Food Waste to Renewable Energy Assessment Overview
for Solid Waste Advisory Committee

Waste Minimization and Planning
& Energy Programs Office

June 14, 2022
• No detailed food waste assessment in past for Pennsylvania
  • High-level estimates at national levels with different methodologies (EPA, ReFED)
• Waste characterization study update in progress
• Serves priorities of both DEP Bureau of Waste Management and Energy Programs Office
• Social and Environmental Impacts of Food Waste
  • USDA estimates 31% of food produced for human consumption was not eaten
  • US EPA estimates food waste to be 24% of municipal solid waste sent to landfills
✓ Quantify current Industrial, Commercial, and Institutional (ICI) food waste generation and diversion
✓ Inventory anaerobic digestion (AD) and composting facilities currently accepting food waste
✓ Identify additional food waste processing capacity available at existing facilities
✓ Estimate the reduction in greenhouse gas (GHG) emissions and biogas generation resulting from the current level of diversion
✓ Identify best practices for expanding existing compost/AD processing capacity and encouraging additional diversion
Additional Assessment Resources

Data:
• All the data collected and generated for this assessment (down to individual facility information) has been provided in GIS format for further analysis

Case Studies:
• Food Waste Generators
  • Weis Markets
  • Square Café and Zero Waste Wrangler
• Food Waste Processors (Anaerobic Digestion)
  • Derry Township Municipal Authority
  • Milton Regional Sewer Authority
  • Reinford Farms
• Food Waste Processors (Composting)
  • Two Particular Acres and FC Partners
Current Actions Around Food Waste Reduction

• DEP **Food Recovery Infrastructure Grant** (2020)
  • **$9.6 million** to 145 nonprofit organizations (food banks, shelters, and soup kitchens)
  • Covers costs of equipment to prepare, transport and store food acquired from retailers, wholesalers, farms, processors and cooperatives
  • Funded through Act 101
  • DEP planning to offer program in future years

• Department of Agriculture **COVID-19 Food Bank Cold Storage Infrastructure Program** (2021)
  • **$11.4 million** to 18 food banks covering 67 counties
  • Funded through American Rescue Plan funds
  • Eligible purchases include refrigerators, coolers, freezers, refrigerator trailers and cargo vans, building expansions, and more.

• DEP and PDA having discussions to coordinate future grant and programmatic activities in this area
Relationship to Climate Action Plan

• Assessment conducted at same time as 2021 Climate Action Plan Update – lessons learned were not incorporated into quantified GHG reductions and cost/benefit analysis for CAP

• Climate Action Plan Recommendations around Food Waste:
  • Reduction of food waste as strategy within waste sector
  • Use of food waste as feedstock for increased production and use of biogas / renewable natural gas
EPA Food Recovery Hierarchy

Aligns with Waste Hierarchy of:
- Reduce
- Reuse
- Recycle
- Resources Recovery (energy)
- Landfilling (disposal)
US Food Waste Management Pathways

Food Waste Generation
Assessment Scope: Food Waste Generation

Food Waste Sectors:

- **Industrial**
  - Food Manufacturers and Processors
- **Commercial**
  - Food Wholesale and Retailers
  - Restaurants and Food Service
  - Hospitality Industry
- **Institutional**
  - Healthcare Facilities
  - Educational Institutions
  - Correctional Institutions

**Agricultural** – Outside scope of assessment

**Residential** – Outside scope of assessment

Distribution of Food Waste Generation

- **21%** Agricultural
- **14%** Industrial
- **22%** Commercial
- **6%** Institutional
- **37%** Residential

**Generation Threshold:**

52 tons per year (1 ton per week) per facility is threshold used to focus on identifying diversion potential for generators where it is more likely to be economically feasible to implement food waste reduction strategies.

