Anaerobic Digestion Facilities Processing Food Waste in the United States (2019)

Survey Results

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Author

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Quality Assurance

EPA conducted a rigorous quality assurance review of the data and calculations used to generate the information in this report. All critical data points were checked for outliers, an assessment of units was conducted to ensure accuracy, and specific data points were compared to test for certain conditions (e.g., reported capacity is greater than reported amounts of feedstock processed). In many instances, anomalies were corrected with assumptions, which are further stipulated.

Disclaimer

The anaerobic digestion facilities and their locations are provided for informational purposes only. Companies mentioned in this report are not certified or approved by U.S. EPA. EPA does not guarantee the accuracy or completeness of this information.

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Executive Summary

The United States Environmental Protection Agency (EPA) encourages the sustainable management of food through prevention of food loss and waste, donation of excess food, and recycling of excess food and food waste into animal feed, fertilizers and soil amendments, and/or renewable energy. While source reduction and donation are the most impactful management pathways, communities will always have some food waste to manage. EPA encourages lifecycle thinking and decision making for communities when choosing which waste management systems and methods work best for their circumstances.

Anaerobic digestion (AD) is one such method. AD is a process by which microorganisms break down organic materials, such as food waste, in the absence of oxygen. AD is an alternative management pathway for food waste that diverts food waste from landfill and recovers both energy and nutrients. AD facilities must be permitted by the relevant federal, state, and local authorities to ensure they are designed, constructed, and operated properly. When developed and operated effectively, AD projects can provide economic, health, and environmental co-benefits to surrounding communities, such as diversified revenue for farms, improved soil and water quality through better nutrient management, and reduced greenhouse gas emissions through diversion of food waste and other organic materials from landfills.

In 2014, EPA began building a dataset of names and locations of anaerobic digestion facilities processing food waste to better understand the practice and prevalence of food waste digestion in the United States (U.S.). In December 2016, EPA was granted the authority to survey digesters annually, and EPA has since renewed that authority until 2025. This report is the fourth in the series. Each report includes data for three types of AD facilities: (1) stand-alone food waste digesters; (2) on-farm digesters that co-digest food waste; and (3) digesters at water resource recovery facilities (WRRFs) that co-digest food waste.

In 2021, EPA surveyed operators of AD facilities that accept food waste to identify the number of facilities in the U.S. and their locations, and to learn about their operations. EPA previously published three reports in calendar years 2017, 2018 and 2019.

EPA administered the survey for a fourth time in 2021 and the data collected from the 2021 survey is summarized in this report. The following critical data points reflect calendar year 2019: processing capacity, the amount of food waste[1] processed, the amount of non-food waste[2] processed, feedstock types, feedstock sources, the amount of biogas produced, and tipping fees. The remaining data points reflect circumstances in 2021: pre-processing/de-packaging, operational specifications, biogas uses, gas cleaning systems, solid digestate uses, and liquid digestate uses. The data used in this report was voluntarily submitted by survey respondents.

[1] For the purposes of this report, food waste includes but is not limited to: food scraps that have been separated and collected by municipalities from residential sources; food scraps that have been separated and collected from institutions or venues (e.g., prisons, hospitals, stadiums); food scraps from food preparation at restaurants, cafeterias, and other food services; plate scrapings from restaurants, cafeterias, and other food services; fats, oils and grease (FOG); unused food collected from grocery stores (e.g., bakery items, bruised fruit, items past shelf life); and pre-consumer by-products of the food and beverage processing industries.

[2] Non-food waste feedstocks include but are not limited to: mixed yard waste, crop residues, manure, wastewater solids (sludge), septage, de-icing fluid, lab (or pharma) wastes, paper mill wastes, and crude glycerin.

EPA shared the survey directly with 275[3] facilities believed to be operational and for which EPA had contact information. Approximately 50 of those facilities were added to the EPA dataset of AD facilities accepting food waste since the last survey in 2019. In addition to emailed surveys, EPA made the survey available on the Agency's AD website. EPA received responses to the 2021 survey from 99 operational facilities, a decrease from 118 responsive facilities in 2019. EPA also added to the dataset of AD facilities that are known to be operational, in the planning and design phase, or under construction; as well as facilities that have ceased operation or ceased co-digestion activities. This report includes information on the status of AD facilities in each of those situations.

The 2021 response rates for the stand-alone and WRRF digester surveys were lower than in 2019 (32% and 46% versus 66% and 77%, respectively). The on-farm digester response rate was slightly higher (23% versus 17%). For each year that the survey has been administered, the list of operating facilities has been different. Because both the facilities offered the survey and the facilities responding to the survey have varied each year, any year-to-year comparisons should be made with caution. Please reference Appendix A for the list of facilities that responded to this survey in 2021.

Table ES-1 summarizes the facilities that received surveys in 2021 and response rates by digester type. See Section II (Table 2) of this report for a more detailed description of respondent participation for each survey year.

Table ES-1: Number of Operational Anaerobic Digestion Facilities Processing Food Waste Surveyed in 2021 and Response Rate

Digester type	Number of Facilities Surveyed in 2021	Number of Submitted Surveys in 2021	Survey Response Rate in 2021
Stand-alone digesters	68	22	32%
On-farm co-digesters	79	18	23%
Co-digestion systems at WRRFs	128	59	46%
Total	**275**	**99**	**36%**

Processing Capacity and Amounts Processed

Based on data submitted by 89[4] survey respondents, the total processing capacity for food waste in all three digester types combined in 2019 was over 42.7 million tons.[5, 6] The total amount of food waste processed in all three digester types in 2019 was over 17.5 million tons.[7] This number is higher than in past years because the collection of new data on feedstock types allowed for updated conversion methods

[3] The number of operational facilities receiving surveys in 2021 was higher than the number of facilities receiving surveys in 2019, mostly because of new additions from top digester states, and keeping the survey open to facilities that may have indicated in the past that they were not "operational." EPA will remove facilities who indicated they ceased operations from its list. There may be more than 275 AD facilities processing food waste in the U.S.

[4] The total number of surveys may not be equal to the total number of respondents providing answers to any question. Some respondents did not answer all questions.

[5] For on-farm and co-digestion systems at WRRFs, "total capacity" excludes capacity dedicated to manure and wastewater solids, respectively, and only refers to the available capacity to process feedstocks from off-site sources, such as food waste. Because this survey focuses on AD capacity to process food waste in the U.S., EPA assumes all available capacity could be used to process food waste.

[6] "Tons" means wet U.S. tons throughout this report, unless otherwise specified.

[7] This number is based on data reported by 73 survey respondents.

(see part III. Results, D. Food Waste Processing for more information). Beverage processing waste from stand-alone digesters comprised the majority of food waste processed (98.5%), as described in **Table ES-2**.

Table ES-2: Total Capacity for Processing Food Waste and Total Amount of Food Waste Processed in 2019 by Survey Respondents

Digester Type	Reported Capacity in 2019 (tons)	Reported Amount Processed in 2019 (tons)	Reported Amount Processed in 2019 without beverage processing waste (tons)	Capacity Utilization (Reported Amount Processed/ Capacity)
Stand-alone digesters	38,461,432	15,055,227	228,836	**39%**
On-farm co-digesters	442,020	319,303	305,330	**72%**
Co-digestion systems at WRRFs	3,831,985	2,223,533	2,126,780	**58%**
Total	**42,735,437**	**17,598,063**	**2,660,946**	**41%**

The total reported amount of non-food waste processed in all three digester types in 2019 was around 945,000 tons (**Table ES-3**).[8]

Table ES-3: Total Amount of Non-Food Waste Processed by Survey Respondents (2019)

Digester Type	Amount (tons)*
Stand-alone digesters	511,675
On-farm co-digesters	2,730
Co-digestion systems at WRRFs	431,049
Total	**945,454**
*Liquid and solid amounts are combined because of increased level of data granularity this year.	

Biogas Production

Based on the data reported by 91 survey respondents, the total amount of biogas produced by all three digester types in 2019 was 29,877 standard cubic feet per minute (SCFM), which is equivalent to 93 megawatts (MW) of installed capacity, or 693 million kilowatt-hours (kWh) of electricity generated per year which is enough energy to power almost 58,333 homes for a year (**Table ES-4**).

Table ES-4: Summary of Biogas Data Reported by Survey Respondents (2019)

Digester type	SCFM*	MW	kWh/yr (million)	Equivalent Number of Homes Powered for One Year
Stand-alone digesters	4,825	15	112	9,428
On-farm co-digesters	1,465	5	37	3,114
Co-digestion systems at WRRFs	23,587	73	544	45,791
Total	**29,877**	**93**	**693**	**58,333**
*SCFM values were reported by facility operators and added together to get a total for 2019. The MW, kWh/yr, and homes powered numbers are calculated using the LMOP interactive conversion tool. These values are rounded to the nearest whole number, which accounts for the fact that the column totals may not sum.				

[8] This is based on data submitted by 31 survey respondents.

The numbers in **Table ES-2** through **Table ES-4** likely underestimate actual processing capacity, food waste and non-food waste processed, and biogas production because not all operational facilities provided a survey response.

Based on the 2021 survey responses, 30 states have at least one operating digester that accepts food waste (**Figure ES-1**). California has the greatest number of operating digesters (20) followed by Pennsylvania (8). Massachusetts (7), New York (7) and Wisconsin (6) round out the top five. All other states have four or fewer digesters.

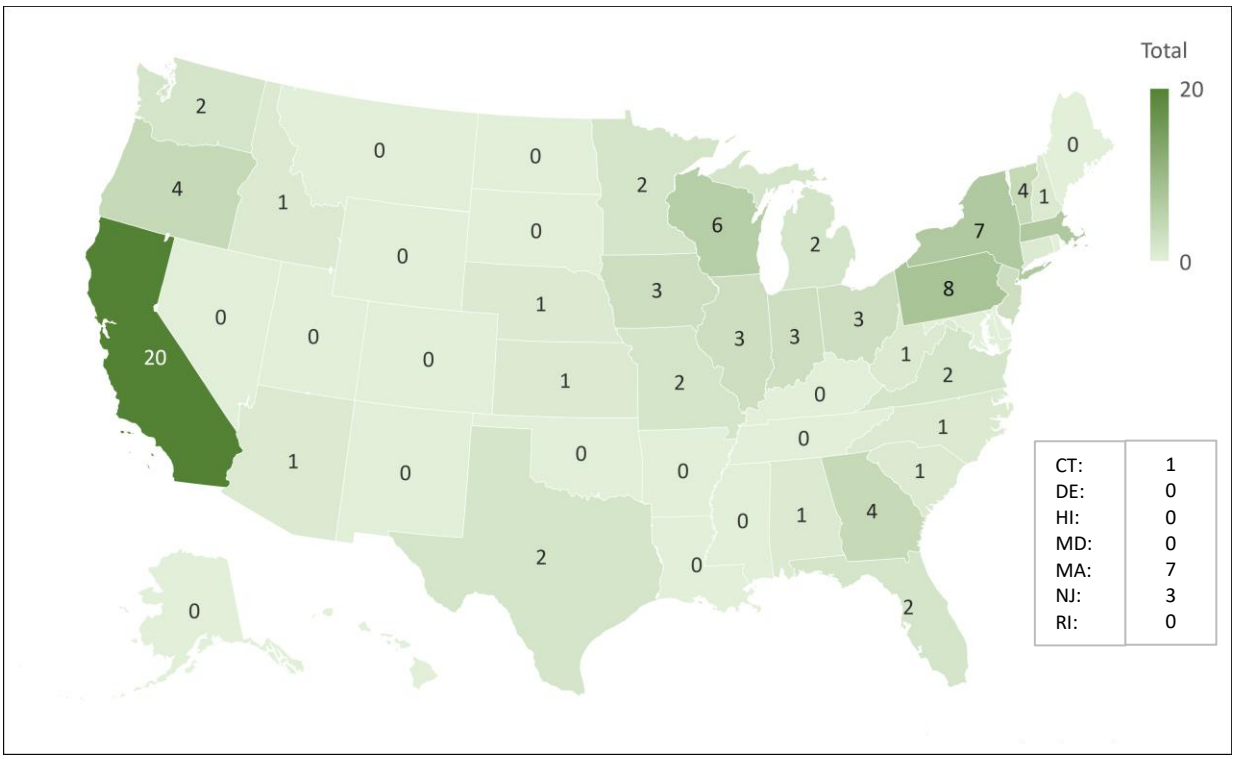

Figure ES-1: Operating Food Waste Digesting Facilities that Returned Surveys by State

Operational Specifications and Pre-Processing Activity

In terms of operational specifications, most of the digester types were found to be wet and mesophilic systems, as in the previous three surveys. For all digester types in 2021, the most common pre-processing activity was screening and/or sorting. This differs from the 2019 survey's results for stand-alone and on-farm digesters, which had reported grinding and/or maceration and manual or mechanized de-packaging as the top pre-processing activities, respectively.

Feedstock Sources and Types

When aggregated, the top five food-based feedstock sources for anaerobic digesters in the U.S. in 2019 were (in order):

- Industrial manufacturing and processing;
- Other;
- Food retailers and wholesalers;

- Restaurants and food services;
- Industrial (other).

When aggregated, the top five food-based feedstock types accepted by anaerobic digesters in the U.S. in 2019 were (in order):

- Beverage processing industry waste;
- Fats, Oils, and Greases (FOG);
- Food processing industry waste;
- Other (not specified);
- Source-separated organics.

Biogas Uses and Cleaning Systems

The top use of biogas across all three digester types in the 2021 survey was production of combined heat and power (CHP). The next two most common uses by digester type are listed below.

- **Stand-Alone Digesters**: to produce electricity (sold to the grid), and to produce electricity (net metering) and to fuel boilers and furnaces to heat digesters;
- **On-Farm Co-Digesters**: to produce electricity (sold to the grid), and to produce electricity used behind the meter; and
- **Co-Digestion Facilities at WRRFs**: to fuel boilers and furnaces to heat digesters, and to fuel boilers and furnaces to heat other spaces.

Approximately 32% of stand-alone digesters, 27% of farm co-digesters and 76% of co-digesters at WRRFs reported that they utilize gas cleaning systems. The top constituents removed for stand-alone digesters were moisture, hydrogen sulfide and sulfur. On-farm digesters reported hydrogen sulfide and sulfur as top constituents. The top constituents removed for co-digestion systems at WRRFs were siloxanes and moisture.

Solid and Liquid Digestate Uses

The top three solid digestate uses by digester type in the 2021 survey were:

- **Stand-Alone Digesters**: land applied with no dewatering/drying, composted into a reusable/salable product, and de-watered/dried and land applied.
- **On-Farm Co-Digesters**: processed into animal bedding, de-watered and land applied, and composted into a reusable/salable product.
- **Co-Digestion Facilities at WRRFs:** de-watered and land applied, landfilled, and composted into a reusable/salable product.

The top uses of liquid digestate by digester type in the 2021 survey were:

- **Stand-Alone Digesters:** reused as fertilizer via land application, and discharge to a wastewater treatment plant.
- **On-Farm Co-Digesters**: reused as fertilizer via land application.
- **Co-Digestion Facilities at WRRFs**: recirculated through the digester and reused as fertilizer via land application.

Annual Survey Results

Table ES-5 is a brief snapshot of annual results in the following categories: capacity, amount of food waste processed, and biogas produced.

Table ES-5: Critical Data Points Reported by Survey Respondents

Calendar Year	Total Available Digester Capacity* (tons)	Food-Based Feedstock Processed (tons)	Capacity Dedicated to Food Waste	Biogas Produced (SCFM)
2015	-	11,341,813	-	34,967
2016	-	10,691,756	-	40,304
2017	24,045,403	9,633,373	40%	25,274
2018	23,993,122	9,814,871	41%	27,193
2019	42,735,437	17,598,063	41%	29,877
*This is total digester capacity minus capacity dedicated to manure at on-farm co-digesters and wastewater solids at WRRF co-digesters.				

Capacity utilization is hard to pinpoint because some reports stated capacities for a different calendar year than processing. Generally, it appears the amount of processed feedstock and capacity remained relatively constant throughout the four calendar years prior to 2019. In 2019, the available capacity and food-based feedstock processed were higher because densities were applied to individual feedstocks. Beverage processing made up 85% of the total food-based feedstock tonnage in 2019, and beverage waste is heavy, with a density assumed to be that of water (8.34 lb/gallon).

The noteworthy takeaway is that capacity utilization appears to have stayed constant since 2017. This could indicate the potential to accept more feedstock at digesters, therefore maximizing capacity utilization and generating more biogas. However, various factors may impact the potential for certain digesters to process additional food-based feedstocks, such as quantities of non-food feedstocks processed, including manure at on-farm digesters and wastewater solids at WRRFs; accessibility of food-based feedstock (e.g., proximity to the digester); pre-processing technologies; and optimal mix of feedstocks for efficient digestion. EPA's Excess Food Opportunities Map (EFOM) is an existing resource to view generators of excess food in areas where digesters are located and could be utilized to initiate discussions and acceptance of more food-based feedstock.

Biogas production was highest in the beginning years of the survey (2015 and 2016 data); those years also had higher survey response rates. Because the reporting facilities and number of facilities responding to survey questions varies annually, it is hard to draw more specific conclusions for this metric.

The higher concentrations of digesters in California, New York, Massachusetts, Pennsylvania, and Wisconsin have remained steady, and this is logical given the dairy operations and local/state policies that drive digester operation. Ohio did not feature prominently in this year's survey compared to prior years.

Key Highlights from the Report

- EPA encourages source reduction and prevention as key activities to reduce food waste, but when food waste is generated, it is important to keep it (and other organics) out of the landfill through alternative management pathways such as composting or AD.
- AD is a management pathway for food waste that recovers both energy and nutrients. AD facilities must be permitted by relevant federal, state, and local authorities to ensure they are designed, developed, and operated properly. When operated properly and effectively, AD projects can provide economic, health, and environmental co-benefits to the agriculture industry and surrounding communities.
- EPA encourages lifecycle thinking and decision making for communities when choosing which waste management pathways and systems work best for their circumstances.
- According to this survey, a majority of food-based feedstock anaerobically digested is beverage processing waste. Increasing the use of AD to process solid food waste in future years is essential to keeping food waste out of landfills. This could also increase biogas yields and the quantity of digestate that can be beneficially utilized.
- The capacity of existing anaerobic digesters appears to be underutilized.
    - There are logistical and geographical considerations in diverting excess food. Although capacity is underutilized, this does not mean it will all be utilized.
    - Anaerobic digestion, like several technologies, should be utilized at a local level to limit emissions from transporting materials over long distances.
    - Other factors may affect capacity of certain digesters to accept food waste, such as other non-food feedstocks processed and available pre-processing technologies.
- This report could be used in tandem with EPA's Excess Food Opportunities Map (EFOM), which is a free tool that estimates where food waste generation is occurring and where opportunities may exist for food waste to be managed locally, including through anaerobic digestion.
- Contamination of digestate with PFAS and microplastics is a topic of concern. Further research is needed to determine levels of contamination and potential risks to human health and the environment.

I. Background

In the U.S., food is the greatest fraction of material, by weight, in the municipal solid waste stream. In other words, food is the most common type of waste in our garbage. In 2018, almost 103 million tons of wasted food were generated in the industrial, residential, commercial, and institutional sectors,[9] imposing significant economic and environmental costs. To help alleviate these costs, EPA encourages diversion of food waste from landfills, including its management in anaerobic digestion facilities.

Anaerobic digestion (AD) is a process by which microorganisms break down organic materials, such as food waste, in the absence of oxygen. AD is an alternative management pathway for food waste that diverts food waste from landfill and recovers energy and nutrients, both of which have environmental and economic value.

Keeping organic materials out of landfills is beneficial for the environment. If these materials are allowed to decay in landfills, methane can be released into the air and contribute to climate change. Methane is a potent greenhouse gas that traps 27 to 30 times more heat in the atmosphere over a 100-year period than carbon dioxide.[10] AD systems capture methane for use in a beneficial way, such as generating heat and electricity, offsetting the need for fossil-derived fuels. AD also produces "digestate," a nutrient-rich material that can be used as a fertilizer or soil amendment. When developed and operated effectively, AD projects can provide various economic, health, and environmental co-benefits such as greenhouse gas emissions reductions and offering an alternative to landfill for managing food waste and other organics.

Permits are needed to construct and operate an AD/biogas system. The system must meet all relevant local, state, and federal permitting requirements for air, solid waste, water, and construction. The operation of an AD/biogas system may also require ongoing regulatory compliance for many of the issued permits. Such permits are meant to ensure that anaerobic digestion does not result in adverse environmental, human health, and other cumulative impacts to communities.

Every type of solid waste management pathway or system may have advantages and/or disadvantages. EPA encourages lifecycle thinking and decision making for communities when choosing which waste management pathway and/or systems work best for their circumstances. Quality data and information can assist stakeholders in understanding the existing options and the landscape of food waste and organics management.

In 2014, EPA began building a dataset of names and locations of AD facilities processing food waste. EPA built the original dataset using publicly available information (e.g., American Biogas Council project profiles, BioCycle articles, EPA AgSTAR[11] database). That list of AD facilities and contacts has since been updated each year prior to the dissemination of a new survey.

To enhance the quality and quantity of available data, EPA sought and was granted authority under an Information Collection Request (ICR) to collect information through a survey for anaerobic digesters (reference Appendix D for survey questions). The approval allowed EPA to collect data annually for three

[9] EPA 2018 Wasted Food Report, page 5. Estimate includes residential, commercial, industrial, and institutional sources of food waste, but not on-farm sources.

