteCap Wisconsin and several companies and individuals, some in conjunction with municipal operations, to reduce food waste, conserving resources, and saving money. It provides resources and solutions to reduce, reuse, and compost food waste. It is intended to provide information to solid waste professionals to implement food waste recovery efforts in their areas. Six case studies over 13 years are highlighted:

- Composting food wastes with duck manure;
- Vermicomposting greenhouse and food-store wastes;
- Feeding raw food waste directly to swine;
- Feeding pelletized food waste to swine;
- Collecting food waste from grocery stores to compost at an existing composting facility for chicken manure;
- Organizing a municipal and regional organic waste coalition.

FATHER DOM'S DUCK DOO COMPOST: 1989

CASE STUDY

Four organizations pooled their efforts and resources to produce a high-quality compost product from cranberry mash, a fruit processing by-product, and duck manure, a poultry waste. The combined efforts are helping to produce a high-quality soil conditioner, trade named Father Dom's Duck Doo Compost; divert more than half of Ocean Spray's waste from landfill disposal; and enhance environmental awareness and stewardship opportunities among the youth

and community of Kenosha County in the southeastern corner of Wisconsin. The four

organizations are Pheasant Run Recycling and Disposal Facility, a division of Waste Management; Kenosha In Neighborhood Works Inc. (KIN), a non-profit grass-roots community organization; Ocean Spray, Inc., a cranberry processor; and Maple Leaf Farms, a local duck farm.

The project began in 1989, when Ocean Spray expressed an interest in reusing its cranberry mash. As a result, Pheasant Run offered to provide the technical foundation and land for composting the material, and the KIN group, founded by Father Dominic Roscioli, agreed to provide manpower for marketing the finished compost product. The KIN organization sells the compost to landscapers and gardeners to raise funds for its operations. To encourage smaller purchases of the compost, KIN has also opened the New Earth store in Kenosha.

According to his website, Father Dom, a personal friend of Paul Newman, is a ten-year veteran volunteer at Newman's camp for terminally ill children, The Hole In The Wall Gang Camp. The actor's "Newman's Own" product line assisted Father Dom with the package design so that he could take his product nation-wide. For more on this, turn to www.fatherdomsducksdoo.com for the latest on their compost happenings.

GROWING POWER, SENDIK'S, AND WASTECAP: 2000 FOOD MARKET CASE STUDY

Will Allen, a Milwaukee farmer, is vermicomposting right in the heart of urban Milwaukee. Allen is codirector of Growing Power, a non-profit organization and land trust dedicated to supporting local food systems. Growing Power composts vegetative waste from its greenhouses. With the assistance of WasteCap Wisconsin to provide linkages, coordination, educational, and technical assistance, Growing Power expanded its operation to include produce trimmings from Sendik's Food Market, a local grocery store known for its fresh, high-quality produce.

Since March 2000, Allen has regularly collected food prep scraps from Sendik's. To separate the scraps, store staff replaced the store's 55-gallon

trash bins with 22-gallon food storage bins, keeping one garbage bin nearby for non-compostable items. The bins were stacked on a pallet and stored near the loading dock to be picked up by Allen the following morning.

One of Growing Power's four greenhouses is designated strictly for vermicomposting (composting with worms), with a total of twenty-five 4' x 2' x 2' wooden worm bins. The pre-composted material is fed to the worms and later harvested as worm castings. These worm castings have been the basis of one of the Living Skills' entrepreneurial projects. The kids have learned to maintain the bins, harvest the worm castings, and sell them as a natural fertilizer at local farmers markets.

Allen and his crew are careful not to overload the vermicomposting system and potentially harming the worms with the heat generated by the composting process. Excess food scraps are either added to two long compost piles (windrows) behind the greenhouses or transported to Allen's farm located about thirty minutes south of his Milwaukee market. Currently Allen collects scraps from Sendik's three days a week, for an average of 6,000 pounds per month.

Challenges to efficient operation include finding in-store storage space for the bins and incorporating hauling time into Allen's schedule. However, if these hurdles can be overcome, both Allen and Sendik's would like to see the program expand, possibly including seven days of collection.

