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DEPARTMENT OF ENVIRONMENTAL PROTECTION

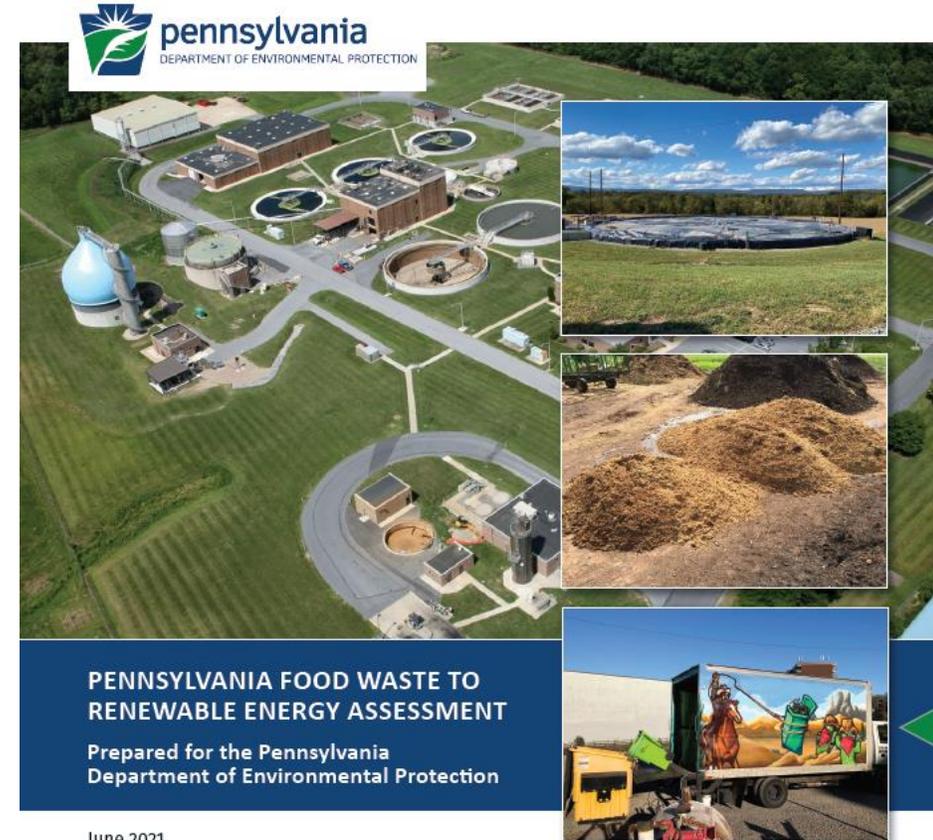


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# Food Waste to Renewable Energy Assessment Overview

## Waste Minimization and Planning & Energy Programs Offices

January 18, 2022



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**PENNSYLVANIA FOOD WASTE TO RENEWABLE ENERGY ASSESSMENT**

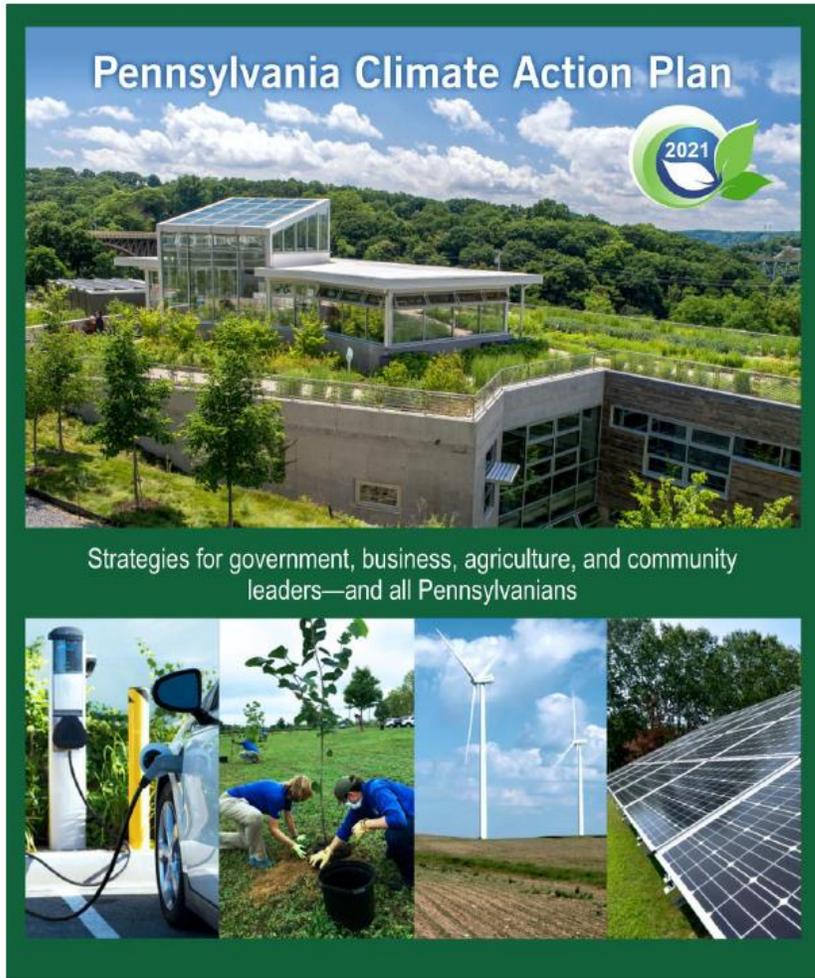
Prepared for the Pennsylvania Department of Environmental Protection