**Food Waste Types:**

**In Scope:**
- By-products from food and beverage processing facilities
- Expired and unsold food from retail stores
- Uneaten prepared food from restaurant or cafeterias
- Plate waste

**Outside Scope:**
- Waste generated at food banks
- Fats / Oils / Greases

Source: ReFED Roadmap to 2030: Reducing U.S. Food Waste by 50%
Quantification Methodology

1. Compile food waste generation factors for each sector

2. Compile a statewide database of ICI generator establishments grouped by sector (52,000+ individual generators)

3. Apply generation factors to statewide database to estimate food waste generation by point source

<table>
<thead>
<tr>
<th>Sector</th>
<th>Subsector</th>
<th>Generation Factor Basis</th>
<th>lbs / unit / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>Food Manufacturers and Processors</td>
<td>Annual Sales Revenue</td>
<td>0.05 lb / $ / yr</td>
</tr>
<tr>
<td>Commercial</td>
<td>Supermarkets / Retailers</td>
<td>Employees</td>
<td>3,000 lb / emp. / yr</td>
</tr>
<tr>
<td>Institutional</td>
<td>Healthcare</td>
<td>Beds</td>
<td>1,248 lb / Bed / yr</td>
</tr>
</tbody>
</table>
ICI Food Waste Generation in Pennsylvania

All Establishments
2.7 million tons

- Industrial: 1.27M
- Commercial: 1.34M
- Institutional: 39,077

Est. Food Waste Generation (tons/yr)

No. of Establishments

- Industrial: 6,750
- Commercial: 39,077
- Institutional: 6,585

Remove establishments generating less than one ton per week

Establishments Generating > 52 Tons per Year
2.0 million tons

- Industrial: 1.21M
- Commercial: 0.70M
- Institutional: 2,115

Est. Food Waste Generation (tons/yr)

No. of Establishments

- Industrial: 2,115
- Commercial: 4,983
- Institutional: 322

Total Amount of Food Waste Generated

- All Establishments: 2.7 million tons
- Establishments Generating > 52 Tons per Year: 2.0 million tons
• 14 percent of ICI establishments exceed the 52 ton per year threshold but are responsible for 73% of total statewide ICI food waste generation.

• Of the establishments generating more than 52 tons per year, 95 percent of this waste comes from:
  • Food Manufacturers and Processors (61%)
  • Food Wholesale and Retail (21%)
  • Restaurant and Foodservice (13%)

• The 370 highest-generating establishments are estimated to generate over 46 percent of the total 2 million tons per year.
ICI Food Waste Generation in Pennsylvania

Thousands of Tons per Year, by County

Counties with greater than 30K tons noted
Organics Processors
AD Facilities Processing ICI Food Waste
## Current Anaerobic Digestion Performance

<table>
<thead>
<tr>
<th>Subtotals for Respondents</th>
<th>No. of Facilities</th>
<th>Current Food Waste Throughput (tons/yr.)</th>
<th>Biogas Generation from Food Waste (million ft³/yr.)</th>
<th>GHG Emissions Reduction from Food Waste (MTCO2e/yr.)[^1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-farm AD</td>
<td>9</td>
<td>21,000</td>
<td>114</td>
<td>14,000</td>
</tr>
<tr>
<td>WWTP AD</td>
<td>3</td>
<td>20,000</td>
<td>82</td>
<td>13,000</td>
</tr>
<tr>
<td>Stand-alone AD</td>
<td>4</td>
<td>39,000</td>
<td>76</td>
<td>26,000</td>
</tr>
<tr>
<td><strong>Respondents Subtotal</strong></td>
<td><strong>16</strong></td>
<td><strong>81,000</strong></td>
<td><strong>271</strong></td>
<td><strong>54,000</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated Subtotals for Nonrespondents</th>
<th>No. of Facilities</th>
<th>Current Food Waste Throughput (tons/yr.)</th>
<th>Biogas Generation from Food Waste (million ft³/yr.)</th>
<th>GHG Emissions Reduction from Food Waste (MTCO2e/yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-farm AD</td>
<td>8</td>
<td>12,000</td>
<td>64</td>
<td>8,000</td>
</tr>
<tr>
<td>WWTP AD</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Stand-alone AD</td>
<td>2</td>
<td>15,000</td>
<td>28</td>
<td>10,000</td>
</tr>
<tr>
<td><strong>Nonrespondents Subtotal</strong></td>
<td><strong>10</strong></td>
<td><strong>27,000</strong></td>
<td><strong>92</strong></td>
<td><strong>18,000</strong></td>
</tr>
</tbody>
</table>

