JEFF DRAPER

2015 NYSAR3 - 26TH ANNUAL NYS RECYCLING CONFERENCE
Mixed Waste Processing and Organics Recovery
NOVEMBER 5, 2015
Four World-Class Brands: One Integrated Solution

Worldwide systems provider for waste processing needs

What’s next.

Screening
Eugene, OR

Air Separation
Amsterdam, NL

Optical Sorting
Nashville, TN

Waste-to-Energy
Lafayette, CA
BHS’ patented process has yielded **results**. We’ve been successfully **recovering** mixed materials for **years**, refining our process. We’re doing it **now**. And we’re doing it **better** than anyone.

**GreenWaste**: San Jose, CA  
75% Diversion

**Newby Island**: Milpitas, CA  
70% Diversion

**IREP**: Montgomery, AL  
60% Diversion

**Athens Services**: Sun Valley, CA  
90-95% Recovery of Recyclables

**Zanker**: San Jose, CA  
90+% Diversion
Zero Waste Energy Expertise

ZWE’s dry anaerobic digestion systems are turning **organic waste** into renewable **energy**. We are doing this **now**. No other technology provider can offer these **results**.

**Monterey Regional Waste Management District**, Marina, CA
SSO Dry Anaerobic Digestion to CHP

**Blue Line Transfer/SSF Scavengers**, South San Francisco, CA
SSO Dry Anaerobic Digestion to CNG

**Zero Waste Energy Development Co.**, San Jose, CA
OFMSW + SSO Dry Anaerobic Digestion to CHP
A majority of the reusable resources in U.S. MSW remain untapped.

Even with Single Stream Recycling available, up to half of recoverable recyclables are thrown away.

Only **34.3%** of MSW Generated is **recycled**

This is a material composition conducted from houses with both curbside recycling and waste bins. Source: GBB
Capturing Lost Commodities

Table 1. Generation, Recovery and Discards of Materials in MSW, 2013 (EPA)

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight Generated</th>
<th>Weight Recovered</th>
<th>Recovery as Percent of Generation</th>
<th>Weight Discarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and paperboard</td>
<td>68.60</td>
<td>43.40</td>
<td>63.3%</td>
<td>25.20</td>
</tr>
<tr>
<td>Glass</td>
<td>11.54</td>
<td>3.15</td>
<td>27.3%</td>
<td>8.39</td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel</td>
<td>17.55</td>
<td>5.80</td>
<td>33.0%</td>
<td>11.75</td>
</tr>
<tr>
<td>Aluminum</td>
<td>3.50</td>
<td>0.70</td>
<td>20%</td>
<td>2.80</td>
</tr>
<tr>
<td>Other nonferrous metals†</td>
<td>2.01</td>
<td>1.37</td>
<td>68.2%</td>
<td>0.64</td>
</tr>
<tr>
<td><strong>Total metals</strong></td>
<td><strong>23.06</strong></td>
<td><strong>7.87</strong></td>
<td><strong>34.1%</strong></td>
<td><strong>15.19</strong></td>
</tr>
<tr>
<td>Plastics</td>
<td>32.52</td>
<td>3.0</td>
<td>9.2%</td>
<td>29.52</td>
</tr>
<tr>
<td>Rubber and leather</td>
<td>7.72</td>
<td>1.24</td>
<td>16.1%</td>
<td>6.48</td>
</tr>
<tr>
<td>Textiles</td>
<td>15.13</td>
<td>2.30</td>
<td>15.2%</td>
<td>12.83</td>
</tr>
<tr>
<td>Wood</td>
<td>15.77</td>
<td>2.47</td>
<td>15.7%</td>
<td>13.30</td>
</tr>
<tr>
<td>Other materials</td>
<td>4.58</td>
<td>1.31</td>
<td>28.6%</td>
<td>3.27</td>
</tr>
<tr>
<td>Total materials in products</td>
<td>178.92</td>
<td>64.74</td>
<td>36.2%</td>
<td>114.18</td>
</tr>
<tr>
<td>Other wastes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food, other‡</td>
<td>37.06</td>
<td>1.84</td>
<td>5.0%</td>
<td>35.22</td>
</tr>
<tr>
<td>Yard trimmings</td>
<td>34.20</td>
<td>20.6</td>
<td>60.2%</td>
<td>13.60</td>
</tr>
<tr>
<td>Miscellaneous inorganic wastes</td>
<td>3.93</td>
<td>Negligible</td>
<td>Negligible</td>
<td>3.93</td>
</tr>
<tr>
<td><strong>Total other wastes</strong></td>
<td><strong>75.19</strong></td>
<td><strong>22.44</strong></td>
<td><strong>29.8%</strong></td>
<td><strong>52.75</strong></td>
</tr>
<tr>
<td>Total municipal solid waste</td>
<td>254.11</td>
<td>87.18</td>
<td>34.3%</td>
<td>166.93</td>
</tr>
</tbody>
</table>
The Advanced Mixed Waste MRF is highly automated.
The Advanced Mixed Waste MRF

PROCESSES HIGH VOLUMES
The Advanced Mixed Waste MRF

PRODUCES HIGH QUALITY PRODUCTS
Why Mixed Materials Processing?