FOOD WASTE DIRECT TO SWINE FEED: 2000

CASE STUDY

Utilizing food scraps has helped Eric Tarman-Ramcheck and his father Bill Tarman-Ramcheck, president of REC Systems, Inc., feed their pigs, save valuable landfill space, and earn college money for Eric, then a junior at East Troy High School. In May 2000, Bill and Eric designed a project that would reuse food waste from local businesses for a food diversion pilot project sponsored by WasteCap Wisconsin. Through this project, Eric also won a college scholarship for his waste reduction achievements.

The project was based on raising three test pigs on non-meat food scraps with a vitamin supplement and raising three control pigs on traditional swine feed.

Bill collected fruit and vegetable preparation scraps from Four Points Hotel Sheraton and leftover bakery from Wildflour Bakery, on his daily commute home from Wauwatosa, a suburb of Milwaukee in southeastern Wisconsin. Bill and Eric would then sort through the food to remove contaminants (rubber bands, plastic wrap, latex gloves, and other non-compostable materials). The nutrient content and amounts of food scraps were carefully monitored during the four-month project.

A veterinarian's check-up at the project's end indicated that the test pigs achieved the same high-quality rating as the control group. The control pigs were auctioned at Walworth County Fair. Meat from the three test pigs was sold to WasteCap Wisconsin for an awards lunch; to Eagle Springs Golf Course for a special event; to a community-supported agriculture (CSA) farmer; and to Four Points Hotel Sheraton, one of the food waste donors. The meat processor who butchered the pigs noted that he could not tell the difference between pigs fed food waste and those fed traditional feed.

This case study's (Tarman-Ramcheck, 2000) final report concluded that a larger effort would be needed to make the cost-effectiveness of that sort of program more widespread. Small-scale pig farmers can save money this way if they don't mind the work of collecting and sorting the food waste, and if they can cost-effectively collect and transport it. It may be cost-effective for Community Supported Agricultural programs or homesteads, as well as perhaps "organic" grocers to consider partnering in such efforts. However, it would likely need an urban collection program, supplemented by centralized processing facility that could transform volumes of such wastes into usable farm products by eliminating actual garbage, nutritionally blending, and perhaps drying/pelletizing them.

ORGANIC WASTE, A MUNICIPAL AND REGIONAL EXPLORATION: 2001 CASE STUDY

Background

The City of Wauwatosa began to organize a project to help minimize costs and expand City

yard waste services to include other organic waste. All City yard waste contracts end December 31, 2002. Superior Services, Inc. (Superior) does the curb collection and recovery, and S & R Compost (S & R) handles all the drop-off yard waste and leaves. Initial talks with S & R and Superior indicated an interest in exploring the handling of more organic materials to increase efficiencies and diversion while maximizing product revenues. Several partners and components were envisioned to potentially be involved in accomplishing this, most oriented broadly toward "sustainability."

Process/Partners

Numerous partners had expressed a variety of action interests.

- *S&R*: diversifying processing, raising product revenues, and managing more site operations.
- Superior: minimizing travel for curb collection, testing organics routing, developing process site(s).
- *NutraCycle*: siting an urban organics facility, partnering to enhance throughput/sustainability.
- *Wisconsin Department of Commerce*: financially supporting recycling start-up/expansion partnerships.
- *Wisconsin Department of Natural Resources*: partnering to develop a model of local sustainability, especially regarding integrated solid waste.
- *Fox River Valley Organic Resources Project*: sharing Fox River Valley experiences and expanding opportunities.
- *University of Wisconsin Extension*: helping regionalize and increase efficiencies of solid waste operations and markets.
- *WasteCap Wisconsin*: expanding organics recycling and aiding partnerships.
- *SWWRC*: facilitating area waste reduction and integrated solid waste management.

The combining of these mutual interests presented an opportunity for the City Public Works sites (both compost and industrial park) to create staging areas that may have transformed organic wastes into numerous marketable products. In essence, City leaves, yard waste, trees, and lumber, together with commercial produce, manufacturers' organic residuals and restaurant plate waste, could be combined to form several saleable products: 1) livestock feed, 2) blended-organics compost (and composted

chicken waste), 3) brush chips, 4) "good" wood chips for mulch, 5) absorbents, 6) firewood, 7) mill logs, and maybe others (e.g. from methane digestion, which can be supplemented from City "dispersed" landfill methane).

