SUSTAINABLE GLASS MANAGEMENT OPTIONS STUDY

PREPARED FOR
DUBUQUE METROPOLITAN AREA SOLID WASTE AGENCY

BARKER LEMAR
ENGINEERING CONSULTANTS

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Executive Summary

This document was developed to characterize the glass industry, identify how other waste management entities are sustainably managing post-consumer container glass, identify economic and environmental conditions impacting glass collection and processing for beneficial use (especially in the Dubuque Metropolitan Area Solid Waste Agency service area) , and assesses alternative glass management options.

The Dubuque Metropolitan Area Solid Waste Agency (DMASWA) could look to improve bottle redemption in the planning area. The redemption program for carbonated and alcoholic beverage containers has existed for over 30 years and it has a proven record of removing for recycling 85% of the redeemable containers. Industry sources report that in 2009 close to 83% of glass containers were beverage containers and nearly 60% were beer bottles; most of which qualify for redemption in Iowa.

If the DMASWA believes glass collection rates via the existing bottle redemption infrastructure is insufficient, then the DMASWA could identify and help improve local markets for glass that does not require sorting via traditional material recovery facility (MRF).

DMASWA could recommend discontinuing the collection of glass via a curbside collection system. Curbside collection (dual stream or multi stream sorting) of glass generates high costs specifically in truck modifications, bags to keep glass separate, and labor to sort. Regardless of the container glass collection system used, net processing and transportation costs are higher than the value of the material when sold.

Drop-off collection for non-redeemable bottles is not recommended unless a local market can accept the material without processing in a MRF. Contamination rates and breakage require a high amount of glass to be discarded from drop-offs, in addition, the net cost to process glass is prohibitive for a MRF.

Understanding glass to be a small percentage (approximately 6%) of the overall waste stream (residential or commercial/institutional/industrial), the DMASWA may look to recommend removing glass and replacing it with other items in the existing curbside collection system or any revised curbside collection system. The addition of other new material types would likely have higher value to the processor and have a net positive impact on the environment compared to glass.

Other highlights of this report include:

- Equipment wear caused by glass was mentioned by many processing facilities interviewed for this report. Cross contamination of glass with paper or other commodities was identified as a common problem with the processors that accept glass and surveyed for this report. The net affect of glass processed in a

MRF reduces the overall gross revenue for the facility an average of $20 to $25/ton.

- The City of Dubuque, the largest city in the DMASWA service area, has invested over $65,000 in truck modifications and bags over the last 10 years specifically for the management of glass collected curbside. Only 6% of the material collected per truck (by weight) is glass. *Fleet replacement is pending review of the long term sustainability of glass collection at curbside.*
- Of material discarded in the municipal solid waste (MSW) waste stream; glass was estimated at: 5.6% for the entire US and 1.9% in Dubuque. Container deposit legislation in Iowa likely plays a significant role in reducing glass in Iowa's MSW stream.
- Historical cullet prices show a 50% drop for the three cullet types (clear, brown, and green) beginning in January 2008 – these prices have only rebounded marginally since January 2010.
- Proximity to markets is a problem in certain areas of the United States, the DMASWA is not immediately close to known beneficiation facilities. The two closest beneficiation facilities are from 170 to 200 miles away.
- Once the cullet is broken or mixed in a single stream processing system, like the system at Dittmer Recycling (Dubuque, IA), contaminants (such as other container glass colors, window glass, ceramics, etc.) are typically very difficult to remove and reduces the value of the cullet and could cause rejection of the material when delivered to a processor. Some processors report up to 40% of glass received within a curbside collection program is broken before it can be effectively sorted; this 40% is usually landfilled.

Municipal curbside collection programs that do not include glass in their curbside collection programs (Omaha, Kansas City) appear to complement their collection program with source separated drop-off collection. These cities are single stream cities and are located in non-bottle bill states. These collected materials are usually diverted to low value one-time uses such as aggregate. Single stream processing does not necessarily negate the acceptance and processing of glass; however, large and small metropolitan areas are finding they can improve value of all other commodities when they keep glass in source separated collection streams (drop-off) and it is not mixed with other materials in a MRF.

The environmental benefits of using container cullet in the manufacture of new containers are fairly well documented with reductions in energy used for glass furnaces, reductions in CO_2 and NO_x emissions. However, these benefits do not yet translate into higher prices as the raw materials required to make glass is primarily (over 70%) silica which is obtained from sand. The EPA's WARM model shows glass recycling to have one of the lowest net environmental benefits as compared to other curbside recyclable commodities.

Section 1.0
Introduction

1.1 Purpose

The purpose of this document is to assist the Dubuque Metropolitan Area Solid Waste Agency (DMASWA) identify how other solid waste agencies within the Midwest sustainably manage glass, identify the motivating factors that drive public and private entities to manage the recycling of glass a specific way, and assess sustainable alternative glass management options. This report is primarily concerned with the sustainable management of post-consumer container glass collected through drop-off and curbside recycling programs and processed in a single stream MRF with relatively small total monthly throughput.

1.2 Approach

The approach used to identify existing glass recycling (collection and processing) infrastructure and marketing options involved phone interviews with representatives participating in the various stages of glass recycling including collectors, processors, and buyers. Researchers complemented phone interviews with working knowledge of recycling systems, information received from trade associations, and information gathered from web-based research.

The discussion regarding the positive and negative environmental impacts of glass recycling (Section 3) is cursory; the discussion in this particular section does not consider all the variables associated with glass collection, processing, and manufacturing. The life-cycle assessment of the environmental impacts of glass recycling is complex; however, researchers reviewed common environmental analysis along with the practical constraints of supply and demand.

Glass management options (Section 4) were developed from an understanding of the current glass recycling systems in the DMSWA service area, potential collection changes being reviewed by the City of Dubuque, potential cost increases under a new MRF contract between DMASWA and the current MRF contractor if glass is continued to be included as an acceptable materials, and an understanding of recycling systems in other cities in the Midwest.

1.3 The Glass Industry

1.3.1 Manufacturing

Glass containers are made from sand, limestone, soda ash, cullet (crushed bottles), and various additives, including those used to color brown, green or blue bottles. Container glass is often referred to as soda-lime glass. Processed glass aggregate is a term for engineering applications such as ballast, shoulder ballast, crushed surface base course, aggregate for gravel base, gravel backfill for foundations, walls, pipe bedding and drains, and bedding material for rigid and flexible pipe. Recycled glass is considered to be a non-combustible, inert material.

Approximately 80% of the glass containers in the US are supplied by just two companies: Owens-Illinois (multiple sites in the United States) and Saint-Gobain (multiple sites in the United States). With only two companies, the manufacturing and distribution process is highly centralized, which increases the distance bottles must travel to reach end users.

1.3.2 General Characteristics of Glass

The density of glass cullet is 1,000-2,000 pounds per cubic yard (lbs. /cu. yd.) and loose glass bottles weigh approximately 600 lbs. /cu yard.

Glass bottles can have up to 70% recycled content. Only 26% of bottles produced in the United States contain recycled content.

Glass bottles now weigh an estimated 50% less than they did in 1970. In the last 10 years; the container weight of 16-ounce glass bottles has been reduced by 30 percent. The glass industry appears to be looking for new technology that can further decrease container weight.

1.3.3 Glass Bottles and Market Share

According to the National Solid Waste Management Association and the Glass Packaging Institute, about 50% of the bottles produced in the United States are clear (also known as “flint”) bottles, followed by brown (sometimes called “amber”) bottles. Most of the remainder is green (of which there are several hues) with a very small amount of blue, yellow, or other colors. Blue or yellow containers are not considered a primary color category in most US recycling programs.