June 2021

**FINAL REPORT**



# 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

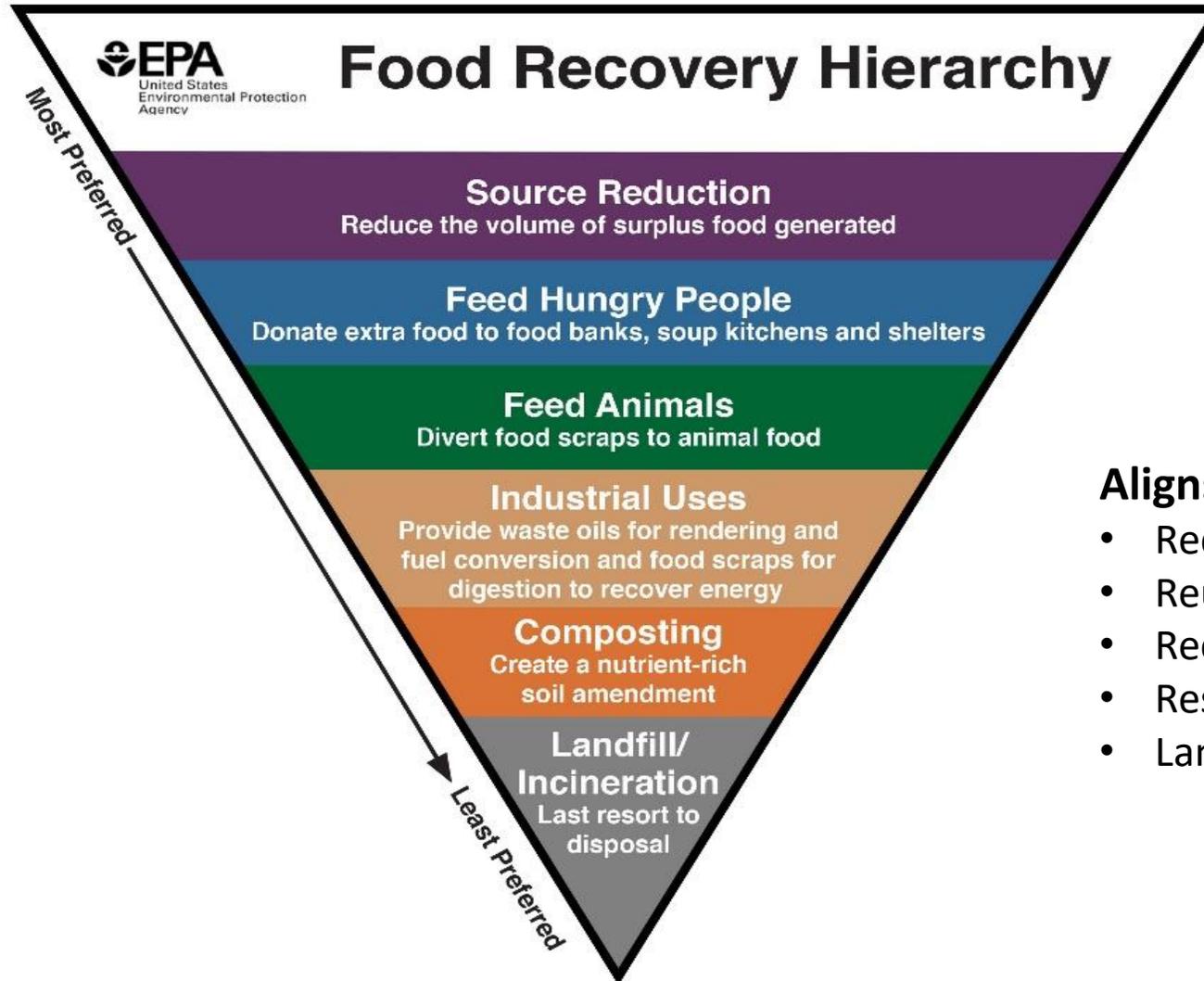
# Background

- 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
- Complements Food Recovery Infrastructure Grants from 2020
- Serves priorities of both BWM and EPO
- 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

