# Ohio Glass Recycling Study

COMMISSIONED BY THE OHIO DNR, DIVISION OF RECYCLING AND LITTER PREVENTION

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# Scope of Work

- Identify current and projected demand for recycled glass cullet, including specifications and limitations to the use of glass cullet
- Estimate  current supply of recycled glass in Ohio, and compare with existing and expected future demand
- Evaluate alternatives for significantly increasing the supply of glass to meet Ohio glass industry demands

# Demand in Ohio

- Five manufacturing facilities for container glass, fiberglass and reflective coatings
  - Due to energy savings associated with substituting glass cullet for raw materials and, in the case of fiberglass, increased demand for insulation manufactured with recycled glass, both the container glass and fiberglass industries are anxious to source significantly more recycled glass cullet than is currently available from Ohio municipalities.
- Four glass processing facilities in Ohio to supply the manufacturing plants
  - Capacity  greater than what is utilized

# Current and Future Demand for Cullet in Ohio

| | Current | Potential Demand | | |
|---|---|---|---|---|
| | **Use** | **Low** | **High** | **Color** |
| **Industry** | *(tons)* | *(tons)* | *(tons)* | |
| Glass Bottles | 15,000 | 100,000 | 100,000 | >95% Flint |
| Fiberglass | 65,000 | 145,000 | 165,000 | < 20 - 40% Amber |
| Other (Bead and Block) | 30,000 | 30,000 | 30,000 | Mixed |
| ***Total:*** | 110,000 | 275,000 | 295,000 | |
| | | | | |
| ***Difference:*** | | **165,000** | **185,000** | |

# Current and Future Use or Recycled Cullet: Float/Plate vs Container Glass

- Plate glass is a significant contributor to current recycled cullet use
  - Primarily flint, clean, and relatively homogeneous
  - Can be blended with container glass to meet most specifications
- Cannot breakdown recycled plate vs. container glass cullet use
  - Plate and container glass are processed together at all facilities except for Rumpke
  - One out-of-state processor did not disclose plate vs. container glass cullet input, and two in-state processors mix small quantities of source separated container glass with plate
- Data reported on current and potential future use should be assumed to be a mix of plate and container glass
  - But focus of study was on finding more container glass since current capture is very low

# General Specifications for Ohio Manufacturers

- 500 ppm total organic contamination, or roughly 1,500 – 3,000 ppm for “Loss on Ignition” (LOI)
- 40-70 ppm ceramic content
- Sizing: particle size important and grinding needs to be done after optical sorting
- Color:
  - Containers - 95 percent or greater flint
  - Fiberglass - 20-40 percent reduced glass (e.g. amber)

# Processing Capacity

- Processing required to remove contaminants, size cullet (though grinding) and separate by color for container end uses
- Significant glass processing capacity already in Ohio:
  - Strategic Materials plants in Cleveland and Newark;
  - Rumpke facility in Dayton which is being expanded
  - Dlubak facility in Upper Sandusky.
- Potential to expand capacity at existing facilities however O-I's demand for flint glass (Zanesville) may require investment in additional optical sorting capacity

# Import and Export Expected to Occur

- While sufficient processing capacity exists in Ohio to supply current use, recycled cullet is exported and imported based on specifications:
  - One processor sells to an OC fiberglass manufacturer outside of Ohio, but not to the two plants in Ohio
  - O-I facility in Ohio needs flint glass only, and sources significant quantities of cullet from out-of-state.
  - Current Rumpke processing configuration cannot color sort three-mix glass

# Current and Planned Processing Capacity

| | Current | | Planned/Potential | |
|---|---|---|---|---|
| | Input | Output | Input | Output |
| Processing Facility | (tons) | (tons) | (tons) | (tons) |
| Total, Four Facilities | 209,000 | 174,300 | 275,000 | 213,000 |

Note that “Input” is different from “Current Use” shown in first table, since in-state processors currently supply out-of-state end users. Current input reflects the total glass processed in-state from MSW.

# Analysis of Glass Supply

- Data reviewed included:
  - Data submitted to Ohio EPA by solid waste districts
  - Ohio landfill waste characterization study (2003)
  - Beer, wine and liquor sales data (and estimate of on-premise (bar and restaurant) generation of glass bottles
  - Potential supply of plate glass currently not being recycled.
  - Five days of residential refuse and recycling route sorting.

