Pre-Consumer Food Waste Composting at Carnegie Mellon University

Jared Carling, Paulina Jaramillo, & Aurora Luscher

12-706 Cost Benefit Analysis
What is Compost?

- “A mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land” (Merriam Webster's 10th Ed.)

- 100 million bacteria
- 800 feet of fungal threads
General Composting

- **GREEN**
  - Fruit and vegetable scraps
  - Coffee filters & grounds
  - Tea bags
  - Unbleached napkins
  - Meat and dairy
    - At CERTIFIED facilities only

- **BROWN**
  - Yard waste
    - Leaves
    - Grass clippings
    - Non-seeding weeds
  - Twigs
  - Vines
  - Newspaper
    - Black and white only
    - No more than 10% of pile
  - Hair clippings
Benefits of Composting

- Promotes soil health.
- Provides nutrients for plants, so it reduces the need for additional fertilizers . . .
- Extends landfill lifetime.
- Reduces greenhouse gas emissions.
- Promotes environmental awareness.
- Can be used as a treatment technique for contaminated soil.
Composting Options

- **Residential**
  - Aerobic
  - Anaerobic
  - Vermicomposting

- **Commercial**
  - All of the above
  - In-vessel
Food Waste

- 2.6% of food residuals are recycled/reused in the U.S.
- Food waste is the largest component of waste by weight.
- National Composting Council estimates the average U.S. household generates 650 lbs of compostables every year.
- ~ 10.8% of Southwest PA waste stream by weight is food waste (PA DEP).
Food Waste

- All food waste from CMU currently goes to a landfill:
  - Landfills produce about 4% of total US greenhouse gas emissions.
  - An average factor of 0.15 MTCE emissions are avoided by diverting a ton of food waste from landfills.
  - Space is a limited resource that should be used sparingly.
Composting Project Client

- Barbara Kviz, Environmental Coordinator

- Previous study performed by R.W. Beck
  - “Establishing a Pre-Consumer Food Waste Collection Pilot in Allegheny County, PA”

- CMU is not a solely cost-oriented client
CMU Composting

- **Types of food waste:**
  - Pre-consumer
  - Post-consumer

- **Places to collect food waste at CMU:**
  - University Center
  - Food Vendors
    - Eateries
    - Trucks
  - Dorms

<table>
<thead>
<tr>
<th>On Campus Dining Locations</th>
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<tbody>
<tr>
<td>Asiana</td>
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<tr>
<td>Barista Café</td>
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<tr>
<td>CK Pretzels</td>
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<tr>
<td>East Street Deli</td>
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<td>Ginger's Coffeehouse - Purnell</td>
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<td>Grab n' Go</td>
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<td>La Prima-Wean</td>
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<td>Main Street Market</td>
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</table>
CMU Composting Issues

- Allegheny County “composting laws”
- Current CMU yard waste composting
- Volume of waste
- Cost of disposal
- Dining Services
  - Ease of implementation
  - Ease of collection
  - Health code issues
Composting Alternatives

- **Agrecycle**
  - Certified composting facility in Fox Chapel
  - Cost to pick-up/compost
  - Sells finished compost at a profit

- **On-site composting**
  - Space is a major issue
  - In-vessel is the only real option
Costs

- Collection
  - Agrecycle
  - Containers
- Dining Services
  - Set-up and Training
  - O&M

Benefits

- Landfill tipping fees avoided (Savings)
- Greenhouse Gas Emissions Reduction (Methane)
- Landfill Space
- Agrecycle
  - Re-sellable product
  - Creation of jobs
Food Waste Collection Model

- **Status quo**
  - All waste going to landfill
    - Furnished UC data does not include recyclables

- **Phase 1**
  - Pre-consumer food waste

- **Phase 2**
  - Pre and Post-consumer food waste
## Actual Disposal Costs

<table>
<thead>
<tr>
<th>Year after (1997-98)</th>
<th>Waste Produced (Tons)</th>
<th>Total Disposal Costs</th>
<th>Disposal Cost Per Ton</th>
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<tr>
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<td>July 99 - June 00</td>
<td>397.06</td>
<td>$14,892</td>
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<td>July 00 - June 01</td>
<td>337.44</td>
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<td>$43.02</td>
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<td>348.59</td>
<td>$15,581</td>
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<td>July 02 - June 03</td>
<td>343.53</td>
<td>$15,337</td>
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Rise in Disposal Costs

Disposal Cost Per Ton Line Fit Plot

\[ y = 2.3095x + 34.384 \]

\[ R^2 = 0.7699 \]