Collection Costs account for 50-70% of total MSW processing costs

- Lower transportation capital costs
- Lower transportation variable costs

One central MRF

- Less labor
- Lower transfer costs
- 100% of the material generated is available for capture

Organics Included

- Able to integrate Anaerobic Digestion and Compost
Breakdown of Organics Process

15-20%* Transformed into Biogas in AD
Mass is reduced as anaerobic digestion creates biogas (carbon dioxide & methane)

35-40% Transformed into Biogas in IVC
With in-vessel composting, mass is further reduced as it becomes biogas & moisture is lost

Less Than Half Remains Ready for Composting
Out of IVC, about half the original mass of organics remain, resulting in:
• Reduced handling cost
• Reduced transportation cost
• Shorter compost curing time
• High product yields
Technology specifically designed and optimized to process solid waste:
- Food waste, organic fraction of MSW (OFMSW) and green waste
- Inorganic and inert materials are generally acceptable
- Shredding/size reduction not required

Dry Anaerobic Digestion introduces the process to the waste rather than the waste to the process
- No direct mechanical contact with waste which minimizes equipment downtime and electrical consumption

SMARTFERM process is engineered to optimize the trade-off between biogas production (i.e., carbon depletion) with quality and cost-effective compost production

Multiple digester batch process maximizes system availability and normalizes biogas production
Acceptable Materials

- Food waste, organic fraction of MSW (OFMSW) and green waste. Inorganic and inert materials are generally acceptable, Shredding/size reduction not required.
- Wide range of food waste / green waste
  - 20/80 either way
  - Accommodates seasonal variations
- Need to consider *stacking*
SMARTFERM In-Vessel Composting

Fully enclosed tunnel system to accelerate and control the natural aerobic breakdown and create a high-quality, ready to bag compost in less than 28 days.

Benefits of In-Vessel Composting
- High quality compost
- Low odor generation and odor filtration included
- High aerobic microbial activity
Composting of Organics

- Material is mechanically processed by specially designed “Lane Turner” vehicle to optimize size reductions
- IVC features and process control
- Best-in-class odor management
- High quality, stable and mature compost suitable for soil amendment and agricultural applications
Carbon Takeout Using Low Carbon Fuel Standard (LCFS)

<table>
<thead>
<tr>
<th>SMARTFERM AD</th>
<th>40,000 TPY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogenic CNG Production</td>
<td>500,000 DGE</td>
</tr>
<tr>
<td>Carbon Intensity of Diesel Fuel</td>
<td>98.3 g CO2e / MJ</td>
</tr>
<tr>
<td>Carbon Intensity of Biogenic CNG</td>
<td>- 21g CO2e / MJ (negative carbon fuel)</td>
</tr>
<tr>
<td>Carbon Displacement</td>
<td>8,083 MTCO2e</td>
</tr>
<tr>
<td>LCFS Fuel Credit</td>
<td>$50 per MTCO2e / $404,000</td>
</tr>
<tr>
<td>RFS2 D3 RIN Value</td>
<td>$1.15 per DGE / $575,000</td>
</tr>
</tbody>
</table>

Carbon Intensity for Diesel & Substitutes, grams CO2 emitted per unit of energy adjusted for energy (g CO2 e/MJ):

- Diesel: 102
- CNG: 75
- BEV/PHEV: 28
- POTW: 34
- Dairy: 9
- Landfill: 15
- HSAD: 13
- 3.6 million\(^1\) dge/yr
- 110 million\(^1\) dge/yr
- 417 million\(^1\) dge/yr
- 100 million\(^1\) dge/yr

Carbon Displacement: 8,083 MTCO2e

LCFS Fuel Credit: $50 per MTCO2e / $404,000

RFS2 D3 RIN Value: $1.15 per DGE / $575,000

*UC Davis

(Information provided by: California Air Resources Board & the Edgar Institute)
BHS/ZWE Difference

Systems & approaches that generate a **solid return on investment**

Technology **built in the US** specifically for the Waste Industry

**US Operating References** for all size operations

Best partner with **experience, resources, & technologies to execute**

**Flexible approaches** from design – build to own-operate
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