

Glass Taskforce Recommendations

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Executive Summary

Glass is made from readily available domestic materials, such as sand, soda ash, limestone and “cullet,” the industry term for furnace-ready scrap glass. Glass can be recycled infinitely without compromising quality or purity. The Institute of Scrap Recycling Industries (ISRI) stated that recycled glass is substituted for up to 70% of raw materials used in making new glass. Manufacturers benefit from glass recycling in several ways: it reduces emissions and consumption of raw materials, extends the life of plant equipment (such as furnaces) and saves energy. Also, glass recycling creates no additional waste or byproducts.

The glass industry prefers programs that result in contaminant-free recycled glass, so while curbside collection of glass can generate large amounts of recyclables, drop-off and commercial collection programs tend to yield higher quality recovered container glass. This taskforce has researched and evaluated cullet and non-cullet glass recycling and developed several recommendations on market-based, technical and regulatory solutions along with implementation strategies.

These recommendations include the areas of:

- Materials Recovery Facility (MRF) Technology
- Industry Standardization and Specifications
- Non-Cullet Uses (Including beneficial reuse)
- Regulatory and Legislative
- Partnerships

Successful glass recycling programs depend upon strong and diverse end-markets. The availability and economics of each potential end market are in turn dictated by MRF size and technology, location (transportation) and collection system (mixed, source separated). While there are regulatory recommendations, supply and demand within the free market system, along with quality, will dominate glass recycling into the foreseeable future.

Taskforce Mission, Goals and Objectives

The AROW Glass Taskforce mission was to research, evaluate and prepare recommendations on market-based, technical and regulatory solutions along with implementation strategies for container glass recycling in Wisconsin. The goals and objectives included:

1. Research, understand, and present industry standards and specifications for glass grades.
 - a. Compare quality/quantity desired versus quality/quantity available.
 - b. Determine technological options to meet end-market specifications.
2. Evaluate beneficial reuse options for mixed container glass.
 - a. Review and report on cullet and non-cullet recycling and beneficial use options.
3. Evaluate current and identify potential end-markets.
 - a. Determine possible solutions with funding/grants.
 - b. Discuss options for additional research in collaboration with University of Wisconsin-Milwaukee Center for By-Product Utilization.
4. Research and summarize state and national glass recycling programs, markets and beneficial reuse to support taskforce recommendations.
 - a. Review and report on collection and source separation, bottle bills, mandatory recycling, end-markets, landfill uses, aggregate and all other relevant programs.
 - b. Summarize results, environmental impacts, and relevant regulations.
5. Develop recommendations with strategies and regulatory/statutory requirements.

Status of Glass Recycling in Wisconsin

Single-sort, more commonly referred to as single-stream, or commingled recycling, is a system in which all paper and containers are collected in the same bin instead of being sorted into separate commodities (source separated). Single-stream programs typically collect more materials than source separated or dual-stream (paper in one bin; glass, plastic, and cans in another). This collection and processing system is widely used throughout Wisconsin. Although it has increased program tonnage, it has also increased contamination of recyclables and higher amounts of non-marketable residue.

Advantages of single-stream recycling include:

- Simplicity for residents (homeowners) to commingle all materials in one larger container
- An increase in types of material that can be processed at the MRF
- Efficiency and cost savings with automated collection
- Larger carts allow programs to switch to every-other-week collection, resulting in cost savings

Although single-stream recycling can be advantageous, there are inherent disadvantages when including glass. It is nearly impossible to prevent breakage when moving it from a curbside recycling bin, loading it onto a recycling truck, compacting it with other materials, and unloading it onto the tip floor at a MRF before being moved by other machinery for sorting. This broken glass contaminates other recyclables, or breaks into smaller fragments considered to be a "residual", or material that is sent to a landfill for disposal.

Wisconsin's recycling programs successfully recover high volumes of container glass, but at a cost. Revenue from the sale of recycled glass typically does not cover the expense of processing and transporting it to a secondary processor or end user. In fact, most recycling programs are actually paying markets to take their glass. As a result, glass recycling here, and nationally, is at a crossroads.

The supply of recovered glass is out of sync with demand in several respects:

- There is only one secondary processor and one end market located in Wisconsin. Competition for glass is limited, and there are high costs to transport it.
- Recycled glass (cullet), while offering several advantages to glass furnaces, still competes with less expensive virgin raw materials, limiting the prices that the market will bear. While the value of recycled glass fluctuates with changes in demand for related end-products such as sand used in hydraulic fracturing, the relative abundance of virgin materials holds pricing fairly steady.
- The shift to single-stream recycling has increased Wisconsin's recycling rate, but has also led to more contamination in the glass that recycling facilities produce. This change in quality is one reason glass revenues have dropped and also creates a barrier to other potential markets.
- As part of a state landfill ban, container glass recycling creates supply unrelated to demand.

Secondary processors indicate that cleaner glass would have a higher value, and would allow them to accept more glass. Theoretically, recycling programs could produce cleaner glass by investing in additional personnel and technologies. The fundamental questions, however, are (1) who would bear the cost of the improvements, and (2) would MRF operators realize a realistic return on investment (ROI) to meet the quality standards desired by end-markets.

Today, the cost of recycling glass largely falls on recycling programs. Wisconsin's residents and businesses, including recycling facilities, are mandated by law to manage glass containers in a way that does not include disposal in a solid waste facility (landfill), conversion into fuel, or burning at a solid waste treatment facility, thereby creating a large glass recycling stream; however, there is no comparable factor increasing demand. There are also environmental fees authorized in state statutes for municipal and industrial waste totaling \$12.997 per ton, of which a \$7 per ton is assessed as the recycling fee.

According to the Wisconsin Department of Natural Resources (WDNR) report *on 2015 Municipal and Industrial Waste Landfill Tonnage*, approximately 4.68 million tons of materials were disposed, generating \$32.8 million in recycling fees; however, an average of only \$20 million, a decrease of 40% since 2010, has been dispersed to Responsible Units to support local recycling programs (with average annual costs exceeding \$100,000,000).