Advantages/Disadvantages

Product revenues could help lower costs for resource inputs, i.e. decrease tipping fees for yard wastes and organics, which in turn may justify separate collections or processing operations. Centralized processing and convenient transport could offer enhanced marketing opportunities. Reduced expenses could decrease local taxes and increase product profitability. However, site, transport, operational, and financial considerations all had to be addressed to ensure proper pro forma, minimal risks, and public acceptance. The numerous players brought significant experience and resources, but unfortunately never got to the more detailed analysis, planning and implementation.

Costs/Benefits

Each interested party could bear some financial burden and other liabilities, all of which would have had to be examined in detail, minimized, and compensated for. The City contract fees at that time were: \$13.32/ton for curb yard waste at Shoreline, plus \$6.71/ton for Superior to get it there; \$15.91/ton for S & R to remove leaves off site; \$13.50/ton to S & R to compost leaves on site; \$19.97/ton to S & R to recover drop-off yard waste, plus \$6.18 to load it; \$5.00/ton revenue from Allar for a portion of City logs; and \$33.77/ton for landfilling solid waste. Wauwatosa handles a total of about 8,000 tons of yard waste, leaves and trees per year. This project may have both increased diversion of materials from landfills and saved Wauwatosa taxpayers' and others' money.

Organic Project Outcome: "done before it started."

Along with an initial organizational meeting bringing together many of the partners above, a further briefing was held for City officials on what this conceptual plan might entail. NutraCycle, a potential key partner, was in those briefing and organizational meetings. Within a couple weeks the area of the Public Works yard under consideration was put out for bid to developers. NutraCycle did not want to

take on that developer role and did not bid. They and others did explore other private structures and operations over the next year and a half. None came to fruition, and finally “September 11th” severely disrupted NutraCycles’ Disney World operations, leading to their company’s demise.

Meanwhile, other organic waste efforts continued underway as described below, all as separate ventures from this municipally organized regional attempt. For a much more progressive and established regional effort, readers are invited to look further into the Fox River Valley Organic Recycling Project, which the Southeastern Wisconsin one was trying to emulate, by viewing their website at www.wastenotorganics.wisc.edu/frvor/frvor/htm.

FOOD WASTE TO PELLETIZED LIVESTOCK FEED

TESTS: 2001 CASE STUDY

To explore potential solutions to the growing problem of useable food materials going to waste in landfills instead of going to beneficial use, WasteCap Wisconsin sponsored a second test of food waste used as livestock feed.

The earlier “Food Waste Direct to Swine Feed: 2000 Case Study” assessed the practice of collecting raw food waste from restaurants and bakeries, transporting it, selfprocessing it, and supplementing it with a minimal amount of other nutrients to produce palletized swine feed. It concluded by recommending urban and/or commercial high volume collection program, with processing done by a centralized processing facility that could transform volumes of such wastes into usable farm products by nutritionally blending, and perhaps drying/pelletizing them.

Following the first testing program, REC Systems located a company that operated food-waste pelletizing facilities around the country. The Nutra-Cycle, Inc. facility in Orlando, Florida, produced feed pellets for livestock from food waste generated at Disney World and other restaurants and commercial food operations. A Nutra-Cycle plant in Oshkosh, Wisconsin, made similar livestock feed from commercially processed food wastes and agreed to work with WasteCap Wisconsin and REC Systems to test pelletized feed in a pig study to expand previous research conducted in 2000 (described in the

earlier section). WasteCap Wisconsin sponsored the supplemental study expenses, and NutraCycle donated the test feed pellets and provided analytical results of earlier tests (Myer et. al., 1999).

Again the father-and-son team of Bill and Eric Tarman-Ramcheck expanded the swine test in

2001 and modified the methods as described below.

Raising feeder pigs to market weight for 4-H projects entails certain limits; for example, the fair pigs had to weigh less than 80 pounds at a late-May weigh-in to qualify for eligibility and had to weigh between 225 and 270 pounds to be shown at Walworth County Fair in July. Assuming the pigs made these weights, they could be sold at the Meat Animal Sale auction to cover the normal expenses of such a 4-H project. Eric had been successful in meeting these requirements in all previous years, including the 2000 raw food-waste study, and he hypothesized that his expenses for 2001 could be lowered by using the pelletized food waste. At the same time he would keep useable materials out of landfills and lower disposal costs for firms supplying the food waste.