# Current Recovery

| Reported Glass Recycling | Residential *(tons)* | Commercial *(tons)* | Total *(tons)* |
|---|---|---|---|
| Curbside Glass (1) | 34,600 | 4,100 | 38,700 |
| Drop-off Glass (2) | | | |
| Three Mix | 7,740 | 860 | 8,600 |
| Separated | 2,970 | 330 | 3,300 |
| Total Glass: | 45,310 | 5,290 | **50,600** |
| *Additional Glass Recycling Estimate:* | | | **3,795** |
| *Total Glass Recycling Estimate:* | | | **54,395** |

# Potential Strategies to Meet Demand

- Expand single stream curbside recycling to households with only curbside refuse collection
- Implement glass recycling programs for bars and restaurants
- Add source separated glass collection (by color) glass drop-off locations throughout Ohio
- Recover windshield replacement glass and glass from construction and demolition waste
- Enact beverage container deposit legislation

# Glass Generation Estimates

| | Sort Data (1) | Sales Data (2) | Waste Comp (Disposal) | Current Recovery | **Total Generation (3)** |
|---|---|---|---|---|---|
| Residential | *(lbs)* | *(lbs)* | *(lbs)* | *(lbs)* | ***(lbs)*** |
| Container Glass | | | | | |
| Beverage | 53 | 48 | | | |
| Food | 9 | 13 | | | |
| Plate Glass | 0.5 | NA | | NA | |
| **Total, Residential:** | **63** | **60** | | 8.5 | |
| | | | | | |
| Commercial | | | | | |
| Container Glass (4) | 16 | 16 | | 0.9 | |
| Other Glass | NA | NA | | | |
| **Total Glass:** | **79** | **76** | **81** | 9.4 | **90** |

1) Sort data residential glass only.
2) With help from Wholesale Beer and Wine Assn of Ohio.
3) Waste composition and disposal data is added to current recovery for total generation
4) Estimated to be 25% of sales per discussions with Wholesale Beer and Wine Assn.

# Annual Glass Generation Estimate

| | Average Per Capita | Total |
|---|---|---|
| **Residential** | (lbs) | (tons) |
| Container Glass | | |
| Beverage | 51 | 292,000 |
| Food | 11 | 64,000 |
| Plate Glass (1) | 6 | 35,000 |
| ***Total, Residential:*** | 68 | 390,000 |
| | | |
| **Commercial** | | |
| Container Glass (2) | 16 | 92,000 |
| Other Glass (3) | 6 | 35,000 |
| ***Total Commecial:*** | 22 | 126,000 |
| | | |
| **Total Glass:** | 90 | 517,000 |
| ***Recovery, from Table 3:*** | | 54,395 |
| ***Estimated Recovery:*** | | 11% |

# Other Glass Supply

- Based on interviews, vast majority of post industrial glass waste is already being recovered in Ohio and therefore does not represent a potential new supply.

- Potential new supplies:
  - Windshield glass from automobile windshield replacement – estimated at 5,500 tons based on 1.4 tons recycled per month at Massachusetts establishments.
  - Plate glass from construction and demolition activities – estimated at 4,200 tons based on glass at 1%+/- of C&D waste and the estimate that 25% might be recovered

# Estimated Glass Available, By Color

| Glass | Flint (tons) | Amber (tons) | Green (tons) | Total (tons) |
|---|---|---|---|---|
| Food | 64,000 | 0 | 0 | **64,000** |
| Beer and Soda | 64,000 | 192,000 | 22,000 | **278,000** |
| Wine | 4,000 | 4,000 | 74,000 | **82,000** |
| Liquor | 22,000 | 1,000 | 1,000 | **24,000** |
| Other Glass | 62,000 | 3,000 | 3,000 | **68,000** |
| **Total** | 216,000 | 200,000 | 100,000 | **516,000** |
| ***Percentage*** | ***42%*** | ***39%*** | ***19%*** | |

Beer's impact on total amber supply explains the high fraction of amber found in DSM's sorting of residential waste. Note that almost all of the industrial plate glass is flint (not shown above) and can be used to mix with amber if the quantity of reduced (amber) glass exceeds a fiberglass manufacturers' specification for amber.

