REMADE CIRCULAR ECONOMY TECH SUMMIT & CONFERENCE

MRF CAPABILITES AND CIRCULAR ECONOMY OFF-RAMPS

Bradley Kelley - GBB

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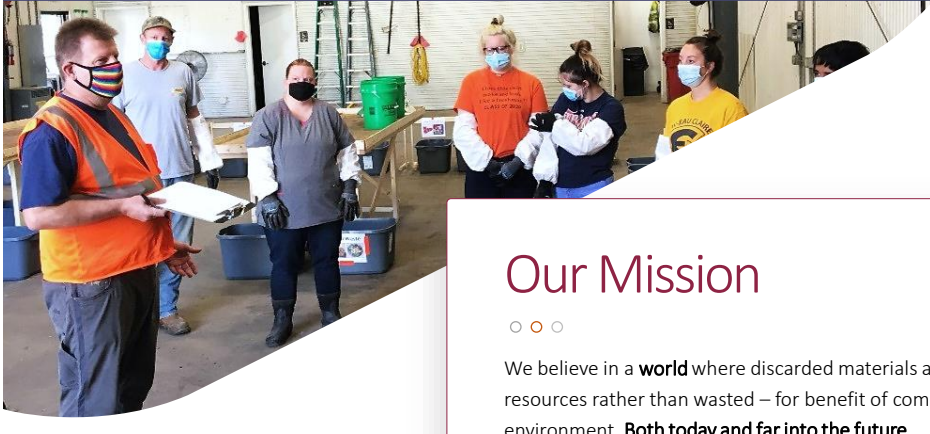

GBB

Our Mission

We believe in a **world** where discarded materials are used as resources rather than wasted – for benefit of communities and the environment. **Both today and far into the future.**

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Today's Agenda

- Existing Circularity Off-Ramps
- GBB Recovery Research Data
- Technology to Increase Circularity
- Current Circularity Model
- Alternative Circularity Model
- Q&A

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Circular Economy and Recycling

The Idealized Goal

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Motivation – Circularity Off-Ramps

- Limited Program Materials: Most MRFs currently can only process materials that make up roughly 1/4 of our waste stream.
- Program Material Specifications: MRFs are not able to recover all recyclable materials that enter their systems.
- Program Materials in the Landfill: Many recoverable and recyclable materials end up in the landfill.
- Recycled Materials Degrade or are used to Make Non-Recyclable Items: Materials that are recovered and recycled at MRFs are often downcycled or used to manufacture non-recyclable or non-recoverable items.

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Circularity Off-Ramp #1 – Limited Program Materials
(Most MRFs will accept)

- **OCC (Cardboard)**
- **Other Flat Fiber**
- **PET #1**
- **HDPE #2**
- **Aluminum Cans**
- **Steel Cans**

Some MRFs may accept other materials on a case-by-case basis

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Circularity Off-Ramp #2 – Program Material Specifications
MRF's Ability to Process and Recover

- OCC needs to be large and flat (~18"x18")
- Containers need to be empty and still intact (3D)
- Items can't be too small (2"x2" is common fines screening)
- Color and label wraps can also cause recovery issues (hard for optical equipment to identify)

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Circularity Off-Ramp #2 – Program Material Specifications
Recovery Research

- Recovery of HDPE Flexible Tubes at an HDPE specific Optical Unit

Item	Number of Items Recovered (Out of 100)
HDPE 1.0" flexible tube	1
HDPE 1.5" flexible tube	3
HDPE 2.00" flexible tube	29

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Circularity Off-Ramp #3 – Recyclable Materials in Landfills

- GBB's Rule of thumb is about 50% of recyclables at a location with curbside single stream recycling ends up in landfill.
- Recent study in Michigan showed about 30% was recycled.
- EPA's national rate of 32% indicates a lot more recyclable material ends up in landfill

Landfilled OCC at a Waste Sort – B. Kelley

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Circularity Off-Ramp #3 – Recyclable Material Degradation and use in Durable Goods

- Only metals and glass are truly circular
- Fiber and plastics degrade over multiple cycles
- Only certain long fibers and clear plastics are easily mechanically recycled back into single-use containers
- Colored plastics and short fibers tend to be used in items that are not recaptured for recycling

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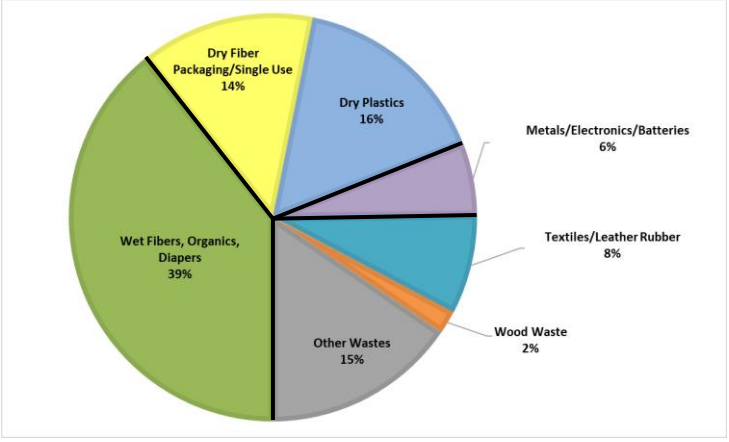
Technology Approach to Increase Circularity

- Mixed Waste Processing
- Source Separation
- Collection (Wet/Dry)



- Dry Single-Use/Packaging – **30%**
- Wet Organics and Fiber – **39%**
- **Total Wet/Dry – 69%**