Methods

The test was designed to track expenses, feed quality, and pork quality. In recent years poor markets have often lowered the value of pigs. Feeding swine traditional feed from co-ops is costly, which often makes it difficult to recover costs for small growers, except in situations like the Fair’s Meat Sale, or selling prizewinners for breeding and then selling their offspring. Sometimes market prices are so low that farmers stop raising pigs, or go out of business because of insufficient revenues. This study was intended to demonstrate that using pelletized commercial food waste could help save some pig farmers money, still produce a quality product, and reduce municipal solid waste (MSW).

Bill and Eric collected data on feed types, amounts, costs, feeding procedures, health checkups, and various swine measurements for this project. The funds to cover the extra costs incurred by this project, like veterinarian visits, waste food tests, and data gathering was again generously provided by WasteCap Wisconsin. NutraCycle kindly provided and

shipped the Oshkosh food waste pellets and their nutrient facts and prices. Their pellet specifications were checked against tests done by the University of Wisconsin Soil and Plant Analyses Labs in Madison and Marshfield, Wisconsin. University of Wisconsin Agriculture Professor Vernon Leibbrandt offered his expertise regarding the food waste analyses and testing procedures.

Eight genetically matched pigs were purchased for the project, four fair pigs and four similar test pigs. These came from Benhart Farms, with six being purebred Duroc littermate barrows, and two being crossbred littermate gilts. They were acquired as feeder pigs in April, 2001 at about 50 pounds each, and had to reach market weight by September. Eric obtained his PQA certification to learn more about pork production and to be able to sell the pigs at the county fair.

An experimental method was used for the project. Four 4-H fair pigs, or “control” pigs, were compared to four matched “test” pigs raised on food waste pellets. The “control” group was raised with traditional bagged Burlington Food Co-op and Kent’s pellets. The “experimental” group was raised with bulk NutraCycle pellets made from waste potato, cheese, ice cream cone, and other food processing wastes. Extensive records were kept on the pigs’ weight, feed weights, and other data.

Several activities were carried out at the Tarman-Ramcheck’s East Troy homestead site during the project. After the eight genetically similar barrows were purchased and grouped, pens and yards were arranged.

Supplies were obtained, including an electronic weighing scale borrowed from the East Troy FFA to check the REC scale; feed and water containers; trailer parts; and computer/video materials. The “test” pigs were transitioned for two week from traditional pellets to the food waste pellets. Vernon Leibbrandt at UW-Madison was periodically contacted for advice. Daily records were kept, and swine weights taken about every other week. Dr. Robert Entwistle, the veterinarian, checked the pigs twice during the test, preparing papers attesting to their health. Measurements were taken for four pigs (2 “fair” and 2 “test”) at the Wisconsin State Fair; and for three pigs (2 “fair” and 1 “test”) at the Walworth County Fair. Meat

processors and others evaluated the quality of the final market weight pigs. Sawyer’s Meat Plant in East Troy evaluated the pork quality for four of the pigs. Together, these and other actions helped produce the study results.

Results

A variety of participants contributed to study results. The Wisconsin State Fair Badger Classic, Walworth County Fair, 4-H and FFA set many

guidelines for showing fair pigs. An East Troy High School agriculture teacher, FFA members, and pork associations offered additional advice (National Pork Producers Council, 1997). UW Agriculture Sciences provided information on nutrition, while Elkhorn Veterinary Clinic ensured the health of the pigs. Local farmers supplied further advice, and are even investigating other uses of the NutraCycle pellets, including feed for chickens. Meat processors evaluated the finished product. Area businesses and individuals bought all the pigs at the end, including one for a Wauwatosa Public Works pig roast, thus further supplementing WasteCap Wisconsin’s support.

Conclusions

It is possible to lower costs for raising pigs (especially those closer to NutraCycle or similar facilities), while at the same time keeping valuable food processing wastes out of landfills, which in turn should lower disposal costs for the commercial food processors. Yet to produce comparably “graded” pork, the formulation for the NutraCycle feed pellets should more custom blended for swine rather than generically formulated for livestock. As a result, the expense of producing high-quality pigs for market could be reduced significantly. This approach also could reduce the need for traditional animal feed products like corn or soybeans, which might find better use elsewhere. Most importantly, it furthers effort to “close the loop” by recycling food waste to produce more edible food.

Small- and large-scale pig farmers could save money in this way if further study optimizes the formulation for foodwaste pellets for swine. Furthermore, these efforts may lead to more food waste collection programs for pre- and postconsumer food wastes. These results could support more centralized food-waste processing facilities like NutraCycle’s, whose facilities in Oshkosh, Wisconsin, and Orlando, Florida, were

pioneers in those areas. Other factors that would help are to get such feed to farmer's normal feed providers, perhaps bagged or packaged in other ways, to expand the distribution system and lower transportation costs to users.

