Effective Food Waste Management in the City of Philadelphia

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Overview

I. Background
   1. Food Waste in the United States
   2. Food Waste in Philadelphia

II. Clean Kitchen, Green Community Initiative
   1. Overview
   2. Role of PWD

III. Food Waste Disposers for Effective Food Waste Management
   1. Environmental Group Policy Support
   2. Case Studies
   3. Life Cycle Assessment

IV. Conclusion
Total U.S. Municipal Solid Waste in 2010

Over **34 million tons** of food waste (FW) generated in the U.S. in 2010, more than any other material category but paper (EPA, 2010).
U.S. FW in 2010 (After Recycling)

After recycling, 33 million tons of FW was thrown away, making FW the single largest component of Municipal Solid Waste (MSW) reaching landfills and incinerators in the U.S. (EPA, 2010).

Municipal Solid Waste Discarded (by material) in 2010

<table>
<thead>
<tr>
<th>Materials</th>
<th>Million tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Waste</td>
<td>33.79</td>
</tr>
<tr>
<td>Plastics</td>
<td>28.49</td>
</tr>
<tr>
<td>Paper and Paperboard</td>
<td>28.74</td>
</tr>
<tr>
<td>Metals</td>
<td>14.54</td>
</tr>
<tr>
<td>Wood</td>
<td>13.58</td>
</tr>
<tr>
<td>Yard Waste</td>
<td>14.2</td>
</tr>
<tr>
<td>Textiles</td>
<td>11.15</td>
</tr>
<tr>
<td>Glass</td>
<td>6.4</td>
</tr>
<tr>
<td>Rubber and Leather</td>
<td>6.61</td>
</tr>
<tr>
<td>Other</td>
<td>3.38</td>
</tr>
</tbody>
</table>
FW in Philadelphia

- Philadelphia Streets Department (Streets Dept.) conducts decennial MSW study:
  - Takes samples of MSW
  - Manually sorts and weighs MSW
  - Analyzes the composition of MSW

- City handles 600,000 tons of non-recyclable MSW annually.

- 11% of MSW is wet organic FW, contributing **66,000 tons** to landfills and incinerators annually.
Consequences of Landfill Disposal

Prior to Trash Collection:
• Unfavorable odors from decomposing FW in garbage bins.
• Pests and rodents attracted to garbage bins containing FW.
• Unsightly appearance of overflowing dumpsters in neighborhoods.

During Trash Collection:
• Fossil fuels consumed by vehicles during collection.
• Harmful carbon monoxide introduced into the environment from collection vehicles.

Following Landfill Disposal:
• Methane production from decomposing FW. Methane is a potent greenhouse gas with 21 times the global warming potential of carbon dioxide (EPA, 2010). Landfills account for more than 20 percent of all methane emissions.
• Contamination of groundwater by toxic liquids that form from interactions between FW and materials in landfills such as metals (InSinkErator, 2012).
Sustainable FW Management

- EPA Hierarchy for Managing FW Effectively
  - Improving upstream production and distribution systems.
  - Smart purchasing and use of food.
  - Feeding people with leftover food.
  - **Using a food waste disposer (FWD).**
  - Composting in the backyard, using green bins and maintaining community gardens.
Clean Kitchen, Green Community

• The installation of 100 FWDs throughout the West Oak Lane and Point Breeze neighborhoods, along with the provision of information to residents for the effective use of the FWDs.

• **Purpose of Program:** To divert FW from landfills and to assess how FWDs can help the City reach its sustainability goals stated in the Greenworks Philadelphia Initiative.

• Program launched on May 24, 2012.

• Collaboration between the Streets Dept., Philadelphia Water Department (PWD) and InSinkErator.

• Streets Dept. will carry out a focused MSW study for the West Oak Lane and Point Breeze neighborhoods.
Addenda – Clean Kitchens

• Target Neighborhoods are working class/ moderate income single family row homes.
• Using community groups to facilitate installation
• Comparing morning trash route to afternoon trash route from same neighborhood 450 homes in route
• Estimated 40% already have FWD (200)
• Installing 100 in each area (300 out of 450 homes with FWD or 66% of homes)
• City Wide Incentive ($20 rebate on new InSinkErator) for buying or upgrading FWD.
Debjani Mallick & Noella Maillard of PWD — Streets Dept. collection truck showcased at the launch of Clean Kitchens, Green Community (May 24, 2012)
PWD in Clean Kitchen, Green Community

• Gravity drives the liquefied FW through the underground sewer system for treatment at PWD’s wastewater treatment facilities.

  - **Cost-efficient response to a local issue which utilizes existing infrastructure.** Food waste is 70% water and sewers are designed to transport water.