In 2006, approximately 35 billion glass containers were made in the United States. According to the Glass Packaging Institute, in 2009 close to 83% were beverage containers and nearly 60% were beer bottles. The remaining 20% were mostly food containers. Another five billion bottles are imported. Most of these are green-hued wine and beer bottles. Glass containers consist of two basic types of containers: narrow neck (nearly 80 percent of the glass containers produced and shipped) and wide mouth

containers. Wide mouth bottles and narrow neck bottles are both recyclable in traditional glass collection programs. Wide mouthed drinking glasses are not accepted in most traditional collection programs including the DMASWA service area.

From 2008 to 2009 the production of glass containers dropped about 5%. Economic factors or material substitutions could be attributed to this decline.

The market share for soft drinks in refillable glass bottles was estimated to be 100 percent in the US in 1947. In 2000, that number declined to approximately just 1%.

1.3.4 Solid Waste and Recycling

The US EPA (Office of Resource Conservation and Recovery) report entitled *"Municipal Solid Waste Generation, Recycling, and Disposal in the United States Detailed Tables and Figures for 2008" (November 2009)* reports that all glass was 4.9% (by weight) of waste generated of which 23% was recovered via a recycling program. Of material discarded in the MSW waste stream glass was estimated at 5.6% by weight.

In 2005, the DMASWA participated in the State of Iowa Waste Characterization Study. The results of this study specific to DMASWA study identified all glass as representing 1.9% (by weight) of the landfilled waste stream. This figure is significantly lower than the EPA estimates described above. Total glass in Iowa's landfilled waste stream, as identified in the 2005 study, was 2.0% by weight. Container deposit legislation likely plays a significant role in reducing glass in Iowa's MSW stream. Eleven states require deposits on glass containers.

According to the National Solid Waste Management Association, the majority of recovered container glass is made into new glass bottles with fiberglass markets serving as the second largest market. Other markets, including civil engineering applications and asphalt additives, are sometimes used by glass collectors/processors. Other uses for recycled glass include kitchen tiles, counter tops, and niche novelties.

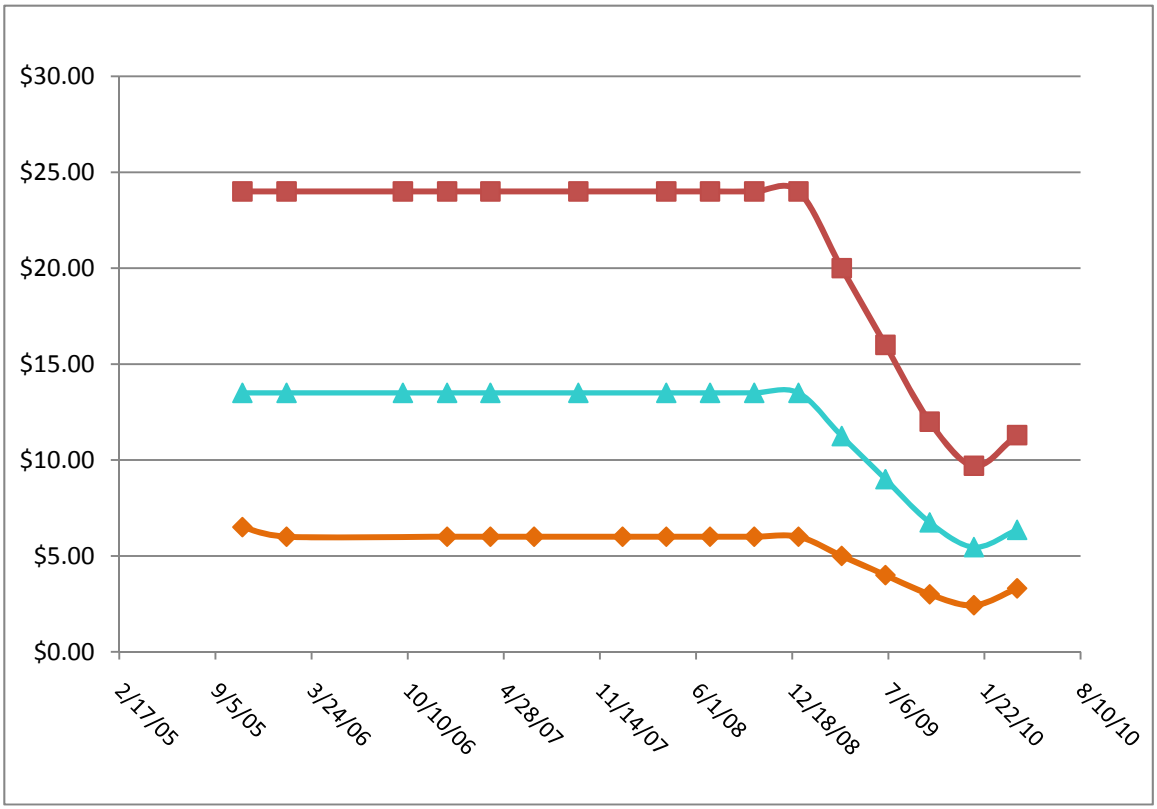
End-market specifications have been developed by the International Scrap Recycling Institute (ISRI) – see ISRI Guidelines for Glass Cullet: GC-2007.

End markets for cullet that are geographically near to Dubuque are described in Section 2.

1.3.5 Historical Cullet Prices

The Figure 1-1 (next page) provides a summary of historical cullet price data for three cullet types. Currently, collectors and processors in Iowa, Missouri, and Nebraska report prices being paid by processors are in the $2/ton range (delivered). These prices do not include the cost of transportation to the processor purchasing the glass.

Figure 1-1
Historical Cullet Prices



■ Scrap Post Consumer Container Glass – Sorted Clear

▲ Scrap Post Consumer Container Glass – Sorted Amber

◆ Scrap Post Consumer Container Glass – Mixed Colors

1.4 Report Contents

This report includes the following sections:

- Section 1.0 Introduction – Purpose, approach, and a summary of the glass industry with specific emphasis on the overall market share of glass bottles and jars, waste characterization data, and cullet price data;
- Section 2.0 Glass Recycling Industry in the Midwest - Summary of the impact of deposit legislation, contamination in sorting methodologies, phone interviews conducted with collectors, intermediate processors, and end users;
- Section 3.0 Global Impacts of Glass Recycling – Discussion of the life cycle of glass with specific attention given to raw materials and greenhouse gas emissions during the recycling process from collection through manufacturing.

  Section 4.0 Glass Management Options – A summary of post consumer glass management options that could assist the residents and businesses in

the DMASWA service area make choices to sustainably manage the impacts of diversion/discard options for glass. The summary of options will also help residents and businesses select glass management options through environmental, economic, and social parameters.

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Section 2.0
Glass Recycling in the Midwest

Glass recycling in the Midwest, and in Iowa, is distinctly impacted by several market forces: bottle deposit legislation (specifically Iowa's Beverage Container Deposit Law), mandatory collection rules, low tolerance for cross contamination, and proximity to intermediate glass processors and glass markets.

In this section, the results of a phone survey of collectors, processors, and end users are summarized.

2.1 Beverage Container Deposit

None of Iowa's geographical neighbors have a beverage container deposit law. The low percentage of glass in Iowa's waste stream can be attributed in part to Iowa's Beverage Container Deposit Law which was enacted in 1978 and implemented in 1979. Iowa's law covers beer, carbonated soft drinks, carbonated mineral water, wine coolers, wine, and liquor and offers a $.05 per container deposit with $.01 processor fee paid by the distributor to retailers or redemption center per bottle. In Iowa, unredeemed deposits are retained by distributors/bottlers; in Iowa, the State of Iowa distributes all alcoholic beverages.