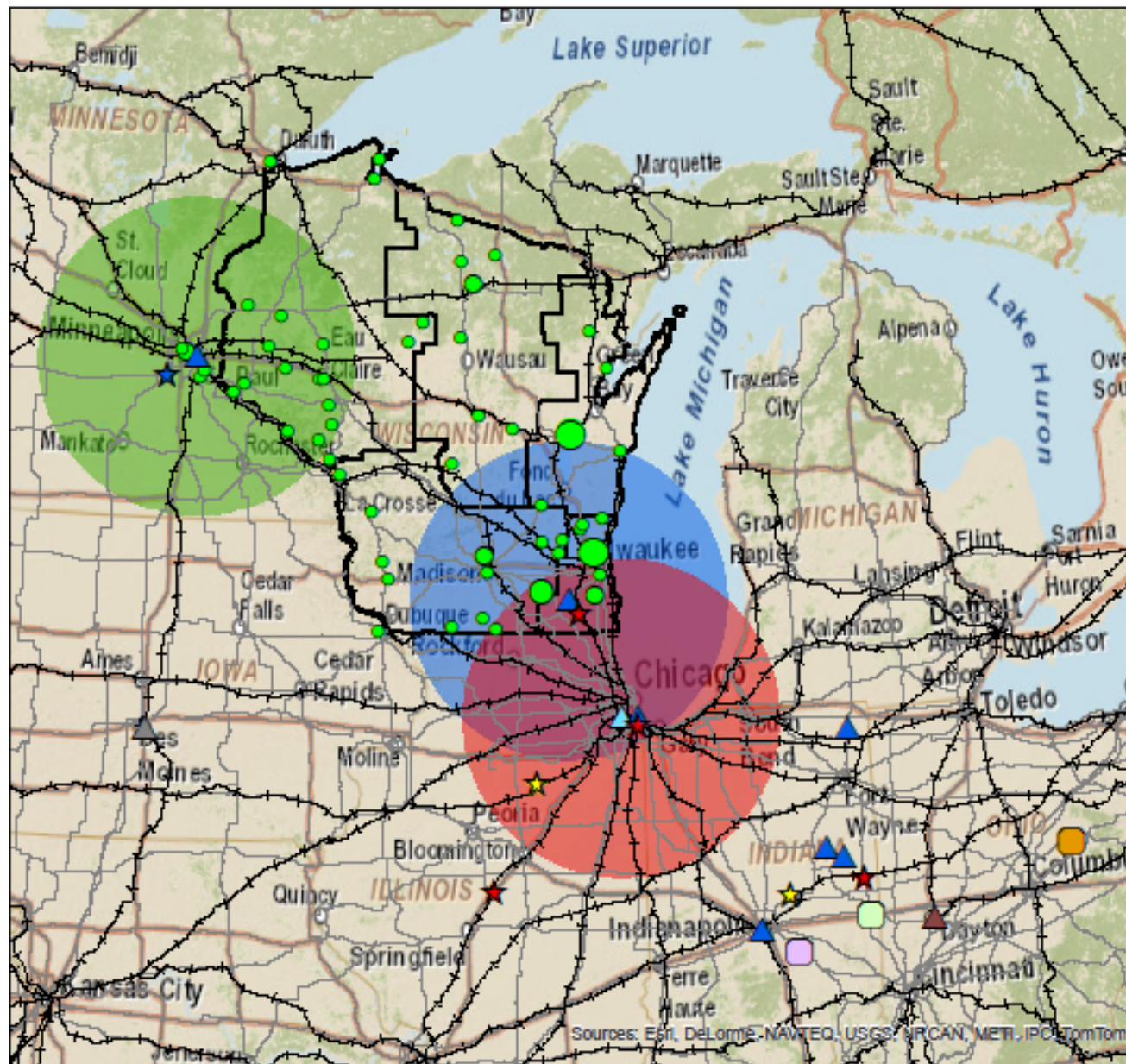
While both industry and society benefit from the use of recycled glass feedstock by reduced energy use and emissions, the cost to clean up three-mix glass (clear, brown and green) for recycling end-markets exceeds the price paid for it. According to a study completed by Barker-Lemar in 2010, prices for cullet began to decline in 2008, with a slight rebound in 2010, maintaining mixed glass revenues under \$5 per ton (not including transportation). The cost to process one ton of material through a single-stream MRF varies from \$30-60, with current glass revenue from secondary processors ranging from \$20 to -\$10 per ton, which is primarily dependent on fines (materials smaller than ¼") and non-glass residue. Currently, even MRFs that have state-of-the-art equipment (glass clean-up systems) are not able to meet the level of market specifications that would yield pricing high enough for revenues to support reasonable ROI. For MRFs to implement additional sorting or clean-up technology would require high annual tonnage and increased revenues with the goal of attaining a reasonable ROI ranging from 0-15% over a 2-5-year period, which would vary widely based upon individual program operations and business standards.

Currently, Wisconsin's public and private MRFs, as well as out-of-state facilities that process Wisconsin tons, produce approximately 121,675 tons of container glass per year for recycling (WI DNR, 2013). This glass is typically sent to secondary processing plants where it is further cleaned and sorted to buyer specifications and sold to glass container manufacturing companies. There is only one secondary processor in Wisconsin, located in East Troy, with a maximum capacity of 85,000 tons per year. Additional regional facilities are in Illinois (1), Minnesota (1), Indiana (4), and Ohio (1), in which end market manufacturing plants are in close proximity.

Approximately 80% of glass containers in the US are supplied by just two (2) companies: Owens-Illinois (O-I) and Saint-Gobain (Barker-Lemar, 2010). While these companies have multiple sites throughout the country, the manufacturing and distribution process is centralized, which increases transportation costs. Select MRF operators in Wisconsin estimate transportation costs for delivery to secondary processors to range from \$10-15 per ton for up to 100 miles, with costs continuing to increase above 100 miles.