[10] EPA Understanding Global Warming Potentials

[11] AgSTAR is an EPA program that promotes the use of biogas recovery systems to reduce methane emissions from livestock waste.

years, from 2017 to 2019. That ICR was then renewed through 2025, and this report is the fourth in the series. Each report includes data for three types of AD facilities: (1) stand-alone food waste digesters; (2) on-farm digesters that co-digest food waste; and (3) digesters at water resource recovery facilities (WRRFs) that co-digest food waste. This information is gathered to better understand the practice and prevalence of digestion of food waste in the United States (e.g., the current amount of food waste being processed by digesters, available capacity, etc.).

EPA has collected data regarding anaerobic digestion facilities processing food waste in four years: 2017, 2018, 2019, and 2021. Because AD facilities are typically not able to provide data for the current year, most of the critical[12] data points (e.g., total amount processed) are calculated after the close of the previous calendar year. Other data are available at the time the survey is conducted (e.g., operational specifications). As a result, each of the published reports contain data from previous years of operation as well as the year in which the survey was conducted. **Table 1** summarizes the different types of data that are included in each report as well as the years from which the data originate.

For the 2021 survey, EPA employed a multi-media strategy for outreach to facilities. In previous years, the survey was distributed via email directly to facilities. The methods used here included distribution through an online survey platform, mailing paper surveys to over 100 facilities, and follow-up through phone calls and email.

This report includes data collected from the 2021 survey and reflects calendar year 2019 for the following *seven* data points: the amount of food waste[13] processed, the amount of non-food waste[14] processed, the amount of biogas produced, digester capacity, feedstock type and feedstock source, and tipping fees. Pre-processing/de-packaging, operational specifications, biogas uses, gas cleaning systems, solid digestate uses, and liquid digestate uses reflect circumstances in 2021.

To identify respondents for the 2021 survey, EPA used the information gathered during the 2017 and 2018 calendar years. Ongoing research conducted throughout 2017, 2018, and 2019 also contributed to the development of both the list of operating AD facilities that accept food waste (reference Appendix A) and the list of AD facilities under development (reference Appendix B).[15]

This report does not address whether the food waste processed at AD facilities could have been prevented, donated to feed people, or used to feed animals. By the time food that may at one time have been recoverable is received by an AD facility, it is considered "food waste." Therefore, the term "food waste" is used throughout this document to describe the food-based feedstock being processed in digesters.

[12] The critical data points are time-specific data points tied to a calendar year. These data points are the amount of food waste processed, amount of non-food waste processed, and amount of biogas produced.

[13] Food waste includes, but is not limited to: food scraps that have been separated and collected by municipalities from residential sources; food scraps that have been separated and collected from institutions or venues (e.g., prisons, hospitals, stadiums); food scraps from food preparation at restaurants, cafeterias, and other food services; plate scrapings from restaurants, cafeterias, and other food services; fats, oils and grease (FOG); unused food collected from grocery stores (e.g., bakery items, bruised fruit, items past shelf life); and pre-consumer by-products of the food and beverage processing industries.

[14] Non-food waste feedstocks include, but are not limited to: mixed yard waste, crop residues, manure, wastewater solids (sludge), septage, de-icing fluid, lab (or pharma) wastes, paper mill wastes, and crude glycerin.

[15] "Under development" refers to phases of development prior to the facility becoming operational: siting, permitting, design, construction, etc.

Table 1: Reports Published and Data Included

Report name	Year survey conducted	Year(s) associated with critical data points	Critical data points	Year associated with remaining data points	Remaining data points	Date report published
Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015	2017	2015	Amount of food waste processed Amount of non-food waste processed Amount of biogas produced	2017	**Processing capacity** **Feedstock type and source** **Tipping fees** Pre-processing/de-packaging Operational specifications Biogas uses Gas cleaning systems Solid digestate uses Liquid digestate uses	September 2018
Anaerobic Digestion Facilities Processing Food Waste in the United States (2016)	2018	2016		2018		September 2019
Anaerobic Digestion Facilities Processing Food Waste in the United States (2017 & 2018)	2019	2017 & 2018		2019		January 2021
Anaerobic Digestion Facilities Processing Food Waste in the United States (2019)	2021	2019	Same as above as well as: **Processing capacity** **Feedstock type and source** **Tipping fees**	2021	Same as above minus **bolded** items which became critical data points to the left	April 2023

II. Survey Data Collection

Under Information Collection Request (ICR) No. 2533, EPA developed electronic data collection surveys for each digester type: stand-alone food waste digesters, on-farm digesters that co-digest food waste, and digesters at WRRFs that co-digest food waste. EPA emailed the surveys directly to digester owners and operators and made the surveys available on EPA's Anaerobic Digestion website. This report is based on data collected via the 2021 survey. The surveys were open from June 2021 through October 2021, and then were inactivated.

The 2021 survey allowed EPA to:

- Identify the number and location of AD facilities that are operational and under development;[16]
- Document the total processing capacity at AD facilities;
- Document how much food waste and non-food waste were processed;
- Document how much biogas was produced;
- Document the types of food and non-food wastes, and the sources of these wastes, that are accepted at these AD facilities;
- Analyze the end-uses of AD products (biogas and digestate); and
- Understand additional information about AD facilities such as pre-processing/de-packaging activity, operational specifications, and gas cleaning systems.

Completion of the survey was voluntary, and the data collected was freely reported by survey respondents. EPA sent the 2021 survey to facilities included in past years as well as additional facilities identified through EPA's AgSTAR program and state[17] referrals.

Consistent with prior survey results, the operational facilities that responded to the 2021 survey were different from the facilities that responded to previous surveys. **Table 2** provides information on the number of facilities responding to each survey since its inception. In the first year, facilities that were not operational were not included so 'N/A' has been assigned to reflect this.

Table 2: Comparison of Facilities Responding to Each Survey

Digester Type	Number of Facilities			
	2017	2018	2019	2021
Stand-alone digesters	50	46	45	22
On-farm co-digesters	15	16	10	18
Co-digestion systems at WRRFs	72	72	63	59
Total (confirmed operational)	**137**	**134**	**118**	**99**
Confirmed non-operational	**N/A**	**20**	**14**	**10**
Total surveyed (response rate %)	**N/A**	**232 (66)**	**229 (58)**	**275 (40)**

In all four reports issued in this series (released in 2018, 2019, 2021, and 2023), EPA aggregated the technical data collected for each facility (e.g., processing capacity) and summarized it in such a way that individual facility information could not be identified. Personally Identifiable Information (PII) will be protected to the extent allowable under the Freedom of Information Act.

[16] This data is current as of October 2021.

[17] The top eight states by digester count (from 2019 report) were CA, WI, NY, OH, MA, PA, IA, and FL.

III. Results

A. Response Rates and Location Data

Out of 275 surveys distributed to AD facilities that are thought to be operational, 99 were returned. Some facilities submitted incomplete responses, and others did not respond, had ceased operations, or shut down. This report only identifies the status of those facilities providing survey responses. The number of potentially operational AD facilities increased from 229 in 2019 to 275 in 2021. This increase is largely due to the joint EPA and USDA AgSTAR program, which provides support for the development of digesters in the agricultural sector. Additionally, new facilities were identified through conversations with the eight states that had the most digesters according to the previous report. The number of operational facilities surveyed and the number of operational facilities returning responses by facility type is provided in **Table 3**. Names of facilities confirmed via survey response to be operating can be found in Appendix A.

Table 3: Number of Operational Anaerobic Digestion Facilities Surveyed and Responding to Survey

Digester Type	Number of Facilities Surveyed	Number of Operational Surveys Submitted	Survey Response Rate
Stand-alone digesters	68	22	32%
On-farm co-digesters	79	18	23%
Co-digestion systems at WRRFs	128	59	46%
Total	**275**	**99**	**36%**

EPA is also tracking facilities that are under development or temporarily shut down. EPA distributed seven surveys to a group of stand-alone AD facilities and WRRF co-digestion systems that are in one of the following phases: planning, design, permitting, under construction, or temporarily shut down. Currently, no on-farm co-digesters have been identified as under development or temporarily shut-down. Names of these facilities and their operational status as reported via survey response can be found in Appendix B. EPA's research also identified facilities that have ceased operations and they can be found in Appendix C.

Stand-Alone Digesters

Stand-alone digesters are primarily built to process food waste. While many of these digesters accept other organic materials (e.g., manure, wastewater solids), they are typically designed for food waste processing. Stand-alone digesters are divided into two categories, as described below: multi-source food waste digesters, and industry-dedicated digesters.

> **Multi-Source Food Waste Digester:** A digester that accepts and processes feedstocks from offsite sources. These feedstocks may be accepted both for their tipping fee revenue and their biogas yield potential. These digesters are sometimes called "merchant digesters." Feedstocks are predominantly food waste, although non-food waste feedstocks (e.g., manure and wastewater solids) may also be processed at these digesters. In most instances, feedstocks are obtained from many different sources.
>
> **Industry-Dedicated Digester:** A digester that is developed to manage food waste generated from a single business (e.g., grocery store chain, food or beverage processing plant). These digesters may accept organic materials from other sources for tipping fees, but this practice is not typical for this type of digester.

EPA received 22 responses to the 2021 survey from a field of 68 operational stand-alone facilities, for a response rate of 32%. According to the survey responses received from the 22 operating stand-alone digesters: nine are multi-source (41%); 13 are industry dedicated (59%); and one was identified as "other" (5%).

Operational stand-alone digesters are located within 15 states. Reference **Figure 1** for a map of operating stand-alone facilities by state and Table 1A in Appendix A for a list of stand-alone facilities that responded to the survey.

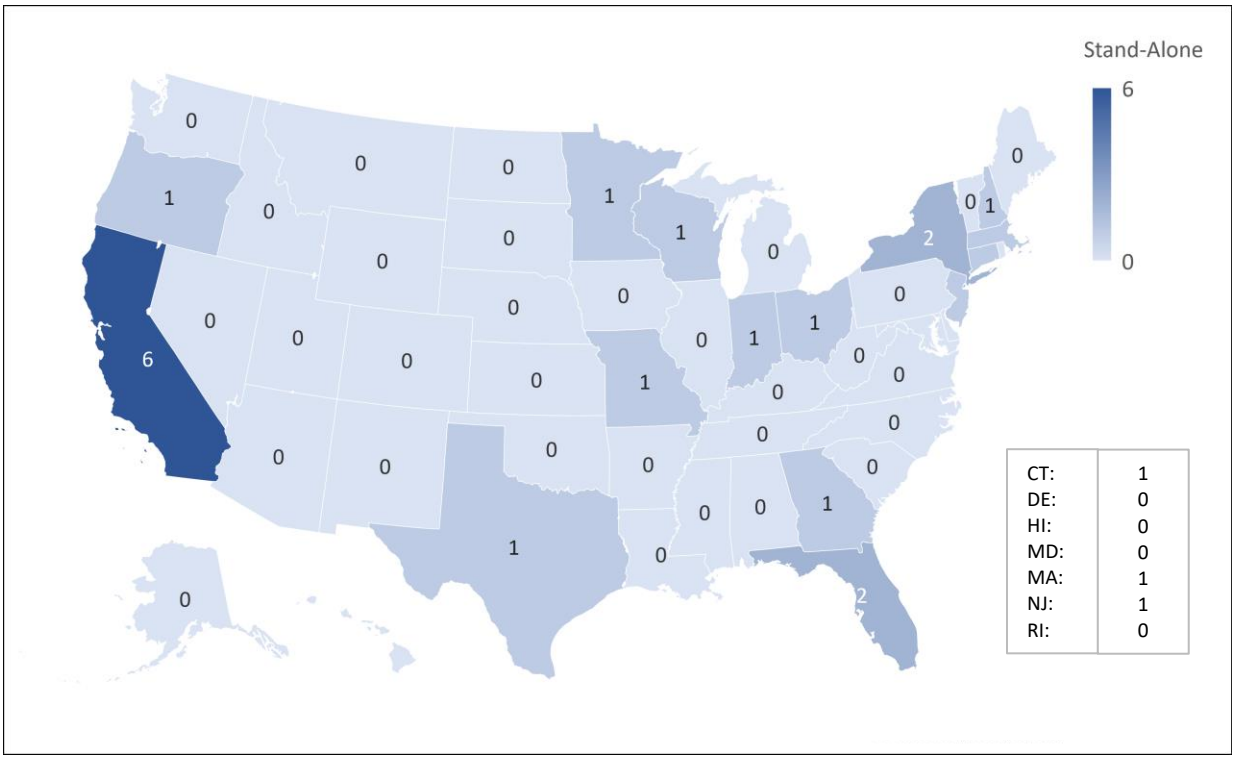

Figure 1: Operating Stand-Alone Food Waste Digesting Facilities that Returned Surveys by State

In all four reports issued in this series, EPA aggregated the technical data collected for each facility (e.g., processing capacity) and summarized it such that individual facility information could not be identified.

On-Farm Co-Digesters

According to EPA's AgSTAR program, there are over 317 anaerobic digester facilities operating on livestock farms in the U.S. These digesters are primarily used for manure management. This survey targeted only those digesters that are co-digesting food waste.

Using the information gathered from on-farm co-digesters during the 2019 survey as a starting point, in 2021, EPA identified and surveyed 79 on-farm facilities that are potentially co-digesting food waste. EPA received 18 survey responses out of the 79 identified digesters for a response rate of 23%. This response rate is comparable to the on-farm digester response rate reported in the 2019 Report (17%). This report identifies the status of only those on-farm co-digesters that provided responses.

Operational on-farm digesters co-digesting food waste were confirmed in seven states. Reference Table 2A in Appendix A for a list of the 18 farms that provided data and **Figure 2** for a map depicting the number of operating on-farm co-digesters by state.

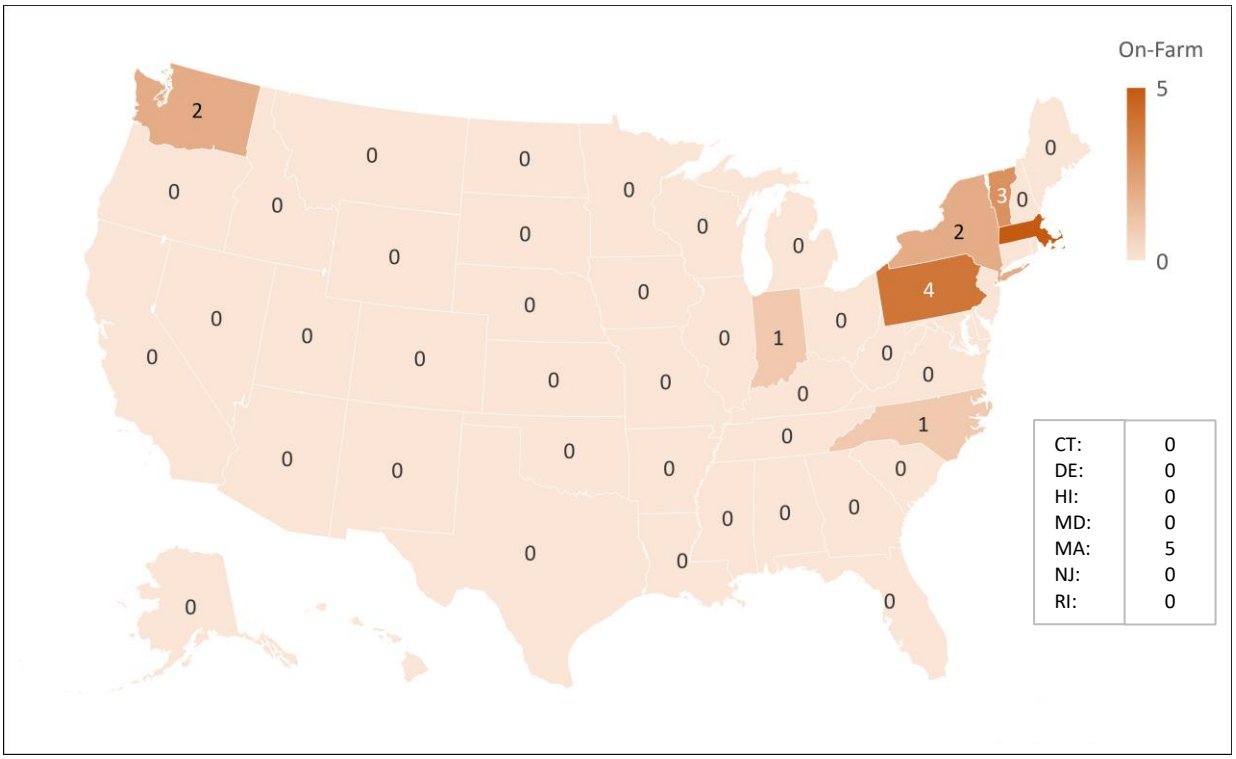

Figure 2: Operating On-Farm Food Waste Co-Digestion Systems that Returned Surveys by State

Digesters at Water Resource Recovery Facilities (WRRFs)

The Water Environment Federation and the American Biogas Council built and maintain a database (www.resourcerecoverydata.org) of information on WRRFs.[18] This database identifies approximately 1,265 WRRFs in the U.S. that have anaerobic digesters to manage wastewater solids, and roughly 20% of these facilities co-digest other materials, including food waste from offsite sources.

In 2021, EPA received 59 survey responses from a field of 128 WRRFs with suspected food-waste co-digestion systems for a response rate of 46%. WRRFs with operating co-digestion systems are located within 25 states, as can be referenced in **Figure 3**. Reference Table A3 in Appendix A for a list of WRRFs that responded to the survey.

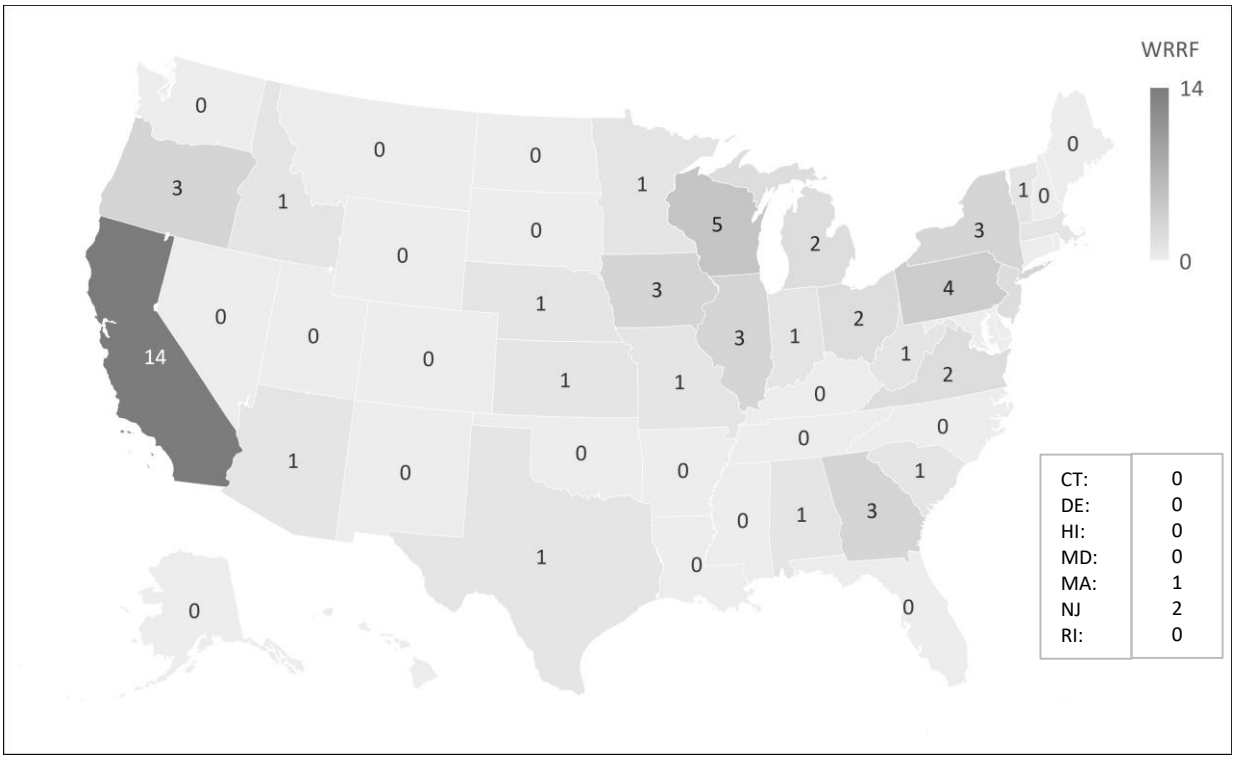

Figure 3: Operating WRRF Food Waste Co-Digestion Systems that Returned Surveys by State

Total Operating Digesters in the U.S.

Figure 4 and **Table 4** summarize total operating digesters by type and location. Note that there are other operating AD facilities processing food waste in the U.S. that did not respond to the survey. **Table 4** identifies the operating facilities that provided survey responses.

[18] Please visit http://www.resourcerecoverydata.org/biogasdata.php for a listing of those WRRFs with operating anaerobic digesters.