The Iowa container deposit law has not been significantly changed since its implementation in 1979 although significant changes to the law have been attempted in the legislature in three years (2007, 2008, and 2009) of the last four years.

According to the website, "BottleBill.org" the redemption rate in Iowa was estimated at 93% in the year 2000 but this rate has decreased to an estimated 86% in 2009.

Although almost all of the larger municipalities in Iowa offer drop-off collection and curbside collection programs for various recyclables; Iowa's unique bottle deposit legislation previously developed a redemption program for defined beverages and associated containers. Drop-off and curbside programs operate concurrently with the redemption of glass, aluminum, and plastic bottles in most communities.

The diversion of glass bottles by redemption programs removes a large quantity of clear, brown, and green glass in Iowa from curbside collection and drop-off programs. Despite the diversion of bottles via redemption centers, some green and brown bottles are still present in glass received from curbside/drop-off programs. The characteristics of the glass received at Dittmer Recycling (Dubuque, IA) have been surveyed in previous years.

Consequently, glass recycling programs in Iowa that do not separate by color (or perform minimal manual sorting) generate a recovered glass product that is primarily clear glass (but sold at a lower grade than clear flint due to color contamination).

2.2 Mandatory Collection Rules

Many Midwest states require that container glass is collected. The State of Minnesota requires that brown, clear, and green glass be collected by each county.

The State of Iowa requires that glass management is described via the development of solid waste comprehensive plans, specifically planning agencies must report specific methodologies for the separation of glass, paper, plastic, and metal (567 101.6). Additionally, containers qualifying for redemption in Iowa are also banned from disposal by a dealer, distributor, manufacturer or person operating a redemption center (Code of Iowa 455C.15)

Wisconsin also implemented a landfill ban for glass containers and mandatory glass recycling.

2.3 A Note Regarding Green Glass

There are very few green bottle manufacturers in the United States; consequently, recycled green cullet often exceeds the domestic demand for this commodity. Recycling programs that market one single color (such as the “green glass” generated in the Des Moines Metro area’s single stream recycling program) must sell a cullet at a decreased market value due to color purity. The willingness to pay for labor to sort glass by color (and the economic return for that labor) is often an undermining factor for programs that accept glass.

An example of reduced revenue can be shown via the Mankato (Minnesota) Recycling Center’s ledger exposing the economics of a system that sorts glass containers by color. Most materials processed in the Mankato Recycling Center generated some revenue in 2008; the following figures were received for selected commodities: $31,000 for newspapers, $25,000 for cardboard, nearly $21,000 for aluminum, and $14,000 for PET plastics. The facility received $4,600 for clear glass (delivered), $1,627 for brown glass, and $0 for green glass. (Note: Anchor Glass Container in Shakopee, Minnesota [56 miles from Mankato]) is a primary market for container glass in Minnesota).

2.4 Contamination of Cullet

Most curbside recycling and drop-off programs only accept container glass and use various education initiatives to keep unacceptable glass types out of the container stream.

Community recycling programs that allow for glass to be mixed by color during collection by collection crews may trade this convenience in collection for lower marketability and net value. Even if color separation does not happen at the curb, colors are rarely sorted manually in the recycling process (not including beneficiation facilities). The Scott County Recycling Center (Davenport, IA) however, does operate a dual stream sorting system that includes designated laborers that hand sort glass bottles and glass shards greater than on inch.

Once the cullet gets broken or mixed (i.e., mixed by color or mixed with other glass pieces), contaminants are almost impossible to remove at a small scale MRF operation (economic considerations would require some form of manual identification and separation of glass pieces at such a facility); contamination can spoil the quality of an entire load of shipped cullet. Some processors report up to 40% of glass received within a curbside collection program is broken before it can be effectively sorted. Broken pieces of glass (and other small bits of contamination) are screened and landfilled. Representatives from Strategic Materials confirmed that materials screened below ¼ inch are discarded at their St. Louis facility along with other contamination.

Other unacceptable glass mentioned in educational materials across the Midwest and the United States often includes: drinking glasses, window glass, heat-resistant ovenware (for example, Pyrex), crystal, and light bulbs.

Cullet manufacturers have limits on the amount of mixed cullet (container glass mixed with non-container glass) they can use for manufacturing new containers and, generally, they prefer not to buy glass that is not completely separated according to its kind.

Ceramics and plastics that may resemble glass are also common contaminants within glass container recycling programs. Like any other recyclable commodity, quality control at local collection sites is imperative.

2.5 Practical Implementation of Sorting Technology

Preliminary research performed by **BARKER LEMAR ENGINEERING CONSULTANTS** was not able to confirm which processors (such as public or private MRFs) or bottle makers serving the Midwest have implemented available optical sorting technologies similar to the technology in use by large recycled plastic resin processors. This technology would be economically impractical technology for the small amount of glass managed at the DMASWA's contracted MRF; this MRF ships to market approximately 500 tons of glass (2009 figures). According to City staff, approximately 10% of the glass that was shipped to market in 2009 was under ¼ inches and was discarded by the processor.

A feasibility study regarding the cost to construct and operate a regional optical sorter for glass cullet was performed in 2007 for four MRF's in the Twin Cities (Minnesota) area. The authors (Tim Goodman of Tim Goodman & Associates) noted that all four of the MRF's would be required to participate; if they all participated and implemented the

system and received an estimated 53,000 tons annually of mixed glass, then the facility would be required to charge a tipping fee for the glass amounting to $12 - $16/ton. Interestingly, the authors calculated that a facility would generate 24,000 tons of flint (clear) cullet (from containers), 8,600 tons of brown (amber), and 8,700 tons of green cullet.

2.6 Market Prices and Market Strength

The lowest grade of recycled container glass is generally considered for the products that contain mixed color from mixed color cullet. Municipal recycling centers, specifically single stream operations, were identified by beneficiation firms as producing the lowest grade of glass as material from these facilities is almost always cross contaminated.

Color sorted, or mixed color from redemption centers was identified by Strategic Materials as having the highest value as contamination is often extremely low and bottles are generally intact or broken glass remains in larger pieces.

According to Strategic Materials, sorted container glass (clear) appears to have a current value of $30 to $40 per ton (delivered) and mixed color appears to have a value of less than $10 per ton (delivered).

Regarding freight efficiency, Strategic Materials offered a recommendation to reduce overall fees associated with freight and disposal costs charged back at beneficiation sites for fines and waste. Strategic Materials recommended first that MRFs screen glass under ¼ inch and remove waste before shipping. Screening this way removes the smaller glass and fines which then are not shipped (which costs money) and the smaller glass is not discarded at the beneficiation facility (which also costs the MRF money). Of course implementation of a final screening costs money as well. Strategic Materials also recommended that full truckload quantities are used to reduce the freight cost per ton of glass recycled. Full truckloads are shipped from the DMASWA contracted facility but they are not pre-screened to remove glass fines under ¼ inch

Strategic Materials also offered the opinion that they felt markets were strong (although prices were comparatively low) – this particular company identified strong demand for their glass cullet products.