# Report Goals

- ✓ 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

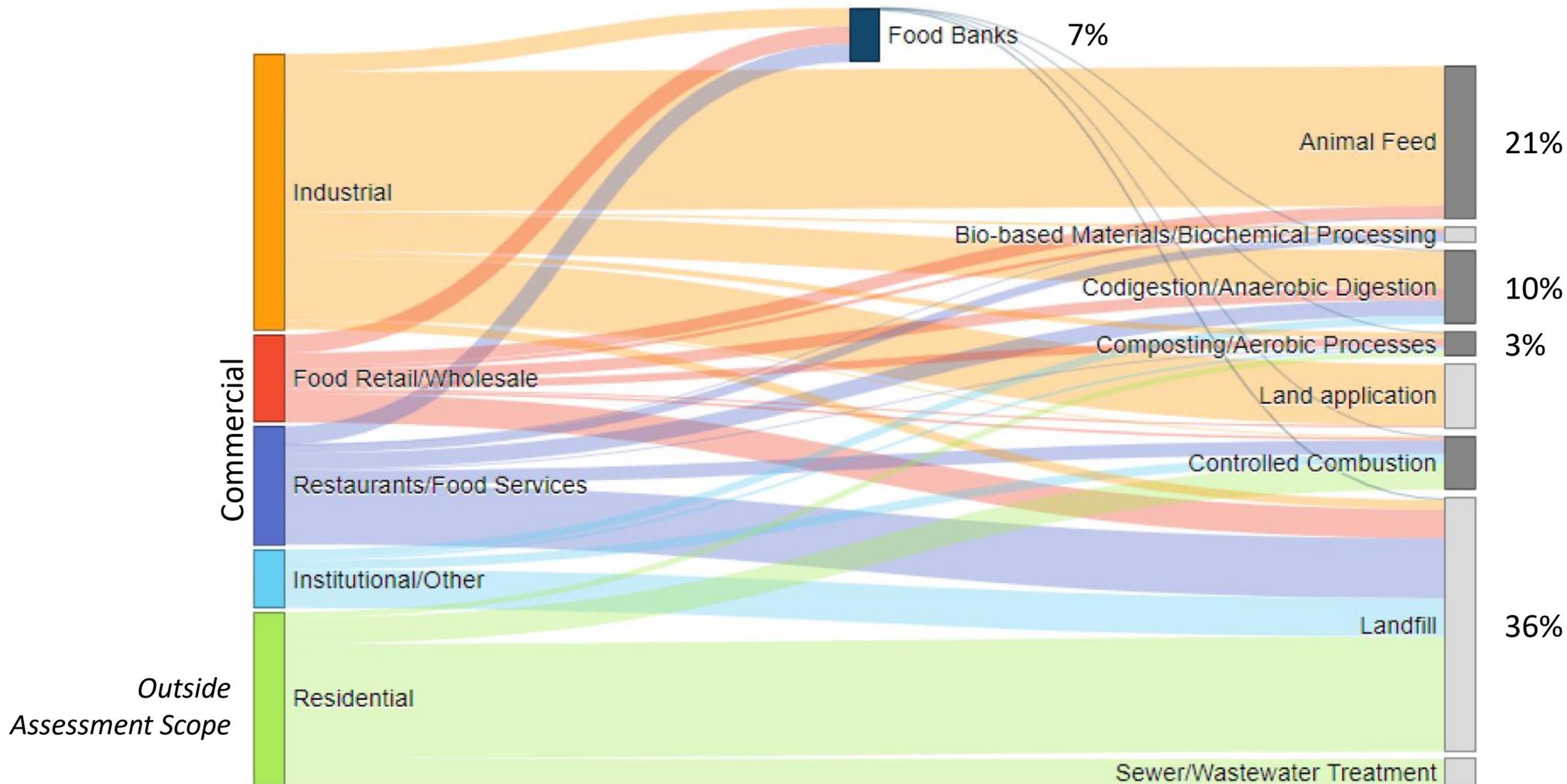
# EPA Food Recovery Hierarchy



## Aligns with Waste Hierarchy of:

- Reduce
- Reuse
- Recycle
- Resources Recovery (energy)
- Landfilling (disposal)

# US Food Waste Management Pathways



# 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



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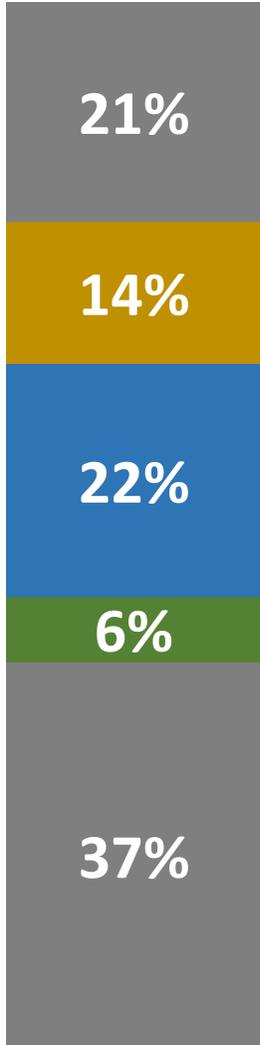
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# Food Waste Generation

# Assessment Scope: Food Waste Generation

## Food Waste Sectors:

Distribution of Food Waste Generation



**Agricultural** – Outside scope of assessment

<b>Industrial</b>	<ul style="list-style-type: none"> <li>• Food Manufacturers and Processors</li> </ul>
<b>Commercial</b>	<ul style="list-style-type: none"> <li>• Food Wholesale and Retailers</li> <li>• Restaurants and Food Service</li> <li>• Hospitality Industry</li> </ul>
<b>Institutional</b>	<ul style="list-style-type: none"> <li>• Healthcare Facilities</li> <li>• Educational Institutions</li> <li>• Correctional Institutions</li> </ul>

**Residential** – Outside scope of assessment

Source: ReFED Roadmap to 2030: Reducing U.S. Food Waste by 50%  
[https://refed.com/uploads/refed\\_roadmap2030-FINAL.pdf](https://refed.com/uploads/refed_roadmap2030-FINAL.pdf)

## 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

# Quantification Methodology

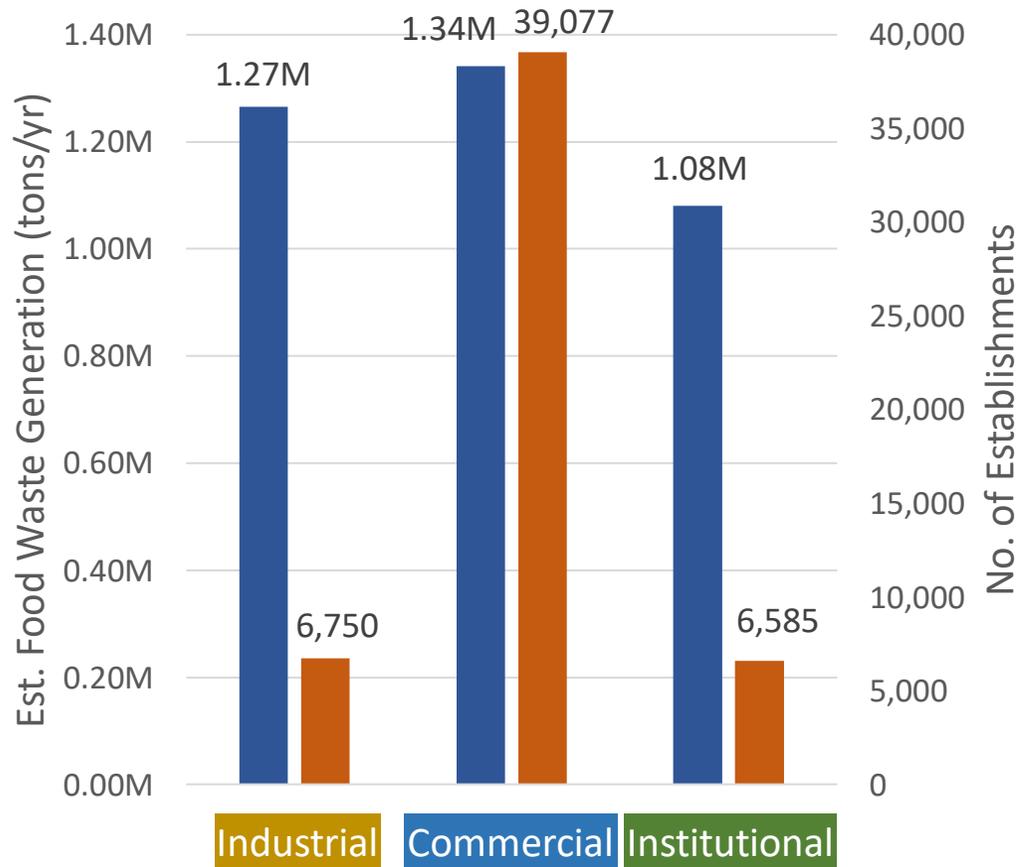
1. Compile food waste generation factors for each sector
2. Compile a statewide database of ICI generator establishments grouped by sector (52,000+ individual generators)
3. Apply generation factors to statewide database to estimate food waste generation by point source