Remaining Non-Metal Waste - 25%

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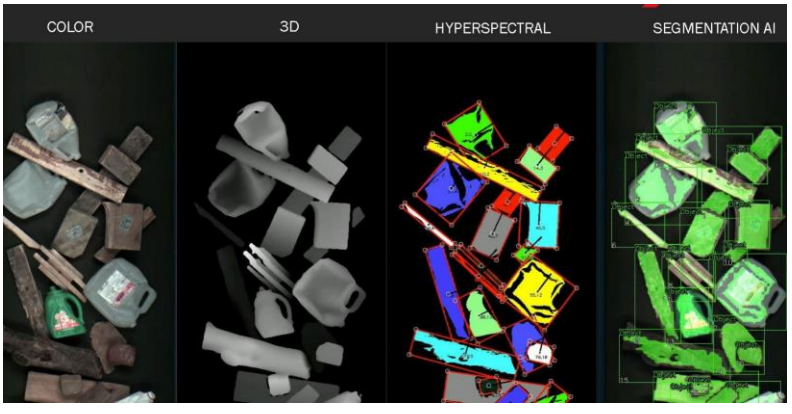
Technology Approaches (Continued)

- Artificial Intelligence (AI)
- Advanced Recycling
- Additional Approaches
  - EPR
  - Brand Capture



Source: Waste Robotics

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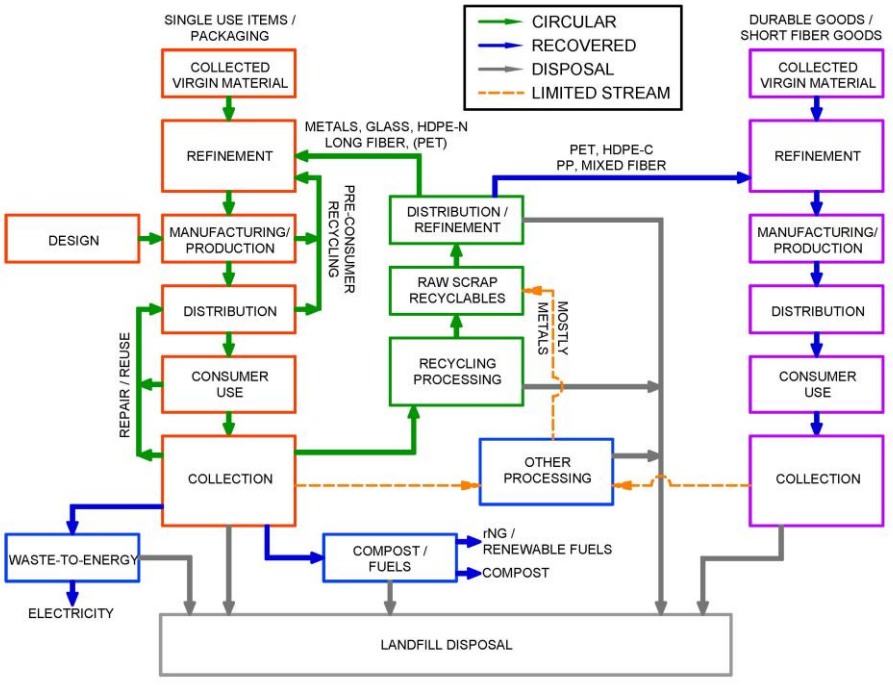

Current Circularity Map

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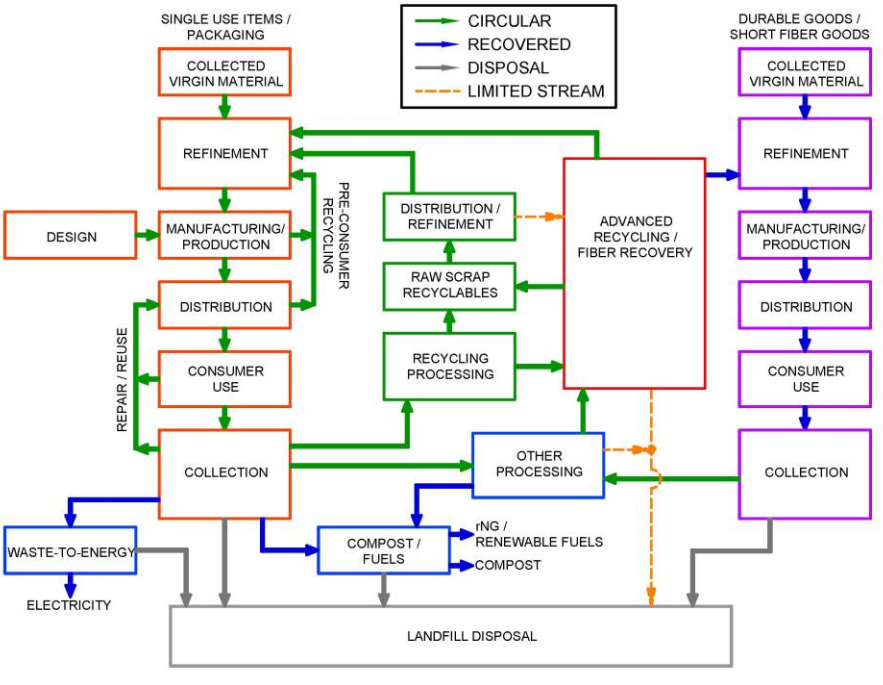

Advanced Circularity Map

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Conclusions

- **Increase recovery of current Program Materials**
  - More Recycling Collection
  - More advanced processing
  - Change Collections to increase material access
- **Review Recoverability of Items**
  - Just because it is a recyclable material doesn't mean it will be recovered
- **Advanced Recovery and Refinement technology to improve circularity of non-circular or limited circularity items**

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THANK YOU

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