  - At the facility, anaerobic digestion is a part of the wastewater treatment process that can be used to create renewable energy and fertilizer from FW. **This exemplifies the transition of wastewater treatment facilities to resource recovery facilities.**

• Holistic approach to energy recovery and landfill use minimization.
FWDs are Cost-Efficient

Benefits for Residents:
• FWDs use less than 1% of a household’s water consumption.
• FWDs cost households less than 50¢/year in electricity to operate.

Benefits for the City of Philadelphia:
• Every ton of FW diverted from landfills saves the City $68 in tipping fees.
Resource Recovery Facilities

- 5.6 MW biogas cogeneration facility being constructed at the Northeast Water Pollution Control Plant.

- Facility will use biogas from the anaerobic digestion process to provide over 85% of the power needed for plant operations.
Environmental Support for FWDs

- National Green Building Certificate

![Green Approved Product](image1)

- UK – Chartered Institute of Water and Environmental Management (CIWEM) Policy Statement

- Support from the Water Environment Research Foundation (WERF)
CIWEM Policy Statement

1. CIWEM considers the evidence and demonstrates that FWDs are valid tools for separating kitchen FW at source and diverting it to treatment, use and recycling via the existing infrastructure and that they offer the opportunity for cost savings compared with other routes.

2. CIWEM considers that FWDs offer the opportunity for wider participation in resource recovery from wastes by a greater proportion of the population than has been the case with exclusive advocacy of curbside collection, which whilst acceptable to some, is not acceptable to all.

3. CIWEM considers FW and other organic residuals should (wherever possible) be treated and then used on land to conserve soil organic matter and complete nutrient cycles. The use of biosolids and other organic resources on land should be viewed from the perspective of the soil rather than from the origins of the materials. It is important to move to a holistic view of all aspects of organic resource production, use, soil protection, countryside stewardship, water protection, air protection and crop and livestock production. CIWEM considers there is scope for simplified, proportionate, science-based regulation of all organic resources and for co-treatment.
• Sustainable FW Evaluation.
• Comparison of economic and environmental benefits and costs of 5 different FW management methods.
• FWDs for cost-efficient FW management with an intermediate carbon footprint.
FWD Case Histories

• FWDs commonly used in the United States, Japan, Canada, Brazil and Australia; less frequently used in Europe.

• **Case Studies:**
  – **NYC:** Tested local law 74 (1997).
  – **Japan:** Tested effects of FWDs on MSW on an area with 97% market penetration (2010).
  – **Italy:** Tested effects of FWDs on MSW for a small and remote mountain village with 67% market penetration (2007).
Addenda - more detail on NYC

- NYC – 1950’s FWD only banned on CSO systems, not in separated sewer areas.
- Review of ban began early 1990’s between DEP commissioner and Sanitation Commissioner in response to City’s Solid Waste Management Plan and cessation of ocean dumping.
- 1995 – City Council requested Pilot Study
- 1997 – study completed, effect deemed “de-minimis”; adopted law to allow installation.
Life Cycle Assessment

- Life Cycle Assessment (LCA) is an important and comprehensive method for analyzing the environmental impact of products and services.
- LCA is a critical step in making informed decisions.
- LCA can be understood intuitively to follow a product from the cradle to the grave.
- **Gate-to-grave analysis for assessing the environmental impacts of FWDs.**
Final Report

Life Cycle Assessment of Systems for the Management and Disposal of Food Waste

Prepared for:
Emerson Appliance Solutions
InSinkErator®

Prepared by:
PE Americas
Functional Unit of LCA

- **FW per Household**
  - 100 kg/year

- **Water**
  - Consumption: 1,000 gallons/year
  - Cost: $3/year

- **Electricity**
  - Consumption: 4 kWh/year
  - Cost: 60¢/year
Boundary for Landfill

Construction of infrastructure equipment, facilities, trucks, etc.

Production and consumption of energy, fuels, water and polymers used during operation.

Food Waste Receptacle → Collection & Transport

Food Production, Distribution, Consumption

Plastic Bag

Garbage Can

Landfill

Leachate Disposal

Ofegas Treatment (generator or flare)

Emissions to air, water and soil (wastes)