Glass will continue to be a challenging commodity for cost-effective recycling at MRFs. There are several reasons that glass recycling remains a viable option, primarily because it is still less expensive and more sustainable to recycle glass than landfill it. With the challenges to produce a marketable glass product, it is crucial for MRFs, public and private sectors, secondary processors and glass manufacturers to come together to develop diverse, economical markets for continued glass recycling.

Recycled Glass Facilities & Markets



Legend

Glass Markets

GPI Member Manufacturing Plant

- ★ Anchor Glass
- ★ Ardagh Glass
- ★ O-I

Recycled Glass Processing Facility

- ▲ Mid America Recycling
- ▲ Resource Management
- ▲ Rumpke
- ▲ Strategic Materials

Fiberglass Manufacturing Facility

- Knaf Insulation
- Johns Manville
- Owens Corning

MRF's by Tonnage

- 0 - 2574
- 2575 - 8068
- 8069 - 20010
- 20011 - 36707

—+— Railroads

— Major Highways

▭ Regional Borders

- ▭ Strategic Mtls - WI (100 ml Radius)
- ▭ Strategic Mtls - MN (100 ml Radius)
- ▭ Resource Mgmt - IL (100 ml Radius)

Sources: Esri, DeLorme, NAVTEQ, USGS, AIRCAN, METI, IPC, TomTom

Recycled Glass Facilities & Markets Map Summary

The Recycled Glass Facilities and Markets map shows MRFs in Wisconsin producing three –mix recycled glass along with secondary processing facilities, Glass Packaging Institute (GPI) member manufacturing plants and fiberglass manufacturing facilities across the Midwest.

Data reported to the WDNR in 2013, *Tonnages for Self-Certified MRFs That Processed Wisconsin Recyclables*, indicate that MRFs processed roughly **121,675 tons** of recycled glass. This data includes residential and commercial tonnage and is the best available data. Wisconsin is regionally disproportionate in production of recycled glass correlating to population density with many rural areas throughout the state. Also, access to available markets is complicated by the great distances between some MRFs and secondary processors. Identifying those distances via highway or railway is critical to understanding the current state of glass recycling in Wisconsin.

Wisconsin recycled glass tonnage and access to markets are highlighted in the following key points:

- Strategic Materials (secondary processor) has a facility located in East Troy, WI which is within 100 miles of the southeast and a portion of the southwest regions of Wisconsin. This facility currently processes ~80-85,000 tons of glass per year.
- Strategic Materials has a facility located in Minneapolis, MN which is within 100 miles of most northwest Wisconsin MRFs. The capacity of this facility and annual tons processed at this facility are unknown.
- Resource Management (secondary processor) has a facility located in Chicago, IL which is within 100 miles of a portion of the Southeast Wisconsin MRFs.
- The North Central and Northeast regions of Wisconsin do not have access to secondary glass processors within 100 miles of their MRF's.
- MRFs that fall within 100 miles of secondary processors still face hurdles with transportation. For example, a MRF located roughly 90 miles from Strategic Materials in East Troy, WI pays \$12/ton to transport glass for processing.
- Currently, recycled glass is hauled from MRF to processor via highway routes, but there is potential within each of the five Wisconsin regions to utilize rail for transportation. Consideration of each transportation method should evaluate distance to market, environmental impacts (carbon footprint) and any associated costs.

Wisconsin Region	Tonnage
North Central	8,647 tons
Northwest	3,376 tons
Northeast	20,793 tons
Southeast	45,438 tons
Southwest	29,403 tons
Processed Out of State	14,018 tons
Wisconsin's Recycled Glass (total)	121,675 tons

Materials Recovery Facility (MRF) Technology



In the past, glass was hand-sorted, producing clean, marketable color-sorted glass. Modern material recovery facilities produce glass that is broken, not color sorted and containing from 10% to 30% non-glass residue. This glass is marketed as 'three-mix' glass, referring to the three common colors (clear/flint, amber and green).

In Wisconsin nearly all of the three-mix glass is processed further at secondary processing facilities in Wisconsin, Minnesota and Illinois. These facilities color-sort the glass with optical sorting technology and market products to container glass producers, fiberglass insulation producers and, to a lesser extent, to producers of sand blast media and other markets.

Three-mix glass can be challenging for processors to produce marketable feedstock clean enough to be melted and recycled into new bottles or fiberglass. Contaminants such as porcelain, rocks, metal and materials with high melt points cause considerable problems in the manufacturing process.

Wisconsin single-stream MRFs process 10 to 50 tons per hour. The latest MRF technology for three-mix glass clean-up begins with a glass breaker screen system that may include air separation equipment and/or additional screens. The glass breaker and screen systems sort out material that is less than two inches in diameter, including broken glass, shredded paper, bottle caps and other non-glass material from the bigger pieces of recycling. Air separation equipment will either blow or vacuum off a portion of the lighter material, like shredded paper and bottle caps. A vacuum system will suck the lighter material off the conveyor belt as it passes, leaving the three-mix glass and other heavier contaminants. In a blower/drum separator system, air blows the lighter material up and into a different area, while heavier material like the broken glass will fall through the air and down. The cost for clean-up systems range from under \$50,000 for simple vacuum systems to over \$200,000 for combined screening and vacuum systems. These systems cannot remove all contaminants mentioned above, or problematic items, including ceramics, stones, wet organics and some metals that must be removed by secondary glass processors.

Technology to sort three-mix glass has been in development for less than twenty (20) years. It is likely that processing technology will continue to improve in the future.

Recommendations for MRF Operators:

1. Review installation of vacuum system and/or screens to remove light weight contaminants from the broken three-mix glass. Three-mix glass that contains low, non-glass residuals will be more marketable than glass that has higher levels of contaminants.
2. Negotiate with contracted secondary processors/end market buyers for financial assistance and solutions for clean-up systems and negotiate better contract rates to increase return on investment for MRF technology upgrades.
3. Review Glass Packaging Institute's MRF grant options to improve glass recycling and recovery.