# Estimated Glass Diversion: 54,000 Tons

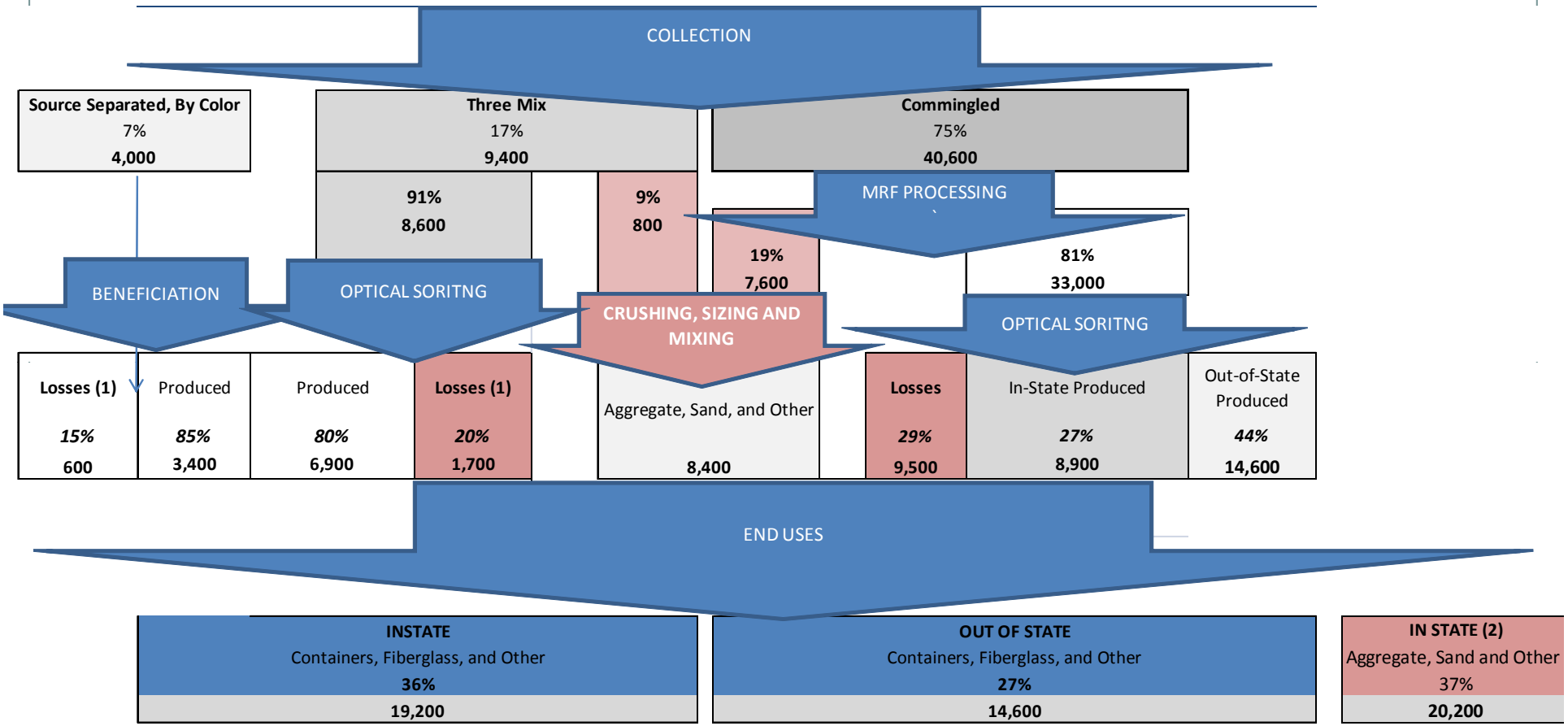


Figure Notes:

(1) Estimated losses based on data from other facilities, and estimated at 15% for source separated material.

(2) End Uses Instate estimate (e.g. 19,200 tons) come from instate source separated, 3 mix and commingled processed glass generated in Ohio.

(3) End Uses Out of State estimate (e.g. 14,600 tons) come from instate commingled processed glass generated in Ohio.

(4) End Uses In State estimated (e.g. 20,200 tons) come from instate and out of state 3 mix and commingled glass generated in Ohio.

(5) Small quantities of this material flows out of state.

(6) Numbers may not add due to rounding.

# Increasing Recycled Cullet Supply

## STRATEGIES TO INCREASE SUPPLY AND ESTIMATED COSTS

# Strategies to Bridge the Gap

- Expansion of curbside recycling
- Source separated collection of glass by color using glass drop-off locations throughout Ohio
- Enactment of glass recycling programs for bars and restaurants (on- premise consumption)
- Enactment of beverage container deposit legislation

# Limitations

- DSM's primary task was to assess potential demand and supply of recycled glass. Cost estimates that follow are very rough and detailed analysis is necessary to guide future State and private investments in creating additional supply.

- Each strategy analyzed will require capital investments and higher operating costs, but this analysis does not address who will pay, but recognizes that a primary reason for Ohio's low glass recycling rates is that landfill costs are low. Another reason for the lack of supply is that current market prices are insufficient.

