The Future of Processing and Collecting

(or Collections and Processing – Have to Get the Material First!)

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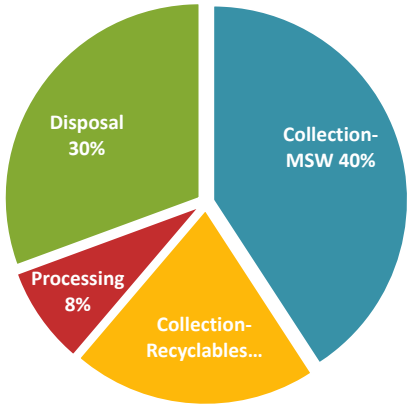
GBB's Waste Consulting Services

- Economic, technical and environmental reviews
- Procurements
- Due diligence third-party reviews
- Waste characterization and sourcing
- Process planning and conceptual designs
- Independent feasibility consultant

2

Cost of Collection, Processing and Disposal

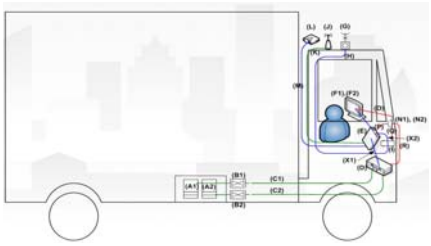


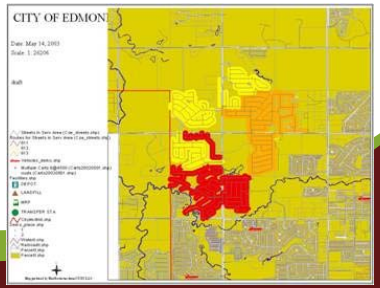
Full cost ranges from $100 to $400 per ton
Source: GBB, 2015.

3

Collection Improvements Can Lower Cost and Improve Service

- Routing Optimization
  - Semi-Automated and Automated
  - Pick-up Schedule
  - Real-Time Updates
- RFID Tags and Wireless Monitoring
- Driver Monitoring and Safety
- Renewable Fuels
- Driverless Vehicles





4

Semi-Automated Collections

- Usually Require a ANSI Type "B" Container
- Can be used with Front or Side Load but most frequently with Rear Load
- Can collect from both sides of curb

Source: Rumpke. GBB

5

Automated Collections – Side Load

- Require a ANSI Type "G" Container
- Can reduce injuries and fatigue
- Can only collect from one side of curb at a time

Source: Labrie

6

Automated Collections – Front Load

- Require a ANSI Type "G" Container
- Improved Vision of Loads for Driver
- Large/Long vehicle required with tall dump height

Source: Curatto-Can

7

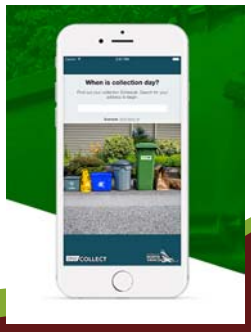
Pick-up Schedules

- Switching to EOW collections can reduce costs
- Portland, OR METRO now collects Organics and Food Scraps every week and MSW and Recyclables EOW
- GBB Waste Characterization Study for Mecklenburg County, NC with EOW Recyclable collections found:
  - *No statistical difference in the amount of recyclables in the waste between recycling and non-recycling weeks*

8

Route Optimization

- Software to optimize routes and timing now can include
  - Real-time updates with Traffic or pick-up changes
  - Use either in-cab tablets or smartphones
- Apps for Customers as well to ask "What goes Where?"



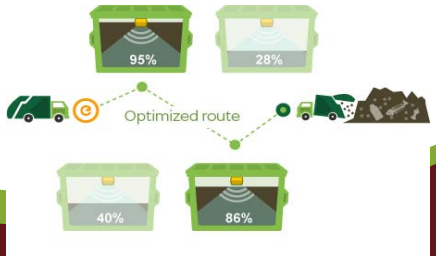
Source: FleetRoute™, ReCollect

9

Cart Monitoring
(The Internet of Things - IoT)

- RFID Tags to Track Individual Carts
  - Monitor Inventory
  - Record Individual Collections
- Wireless Fill Monitors to Signal when Carts are Nearing Capacity
  - Can customize routes to only collect carts that are nearly full

Source: Evevo



10

Driver Monitoring and Safety

- Internal cameras monitor driver behavior at critical moments
- External cameras monitor vehicle
  - For automation cart collections
  - To prevent fraudulent claims
  - To prevent damage in tight areas