The lessons learned from this project may be applied in other ways to more farmers, hotels, restaurants, bakeries, and other sources of food wastes. In southern Wisconsin, waste haulers, commercial food and organic waste processors, and facilitators like WasteCap Wisconsin may continue to investigate and promote such production, or other alternatives as noted below. Educational institutions have expressed interest in researching more food waste applications and formulations, as well as assisting others in learning about and implementing such alternative procedures.

Results of this and the earlier study are summarized in the widely distributed Business Food Waste Briefing Paper: Options for Grocers, Restaurants and Food Processors (see WasteCap's website at www.wastecapwi.org). This excellent resource provides a great beginning for those interested in diverting more food waste from landfills and getting it into more beneficial uses, but also acknowledges that more questions need to be answered as food waste recovery programs evolve.

***FROM GROCERS TO COMPOSTERS –
WASTECAP WISCONSIN PROVIDES
THE LINK TO COMMERCIAL FOOD
WASTE RECOVERY:***

2002 CASE STUDY

A food waste recovery project in southeastern Wisconsin recovered nearly 120,000 pounds of compostable material through a cooperative effort among six Waukesha-area grocery stores, a waste hauler, a compost facility, and WasteCap Wisconsin, the coordinator of the program. During the three-month pilot, five of the six participating stores experienced cost savings from avoided disposal costs.

The three-month collection pilot ran from February 11 through May 13, 2002. Supported by a grant from Greater Milwaukee Foundation, WasteCap Wisconsin's goal was to help recover this valuable resource by serving as the link

stores that generate food waste, haulers that can transport the material, and facilities that can compost the material.

Methods

WasteCap Wisconsin encouraged participation and provided direct outreach, education, and technical assistance to farmers, waste haulers and food waste generators in the greater Milwaukee metropolitan area.

Markets

To make these connections, WasteCap Wisconsin staff first worked with many different food waste markets and was approached by or discovered potential new markets for food residuals in the area. For the three-month collection, S&R Compost was selected.

S&R Compost processes yard waste from several municipalities and chicken manure from its egg farms to produce commercially available compost. S&R staff tested the concept of including food scraps in the yard waste composting, then processed the organics from the grocery stores during the three-month pilot in the compost plant. Processing included shredded the organic material, including waxed cardboard.

Frank Schimpf, S&R Compost, was very pleased with the material coming from the grocery stores, noting that "the material was free from any major contamination and broke down very well in the compost pile." They noted that waxed cardboard takes significantly longer than the food scraps to compost, however. Schimpf closely monitored the compost recipe and developed a procedure to create the highest quality compost. S&R Compost is able to produce finished compost in about two months. The finished product is suitable for use by home gardens, landscaping, and municipal projects.

Haulers

WasteCap Wisconsin located haulers willing to collect and transport separated food scraps. We met with over a dozen haulers to determine quantities of organics needed for a cost-effective route, optimal route sizes, and other issues such as types of collection containers, types of trucks, and other factors.

Best Disposal, Inc.'s willingness to track materials, to take the time to talk to store staff about any contamination issues, to monitor the

dumpsters, and provide other oversight was the key to the program's success. The organic materials were collected twice a week, containers were monitored for contamination, container volumes were tracked, compostable material was weighed, and the organic materials were hauled to the S&R Compost facility near Whitewater, Wisconsin.

Business Food Waste Generators

In order to develop a cost-effective route, grocery stores were identified within an 11-mile route (distance between the stores starting from the first through the last). Six of the seven stores invited agreed to participate.

All of the major grocery store chains in the area participated in the program. BKT Sentry Foods-Meadowbrook, BKT Sentry Foods-Fox Run, Jewel Osco, Kohl's Food Emporium, Pick n' Save and Rainbow Foods in Waukesha separated their food waste and other organic materials for composting. During the three-month pilot, employees collected all produce and bakery unfit for sale or donation, produce preparation trimmings and waxed cardboard in designated containers.

WasteCap Wisconsin worked closely with the department managers and staff to explain the logistics of the separation program and provide the stores with signs that clearly explain the separation procedures. The organic materials are emptied into outside dumpsters, clearly labeled "Compostables Only." The dumpsters range in size from two to eight yd³ and come equipped with locks to avoid contamination.