Industry Standards and Specifications

With the exception of glass, all major recycled commodities have established specifications through the Institute for Scrap Recycling Industries (ISRI) for their recycled material as it leaves the MRF and goes to a secondary processor. The Glass Packaging Institute (GPI) and the glass container industry are at work with ISRI to develop voluntary specifications for recycled glass exiting MRFs. The creation of an authoritative glass specification for MRFs will establish clear expectations regarding required quality. Recycled glass that achieves the specifications, currently under development, increases the likelihood that it will be purchased by a manufacturing-based end market, such as glass container manufacturing or fiberglass. These new specifications may also be adopted into agreements and contracts between communities and recycling companies, helping to establish a broad-based standard for the glass industry. While ISRI already publishes guidance on recycled glass cullet denoting size, contamination concerns, and colors currently required for purchase by the glass container industry, this new glass specification will put recycled glass on more equal footing with other recovered commodities.

Table 1 below provides the cullet specifications required by Strategic Materials facility located in East Troy, WI. Each facility and negotiated contract may have varied requirements and pricing matrices based on fines and non-glass residue.

Table 1 - Strategic Materials Specifications for Single-stream Cullet			
Criteria	Description	Examples	Target
Amber	Brown container glass	Beer bottles	50%
Flint	Clear container glass	Food and beverage bottles	30%
Green & Other	Various shades of green, blue, and other	7up, Sprite green, wine bottles, blue bottles	20%
3-MIX Single-stream Specification			
Criteria	Description	Examples	Target
NGR	Non-Glass-Residual found in municipal recycling program	Paper, Plastic, Aluminum, steel	10% Maximum
U/S	Undersize Glass particles < 3/8" (or < 1/8")	Mixed color glass particles	12% Maximum
Other Criteria			Target
Ceramics	Broken bits of household ceramic	Dinner plates, mugs, cups	.01% Maximum
Color	Flint, Amber, Green(s) & other	Food containers, beer bottles, wine/ soda bottles	20-50%
Moisture	Excessive water mixed with glass	Rain, snow, ice	5% Maximum
Excluded Waste	Other, possibly hazardous waste	Any glass ceramic blends, such as PyroCeram or Neoceram, mirror, leaded glass or any CRT glass, batteries, medical waste, or any radioactive, volatile, corrosive, bio-hazardous, toxic, or hazardous material as defined by applicable law	0% (Zero)

Recommendations:

1. State-wide industry associations including the Associated Recyclers of Wisconsin (AROW), Solid Waste Association of North America - Badger Chapter (SWANA), WI Counties Solid Waste Manager Association (WCSWAMA) and MRF operators should support the GPI efforts to establish and implement national glass recycling standards and specifications to include cullet and non-cullet recycling options.

Non-Cullet Uses of Glass

Traditionally, glass collected by Wisconsin recycling programs has been processed and marketed as cullet to be recycled into new bottles and jars. Recent trends, including high transportation costs, stricter quality requirements by secondary processors, increased costs to manage glass and decreased revenues have forced public and private collection systems and MRF operators to evaluate glass recycling alternatives. Several alternatives for post-consumer glass have been developed, including numerous uses within landfills, aggregate in road base or asphalt, sand blast media/abrasive, fiberglass and drainage/utility trench backfilling.

Identified below are three categories of alternative uses of glass, including: 1. Uses that are within the disposal limits of a licensed landfill, 2. Uses that are outside the disposal limits of the landfill which require a WDNR Low Hazard Waste Grant of Exemption (LHE) and 3. Use as aggregate in roadways. All state statute and administrative code regarding glass management in Wisconsin was provided by the WDNR and is listed in Table 2.

1. Uses of glass that are within the disposal limits of a licensed landfill

- **Alternative Daily Cover (ADC)**
 - If a landfill chooses to use glass as ADC, it is required to receive an operation plan modification approval from WI DNR prior to the use. NR 506.055, Wis. Adm. Code outlines information needed to request use as ADC.
 - ADC for "Municipal Solid Waste Landfills" does not address glass produced from a MRF that cannot be sent to market as ADC but rather "Residual Crushed Glass".
- **Road base material**
- **Screening Berms**
- **Decking**
 - This application is similar to road base material to provide a stable surface for trucks dumping materials into the landfill.
- **Aggregate around piping**
 - In this application glass would replace crushed stone around leachate drainage or gas piping in the landfill.
- **Other**
 - Additional proposed uses in a landfill plan of operation or plan modification would also be considered.

All of these potential uses within the disposal limits of the licensed landfill currently require an approved landfill plan or plan modification (unless approved as part of the original licensing) as identified in s.287.07(7)(f), Stats. The above listed uses, should they be approved, would be considered "beneficial reuse" based on the definition stated in s. NR 500.03(19), Wis. Adm. Code. "beneficial use" or "beneficial reuse" means the utilization of a solid waste or an industrial by-product in a productive manner. *Note: this does not include glass regulated by Ch. NR 538 which is specifically for the Beneficial Reuse of Industrial Byproducts.* Although, these applications are considered beneficial reuse of a solid waste, currently WDNR allows Responsible Units of Recycling (RU's), those local units of government implementing the recycling law, to record this material as "recycling" on their WDNR annual report under "alternative use" on the MRF self-certification.

Note: "Beneficial reuse" refers to the reuse of industrial waste as a 'product' or material in an industrial or commercial activity. Direct beneficial reuse (DBR) refers to the reuse of a product or material without prior treatment or reprocessing, and secondary beneficial reuse (SBR) is the use of a product after it has been treated or reprocessed.

Currently there are three definitions of "recycling" in state statute.

- 1) S. 287.13(1)(h), Stats., recycling definition that applies to section 287.13 of Statute.
"Recycling" means the transfer, transporting, processing, marketing and conversion of solid wastes into usable materials or products and includes the stockpiling and disposal of non-usable portions of solid wastes, but does not include the collection of solid wastes.
- 2) S. 289.43(1), Stats., recycling definition that applies to section 289.43 of Statute.

In this section, "recycling" means the process by which solid waste is returned to productive use as material or energy, but does not include the collection of solid waste.

- 3) S. 544.03(33m), Wis. Adm. Code, recycling definition that applies to Ch. 544 of Code.