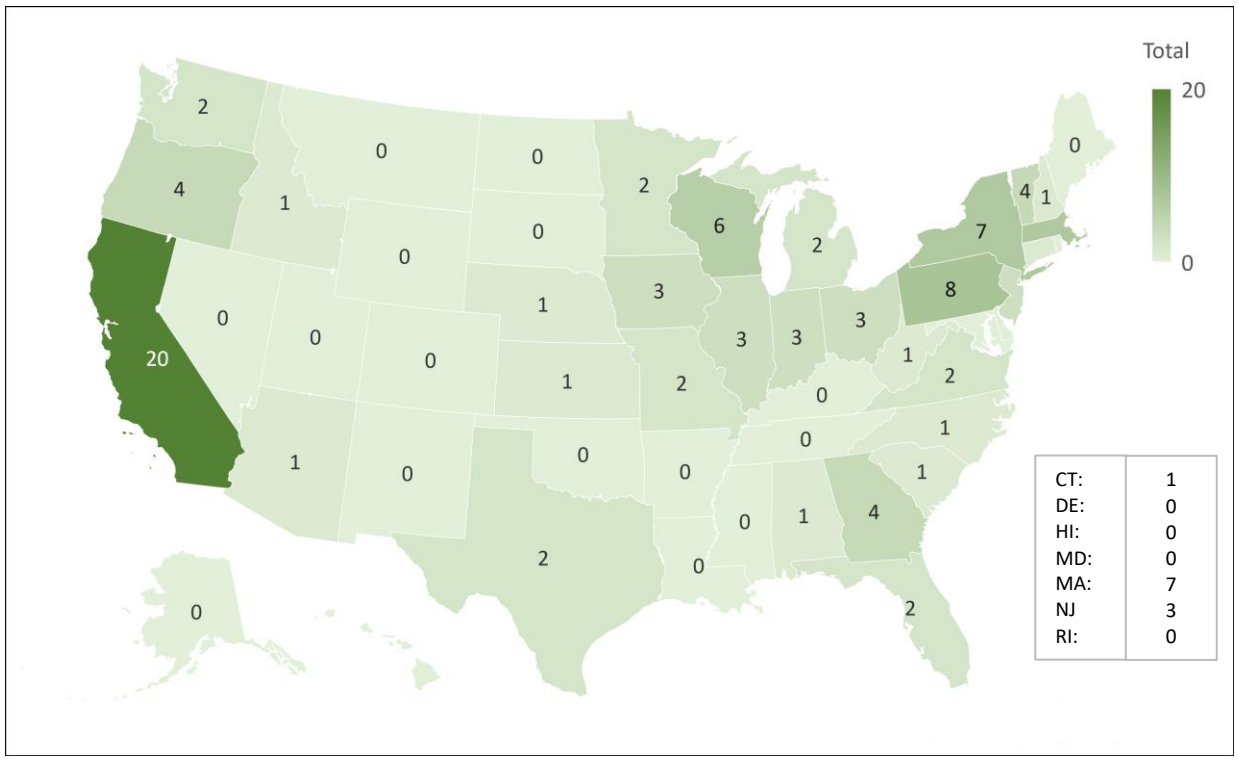

Figure 4: Total Operating Food Waste Digesting Facilities that Returned Surveys by State

Table 4: Number of Operating Anaerobic Digestion Facilities in each State that Returned Surveys

	Number of Facilities		
State	***Stand-Alone***	***On-Farm***	***WRRF***
Alabama	0	0	1
Alaska	0	0	0
Arizona	0	0	1
Arkansas	0	0	0
California	6	0	14
Colorado	0	0	0
Connecticut	1	0	0
Delaware	0	0	0
Florida	2	0	0
Georgia	1	0	3
Hawaii	0	0	0
Idaho	0	0	1
Illinois	0	0	3
Indiana	1	1	1
Iowa	0	0	3
Kansas	0	0	1
Kentucky	0	0	0
Louisiana	0	0	0
Maine	0	0	0
Maryland	0	0	0

	Number of Facilities		
State	***Stand-Alone***	***On-Farm***	***WRRF***
Massachusetts	1	5	1
Michigan	0	0	2
Minnesota	1	0	1
Mississippi	0	0	0
Missouri	1	0	1
Montana	0	0	0
Nebraska	0	0	1
Nevada	0	0	0
New Hampshire	1	0	0
New Jersey	1	0	2
New Mexico	0	0	0
New York	2	2	3
North Carolina	0	1	0
North Dakota	0	0	0
Ohio	1	0	2
Oklahoma	0	0	0
Oregon	1	0	3
Pennsylvania	0	4	4
Rhode Island	0	0	0
South Carolina	0	0	1
South Dakota	0	0	0
Tennessee	0	0	0
Texas	1	0	1
Utah	0	0	0
Vermont	0	3	1
Virginia	0	0	2
Washington	0	2	0
West Virginia	0	0	1
Wisconsin	1	0	5
Wyoming	0	0	0
Total	**22**	**18**	**59**

B. Processing Capacity

Processing capacity refers to the maximum amount of food waste feedstock an anaerobic digester can accept per unit of time. EPA collected data on food waste processing capacity in either gallons or tons per year.[19] Capacity reported in gallons per year was converted to tons per year to quantify the total capacity available for processing food waste.[20] EPA recognizes that most anaerobic digesters typically process a

[19] Throughout this document "ton" refers to a wet U.S. ton, unless otherwise specified.

[20] Compared to previous iterations of the report, this report used an updated calculation for converting food waste from gallons to tons. The updated conversion: 1) used a specific feedstock density if the entity only accepted that

liquid slurry, which can be measured in gallons or wet tons (as opposed to dry tons, which measure solids separated from a slurry). For food waste processing capacity, EPA converted the data from gallons per year to wet tons per year because those are the industry standard for measuring food waste.

Out of the 99 operational facilities that provided survey responses, 89 provided information about food waste processing capacity. EPA documented that the total capacity for processing food waste in all three digester types combined is approximately 42.7 million tons per year (**Table 5**). Note that the actual processing capacity for digesters in the United States is higher than the values reported because not all operating facilities responded to the survey. This is true for all facility types.

Stand-Alone Digesters

Stand-alone digester operators were asked for the following:

> *Please provide the total capacity for accepting food-based feedstock of your facility in 2019.*

The total reported available processing capacity for food waste at stand-alone digesters was approximately 38.5 million tons.

On-Farm Co-Digesters

EPA asked operators of on-farm co-digesters to consider the following when calculating available food waste processing capacity:

> *Considering the average volume of manure from your livestock processed in your anaerobic digestion system, please identify the available capacity in 2019 to process other feedstocks from offsite sources.*

EPA's goal was to determine how much outside food waste could potentially be processed at on-farm co-digesters in the U.S. The total available processing capacity reported for on-farm co-digesters was approximately 442,000 tons.

Co-Digestion Facilities at WRRFs

Determining the capacity for WRRFs to co-digest food waste is more challenging because there are more factors to consider than just the size of the tanks. EPA asked plant operators to consider the following when calculating available food waste processing capacity:

> *Please identify your facility's available capacity to accept feedstocks from offsite sources for all digesters combined, in 2019. When calculating this available capacity, please consider the average volume of wastewater solids processed at your facility and conveyed to your plant via your collection system.*

feedstock (e.g., FOG); 2) for an outlier or potentially erroneous reported capacity (that was low, high, or under amount processed), confirmation of validity was sought from reporting entity, and if not confirmed, that capacity was either assigned the previous year's capacity or leveled with reported processing total; or 3) 3.8 lb/gallon was assumed to convert (this factor comes from *Volume-to-Weight Conversion Factors*, USEPA ORCR, April 2016).

Again, EPA's goal was to determine how much food waste could potentially be processed at WRRFs in the U.S. The total available processing capacity reported for food waste at co-digestion systems at WRRFs was approximately 3.8 million tons.

Total Food Waste Processing Capacity

Table 5 summarizes the total capacity for each type of digester. The total available processing capacity reported for food waste in 2019 for all three types of digesters in the U.S. was approximately 42.7 million tons.

Table 5: Total Reported Capacity for Processing Food Waste (2019)

Digester Type	Capacity (tons/year)	Respondents Providing Data	Median (tons/year)	Min (tons/year)	Max (tons/year)
Stand-alone digesters	38,461,432	20	709,445	2,090	7,089,000
On-farm co-digesters	442,020	16	5,844	263	124,987
Co-digestion systems at WRRFs	3,831,985	53	17,338	152	1,091,792
Total	**42,735,437**	**89**	N/A	N/A	N/A

C. Operational Dates

Figure 5 shows when digesters in all three categories began operations. In the last three decades, the number of operational facilities has increased.

The earliest start dates reported for this survey are as follows:

- Co-digestion at farms: 1980s;
- Co-digestion at WRRFs: 1920s;
- Digestion at stand-alone digesters: 2000s.

The 2000s and 2010s showed the highest rate of facilities becoming operational. Historically, WRRFs have become operational most frequently, because municipal governments incorporate digesters into wastewater treatment plants, and wastewater treatment plants have been used since the 1920s. The number of facilities that have started operations since 2020 may be lower because of the COVID-19 pandemic. While processing food waste via AD is still perceived as a relatively new practice, momentum is gaining as interest in AD and biogas grows and funding opportunities help to overcome high construction costs.

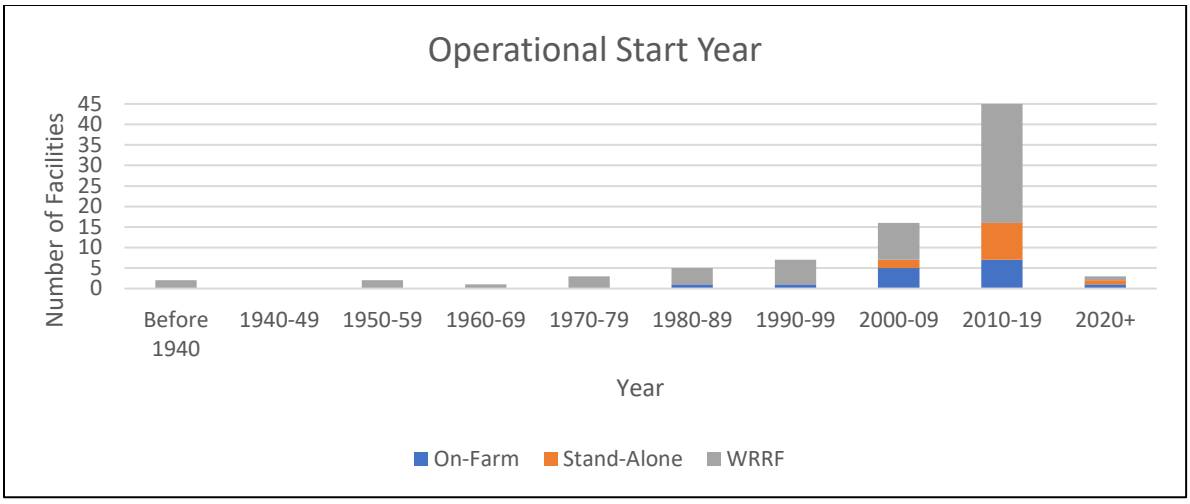

Figure 5: **Distribution of First Year of Digester Operation**

D. Food Waste Processed

A wide variety of feedstocks are processed in digesters throughout the U.S. Some feedstocks are more common than others, varying based on local availability, demand, and type of digester accepting the feedstock.

Feedstocks are classified as follows:

- **Food**: beverage processing industry waste; food processing industry waste; FOG; fruit/vegetative wastes; food service waste pre- & post-consumer; retail food waste; slaughterhouse wastes; and source-separated commercial, institutional, or residential organic wastes.
- **Non-Food:** crude glycerin; manure; wastewater solids (sludge); septage; crop residues; mixed yard waste; de-icing fluid; and lab (or pharma[21]) wastes.

In the 2021 survey, EPA requested that AD facilities report data on the amount of food waste processed in 2019 in either gallons or tons. EPA converted any amounts reported in gallons to tons.[22] As with capacity data, the amount of material processed is reported in tons because tons are the industry standard for measuring food waste. Note that the amount of food waste processed in 2019 was likely higher than the values reported because not all facilities known to be operating provided data. Out of the 99 operational facilities that provided survey responses, 73 provided information about the amount of food waste processed in 2019: 19 stand-alone, 14 on-farm, and 40 WRRF digesters. Projecting or predicting volumes processed at non-reporting facilities was not within the scope of this report.

For the 2021 survey, respondents from 86% of stand-alone facilities, 78% of on-farm co-digesters, and 68% of WRRFs provided data on the type of feedstocks processed. **Table 6**, **Table 7**, and **Table 8** show the source and type of feedstock for stand-alone, on-farm, and WRRF digesters, respectively, and

[21] In the survey, lab wastes are described as “pharma” wastes, which is an abbreviation of pharmaceutical.
[22] The gallons-to-tons conversion for food waste was calculated using various lb/gallon densities for various feedstocks (e.g., FOG, all other food waste types) (Reference *Volume-to-Weight Conversion Factors*, USEPA ORCR, April 2016).

Table 9 shows the source and type of feedstock for all facilities. For all digesters, **Figure 6** and **Figure 7** show the top five types and top five sources of food waste feedstock, respectively.

Beverage processing industry waste comprised the largest percentage (85%) of the total food waste processed, largely because of ten facilities belonging to the stand-alone digester group that solely digest beverage waste (98.5% of the total in the stand-alone category). Beverage processing waste was converted using the density of water (8.34 lb/gallon), which was suggested by several digesters to be an appropriate conversion factor. Because of this updated conversion factor, beverage processing waste was heavier than any other feedstock, and increased the tonnage of the total processed waste such that it was 79% greater than in 2018. Note that **Figure 6** and **Figure 7** have logarithmic *y*-axes for increased detail on feedstocks other than beverage processing industry waste.

This was also the first year that quantitative amounts of food waste feedstock *processed* were related to the qualitative *type* of the food waste feedstock. Because of this connection, specific densities were applied to feedstock types. Behind beverage processing, the next four most processed feedstock types were: FOG, food processing industry waste, other, and source-separated organics. Reference Appendix E: Conversion Sources for information on converting specific feedstocks.

Table 6: Food Waste Processed at Stand-Alone Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)											
Type / Source	**Beverage processing industry waste**	**Fats, Oils, and Greases (FOG)**	**Food processing industry waste**	**Food service waste, pre- and post-consumer**	**Fruits/vegetative waste**	**Other**	**Retail food waste**	**Slaughterhouse waste**	**Source-separated commercial, institutional, or residential organic waste**	**Total**	**Percent (%) of Total**
Colleges/ universities	-	-	-	-	-	-	-	-	-	**-**	**-**
Correctional facilities	-	-	-	-	-	-	-	-	-	**-**	**-**
Farmer's markets	-	-	-	-	-	-	-	-	-	**-**	**-**
Food banks	-	-	-	-	-	-	-	-	-	**-**	**-**
Fruit/vegetable farms	-	-	-	-	-	-	-	-	-	**-**	**-**
Hospitals	-	-	-	-	-	-	-	-	-	**-**	**-**
Hotels	-	-	-	-	-	-	-	-	-	**-**	**-**
Industrial (other)	-	11,985	-	-	-	-	-	-	-	**11,985**	**<1**
K-12 schools	-	-	-	-	-	-	-	-	-	**-**	**-**
Livestock farms	-	-	-	-	-	3,984	-	-	-	**3,984**	**<1**
Manufacturing/ processing	14,826,377	40,157	53,652	-	-	10,000	-	16,209	-	**14,946,395**	**99.3**
Military installations	-	-	-	-	-	-	-	-	-	**-**	**-**
Office buildings	-	-	-	-	-	-	-	-	-	**-**	**-**
Other	-	-	-	-	-	-	-	-	50,000	**50,000**	**<1**
Residential	-	-	-	-	-	-	-	-	-	**-**	**-**
Restaurants/food services	-	-	-	-	-	-	-	-	-	**-**	**-**
Retail/wholesale	13	56	-	-	-	40,000	-	-	2,793	**42,862**	**<1**
Sports venues	-	-	-	-	-	-	-	-	-	**-**	**-**
Total	**14,826,390**	**52,198**	**53,652**	**-**	**-**	**53,984**	**-**	**16,209**	**52,793**	**15,055,226**	
Percent (%) of Total	**98.5**	**<1**	**<1**	**-**	**-**	**<1**	**-**	**<1**	**<1**		

Table 7: Food Waste Processed at Farm Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)											
Source \ Type	Beverage processing industry waste	Fats, Oils, and Greases (FOG)	Food processing industry waste	Food service waste, pre- and post-consumer	Fruits/vegetative waste	Other	Retail food waste	Slaughterhouse waste	Source-separated commercial, institutional, or residential organic waste	Total	Percent (%) of Total
Colleges/ universities	-	-	-	-	-	-	-	-	-	**-**	**-**
Correctional facilities	-	-	-	-	-	-	-	-	-	**-**	**-**
Farmer's markets	-	-	-	-	-	-	-	-	-	**-**	**-**
Food banks	-	-	-	-	-	-	-	-	-	**-**	**-**
Fruit/vegetable farms	-	-	-	-	-	-	-	-	-	**-**	**-**
Hospitals	-	-	-	-	-	-	-	-	-	**-**	**-**
Hotels	-	-	-	-	-	-	-	-	-	**-**	**-**
Industrial (other)	-	-	-	-	-	-	-	-	-	**-**	**-**
K-12 schools	-	-	-	-	-	-	-	-	-	**-**	**-**
Livestock farms	-	-	-	-	-	-	-	-	-	**-**	**-**
Manufacturing/ processing	10,223	2,091	143,922	-	132	188	-	16,752	52,000	**225,308**	**70.6**
Military installations	-	-	-	-	-	-	-	-	-	**-**	**-**
Office buildings	-	-	-	-	-	-	-	-	-	**-**	**-**
Other	-	-	-	-	-	-	-	-	-	**-**	**-**
Residential	-	-	-	-	-	-	-	-	-	**-**	**-**
Restaurants/food services	-	3,521	-	-	-	-	-	-	-	**3,521**	**1.1**
Retail/wholesale	3,750	59,406	15,069	1,000	3,750	-	3,750	-	3,750	**90,474**	**28.3**
Sports venues	-	-	-	-	-	-	-	-	-	**-**	**-**
Total	**13,973**	**65,017**	**158,991**	**1,000**	**3,882**	**188**	**3,750**	**16,752**	**55,750**	**319,303**	
Percent (%) of Total	**4.4**	**20.4**	**49.8**	**<1**	**1.2**	**<1**	**1.2**	**5.2**	**17.5**		

Table 8: Food Waste Processed at WRRF Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)											
Type / Source	Beverage processing industry waste	Fats, Oils, and Greases (FOG)	Food processing industry waste	Food service waste, pre- and post-consumer	Fruits/vegetative waste	Other	Retail food waste	Slaughterhouse waste	Source-separated commercial, institutional, or residential organic waste	Total	Percent (%) of Total
Colleges/ universities	-	700	-	20	-	-	-	-	925	**1,645**	**<1**
Correctional facilities	-	-	-	-	-	-	-	-	-	**-**	**-**
Farmer's markets	-	-	-	-	-	-	-	-	-	**-**	**-**
Food banks	-	-	-	7	-	-	-	-	-	**7**	**<1**
Fruit/vegetable farms	-	-	-	-	-	-	-	-	-	**-**	**-**
Hospitals	-	1,400	-	6	-	-	-	-	-	**1,407**	**<1**
Hotels	-	1,400	-	-	-	-	-	-	-	**1,400**	**<1**
Industrial (other)	27,431	-	1,652	-	-	33,790	-	10,547	3,100	**76,520**	**3.4**
K-12 schools	-	2,801	-	13	-	-	-	-	2,267	**5,081**	**<1**
Livestock farms	-	-	-	-	-	-	-	-	-	**-**	**-**
Manufacturing/ processing	41,978	1,106,025	124,653	-	2,780	7,383	-	5,178	-	**1,287,997**	**57.9**
Military installations	-	-	-	-	-	-	-	-	-	**-**	**-**
Office buildings	-	5,602	-	-	-	-	-	-	-	**5,602**	**<1**
Other	16,618	5,729	283,251	-	-	151,728	-	-	-	**457,326**	**20.6**
Residential	-	4	-	-	-	2,278	-	-	4,148	**6,430**	**<1**
Restaurants/food services	-	208,657	-	1,000	-	-	-	-	-	**209,657**	**9.4**
Retail/wholesale	10,726	134,316	5,352	884	-	-	1,016	998	16,468	**169,761**	**7.6**
Sports venues	-	700	-	-	-	-	-	-	-	**700**	**<1**
Total	**96,753**	**1,467,335**	**414,909**	**1,930**	**2,780**	**195,179**	**1,016**	**16,723**	**26,908**	**2,223,532**	
Percent (%) of Total	**4.4**	**66.0**	**18.7**	**<1**	**<1**	**8.8**	**<1**	**<1**	**1.2**		