Source: Brigade

11

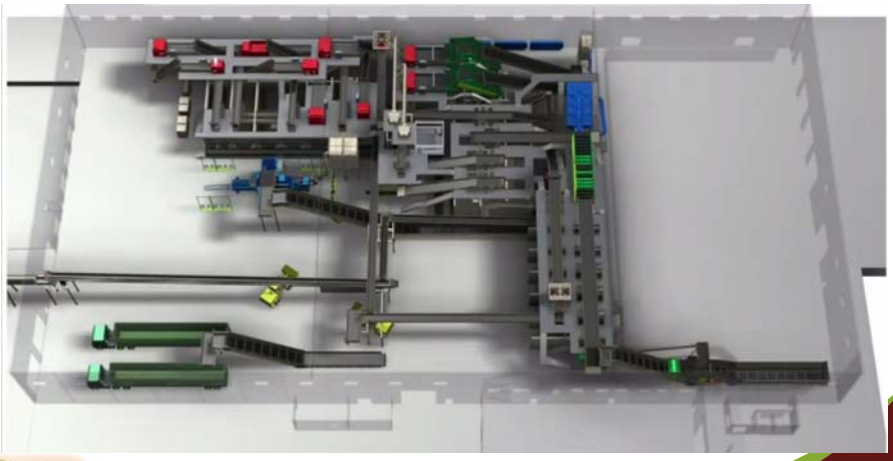
Driverless Vehicles

- Big Push in Passenger Vehicles and Trucking
- Government has recently issued guidelines
- Volvo has a prototype electric driverless dump truck
- Collection Drivers have additional tasks required than just driving from A to B!

Source: Volvo

12

Processing of MSW and Recyclables



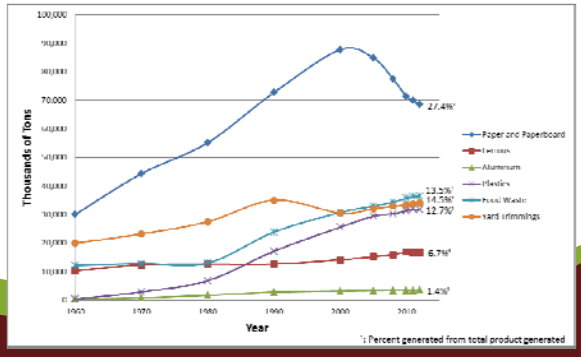
Source: BHS/Infinitus

13

The Changing Waste Stream

- Less Paper
- Product Lightening – Lower weight and more volume
  - 30 TPH systems are now 25 TPH systems
- Increased Product Complexity
  - Colored PET, increased uses of #5 Polypropylene

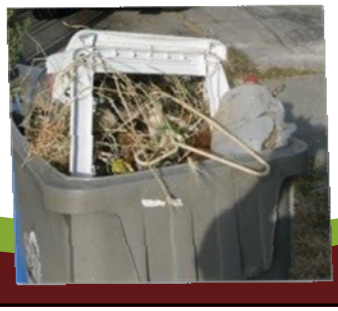
Source: EPA Generated Materials/GBB



14

Contamination and "Wish"-Cycling

- Households are now Customers, not Participants
- Contamination has been increasing in recent years
  - Non-program materials and single stream contamination is different than MRF Residue Rate, which is what is usually reported
- Push to "Recycle More" leads to "Wish"-cycling



15

Examples of Single Stream Contamination Issues

Food Waste & Vegetation

Contaminated Material & Food Waste

ONP Screen Jammed w/Plastic Waste

Household Trash, Electronics and Hoses

Source: ReCommunity

16

Contamination Causes

- Generator Problems
  - Confused
  - Poor communications
  - Too many targeted recyclables
  - Maybe this is recyclable!
- Operator Problems
  - PAYT waste cart too small
  - Dual compartment collection
  - Glass!

17

Automation Key to Separation and Quality

18

Differences Between MWPF and MRFs are Narrowing

- Materials are becoming similar with greater SS contamination
- Machines are much the same, different front end, identical on the back end
- MWPF can also process Single Stream, but not the other way around
- All machines are being developed to wrap less materials

19

Additional Info:

- MWPF Reports from American Chemistry Council
  - Evolution of MWPF (1970-Today)
  - Supplemental Technology and Equipment Guide

20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21