**Example Waste Generation Factors**

Sector	Subsector	Generation Factor Basis	lbs / unit / year
<b>Industrial</b>	Food Manufacturers and Processors	Annual Sales Revenue	<b>0.05 lb / \$ / yr</b>
<b>Commercial</b>	Supermarkets / Retailers	Employees	<b>3,000 lb / emp. / yr</b>
<b>Institutional</b>	Healthcare	Beds	<b>1,248 lb / Bed / yr</b>

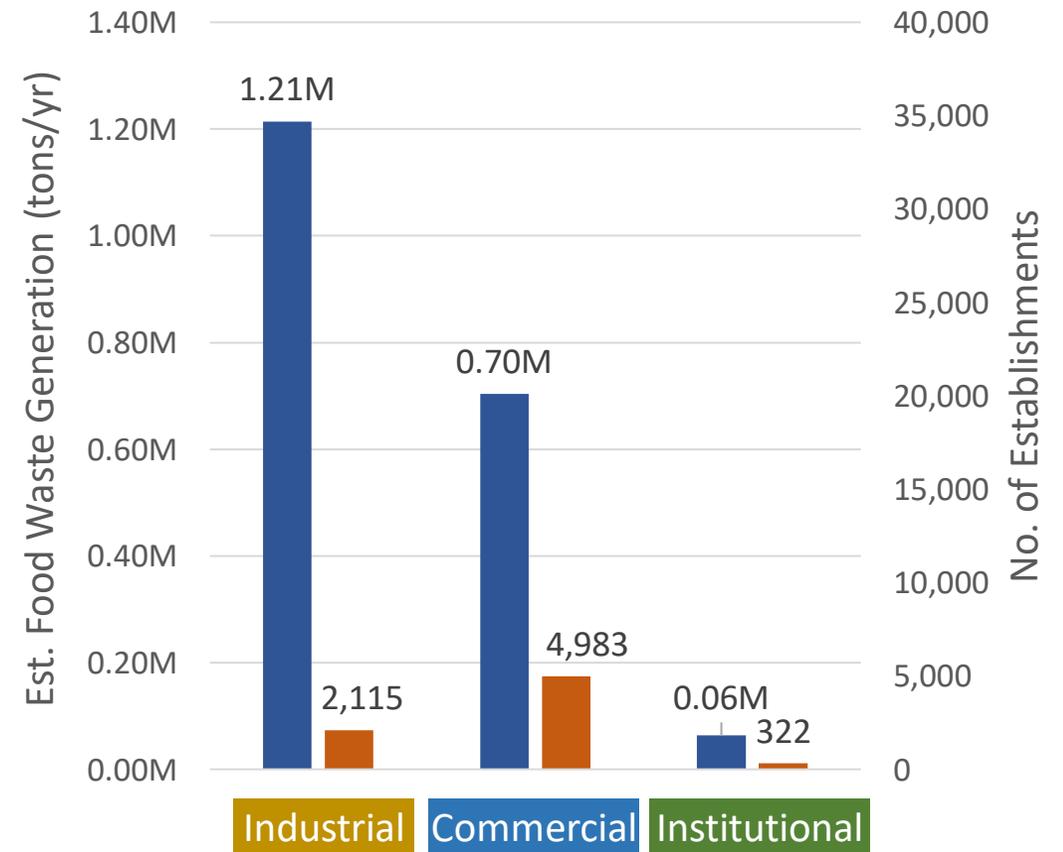
# ICI Food Waste Generation in Pennsylvania