2.7 Proximity of Glass (Bottle Manufacturing) Markets

Table 1-1 provides the name, location and distance from Dubuque for Bottle Manufacturers (cullet markets) and beneficiation facilities. *(Note: The DMASWA contractor cannot meet the required specification of the bottle manufacturers without substantial investment in optical sorting technology.)*

Table 1-1
Cullet Users (Bottle Manufacturers)

Facility Name	City, State	Distance from Dubuque (miles)	Type
Strategic Materials	Chicago, IL	170	Beneficiation
GreenStar	Des Moines, IA	200	Beneficiation
Strategic Materials	St. Louis, MO	340	Beneficiation
Saint Gobain	Burlington, WI	140	Bottle Manufacturer
Owens-Illinois	Streator, IL	190	Bottle Manufacturer
Saint Gobain	Dolton, IL	200	Bottle Manufacturer
Anchor Glass	Shakopee, MN	310	Bottle Manufacturer
Saint Gobain	Pevely, MO	370	Bottle Manufacturer
Coors Bottling	Golden, CO	880	Bottle Manufacturer
Longhorn Glass	Houston, TX	1,130	Bottle Manufacturer

Note: Owens-Illinois supplies glass bottles to many of the Anheuser-Busch breweries around the world. Anheuser-Busch bought Longhorn Glass, a former Anchor Hocking Glass plant to provide glass for the Anheuser-Busch Houston Brewery.

2.8 Brokers and Intermediate Processors (Beneficiation Facilities)

Businesses that receive glass cullet and perform further processing may be considered beneficiation sites. GreenStar (Des Moines) and Strategic Materials (multiple locations throughout the Midwest) provide cullet processing to meet strict criteria for bottle makers, fiberglass insulation makers, plate glass manufacturers, and tile/counter top manufacturers.

Intermediate processors may be more flexible than a bottle market as they serve multiple clients. Intermediate processors are able to handle a larger variety of contamination and/or glass mixes as they may use optical sorting technology. Strategic

Materials confirmed that they use optical sorting technology at their Chicago and St. Louis facilities.

2.9 Equipment Wear, Safety, and Residue Disposal

Equipment wear caused by glass was mentioned by many processing facilities interviewed for this report. Processing and collection mechanisms vary; this variability also impacts fragile glass containers and the percentage of containers that break before manual sorting. Although no processing facility could identify specific costs associated exclusively with glass; most of the facility managers that were interviewed knew intuitively that glass wears/abrades a wide assorted of equipment including rollers, belts, trommels, and tires. Similarly, safety issues identified with the handling of glass could not be quantified but processors mentioned the issue of handling or being near broken glass as something they would like to see reduced or eliminated.

While speaking at the National Residential Recycling Conference in March 2010, Michele Thornhill, Vice President and General Manager SP Corporation mentioned that comingled processing with glass added $5.00 per ton of cost to every ton processed due to wear and tear on equipment and residual disposal. SP Recycling Corporation (Atlanta, GA), a large recycled newsprint recycler operating 3 single stream and 2 dual stream plants.

The Scott County Recycling Center (Davenport, IA) reported that they replace mesh belts approximately one time per year; the belt wear is thought to be caused in part by the abrasive nature of glass.

The Columbia, Missouri recycling facility reported that glass is a major tear issue for equipment in their material recovery facility.

Firststar Fiber (Omaha, NE) specifically identified glass as a material that wears equipment and serves as a safety issue for sort line workers. Firstar Fiber also mentioned that the percentage of material received at the facility (by weight) is less than 2% - the facility manager attributed this low residual to the decision to not accept glass in their single stream curbside program. *Note: some material recovery facilities accepting glass in single stream programs have residual amounts in the 6-10% range with some reporting residual amounts as high as 20% of the combined incoming feedstock of all commodities.* The increased weight of residual is attributed to broken (fine) glass. Residual materials are generally discarded as waste. Although not surveyed for this report, the City of Madison Wisconsin participates in a single stream recycling program that accepts three colors of glass containers. On average 8.3% of the material that is put in Madison's single stream system cannot be recycled (residual amount).

City Carton only accepts source separated glass at their seven facilities in Iowa, safety and wear and tear on equipment was cited as the primary reasons for only accepting glass in this fashion.

2.10 Cross Contamination/Breakage

Cross contamination of glass with paper or other commodities was identified as a potential problem with the processors surveyed for this report. Although much glass breaks in a co-mingled system, the various forms of manual and mechanical separation in a material recovery facility are not always able to remove an acceptable amount of glass from the other paper, plastic, and metal commodities. Plastic, metal, and paper markets may charge disposal for rejected material – these entities have a near zero tolerance for glass contamination according to representatives from City Carton.

Single stream recycling and the efficient processing systems associated with this form of collection tend to break glass, causing additional waste. Wisconsin has used regulations to try and reduce glass breakage in single stream systems. Wisconsin code, 544.05(1)(a), states that the system for collecting recyclable materials from single family and 2-4 unit residents must prohibit the compaction of glass containers with newspaper or with municipal solid waste during collection. If a business is considering adoption of a collection system that does not meet the requirement listed above, they must apply to the Wisconsin DNR for approval of an alternative collection system.

Processing facilities receiving glass as a source separated material (like City Carton facilities) do not generally have a significant problem with cross-contamination with glass.

Michele Thornhill, Vice President and General Manager for SP Recycling Corporation (Atlanta, GA), says that when glass is included in the incoming feedstock of a MRF the glass lowers the combined shipped product net revenue potential of the MRF by $20 to $25 per ton due to low market value for glass commodities, cross contamination, equipment wear and tear, and increased residuals for landfill disposal. Regardless of commodity prices, the costs to operate a MRF remain constant. Ms. Thornhill believes that the radical swings in commodity prices experienced during the last five years require processors to maximize the commodity prices they receive. She believes, based on her direct experience with different systems, glass should be kept separate regardless of the collection/processing system.

2.11 Municipal Collection Programs

Municipal glass collection programs typically include drop-off collection sites and/or curbside collection services designed to collect glass from residents and small businesses or organizations. These Municipal glass collection programs are separate from services to collect deposit bottles for return to distributors or the distributor's selected processing center.

The DMASWA contractor's total feedstock averages approximately 60% from curbside programs in the tri state area; some of which are single stream programs (not all of the

collection programs include glass). Of the material processed by the DMASWA contractor, 45% of the material (by weight) is glass separated by City of Dubuque collection crews and is therefore not included in the single stream sort. The facility generates slightly less than 5% residuals (material landfilled); glass constitutes approximately 50% of this landfilled material (total landfilled materials equals approximately 1,000 tons per year). The City of Dubuque and the DMASWA staff report that most of the glass residuals come from Wisconsin and Illinois curbside recycling programs. Wisconsin and Illinois do not have container deposit programs.

2.11.1 Drop-Off Glass Collection Sites: General Information

Drop-off collection sites accept glass in various sized containers which are transported to a facility for processing. The containers are typically metal roll-off containers, these containers cause recycled glass bottles to break. This breakage causes a potential safety concern for processors as the glass shards can cut personnel's hands and fingers. Broken glass also increases the difficulty for the processor to efficiently and effectively sort the material to generate different products (i.e. single color glass cullet) unless the drop-off container would require recyclers to segregate glass into separate compartments. However, drop-off collection sites are typically not staffed or secure leading to abuse of the site and prohibited materials (i.e. window pane glass, light bulbs, aquarium glass, etc.) placed in the glass recycling containers. The high probability of a drop-off container receiving prohibited materials requires all glass received to be sorted by the processor and ultimately sorted a final time with optical sorting technology.

2.11.2 Manual Curbside Collection (with Glass Separation Capabilities): General Information

Manual curbside collection programs allow the collection crews an opportunity to sort the glass being collected to prevent prohibited materials from being accepted. In some programs, such as the City of Dubuque and the City of Cedar Rapids, the glass is placed in a designated compartment to keep the glass separated from other collected materials (i.e. cardboard, plastic, tin, etc.). The collection vehicles used do not typically have the capacity for collection crews to segregate glass into separate categories (i.e. separated by color) due to the limited storage capacity of the vehicle and the other materials they are collecting at the same time.