**Grand Total** | **26** | **107,000** | **363** | **72,000**

107,000 tons per year is **5.4%** of the ICI Food Waste from establishments generating more than 52 tons per year.
### Current Compost Performance

<table>
<thead>
<tr>
<th>Subtotals for Survey Respondents</th>
<th>No. of Facilities</th>
<th>Current Food Waste Throughput (tons/yr.)</th>
<th>GHG Emissions Reduction from Food Waste (MTCO2e/yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>35,000</td>
<td>25,000</td>
<td></td>
</tr>
<tr>
<td>Estimated Subtotals for Nonrespondents</td>
<td>5</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Grand Total</td>
<td>25</td>
<td>38,000</td>
<td>27,000</td>
</tr>
</tbody>
</table>

38,000 tons per year is **1.9%** of the ICI Food Waste from establishments generating more than 52 tons per year.
ICI Food Waste Processing Capacity

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Current Throughput</th>
<th>Unused Available Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-farm AD</td>
<td>33,000</td>
<td>25,000</td>
</tr>
<tr>
<td>WWTP AD</td>
<td>15,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Stand-alone AD</td>
<td>54,000</td>
<td>500</td>
</tr>
<tr>
<td>Compost</td>
<td>38,000</td>
<td>70,000</td>
</tr>
</tbody>
</table>

Barriers to Increasing Capacity:

- Cannot Utilize Additional Biogas
- Food Waste Supply/Economics
- Permitting
- Land to Apply Digestate
- Contamination
- Brown Waste Supply

Percent of Survey Respondents

0% 20% 40% 60% 80% 100%

1. 6 facilities
Upgrading AD Facilities Not Processing Food Waste

• 83 AD facilities (WWTP and on-farm digesters) identified that do not currently process food waste
  • 28 responded to survey
  • Evaluated using Co-EAT model – physical and economic constraints
• 7 facilities potentially capable of co-digesting food waste –
  • Average capital cost to upgrade a single facility is $3M
  • Upgrading all 7 facilities would provide and additional 77,000 tons of food waste processing capacity each year

Typical Upgrades Required to Process Food Waste

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Capital Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Digester Reactor</td>
<td>$350k</td>
</tr>
<tr>
<td>Larger Capacity Generator</td>
<td>$300k-$500k</td>
</tr>
<tr>
<td>Effluent Storage Tank</td>
<td>$8k</td>
</tr>
<tr>
<td>Dewatering Equipment</td>
<td>$400k</td>
</tr>
<tr>
<td>Depackaging Equipment</td>
<td>$400k-$600k</td>
</tr>
<tr>
<td>Buffer Tank</td>
<td>$40k</td>
</tr>
</tbody>
</table>
Key Findings: Organics Processing

- Throughput currently 145,000 tons per year, which represents 7.3% of ICI food waste from generators producing more than 52 tons per year.

- An additional 111,000 tons per year (5.6%) of capacity available by overcoming operational barriers at facilities currently processing food waste.

- An additional 77,000 tons per year (3.9%) of capacity through $20M+ in upgrades to existing AD facilities not currently processing food waste.