Results

WasteCap closely monitored and tracked the quantities of organics diverted and all associated costs of the program.

Five of the six stores saved money through this program based on avoided disposal costs. The stores used the cost-savings from reduced trash pick-ups to offset the collection costs of the organic materials. One grocery store reduced its trash collection from six times a week to two times a week, thereby reducing collection costs. During the three-month pilot, 118,360 pounds of compostable material were recovered.

In interviews after the pilot, all of the grocery stores indicated that they would like the program to continue and expand the program. The composter is investigating expanding its operations to permanently include food scraps.

WasteCap Wisconsin staff believes that the next step needed for economically sustainable food waste recovery efforts is to develop the end markets for compost. Roadside landscaping for state and local highway projects have the

potential to transform the market for compost if compost were specified in construction plans. These case studies have provided us with the background and the information to move forward and pursue these markets and others.

RECOMMENDATIONS OF THE MULTI-YEAR EXPERIMENTATION WITH FOOD WASTES

Utilize Food Waste

There are a variety of ways food waste can and should be used. A food waste hierarchy following the "reduce, reuse, recycle" model has been developed, with options for feeding food to people, then animals, then for use as compost.

Make sure on all of these options to check with appropriate regulatory authorities before proceeding.

Options for food waste include:

1. Reduce food scraps is the highest priority (Note: separation programs such as those done with grocery stores help food waste generators identify, and thus reduce, their food waste)
2. Reuse first by donating suitable leftovers to food pantries or sheltered housing for human consumption.
3. Reuse what can't be given to people by feeding it directly to animals after sorting out garbage and meat products.
4. Reuse whatever food scraps can't be given directly to people or animals and process it to produce edible feedstock for animals.
5. Recycle/Compost onsite using worms, an in-vessel composter, or with enough space, windrows.
6. Recycle/Compost offsite and larger scale commercially or municipally to produce bulk or bagged soil conditioners.
7. Then Landfill. Even with the best efforts to utilize waste, there will likely be some situations where there are no practical alternatives to

hauling certain waste items to a licensed sanitary landfill. Although landfilling is the option of last resort, a sanitary landfill is designed to capture leachate, prevent groundwater pollution, and, in certain cases, capture methane to generate power.

Set Up Food Waste Recovery Programs

The decision to utilize food waste is only the beginning. Next, a system must be set up to accomplish whichever choice is made for how it will be used. This “top 10 list” should help in that process.

1. Ensure support and coordination among participants.

2. Identify the amount of food scraps available for diversion into reuse, recycling, or composting.
3. Determine market(s).
4. Arrange technical and financial components.
5. Develop the collection method(s).
6. Establish the processing system(s).
7. Educate and train everyone involved continuously.
8. Monitor the program(s) and make changes as necessary.
9. Celebrate successes.
10. Inform and network with others (as through this).

REFERENCES

- EPA (Environmental Protection Agency), 1998, Characterization of Municipal Solid Waste in the United States: 1998 Update. Washington, D.C.
- Myer, R.O., J.H. Brendemuhl, and D.D. Johnson. 1999. "Evaluation of Dehydrated Restaurant Food Waste Products as Feedstuffs for Finishing Pigs." *Journal of Animal Science*. Vol. 77, pp. 685-692.
- National Pork Producers Council. 1997. *Pork Quality Assurance*. Des Moines, Iowa.
- Swartz, N., 2002, "The San Francisco Feat." *Waste Age Magazine*, April, Vol.. 33, Number 4, pp. 94-96.
- Tarman-Ramcheck, Bill & Eric. 2000. *Final Report for a Waste Reduction Study Raising Pigs On Commercial FoodWaste*. East Troy, WI: REC Systems.
- Tarman-Ramcheck, Bill & Eric, 2001. *Final Report for the 2001 Waste Reduction Study Raising Pigs On Commercial Food Waste Pellets*. East Troy, WI: REC Systems.
- USDA (United States Department of Agriculture), Economic Research Service, 1997. *Estimating and Addressing America's Food Losses*. Washington, D.C.
- WasteCap Wisconsin, 2000. *Business Food Waste Briefing Paper*. Milwaukee, WI.

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See especially WasteCap Wisconsin's web site for "Business Food Waste Briefing Paper," with more resources for diverting food scraps.

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