Glass collected in manual curbside programs is considered to be less contaminated than glass accepted at drop-off sites due to the screening process the collection crews perform. Facilities processing manual curbside materials experience a 2% to 5% residual stream with little glass residuals that are missed by the collection crews.

Operating a curbside collection program requires more infrastructure (i.e. containers for each resident, collection vehicles, maintenance facilities, etc.) and personnel (i.e.

collection crews, maintenance staff, route managers, customer service operators, etc.) than typical drop-off collection sites require. Contamination levels (i.e. prohibited materials and glass mixing with other recyclables) are much lower (2%-5%) in systems processing these materials.

2.11.3 Automated and Semi-Automated Curbside Recyclables Collection

Automated and semi-automated curbside recyclables collection programs require collection crews to accept recyclable materials mixed together in a single container. Automated collection vehicles use a robotic arm which tips the contents of the container into a single storage compartment. Collection crews do not need to exit the vehicle unless the container is set out improperly. Semi-automated collection vehicles require the collection crew to maneuver the container to the vehicle and use a mechanical device to tip the contents into a single storage compartment. The collection vehicles unload the materials at a recycling facility where the items are processed.

Both automated and semi-automated curbside collection programs do not provide the collection crews an opportunity to inspect the materials to ensure prohibited items are not in the container. The programs also do not allow glass to be collected separately from other recyclables; therefore, contamination levels (i.e. prohibited materials and glass mixing with other recyclables) are higher (up to 40%) at the processing centers processing materials from these types of collection systems.

2.11.4 Summary of City of Dubuque Collection Program

The City of Dubuque collects mixed glass using one (1) rear load packer truck (which services most alleyways) and five (5) side-load vehicles. Glass accounts for approximately 6% of the material weight on each truck. Four (4) of the side-load vehicles have been modified with a separate internal compartment to store glass, a hydraulic lift system to load glass into the vehicle, and an unloading door at a cost of $15,000 per vehicle. The other two vehicles do not have a separate compartment to store collected glass.

Collection crews operating the modified vehicles collect glass into a 10 gallon bucket that is affixed to the hydraulic lift which deposits the glass into an overhead internal storage compartment. The rest of the collected recyclables are placed into the main internal storage compartment. The cycling of the hydraulic lift and the crash of glass into the storage compartment creates a significant amount of noise. The City has received noise complaints from residents.

Collection crews that operate vehicles (that have not been modified to store glass) use large industrial strength bags to collect the glass. Each bag costs approximately $150 and can hold 75 pounds of mostly whole bottles. Once the bag is full, the collection crew either stores the bags in the cab or secures them to the outside of the vehicle. Due to

the limited space of these collection vehicles to secure full bags, the collection crews must leave their route and meet up with a modified collection vehicle to transfer the glass from the bags into the glass storage compartment via the hydraulic lift. The requirement to leave a route occurs once or twice each recycling collection day. The drive time to meet with the modified vehicle and return to the assigned collection route varies but may take approximately 30 minutes according to City staff. This additional drive time increases the vehicles fuel consumption, maintenance costs, and time the vehicle is operating on public streets.

The City spends approximately $5,000 each year to repair or replace the large glass bags. The City has also received complaints from residents of broken glass spilled in the parking lanes. The bags wear which sometimes allows the glass fines to leak out when the collection vehicle hits bumps when moving.

All recycling collection vehicles end their routes at the Dittmer Recycling Facility. Collected glass is unloaded into a glass bunker. Dittmer Recycling does not process this glass since the City collection crews have already performed screening to eliminate prohibited materials from contaminating the glass. The glass is further densified and is loaded into a trailer for transport to a cullet beneficiation facility.

The City has invested nearly $65,000 in equipment in order to facilitate the separate collection of glass through the manual curbside collection program. Additional direct annual collection costs include fuel consumed to transfer collected glass between vehicles, repair and replacement of bags, and maintenance to modified collection vehicles. Additional non-direct annual collection costs include loss of collection efficiencies caused by transfer requirements and vehicle storage limits, collection crew injuries caused by glass, and receiving and responding to glass related complaints (i.e. noise and broken glass in streets). There is significant crew collection time spent sorting glass from other materials in the customer recycling container, running the hydraulic lift, and moving and securing bags containing glass.

2.12 Cullet Recyclers and Collection Programs

Table 1-2 provides the name, location, associated collection program(s), and type of container glass accepted by the companies interviewed for this report.

Table 1-2
Multi-Material Programs & MRFs Interviewed

Facility Name	City, State	Associated Collection Program(s) for Container Glass	Type of Glass
Great River Regional Waste Authority (GRRWA)	Ft Madison, IA	Curbside (No Glass) and Drop-off	Clear Glass Only
Scott County Material Recovery Facility	Davenport, IA	Curbside and Drop-off	All Colors
Greenstar (optical scanner)	Des Moines, IA	***Single Stream*** Curbside and Drop Off	All Colors
City Carton	Seven Sites in IA	Curbside and Drop-off – (Source Separated Glass Only)	All Colors
Mason City Recycling	Mason City, IA	Curbside and Drop-off	Clear Only
Ottumwa Recycling Center	Ottumwa, IA	Curbside and Drop-off	All Colors
Northwest Iowa Area Solid Waste Agency	Sheldon, IA	No Glass	N/A
City of Council Bluffs Material Recovery Facility	Council Bluffs, IA	Curbside and Drop-off	All Colors
Firstar Fiber Corporation*	Omaha, NE	***Single Stream*** Curbside (No Glass) and Drop-off	All Colors
WM Recycle America, LLC (optical scanner)	Madison, WI	***Single Stream*** Curbside and Drop Off	All Colors

** Firststar Fiber receives curbside recyclables from Deffenbaugh Industries, Inc. See below for a summary of Deffenbaugh Industries' single stream recycling program.*

Glass is collected and processed in a variety of ways, as indicated in Table 1-2, with some facilities (service areas) only accepting clear glass (Ft. Madison and Mason City), and others not accepting glass at all (Sheldon, Iowa). Programs not accepting glass at curbside generally offer glass recycling within at least one drop-off location. Recycling facilities in Sheldon are quick to point out that although glass was dropped entirely they were then able to add magazines and slick newspaper inserts to the acceptable materials mix.

Deffenbaugh Industries, Inc is a large single stream recycler (collection and processing) serving the Kansas City metropolitan area. Deffenbaugh also serves a residential

customer base in urban, suburban, and rural areas of Kansas, Missouri, Nebraska, and Iowa. Deffenbaugh accepts no glass in their single stream recycling program. Glass collection in the Kansas City area is supplemented by an aggressive drop-off program supported in part by Boulevard Brewing Company, other Kansas City area recyclers and community organizations by forming Ripple Glass. Ripple Glass operates a modern container glass processing plant (with optical sorting) in Kansas City, and places and pulls over 60 dedicated glass recycling containers (which accept all colors of container glass) throughout the Kansas City metro area. The glass is processed by Ripple Glass and sold in Kansas City to Owens-Corning - a fiberglass insulation manufacturer.

The publicly operated material recycling facilities in Scott County and Council Bluffs use additional labor to pick and sort glass by color. Although Council Bluffs has a glass pulverizer, they are unable to market glass and are waiting for economically appropriate markets to be identified. Council Bluffs previously accepted plate glass but discontinued accepting this type of glass approximately three years ago. Scott County is selling color sorted glass to markets in Chicago and St. Louis. A 2003 study of the Scott County MRF recommended that; if the MRF converted to single stream, then it should eliminate glass as an acceptable recyclable material.

The City of Ottumwa uses a glass crusher at the MRF to break glass. The glass is then stored in a bunker until it can e used by the landfill for various applications. Glass has not been color sorted or marketed outside of SE Iowa for more than 10 years.