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>No. of Facilities</th>
<th>Food Waste (tons/yr.)</th>
<th>Biogas Generation from Food Waste (million ft³/yr.)</th>
<th>GHG Emissions Reduction from Food Waste (MTCO2e/yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Food Waste Throughput</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digestors</td>
<td>26</td>
<td>107,000</td>
<td>363</td>
<td>71,000</td>
</tr>
<tr>
<td>Compost</td>
<td>25</td>
<td>38,000</td>
<td>0</td>
<td>27,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>51</strong></td>
<td><strong>145,000</strong></td>
<td><strong>363</strong></td>
<td><strong>99,000</strong></td>
</tr>
<tr>
<td>Unused Available Capacity (using existing infrastructure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digestors</td>
<td>10</td>
<td>41,000</td>
<td>197</td>
<td>27,000</td>
</tr>
<tr>
<td>Compost</td>
<td>18</td>
<td>70,000</td>
<td>0</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>28</strong></td>
<td><strong>111,000</strong></td>
<td><strong>197</strong></td>
<td><strong>77,000</strong></td>
</tr>
<tr>
<td>Additional AD Capacity Accessible via Capital Investment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-farm AD</td>
<td>1</td>
<td>6,000</td>
<td>37</td>
<td>4,000</td>
</tr>
<tr>
<td>WWTP AD</td>
<td>6</td>
<td>71,000</td>
<td>209</td>
<td>46,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>7</strong></td>
<td><strong>77,000</strong></td>
<td><strong>246</strong></td>
<td><strong>51,000</strong></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>N/A</strong></td>
<td><strong>333,000</strong></td>
<td><strong>807</strong></td>
<td><strong>226,000</strong></td>
</tr>
</tbody>
</table>
Greenhouse Gas Emission Reductions and Energy Generation through Food Waste Processing
GHG Emissions Reductions by Scenario

Cumulative Reduction in GHG Emissions (MTCO2e)

- Current ICI food waste throughput via composting and AD is held constant.
- Unused available AD and composting capacity is utilized and held constant.
- ICI food waste diversion rate via AD and composting is increased 1% per year (combined).

Increase food waste diversion by 1% per year and build new processing capacity
Increase food waste diversion to utilize existing processing capacity
Food waste processing at current diversion rate
## Food Waste Processing Impact on Climate Goals

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Current Diversion via AD and Composting</th>
<th>Potential Diversion Using All Unused Available Capacity</th>
<th>Potential Diversion at 35% Diversion Rate via AD or Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICI Food Waste Tons Diverted</td>
<td>145,000</td>
<td>255,000</td>
<td>731,000</td>
</tr>
<tr>
<td>ICI Food Waste Diversion Rate via Anaerobic Digestion or Composting</td>
<td>7%</td>
<td>13%</td>
<td>35%</td>
</tr>
<tr>
<td>GHG Emissions Reduction (MTCO(_2)e/yr.)</td>
<td>99,000</td>
<td>176,000</td>
<td>508,000</td>
</tr>
<tr>
<td>Biogas Generation (million ft3/yr.)</td>
<td>363</td>
<td>561</td>
<td>1,605</td>
</tr>
</tbody>
</table>

Solid Waste Management sector contributed **2,530,000 MTCO\(_2\)e** to Pennsylvania GHG emissions in 2018 (PA Greenhouse Gas Inventory)

- Current diversion (99,000 MTCO2e) avoids 4.0% in additional emissions
- Unused capacity (77,000 MTCO2e) could reduce sector emissions by additional 3.0%
- A 35% diversion goal (508,000 MTCO2e) could reduce sector emissions by additional 16.2%
Assessment Recommendations & Next Steps
Assessment Recommendations & Next Steps

• **Reinstituting/Expanding the Food Recover Infrastructure Grant:** In 2020, program provided $9.6M Grants to food banks, shelters and soup kitchens to cover the costs of equipment purchases necessary to prepare, transport and store food from ICI establishments generating excess food.

• **Dedicated Resources to Address Food Waste Within DEP:** Creating a Commonwealth wide Organic Management Coordinator and expand capacity to develop and review permits for digestion and composting facilities.

• **Establish A Grant Fund for Food Waste-to-Energy Infrastructure:** For existing and new facilities. Emphasis on Environmental Justice communities.

• **Technical Assistance to Largest Food Waste Generators:** Outreach and education program to food manufacturing sector.

• **Leading by Example:** Diversion goals for Commonwealth agencies through GreenGov coordination.
Q & A

Full assessment can be downloaded at:
https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/Renewables/Pages/Biomass.aspx