"Recycling" means the series of activities by which solid waste is collected, sorted, processed and converted into raw materials and used in the production of new materials. It excludes the use of these materials as a fuel substitute or for energy production.

There are efforts with another statewide industry workgroup, the Future of Wisconsin's Recycling Development (FORWD), to support development and implementation of a common definition of recycling to establish a clear understanding of what recycling is and is not. This is considered a necessary step to define the success of recycling programs as well as review of terms including industrial by-products, beneficial use and beneficial reuse as it pertains to glass and other materials collected and processed at a MRF.

2. Uses of glass that are outside the disposal limits of a licensed landfill

Non-cullet uses of glass outside the disposal limits of a licensed landfill, with the exception of glass as an aggregate replacement in asphalt pavement or subbase material under roadways, require a WDNR Low Hazard Waste Grant of Exemption (LHE). There is an application form for this type of exemption, WDNR WA1540 (provided in appendix). There are currently six identified categories on the form, and the WDNR may require additional information for other use requests.

The following are the uses identified on the LHE form:

- **Drainage medium or backfill for buried utility lines, drain tile or similar use**

Glass may be used to replace washed stone/gravel as fill material around pipes or utility trenches if able to meet specifications typically provided by project engineers or designers.

- **Aggregate for a building foundation**

Glass is used as a portion of the aggregate in ready mix concrete.

- **Aggregate in road base or parking lot subbase**

- Although this use is listed on the WDNR WA1540, Wis. Adm. Code exempts glass from solid waste requirements when used as an aggregate replacement in asphalt pavement and subbase material under roadways (s. NR 500.8 (2)(f)).

Note: Parking lots are not roadways. Any use in roadways that does not meet the specific exemption could be considered with LHE approval such as road shoulders.

- **Sand blasting medium**

There may be more stringent product specifications and requirements particular for size.

- **Decorative landscaping material**

Decorative application that may require additional processing to crush, size and tumble.

Note: Glass use as a component in glasphalt pavement is exempt under S. NR 500.0(2)(f), Wis. Adm. Code.

The following is a list of alternative uses that are not currently listed on the LHE form:

- **Septic Tank Treatment Systems**

Requirements for use in the construction of these systems are provided by the Wisconsin Department of Safety and Professional Services.

- **Flowable Fill**

The Center for By-Product Utilization at UW-Milwaukee has performed testing on using glass aggregates for this application.

- **Glass Sand**

Used as a direct replacement for sand in various applications (golf courses, beaches).

- **Water and Wastewater Filter Media**

Water and wastewater treatment systems often utilize aggregate materials in the construction of filter systems. Glass has been used in various locations alone as well as in combination with other materials such as anthracite or sand.

3. Uses of glass in asphalt or road base

In accordance with s. NR 500.08(2)(f), Wis. Adm. Code, facilities where glass is processed or used as an aggregate replacement in asphalt or subbase material under roadways do not require a LHE or any approval from the WDNR as long as the glass is not used in a location where it will be exposed or frequently disturbed and may pose a safety threat; the glass particles are smaller than ½ inch in size unless the facility has obtained written approval to use larger particles from the department; the glass is stockpiled and stored in a nuisance-free manner, on a hard all-weather surface with controlled access to the storage area; contaminants such as labels, caps, and metal rings are kept to an amount which will not impede the effectiveness of glass in asphalt or as aggregate and the glass is designed and used in accordance with generally accepted engineering practices. One way to demonstrate that the glass contaminant level will not impede its effectiveness and that the glass will meet generally accepted engineering practices is for local transportation departments to write acceptable specifications for glass being used in roadway projects.

Note: A LHE would be required for subbase proposals not in roadways or any other use that doesn't meet the exact exemption criteria.

Recommendations:

1. Encourage local units of governments and MRF operators to work cooperatively with municipal public works departments, the State Department of Transportation and private firms to develop specifications, policies and partnerships for recycled glass use.
2. Support WDNR development and implementation of standing Beneficial Use determinations, as done by the Minnesota Pollution Control Agency (<https://www.pca.state.mn.us>) that allows the generator or end user of a material to use in accordance with applicable rules without contacting the agency or requiring a permit.
3. Review and revise ambiguous language in regulations and required processes (see Table 2 - Statutes and Code References to Wisconsin Glass Management) to eliminate confusion and accelerate the use of glass in non-cullet recycling and beneficial reuse methods. Standardize language that clearly defines and is directly linked to above noted uses including:
 - a. Recycling
 - i. Support the FORWD group's recommendation to define recycling.
 - b. Beneficial Use and Reuse
 - c. Roadways
 - i. Pertaining to use of glass in construction
 - ii. State, county and town-owned road definitions of shoulders differ
4. Request industry association(s) to hire a consultant and engineering firm to prepare a report and develop specifications regarding acceptable contamination levels and generally accepted engineering practices for non-cullet uses of recycled glass to provide the WDNR and local units of government guidance on policy development.
5. Request and support development of WDNR guidance document, based partly on independent, professional review, for cullet and non-cullet recycling, alternative and beneficial reuse and LHE requirements, standards and specifications.
6. Evaluate components and identify possible modifications to WDNR WA 1540 in the following areas:
 - a. Length of exemption
 - b. Include standard specifications
 - c. Provide form for annual reporting requirement
 - d. Include language that defines whether this material is "recycled"
 - e. Modify form (or create a new form) to allow flexibility for pilot programs including waiving fees and simplifying the application process to allow for small quantity testing or low tonnage uses
 - f. Include "other" category for potential other alternative uses