Gate-to-Grave: Boundary of Food Waste Landfilled

Source: PE Americas, 2011
Gate-to-Gate Life Cycle Inventory of FW Receptacle

<table>
<thead>
<tr>
<th>Food Waste Receptacle</th>
<th>Units</th>
<th>per kg food waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flow</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
<td></td>
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<tr>
<td>Dry Food Waste</td>
<td>kg</td>
<td>0.3</td>
</tr>
<tr>
<td>Food Waste Water Content</td>
<td>kg</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Plastic Bag</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyethylene Film</td>
<td>kg</td>
<td>5.4E-04</td>
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<tr>
<td><strong>Garbage Can</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyethylene High Density Granulate (PE-HD)</td>
<td>kg</td>
<td>7.3E-04</td>
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<tr>
<td>Power (Injection Molding)</td>
<td>kWh</td>
<td>1.3E-03</td>
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<tr>
<td><strong>Outputs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Waste</td>
<td>kg</td>
<td>1.0</td>
</tr>
<tr>
<td>Plastic Bag to Landfill</td>
<td>kg</td>
<td>5.4E-04</td>
</tr>
<tr>
<td>Garbage Can to Landfill</td>
<td>kg</td>
<td>7.2E-04</td>
</tr>
</tbody>
</table>

Source: PE Americas, 2011
Summary of Gate-to-Grave FW Disposal System

Source: PE Americas, 2011
Boundary of Sludge Handling

Source: PE Americas, 2011
Important Terms and Definitions

• **Con-AD-Cogen**: Conveyance to conventional activated sludge process with anaerobic digestion, biogas used for cogeneration and biosolids land applied.

• **Ext-Aer-Landfill**: Conveyance to extended aeration sludge process with aerobic digestion and biosolids landfilled.

• **Landfill with Generation**: Biosolids landfilled and biogas used for cogeneration.
## 1-Year Summary of End-of-Life Disposal Results

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Primary Energy Demand (MJ)</th>
<th>Global Warming Potential (kg CO2-eq)</th>
<th>Acidification Potential (mol H+ eq)</th>
<th>Eutrophication Potential (kg N-eq)</th>
<th>Smog Potential (kg NOx eq)</th>
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<tbody>
<tr>
<td>Con-AD-Cogen</td>
<td>19</td>
<td>-0.16</td>
<td>9.8</td>
<td>9.8E-03</td>
<td>2.2E-04</td>
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<tr>
<td>Con-AD-Flare</td>
<td>170</td>
<td>9.8</td>
<td>4.5</td>
<td>1.4E-03</td>
<td>2.5E-05</td>
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<td>Con-AD-Boiler</td>
<td>120</td>
<td>6.4</td>
<td>4.2</td>
<td>1.1E-03</td>
<td>1.9E-05</td>
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<tr>
<td>Ext-Aer</td>
<td>610</td>
<td>43</td>
<td>15</td>
<td>8.7E-03</td>
<td>7.6E-05</td>
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<tr>
<td>Ext-Aer-Landfill</td>
<td>610</td>
<td>37</td>
<td>15</td>
<td>8.8E-03</td>
<td>7.8E-05</td>
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<td>Con-Lime-Stab</td>
<td>210</td>
<td>14</td>
<td>4.8</td>
<td>1.9E-03</td>
<td>2.5E-05</td>
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<tr>
<td>Ext-Lime-Stab</td>
<td>400</td>
<td>29</td>
<td>10.2</td>
<td>7.1E-03</td>
<td>4.9E-05</td>
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<tr>
<td>Con-Incin</td>
<td>210</td>
<td>14</td>
<td>4.7</td>
<td>2.6E-03</td>
<td>2.7E-05</td>
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<tr>
<td>Compost</td>
<td>30</td>
<td>2.1</td>
<td>4.0</td>
<td>4.4E-03</td>
<td>7.6E-08</td>
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<td>Waste-to-Energy</td>
<td>57</td>
<td>3.6</td>
<td>2.2</td>
<td>1.4E-03</td>
<td>2.9E-05</td>
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<tr>
<td>Landfill w/ Flare</td>
<td>190</td>
<td>81</td>
<td>7.1</td>
<td>1.7E-03</td>
<td>4.2E-05</td>
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<tr>
<td>Landfill w/ Generation</td>
<td>110</td>
<td>84</td>
<td>21</td>
<td>1.8E-02</td>
<td>4.2E-04</td>
</tr>
</tbody>
</table>

Source: PE Americas, 2011
Primary Energy Demand (MJ)

Source: PE Americas, 2011
Source: PE Americas, 2011
Global Warming Potential (kg CO₂ – eq)

Source: PE Americas, 2011
Conclusions

• **Environmental**
  – Reduces landfill use by 70%
  – Increase renewable Energy Production.
  – Reduces primary energy demand and global warming potential.

• **Social**
  – Makes the City cleaner.
  – Allows home owner not currently composting to participate in composting efforts.

• **Economic**
  – Cost-efficient for residents.
  – Saves the City money, reduced cost (tipping fees).
  – Leverages existing infrastructure.
Acknowledgments

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Questions?