Table 9: Total Food Waste Processed at All Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)											
Type / Source	Beverage processing industry waste	Fats, Oils, and Greases (FOG)	Food processing industry waste	Food service waste, pre- and post-consumer	Fruits/vegetative waste	Other	Retail food waste	Slaughterhouse waste	Source-separated commercial, institutional, or residential organic waste	Total	Percent (%) of Total
Colleges/ universities	-	700	-	20	-	-	-	-	925	**1,645**	**<1**
Correctional facilities	-	-	-	-	-	-	-	-	-	**-**	**-**
Farmer's markets	-	-	-	-	-	-	-	-	-	**-**	**-**
Food banks	-	-	-	7	-	-	-	-	-	**7**	**<1**
Fruit/vegetable farms	-	-	-	-	-	-	-	-	-	**-**	**-**
Hospitals	-	1,400	-	6	-	-	-	-	-	**1,407**	**<1**
Hotels	-	1,400	-	-	-	-	-	-	-	**1,400**	**<1**
Industrial (other)	27,431	11,985	1,652	-	-	33,790	-	10,547	3,100	**88,505**	**<1**
K-12 schools	-	2,801	-	13	-	-	-	-	2,267	**5,081**	**<1**
Livestock farms	-	-	-	-	-	3,984	-	-	-	**3,984**	**<1**
Manufacturing/ processing	14,878,578	1,148,273	322,227	-	2,912	17,571	-	38,139	52,000	**16,459,700**	**93.5**
Military installations	-	-	-	-	-	-	-	-	-	**-**	**-**
Office buildings	-	5,602	-	-	-	-	-	-	-	**5,602**	**<1**
Other	16,618	5,729	283,251	-	-	151,728	-	-	50,000	**507,326**	**2.9**
Residential	-	4	-	-	-	2,278	-	-	4,148	**6,430**	**<1**
Restaurants/food services	-	212,178	-	1,000	-	-	-	-	-	**213,178**	**1.2**
Retail/wholesale	14,489	193,778	20,421	1,884	3,750	40,000	4,766	998	23,011	**303,096**	**1.7**
Sports venues	-	700	-	-	-	-	-	-	-	**700**	**<1**
Total	**14,937,115**	**1,584,550**	**627,551**	**2,930**	**6,662**	**249,350**	**4,766**	**49,684**	**135,451**	**17,598,061**	
Percent (%) of Total	**84.9**	**9.0**	**3.6**	**<1**	**<1**	**1.4**	**<1**	**<1**	**<1**		

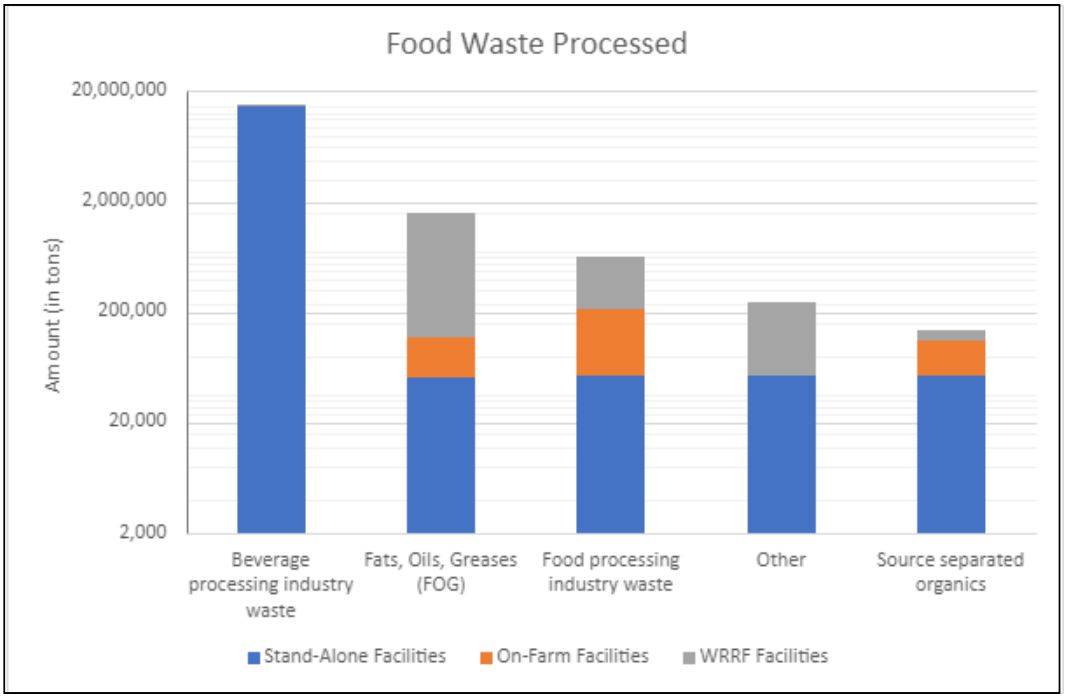

Figure 6: Top Five Food Waste Types

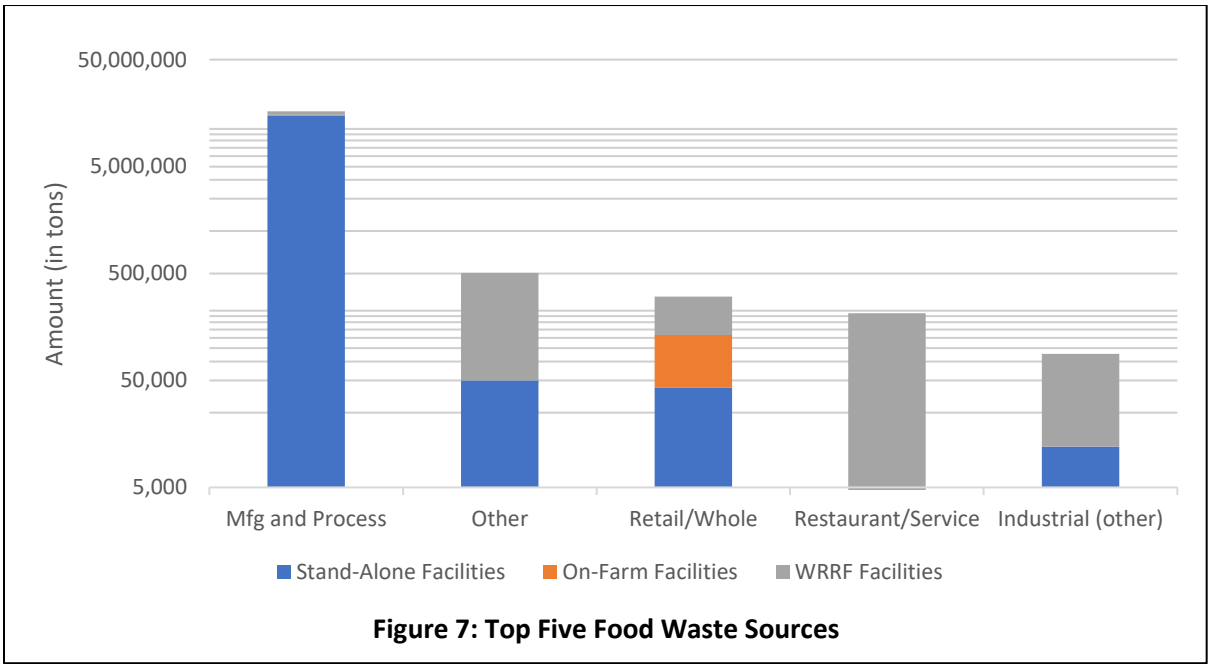

Figure 7: Top Five Food Waste Sources

Digester feedstocks come from many different locations, such as industrial, commercial, institutional, and residential sources. The survey question about feedstock sources directed respondents to identify all sources for the feedstocks that were received and processed at each facility. Some digesters have multiple sources, and some have one or just a few. By source, manufacturing and processing comprised about 96% of the food waste total **(Table 9** and **Figure 8**), followed by other, retail/wholesale, restaurants/ food services, and industrial (other). Facilities were required to specify the source to be included in this section.

E. Non-Food Waste Processed

EPA also collected data on the amount of non-food waste processed via AD, in either gallons or tons. Non-food waste feedstocks include, but are not limited to: mixed yard waste, crop residues, manure, wastewater solids (sludge), septage, de-icing fluid, lab (or pharma) wastes, and crude glycerin. In the next section, variable densities were applied given the specific feedstocks to generate totals.

The scope of the survey was limited to anaerobic digesters that digest food waste. For example, the survey scope does not include the amount of manure being digested at farm digesters that do not co-digest food, or the amount of wastewater solids being digested at WRRFs that do not co-digest food. Additionally, farms and WRRFs with co-digestion systems were not asked for quantities of manure and wastewater solids that were generated on-site and processed in their digesters, so the numbers here do not include those quantities, which are assumed to be the primary feedstocks at farm and WRRF digesters, respectively. As a result, the numbers below represent only a portion of non-food waste being digested in the U.S. The non-food waste data collected was intended to provide additional information about the types of wastes being processed via AD.

Processing of non-food waste was reported at different frequencies:

- Stand-alone digesters: eight out of 22 (36%);
- On-farm digesters: three out of 18 (17%);
- WRRFs: 20 out of 59 (34%).

Non-food waste is processed at all on-farm co-digesters (manure) and WRRF digestion systems (wastewater solids), but those quantities are not included here. As mentioned previously, not all operational digesters responded to this survey. The actual amount of non-food waste processed at anaerobic digesters in 2019 is likely to be higher than the values reported above.

For non-food-based feedstocks, densities were applied from various sources (Appendix E). **Table 10**, **Table 11**, and **Table 12** show the source and type of non-food waste for stand-alone, on-farm, and WRRF digesters, respectively. **Table 13**, **Figure 8**, and **Figure 9** show the top five non-food waste feedstock types and sources. Septage and Other feedstocks were the top two non-food waste types processed, while Other and Industrial were the top two non-food waste sources.

Table 10: Non-food Waste Processed at Stand-Alone Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)												
Type / Source	Crop residues	Crude glycerin	De-icing fluid	Lab (or pharma) waste	Manure	Mixed yard waste	Other	Paper mill waste	Septage	Wastewater solids (sludge)	Total	Percent (%) of Total
Airports	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Biodiesel production	-	11,912	-	-	-	-	-	-	-	-	**11,912**	**2.3**
Industrial	40,000	-	-	-	-	-	-	-	-	12,223	**52,223**	**10.2**
Labs/pharma companies	-	-	-	7,810	-	-	-	-	-	-	**7,810**	**1.5**
Other	-	-	-	-	155,059	52,798	5,000	-	225,326	-	**438,183**	**85.6**
Retail stores	-	-	-	-	-	-	-	-	-	-	**-**	**-**
WWTP	-	-	-	-	-	-	-	-	-	1,547	**1,547**	**<1**
Total	**40,000**	**11,912**	**-**	**7,810**	**155,059**	**52,798**	**5,000**	**-**	**225,326**	**13,770**	**511,675**	
Percent (%) of Total	**7.8**	**2.3**	**-**	**1.5**	**30.3**	**10.3**	**<1**	**-**	**44.0**	**2.7**		

Table 11: Non-food Waste Processed at Farm Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)												
Type / Source	Crop residues	Crude glycerin	De-icing fluid	Lab (or pharma) waste	Manure	Mixed yard waste	Other	Paper mill waste	Septage	Wastewater solids (sludge)	Total	Percent (%) of Total
Airports	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Biodiesel production	-	2,730	-	-	-	-	-	-	-	-	**2,730**	**100**
Industrial	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Labs/pharma companies	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Other	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Retail stores	-	-	-	-	-	-	-	-	-	-	**-**	**-**
WWTP	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Total	**-**	**2,730**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,730**	
Percent (%) of Total	**-**	**100**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		

Table 12: Non-food Waste Processed at WRRF Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)												
Type / Source	Crop residues	Crude glycerin	De-icing fluid	Lab (or pharma) waste	Manure	Mixed yard waste	Other	Paper mill waste	Septage	Wastewater solids (sludge)	Total	Percent (%) of Total
Airports	-	-	786	-	-	-	-	-	-	-	**786**	**<1**
Biodiesel production	-	5,174	-	-	-	-	3,231	-	-	-	**8,405**	**2.0**
Industrial	-	-	-	-	-	-	160,579	-	-	7,942	**168,521**	**39.1**
Labs/pharma companies	-	-	-	15,206	-	-	-	-	-	-	**15,206**	**3.5**
Other	-	-	-	-	-	-	30,898	-	149,752	-	**180,650**	**41.9**
Retail stores	-	-	-	-	-	-	-	-	20,864	-	**20,864**	**4.8**
WWTP	-	-	-	-	-	-	-	-	6,813	29,804	**36,617**	**8.5**
Total	**-**	**5,174**	**786**	**15,206**	**-**	**-**	**194,708**	**-**	**177,429**	**37,746**	**431,049**	
Percent (%) of Total	**-**	**1.2**	**<1**	**3.5**	**-**	**-**	**45.2**	**-**	**41.2**	**8.8**		

Table 13: Total Non-food Waste Processed at All Digesters (2019)

Source of Food Waste Feedstock versus Type of Food Waste Feedstock (tons)												
Type / Source	Crop residues	Crude glycerin	De-icing fluid	Lab (or pharma) waste	Manure	Mixed yard waste	Other	Paper mill waste	Septage	Wastewater solids (sludge)	Total	Percent (%) of Total
Airports	-	-	786	-	-	-	-	-	-	-	**786**	**<1**
Biodiesel production	-	19,816	-	-	-	-	3,231	-	-	-	**23,047**	**2.4**
Industrial	40,000	-	-	-	-	-	160,579	-	-	20,165	**220,744**	**23.4**
Labs/pharma companies	-	-	-	23,016	-	-	-	-	-	-	**23,016**	**2.4**
Other	-	-	-	-	155,059	52,798	35,898	-	375,078	-	**618,833**	**65.5**
Retail stores	-	-	-	-	-	-	-	-	20,864	-	**20,864**	**2.2**
WWTP	-	-	-	-	-	-	-	-	6,813	31,351	**38,164**	**4.0**
Total	**40,000**	**19,816**	**786**	**23,016**	**155,059**	**52,798**	**199,708**	**-**	**402,755**	**51,516**	**945,454**	
Percent (%) of Total	**4.2**	**2.1**	**<1**	**2.4**	**16.4**	**5.6**	**21.1**	**-**	**42.6**	**5.5**		

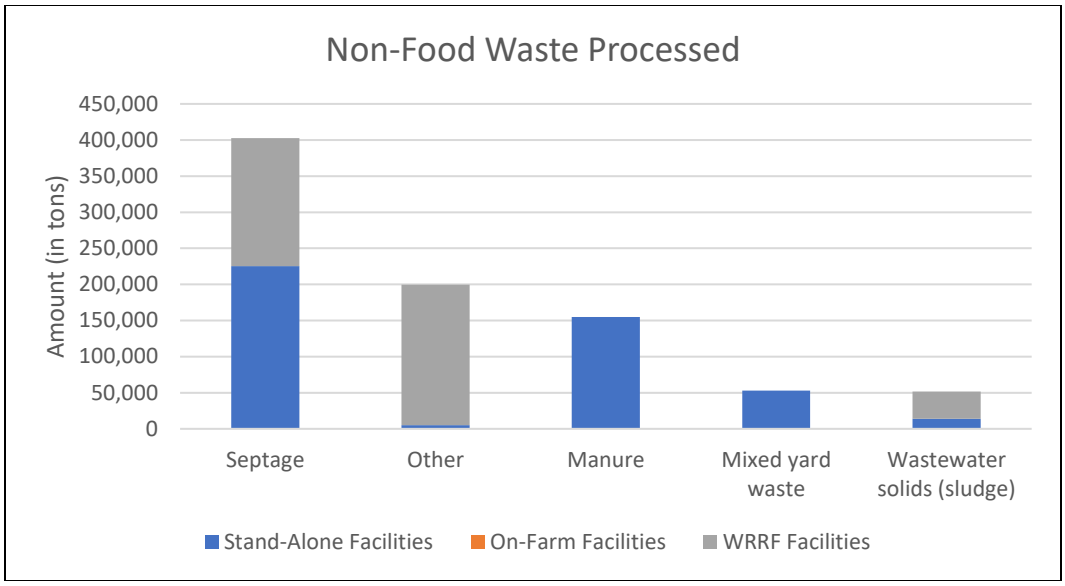

Figure 8: Top Five Types of Non-Food Waste

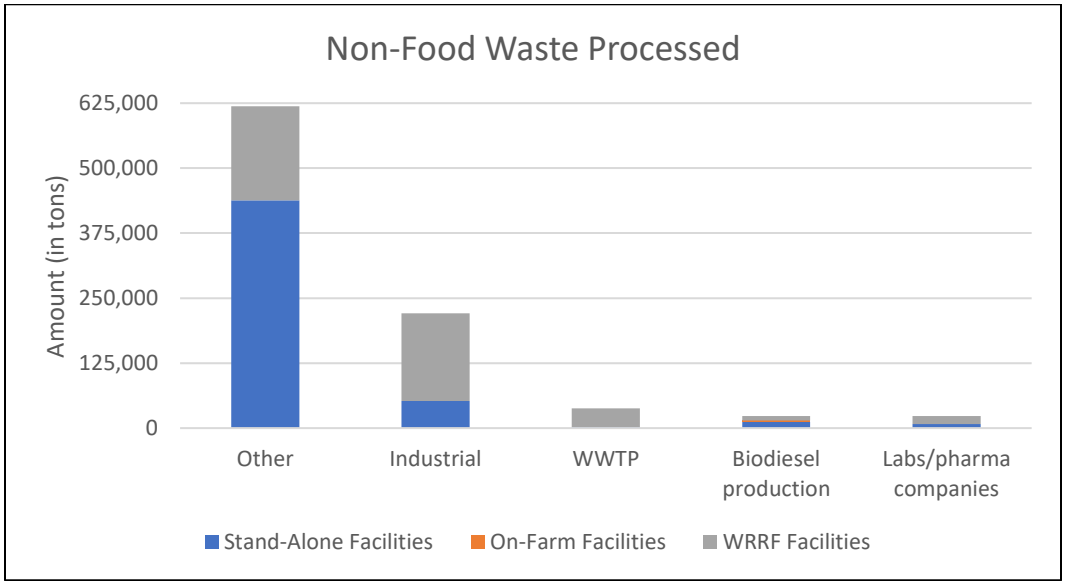

Figure 9: Top Five Sources of Non-Food Waste

F. Tipping Fees

Facilities can generate revenue through contracts to accept and process feedstocks by using tipping fees. Tipping fees can vary based on factors including, but not limited to, the type of feedstock; regional landfill tipping fees; availability of organics recycling options.; and regulatory landscape (e.g. state and local organics diversion laws). EPA included survey questions about tipping fees to gain a better understanding of how digesters may be using them to offset capital expenditures and maintenance costs. EPA recognizes that tipping fee data may be considered proprietary and therefore made these questions optional as part of completing the survey.

EPA asked respondents if they collected tipping fees and if they were willing to share information about the fees they collected. **Table 14** provides a summary of the tipping fee data collected.

Table 14: Reported Tipping Fee Data

Digester type	Number of Facilities Reporting Collecting Tipping Fees	Percentage of Facilities Reporting Collecting Tipping Fees	Number of Facilities Providing Tipping Fee Revenue	Highest Annual Facility Revenue Reported 2019	Average Annual Revenue Reported 2019	Highest/ Average Tip Fee Rate Reported per gallon
Stand-alone digesters	9	41%	3	$1,000,000	$471,130	N/A
On-farm digesters	14	93%	2	$115,000	$58,800	N/A
Co-digester systems at WRRFs	47	80%	30	$1,522,318	$298,412	0.1 cents/ 0.06 cents

In addition to the tipping fee data provided, many operators provided additional comments regarding how tipping fees are collected as well as their tipping fee structures. Many WRRFs – but less so other types of facilities – provided comments on tipping fees, including:

- Tipping fees are set based on cost recovery needs for facility solids handling;
- Tipping fees are based on the type of product and packaging;
- Administering a tiered system for tipping fees;
- Charging higher rates for waste generated outside of county;
- Fees varying depending on quality of product;
- Invoicing only for labor to process brewing waste.

G. Pre-processing

EPA asked operators if pre-processing activities were performed at their facilities. Of the facilities that provided survey responses, 32% of stand-alone digesters, 100% of on-farm co-digesters and 57% of co-digestion systems at WRRFs perform some type of feedstock pre-processing.

EPA also asked operators if pre-processing occurred onsite, offsite or both. **Table 15** depicts the data reported by facility type.

Table 15: Reported Location of Pre-processing Activities

Digester Type	Number of Facilities		
	Pre-Processing Onsite	Pre-Processing Offsite	Pre-Processing both Onsite and Offsite
Stand-alone digesters	5	2	0
On-farm co-digesters	2	7	1
Co-digestion systems at WRRFs	13	14	6

EPA also asked operators to identify what types of pre-processing activities were performed on the feedstocks utilized at their facility. Multiple types of pre-processing can occur at any one facility. **Table 16**, **Table 17**, and **Table 18** show the number of facilities that reported the use of each type of pre-processing activity to prepare feedstocks for digestion. Third-party processing is typically conducted at an off-site location and pre-processed feedstocks are then transported to the digester in a ready-to-digest form.

Table 16: Reported Pre-processing Activities for Stand-Alone Digester Facilities

Pre-processing Activity	Number of Facilities with Specified Pre-processing Activities
Screening for debris or sorting	15
pH adjustment	11
Liquid/solid separation	8
Grinding and/or maceration	4
Manual or mechanized de-packaging	3
Heating	3
Shredding	1
Centrifugal separation	1

Table 17: Reported Pre-processing for On-Farm Co-Digestion Facilities

Pre-processing/De-packaging Activity	Number of Facilities with Specified Pre-processing Activities
Screening for debris or sorting	4
Manual or mechanized de-packaging	3
Grinding and/or maceration	1
Liquid /solid separation	1
Shredding	1

Table 18: Reported Pre-processing for Co-Digestion Facilities at WRRFs

Pre-processing/De-packaging Activity	Number of Facilities with Specified Pre-processing Activities
Screening for debris or sorting	24
Grinding and/or maceration	23
Manual or mechanized de-packaging	8
Heating	7
Liquid/solid separation	4
Third-Party Processing	3
pH adjustment	2
Shredding	1
Centrifugal separation	1

For pre-processing, a few WRRFs – but no on-farm or stand-alone digesters – provided unique responses, including:

- Screening the waste type to ensure it complies with criteria prior to delivery;
- Special screening equipment to remove inorganics (plastics, glass, etc.);
- A rock trap (grinder to remove large debris) is part of the biogas facility and staff manually check for garbage.