Table 2 - Statute and Code References to Wisconsin Glass Management

Type	Reference	Description
Disposal Ban	S. 287.07(4)(d)	Bans glass containers from disposal in a landfill.
Disposal Ban	S. 287.07(7)(g)	Provides an exemption for glass containers to be disposed of in a landfill under very specific circumstances with a written waiver from the WDNR
Alternative Uses in Landfills	S. 287.07(7)(f)	Allows container glass to be placed in landfills if it is being beneficially used in the landfill and its use is approved in the landfill Plan of Operations.
Alternative Uses in Landfills	S. NR 506.05	Describes the purpose of daily cover.
Alternative Uses in Landfills	S. NR 506.055	Lists the information that is required to be submitted when proposing an alternate daily cover.
Alternative Uses Outside of Landfills	S. 289.43(8)	Covers WDNR authority to issue Low Hazard Exemptions.
Alternative Uses Outside of Landfills	S. NR 500.08(2)(f)	Allows glass to be used as aggregate in asphalt pavement or as a subbase material under roadways without a Low Hazard Exemption from WDNR under certain circumstances.
MRF Requirements	S. NR 502.08(2)(b)	Exempts MRFs from needing to be licensed solid waste processors if they operate in accordance with the single commodity exemption or the self-certification requirements.
MRF Requirements	S. NR 544.14(4)	Allows WDNR to grant exemptions to requirements of chapter NR 544 under certain circumstances where the department determines that an exemption is needed to allow or encourage the management of solid waste in accordance with state policy.
MRF Requirements	S. NR 544.16 (1)(c)	Requires a MRF to maintain materials in a marketable condition.
MRF Requirements	S NR 544.16(3)(13)	Requires information on the total quantity and percentage of residuals created in the previous year when self-certifying.
MRF Requirements	S. NR 544.16(3)(14)	Requires a MRF to describe the procedures they will use to reduce residuals when self-certifying.
MRF Requirements	S. NR 544.16(3)(15)	Requires a MRF to certify that they will produce recyclables in accordance with market quality specification when self-certifying.

MRF Requirements	S. NR 544.16(4)(a)	Requires a MRF to certify that they are operating in accordance with their original self-certification.
MRF Requirements	S. NR 544.16(4)(d)	Requires a MRF to report the tons and percent of residuals generated over the course of the year.
MRF Requirements	S. NR 544.16(5)	Allows WDNR to invalidate the self-certification of a MRF not operating in accordance with their original or yearly self-certification.
MRF Requirements	S. 289.63(6)(d), 289.64(4)(d), 289.645(4)(h), 289.67(1)(fj)	Exempt MRFs from paying certain landfill tipping fees for residuals up to 10% of the weight of materials accepted by the MRF.
RU Requirements	S. NR 544.06(2)(a)	Requires RUs to mandate by ordinance that residential and business properties in their RU send their materials to a processing facility that recovers for recycling materials in as pure form as technically feasible.
RU Requirements	S. NR 544.14(2)	Allows RUs to request variances to the glass container recycling requirements under certain cost situations.
RU Requirements	S. NR 544.14(3)(a)	Allows the WDNR to grant variances to the glass container recycling requirements under certain cost circumstances.

Regulatory and Legislative

Typically, technological advancement takes place if driven by economics, quality or performance improvements, government legislation and/or voluntary efforts. In Wisconsin, current law, S. 287.07 (4)(d), Stats., bans glass containers and other materials from landfill disposal, and S. NR 544.06 (2)(a), Wis. Adm. Code, requires Responsible Units of recycling to mandate container glass recycling by ordinance. Regionally and nationally, container glass management varies, as do collection and processing systems. Legislative and regulatory solutions are an important aspect for glass recycling future as the industry faces continued demand for container glass with historically low value.

There are several options to consider moving forward with glass recycling in Wisconsin, including:

1. Glass Bottle Bills (Beverage Container Deposit)

Bottle bills requiring container deposit systems have been among the glass industry's best source of quality recycled container glass in the United States. Currently, there are 11 states with bottle redemption legislation with an average recycling rate of just over 63%, while non-deposit states average 24%, according to the Container Recycling Institute. Iowa reported an 86% recycling rate with their deposit system (Barker-Lemar, 2010). A recent Glass Packaging Institute report states that glass companies estimate more than 65% of cullet used in the glass manufacturing process comes directly from states that have bottle bill programs in place.

Container deposit systems take many unique forms. Containers, including glass, can be returned to a private recycling center, grocery store, a major retailer, or a separate curbside collection. There are a number of ways in which states have established infrastructure and support to provide container deposit programs to residents. For instance, according to the Bottle Bill Resource Guide, proposed legislation in Maryland includes redemption centers in convenience zones established by counties and a recycling reserve fund for unredeemed money. These funds help ensure sustainability of the program, and could be used to fund investments in program infrastructure.

Job creation is a potentially positive impact of a bottle bill, along with increased recovery rates and accompanying conservation of natural resources. Obstacles and/or negative impacts include implementation expenses, providing education to change recycling behaviors, possible changes in purchasing habits and loss of end-markets for single-stream MRFs. Bottle bills focusing on glass only can have a profound impact in many areas including, but not limited to: volume collected in single-stream systems, total program costs, marketability, economic development, and the overall effect on the environment.

2. Update and expand the LHE, or develop a standing beneficial reuse determination list similar to the Minnesota Pollution Control Agency (<https://www.pca.state.mn.us/waste/standing-beneficial-use-determinations>).
3. Update 287.11(2m) of Wisconsin Statutes, which allows RUs to request a variance to the landfill ban requirements, to include not only the cost of processing glass, but also the cost of transportation to the end user or secondary processor.

Recommendations:

1. Request a guidance document from WDNR that is user-friendly and summarizes connections related to administrative codes and statutes for all possible options under recycling and beneficial use.

Partnerships

There are many opportunities for partnerships within the public and private sectors to develop, implement and sustain viable solutions for economical glass recovery, recycling and manufacturing.