Greenstar reported that they would prefer not to collect or process glass in the single stream system serving the Des Moines metro area. Glass generated at Greenstar is sold at a reduced value because the cullet is sold as a “green mix” although it is ”mostly clear glass”.

Strategic Materials is one of the largest glass recyclers in North America. Their Chicago facility currently receives glass from the DMASWA contractor; this facility uses optical sorting technology before glass is marketed to end users.

2.13 Public Perception of the Elimination of Glass Programs

For this section, the uniqueness of each single stream system is recognized and it is understood that many factors contribute to the impact of glass, glass residuals (mostly broken glass), and overall marketability of collected resources.

Municipal collection programs that do not include glass in their curbside collection programs (Omaha, Kansas City) appear to complement their collection program with source separated drop-off collection. Providing reasonable access to glass recycling options appears to satisfy municipalities that have a constituency that wants to recycle glass. Like the example given for Boulevard Brewing Company in Kansas City, corporate stewardship and public/private partnerships have helped to collect glass in the

Kansas City metropolitan area. Optical sorting in place in Kansas City is used to process the locally collected glass.

The Northwest Iowa Area Solid Waste Agency addressed their removal of glass from their processing system by highlighting the additional materials accepted such as magazines and slick glossy newspaper inserts.

Single stream recycling programs do often add additional fiber (paper) recycling options. Although more paper grades may be collected, some of these grades may be "downcyled" (high quality fiber sold for lower value uses). Each single stream system is unique and many factors contribute to the impact of glass, residuals (mostly broken glass), and overall marketability of the total collected commodities.

Bottle deposit states like Iowa are unique in that a majority (over 85%) of beer, wine, and liquor glass containers are recycled via redemption programs and are not recycled through curbside or drop-off collection systems. Consequently, the majority of glass generated by households is not collected in single stream programs.

If a material is selected to be removed, such as glass, from a single stream recycling program, adding new acceptable materials might help offset some negative public perception about the removal of glass. Recycling rates and pounds collected per person have both increased with the implementation of single stream curbside collection system (using toters/carts) operating within the Des Moines and Omaha metropolitan areas.

Identifying and communicating noise reduction, cleaner/safer streets, sustainability, carbon footprint reduction, and savings to the public is also a common method of working with a public that might think the removal of glass is a step in the wrong direction. When the City of Omaha stopped picking up glass, newspaper articles quoted Omaha staff speaking about the total annual savings the City would see based on the savings single stream provides in collection labor, lower tipping fee costs associated with glass disposal at landfills, worker's compensation claims, etc. Trucks and containers are a known cost to implement single stream but if fleet replacement is performed during scheduled fleet replacement the new costs may be reduced – in part because fewer trucks are needed and the single stream (single hopper) trucks are less expensive and more versatile. Unique cost items, like the separate sorting of glass collected curbside in Dubuque using bags on some trucks, can also be communicated.

Additionally, some efficiencies are gained with single stream trucks as the trucks can be used for other collection streams (yard debris, refuse) and fewer trucks may be needed as crews can service more households per hour.

Section 3.0
Environmental Impacts of Glass Recycling

3.1 Summary of Environmental Benefits

The environmental benefits of using container cullet in the manufacture of new containers are well documented but each list of facts and figures often fails to tell a complete story.

The Glass Packaging Institute's website shows that recycling just one glass bottle saves "enough energy to power a 60-watt bulb for four hours, or a computer for 30 minutes". The glass industry also has a goal to use 50% recycled content by 2013.

Other information regarding glass recycling and its impact on the environment as presented by the Glass Packaging Institute at the Iowa Recycling and Solid Waste Conference (Waterloo, IA – 2009) includes:

- Over a ton of natural resources saved for every ton of glass recycled.
- Energy costs drop about 2-3% for every 10% cullet used in the manufacturing process.
- Six tons of recycled container glass used equals one ton of carbon dioxide reduced.

Understanding that optical sorting is the only known way to efficiently remove contamination, the Minnesota Pollution Control Agency contracted with Tim Goodman & Associates in 2007 to review the potential for a optical sorting technology for cullet in or near the Twin Cities. In this report, the environmental benefits of using cullet were described, specific highlights of the environmental benefits include:

- For every 10% of cullet used in the manufacturing process there is:
    - A 60°C drop in furnace temperature allowing a furnace to be operated at a lower temperature resulting in prolonged furnace life;
    - Up to a 3% reduction in fossil fuels leading to a 3% reduction in CO_2 emissions;
    - A 6% reduction in NO_x emissions; and
    - A 17% reduction in CO_2 emissions associated with raw material conversion.

3.2 Balancing Collection & Recovery Costs with Industry Benefits

The glass industry wants to use more post consumer cullet in the next three years, this same industry is investing in optical sorting technology that will allow them to use more cullet, yet prices for cullet remain very low compared to other commonly recycled commodities like newsprint, cardboard, and HDPE and PET plastics. It can be reasoned that if market prices were strong, the economic incentives (dollars paid per ton) would offer smaller municipal recovery facilities and smaller beneficiation facilities the payback required to invest in better sorting equipment and/or collection/sorting labor.

Related to low prices is the increasing cost to transport cullet via truck to regionalized end users (specifically glass bottle manufacturers). As mentioned in the report by Goodman and Associates:

- "Due to the high capital and operating costs associated with a regional glass beneficiation facility, such a facility should be located close to major suppliers of mixed glass, major glass markets, and a well developed transportation network.
- The longer haul distances and smaller quantities of mixed glass generated at MRFs in greater Minnesota make it unlikely that any significant amounts of glass would be delivered to a glass beneficiation facility in the metro (Minneapolis/ St. Paul) area from these facilities."

Even the Twin Cities and Madison, WI markets are not identified in the literature as being large enough to warrant the cost of optical sorting.

3.3 Re-fillable Containers as an Alternative to Discarding Glass Bottles

Re-fillable glass containers are also mentioned in the literature as having the potential to reduce waste, reduce energy associated with melting and re-using glass, etc. Large energy savings are obtained after the bottle is re-filled five or more times. However refillable containers have not gained in popularity, especially in a state that has a redemption law in place.

The public policy advocacy group INFORM, list five public policy options that would encourage glass bottle refilling in the United States:

- Requiring the use of generic (standardized) bottles
- Providing financial incentives for companies that switch from one-way containers to refillable bottles
- Establish broad materials policies — such as taxes on virgin materials or energy consumption

- Establishing government procurement guidelines that require or give preference to refillables
- Setting two-tier quantity based user fees for collection of recyclable and non-recyclable solid waste, giving consumers an incentive to use refillables

The work put forward by INFORM above highlights an issue that may be at the heart of the suppressed prices being received for glass cullet: inexpensive and readily available virgin materials.

3.4 Raw Material Prices and Slow Demand Driving Cullet Prices

The raw materials required to make glass is primarily silica (over 70%) which is obtained from sand. Sand as a raw material is widely available and is relatively inexpensive. The United States Geological Survey (USGS) says on its website that "construction sand and gravel, one of the most accessible natural resources and a major basic raw material, is used mostly by the construction industry. Despite the low unit value of its basic products, the construction sand and gravel industry is a major contributor to and an indicator of the economic well-being of the Nation."

The 2009 Mineral Commodity Summary developed by the USGS says that "sand and gravel resources of the world are large. However, because of environmental restrictions, geographic distribution, and quality requirements for some uses, sand and gravel extraction is uneconomic in some cases. The most important commercial sources of sand and gravel have been glacial deposits, river channels, and river flood plains. The DMASWA services area has inexpensive, abundant sand and gravel resources.