H. Operational and Design Specifications

EPA asked respondents to share information about the operational specifications of their digesters, including temperature range and whether operations were wet or dry. The temperature ranges are typically 86 – 100°F for mesophilic and 122 – 140°F for thermophilic. Wet and dry classifications of digesters refer to the moisture content of the feedstocks. A wet digester generally processes feedstock with less than 15% solids content, whereas a dry digester generally processes feedstock with greater than 15% solids content.

The wet versus dry distinction was not posed to WRRFs because all WRRF digester systems are wet. **Table 19** and **Table 20** show the data for temperature range and wet versus dry facilities by facility type.

Table 19: Reported Temperature Range Data

	Temperature Range			Response Rate	
Digester Type	***Mesophilic***	***Thermophilic***	***Unheated***	***Number of Respondents Providing Data for this Survey Question***	***Total Surveys Received***
Stand-alone digesters	7	5	10	22	22
On-farm co-digesters	8	3	0	11	18
Co-digestion systems at WRRFs	50	8	1	59	59
Total	**65**	**16**	**11**	**92**	**99**

Table 20: Reported Data on Wet vs. Dry Systems

	Wet vs. Dry Systems		Percentage		Response Rate	
Digester Type	***Wet***	***Dry***	***Wet***	***Dry***	***Number of Respondents Providing Data for this Survey Question***	***Total Surveys Received***
Stand-alone digesters	20	2	89%	11%	22	22
On-farm co-digesters	12	0	100%	0%	12	18
Co-digestion systems at WRRFs*	--	--	100%	--	--	59
Total	**32**	**2**	**--**	**--**	**34**	**99**
***WRRFs are all assumed to be wet.						

Respondents were also asked to identify the design that best fits their facility's design type/configuration. **Table 21**, **Table 22**, and **Table 23** show the number of facilities that reported each design type.

Table 21: Reported Design Type/Configuration Reported for Stand-Alone Digester Facilities

Design Type/Configuration	Number of Facilities with Specified Design Type/Configuration
Continuously Stirred Tank Reactor	7
Upflow Anaerobic Sludge Blanket	6
Expanded Granular Sludge Bed	4
Anaerobic Sequencing Batch Reactor	2
Internal Circulation	1

Table 22: Reported Design Type/Configuration Reported for On-Farm Co-Digestion Facilities

Design Type/Configuration	Number of Facilities with Specified Design Type/Configuration
Continuously Stirred Tank Reactor	7
Mixed Plug Flow	5

Table 23: Reported Design Type/Configuration Reported for Co-Digestion Facilities at WRRFs

Pre-processing/De-packaging Activity	Number of Facilities with Specified Pre-processing Activities
Continuously Stirred Tank Reactor	39
Plug-flow	7
Hybrid/Multi-stage	2

Nine WRRFs responded that the design of their co-digestion facility was "other." These responses are summarized below from survey responses:

- Two WRRFs specified their design as "egg-shaped."

The other responses included:

- Floating cover/no mechanical mixing;
- Fixed film reactor followed by solids contact tank;
- Timed feedings;
- Heated and stirred.

I. Biogas Production

Biogas production data was collected in, or converted to, standard cubic feet per minute (SCFM), which is the industry standard unit of measurement for biogas. The total biogas produced is summarized below as reported by facility type. SCFM was then used to estimate installed capacity in megawatts (MW), and generation potential in kilowatt-hours per year (kWh/yr) using methods described in the interactive conversion tool[23] on EPA's Landfill Methane Outreach Program (LMOP) website. The LMOP interactive conversion tool assumes landfill gas is 50% methane. The calculation for SCFM landfill gas to MW capacity was revised for the purposes of this report to reflect that biogas tends to be about 60% methane.[24] To provide a frame of reference, EPA presents the kWh/yr values for each type of digester in terms of powering homes.[25] **Table 24** shows biogas production data by facility type for 2019.

Table 24: Summary of Biogas Data Reported (2019)

Digester Type	Respondents Providing Data	SCFM*	MW†	kWh/yr (million) †	Number of Homes Powered for One Year†
Stand-alone digesters	20	4,825	15	112	9,428
On-farm co-digesters	12†	1,465	5	37	3,114
Co-digestion systems at WRRFs	55†	23,587	73	544	45,791
Total	**87**	**29,877**	**93**	**693**	**58,333**

*SCFM values are reported by facility operators and added together to get total SCFM.

†The MW, kWh/yr, and homes powered were calculated using the LMOP interactive conversion tool. Values were rounded to the nearest whole number, so column totals may not align.

J. Biogas Uses

Most AD facilities have more than one use for the biogas they produce, and the survey questions regarding biogas uses permitted multiple responses. All digester types were asked 1) if the biogas produced was used onsite, sold, or flared, with multiple responses permitted, and 2) if they were able to utilize all the biogas produced at their facility. Not all respondents provided data on biogas uses.

Table 25 summarizes the ways in which respondents reported using biogas and **Figure 10** shows the top five uses of biogas produced at AD facilities as reported by each type of respondent. All types of respondents reported flaring some biogas, and all facilities that were unable to use all their biogas onsite flared the excess. Flaring is not included in Table 25 or Figure 10.

[23] https://www.epa.gov/sites/production/files/2016-05/interactiveconversiontool.xls

[24] Anaerobic Digestion and its Applications, EPA, October 2015, page 9.

[25] The average home consumed 11,880 kWh of delivered electricity in 2019, the most recent date for which data is available (https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references).

Stand-Alone Digesters

Ninety-five percent of facilities used some or all of the biogas onsite, 5% flared some or all biogas, and 5% sold some or all biogas produced at their facility; 5% reported multiple uses. Eighty-six percent of stand-alone digesters reported being able to utilize all of the biogas they produced, through onsite use or sale.

On-Farm Co-Digesters

Sixty-seven percent of on-farm co-digesters stated onsite use for some or all biogas produced, 50% stated it was sold, 33% stated it was flared; 50% reported multiple uses. Seventy-five percent of on-farm digesters reported that all the biogas they produced was used.

Co-Digestion Systems at WRRFs

Of WRRFs with co-digestion systems, 86% reported some or all biogas used onsite, 12% reported some or all sold, 64% reported some or all flared; 56% reported multiple uses. Thirty-seven percent of facilities stated they utilize all the biogas produced at their facility. In addition to the uses in Table 25, one WRRF operator reported using biogas to fuel a sludge dryer.

Table 25: Reported Uses of Biogas Produced at Anaerobic Digesters

	Stand-Alone Digesters		On-Farm Co-Digesters		Co-Digestion Systems at WRRFs	
Biogas Use	***Number of Facilities Reporting Use***	***Percentage of Facilities using Biogas as Specified****	***Number of Facilities Reporting Use***	***Percentage of Facilities using Biogas as Specified†***	***Number of Facilities Reporting Use***	***Percentage of Facilities using Biogas as Specified‡***
Produce heat and electricity (CHP)	7	32%	6	50%	39	67%
Fuel boilers and furnaces to heat digesters	2	9%	2	17%	31	53%
Fuel boilers and furnaces to heat other spaces	12	55%	2	17%	21	36%
Produce electricity (sold to grid)	6	29%	4	33%	5	9%
Produce electricity used behind the meter (including net metering)	2	10%	4	33%	11	19%
Produce mechanical power	0	-	0	-	3	5%
Compressed to vehicle fuels: used for company fleet/personal vehicles	1	5%	0	-	1	2%
Compressed to vehicle fuels: sold to customers	0	-	0	-	1	2%
Renewable natural gas (inject to pipeline)	0	-	1	8%	4	7%

*Percentage out of the 22 stand-alone facilities providing data on biogas uses.
†Percentage out of the 12 farms providing survey responses.
‡Percentage out of the 59 WRRFs providing survey responses.

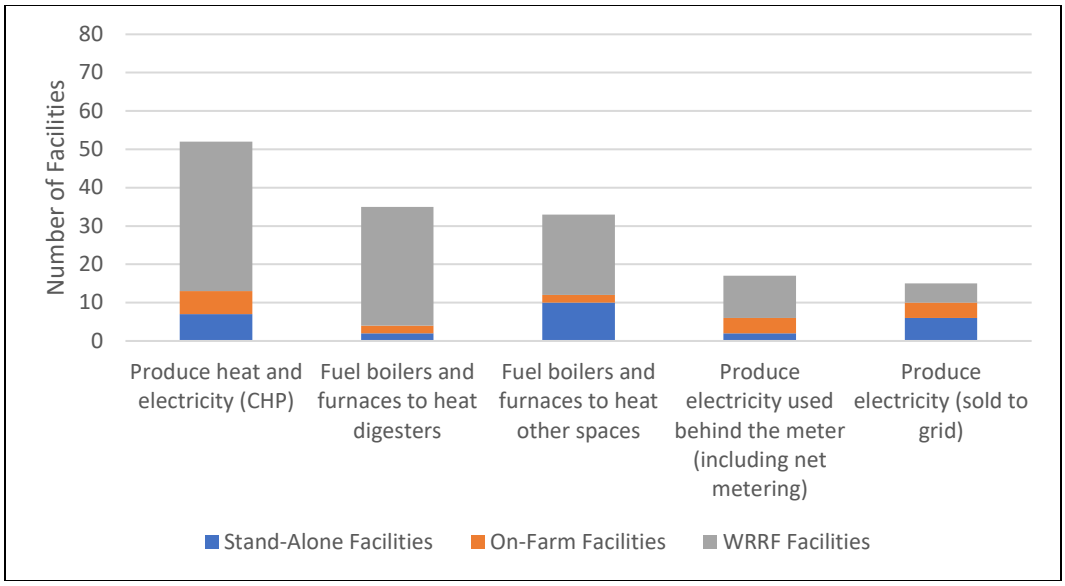

Figure 10: Top Five Uses of Biogas

K. Gas Cleaning Systems

The 2021 survey asked each facility type whether they had a gas cleaning system. Gas cleaning systems were utilized at 17 out of 21 (81%) stand-alone digesters, four out of 12 (33%) on-farm co-digesters, and 45 out of 59 (76%) co-digesters at WRRFs.

Each facility type was also asked what constituents were removed by their gas cleaning systems. All digesters that utilize gas cleaning systems provided data on the constituents removed by these systems. **Table 26** summarizes the type and frequency of constituents removed by gas cleaning systems for each type of digester and **Figure 11** shows the top five constituents removed by digester type.

Table 26: Reported Gas Cleaning Systems at Anaerobic Digesters

	Stand-Alone Digesters		On-Farm Co-Digesters		Co-Digestion Systems at WRRFs	
Constituent	***Number of Facilities Reporting Removal***	***Percentage Reporting Removal of this Constituent****	***Number of Facilities Reporting Removal***	***Percentage Reporting Removal of this Constituent†***	***Number of Facilities Reporting Removal***	***Percentage Reporting Removal of this Constituent‡***
Sulfur	13	62%	2	50%	19	42%
Moisture	5	24%	1	25%	40	89%
Siloxanes	1	5%	0	-	42	93%
Carbon Dioxide	1	5%	1	25%	8	18%
Hydrogen Sulfide	3	14%	2	50%	36	80%
Compressed gas	0	-	0	-	4	9%
VOCs	1	5%	0	-	4	9%
Oxygen	0	-	0	-	3	7%
Nitrogen	0	-	0	-	3	7%
Particulates	1	5%	1	25%	14	31%

*Percentage out of 21 stand-alone digesters providing data on constituents removed.
†Percentage out of four on-farm digesters providing data on constituents removed.
‡Percentage out of 45 WRRFs providing data on constituents removed.

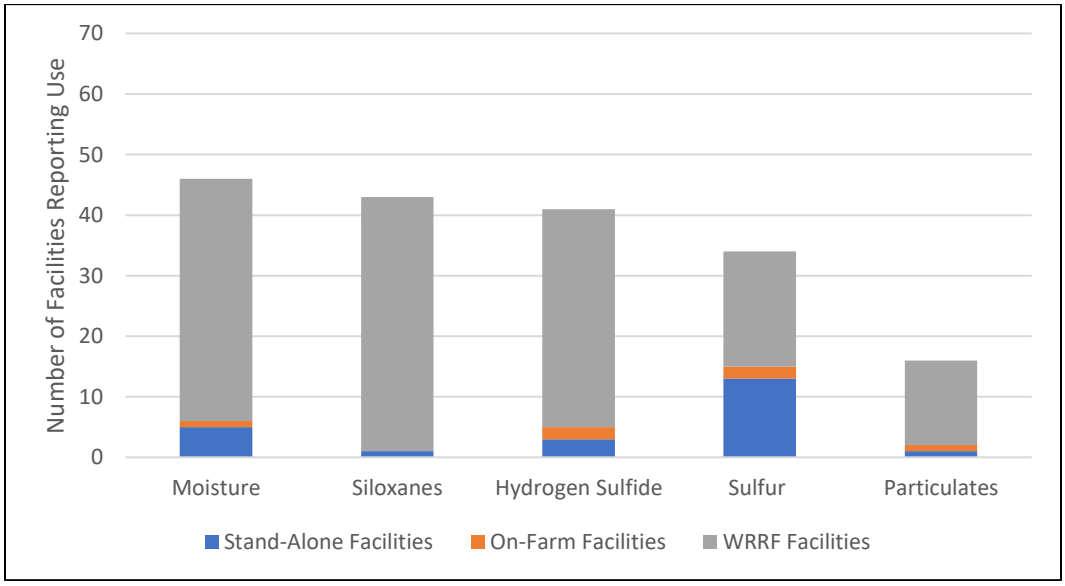

Figure 11: Top Five Constituents Removed

L. Solid Digestate Uses

EPA asked how facilities use the solid digestate they produce, allowing respondents to provide more than one answer. **Table 27** shows the frequencies at which common uses/destinations of solid digestate were reported by the three digester types surveyed. **Figure 12** shows the top five uses/destinations of solid digestate by digester type.

Table 27: Reported Solid Digestate Uses/Destinations

	Stand-Alone Digesters		On-Farm Co-Digesters		Co-Digestion Systems at WRRFs	
Digestate Use	***Number of Facilities Reporting Use***	***Percentage using Solid Digestate as Specified****	***Number of Facilities Reporting Use***	***Percentage using Solid Digestate as Specified†***	***Number of Facilities Reporting Use***	***Percentage using Solid Digestate as Specified‡***
De-watered and land applied**	5	25%	3	25%	36	62%
Composted into a reusable/ salable product	11	55%	3	25%	8	14%
Landfilled	0	-	0	-	19	33%
Other	5	25%	1	13%	8	14%
Processed into animal bedding	1	5%	8	67%	-	-
Dried into a reusable/ salable product (e.g., fertilizer)	1	5%	0	-	3	5%
Land applied as is with no dewatering or drying	4	20	-	-	7	12%
Incinerated	0	-	0	-	2	3%

*Percentage calculation based on 20 stand-alone facilities providing data on use of solid digestate.
†Percentage calculation based on 12 farms providing data on use of solid digestate.
‡ Percentage calculation based on 58 WRRFs providing data on use of solid digestate.
**"Land application" most often refers to spreading digestate or biosolids as fertilizer or soil amendment, most often on agricultural or reclaimed land.

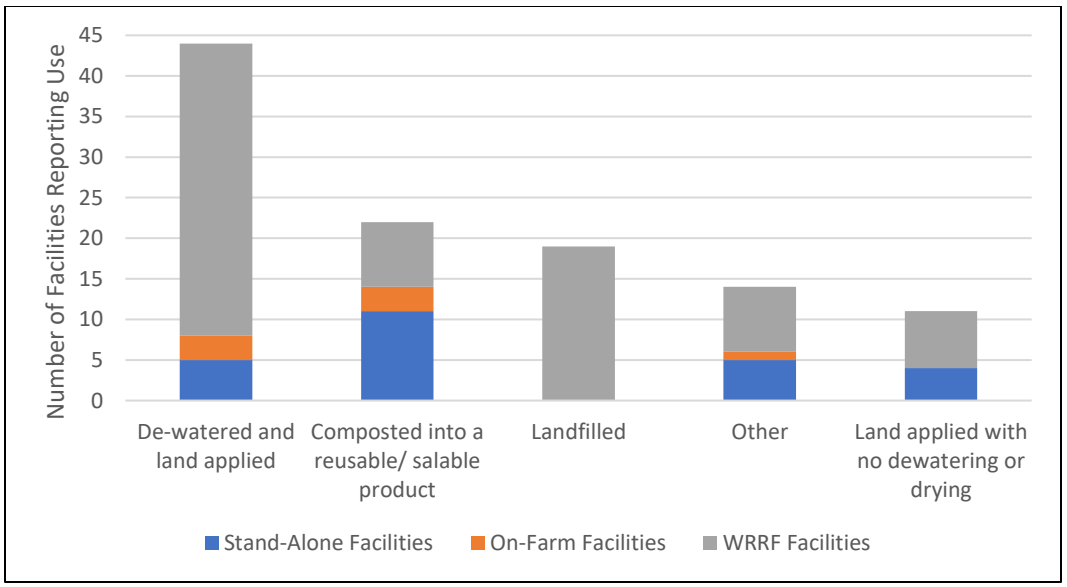

Figure 12: Top Five Uses/Destinations of Solid Digestate

Stand-alone digester operators also reported the following other uses/destinations of digestate, summarized from survey responses:

- Sold to other digesters (three responses);
- Registered as fertilizer with state chemist (one);
- Sent to landfill or WWTP (one).

No on-farm co-digester operators specified "other" digestate use. WRRF digester operators reported the following other uses for biosolids (digested wastewater solids) produced (one WRRF per use):

- Thermal hydrolysis;
- Used as alternative daily landfill cover;
- Heat dried and sold as fertilizer;
- Dewatered with centrifuges and processed in rotary kiln for class "A" fertilizer land application;
- Sent to gypsum mine and used as backfill of exhausted mines;
- Thermal oil sludge dryer;
- Transshipped as liquid for dewatering;
- Facility manufacturing of fertilizer pellets.

Out of the responses received from WRRF digester operators, nine facilities (16%) indicated that they produce Class A biosolids and 48 facilities (84%) indicated that they produce Class B biosolids.[26] This is a change from the previous survey, in which 22% of responding facilities reported producing Class A biosolids and 78% reported producing Class B biosolids. This change could be due to different facilities responding to the survey in 2019 versus 2021.

The federal biosolids rule is contained in Title 40 of the Code of Federal Regulations (CFR) Part 503 and defines two types of biosolids with respect to pathogen reduction, Class A and Class B, depending on the degree of treatment the solids have received. Class A biosolids contain no detectible levels of pathogens. Class B biosolids are treated but still contain detectible levels of pathogens. There are buffer requirements, public access, and crop harvesting restrictions for virtually all forms of Class B biosolids.

Table 28 shows the breakout of landfilled and incinerated amounts in tons of solid digestate as reported by digesters.

Table 28: Solid Digestate Landfill and Incineration (dry tons)

	Stand Alone*	On-Farm	WRRF†
Landfilled	3.91	-	235,228
Incinerated	-	-	48,662
*Assume 0.032 kg/l to convert from gallons to dry tons. From "Density of biogas digestate depending on temperature and composition," May 2015. †Assume 30% Total Solids (TS) to convert wet tons to dry tons.			

M. Liquid Digestate Uses

EPA asked how facilities manage liquid digestate, allowing respondents to provide more than one answer, and these responses are summarized in **Table 29**. **Figure 13** shows the top uses/destinations of liquid digestate. No stand-alone digesters, one on-farm digester, and five WRRF

[26] For additional information on biosolids, please reference https://www.epa.gov/biosolids.

digesters that used liquid digestate as fertilizer via land application indicated further processing prior to application. Further treatments included thermal hydrolysis, belt press, rotary kiln, and aerobic holding tank.

Table 29: Reported Liquid Digestate Uses/Destinations

	Stand-Alone Digesters		On-Farm Co-Digesters		Co-Digestion Systems at WRRFs	
Digestate Use	***Number of Facilities Reporting Use***	***Percentage using Liquid Digestate as Specified****	***Number of Facilities Reporting Use***	***Percentage using Liquid Digestate as Specified†***	***Number of Facilities Reporting Use***	***Percentage using Liquid Digestate as Specified‡***
Recirculated through digester	1	5%	2	17%	15	26%
Reused as fertilizer via land application	7	33%	12	100%	16	28%
Discharged to a wastewater treatment plant	12	57%	0	-	-	-
Other	3	14%	0	-	27	47%

*Percentage calculation based on 21 stand-alone facilities providing data on use of liquid digestate.
†Percentage calculation based on 12 farms providing data on use of liquid digestate.
‡Percentage calculation based on 57 WRRFs providing data on use of liquid digestate.

Many WRRF facilities (22 of the 27) checking "other" indicated that the liquid digestate is recirculated through the treatment plant.