# Key Assumptions

- Access to recycling
- Capture through drop-offs

# Access to Recycling

| Curbside Recycling Service | Population in Collection Region (persons) | Percentage Served by Recycling Collection (%) | Total Population Served (persons) | Percent of State Population (%) |
|---|---|---|---|---|
| Municipal Curbside | 5,347,640 | 75% | 4,010,730 | 35% |
| Subscription Curbside | 2,294,434 | 5% | 114,722 | 1% |
| ***Curbside Population*** | | | **4,125,452** | **36%** |

- Roughly 28% is estimated to have access to drop-off glass recycling
- The balance, roughly 36%, have no easy access to glass recycling
  - Assumed 50% is in area where drop-off recycling could be added (18% of population)

# Drop-off Recycling Capture

- Unlikely that a system that relies on drop-off recycling of residential glass will be sufficient to supply significant quantities of glass in areas where curbside collection of refuse is the norm.
  - Medina County drop-off program for glass recovered roughly 4.3 pounds per household of glass last year (compared to average household generation of 68 pounds)
  - DSM surveys of Columbus drop-off recycling indicate that roughly 8% of households with curbside refuse collection were participating in drop-off recycling in 2008.
  - Quantity of glass collected in two excellent drop-off systems was roughly 13.7 pounds per capita (Knoxville) and 6 pounds per capita (Delaware)

# Expand Curbside Collection

**Curbside collection expanded to households with curbside refuse collection (and no curbside recycling)**

**Result:** Roughly **68,000** new tons of glass supply (after accounting for losses during separation and processing) plus substantial new supplies of paper, and plastic, aluminum and steel containers.

**Issues:** Need for continued investment at MRFs to reduce glass losses, and at processing facilities to color separate and remove contaminants

**Costs:** Estimated **$68.4 million** annually. However, ***cost includes collection of all curbside materials,*** including plastic, aluminum, tin, and paper, and does not account for savings in collection costs, avoided tip fees or other collection efficiencies that might reduce total system costs.

# Curbside Data

| | | Households | Glass Collected | | All Material | |
|---|---|---|---|---|---|---|
| | *(%)* | Served | *(lbs/hh)* | *(tons)* | *(lbs/hh)* | *(tons)* |
| Curbside refuse and no recycling | 54% | | | | | |
| Urban Households | 22% | 1,006,093 | 75 | 37,728 | 375 | 188,642 |
| Suburban households | 22% | 1,006,093 | 95 | 47,789 | 450 | 226,371 |
| *Total Recycled, Tons:* | | | | **85,518** | | **415,013** |

| | Households | Monthly Household Cost | Annual Cost |
|---|---|---|---|
| | *(hhs)* | *($/hh)* | *($)* |
| No recycling | 2,978,793 | | |
| Urban Households | 991,938 | $2.50 | $29,758,138 |
| Suburban Households | 991,938 | $3.25 | $38,685,579 |
| ***Total Cost:*** | | | **$68,443,716** |

# Additional Drop-off Glass Recycling

**Drop-off programs expanded to urban and suburban populations with no current access to curbside or drop-off recycling.**

**Result: 14,400** tons of additional container glass.

**Issues:** Those serving mostly residential areas would be source separated by color, but those serving mix of residential and commercial (bars and restaurants) would accept three-mix glass

**Costs: $5.5 to 6 million** which covers cost of households and businesses driving (out of their way) to drop-offs to deliver recycled glass, as well as cost to construct and operate the drop-offs, and transfer material to glass processors who would clean to market specifications.

# Bar and Restaurant Recycling Programs

**Recycling program for bars and restaurants, modeled after the Ohio pilots, and state-wide North Carolina program**

**Result:** Estimated **53,000 new tons** of glass cullet after full implementation

**Costs:** Range from **$1.5 - $3 million** with 66% participation from all bars and restaurants. (Costs are low because DSM assumes significant savings in existing refuse collection and disposal costs if glass were diverted for recycling)

# Plate and Windshield Glass Recycling Program

**Implementation of a windshield glass replacement recycling program and window glass recovery program during building renovation and demolition**

**Results: 10,000 tons** (rounded) of plate glass might be recovered

# Deposit Legislation For Glass

**Deposit legislation for glass bottles where deposits are collected and bottles could be returned to retailers was reviewed**

**Results:** Estimated **239,000 tons** of glass, which would be more than sufficient to supply future Ohio glass manufacturing demand

**Costs:** Rough estimate of **$68 million** includes handling fee, collection costs for glass and scrap value for separated glass

# Discussion

REPORT AVAILABLE FROM:

OHIO DNR, DIVISION OF RECYCLING AND LITTER PREVENTION