Recommendations:

1. University of Wisconsin – Milwaukee Center for Byproduct Utilization (CBU)
 - a. Utilize the expertise of the CBU and urge its resources to be utilized on three-mix glass for the purpose of expanding uses and increasing acceptance and adoption of those uses.
 - b. MRF operators should work with CBU on materials sampling and testing to understand options for end market and alternative uses.
2. Wisconsin Economic Development Corporation (WEDC)
 - a. There is potential for the private sector to invest in MRF technology or infrastructure as it may relate to job growth and development. There are several programs that offer some form of a funding mechanism (financing, grants, tax credits).
 - b. Pursue a targeted grant/low interest loan with a mix of public and private funding (based on Iowa's Solid Waste Alternatives Program, or SWAP). Such a targeted financial assistance program could build the capacity to recover resources and add in-state value, a sound strategy for economic growth. It could also boost development of infrastructure. Request that the DNR manage a program in cooperation with WEDC and advise on strategic focus areas.
3. Glass Packaging Institute (GPI) and the recently formed Glass Recycling Coalition (GRC)
 - a. GPI has provided grant funding for MRFs to improve technology and glass clean-up systems.
 - b. GRC is defined as, *"a dynamic group of organizations that will collaborate on efforts to make glass recycling work in the U.S., through identifying and sharing best practices, developing strategies to assist municipalities with glass recycling decisions, and establishing a network of glass recycling champions to increase the availability of recycled glass that can become new bottles and jars as well as fiberglass."*
4. Statewide Public-Private Cooperative for Secondary Processing
 - a. Consider working with a local processor or other private or public entity to expand secondary processing operations to meet needs of MRF operators (supply) and market conditions (industry specifications), resulting in stable markets (demand) and reasonable revenue for materials.

Conclusions

According to the US EPA (2013), glass has a 34% recycling rate as compared to 30% for plastics, 55% for aluminum and 67% paper. Glass is made from readily available domestic materials, such as sand, soda ash, limestone and “cullet,” the industry term for furnace-ready scrap glass. Glass can be recycled infinitely without compromising quality or purity. ISRI stated that recycled glass is substituted for up to 70% of raw materials used in making new glass. An estimated 80% of recovered glass containers are made into new glass bottles. According to the U.S. EPA and the Container Recycling Institute (CRI), 41% of beer and carbonated soft drinks bottles, 25% of wine and liquor bottles, and 18% of other glass bottles and jars were recovered in 2010, saving the energy equivalent of 7.5 trillion BTUs and avoiding 1 million tons of greenhouse gas emissions (MTCO₂E). Manufacturers benefit from recycling in several ways: it reduces emissions and consumption of raw materials, extends the life of plant equipment (such as furnaces) and saves energy. Glass recycling creates no additional waste or byproducts.

The Sustainable Glass Management Options Study completed by Barker Lemar in 2010 identified the following environmental impacts of glass recycling:

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

Glass manufacturers are placing more stringent quality standards on recycled container glass to meet market demands for new glass containers. Color-sorted, contaminant-free recycled glass helps ensure that these materials are recycled into new glass containers. While curbside collection of glass containers can generate high participation and large volumes, drop-off and commercial collection programs are more effective at yielding high-quality container glass. It is critical that MRF operators or alternate collection systems are able to balance collection and recovery costs with industry requirements. Revenues have not been adequate to cover the costs of improving MRF technology or other upgrades in glass collection systems. The relative abundance and low cost of virgin materials continues to limit demand and revenues for recycled container glass, making continued development of recycling options imperative to improve and sustain recycled glass markets.

The AROW Glass Taskforce has reviewed: MRF technology, industry standards and specifications, non-cullet uses, regulatory and legislative concerns, and partnership options to develop diverse recommendations. Many require continued and enhanced cooperation among the public and private sectors, as well as local and national organizations, to produce economically feasible and environmentally sustainable implementation strategies. These strategies will need to take into account location, collection systems, and available end-markets. In addition, it will be imperative that the WDNR develop common definitions and prepare detailed guidance documents on non-cullet uses to further simplify the process for alternate use and end market development.

Resources and References

1. "2014 Sustainability Report." Casella. N.p., 2014. Web.
2. "2015 Municipal and Industrial Waste Landfill Tonnage." Wisconsin Department of Natural Resources. N.p, n.d. 8 Aug. 2016. Web.
3. "Achieving 50% Recycled Content for Glass Containers." GPI. N.p., Sept. 2014. Web.
4. "Alternative Uses for Post-Consumer Glass." UW-Extension. N.p., June 2012. Web.
5. "Best Management Practices for Glass Recycling in Northern Colorado." City of Fort Collins. N.p., 25 Apr. 2008. Web.
6. "Beverage Containers: Summary of the Stewardship Initiative for Minnesota and Wisconsin." Minnesota Pollution Control Agency. N.p., July 2009. Web.
7. "Chapter NR 538: Beneficial Use of Industrial Byproducts." Wisconsin Department of Natural Resources. N.p., Dec. 1997. Web.
8. "Clear Solutions." GPI. N.p., Sept. 2014. Web.
9. Collins, Susan. "A Common Theme." Container Recycling. N.p., Feb. 2012. Web.
10. "Color-coated Recycled Glass for Concrete Products." NERC. N.p., n.d. Web.
11. "Conference and Workshop Archives." NERC. N.p., Nov. 2015. Web.
12. "Environmental Overview: Complete Life Cycle Assessment of North American Container Glass." GPI. N.p., n.d. Web. 17 May 2016.
13. Gitlitz, Jenny. "Bottled Up: Beverage Container Recycling Stagnates." Bottlebill.org. N.p., Oct. 2013. Web.
14. "Glass as Road Aggregate." Minnesota Pollution Control Agency. N.p., n.d. Web.
15. "Glass Recycling." Ohio Environmental Protection Agency. N.p., n.d. Web.
16. "Glass Recycling Resumes at Community Recycling Center." Alabama Environmental Council. N.p., n.d. Web.
17. "Glass Resource Locator." GPI. N.p., n.d. Web.
18. Barker-Lemar. Sustainable Glass Management Options Study. May 2010. Print. Prepared for Dubuque Metropolitan Solid Waste Agency.
19. Marcheskie, Dave. "Harrisburg to Stop Recycling Glass, Expand Paper and Plastics." ABC 27 News. N.p., 13 Feb. 2015. Web.
20. "Materials Recovery Facilities." WRAP. N.p., Sept. 2006. Web.
21. Naik, Tarun, Rudolph Kraus, and Shiw Singh. "Use of Glass and Fly Ash in Manufacture of Controlled Low Strength Materials." UWM. N.p., July 2001. Web.
22. Paben, Jared. "One Firm's Vision for Growth in Recycled Glass Market." Resource Recycling. N.p., 3 May 2016. Web.
23. Pressley, Phillip, James Levis, Anders Damgaard, Morton Barlaz, and Joseph DeCarolis. "Waste Management." NCSU. N.p., 23 May 2014. Web.
24. "Raise A Glass to Ohio's Recycling Success." Earth911. N.p., 4 Nov. 2014. Web.
25. "Recycle Alabama." Alabama Environmental Council. N.p., n.d. Web.
26. "Recycling." GPI. N.p., n.d. Web.
27. "Reuse/Recycling of Glass Cullet for Non-Container Uses." UWM. N.p., 10 Jan. 2007. Web.
28. "Scrap Specifications Circular." ISRI. N.p., 21 Jan. 2016. Web.
29. "Spartanburg County, City to Stop Glass Recycling in March." Waste 360. N.p., 5 Feb. 2016. Web.
30. "The Scrap Recycling Industry: Glass." Isri. N.p., n.d. Web. 17 May 2016.
31. "The Scrap Recycling Industry: Glass." ISRI. N.p., Jan. 2016. Web.
32. Thomas, Dylan. "The Story of Glass and Recycling in 2015." Resource Recycling. N.p., 10 Nov. 2015. Web.
33. Wayman, M., B. Cordell, and E. Houghton. "Life Cycle Assessment of the Use of Solid Waste Materials in Highway Construction." Transportation Research Foundation. N.p., Mar. 2009. Web.
34. "WI DNR Materials Recovery Facilities (MRFs) Tonnages for Self-Certified MRFs That Processed Wisconsin Recyclables." WI DNR. N.p., n.d. Web.
35. "Maryland." BottleBill.org. N.p., n.d. Web. 11 Nov. 2016."

Appendix

1. Exempting Low-Hazard Wastes from Solid Waste Regulations. WA1540. April 2012. dnr.wi.gov/files/PDF/pubs/wa/WA1540.pdf

Solid Waste Low Hazard Waste Exemption Request Use of Processed Container Glass

Bureau of Waste and Materials Management, WI DNR

This exemption request is authorized by section 289.43 (8), Stats. If approved, the exemption is effective for five years and authorizes the applicant to provide processed glass to multiple end users, subject to the conditions of approval. This request may be used for the specific processed glass uses listed in Part 3, below; in all instances, uses are prohibited within the disposal limits of a licensed landfill. When signed by the applicant, and accompanied by a one-time \$550 exemption fee, this submittal constitutes a request for a low-hazard waste grant of exemption from regulation under chs. NR 500 - 538, Wis. Adm.

PART 1: Applicant Information

Name: _____

Company/Municipality: _____

Address: _____

- Check if applicant is a DNR self-certified Materials Recovery Facility (MRF) under NR 544.16, Wis. Adm. Code. If the name of the MRF is not the same as the applicant or company name above, provide the MRF name below as it appears on the DNR list of certified MRFs (see attached).

PART 2: Processor Information (if different from applicant)

Name: _____

Company/Municipality: _____

Address: _____

- Check if processor is a DNR self-certified Materials Recovery Facility (MRF) under NR 544.16, Wis. Adm. Code. If the name of the MRF is not the same as the processor or company name above, provide the MRF name below as it appears on the DNR list of certified MRFs (see attached).

PART 3: Conditionally Exempted Uses of Processed Container Glass

- a. Check all anticipated uses for which the processed glass might be used during the following five years and indicate the approximate amount of glass expected to be used for this/these purpose(s) per year in the table below. You will need to submit a new application for additional uses not checked in this application.
- b. Facilities where glass is processed or used as an aggregate replacement in asphalt pavement and subbase materials under roadways are conditionally exempted from solid waste requirements under NR 500.08(2)(f), Wis. Adm. Code. If no other uses are anticipated, you do not need to apply for a low hazard grant of exemption.

WA1540
April 2012

Conditionally Exempted Uses	Estimated annual use (Indicate tons or CYs)
<input type="checkbox"/> Drainage medium or backfill for buried utility lines, drain tile or similar uses	
<input type="checkbox"/> Use as aggregate under a building foundation	
<input type="checkbox"/> Use as aggregate in road base or parking lot subbase	
<input type="checkbox"/> Use as a component in glasphalt pavement	
<input type="checkbox"/> Use as a sand blasting medium	
<input type="checkbox"/> Use as a decorative landscaping material	

- c. Provide information on the sources of processed glass to be used under this exemption. Include the name and address of the intended sources.
- d. Provide a statement documenting that the processed glass will meet the standard specifications for each of the anticipated uses. Include photos of processed glass to be used for each of the proposed uses. Standards and test methods for alternate uses of glass are provided in UW-Extension publication "Alternative Uses for Post-Consumer Glass (#525.JV.0501) available at the publications website: <http://www4.uwm.edu/shwec/publications/publications.cfm>.
- e. Provide a statement documenting your evaluation of other options for glass-to-glass recycling.

PART 4: Applicant Certification

I hereby request a low-hazard waste grant of exemption under s. 289.43 (8), Stats., for the use(s) of container glass collected for recycling listed in Part 3, above. I certify that the glass that will be used for the listed purpose(s) will be processed to the extent necessary to meet all applicable industry specifications for the intended use(s). I further certify that the glass used under this grant of exemption will not be used within the disposal limits of a licensed landfill or disposed of on the land or in waters of the state for uses different than those listed in Part 3, above. I understand that the proposed use(s) of processed glass may be subject to limitations under other local, state or federal laws.

I will submit an annual report each year to the DNR, on a form provided by the DNR, identifying the use/s and amounts in tons of processed container glass used during the previous year. Failure to submit a complete report in a timely manner may result in revocation of my conditional grant of exemption.

I certify I have evaluated other options for glass-to-glass recycling and found the proposed use noted above to be economically or technically preferable at this time.

Signature of Applicant: _____

Date of Submittal: _____