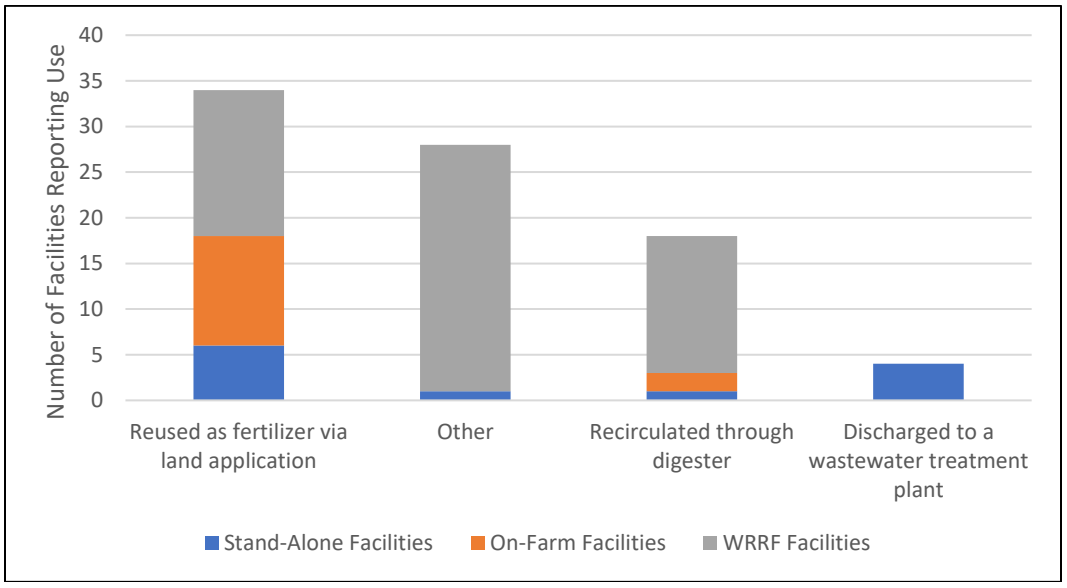

Figure 13: Uses/Destinations of Liquid Digestate

Facilities were also asked about recovering nutrients from digestate. The results are below:

- Ammonia recovery: one farm, one stand-alone, one WRRF;
- Phosphorus recovery by chemical precipitation (struvite): three WRRFs.

IV. Conclusion

EPA's 2021 survey of three types of AD facilities in the U.S. (stand-alone digesters, on-farm co-digesters, and co-digesters at WRRFs) provided estimates of the number and location of facilities processing food waste in the U.S., their total amounts processed in 2019, and their available capacity to process food waste. EPA's survey also gathered information on the non-food waste processed at these facilities, feedstock types and sources, tipping fees, pre-processing/de-packaging techniques, operational specifications, biogas production and uses, gas cleaning systems, and solid and liquid digestate uses. Lastly, EPA gathered information on facilities not yet operational, but that were anticipated to become operational in the future.

Based on information received directly from facilities that responded to the 2021 survey, the total reported processing capacity for food waste at the responding AD facilities was approximately 42.7 million tons per year in 2019. The total amount of food waste processed was approximately 17.6 million tons. The total amount of non-food waste from off-site sources (i.e. not manure at on-farm digesters or wastewater solids at WRRFs) processed was approximately 945,000 tons.

Table 30: Summary of 2021 Survey Results

Area of Data Collection	Result
Total Processing Capacity (2019)	42,735,437 tons
Total Food Waste Processed (2019)	17,598,063 tons
Total Food Waste Processed w/o Beverage Processing Waste	2,660,946 tons (15% of total)
Total Non-Food Waste Processed at Co-Digesting Facilities (2019)	945,454 tons
Total Biogas Produced (2019)	29,877 SCFM
Top Five States with the Most Digesters	CA (20), PA (8), NY & MA (7), WI (6)
Top Three Food-based Feedstock Types (2019)	Beverage processing, FOG, food processing
Top Three Food-based Feedstock Sources (2019)	Manufacturing and processing, wholesale and retail, restaurants/food services
Top Three Biogas Uses	Produce heat and electricity (CHP), fuel boilers and furnaces to heat digesters, fuel boilers and furnaces to heat other spaces
Top Three Biogas Constituents Removed	Siloxanes, moisture, hydrogen sulfide
Top Three Uses of Solid Digestate	De-watered and land applied, composted into a reusable/salable product, landfilled
Top Three Uses of Liquid Digestate	Reused as fertilizer via land application, other, recirculated through digester

The extent to which the results of the 2021 survey can be compared with previous surveys should be caveated by the fact that the individual facilities responding from year to year are not identical. It should also be noted that facilities voluntarily choose to submit data. Because the 2021 survey had different facilities respond, the report cannot be used to express how the state of AD is increasing or decreasing overall.

Processed food waste doubled in this year's survey results because of the redesign of some key questions in the ICR renewal (effective as of February 2022). This allowed EPA to collect more granular data on the type and source of food-based feedstocks, and to apply densities to specific feedstocks. For example, beverage processing waste was assigned a density of 8.34 lb/gallon, while other food waste has a density closer to 3.8 lb/gallon. By using more specific conversion factors, EPA determined that beverage processing waste made up 85% of total food-based feedstock by weight. The 2021 survey was also the first time that non-food-based feedstocks were able to be combined into one unit, tons. The conversion of processing capacity from gallons to tons was also different than in previous surveys and capacity totals doubled.

The application of specific densities to specific feedstocks added detail to the data, but also made the total quantities of food waste processed less easily comparable to previous years' data. Quantifying food waste processed via AD in units such as calories or BTUs could better express the energy potential of a feedstock and offer a more nuanced description of the differences between feedstocks.

EPA hopes that the data submitted by AD facilities across the U.S. and summarized in this report will assist stakeholders in their strategies to divert more organic waste from landfills. Every type of solid waste management pathway or system has advantages and/or disadvantages. EPA encourages lifecycle thinking and decision making for communities when choosing which waste management pathways or systems work best for their circumstances. When developed and operated effectively, AD projects can provide economic, health, and environmental co-benefits to surrounding communities.

Appendix A – Operational Digesters and Co-Digestion Systems

This appendix lists the facilities that responded for each digester type. Two stand-alone facilities and five on-farm digesters preferred not to be mentioned by name but are included in the results. Facilities that responded to the 2021 survey are numbered, and this list is current as of October 2021.

Table 1A: Stand-Alone Digesters Co-Digesting Food Waste in the U.S.

Stand-Alone Facility Name		Location	Multi-Source (MS)/Industry-Dedicated (ID)/Other
1	AB-Inbev Baldwinsville	Baldwinsville, NY	ID
2	Cartersville BTS	Cartersville, GA	ID
3	Columbus BTS	Columbus, OH	ID
4	CRMC Bioenergy LLC	New Bedford, MA	MS
5	Fairfield Brewery BTS	Fairfield, CA	ID
6	Gills Onions, LLC	Oxnard, CA	ID
7	Hometown BioEnergy	Le Sueur, MN	MS
8	Houston BTS	Houston, TX	ID
9	Jacksonville BTS	Jacksonville, FL	ID
10	LA BTS	Van Nuys, CA	ID
11	Merrimack BTS	Merrimack, NH	ID
12	Newark BTS	Newark, NJ	ID
13	Pinellas County Utilities – South Cross Bayou AWRF	St. Petersburg, FL	Other
14	Quantum Biopower	Southington, CT	MS
15	Rialto Bioenergy Facility	Bloomington, CA	MS
16	St. Louis BTS	St. Louis, MO	ID
17	Stahlbush Island Farms	Corvallis, OR	ID
18	Viresco	Turtle Lake, WI	MS, ID
19	Waste No Energy, LLC	Monticello, IN	MS
20	Yolo County Anaerobic Composter Facility	Woodland, CA	MS

Table 2A: On-Farm Digesters Co-Digesting Food Waste in the U.S.

Farm Name		Location
1	Bar-way Farm AD	Deerfield, MA
2	Belden Ag-Grid LLC	Hatfield, MA
3	Bio Town Ag, Inc.	Reynolds, IN
4	Edaleen Cow Power LLC	Lynden, WA
5	FPE Renewables/Vander Haak Dairy	Lynden, WA
6	Green Mountain Dairy Farm LLC	Highgate, VT
7	Haverhill AD, Crescent Farm	Haverhill, MA
8	Hillcrest Saylor Dairy Farms LLC	Rockwood, PA
9	JMA Farms LLC	Beavertown, PA
10	Jordan Farm, Rutland AD1	Rutland, MA
11	Monument Farms Three Gen	Weybridge, VT
12	Noblehurst Green Energy	Linwood, NY
13	Salisbury AD1	Salisbury, VT

Table 3A: WRRF Digesters Co-Digesting Food Waste in the U.S.

WRRF Name		Location
1	Burlington Water Pollution Control Facility	Burlington, WI
2	Central Marin Sanitation Agency	San Rafael, CA
3	City of Davenport WPCP	Davenport, IA
4	City of Dubuque Water & Resource Recovery Center	Dubuque, IA
5	City of Flagstaff	Flagstaff, AZ
6	City of Gresham WWTP	Gresham, OR
7	City of Hayward WPCF	Hayward, CA
8	City of Newark Ohio Wastewater	Newark, OH
9	City of Pendleton WWTP	Pendleton, OR
10	City of Riverside, Regional Water Quality Control Plant	Riverside, CA
11	City of Sandpoint	Sandpoint, ID
12	City of Santa Rosa, Laguna Treatment Plant	Santa Rosa, CA
13	City of Springfield Southwest Wastewater Treatment Plant	Springfield, MO
14	City of St. Cloud NEW Recovery Facility	St. Cloud, MN
15	City of Stevens Point WWTP	Stevens Point, WI
16	Danville Sanitary District	Danville, IL
17	Delhi Charter Township Wastewater Treatment Plant	Holt, MI
18	Delta Diablo	Antioch, CA
19	Derry Twp Municipal Authority	Hershey, PA
20	Des Moines Metro WRA	Des Moines, IA
21	Douglas L Smith Middle Basin Wastewater Treatment Plant	Overland Park, KS
22	Downers Grove Sanitary District Wastewater Treatment Center	Downers Grove, IL
23	Durham Advanced Wastewater Facility	Tigard, OR
24	East Bay Municipal Utility District MWWTP	Oakland, CA
25	El Estero WRC	Santa Barbara, CA
26	Encina Wastewater Authority	Carlsbad, CA
27	F. Wayne Hill WRC	Buford, GA
28	Fairfield-Suisun Sewer District	Fairfield, CA
29	Flint Biogas	Flint, MI
30	Fond du Lac WTRRF	Fond du Lac, WI
31	Fresno Clovis RWRF	Fresno, CA
32	Gloversville Johnstown Joint Wastewater Treatment Facility	Johnstown, NY
33	Greater Lawrence Sanitary District	North Andover, MA
34	Green Bay Metropolitan Sewerage District (NEW Water)	Green Bay, WI
35	Hermitage Food Waste to Energy Facility	Hermitage, PA
36	Hill Canyon Treatment Plant	Camarillo, CA
37	Joint Water Pollution Control Plant	Carson, CA
38	Lower Poplar Water Reclamation Facility	Macon, GA
39	Lucas County WRRF	Waterville, OH
40	Mauldin Road Water Resource Recovery Facility	Greenville, SC
41	Milton Regional Sewer Authority	Milton, PA
42	MMSD - South Shore Water Reclamation Facility	Oak Creek, WI
43	MUB Wastewater Treatment	Albertville, AL

WRRF Name		Location
44	NAPA Sanitation District	Napa, CA
45	New Castle Sanitation Authority	New Castle, PA
46	North River Wastewater Treatment Facility	Mt. Crawford, VA
47	NYCDEP Newtown Creek Wastewater Resource Recovery Facility Codigestion Program	Brooklyn, NY
48	Oneida County Water Pollution Control Plant	Utica, NY
49	Opequon Water Reclamation Facility	Winchester, VA
50	Piney Creek WWTP	Beckley, WV
51	Rahway Valley Sewerage Authority	Rahway, NJ
52	Silicon Valley Clean water	Redwood City, CA
53	South Columbus Water Resource Facility	Columbus, GA
54	The Landis Sewerage Authority	Vineland, NJ
55	Theresa Street WRRF	Lincoln, NE
56	Urbana & Champaign Sanitary District	Urbana, IL
57	Village of Essex Junction	Essex Junction, VT
58	Waco Central WWTP	Waco, TX
59	West Lafayette WRRF	West Lafayette, IN

Appendix B – Digesters and Co-Digestion Systems Under Development or Temporarily Shut-Down

This appendix lists the stand-alone facilities and co-digestion systems at WRRFs that are under development or temporarily shut down. Two stand-alone facilities preferred not to be mentioned and are not included in this list. The lists in Table 1B and 2B are current as of October 2021.

Table 1B: Stand-Alone Anaerobic Digestion Facilities in the U.S. that are Under Development or Temporarily Shut Down

Stand-Alone Facility Name		Facility Status	Location
1	Linden Renewable Energy, LLC	Under construction	Linden, NJ
2	The ReSource Center at Tajiguas Landfill	Under construction	Santa Barbara, CA

Table 2B: WRRF's with Co-Digestion Systems in the U.S. that are Under Development or Temporarily Shut Down

WRRF Name		Facility Status	Location
3	City of Medford WRD	Planning/design/permitting	Central Point, OR
4	Regional Treatment Plant	Planning/design/permitting	Marina, CA
5	Sacramento Regional Community Services District	Temporarily shutdown	Elk Grove, CA

Appendix C – Digesters and Co-Digestion Systems that have Ceased Operations

This appendix lists the facilities for each digester type that have either ceased operations or are not going to be completed. One facility preferred not to be mentioned by name. This list is current as of October 2021.

Table 1C: Facilities that Have Ceased Operation or are not going to be Completed in the U.S.

Stand-Alone Digesters		
	Digester Name	**Location**
1	CR&R	Perris, CA
2	CleanWorld SATS (formerly Sacramento Biodigester)	Sacramento, CA
3	Garelick Farms	Lynn, MA
4	Gloucester City Organic Recycling	Marlton, NJ
5	Heartland Biogas	LaSalle, CO
6	IEUA RP5 Solids Handling Facility	Chino, California
7	JC- Biomethane Biogas Plant	Junction City, OR
8	Lime Lakes Energy	Norton, Ohio
9	Turning Earth	Southington, CT
Farm Digesters		
	Digester Name	**Location**
1	Central Sands Dairy	Nekoosa, WI
2	George Deruyter Dairy	Outlook, WA
3	Wild Rose Dairy	LaFarge, WI
WRRF Digesters		
	Digester Name	**Location**
1	Hyperion Treatment Plant	Playa del Rey, CA
2	Janesville Wastewater Treatment Plant	Janesville, WI
3	Sheboygan Wastewater Treatment Plant	Sheboygan, WI
4	Struthers Wastewater Treatment Plant	Struthers, OH

Appendix D – Survey Questions

This appendix provides the survey questions for each digester type regarding their use of food waste and food-based materials as a feedstock. EPA distributed the surveys via email directly to facility contacts, when known, and made the survey available on EPA's website under Anaerobic Digestion Data Collection Project.

Survey 1: Stand-Alone Anaerobic Digestion Facility Survey Questions
Survey 2: On-Farm Anaerobic Digester Survey Questions
Survey 3: Co-Digestion Systems at Water Resource Recovery Facilities Survey Questions

Welcome to the EPA 2021 Anaerobic Digestion (AD) **stand-alone** survey.

Participating in this survey enables policymakers, investors, and interested stakeholders to gain a comprehensive picture of how food waste is being handled in AD facilities across the country. Your answers help others glean important information, such as:

- how much food waste is digested,
- what available capacity exists,
- feedstock type,
- feedstock source, and
- tipping revenue.

We only publish results in aggregate, so anything you note about your operations is solely for our purposes at EPA to communicate with you individually.

We sincerely appreciate your input and completion of the survey!

1. I am a **stand-alone** digester taking the **stand-alone** survey.	
Yes.	☐
No. Please see other two links in your email.	☐

2. Please provide the following information about your Project/Facility. [Answer this question only if answer to Q#1 is Yes.]	
(a) Project/Facility Name:	
(b) Street 1:	
(c) Street 2:	
(d) City/Town:	(e) State:
(f) ZIP:	

3. Please provide the following information for the contact person for facility operations.
(a) Title:
(b) Full Name:
(c) Telephone:
(d) Email Address:

4. If you **do not** wish to have your facility's general information (facility name, city, state, facility type and operational status) included in future EPA reports, please check the box below.	
Please do not include the information above in future publications summarizing the data collected via this survey.	O

Follow the branching rules in the sequence given below. Jump to the page as specified in the branching rule if all the conditions specified in the rule are satisfied.
Rule 1: IF ANSWER TO (Question# 1 is (No. Please see other two links in your email.)) THEN Stop, you have finished the survey.

5. Which of the following choices best describes your facility?	
Multi-source Food Digester	☐
Industry-dedicated digester	☐
Other	☐

6. Please identify the status of your facility	
Planning stage/ Design stage/Permitting process	O
Under construction	O
Operational	O
Temporary shut-down	O
Ceased operation	O
Other	O

7. What date did your facility become operational? [Answer this question only if answer to Q#6 is Operational]

8. What date did your facility temporarily shut-down? [Answer this question only if answer to Q#6 is Temporary shut-down]

9. What date did your facility cease operations? [Answer this question only if answer to Q#6 is Ceased operation]

Follow the branching rules in the sequence given below. Jump to the page as specified in the branching rule if all the conditions specified in the rule are satisfied.
Rule 1: IF ANSWER TO (Question# 6 is (Planning stage/ Design stage/Permitting process OR Under construction)) THEN GO TO Question# 10
Rule 2: IF ANSWER TO (Question# 7 is before (01/01/2020)) THEN GO TO Question# 15
Rule 3: IF ANSWER TO (Question# 7 (01/01/2020)) THEN Stop, you have finished the survey.
Rule 4: IF ANSWER TO (Question# 6 is (Other)) THEN GO TO Question# 15
Rule 5: IF ANSWER TO (Question# 8 is before (01/01/2019)) THEN GO TO Question# 11
Rule 6: IF ANSWER TO (Question# 8 (01/01/2019)) THEN GO TO Question# 12
Rule 7: IF ANSWER TO (Question# 9 is before (01/01/2019)) THEN GO TO Question# 13
Rule 8: IF ANSWER TO (Question# 9 (01/01/2019)) THEN GO TO Question# 14

10. What is the targeted date for your facility to be operational?

Branching Instructions If 10 is Answered, then Stop, you have finished the survey If 10 is not Answered, then Stop, you have finished the survey

11. What is the targeted date for your facility to re-start operations?

Branching Instructions If 11 is Answered, then Stop, you have finished the survey If 11 is not Answered, then Stop, you have finished the survey

12. What is the targeted date for your facility to re-start operations?

Branching Instructions If 12 is Answered, then Go To 15 If 12 is not Answered, then Go To 15

13. Please state the reason your facility ceased operations.

Branching Instructions If 13 is Answered, then Stop, you have finished the survey If 13 is not Answered, then Stop, you have finished the survey

14. Please state the reason your facility ceased operations.

Please provide the total capacity for accepting food-based feedstock of your facility in 2019. Please watch zeros and use commas for amount, if helpful.

15. Select Units Here	Gallons	Tons (US)
Total Capacity	O	O

16. Type Number Here
(a) Total Capacity

17. Does your facility accept and process food-based feedstocks?	
Yes	O
No	O

Please describe the total amount of food-based feedstock accepted by your facility in 2019. Do this by typing in the amount of food waste, and selecting the units, feedstock type, and feedstock source. Please watch zeros and use commas, if helpful. [Answer this question only if answer to Q#17 is Yes]

18. Feedstock Type	Beverage Processing Industry Waste	Fats, Oils and Greases (FOG)	Food processing industry waste	Food service waste, pre- and post-consumer	Fruits/ vegetative wastes	Retail food waste	Slaughterhouse wastes	Source-separated commercial, institutional or residential organic wastes	Other
Feedstock 1	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O

19. Feedstock Source	Commercial-food retail/wholesale	Commercial-hospitality-sports venues	Commercial-hospitality and hotels	Commercial-hospitality-restaurants/food services	Industrial-manufacturing/processing	Industrial (other)	Institutional-office buildings	Institutional-hospitals	Institutional-correctional facilities	Institutional-colleges/universities	Institutional-K-12 schools	Institutional-military installations	Farmers Markets	Fruit/vegetable farms	Livestock farms	Residential	Food banks	Other
Feedstock 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

20. Units	Gallons	Tons (US)
Feedstock 1	O	O
Feedstock 2	O	O
Feedstock 3	O	O
Feedstock 4	O	O
Feedstock 5	O	O
Feedstock 6	O	O
Feedstock 7	O	O
Feedstock 8	O	O
Feedstock 9	O	O
Feedstock 10	O	O
Feedstock 11	O	O
Feedstock 12	O	O
Feedstock 13	O	O
Feedstock 14	O	O
Feedstock 15	O	O
Feedstock 16	O	O
Feedstock 17	O	O
Feedstock 18	O	O
Feedstock 19	O	O
Feedstock 20	O	O
Feedstock 21	O	O
Feedstock 22	O	O
Feedstock 23	O	O
Feedstock 24	O	O
Feedstock 25	O	O
Feedstock 26	O	O
Feedstock 27	O	O
Feedstock 28	O	O
Feedstock 29	O	O
Feedstock 30	O	O

21. Amount
(a) Feedstock 1
(b) Feedstock 2
(c) Feedstock 3
(d) Feedstock 4
(e) Feedstock 5
(f) Feedstock 6
(g) Feedstock 7
(h) Feedstock 8
(i) Feedstock 9
(j) Feedstock 10
(k) Feedstock 11
(l) Feedstock 12
(m) Feedstock 13
(n) Feedstock 14
(o) Feedstock 15
(p) Feedstock 16
(q) Feedstock 17
(r) Feedstock 18
(s) Feedstock 19
(t) Feedstock 20
(u) Feedstock 21
(v) Feedstock 22
(w) Feedstock 23
(x) Feedstock 24
(y) Feedstock 25
(z) Feedstock 26
(aa) Feedstock 27
(ab) Feedstock 28
(ac) Feedstock 29
(ad) Feedstock 30

22. Does your facility accept and process non-food-based feedstocks?	
Yes	O
No	O

Please describe the total amount of non-food-based feedstock accepted by your facility in 2019. Do this by typing in the amount of non-food waste, and selecting the units, feedstock type, and feedstock source. If feedstock type or source is unknown or if you do not collect it, please select "other" for these responses. Please watch zeros and use commas for amount, if helpful.