Low cullet prices could be contributed to slow demand (and potentially lower prices) for delivered sand. The USGS said in the same 2009 report, "As the U.S. economy continued to falter, construction sand and gravel output dropped for the second straight year, down by more than 15%, or nearly 200 million tons, compared with that of 2007. Demand for construction aggregate fell because total U.S. construction declined in 2008, led by a double-digit decline in housing construction. It is estimated that 2009 domestic production will decrease to about 1 billion tons as housing construction and home prices remain at historically low levels, and revenues to governments are affected by lower home values and associated revenues. Decreased revenues could curtail publicly funded construction projects, which in turn would lower demand for construction sand and gravel."

Slow demand for consumer goods in a slowing economy could also be a driving force for slow cullet prices. Baled newspaper and other paper commodities dropped substantially as demand decreased.

3.5 Discussion of Packaging Weight and Resource Consumption

The inert nature of glass, its ability to maintain strength and retain a degree of molding, and the low cost of raw materials make this packaging material the preferred choice for many products. However a second look at total raw material use shows this relatively heavy package delivers higher emissions in transport.

Reducing packaging weight is a known method to save on shipping costs. The higher amount of product (consumer goods not including packaging) transported per truck improves the fuel needed to transport the product. Milk is often transported from the dairy in bulk transporters for this reason.

Semi-trucks may average 5 miles per gallon and can carry a predetermined weight according to the truck type, so any incremental savings in the product/mile driven ratio decreases the cost of the product. Improving the product/mile or product/gallon of fuel ratio also decreases emissions such as CO_2.

Material intensity is the measure of all material inputs related to product outputs; it is a measure that tries to provide some measure of material efficiency. These types of calculations have been around for years, notably paper cup/foam cup calculations and re-useable/disposable diaper calculations from the early 1990's.

Material intensity calculations show that the weight of glass containers and their ability to transport the same amount of product as a lighter type of recyclable container (HDPE or PET plastic) generates more greenhouse gases per unit of product delivered. The adoption of HDPE milk jugs are another example from the dairy industry that illustrates the monetary savings and probable overall reduction in environmental emissions.

3.6 Discussion of EPA WARM Model (Emissions Reductions and Energy Savings)

The Environmental Protection Agency (EPA) created the WAste Reduction Model (WARM) to "help solid waste planners and organizations track and voluntarily report greenhouse gas emissions reductions from several different waste management practices. WARM calculates and totals GHG emissions of baseline and alternative waste management practices—source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent (MTCO2E), and energy units (million BTU) across a wide range of material types commonly found in municipal solid waste (MSW)."

The WARM model does not adequately address the energy required to transport cullet from a small processor/MRF, to a beneficiation facility (optical sorting facility). Glass recycling usually also requires a third transport from the optical sorting facility to an end user (fiberglass, bottles, etc.). The WARM model also does not address resale value of

the commodities. However, the EPA WARM model can help provide some idea of the potential emissions removed and energy saved via recycling (which is likely reflected in the prices end users are willing to pay for the commodity).

The WARM model does not identify significant emission or energy savings for glass in comparison to other readily recycled commodities such as plastics and paper. For example: the WARM model identifies the greenhouse gas reduction for 500 tons of glass as being equivalent to removing eight (8) passenger cars from the roadway or 12 households energy consumption. An exact duplication of the WARM model for HDPE plastic saves energy from the equivalent of 240 households; regarding newsprint the energy from 79 households is saved.

3.7 Summary of Financial and Environmental Impacts of Glass Collection Specific to the DMASWA Service Area

Specific to the DMASWA, the costs associated with the curbside collection of glass is high compared to the tons of material collected and the tons of material that can be reasonably sorted. The City of Dubuque specifically has invested over $65,000 in capital costs just to manage glass. Indirect costs, such as the cost for collection crews to sort and handle glass, as well as the cost to leave a route for glass, is significant but difficult to quantify.

Fixed processing costs at MRFs range from $30 to $38 per ton (dual stream system) and from $60 to $70 per ton for single stream systems. Glass markets are unable to support prices that exceed the cost to process the material (even dual stream systems) without optical sorting equipment; consequently, the processing/sorting of glass is a losing unsustainable operation.

Glass requires a higher cost per ton to manage at the curb and does not offer the financial payback on the marketing end as a reclaimed commodity. Additionally, the cost of processing glass drives down the total revenue of the facility $20 to $25 per ton of material sold (including the paper, metal, and plastic commodities). For the highest payback, glass must be sent to bottle makers, this market has low tolerances requiring the glass to be contaminant free. The cost to transport glass to the required beneficiation facilities further drives down the value.

Regardless of the cost to collect, process, and market glass, an argument could be made that the impact on the environment outweighs these other factors. However, the environmental impact of recycling glass, according to the EPA model, is considerably less than other commodities like plastics and paper.

The majority of glass containers are already collected via the infrastructure available via the bottle redemption program in the DMASWA service area. This system is able, due

to the manual nature of sorting by distributor, to generate very clean (contaminant free) glass.

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Section 4
Sustainable Glass Management Options

As we have shown in earlier sections, container glass management varies across the Midwest but also across collection and processing systems. Glass prices are currently at or near all time lows but, unlike paper markets, these lower prices have not reduced demand. Contaminant free glass cullet does contribute to reduced manufacturing costs (energy, labor, etc.) so markets are still strong. Unlike paper and petroleum-based plastics the raw material that replace glass are not currently in low supply and are relatively inexpensive.

The DMASWA is not close to beneficiation facilities or glass processors/manufacturers with two markets from 170 to 200 miles away.

4.1 Promotion of Existing Systems (Bottle Redemption)

Iowa is fortunate to be one of 11 states with bottle redemption legislation. Although not all glass containers are acceptable in this system, the vast majority of glass containers, specifically glass used in a residential home, can be accepted for deposit. The State of Iowa has reported that the overall percentage of containers redeemed has dropped below 93% to 86%. 86% is still a strong recycling figure and it should be noted how the redemption program serves as an excellent example of how to increase recycling rates for a specific commodity. Although no specific cause has been identified, the reduced value of $.05 over the past 31 years might be a contributing factor. Additionally the processing fees ($.01) per container associated with Iowa's bottle bill has seen a marked reduction in the number of private, independent redemption centers impacting customer convenience with an increase in reverse vending machines.

If glass were removed from the curbside collection programs within the DMASWA service area, promoting glass bottle redemption within the DMASWA service area would be one way to increase divert some recycling of glass without offering a system that is redundant for the majority of containers. The promotion of redemption services may take many forms from education and promotion to incentives directed toward private redemption centers.

Another drawback to the existing bottle redemption program in Iowa is that glass is transported from many distant locations back to a single distribution centers (because the distributor technically owns the glass bottle) or the distribution center's selected processing center. Even if markets exist locally, glass redemption bottles are required to leave the area (due to contractual collection arrangements made by the distributor) and

move to a pre-selected processing site. Iowa is one of nineteen control states that, since the repeal of prohibition, directly control the sale and distribution of liquor. An example of glass moving in this way, involves the State of Iowa's liquor distribution facility in Ankeny, Iowa. Changing the way the State moves redeemed glass bottles may be difficult due to contractual arrangements.

Promoting glass redemption/recycling at bars and restaurants may also improve the amount of glass recycled and captured – the Glass Packaging Institute reports that 18% of beverages are consumed on premise; glass makes up to about 80% of that container mix. Many bars and restaurants are reported to not recycle or turn in their deposit containers.

4.2 Expand Drop-off Recycling Services

Five of the six DMASWA's drop-off sites do not accept glass. According to the DMASWA website, glass is not accepted due to historic contamination of other materials. The collection, processing, and local marketing of glass in Kansas City is one example (although it is an example from a much larger metropolitan area with optical sorting) that glass collection via drop-off is an alternative to collection via curbside collection. The Kansas City program can be noted for its development of a local processing center and a local buyer for the container glass (fiberglass).

4.3 Geographically Near Market Development Initiatives

Although drop-off recycling can on rare occasions produce a passable glass cullet, the collection, processing, and transportation costs often exceeds the value of the cullet. Cullet value is likely tied closely to the cost (value) of the raw materials required to manufacture glass. Local market development initiatives may be a required to move collected glass until glass cullet prices rebound to, or exceed, historical price levels. Currently, government incentives, rebates, taxes, laws, ordinances or other non-market forces are not in place (beside state container redemption) that are dramatically improving the value of cullet.

Local or near local markets that add value to the cullet may help alleviate current market conditions. Beyond the manufacturing of glass containers and bottles, float glass, counter tops, construction aggregates, and sand blasting media are examples of markets that could have some potential for some glass within close proximity to the DMASWA service area. However, pricing may not be competitive.

Understanding the specific needs of container glass markets and designing collection systems that can cater to these near markets reduces transportation costs and assists develop our Iowa communities. Examples include float glass plants (see Guardian

Glass plant in DeWitt, Iowa), countertop manufacturers (see GreenField Recycled Glass Stone Products in Dubuque, Iowa), or the manufacture of reflective glass micro beads (see Potters Industry in Muscatine).

Another local market development initiative for recycled cullet could involve the use of construction aggregates manufactured from glass. Glass as a construction aggregate has been developed and promoted in the State of Minnesota with the Minnesota Department of Transportation (MnDOT) developing specifications for recycled aggregates for use in road base; one class of aggregate (Class 7) provides for use of up to 10% reclaimed glass blended with other aggregate materials.

Iowa also has experience using glass in asphalt (glassphalt); however, Dittmer Recycling (Dubuque, Iowa) reports that the specialty grinding and screening required for the asphalt markets is cost prohibitive without very large quantities of glass staged on hand. It is this same potential for very high quantities of glass potentially used in a single project that makes this application attractive to glass generators. The Landfill of North Iowa used 32 tons of glass in its facility's glassphalt parking lot and the City of Cedar Falls used more than 70 tons of glass for a glassphalt trail near the University of Northern Iowa.

Glass aggregates are also being used as leachate drainage aggregates at Landfills (Burlington, Iowa); however, economic analysis showed the use of glass to be more expensive than sand.

4.4 Process Glass Using Single Stream Processing

Single Stream processing does not necessarily negate the acceptance and processing of glass at large facilities. Processing facilities in Madison Wisconsin, Des Moines, Iowa, and St. Louis, Missouri both manage glass collected from single stream recycling processes.

Direct comparisons of any MRF is difficult; the population centers that these facilities collect from are larger than the DMASWA service area, state regulations are different, and the volume/throughput of total materials at each facility influences/justifies sorting equipment/labor and provides leverage for the marketing of glass. As previously mentioned, single stream processing of glass (like at the DMASWA contractor's facility will break glass into unusable pieces; single stream may only capture 30% of the recycled glass, drop-off programs (redemption programs included) may capture from 50% to almost 100%.

4.5 Industry Support for Infrastructure Development

The Glass Packaging Institute wants to increase the recycled content used in glass, to reach this goal, the Institute will help communities and MRF's in several ways, including:

- Support single-stream curbside recycling best practices
- Expand dual-stream curbside collection and drop-off
- Expand on-premise collection programs
- Improve beneficiation technology
- Encourage consumer glass recycling
- Build on current deposit programs
- Accelerate support of legislative initiatives

If the industry is serious about increasing the amount of cullet used in their products they might be willing to assist the DMASWA with suggesting a glass diversion plan that could work for all the players involved.

4.6 Local/State Ordinances

Either local or state regulations can be passed to require specific industries recycle glass.

The State of North Carolina requires anyone with an Alcohol Beverage Control permit recycle glass and plastic bottles (effective January 1, 2008.).

Iowa State code (455C.16) states that the final disposal of beverage and alcoholic containers by a dealer, distributor, or manufacturer, or person operating a redemption center, may not be in a sanitary landfill.

4.7 Sustainable Strategic Options for DMASWA

DMASWA could recommend discontinuing the collection of glass via curbside collection systems (or any future system). Curbside collection (dual stream or multi stream sorting) of glass generates high costs specifically in truck modifications, bags to keep glass separate, and collection crew labor to sort. Regardless of the container glass collection system used, net processing costs, and transportation costs alone are higher than the value of the material.

The net environmental benefits are dependent upon the model and all the variables used for input; however, EPA modeling shows glass having a very low net environmental impact (energy saved and emissions reduced).

The DMASWA could work toward reducing some costs associated with collecting materials, maximizing the value of all collected materials, and maximizing the net environmental benefits of the collected materials.

A question could be asked, “How the DMASWA should subsidize the collection of glass”. A better question might be, “should DMASWA develop a duplicate collection system for a firmly established commodity”. The redemption program for carbonated and alcoholic beverage containers has existed for over 30 years and it has a proven record of removing for recycling 85% of the redeemable containers. Industry sources report that in 2009 close to 83% of glass containers were beverage containers and nearly 60% were beer bottles all of which qualify for redemption in Iowa.

DMASWA could look to improve bottle redemption in the planning area. Ready access to redemption centers has suffered over the years as the $.01 per bottle processing fee is not enough to cover the expense of processing (manual or optical separation by/for each representative distributor). Improving redemption center infrastructure could involve identifying and promoting redemption locations, assisting financially in the operation of a redemption center, and providing technical assistance to redemption center operations on methods to improve profitability by offering additional services. Legislative changes to the bottle bill, to help alleviate the cost of processing and handling, would be another change that would allow the small private redemption center, the local entrepreneur, an opportunity to be successful. The DMASWA reports that the organization has substantially assisted the local redemption center in the past.

Understanding glass to be approximately 6% of material discarded in the MSW waste stream, the DMASWA may look to remove glass and replace it with another commodity in the existing curbside collection system or any modified curbside collection system. The addition of new acceptable materials/items would likely have higher value to the processor and have a net positive impact on the environment compared to glass.

4.8 Summary of Sustainable Glass Management Options

Sustainability requires communities to address decisions based upon positive economic (financial) models as well as positive environmental protection/environmental improvement models.

Throughout the Midwest, various systems exist for the management of post consumer glass (outside bottle bill collection systems); however, post-consumer glass collection/transportation and post consumer glass processing/sorting requires expenses in excess of the cullet prices paid by beneficiation facilities. Additionally, the inclusion of glass in a processing system (like a MRF) tends to increase operating costs, in effect lowering the net revenue of a MRF.

From the research conducted for this report, the existing infrastructure for the collection of post consumer glass containers via curbside or drop-off programs and the existing infrastructure for the cleaning, separation, and eventual manufacture of glass products has a relatively low or weak environmental benefit compared to other commodities (see discussion of EPA WARM Model in Section 3.6 of this report). Consequently, the economics and the environmental aspects of post consumer glass recycling are different than other traditionally accepted post consumer commodities like HDPE, newsprint, etc.

To implement a sustainable system that is fair to residents and fair to the environment, the DMASWA service area could recommend the continued support of post consumer glass containers using the existing bottle redemption program. In addition to the strengthening of the bottle redemption program; the service area could recommend the discontinuation of collecting glass in curbside and/or drop-off programs and the addition of a new material(s) to that recovery system. The new material selected should have a positive economic model (generate more revenue than expenses required for collection, processing and transportation) and a larger (more positive) environmental impact than the post consumer glass.