All Establishments  
2.7 million tons



Remove establishments generating less than one ton per week

Establishments Generating > 52 Tons per Year  
2.0 million tons



■ Total Amount of Food Waste Generated ■ No. of Establishments

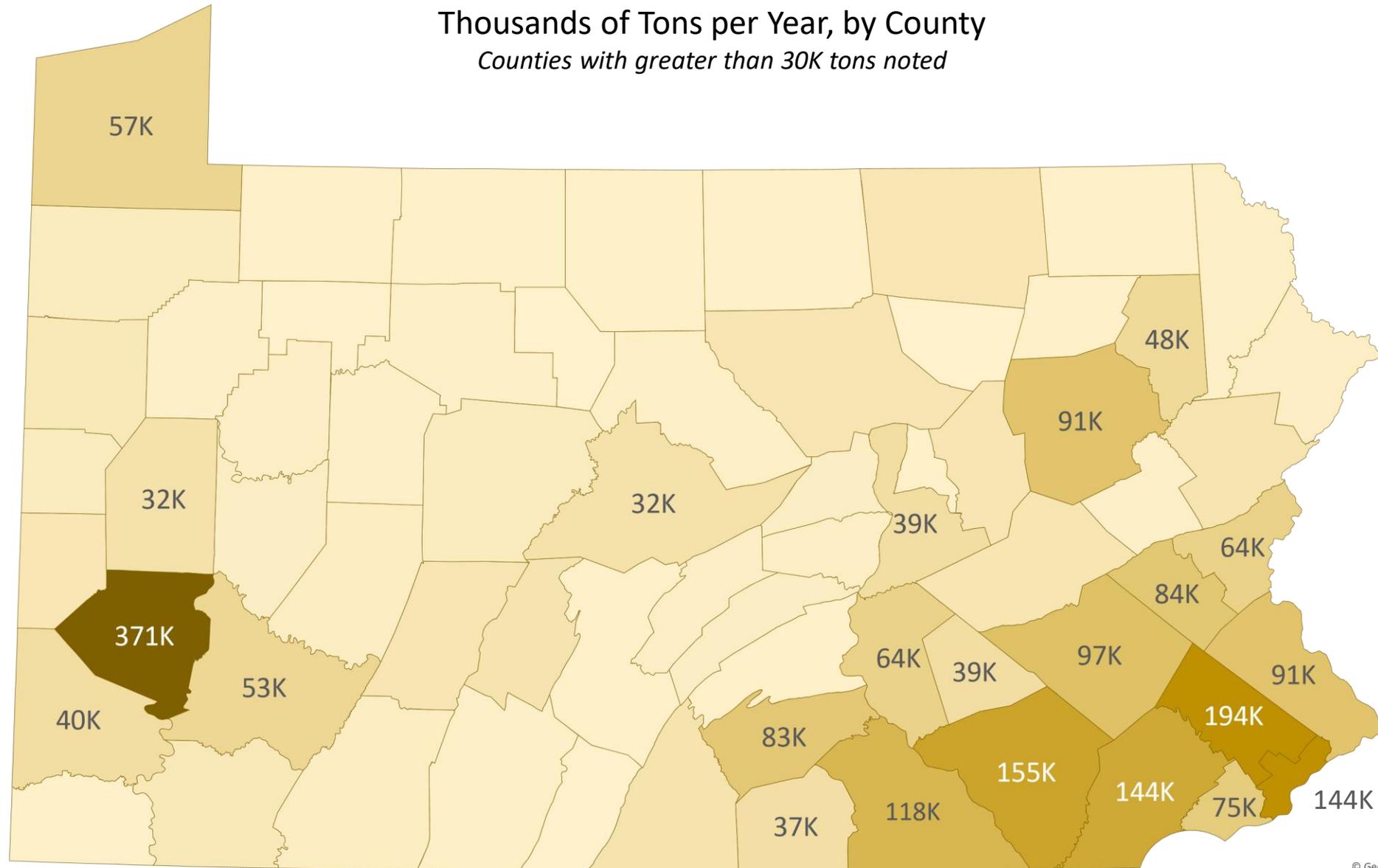
■ Total Amount of Food Waste Generated ■ No. of Establishments

## Key Findings: Food Waste Generation

- 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*





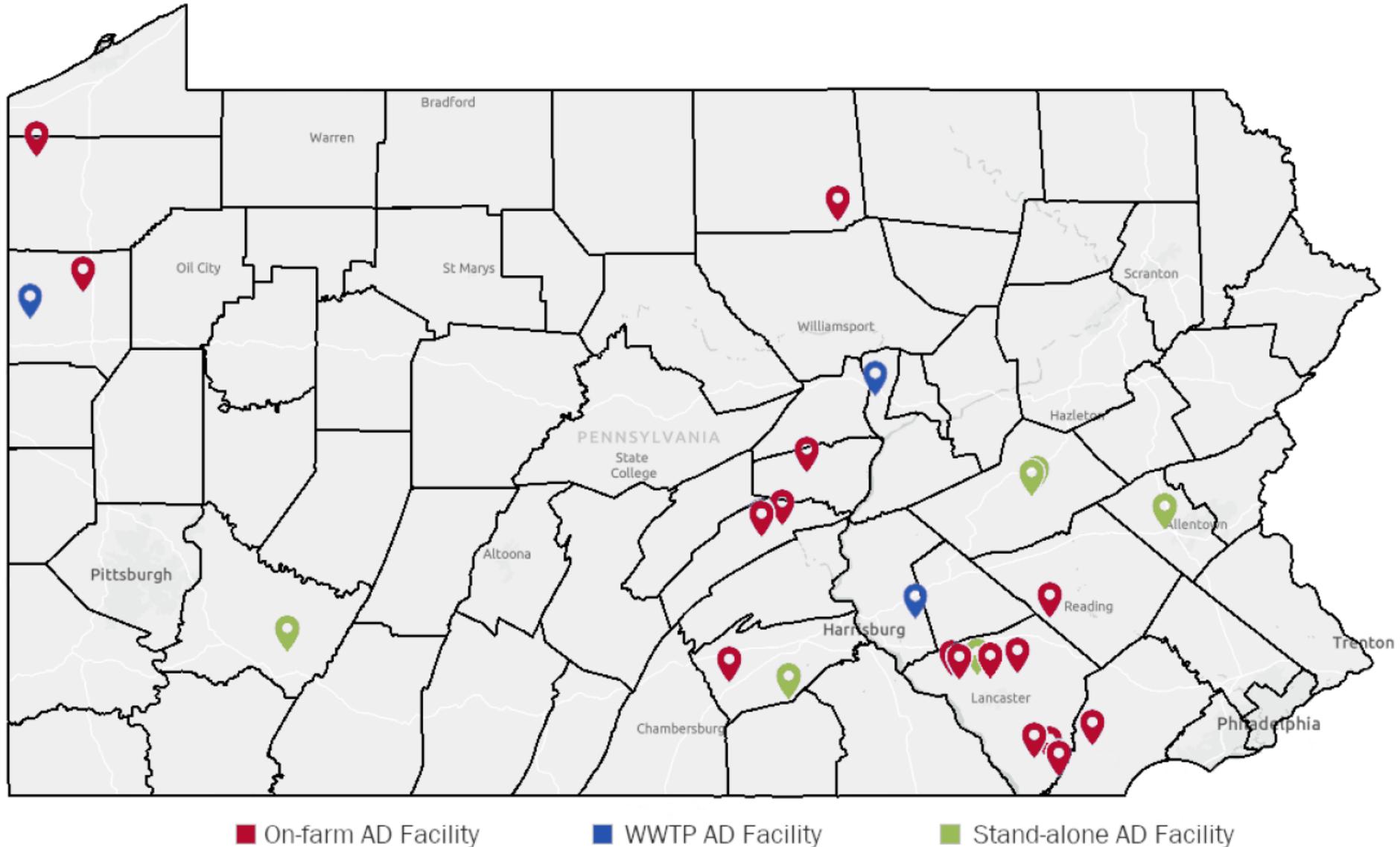
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# Organics Processors

# AD Facilities Processing ICI Food Waste

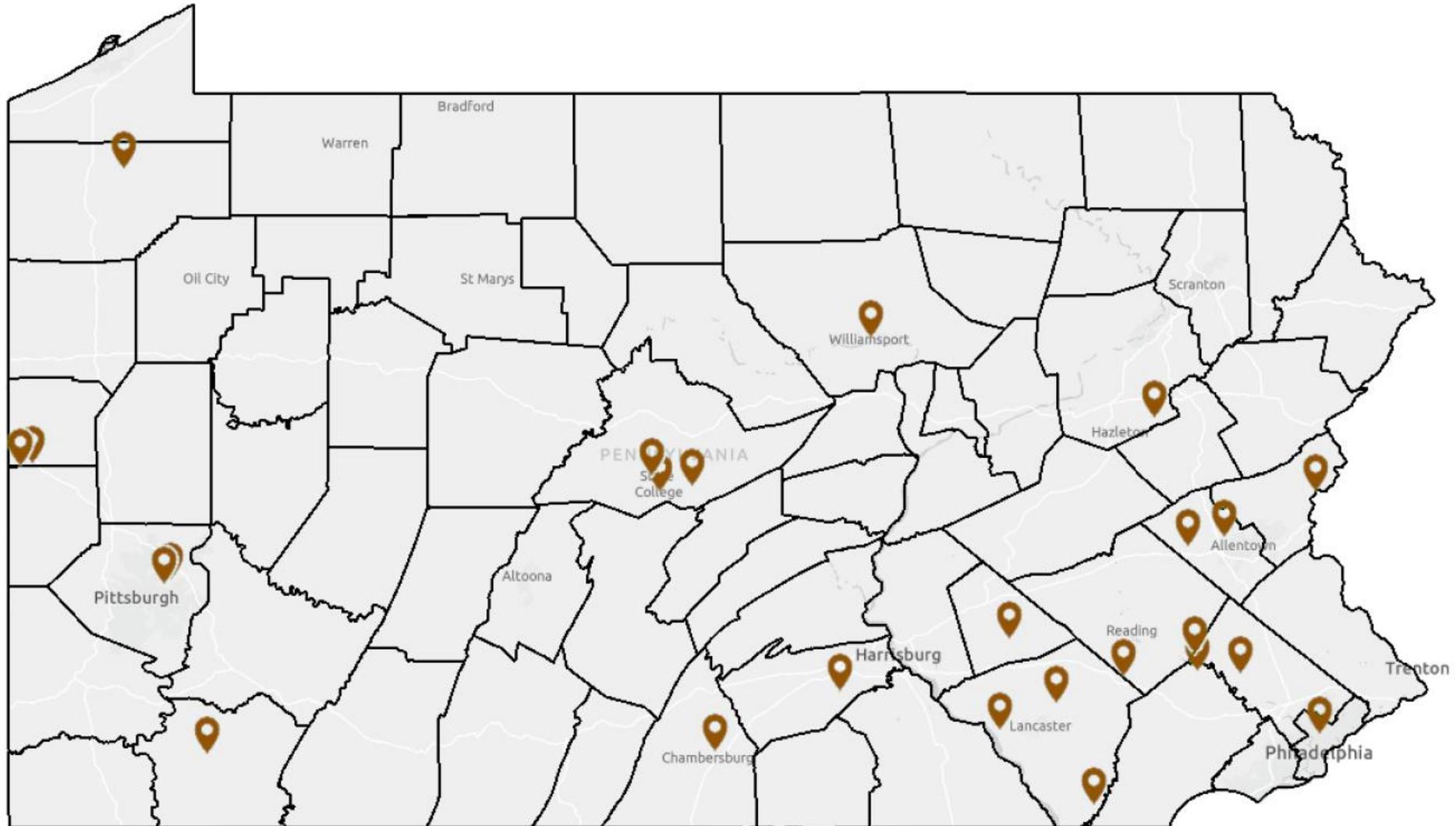


# Current Anaerobic Digestion Performance

	No. of Facilities	Current Food Waste Throughput (tons/yr.)	Biogas Generation from Food Waste (million ft <sup>3</sup> /yr.)	GHG Emissions Reduction from Food Waste (MTCO <sub>2</sub> e/yr.) <sup>[1]</sup>
<b>Subtotals for Respondents</b>				
On-farm AD	9	21,000	114	14,000
WWTP AD	3	20,000	82	13,000
Stand-alone AD	4	39,000	76	26,000
<i>Respondents Subtotal</i>	<i>16</i>	<i>81,000</i>	<i>271</i>	<i>54,000</i>
<b>Estimated Subtotals for Nonrespondents</b>				
On-farm AD	8	12,000	64	8,000
WWTP AD	0	0	0	0
Stand-alone AD	2	15,000	28	10,000
<i>Nonrespondents Subtotal</i>	<i>10</i>	<i>27,000</i>	<i>92</i>	<i>18,000</i>
<b>Grand Total</b>	<b>26</b>	<b>107,000</b>	<b>363</b>	<b>72,000</b>

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

# Compost Facilities Processing ICI Food Waste

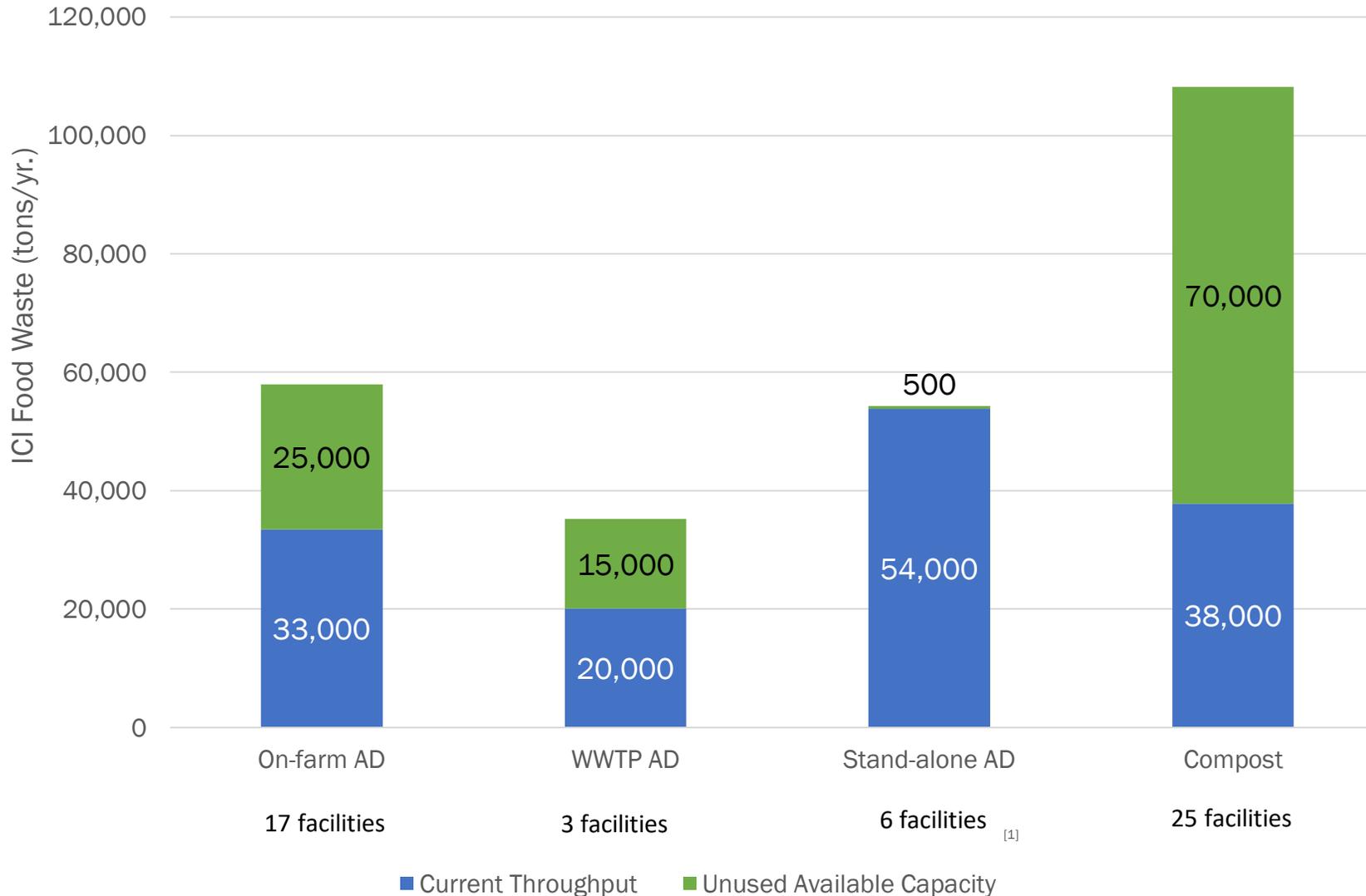


# Current Compost Performance

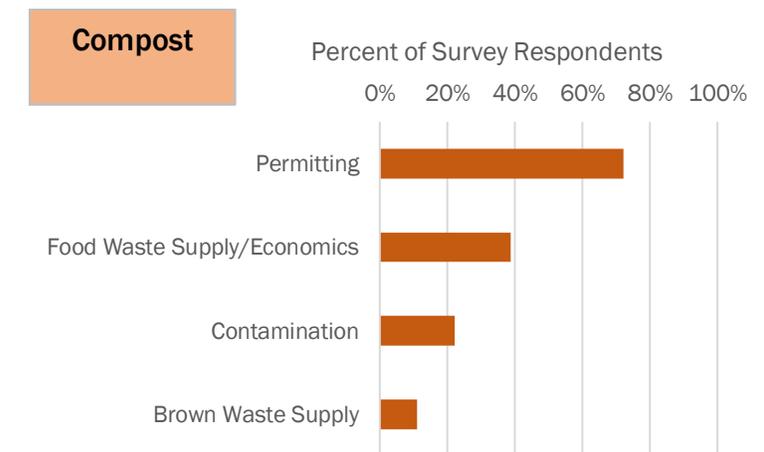
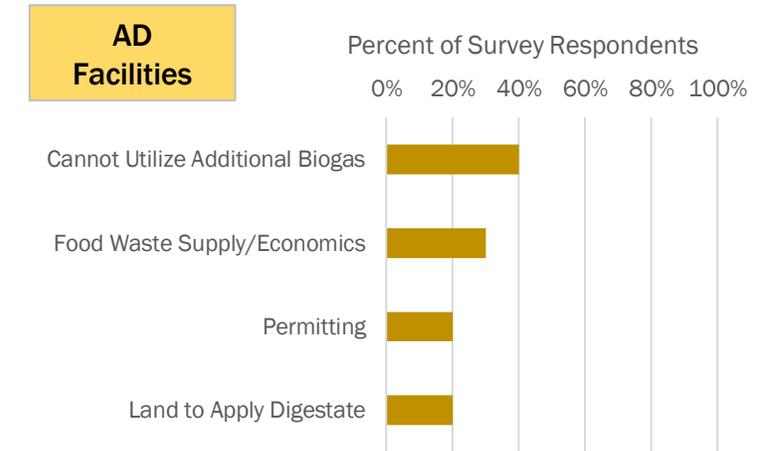
	No. of Facilities	Current Food Waste Throughput (tons/yr.)	GHG Emissions Reduction from Food Waste (MTCO <sub>2</sub> e/yr.)
Subtotals for Survey Respondents	20	35,000	25,000
Estimated Subtotals for Nonrespondents	5	3,000	2,000
<b>Grand Total</b>	<b>25</b>	<b>38,000</b>	<b>27,000</b>

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



## Barriers to Increasing Capacity:



# ➤ Upgrading AD Facilities Not Processing Food Waste

- 83 AD facilities (WWTP and on-farm digesters) identified that do not currently process food waste
- 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

Equipment Type	Capital Cost Estimate
Additional Digester Reactor	\$350k
Larger Capacity Generator	\$300k-\$500k
Effluent Storage Tank	\$8k
Dewatering Equipment	\$400k
Depackaging Equipment	\$400k-\$600k
Buffer Tank	\$40k

# Key Findings: Organics Processing

Facility Type	No. of Facilities	Food Waste (tons/yr.)	Biogas Generation from Food Waste (million ft <sup>3</sup> /yr.)	GHG Emissions Reduction from Food Waste (MTCO <sub>2</sub> e/yr.)
<b>Current Food Waste Throughput</b>				
Digestors	26	107,000	363	71,000
Compost	25	38,000	0	27,000
<i>Subtotal</i>	<i>51</i>	<i>145,000</i>	<i>363</i>	<i>99,000</i>
<b>Unused Available Capacity (using existing infrastructure)</b>				
Digestors	10	41,000	197	27,000
Compost	18	70,000	0	50,000
<i>Subtotal</i>	<i>28</i>	<i>111,000</i>	<i>197</i>	<i>77,000</i>
<b>Additional AD Capacity Accessible via Capital Investment</b>				
On-farm AD	1	6,000	37	4,000
WWTP AD	6	71,000	209	46,000
<i>Subtotal</i>	<i>7</i>	<i>77,000</i>	<i>246</i>	<i>51,000</i>
<b>Grand Total</b>	<b>N/A</b>	<b>333,000</b>	<b>807</b>	<b>226,000</b>

- 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



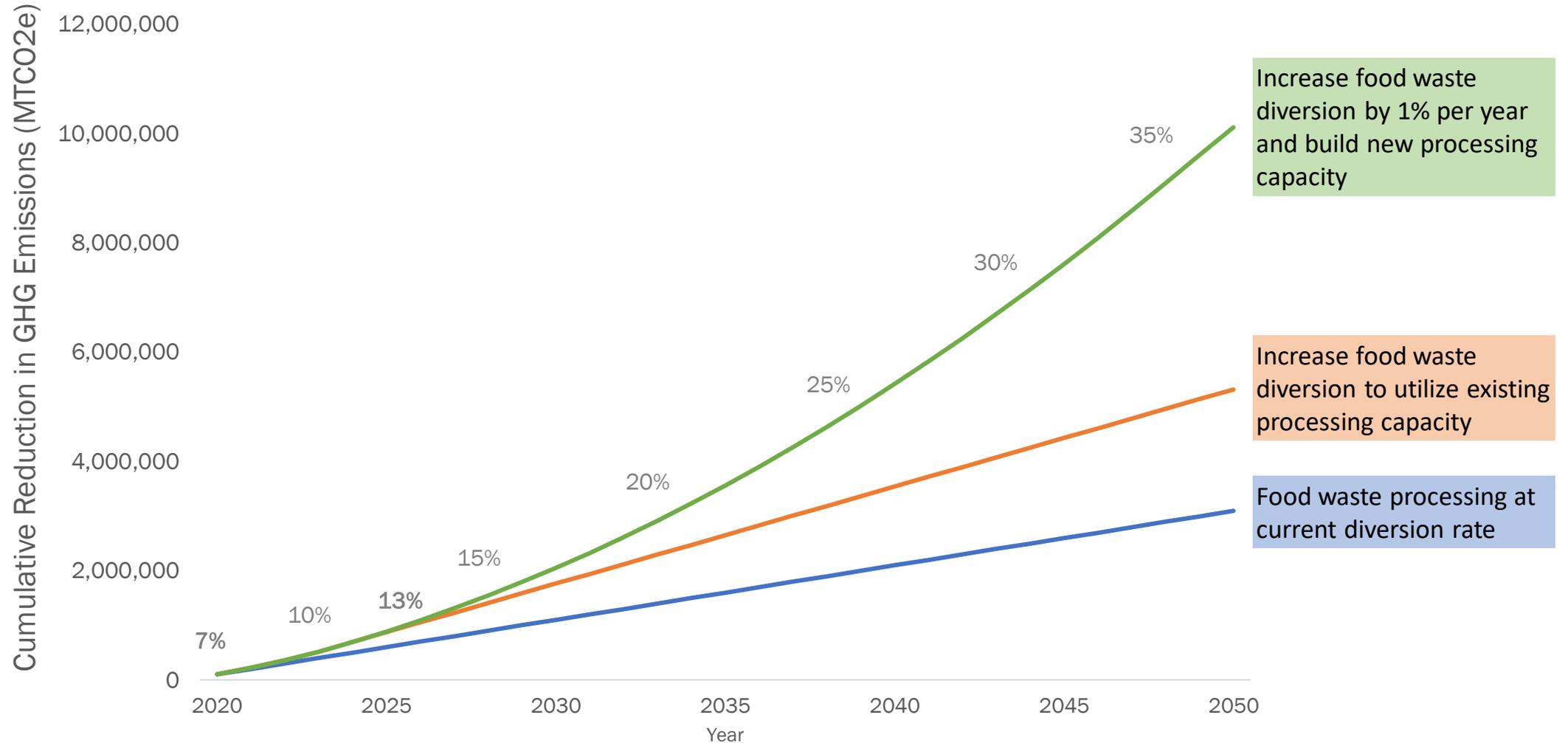
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# Greenhouse Gas Emission Reductions and Energy Generation through Food Waste Processing

# GHG Emissions Reductions by Scenario



- 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).

# Food Waste Processing Impact on Climate Goals

Parameter	Current Diversion via AD and Composting	Potential Diversion Using All Unused Available Capacity	Potential Diversion at 35% Diversion Rate via AD or Compost
ICI Food Waste Tons Diverted	145,000	255,000	731,000
ICI Food Waste Diversion Rate via Anaerobic Digestion or Composting	7%	13%	35%
GHG Emissions Reduction (MTCO <sub>2</sub> e/yr.)	99,000	176,000	508,000
Biogas Generation (million ft <sup>3</sup> /yr.)	363	561	1,605

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

- Current diversion (99,000 MTCO<sub>2</sub>e) avoids 4.0% in additional emissions
- Unused capacity (77,000 MTCO<sub>2</sub>e) could reduce sector emissions by additional 3.0%
- A 35% diversion goal (508,000 MTCO<sub>2</sub>e) could reduce sector emissions by additional 16.2%



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# Assessment Recommendations & Next Steps

## ➤ Assessment Recommendations & Next Steps

- **Reinstating/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.



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Q & A