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<th>Year After 1997-98</th>
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<th>$34.00</th>
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<th>$40.00</th>
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</table>

- Actual Disposal Cost Per Ton
- Predicted Disposal Cost Per Ton
- Linear (Actual Disposal Cost Per Ton)
Annual UC Waste Collection

- Constant vs. Exponential Decline of Waste Production

Exponential Fit Plot

\[ y = 420.5e^{-0.0467x} \]

\[ R^2 = 0.7117 \]

University Center Total Waste (Tons)

School Year After 1997-98

- Exon. (University Center Total Waste (Tons))
# Present Value of Total Disposal Costs

<table>
<thead>
<tr>
<th>Year</th>
<th>Year after 2003</th>
<th>Constant Waste Produced (Tons)</th>
<th>Exponential Waste Produced (Tons)</th>
<th>Disposal Cost Per Ton</th>
<th>Total Disposal Costs (Constant Waste)</th>
<th>Total Disposal Costs (Exponential Waste)</th>
<th>Present Value (Constant Waste)</th>
<th>Present Value (Exponential Waste)</th>
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<tr>
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<td>1</td>
<td>344</td>
<td>318</td>
<td>$47</td>
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<td>344</td>
<td>303</td>
<td>$49</td>
<td>$16,924</td>
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<td>$52</td>
<td>$17,717</td>
<td>$14,926</td>
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<tr>
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<td>$14,718</td>
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<td>240</td>
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<td>$20,891</td>
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<td>$23,271</td>
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<td>TOTAL</td>
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<td>$158,552</td>
<td>$119,814</td>
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$120,000 to $160,000 spent over next 10 years
Phase 1

- Pre-consumer waste:
  - Food Waste Audit:
    - Preliminary data
      - 1 day
      - 2 employees
      - 42 lbs for one day
    - Need more info from Dining Services
### Food Waste is 15-25% of Waste Stream

$18,000 to $40,000 saved over next 10 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Year after 2003</th>
<th>Constant Food Waste Produced (Tons)</th>
<th>Exponential Food Waste Produced (Tons)</th>
<th>Present Value of Landfill Disposal Costs Saved (Constant)</th>
<th>Present Value of Landfill Disposal Costs Saved (Exponential)</th>
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<tbody>
<tr>
<td>July 03 - June 04</td>
<td>1</td>
<td>52</td>
<td>48</td>
<td>$2,329</td>
<td>$2,154</td>
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<td>43</td>
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<tr>
<td>July 06 - June 07</td>
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<td>40</td>
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<td>July 10 - June 11</td>
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<td>34</td>
<td>$2,395</td>
<td>$1,598</td>
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<tr>
<td>July 11 - June 12</td>
<td>9</td>
<td>52</td>
<td>33</td>
<td>$2,389</td>
<td>$1,521</td>
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<td>July 12 - June 13</td>
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<td>52</td>
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<td>$2,381</td>
<td>$1,447</td>
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<td><strong>$23,783</strong></td>
<td><strong>$17,972</strong></td>
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</table>

### ASSUMING 25% OF WASTE STREAM IS FOOD WASTE

<table>
<thead>
<tr>
<th>Year</th>
<th>Year after 2003</th>
<th>Constant Food Waste Produced (Tons)</th>
<th>Exponential Food Waste Produced (Tons)</th>
<th>Present Value of Landfill Disposal Costs Saved (Constant)</th>
<th>Present Value of Landfill Disposal Costs Saved (Exponential)</th>
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</thead>
<tbody>
<tr>
<td>July 03 - June 04</td>
<td>1</td>
<td>86</td>
<td>79</td>
<td>$3,881</td>
<td>$3,590</td>
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<td>86</td>
<td>76</td>
<td>$3,919</td>
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<td>July 06 - June 07</td>
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<td>July 07 - June 08</td>
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<td>66</td>
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<td>63</td>
<td>$3,994</td>
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<td><strong>$39,638</strong></td>
<td><strong>$29,954</strong></td>
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</table>
Reduction of Methane Emissions

- 0.15 MTCE per ton of food waste diverted from landfill
- $13 (1992 $) per ton of carbon equivalent.
- Converted to 2003 $ by federal reserve rate

WHY ARE THESE VALUES SO LOW?
Preliminary Conclusions

- **Low Benefits for CMU alone**

- **Costs not yet included**
  - Training
  - Collection bins
  - Agrecycle collection

- **Social benefits not monetized**
  - Jobs created
  - Resellable product
  - Landfill space

- **Sensitivity Analysis**
Questions & Suggestions