23. Feedstock type	Crop Residues	Crude Glycerin	De-icing fluid	Lab (or pharma) wastes	Manures	Mixed Yard Waste	Paper Mill Wastes	Septage	Wastewater solids (sludge)	Other
Feedstock 1	O	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O	O

24. Feedstock source	Airports	Biodiesel production	Industrial	Laboratories/ Pharmaceutical companies	Retail Stores	Wastewater Treatment Plants	Other
Feedstock 1	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O

25. Units	Gallons	Tons (US)
Feedstock 1	O	O
Feedstock 2	O	O
Feedstock 3	O	O
Feedstock 4	O	O
Feedstock 5	O	O
Feedstock 6	O	O
Feedstock 7	O	O
Feedstock 8	O	O
Feedstock 9	O	O
Feedstock 10	O	O
Feedstock 11	O	O
Feedstock 12	O	O
Feedstock 13	O	O
Feedstock 14	O	O
Feedstock 15	O	O
Feedstock 16	O	O
Feedstock 17	O	O
Feedstock 18	O	O
Feedstock 19	O	O
Feedstock 20	O	O
Feedstock 21	O	O
Feedstock 22	O	O
Feedstock 23	O	O
Feedstock 24	O	O
Feedstock 25	O	O
Feedstock 26	O	O
Feedstock 27	O	O
Feedstock 28	O	O
Feedstock 29	O	O
Feedstock 30	O	O

26. Amount
(a) Feedstock 1
(b) Feedstock 2
(c) Feedstock 3
(d) Feedstock 4
(e) Feedstock 5
(f) Feedstock 6
(g) Feedstock 7
(h) Feedstock 8
(i) Feedstock 9
(j) Feedstock 10
(k) Feedstock 11
(l) Feedstock 12
(m) Feedstock 13
(n) Feedstock 14
(o) Feedstock 15
(p) Feedstock 16
(q) Feedstock 17
(r) Feedstock 18
(s) Feedstock 19
(t) Feedstock 20
(u) Feedstock 21
(v) Feedstock 22
(w) Feedstock 23
(x) Feedstock 24
(y) Feedstock 25
(z) Feedstock 26
(aa) Feedstock 27
(ab) Feedstock 28
(ac) Feedstock 29
(ad) Feedstock 30

27. Do you collect tipping fees?	
Yes	O
No	O

28. Are you willing to share information about the tipping fees you collect? [Answer this question only if answer to Q#27 is Yes] [Please consider providing a response. This information will be helpful for survey administrators.]	
Yes	O
No	O

29. How much revenue did your facility collect in tipping fees in 2019? [Answer this question only if answer to Q#28 is Yes] [Please consider providing a response. This information will be helpful for survey administrators.]

30. If you would like to provide any other relevant or important information related to tipping fees, please do so below.

31. Are pre-processing or de-packaging activities conducted on your feedstocks before they are added to your digester?	
Offsite	O
Onsite (at your facility)	O
Both	O
None of the above	O

32. Please identify the pre-packaging or de-packaging activities that are conducted at your facility. Check all that apply.	
Manual or mechanized de-packaging	☐
Screening for debris or sorting	☐
Grinding and/or maceration	☐
Third party processing	☐
Shredding	☐
Heating	☐
pH adjustment	☐
Centrifugal separation	☐
Liquid/solid separation	☐
Other (Please specify)	☐

33. Please identify the operating temperature range for your digester.	
Mesophilic	O
Thermophilic	O
Unheated/ambient	O

34. Please indicate if your digester is "wet" or "dry."	
Wet, low-solids system, less than 15% (by volume) solids content.	O
Dry, high-solids system, greater than 15% (by volume) solids content.	O

35. Please identify the design that best fits your design type/configuration:	
Continuously Stirred Tank Reactor (CSTR)	O
Plug-flow	O
Covered Lagoon	O
Fixed film	O
Suspended Media	O
Percolating Bed	O
Up flow Anaerobic Sludge Blanket (UASB)	O
Anaerobic Sequencing Batch Reactor (ASBR)	O
Membrane Bioreactor (MBR)	O
Hybrid/Multi-stage	O
Other (Please specify)	O

Please provide the average biogas production volume at your facility during calendar year 2019 in one of the units identified below. Please watch zeros and use commas for amount, if helpful.

36. Units	SCFD	SCFM	SCFY	Other (Please specify with amount)
Average Biogas Production	O	O	O	O

37. Amount
(a) Average Biogas Production

38. Is the biogas produced at this facility?	
Used onsite	☐
Sold	☐
Flared	☐
Other (Please specify)	☐

39. Please identify how the biogas produced at this facility is used. It could be used onsite by the facility or offsite by a purchaser. Check all that apply.	
Produce mechanical power	☐
Produce heat and electricity (CHP)	☐
Produce electricity (including net metering)	☐
Produce electricity (sold to grid)	☐
Fuel boilers and furnaces to heat digesters	☐
Fuel boilers and furnaces to heat other spaces	☐
Compressed to vehicle fuels: used for company fleet/personal vehicles	☐
Compressed to vehicle fuels & sold to customers	☐
Renewable natural gas (processed in order to inject to pipeline)	☐
Other (Please specify)	☐

40. Are you able to utilize all of the biogas produced?	
Yes	O
No	O

41. Do you flare the excess biogas? [Answer this question only if answer to Q#40 is No]	
Yes	O
No	O

42. Do you have a gas cleaning system?	
Yes	O
No	O

43. What is removed by your gas purification system? Check all that apply. [Answer this question only if answer to Q#42 is Yes]	
Moisture	☐
Sulfur	☐
Siloxanes	☐
Carbon Dioxide	☐
Compressed Gas	☐
Hydrogen sulfide	☐
Particulates	☐
Oxygen	☐
Nitrogen	☐
VOCs	☐
Other (Please specify)	☐

44. Do you use the solid digestate you produce in any of the following ways? Check all that apply.	
De-watered/dried and land applied	☐
Land applied as is with no dewatering or drying	☐
Composted into a reusable or salable product	☐
Processed into other salable products (e.g., flower pots)	☐
Landfilled	☐
Incinerated	☐
Other (Please specify)	☐

If any digestate was disposed of in landfills or incinerated in 2019, please specify the amount in tons or gallons (if known).

45. Units	Tons (US)	Gallons
Landfilled	O	O
Incinerated	O	O

46. Amount
(a) Landfilled
(b) Incinerated

47. Is the de-watered/dried digestate further treated prior to land application?	
Yes	O
No	O
N/A	O

48. How do you manage the liquid digestate you produce? Check all that apply.	
Beneficially reused as fertilizer via land application	☐
Recirculated through digester	☐
Discharged to a wastewater treatment plant	☐
Other (Please specify)	☐

49. Is the liquid digestate further treated prior to land application?	
Yes	O
No	O
N/A	O

50. Please indicate what the further treatment is and why it is necessary. [Answer this question only if answer to Q#49 is Yes]

51. Do you recover nutrients from your digestate?	
No	O
Yes, phosphorous recovery by chemical precipitation (e.g., struvite)	O
Yes, ammonia recovery	O
Other (Please specify)	O

52. If you have any additional comments, please leave them below.

End of Survey.

Welcome to the EPA 2021 Anaerobic Digestion (AD) **Farm** Survey.

Participating in this survey enables policymakers, investors, and interested stakeholders to gain a comprehensive picture of how food waste is being handled in AD facilities across the country. Your answers help others glean important information, such as:

- how much food waste is digested,
- what available capacity exists,
- feedstock type,
- feedstock source, and
- tipping revenue.

We only publish results in aggregate, so anything you note about your farm operations is solely for our purposes at EPA to communicate with you individually.

We sincerely appreciate your input and completion of the survey!

1. I am a **farm** and am taking the **farm** survey.	
Yes.	☐
No. Please see other two links in your email.	☐

2. Please provide the following information about your Project/Farm. [Answer this question only if answer to Q#1 is Yes.]	
(a) Project/Farm Name:	
(b) Street 1:	
(c) Street 2:	
(d) City/Town:	(e) State:
(f) ZIP:	

3. Please provide the following information for the contact person for farm operations.
(a) Title:
(b) Full Name:
(c) Telephone:
(d) Email Address:

4. If you **do not** wish to have your farm's general information (farm name, city, state, farm type and operational status) included in future EPA reports, please check the box below.	
Please do not include the information above in future publications summarizing the data collected via this survey.	O

Follow the branching rules in the sequence given below. Jump to the page as specified in the branching rule if all the conditions specified in the rule are satisfied.
Rule 1: IF ANSWER TO (Question# 1 is (No. Please see other two links in your email.)) THEN Stop, you have finished the survey.

5. It is assumed that your anaerobic digestion system was primarily built to process livestock manures produced on your farm. In addition to this manure waste stream, are organic wastes accepted from offsite sources and processed in your anaerobic digester (practice of co-digestion)?	
Yes	O
No	O

6. If organic waste is currently not accepted from offsite sources and processed in your anaerobic digester, is your farm planning for or interested in receiving organic wastes from offsite? [Answer this question only if answer to Q#5 is No]	
Yes	O
No	O

7. Please identify the status of your farm.	
Planning stage/ Design stage/Permitting process	O
Under construction	O
Operational	O
Temporary shut-down	O
Ceased operation	O
Other	O

8. What date did your farm become operational? [Answer this question only if answer to Q#7 is Operational]

9. What date did your farm temporarily shut-down? [Answer this question only if answer to Q#7 is Temporary shut-down]

10. What date did your farm cease operations? [Answer this question only if answer to Q#7 is Ceased operation]

Follow the branching rules in the sequence given below. Jump to the page as specified in the branching rule if all the conditions specified in the rule are satisfied.
Rule 1: IF ANSWER TO (Question# 8 is before (01/01/2020)) THEN GO TO Question# 16
Rule 2: IF ANSWER TO (Question# 8 (01/01/2020)) THEN Stop, you have finished the survey .
Rule 3: IF ANSWER TO (Question# 7 is (Planning stage/ Design stage/Permitting process OR Under construction)) THEN GO TO Question# 11
Rule 4: IF ANSWER TO (Question# 9 is before (01/01/2019)) THEN GO TO Question# 12
Rule 5: IF ANSWER TO (Question# 9 (01/01/2019)) THEN GO TO Question# 13
Rule 6: IF ANSWER TO (Question# 10 is before (01/01/2019)) THEN GO TO Question# 14
Rule 7: IF ANSWER TO (Question# 10 (01/01/2019)) THEN GO TO Question# 15
Rule 8: IF ANSWER TO (Question# 7 is (Other)) THEN GO TO Question# 16

11. What is the targeted date for your farm to be operational?

Branching Instructions If 11 is Answered, then Stop, you have finished the survey If 11 is not Answered, then Stop, you have finished the survey

12. What is the targeted date for your farm to re-start operations?

Branching Instructions If 12 is Answered, then Stop, you have finished the survey If 12 is not Answered, then Stop, you have finished the survey

13. What is the targeted date for your farm to re-start operations?

Branching Instructions If 13 is Answered, then Go To 16 If 13 is not Answered, then Go To 16

14. Please state the reason your farm ceased operations.

Branching Instructions If 14 is Answered, then Stop, you have finished the survey If 14 is not Answered, then Stop, you have finished the survey

15. Please state the reason your farm ceased operations.

Taking into account the average volume of manure from your livestock processed in your anaerobic digestion system, please identify the available capacity in 2019 to process other feedstocks from offsite sources. Please watch zeros and use commas, if helpful.

16. Units	Tons (US)	Gallons
Available capacity	O	O

17. Amount
(a) Available capacity

18. Please briefly describe how you calculated the available capacity to accept feedstocks from offsite sources.

19. Please identify the number of months during the year 2019 that your anaerobic digestion system received and processed feedstocks from offsite sources.

20. Does your farm accept and process food-based feedstocks from off-site sources?	
Yes	O
No	O

Please describe the total amount of food-based feedstock accepted by your farm in 2019. Do this by typing in the amount of food waste, and selecting the units, feedstock type, and feedstock source. Please watch zeros and use commas, if helpful. [Answer this question only if answer to Q#20 is Yes]

21. Feedstock Type	Beverage Processing Industry Waste	Fats, Oils and Greases (FOG)	Food processing industry waste	Food service waste, pre- and post-consumer	Fruits/ vegetative wastes	Retail food waste	Slaughter-house wastes	Source-separated commercial, institutional or residential organic wastes	Other
Feedstock 1	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O

22. Feedstock Source	Commercial-food retail/ wholesale	Commercial-hospitality-sports venues	Commercial-hospitality and hotels	Commercial-hospitality-restaurants/ food services	Industrial-manufacturing /processing	Industrial (other)	Institutional-office	Institutional-hospitals	Institutional-correctional facilities	Institutional-colleges/universities	Institutional-K-12 schools	Institutional-military installations	Farmers Markets	Fruit/vegetable farms	Livestock farms	Residential	Food banks	Other
Feedstock 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

23. Units	Gallons	Tons (US)
Feedstock 1	0	0
Feedstock 2	0	0
Feedstock 3	0	0
Feedstock 4	0	0
Feedstock 5	0	0
Feedstock 6	0	0
Feedstock 7	0	0
Feedstock 8	0	0
Feedstock 9	0	0
Feedstock 10	0	0
Feedstock 11	0	0
Feedstock 12	0	0
Feedstock 13	0	0
Feedstock 14	0	0
Feedstock 15	0	0
Feedstock 16	0	0
Feedstock 17	0	0
Feedstock 18	0	0
Feedstock 19	0	0
Feedstock 20	0	0
Feedstock 21	0	0
Feedstock 22	0	0
Feedstock 23	0	0
Feedstock 24	0	0
Feedstock 25	0	0
Feedstock 26	0	0
Feedstock 27	0	0
Feedstock 28	0	0
Feedstock 29	0	0
Feedstock 30	0	0

24. Amount
(a) Feedstock 1
(b) Feedstock 2
(c) Feedstock 3
(d) Feedstock 4
(e) Feedstock 5
(f) Feedstock 6
(g) Feedstock 7
(h) Feedstock 8
(i) Feedstock 9
(j) Feedstock 10
(k) Feedstock 11
(l) Feedstock 12
(m) Feedstock 13
(n) Feedstock 14
(o) Feedstock 15
(p) Feedstock 16
(q) Feedstock 17
(r) Feedstock 18
(s) Feedstock 19
(t) Feedstock 20
(u) Feedstock 21
(v) Feedstock 22
(w) Feedstock 23
(x) Feedstock 24
(y) Feedstock 25
(z) Feedstock 26
(aa) Feedstock 27
(ab) Feedstock 28
(ac) Feedstock 29
(ad) Feedstock 30

25. Does your farm accept and process non-food-based feedstocks from off-site sources?	
Yes	O
No	O

Please describe the total amount of non-food-based feedstock accepted by your farm in 2019. Do this by typing in the amount of non-food waste, and selecting the units, feedstock type, and feedstock source. If feedstock type or source is unknown or if you do not collect it, please select "other" for these responses. Please watch zeros and use commas for amount, if helpful. [Answer this question only if answer to Q#25 is Yes]

26. Feedstock type	Crop Residues	Crude Glycerin	De-icing fluid	Lab (or pharma) wastes	Manures	Mixed Yard Waste	Paper Mill Wastes	Septage	Wastewater solids (sludge)	Other
Feedstock 1	O	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O	O

27. Feedstock source	Airports	Biodiesel production	Industrial	Laboratories/ Pharmaceutical companies	Retail Stores	Wastewater Treatment Plants	Other
Feedstock 1	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O

28. Units	Gallons	Tons (US)
Feedstock 1	0	0
Feedstock 2	0	0
Feedstock 3	0	0
Feedstock 4	0	0
Feedstock 5	0	0
Feedstock 6	0	0
Feedstock 7	0	0
Feedstock 8	0	0
Feedstock 9	0	0
Feedstock 10	0	0
Feedstock 11	0	0
Feedstock 12	0	0
Feedstock 13	0	0
Feedstock 14	0	0
Feedstock 15	0	0
Feedstock 16	0	0
Feedstock 17	0	0
Feedstock 18	0	0
Feedstock 19	0	0
Feedstock 20	0	0
Feedstock 21	0	0
Feedstock 22	0	0
Feedstock 23	0	0
Feedstock 24	0	0
Feedstock 25	0	0
Feedstock 26	0	0
Feedstock 27	0	0
Feedstock 28	0	0
Feedstock 29	0	0
Feedstock 30	0	0

29. Amount
(a) Feedstock 1
(b) Feedstock 2
(c) Feedstock 3
(d) Feedstock 4
(e) Feedstock 5
(f) Feedstock 6
(g) Feedstock 7
(h) Feedstock 8
(i) Feedstock 9
(j) Feedstock 10
(k) Feedstock 11
(l) Feedstock 12
(m) Feedstock 13
(n) Feedstock 14
(o) Feedstock 15
(p) Feedstock 16
(q) Feedstock 17
(r) Feedstock 18
(s) Feedstock 19
(t) Feedstock 20
(u) Feedstock 21
(v) Feedstock 22
(w) Feedstock 23
(x) Feedstock 24
(y) Feedstock 25
(z) Feedstock 26
(aa) Feedstock 27
(ab) Feedstock 28
(ac) Feedstock 29
(ad) Feedstock 30

30. Do you collect tipping fees?	
Yes	O
No	O

31. Are you willing to share information about the tipping fees you collect? [Answer this question only if answer to Q#30 is Yes] [Please consider providing a response. This information will be helpful for survey administrators.]	
Yes	O
No	O

32. How much revenue did your farm collect in tipping fees in 2019? [Answer this question only if answer to Q#31 is Yes] [Please consider providing a response. This information will be helpful for survey administrators.]

33. If you would like to provide any other relevant or important information related to tipping fees, please do so below.

34. Are pre-processing or de-packaging activities conducted on your feedstocks before they are added to your digester?	
Offsite	O
Onsite (at your farm)	O
Both	O

35. Please identify the pre-packaging or de-packaging activities that are conducted at your farm. Check all that apply.	
Manual or mechanized de-packaging	☐
Screening for debris or sorting	☐
Grinding and/or maceration	☐
Third party processing	☐
Shredding	☐
Heating	☐
pH adjustment	☐
Centrifugal separation	☐
Liquid/solid separation	☐
Other (Please specify)	☐

36. Please identify the operating temperature range for your digester.	
Mesophilic	O
Thermophilic	O
Unheated/ambient	O

37. Please indicate if your digester is "wet" or "dry."	
Wet, low-solids system, less than 15% (by volume) solids content.	O
Dry, high-solids system, greater than 15% (by volume) solids content.	O

38. Please identify the design that best fits your design type/configuration:	
Continuously Stirred Tank Reactor (CSTR)	O
Plug-flow	O
Covered Lagoon	O
Fixed film	O
Suspended Media	O
Percolating Bed	O
Up flow Anaerobic Sludge Blanket (UASB)	O
Anaerobic Sequencing Batch Reactor (ASBR)	O
Membrane Bioreactor (MBR)	O
Hybrid/Multi-stage	O
Other (Please specify)	O

Please provide the average biogas production volume at your farm during calendar year 2019 in one of the units identified below. Please watch your zeros and use commas for amount, if helpful.

39. Units	SCFD	SCFM	SCFY	Other (Please specify with amount)
Average Biogas Production	O	O	O	O

40. Amount
(a) Average Biogas Production

41. Is the biogas produced at this farm?	
Used onsite	☐
Sold	☐
Flared	☐
Other (Please specify)	☐

42. Please identify how the biogas produced at this farm is used. It could be used onsite by the farm or offsite by a purchaser. Check all that apply.	
Produce mechanical power	☐
Produce heat and electricity (CHP)	☐
Produce electricity (including net metering)	☐
Produce electricity (sold to grid)	☐
Fuel boilers and furnaces to heat digesters	☐
Fuel boilers and furnaces to heat other spaces	☐
Compressed to vehicle fuels: used for company fleet/personal vehicles	☐
Compressed to vehicle fuels/sold to customers	☐
Renewable natural gas (processed in order to inject to pipeline)	☐
Other (Please specify)	☐

43. Are you able to utilize all of the biogas produced?	
Yes	O
No	O

44. Do you flare the excess biogas? [Answer this question only if answer to Q#43 is No]	
Yes	O
No	O

45. Do you have a gas cleaning system?	
Yes	O
No	O

46. What is removed by your gas purification system? Check all that apply. [Answer this question only if answer to Q#45 is Yes]	
Moisture	☐
Sulfur	☐
Siloxanes	☐
Carbon Dioxide	☐
Compressed Gas	☐
Hydrogen sulfide	☐
Particulates	☐
Oxygen	☐
Nitrogen	☐
VOCs	☐
Other (Please specify)	☐

47. Do you beneficially reuse the solid digestate you produce? Check all that apply.	
Yes, de-watered/dried and land applied.	☐
Yes, composted into a reusable or salable product.	☐
Yes, processed into animal bedding.	☐
Yes, processed into other salable product (e.g., flower pots).	☐
No, landfilled.	☐
No, incinerated.	☐
Other (Please specify)	☐

If any digestate was disposed of in landfills or incinerated in 2019, please specify the amount in tons or gallons (if known).

48. Units	Tons (US)	Gallons
Landfilled	O	O
Incinerated	O	O

49. Amount
(a) Landfilled
(b) Incinerated

50. Is the de-watered/dried digestate further treated prior to land application?	
Yes	O
No	O
N/A	O

51. How do you manage the liquid digestate you produce? Check all that apply.	
Beneficially reused as fertilizer via land application	☐
Recirculated through digester	☐
Discharged to a wastewater treatment plant	☐
Other (Please specify)	☐

52. Is the liquid digestate further treated prior to land application?	
Yes	O
No	O
N/A	O

53. Please indicate what the further treatment is and why it is necessary. [Answer this question only if answer to Q#52 is Yes]

54. Do you recover nutrients from your digestate?	
No	O
Yes, phosphorous recovery by chemical precipitation (e.g., struvite)	O
Yes, ammonia recovery	O
Other (Please specify)	O

55. If you have any additional comments, please leave them below.

End of survey.

Welcome to the EPA 2021 Anaerobic Digestion (AD) **Water Resource Recovery Facility (WRRF)** Survey.

Participating in this survey enables policymakers, investors, and interested stakeholders to gain a comprehensive picture of how food waste is being handled in AD facilities across the country. Your answers help others glean important information, such as:

- how much food waste is digested,
- what available capacity exists,
- feedstock type,
- feedstock source, and
- tipping revenue.

We only publish results in aggregate, so anything you note about your operations is solely for our purposes at EPA to communicate with you individually.

We sincerely appreciate your input and completion of the survey!

1. I am a **WRRF** taking the **WRRF** survey.	
Yes.	☐
No. Please see other two links in your email.	☐

2. Please provide the following information about your Project/Facility. [Answer this question only if answer to Q#1 is Yes.]	
(a) Project/Facility Name:	
(b) Street 1:	
(c) Street 2:	
(d) City/Town:	(e) State:
(f) ZIP:	

3. Please provide the following information for the contact person for facility operations.
(a) Title:
(b) Full Name:
(c) Telephone:
(d) Email Address:

4. If you **do not** wish to have your facility's general information (facility name, city, state, facility type and operational status) included in future EPA reports, please check the box below.	
Please do not include the information above in future publications summarizing the data collected via this survey.	O

5. In addition to wastewater solids, is organic waste accepted and processed in your anaerobic digesters (practice of co-digestion)?	
Yes	O
No	O

6. If organic waste is currently not accepted at your anaerobic digesters, is your facility planning for or interested in receiving organic wastes from offsite? [Answer this question only if answer to Q#5 is No]	
Yes	O
No	O

7. Please identify the status of your facility	
Planning stage/ Design stage/Permitting process	O
Under construction	O
Operational	O
Temporary shut-down	O
Ceased operation	O
Other	O

8. What date did your facility become operational? [Answer this question only if answer to Q#7 is Operational]

9. What date did your facility temporarily shut-down? [Answer this question only if answer to Q#7 is Temporary shut-down]

10. What date did your facility cease operations? [Answer this question only if answer to Q#7 is Ceased operation]

Follow the branching rules in the sequence given below. Jump to the page as specified in the branching rule if all the conditions specified in the rule are satisfied.
Rule 1: IF ANSWER TO (Question# 1 is (No. Please see other two links in your email.)) THEN Stop, you have finished the survey .
Rule 2: IF ANSWER TO (Question# 7 is (Planning stage/ Design stage/Permitting process OR Under construction)) THEN GO TO Question# 11
Rule 3: IF ANSWER TO (Question# 8 is before (01/01/2020)) THEN GO TO Question# 16
Rule 4: IF ANSWER TO (Question# 8 (01/01/2020)) THEN Stop, you have finished the survey .
Rule 5: IF ANSWER TO (Question# 9 is before (01/01/2019)) THEN GO TO Question# 12
Rule 6: IF ANSWER TO (Question# 9 (01/01/2019)) THEN GO TO Question# 13
Rule 7: IF ANSWER TO (Question# 10 is before (01/01/2019)) THEN GO TO Question# 14
Rule 8: IF ANSWER TO (Question# 10 (01/01/2019)) THEN GO TO Question# 15
Rule 9: IF ANSWER TO (Question# 7 is (Other)) THEN GO TO Question# 16

11. What is the targeted date for your facility to be operational?

Branching Instructions If 11 is Answered, then Stop, you have finished the survey If 11 is not Answered, then Stop, you have finished the survey

12. What is the targeted date for your facility to re-start operations?

Branching Instructions If 12 is Answered, then Stop, you have finished the survey If 12 is not Answered, then Stop, you have finished the survey

13. What is the targeted date for your facility to re-start operations?

Branching Instructions If 13 is Answered, then Go To 16 If 13 is not Answered, then Go To 16

14. Please state the reason your facility ceased operations.

Branching Instructions If 14 is Answered, then Stop, you have finished the survey If 14 is not Answered, then Stop, you have finished the survey

15. Please state the reason your facility ceased operations.

Please identify your facility's available capacity to accept feedstocks from offsite sources for all digesters combined, in 2019. When calculating this available capacity, please take into account the average volume of wastewater solids processed at your facility and conveyed to your plant via your collection system. Please watch zeros and use commas for amount, if helpful.

16. Units	Tons (US)	Gallons
Available capacity	O	O

17. Amount
(a) Available capacity

18. Please briefly describe how you calculated the available capacity to accept feedstocks from offsite sources.

19. Please identify the number of months during the year 2019 that your co-digestion system received and processed feedstocks (other than wastewater solids) from offsite sources.

20. Please indicate how organic feedstocks from offsite sources are handled upon receipt at your facility.	
Fed into a separate digester	O
Combined with wastewater solids	O
Other (Please specify)	O

21. Does your facility accept and process food-based feedstocks?	
Yes	O
No	O

Please describe the total amount of food-based feedstock accepted by your facility in 2019. Do this by typing in the amount of food waste, and selecting the units, feedstock type, and feedstock source. Please watch zeros and use commas, if helpful. [Answer this question only if answer to Q#21 is Yes]

22. Feedstock Type	Beverage Processing Industry Waste	Fats, Oils and Greases (FOG)	Food processing industry waste	Food service waste, pre- and post-consumer	Fruits/vegetative wastes	Retail food waste	Slaughterhouse wastes	Source-separated commercial, institutional or residential organic wastes	Other
Feedstock 1	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O

23. Feedstock Source	Commercial-food retail/wholesale	Commercial-hospitality-sports venues	Commercial-hospitality and hotels	Commercial-hospitality-restaurants/food services	Industrial-manufacturing/processing	Industrial (other)	Institutional-office buildings	Institutional-hospitals	Institutional-correctional facilities	Institutional-colleges/universities	Institutional-K-12 schools	Institutional-military installations	Farmers Markets	Fruit/vegetable farms	Livestock farms	Residential	Food banks	Other
Feedstock 1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

24. Units	Gallons	Tons (US)
Feedstock 1	O	O
Feedstock 2	O	O
Feedstock 3	O	O
Feedstock 4	O	O
Feedstock 5	O	O
Feedstock 6	O	O
Feedstock 7	O	O
Feedstock 8	O	O
Feedstock 9	O	O
Feedstock 10	O	O
Feedstock 11	O	O
Feedstock 12	O	O
Feedstock 13	O	O
Feedstock 14	O	O
Feedstock 15	O	O
Feedstock 16	O	O
Feedstock 17	O	O
Feedstock 18	O	O
Feedstock 19	O	O
Feedstock 20	O	O
Feedstock 21	O	O
Feedstock 22	O	O
Feedstock 23	O	O
Feedstock 24	O	O
Feedstock 25	O	O
Feedstock 26	O	O
Feedstock 27	O	O
Feedstock 28	O	O
Feedstock 29	O	O
Feedstock 30	O	O

25. Amount
(a) Feedstock 1
(b) Feedstock 2
(c) Feedstock 3
(d) Feedstock 4
(e) Feedstock 5
(f) Feedstock 6
(g) Feedstock 7
(h) Feedstock 8
(i) Feedstock 9
(j) Feedstock 10
(k) Feedstock 11
(l) Feedstock 12
(m) Feedstock 13
(n) Feedstock 14
(o) Feedstock 15
(p) Feedstock 16
(q) Feedstock 17
(r) Feedstock 18
(s) Feedstock 19
(t) Feedstock 20
(u) Feedstock 21
(v) Feedstock 22
(w) Feedstock 23
(x) Feedstock 24
(y) Feedstock 25
(z) Feedstock 26
(aa) Feedstock 27
(ab) Feedstock 28
(ac) Feedstock 29
(ad) Feedstock 30

26. Does your facility accept and process non-food-based feedstocks?	
Yes	O
No	O

Please describe the total amount of non-food-based feedstock accepted by your facility in 2019. Do this by typing in the amount of non-food waste, and selecting the units, feedstock type, and feedstock source. If feedstock type or source is unknown or if you do not collect it, please select "other" for these responses. Please watch zeros and use commas for amount, if helpful. [Answer this question only if answer to Q#26 is Yes]

27. Feedstock type	Crop Residues	Crude Glycerin	De-icing fluid	Lab (or pharma) wastes	Manures	Mixed Yard Waste	Paper Mill Wastes	Septage	Wastewater solids (sludge)	Other
Feedstock 1	O	O	O	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O	O	O	O

28. Feedstock source	Airports	Biodiesel production	Industrial	Laboratories/ Pharmaceutical companies	Retail Stores	Wastewater Treatment Plants	Other
Feedstock 1	O	O	O	O	O	O	O
Feedstock 2	O	O	O	O	O	O	O
Feedstock 3	O	O	O	O	O	O	O
Feedstock 4	O	O	O	O	O	O	O
Feedstock 5	O	O	O	O	O	O	O
Feedstock 6	O	O	O	O	O	O	O
Feedstock 7	O	O	O	O	O	O	O
Feedstock 8	O	O	O	O	O	O	O
Feedstock 9	O	O	O	O	O	O	O
Feedstock 10	O	O	O	O	O	O	O
Feedstock 11	O	O	O	O	O	O	O
Feedstock 12	O	O	O	O	O	O	O
Feedstock 13	O	O	O	O	O	O	O
Feedstock 14	O	O	O	O	O	O	O
Feedstock 15	O	O	O	O	O	O	O
Feedstock 16	O	O	O	O	O	O	O
Feedstock 17	O	O	O	O	O	O	O
Feedstock 18	O	O	O	O	O	O	O
Feedstock 19	O	O	O	O	O	O	O
Feedstock 20	O	O	O	O	O	O	O
Feedstock 21	O	O	O	O	O	O	O
Feedstock 22	O	O	O	O	O	O	O
Feedstock 23	O	O	O	O	O	O	O
Feedstock 24	O	O	O	O	O	O	O
Feedstock 25	O	O	O	O	O	O	O
Feedstock 26	O	O	O	O	O	O	O
Feedstock 27	O	O	O	O	O	O	O
Feedstock 28	O	O	O	O	O	O	O
Feedstock 29	O	O	O	O	O	O	O
Feedstock 30	O	O	O	O	O	O	O

29. Units	Gallons	Tons (US)
Feedstock 1	O	O
Feedstock 2	O	O
Feedstock 3	O	O
Feedstock 4	O	O
Feedstock 5	O	O
Feedstock 6	O	O
Feedstock 7	O	O
Feedstock 8	O	O
Feedstock 9	O	O
Feedstock 10	O	O
Feedstock 11	O	O
Feedstock 12	O	O
Feedstock 13	O	O
Feedstock 14	O	O
Feedstock 15	O	O
Feedstock 16	O	O
Feedstock 17	O	O
Feedstock 18	O	O
Feedstock 19	O	O
Feedstock 20	O	O
Feedstock 21	O	O
Feedstock 22	O	O
Feedstock 23	O	O
Feedstock 24	O	O
Feedstock 25	O	O
Feedstock 26	O	O
Feedstock 27	O	O
Feedstock 28	O	O
Feedstock 29	O	O
Feedstock 30	O	O

30. Amount
(a) Feedstock 1
(b) Feedstock 2
(c) Feedstock 3
(d) Feedstock 4
(e) Feedstock 5
(f) Feedstock 6
(g) Feedstock 7
(h) Feedstock 8
(i) Feedstock 9
(j) Feedstock 10
(k) Feedstock 11
(l) Feedstock 12
(m) Feedstock 13
(n) Feedstock 14
(o) Feedstock 15
(p) Feedstock 16
(q) Feedstock 17
(r) Feedstock 18
(s) Feedstock 19
(t) Feedstock 20
(u) Feedstock 21
(v) Feedstock 22
(w) Feedstock 23
(x) Feedstock 24
(y) Feedstock 25
(z) Feedstock 26
(aa) Feedstock 27
(ab) Feedstock 28
(ac) Feedstock 29
(ad) Feedstock 30

31. Do you collect tipping fees?	
Yes	O
No	O

32. Are you willing to share information about the tipping fees you collect? [Answer this question only if answer to Q#31 is Yes] [Please consider providing a response. This information will be helpful for survey administrators.]	
Yes	O
No	O

33. How much revenue did your facility collect in tipping fees in 2019? [Answer this question only if answer to Q#32 is Yes] [Please consider providing a response. This information will be helpful for survey administrators.]

34. If you would like to provide any other relevant or important information related to tipping fees, please do so below.

35. Are pre-processing or de-packaging activities conducted on your feedstocks before they are added to your digester?	
Offsite	O
Onsite (at your facility)	O
Both	O
None of the above	O

36. Please identify the pre-packaging or de-packaging activities that are conducted at your facility. Check all that apply.	
Manual or mechanized de-packaging	☐
Screening for debris or sorting	☐
Grinding and/or maceration	☐
Third party processing	☐
Shredding	☐
Heating	☐
pH adjustment	☐
Centrifugal separation	☐
Liquid/solid separation	☐
Other (Please specify)	☐

37. Please identify the operating temperature range for your digester.	
Mesophilic	O
Thermophilic	O
Unheated/ambient	O

38. Please identify the design that best fits your design type/configuration.	
Continuously Stirred Tank Reactor (CSTR)	O
Plug-flow	O
Covered Lagoon	O
Fixed film	O
Suspended Media	O
Percolating Bed	O
Up flow Anaerobic Sludge Blanket (UASB)	O
Anaerobic Sequencing Batch Reactor (ASBR)	O
Membrane Bioreactor (MBR)	O
Hybrid/Multi-stage	O
Other (Please specify)	O

Please provide the average biogas production volume at your facility during calendar year 2019 in one of the units identified below. Please watch zeros and use commas for amount, if helpful.

39. Units	SCFD	SCFM	SCFY	Other (Please specify with amount)
Average Biogas Production	O	O	O	O

40. Amount
(a) Average Biogas Production

41. Is the biogas produced at this facility?	
Used onsite	☐
Sold	☐
Flared	☐
Other (Please specify)	☐

42. Please identify how the biogas produced at this facility is used. It could be used onsite by the facility or offsite by a purchaser. Check all that apply.	
Produce mechanical power	☐
Produce heat and electricity (CHP)	☐
Produce electricity (including net metering)	☐
Produce electricity (sold to grid)	☐
Fuel boilers and furnaces to heat digesters	☐
Fuel boilers and furnaces to heat other spaces	☐
Compressed to vehicle fuels: used for company fleet/personal vehicles	☐
Compressed to vehicle fuels & sold to customers	☐
Renewable natural gas (processed in order to inject to pipeline)	☐
Other (Please specify)	☐

43. Are you able to utilize all of the biogas produced?	
Yes	O
No	O

44. Do you flare the excess biogas? [Answer this question only if answer to Q#43 is No]	
Yes	O
No	O

45. Do you have a gas cleaning system?	
Yes	O
No	O

46. What is removed by your gas purification system? Check all that apply. [Answer this question only if answer to Q#45 is Yes]	
Moisture	☐
Sulfur	☐
Siloxanes	☐
Carbon Dioxide	☐
Compressed Gas	☐
Hydrogen sulfide	☐
Particulates	☐
Oxygen	☐
Nitrogen	☐
VOCs	☐
Other (Please specify)	☐

47. Are the post-digestion biosolids Class A or Class B?	
Class A	O
Class B	O

48. Do you use the solid digestate you produce in any of the following ways? Check all that apply.	
De-watered/dried and land applied.	☐
Land applied as is with no dewatering or drying.	☐
Composted into a reusable or salable product.	☐
Processed into other salable products (e.g., flower pots).	☐
Landfilled.	☐
Incinerated.	☐
Other (Please specify)	☐

If any digestate was disposed of in landfills or incinerated in 2019, please specify the amount in tons or gallons (if known).

49. Units	Tons (US)	Gallons
Landfilled	O	O
Incinerated	O	O

50. Amount
(a) Landfilled
(b) Incinerated

51. Is the de-watered/dried digestate further treated prior to land application?	
Yes	O
No	O
N/A	O

52. Please indicate what the further treatment is and why it is necessary. [Answer this question only if answer to Q#51 is Yes]

53. How do you manage the liquid digestate you produce? Check all that apply.	
Beneficially reused as fertilizer via land application	☐
Recirculated through digester	☐
Other (Please specify)	☐

54. Is the liquid digestate further treated prior to land application?	
Yes	O
No	O
N/A	O

55. Please indicate what the further treatment is and why it is necessary. [Answer this question only if answer to Q#54 is Yes]

56. Do you recover nutrients from your digestate?	
No	O
Yes, phosphorous recovery by chemical precipitation (e.g., struvite)	O
Yes, ammonia recovery	O
Other (Please specify)	O

57. If you have any additional comments, please leave them below.

End of survey.

Appendix E – Conversion Sources

Table 1E: Feedstock Conversion Sources

Non-food waste sources			
	Feedstock	**Density (tons/gallon)**	**Source**
1	Septage	0.0042	Assume like water (1,000 kg/m3). Several results online show assumptions like this.
2	De-icing fluid	0.0053	Guide Specification: Fluid, Deicing/Anti-icing, Runways and Taxiways, Potassium Acetate Base in addition to requirements set by AMS 1435A. https://p2infohouse.org/ref/19/18054/e36gdspec.htm
3	Crude glycerin	0.0052	Crude Glycerin. Safety Data Sheet Univar. 2015. https://www.chemicalassociates.com/images/stories/virtuemart/product/sds/CA2803-Crude-Glycerine-SDS.pdf
4	Wastewater solids (sludge)	0.0043	Climate Policy Watcher. Physical and Biological Properties. June 2022. https://www.climate-policy-watcher.org/wastewater-sludge/physical-and-biological-properties.html#:~:text=The%20density%20of%20primary%20sludge,1.2%20to%201.4%20g%2F%20cm3. Assume mix of activated and primary sludge.
5	Lab (or pharma) wastes	0.0042	Chapter 1: Characterizing Medical Wastes and Applying a Comprehensive Management Strategy. US EPA. https://archive.epa.gov/epawaste/nonhaz/industrial/medical/web/pdf/ch1.pdf Assume fluids, residuals.
6	Mixed yard waste (MYW)	0.0006	Volume-to-Weight Conversion Factors. US EPA. ORCR. April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
7	Crop residues	0.0017	Engineering Properties of Various Agricultural Residue. J.M Makavana, V.V. Agravat, P.R. Balas, et. al. 2018. https://www.researchgate.net/publication/325824638_Engineering_Properties_of_Various_Agricultural_Residue. Mix of rice husk, rice straw, sugarcane bagasse, and cotton stalk.
8	Manures	0.0042	Manure Sampling for Nutrient Management Planning. Penn State Extension. 2014. https://extension.psu.edu/manure-sampling-for-nutrient-management-planning#:~:text=Liquid%20manure%20density%20can%20vary,and%20a%20set%20of%20scales
9	Other	0.0037	Average of all other non-food-based feedstocks.

Food waste sources			
	Feedstock	**Density (tons/gallon)**	**Source**
1	Beverage industry processing waste	0.0042	Individual correspondence with facilities confirming this density if they processed this waste. This number is the density of water, what many facilities told us to use as a proxy.
2	Food industry processing waste	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
3	Food service waste, pre- and post-consumer	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
4	Fruits and vegetative waste	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
5	Other	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
6	Retail food waste	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
7	Slaughterhouse waste	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
8	Source-separated commercial, institutional, or residential organic waste	0.0012	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf
9	Fats, Oils, and Greases (FOG)	0.0037	Volume-to-Weight Conversion Factors. EPA ORCR, April 2016. https://www.epa.gov/sites/default/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf