Anaerobic Digestion Facilities Processing Food Waste in the United States (2016)

Survey Results

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EPA would like to acknowledge all the facility operators who provided data for this report. Not only did these individuals provide data, but in many instances, they took the time to speak with us and clarify the data provided. The operators went above and beyond this year. EPA greatly appreciates this effort and this report could not be generated without their valuable input. We hope that the information provided in this report is useful to all facility operators and the industry as a whole.

The behind the scenes work on the development and maintenance of the electronic surveys is substantial. This project could not happen without the outstanding technical support of David MacFarlane in EPA Region 3's Information Systems Branch who steadfastly and efficiently revised the electronic surveys and assisted with data management.

All the tedious and time-consuming work that went into the quality assurance review of the datasets can be attributed to the tireless efforts of Chris Carusiello in EPA's Office of Land and Emergency Management, Office of Resource Conservation and Recovery. Chris deserves the highest kudos for his efforts!

Document Review

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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). Where necessary, anomalies were verified with the respondent.

Disclaimer

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

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Executive Summary

In 2014, the United States (U.S.) Environmental Protection Agency (EPA) began building a dataset of names and locations of anaerobic digestion (AD) facilities processing food waste to better understand the practice and the prevalence of food waste digestion in the United States. In December 2016, EPA was granted the authority to survey digesters annually for 3 years, from 2017 – 2019. This report is the second in a series of three reports. 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 2017, 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. In September 2018, this data was published in the report titled: Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015.

EPA administered the survey again in 2018. The data collected during the 2018 survey is summarized in this report. Three data points are specific to the calendar year 2016: amount of food waste[1] processed, amount of non-food waste[2] processed, and amount of biogas produced. Processing capacity, feedstock types, feedstock sources, tipping fees, pre-processing/de-packaging, operational specifications, biogas uses, gas cleaning systems, solid digestate uses, and liquid digestate uses reflect circumstances in 2018.

The third collection of AD data is targeted to begin later in 2019 at which time EPA will collect data for the three time-specific data points (amount of food waste processed, amount of non-food waste processed, and amount of biogas produced) for operating years 2017 and 2018 and remaining data will reflect circumstances for 2019. Data from the 2019 survey will be summarized in the third report in this series targeted for publication in 2020. EPA will continue to gather data and seek to verify data received in 2017 and 2018 to clarify the information in these reports over time. The data used in this report was voluntarily submitted by survey respondents.

For the 2018 survey (data summarized in this report), EPA received responses from 134 operational facilities. Table ES-1 shows these responses broken down by facility type. EPA offered the survey to 198 operating facilities including all 137 facilities that provided responses in 2017. EPA also made the survey available on the Agency's website. EPA has continued to build the dataset of AD facilities that are known to be operational, in the planning and design phase, under construction, and facilities that have ceased operation or ceased co-digestion activities. This report provides information on the status of AD facilities in each of these situations.

[1] Food-based materials include, but are 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.

The 2018 response rates for each type of survey are comparable to the response rates from the 2017 survey. The operational facilities responding to the 2017 survey and the operational facilities responding to the 2018 survey are not identical. Not all operating facilities that responded to the 2017 survey responded to the 2018 survey, so results may not be directly comparable from the previous report. Table ES-1 summarizes response rates for operational facilities by digester type. See Section II for a more detailed description of respondent participation in the 2017 and 2018 surveys (specifically Table 2).

Table ES-1: Number of Operational Anaerobic Digestion Facilities Surveyed and Response Rate by Digester Type

Digester type	Number of Facilities Surveyed	Submitted Survey	Survey Response Rate
Stand-alone digesters	62	46	74%
On-farm co-digesters	59	16	27%
Co-digestion systems at WRRFs	77	72	94%
Total	**198**	**134**	**68%**

During the 2018 survey, EPA confirmed that 11 facilities have ceased operations (3 stand-alone facilities, 3 farm co-digestion systems, and 5 co-digestion systems at WRRFs). These facilities will no longer receive surveys and have been removed from the response rate data in Table ES-1.

Processing Capacity and Amounts Processed

Based on data submitted by 131 survey respondents, the total processing capacity for food waste in all three digester types combined as of 2018 is about 24 million tons per year. Based on data submitted by 126 survey respondents, the total amount of food waste processed in all three digester types in 2016 was about 10.7 million tons (Table ES-2).

Table ES-2: Total Capacity for Processing Food Waste and Total Amount of Food Waste Processed by Digester Type

Digester Type	Reported Capacity in 2018 (tons per year)	Reported Amount Processed in 2016 (tons)
Stand-alone digesters	21,126,270	9,222,413
On-farm co-digesters	256,044	154,789
Co-digestion systems at WRRFs	2,610,808	1,314,554
Total	**23,993,122**	**10,691,756**

Based on data submitted by 62 survey respondents, the total amount of non-food waste processed in all three digester types combined was about 492 million gallons and 103,952 tons (Table ES-3).

Table ES-3 Total Amount of Non-Food Waste Processed by Digester Type (2016)

Digester Type	Liquid Amount (in gallons)	Solid Amount (in tons)*
Stand-alone digesters	31,021,709	82,730
On-farm co-digesters	1,734,745	0
Co-digestion systems at WRRFs	459,216,246	21,222
Total	**491,972,700**	**103,952**

* Amounts were reported in liquid and solid units. Because there is no common conversion factor for non-food waste, these values are separated.

Biogas Production

Based on data submitted by 119 survey respondents, the total amount of biogas produced at digesters in 2016 was 40,304 standard cubic feet per minute (SCFM), equivalent to 126 megawatts (MW) installed capacity, 939 million kilowatt-hours (kWh) generated per year, or enough energy to power 79,820 homes for a year.

Table ES-4: Summary of Biogas Data Reported by Digester Type (2016)

Digester type	SCFM*	MW	kWh/yr (million)	Number of Homes Powered for One Year
Stand-alone digesters	10,498	33	246	20,911
On-farm co-digesters	4,053	13	97	8,246
Co-digestion systems at WRRFs	25,753	80	596	50,663
Total	**40,304**	**126**	**939**	**79,820**

* SCFM values are reported by facility operators and added together to get total SCFM for 2016 (40,304). 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.

These figures 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 facilities returning surveys in 2018, 31 states have at least one operating digester (Figure ES-1). States with ten or more confirmed operating digesters included California (30), Wisconsin (14) and Ohio (11).

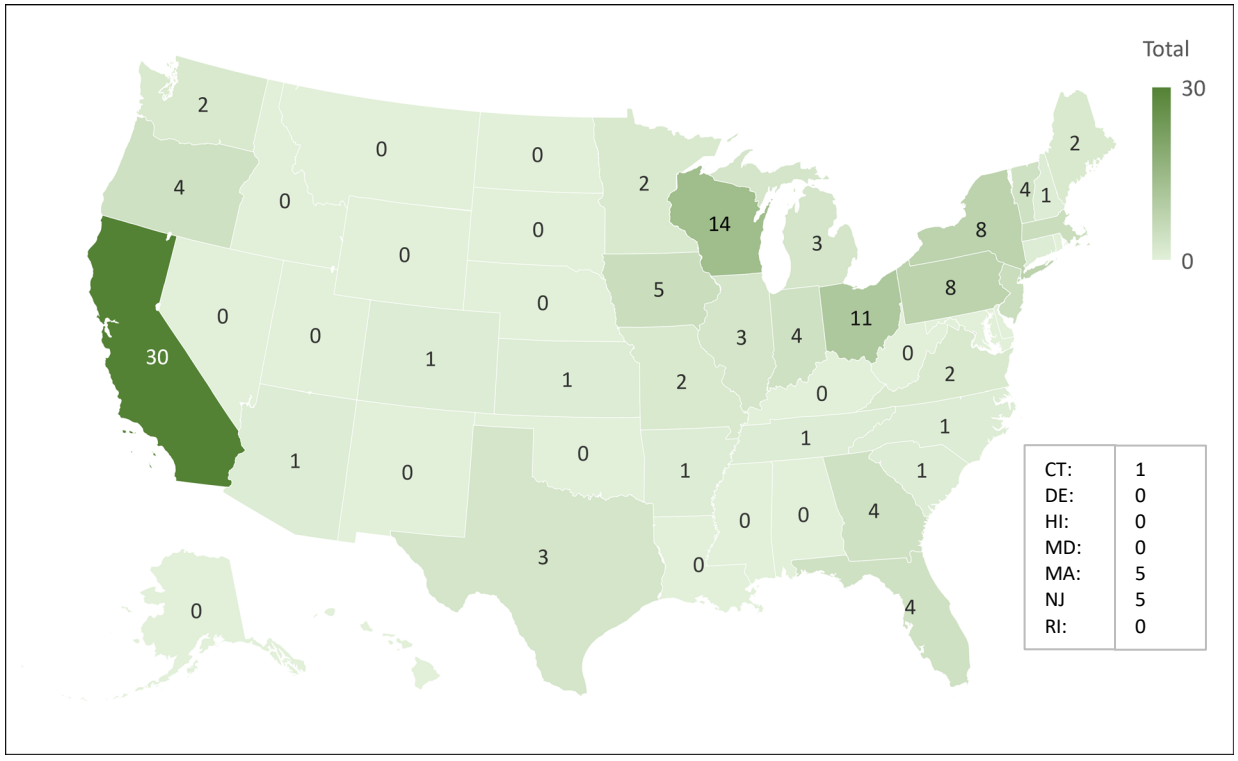

Figure ES-1: Confirmed Operating Food Waste Digesting Facilities by State

Operational Specifications and Pre-Processing Activity

In terms of operational specifications, the majority of the digester types were found to be wet and mesophilic systems, similar to the previous survey. The top pre-processing/de-packaging activity for both stand-alone digesters and co-digestion facilities at WRRFs was screening and/or sorting. For on-farm co-digesters the number one activity was manual or mechanized de-packaging.

Feedstock Sources and Types

When aggregated, the top five feedstock sources for anaerobic digesters in the U.S. in 2018 are:

- Food/beverage processors;
- Restaurants and food service;
- Grocery stores/supermarkets
- Industrial sources; and
- Municipal/residential sources.

When aggregated the top five feedstocks accepted by anaerobic digesters in the U.S. in 2018 are:

- Fats, oils and greases (FOG);
- Food processing industry waste;
- Beverage processing industry waste;
- Fruit/vegetative waste; and
- Food service waste, pre- and post-consumer.

Biogas Uses and Cleaning Systems

The top use of biogas among all three digester types was to produce combined heat and power (CHP). The next two highest uses by digester type were:

- **Stand-Alone Digesters**: to produce electricity (sold to the grid), and to fuel boilers and furnaces to heat other spaces/produce electricity used behind the meter (tied);
- **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.

In 2018 approximately 78% of stand-alone digesters, 56% of farm co-digesters and 69% of co-digesters at WRRFs reported that they utilize gas cleaning systems. The top constituents removed for all digester types included moisture and sulfur.

Solid and Liquid Digestate Uses

The top three solid digestate uses by specific digester type were:

- **Stand-Alone Digesters**: composted into a reusable/salable product, other, 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; and
- **Co-Digestion Facilities at WRRFs:** de-watered and land applied, landfilled, and land applied "as is" with no dewatering or drying.

The top uses of liquid digestate for stand-alone digesters, on-farm co-digesters, and co-digestion facilities at WRRFs, respectively, were: discharged to a wastewater treatment plant, reused as fertilizer via land application, and recirculated through the digester.

I. Background

In the United States (U.S.), food is the greatest fraction of material, by weight, in the municipal solid waste stream. In 2015, approximately 37.5 million tons of food from the residential, commercial, and institutional sectors was sent to landfills and combusted for energy, [3] imposing significant economic and environmental costs. To help alleviate these costs, the U.S. Environmental Protection Agency (EPA) encourages diversion of food waste from landfills, including its use in anaerobic digestion (AD) facilities.

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[4] database).

To enhance the quality and quantity of available data, EPA sought and was granted authority to collect information through a survey for digesters (see Appendix D for a list of survey questions). The approval allows EPA to collect data annually for 3 years, from 2017 to 2019. This report is the second in a series of three reports. 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.).

Data collected during the 2017 survey was published in the report titled *Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015*. Data collected during the 2018 survey is summarized in this report. This report includes data from operational year 2016 for the following three data points: the amount of food waste[5] processed, the amount of non-food waste[6] processed, and the amount of biogas produced. Processing capacity, feedstock types, feedstock sources, tipping fees, pre-processing/de-packaging, operational specifications, biogas uses, gas cleaning systems, solid digestate uses, and liquid digestate uses reflect circumstances in 2018.

Data collected during the 2019 survey will be summarized in the anticipated third report in this series targeted for publication in 2020.

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[3] Advancing Sustainable Materials Management 2015 Fact Sheet, Table 1, page 8. Estimate includes residential, commercial, and institutional sources of food waste, but not industrial or on-farm sources.

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

[5] Food-based materials include, but are 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.

[6] 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.

To identify respondents for the 2018 survey, EPA used the information gathered during the 2017 survey as a starting point. Ongoing research conducted throughout 2017 and 2018 also contributed to the development of both the list of operating AD facilities that accept food waste (See Appendix A, Tables 1A, 3A and 5A) and the list of AD facilities under development (See Appendix B).

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.

II. Survey Data Collection

Under ICR (No. 2533.01), 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 during the 2018 survey. EPA collected data from June 2018 through February 2019[7], and then the surveys were inactivated. For the 2018 survey, the time-specific data points[8] reflect operating year 2016. All other data reflects circumstances in 2018.

This data collection allowed EPA to:

- Identify the number and location of AD facilities that are operational and under development[9];
- Document the total processing capacity at AD facilities;
- Document how much food waste and non-food waste was processed (in 2016);
- Document how much biogas was produced (in 2016);
- 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. All the AD facilities that responded to the 2017 survey (both operating facilities and facilities under development) received the 2018 survey[10]. Additional facilities to survey each year are identified on an on-going basis as a result of research and collaboration with Agency partners. The number of facilities surveyed and the number of facilities responding to the survey in 2018, both operating and non-operating, are identified in Table 1.

[7] Data collection is typically confined to the calendar year in question. However, a significant amount of time was lost due to the 2018-2019 government shutdown.

[8] Amount of food waste processed, amount of non-food waste processed and amount of biogas produced

[9] This data is current as of December 2018.

[10] Data collected during the 2017 survey was published in the 2018 report titled *Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015*, September 2018. Data collected during the 2018 survey is included in this report.

Table 1: Number of Operational and Non-Operational Anaerobic Digestion Facilities Surveyed and Responding to the 2018 Survey

Operational Status	Number of Facilities Surveyed	Number of Surveys Submitted	Survey Response Rate
Operational	198	134	68%
Non-operational	34	20	59%
Total	**232**	**154**	**66%**

The operational facilities responding to the 2017 survey and the operational facilities responding to the 2018 survey are not identical. Not all operating facilities that responded to the 2017 survey responded to the 2018 survey. Also, there were several facilities that responded to the 2018 survey that did not respond to the 2017 survey. Table 2 provides information on the number of facilities providing surveys for both years. Please see Tables 1A, 3A, and 5A for lists of those facilities that responded to the 2018 survey and Tables 2A, 4A, and 6A for lists of those facilities that responded to the 2017 survey, located in Appendix A. Please note that the names of several facilities have changed (e.g., Niagara BioEnergy is now known as Generate Niagara Digester due to an ownership change). Facilities responding to the 2017 survey can be cross-checked with facilities responding to the 2018 survey by location.

Table 2: Comparison of Facilities Responding to 2017 Survey and Facilities Responding to the 2018 Survey

Digester Type	Number of Surveys Submitted (2017)	Number of Surveys Submitted (2018)	Number of Facilities Reporting in 2017 that did not Report in 2018	Number of New Facilities Reporting in 2018
Stand-alone digesters	50	46	11*	7
On-farm co-digesters	15	16	10	11
Co-digestion systems at WRRFs	72	72	3	3
Total	**137**	**134**	13	21

*Two of these facilities have ceased operation and one facility was incorrectly categorized as a stand-alone facility for the 2017 survey and returned an on-farm digester survey for 2018.

For both the 2018 report and this report, 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. Personally Identifiable Information will be protected to the extent allowable under the Freedom of Information Act.

III. Results

A. Response Rates and Location Data

Out of the 232 surveys distributed to AD facilities, 134 were returned by operational facilities. This report only identifies the status of those facilities providing survey responses. Another 64 facilities are believed to be operating (for a total of 198), however the status of these facilities cannot be documented at this

time.[11] The number of operational facilities surveyed and the number of operational facilities returning responses by facility type is provided in Table 3. Lists of facilities confirmed via survey response to be currently operating can be found in Appendix A (Tables 1A, 3A and 5A).

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

Digester Type	Number of Facilities Surveyed	Number of Surveys Submitted	Survey Response Rate
Stand-alone digesters	62	46	74%
On-farm co-digesters	59	16	27%
Co-digestion systems at WRRFs	77	72	94%
Total	**198**	**134**	**67%**

EPA is also tracking facilities that are under development or temporarily shut-down. EPA distributed 47 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, start-up mode or temporarily shut-down. No on-farm co-digesters under development have been identified as under development or temporarily shut-down. EPA received survey responses confirming the operational status of 20 facilities that are in one of these categories. Lists of these facilities and their operational status as reported via survey response can be found in Appendix B (Tables 1B and 2B). This report only identifies the status of those facilities providing responses. The operational status of the remaining 27 facilities surveyed cannot be documented at this time. The breakdown of the number of non-operational facilities surveyed and the number of facilities returning responses by facility type is provided in Table 4.

Table 4: Number of Anaerobic Digestion Facilities in the Planning/Construction Phase Surveyed and Responding to Survey by Digester Type

Digester Type	Number of Facilities Surveyed	Number of Surveys Submitted	Survey Response Rate
Stand-alone digesters	24	12	50%
On-farm co-digesters	0	0	-
Co-digestion systems at WRRFs	23	8	40%
Total	**47**	**20**	**43%**

EPA's research also identified facilities that have ceased operations or did not advance beyond the pilot stage for a variety of reasons. The facilities that have ceased operation are identified in Appendix C. It has been documented that 12 WRRFs considering co-digestion did not advance beyond the pilot stage. A list of these facilities is not included in this report.

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.

[11] The 64 facilities in this category that did not respond to the survey are believed to be operational based on current research, available public information and information provided by facility representatives other than survey responses (e.g., phone and face-to-face conversations).

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 46 survey responses from a field of 62 operational stand-alone facilities for a response rate of 74%. The remaining 16 operational facilities did not submit data. EPA received 12 survey responses from a field of 24 non-operational stand-alone facilities for a response rate of 50%. The remaining 12 non-operational facilities did not submit data. See Tables 3 and 4 above for response rates for operational and non-operational facilities. See Appendix A (Table 1A) for a list of operational stand-alone facilities and Appendix B (Table 1B) for a list of stand-alone facilities under development.

According to the survey responses received from the 46 operating stand-alone digesters: 23 are multi-source (50%); 19 are industry dedicated (41%); and four were identified by survey respondents as "other" (9%).

Operational stand-alone digesters are located within 21 states. See Figure 1 for a map and Table 5 for a listing of the number of operating stand-alone facilities by state.

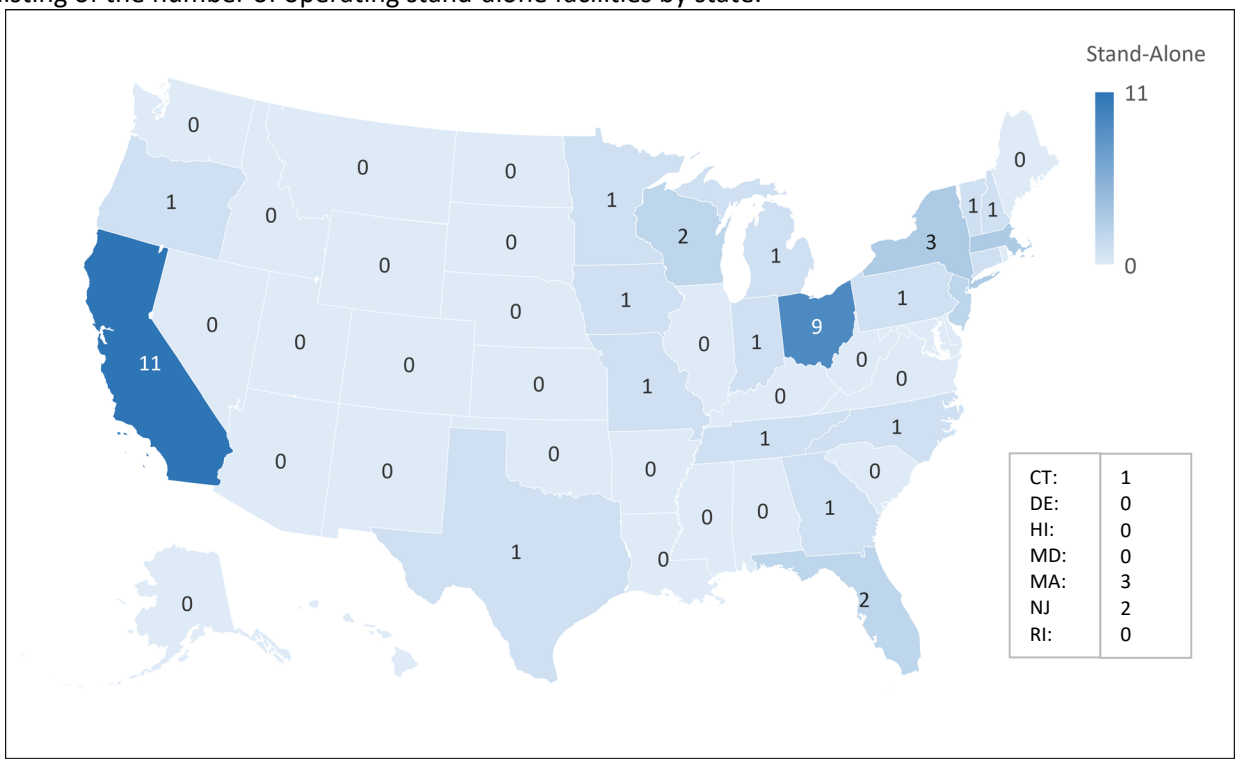

Figure 1: Operating Stand-Alone Food Waste Digesting Facilities by State

On-Farm Co-Digesters

According to EPA's AgSTAR program, there are approximately 250 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 2017 survey as a starting point, EPA identified and surveyed 59 on-farm co-digester facilities that are potentially co-digesting food waste. EPA received 16 survey responses out of the 59 identified digesters for a response rate of 27%. The remaining 43 farms did not submit data. The exact reason or reasons for this low response rate is not known. EPA spent a significant amount of time seeking accurate contact information for the identified on-farm co-digesters as well as a substantial effort contacting the operators of on-farm co-digesters by phone and email to improve the response rate. Unfortunately, the number of responses for on-farm co-digesters remained low for the 2018 survey. This report identifies the status of only those on-farm co-digesters providing responses. The operational status of the remaining 43 farms surveyed cannot be documented at this time. The actual number of digesters on farms that are co-digesting food waste is believed to be much higher than 16, but this cannot be confirmed due to the lack of participation in this survey.

Operational on-farm digesters co-digesting food waste were identified in 8 states. See Table 3A in Appendix A for a list of the 16 farms that provided data and Figure 2 for a map depicting the number of operating on-farm co-digesters by state.

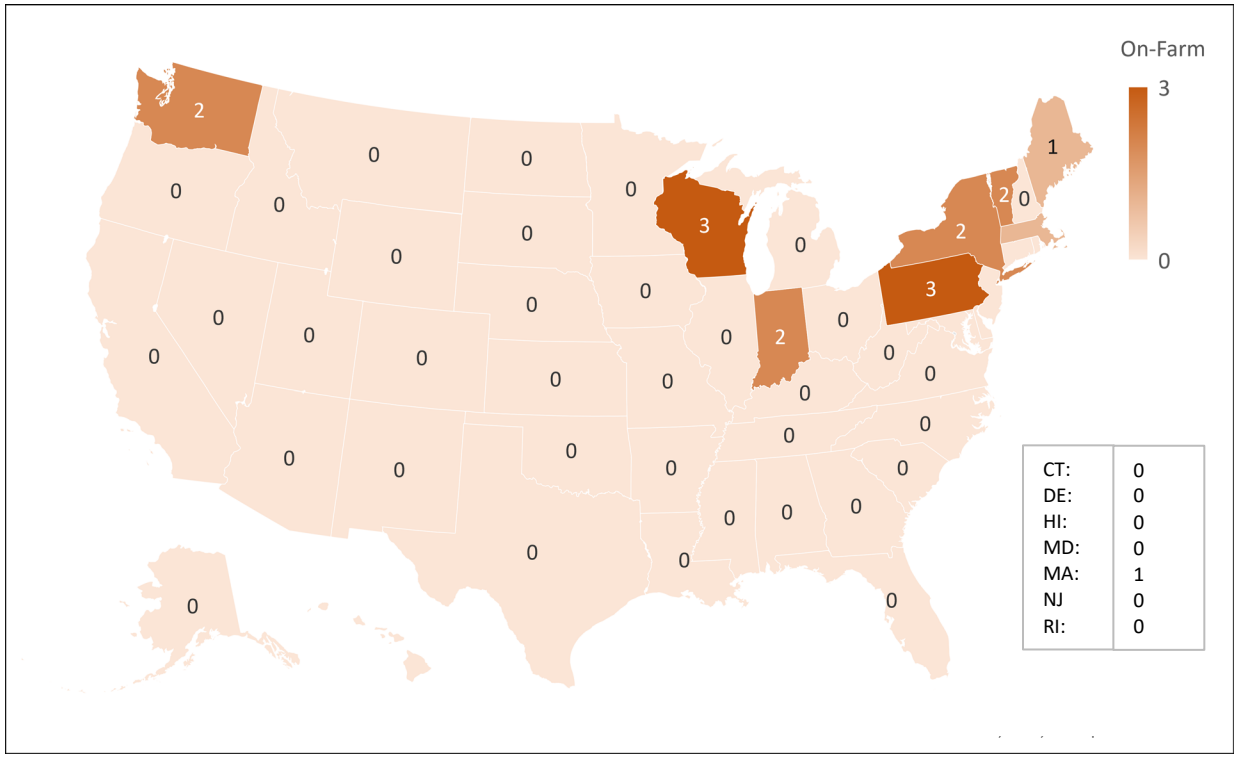

Figure 2: Operating On-Farm Food Waste Co-Digestion Systems by State (2016)

Digesters at Water Resource Recovery Facilities (WRRFs)

The Water Environment Federation and the American Biogas Council built and maintain a database of information on WRRFs.[12] This database identifies approximately 1,200 WRRFs in the U.S. that have anaerobic digesters to manage wastewater solids, and roughly 20% of these facilities co-digest materials, including food waste from offsite sources.

EPA received 72 survey responses from a field of 77 WRRFs with operational food-waste co-digestion systems for a response rate of 94%. The remaining five facilities did not submit data. Independent from the 77, EPA received 8 survey responses from a field of 23 non-operational co-digestion systems at WRRFs for a response rate of 35%. The remaining 15 non-operational facilities did not submit data. This report identifies the status of only those facilities providing responses. The operational status of the remaining 20 WRRFs surveyed cannot be documented at this time. See Tables 3 and 4 above for response rates for operational and non-operational WRRF co-digestion systems. See Table 5A in Appendix A for a list of the 72 facilities providing data and Figure 3 for a map depicting the number of operating WRRF food waste co-digestion systems by state. WRRFs with operating co-digestion systems are located within 25 states.

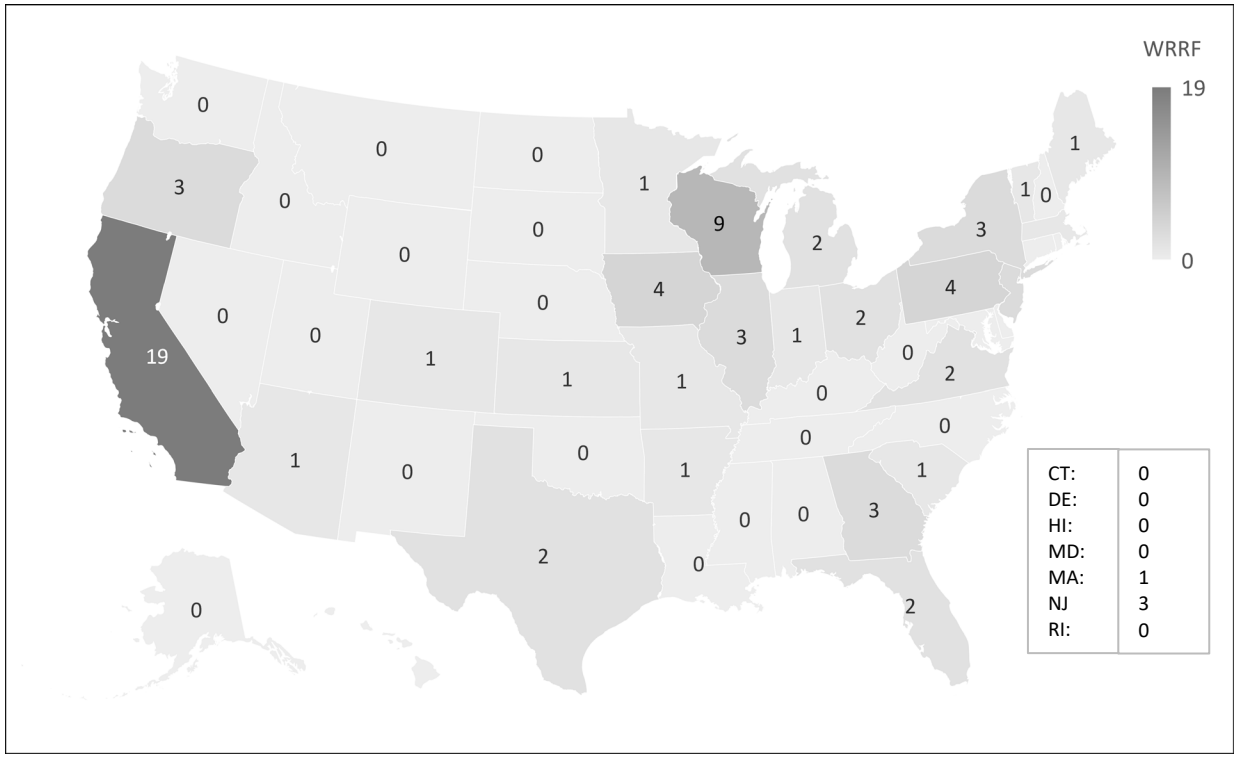

Figure 3: Operating WRRF Food Waste Co-Digestion Systems by State

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

Total Operating Digesters in the U.S.

Figure 4 and Table 5 summarize total operating digesters by type and location. Note that there are other operating AD facilities processing food waste in the U.S. Table 5 identifies the number of operating facilities that provided survey responses.

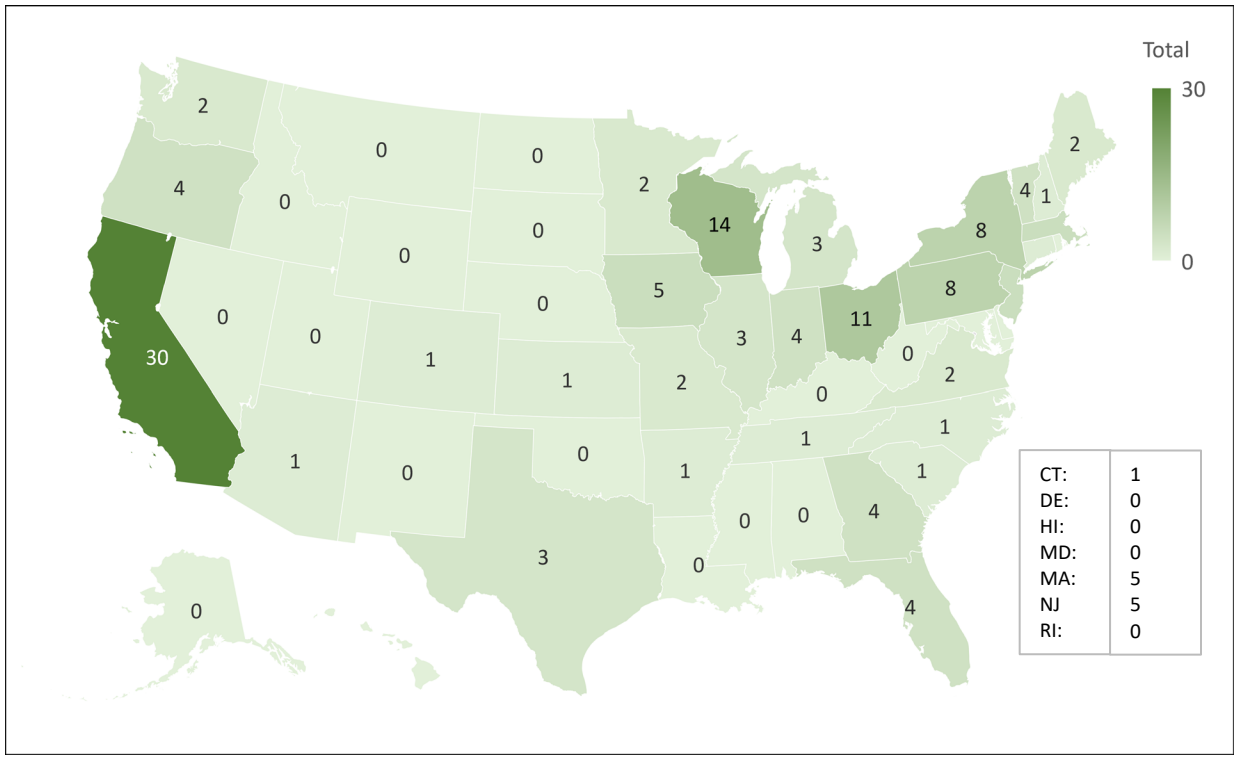

Figure 4: Operating Food Waste Digesting Facilities by State

Table 5: Number of Operating Anaerobic Digestion Facilities in each State by Facility Type

	Number of Facilities*		
State	***Stand-Alone***	***On-Farm***	***WRRF***
Alabama	0	0	0
Alaska	0	0	0
Arizona	0	0	1
Arkansas	0	0	1
California	11	0	19
Colorado	0	0	1
Connecticut	1	0	0
Delaware	0	0	0
Florida	2	0	2
Georgia	1	0	3
Hawaii	0	0	0
Idaho	0	0	0
Illinois	0	0	3
Indiana	1	2	1
Iowa	1	0	4
Kansas	0	0	1
Kentucky	0	0	0

	Number of Facilities*		
State	***Stand-Alone***	***On-Farm***	***WRRF***
Louisiana	0	0	0
Maine	0	1	1
Maryland	0	0	0
Massachusetts	3	1	1
Michigan	1	0	2
Minnesota	1	0	1
Mississippi	0	0	0
Missouri	1	0	1
Montana	0	0	0
Nebraska	0	0	0
Nevada	0	0	0
New Hampshire	1	0	0
New Jersey	2	0	3
New Mexico	0	0	0
New York	3	2	3
North Carolina	1	0	0
North Dakota	0	0	0
Ohio	9	0	2
Oklahoma	0	0	0
Oregon	1	0	3
Pennsylvania	1	3	4
Rhode Island	0	0	0
South Carolina	0	0	1
South Dakota	0	0	0
Tennessee	1	0	0
Texas	1	0	2
Utah	0	0	0
Vermont	1	2	1
Virginia	0	0	2
Washington	0	2	0
West Virginia	0	0	0
Wisconsin	2	3	9
Wyoming	0	0	0
Total	**46**	**16**	**72**

*****The number of digesters per state shown in Table 5 represents the digesters that EPA received surveys from in 2018. Table 5 is not directly comparable to Table 2 from "*Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015",* September 2018. The number of digesters shown in the previous Table 2 included digesters submitting surveys in 2017 and other confirmed operational digesters.

B. Processing Capacity

Processing capacity refers to the maximum amount of food waste feedstock an anaerobic digester can accept per unit time. EPA collected data on food waste processing capacity in either gallons or tons per year.[13] Capacity reported in gallons per year was converted to tons per year to quantify

[13] Throughout this document "ton" refers to a US ton, which equals 2,000 lb.

the total capacity available for processing food waste.[14] EPA recognizes that most anaerobic digesters typically process a liquid slurry. However, for food waste processing capacity, EPA converted the data from gallons per year to tons per year because tons are the industry standard for measuring food waste.

Out of the 134 operational facilities that provided survey responses, 131 provided information about food waste processing capacity. EPA documented that the total capacity for processing food waste in all three digester types combined is 23,993,122 tons per year (Table 6). Note that the actual processing capacity for digesters in the United States is higher than the values reported in Table 6 because not all operating facilities responded to the survey.

Stand-Alone Digesters

For stand-alone digesters, all 46 (100%) of the survey respondents provided data on processing capacity. Stand-alone digester operators were asked to provide the following:

> *Provide the total capacity of your facility in tons per year or gallons per year.*

The total current processing capacity reported for food waste at stand-alone digesters in the U.S. is about 21 million tons per year.

On-Farm Co-Digesters

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

> *Taking into account the average volume of manure from your livestock processed in your anaerobic digestion system, please identify the available capacity to co-digest other feedstocks.*

EPA's goal was to determine how much outside food waste could potentially be processed at on-farm co-digesters in the U.S. All 16 survey respondents provided data on processing capacity, which totals 256,044 tons per year. This number only represents 27% of the on-farm co-digestion systems identified by EPA to be operating in the U.S. Therefore, the actual capacity is likely to be greater than this amount.

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. When calculating this available capacity, please take into account the average volume of wastewater solids processed at your facility and the total capacity of your digesters. Assume that your facility has all the necessary equipment to receive additional feedstocks (e.g., a receiving station, storage, mixing equipment, etc.)*

[14] The gallons to tons conversion for food waste was calculated based on a factor of 3.8 lbs/gallon. 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 data in this report directly reflects the information provided by the plant operators that responded to the survey.[15] For operating WRRF co-digestion systems, 96% of respondents (69 out of 72) provided data on processing capacity. The total current processing capacity reported for food waste at co-digestion systems at WRRFs in the U.S. was about 2.6 million tons per year.

Total Food Waste Processing Capacity

Table 6 below summarizes the total capacity for each type of digester and provides the mean and median. The total current processing capacity reported for food waste at all three types of digesters in the U.S. was about 24 million tons per year.

Table 6: Total Capacity for Processing Food Waste via Anaerobic Digestion by Digester Type

Digester Type	Reported Capacity (tons per year)	Mean (tons per year)	Median* (tons per year)	Respondents Providing Data	Total Surveys Received
Stand-alone digesters	21,126,270	459,267	48,725	46	46
On-farm co-digesters	256,044	16,003	13,110	16	16
Co-digestion systems at WRRFs	2,610,808	36,469	8,669	69	72
Total	**23,993,122**			**131**	**134**
*Amounts were reported by facility response.					

C. Operational Dates

The dates that the AD facilities surveyed became operational have not changed since the last publication. However, the individual facilities that provided data are slightly different than last year (see Table 2). It is still the general perception that processing food waste via AD is a relatively new practice.

It continues to be true that most of the facilities that provided data for this survey began operations before 2015 (Figure 5). A stand-alone digester that began operations in 1958 was the earliest start date recorded this year. For co-digestion at WRRFs, the earliest start date reported was 1959 and for co-digestion at farms the earliest start date reported was 1985.

Twenty-one stand-alone and WRRF digesters began processing food waste in the 1980s and 1990s, whereas only one farm co-digester started operations in that timeframe. In the early 2000s, AD of food waste and co-digestion of food waste with other waste streams started to become more prevalent in the U.S. One farm began co-digestion operations in 1985. Except for this farm, the practice seems to have taken a little longer to reach the farming sector. According to the survey responses received from farmers, co-digestion at on-farm digesters did not begin to occur more frequently until the early 2000s.

[15] In some cases, the capacity to process food waste reported by plant operators was less than the reported amount of food waste processed. For the facilities where this discrepancy was significant, EPA reconciled the numbers based on additional input from the operators.

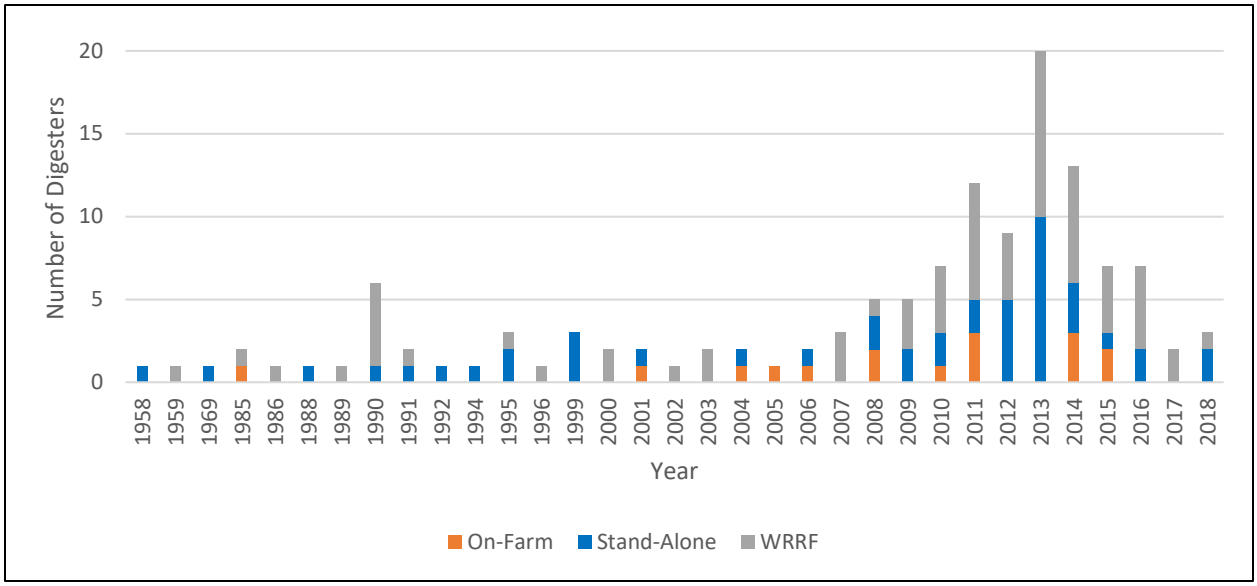

Figure 5: **Distribution of First Year of Digester Operation by Digester Type**

D. Food Waste Processed

EPA requested data on the amount of food waste processed via AD, reported in either gallons or tons. The amount of food waste processed reported in gallons was converted to tons.[16] As with information about capacity, the amount of material processed is reported in tons because tons is the industry standard for measuring food waste. Note that the actual amount of food waste processed in 2016 was likely to be higher than the value reported in Table 7 because not all facilities known to be operating provided data. In addition, out of the 134 operational facilities that provided survey responses, 126 provided information about the amount of food waste processed. Projecting or predicting volumes processed at non-reporting facilities was not within the scope of this report.

Table 7: Total Amount of Food Waste Processed by Each Digester Type (2016)

Digester Type	Reported Amount Processed (tons)	Mean (tons)	Median* (tons)	Respondents Providing Data	Total Surveys Received
Stand-alone digesters	9,222,413	209,600	21,919	44	46
On-farm co-digesters	154,789	9,674	8,075	16	16
Co-digestion systems at WRRFs	1,314,554	18,258	4,522	66	72
Total	**10,691,756**			**126**	**134**

* Amounts were reported by facility response

[16] The gallons to ton conversion for food waste was calculated using 3.8 lbs/gallon (See *Volume-to-Weight Conversion Factors*, USEPA ORCR, April 2016).

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[17]) wastes, paper mill wastes, and crude glycerin. Given that the content of non-food waste feedstocks is highly variable and can be liquid or solid, there is no suitable conversion factor to combine values reported in different units. Therefore, both liquid volume and solid weight amounts reported by facility operators are presented in Table 8.

The scope of the survey is limited to anaerobic digesters that digest food waste. For example, this project 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 in digesters at WRRFs that do not co-digest food. 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 occurs at stand-alone digesters but the frequency is relatively low. For example, of the 46 stand-alone digesters providing survey responses, only 20 (43%) reported that non-food waste is processed. Non-food waste is processed at all on-farm co-digesters (manure) and WRRF digestion systems (wastewater solids).

Table 8: Total Amount of Non-food Waste Processed by each Digester Type (2016)

Digester Type	Liquid Amount (in gallons)	Solid Amount (in tons)*	Respondents Providing Data	Total Surveys Received
Stand-alone digesters	31,021,709	82,730	20	46
On-farm co-digesters	1,734,745	0 †	8	16
Co-digestion systems at WRRFs	459,216,246	21,222	34	72
Total	**491,972,700**	**103,952**	**62**	**134**

* Amounts were reported in liquid and solid units. Because there is no common conversion factor for non-food waste, these values are separated.

† The amount of non-food waste reported to be processed in 2017 (for the 2015 calendar year) was 2,103 tons. Two of the three farms reporting non-food waste processed in tons did not provide a survey response in 2018 and one farm no longer processes any non-food waste from offsite.

As mentioned previously, not all operational digesters provided data for this project. The actual amount of non-food waste processed at anaerobic digesters in 2016 is likely to be higher than the values reported above.

F. Feedstock Types

A wide variety of feedstocks are processed in digesters throughout the U.S. Some feedstocks are more common than others, which varies based on local availability, demand, and type of digester accepting the feedstock. Tables 9, 10 and 11 and Figure 6 show the types of food waste and non-food waste feedstocks processed at each of the three types of digesters.

[17] In the survey, lab wastes are described as "pharma" wastes which is an abbreviation of pharmaceutical.

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; rendering 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; lab (or pharma) wastes; and paper mill wastes.

For the 2018 survey, respondents from 45 of the 46 stand-alone facilities (98%), all 16 on-farm co-digesters (100%), and 71 of the 72 WRRFs (99%) provided data on the type of feedstocks processed. Figure 6 shows the top five feedstocks accepted by digester type. The top five feedstocks processed overall are: FOG, food processing industry waste, beverage processing industry waste, fruit/vegetable wastes, and pre-and-post- consumer food services waste. EPA did not collect data on the quantity of individual feedstocks processed.

There were a few results worth noting in comparison to the feedstock data collected in 2017 survey for stand-alone digesters. The top five feedstocks processed at stand-alone digesters remained the same: beverage processing industry waste, food processing industry waste, fats oils and greases (FOG), fruit and vegetative waste and food service waste, pre- and post- consumer. The number of stand-alone digesters processing manure decreased by 50% (16 digesters reported in 2017 compared to 8 digesters reported in 2018). Zero facilities reported processing septage, de-icing fluid, and paper mill waste in 2018.

Table 9: Types of Food Waste and Non-Food Waste Feedstocks Processed at Stand-Alone Digesters

Feedstock	Number of Stand-Alone Facilities processing this feedstock	Percentage of Stand-Alone Facilities processing this feedstock*
Beverage processing industry waste	33	73%
Food processing industry waste	26	58%
Fruit/vegetative wastes	24	53%
FOG	23	51%
Food service waste, pre- & post-consumer	18	40%
Retail food waste	17	38%
Crude Glycerin	17	38%
Source-separated commercial, institutional or residential organic wastes	14	31%
Manure	8	18%
Wastewater solids (sludge)	8	18%
Rendering wastes	7	16%
Crop residues	7	16%
Other (please specify)†	5	11%
Mixed yard waste	4	9%
Lab (or Pharma) wastes	3	7%

* Percentage calculated based on the 45 facilities providing data on the type of feedstocks processed in 2016.

† Other reported feedstocks include organic non-food industrial wastes and leachate from compost operation.

Table 10: Types of Food Waste and Non-food Waste Feedstock Processed at On-Farm Co-Digesters

Feedstock	Number of On-Farm Facilities processing this feedstock	Percentage of On-Farm Facilities processing this feedstock*
Food processing industry waste	14	88%
FOG	12	75%
Beverage processing industry waste	11	69%
Fruit/vegetative wastes	9	56%
Food service waste, pre- & post-consumer	6	38%
Crude glycerin	6	38%
Retail food waste	5	31%
Rendering waste	5	31%
Source-separated commercial, institutional or residential organic wastes	4	25%
Wastewater solids (sludge)	4	25%
Manure from other farms	1	6%
De-icing fluid	1	6%
Other	1	6%

* Percentage calculated based on 16 farms providing survey responses.

The top five feedstocks processed at WRRFs remained the same: fats oils and greases (FOG), food processing industry waste, beverage processing industry waste, septage and wastewater solids (sludge) from other WRRFs. The number of facilities co-digesting source-separated commercial, institutional or residential organic wastes doubled, and the number of facilities co-digesting beverage processing industry waste almost doubled between the 2017 and 2018 surveys.

Table 11: Types of Food Waste and Non-Food Waste Feedstock Processed at Co-Digestion Systems at WRRFs

Feedstock	Number of WRRFs processing this feedstock	Percentage of WRRFs processing this feedstock*
FOG	60	85%
Food processing industry waste	37	52%
Beverage processing industry waste	30	42%
Septage	26	37%
Wastewater solids (sludge)	24	34%
Food service waste, pre- & post-consumer	18	25%
Fruit/vegetative wastes	14	20%
Source-separated commercial, institutional or residential organic wastes	10	14%
Other (please specify) †	8	11%
Rendering wastes	7	10%
Crude glycerin	6	8%
Retail food waste	6	8%
De-icing fluid	5	7%
Lab (or Pharma) wastes	2	3%
Poultry litter	2	3%
Manure	1	1%

* Percentage calculated based on 71 WRRFs providing feedstock data in survey responses.

† Other reported feedstocks include landfill leachate, landfill gas condensate, propylene glycol, wastewater from cleaning biodiesel process equipment and pressed municipal solid waste.

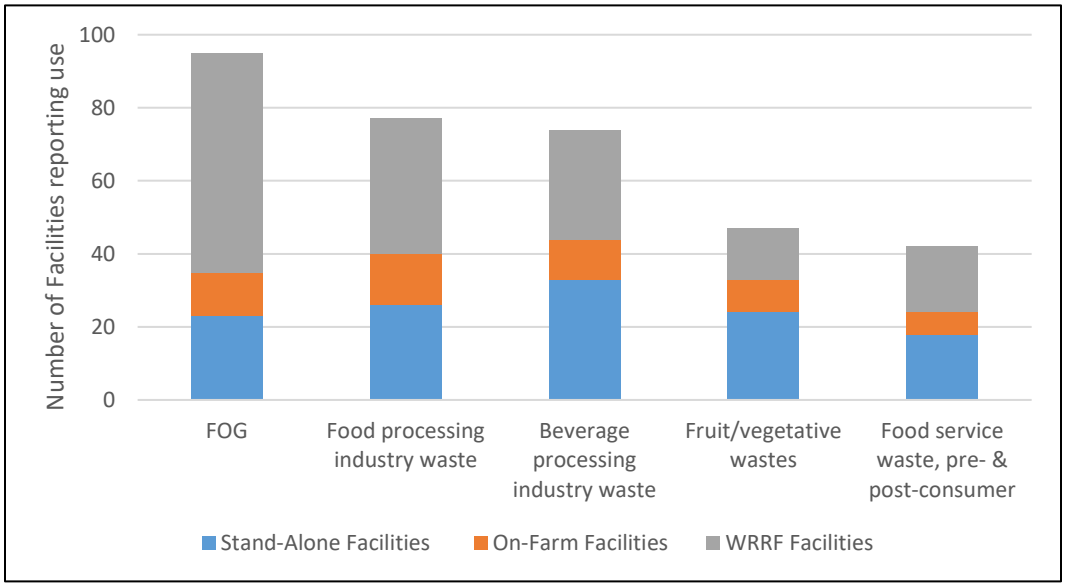

Figure 6: Top Five Feedstocks Accepted by Digesters Taking Food Waste by Digester Type

G. Feedstock 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. Tables 12, 13 and 14 show the number of facilities that reported receipt of feedstocks from each of the possible sources. Figure 7 shows the top five sources of feedstock by digester type. Respondents from 45 of the 46 stand-alone facilities (98%), all 16 on-farm co-digesters (100%), and 71 of 72 WRRFs (99%) provided data on sources of feedstocks processed.

Table 12: Sources of Food Waste and Non-Food Waste Feedstock Processed by Stand-Alone Digesters

Source	Number of Facilities Receiving Feedstock from Specified Source	Percentage of Facilities Receiving Feedstock from Specified Source*
Food/beverage processors	39	87%
Industrial	19	42%
Restaurants and food service	18	40%
Grocery stores/supermarkets	16	36%
Biodiesel production	14	31%
Fruit/vegetable farms	10	22%
Livestock farms	8	18%
Retail stores	8	18%
Wastewater treatment plants	8	18%
Hospitality	7	16%
Municipal/residential	6	13%
Sports and entertainment venues	6	13%
Corporate complex	6	13%

Source	Number of Facilities Receiving Feedstock from Specified Source	Percentage of Facilities Receiving Feedstock from Specified Source*
Schools	5	11%
Farmers markets	4	9%
Airports	4	9%
Healthcare	4	9%
Laboratories/ pharmaceutical companies	4	9%
Prisons	3	7%
Other	1	2%
* Percentage calculated is based on 45 facilities providing data on feedstock sources.		

Table 13: Sources of Food Waste and Non-Food Waste Feedstock Processed by On-Farm Co-Digesters

Source	Number of Facilities Receiving Feedstock from Specified Source	Percentage* of On-farm Digesters Receiving Feedstock from Specified Source
Food/beverage processors	16	100%
Biodiesel production	6	38%
Grocery stores/supermarkets	5	31%
Industrial	5	31%
Restaurants and food service	5	31%
Corporate complex	3	19%
Healthcare	3	19%
Municipal/Residential	3	19%
Retail stores	3	19%
Fruit/vegetable farms	2	13%
Hospitality	2	13%
Laboratories/pharmaceutical companies	2	13%
Schools	2	13%
Wastewater treatment plants	2	13%
Other	2	13%
Airports	1	6%
Other livestock farms	1	6%
Prisons	1	6%
Sports and entertainment venues	1	6%
* Percentage calculated based on 16 farms providing data on feedstock sources.		

Table 14: Sources of Food Waste and Non-Food Waste Feedstock Processed by Co-Digestion Systems at WRRFs

Source	Number of Facilities Receiving Feedstock from Specified Source	Percentage of WRRFs Receiving Feedstock from Specified Source*
Restaurants and food service	51	72%
Food/beverage processors	51	72%
Municipal/residential	28	39%
Other wastewater treatment plants	24	34%
Grocery stores/supermarkets	22	31%
Industrial	18	25%
Schools	16	23%
Biodiesel production	9	13%
Retail stores	9	13%
Fruit/vegetable farms	9	13%
Hospitality	9	13%
Sports and entertainment venues	9	13%
Healthcare	7	10%
Laboratories/pharmaceutical companies	6	8%
Prisons	6	8%
Airports	5	7%
Corporate complex	4	6%
Farmers markets	3	4%
Other	3	4%
Livestock farms	2	3%
* Percentage based on 71 WRRFs providing data on feedstock sources.		

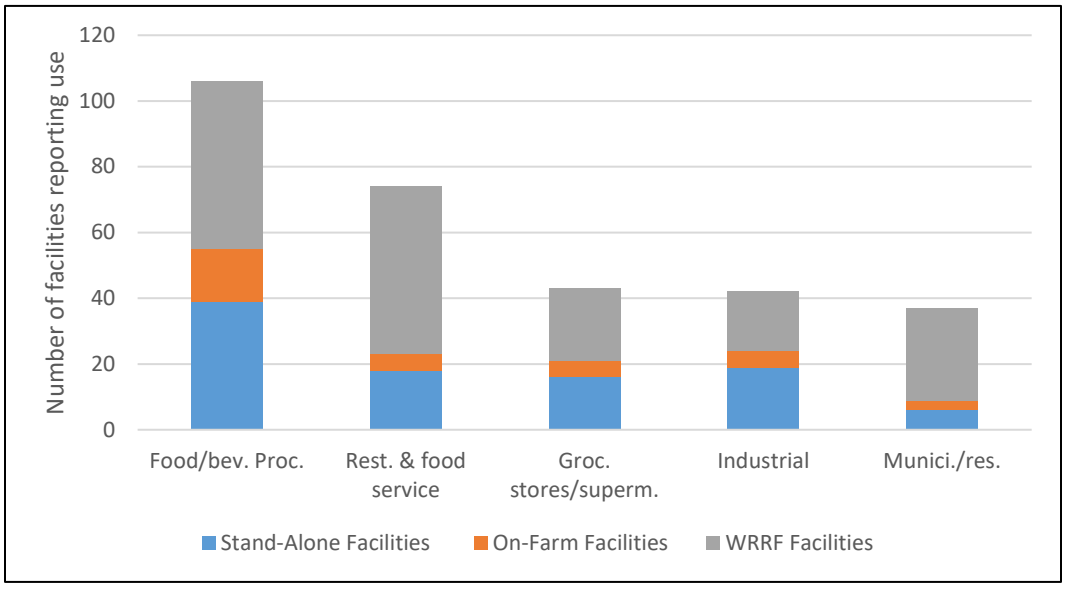

Figure 7: Top Five Sources of Digester Feedstock by Digester Type

H. 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; and availability of organics recycling options. 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.

Most survey respondents for all three digester types either did not answer the questions about tipping fees, or indicated "$0.00" or "prefer not to say," as the answer. As was the case with the 2017 survey, not enough information was collected to draw meaningful or useful conclusions about tipping fee trends.

I. Pre-processing

EPA asked operators about the types of pre-processing activities performed at their facilities. Respondents from 21 of the 46 stand-alone facilities (46%), 6 of the 16 on-farm co-digesters (38%), and 41 of the 72 WRRFs (57%) provided data on pre-processing of feedstocks. Multiple types of pre-processing can occur at any one facility. Tables 15, 16 and 17 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 offsite location and pre-processed feedstocks are then transported to the digester in a ready to digest form.

Table 15: Pre-processing Activities for Stand-Alone Digester Facilities

Pre-processing Activity	Number of Facilities with Specified Pre-processing Activities
Screening and/or sorting	8
Manual or mechanized de-packaging/de-bagging	7
Grinding, particle size reduction or maceration	6
Mixing	4
Third-Party Processing	4
Shredding/crushing	2
Solids concentration using Dissolved Air Flotation Tanks	1
Metals removal	1
pH adjustment	1
Hydrolysis	1

Table 16: Pre-processing for On-Farm Co-Digestion Facilities

Pre-processing/De-packaging Activity	Number of Facilities with Specified Pre-processing Activities
Manual or mechanized de-packaging/de-bagging	3
Third-Party Processing	3
Grinding, particle size reduction or maceration	1
Mixing	1
Dewatering and compressing	1

Table 17: Pre-processing for Co-Digestion Facilities at WRRFs

Pre-processing/De-packaging Activity	Number of Facilities with Specified Pre-processing Activities
Screening and/or sorting	16
Third-Party Processing	14
Grinding, particle size reduction or maceration	13
Mixing	7
Manual or mechanized de-packaging/de-bagging	4
pH Adjustment	2
Heating	1
Centrifugal Separation	1

J. Operational 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.

Respondents from 43 of 46 stand-alone digesters (93%), 15 of 16 on-farm co-digesters (94%), and 71 of 72 WRRFs (99%) provided data on temperature range. Respondents from 44 of 46 stand-alone digesters (96%) and all 16 on-farm co-digesters (100%) provided data on whether their digester system was wet or dry. This question was not posed to WRRFs because all WRRF digester systems are wet. Tables 18 and 19 show the data for temperature range and wet versus dry facilities by facility type.

Table 18: Temperature Range Data for each Digester Type

	Temperature Range			Response Rate	
Digester Type	***Mesophilic***	***Thermophilic***	***Unheated***	***Number of Respondents Providing Data for this Survey Question***	***Total Surveys Received***
Stand-alone digesters	22	9	12	43	46
On-farm co-digesters	12	3	0	15	16
Co-digestion systems at WRRFs	59	12	0	71	72
Total	**93**	**24**	**12**	**129**	**134**

Table 19: Data on Wet vs. Dry Systems for each Digester Type

	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	39	5	89%	11%	44	46
On-farm co-digesters	16	0	100%	0%	16	16
Co-digestion systems at WRRFs*	--	--	100%	--	--	--
Total	**55**	**5**			**60**	**62**

***** This question was not posed to WRRFs because all WRRF digester systems are wet.

K. 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[18] 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. [19] To provide a frame of reference, EPA presents the kWh/yr values for each type of digester in terms of powering homes.[20] Table 20 shows biogas production data by facility type.

Table 20: Summary of Biogas Data Reported by Digester Type (2016)

Digester Type	Respondents Providing Data	Surveys Received	SCFM*	MW	kWh/yr (million)	Number of Homes Powered for One Year
Stand-alone digesters	40	46	10,498	33	246	20,911
On-farm co-digesters	12	16	4,053	13	97	8,246
Co-digestion systems at WRRFs	67	72	25,753	80	596	50,663
Total	**119**	**134**	**40,304**	**126**	**939**	**79,820**

* SCFM values are reported by facility operators and added together to get total SCFM for 2016 (40,304). 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.

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

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

[20] The average home consumed 11,764 kWh of delivered electricity in 2017, the most recent date for which data is available (https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references).

L. Biogas Uses

Most facilities have more than one use for the biogas, and the survey permitted multiple responses. Respondents from 43 of 46 stand-alone facilities (93%), all 16 on-farm co-digesters (100%), and 70 of 72 WRRFs (97%) provided data on biogas uses. Table 21 summarizes the ways in which respondents reported using the biogas produced and Figure 8 shows the top five uses of the biogas produced at AD facilities as reported by each type of respondent.

Stand-Alone Digesters

The stand-alone digester survey asked respondents if the biogas produced was used onsite, sold, or both. The data reported show that 74% used the biogas onsite, 5% sold it, and 23% used it both onsite and sold it. The survey also asked respondents if they were able to utilize all the biogas produced at their facility. Sixty-nine percent (69%) reported that all the biogas produced was used. This result represents a decrease from the 2017 survey last year when 82% of stand-alone facilities reported that all biogas produced was used. For the 2018 survey, 31% reported that they did not use all the biogas produced. Facilities that did not use all the biogas produced uniformly reported that they flared the unused biogas.

On-Farm Co-Digesters

The survey asked on-farm co-digester respondents if the biogas produced was used onsite, sold, or flared. The reported data show that 81% used the biogas onsite, 25% sold it, and 31% flared at least some of the biogas. This result represents a decrease from last year when 60% of on-farm co-digesters reported flaring at least some of the biogas produced.

Co-Digestion Systems at WRRFs

The WRRF co-digester survey asked respondents if the biogas produced was used onsite, sold, or flared. The reported data show that 94% used the biogas onsite, 4% sold it, and 64% flared at least some of the biogas. The survey also asked WRRF respondents if they utilized all the biogas produced at their facility. Seventy-one out of 72 WRRFs (99%) provided data for this question. Forty-five percent of the facilities reported that they used all the biogas produced for onsite purposes. The other 55% confirmed that they flared the unused biogas.

The following other uses were reported by one WRRF operator at four individual facilities:

- Produce heat to run furnace on sludge dryer;
- Provides fuel for heat drying facility;
- Supplement natural gas in a sludge dryer; and
- Used exclusively by sludge pelletizing process.

Table 21: 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)	26	60%	13	81%	53	76%
Fuel boilers and furnaces to heat digesters	4	9%	4	25%	42	60%
Fuel boilers and furnaces to heat other spaces	13	30%	4	25%	23	33%
Produce electricity (sold to grid)	17	40%	11	69%	11	16%
Produce electricity used behind the meter (including net metering)	13	30%	8	50%	15	21%
Produce mechanical power	0	-	1	6%	2	4%
Compressed to vehicle fuels: used for company fleet/personal vehicles	3	7%	0	-	0	-
Compressed to vehicle fuels: sold to customers	2	5%	0	-	0	-
Renewable natural gas (inject to pipeline)	0	-	0	-	2	3%

*: Percentage out of the 43 stand-alone facilities providing data on biogas uses.
†: Percentage out of the 16 farms providing survey responses.
§: Percentage out of the 70 WRRFs providing survey responses.

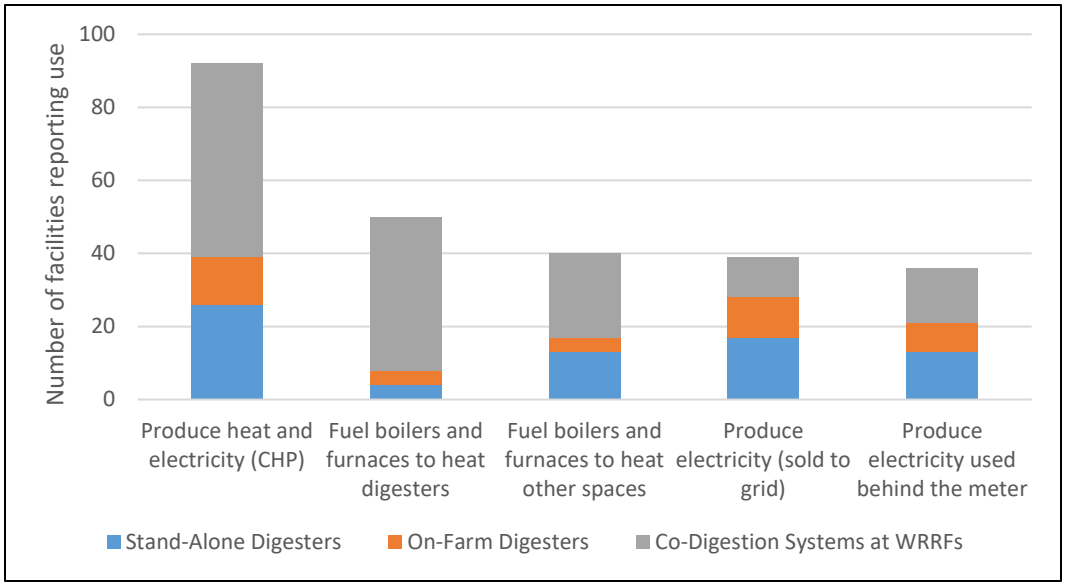

Figure 8: Top Five Uses of Biogas by Digester Type

M. Gas Cleaning Systems

Each facility type was asked whether they had a gas cleaning system (yes or no). Respondents from 45 of 46 stand-alone facilities (98%), all 16 on-farm co-digesters (100%), and 71 out of 72 WRRFs (99%) answered this question. The data reported show that gas cleaning systems were utilized at 35 out of 45 (78%) of stand-alone food waste digesters, nine out of 16 (56%) on-farm co-digesters, and 49 out of 71 (69%) digesters at WRRFs.

Each facility type was also asked what constituents were removed by their gas cleaning systems. All 35 stand-alone facilities, 9 on-farm co-digesters and 48 out of 49 WRRFs that utilize gas cleaning systems provided data on the constituents removed by these systems. Table 22 summarizes the type and frequency of constituents removed by gas cleaning systems for each type of digester and Figure 9 shows the top five constituents removed by digester type.

Table 22: 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	28	80%	6	67%	35	73%
Moisture	23	66%	8	89%	43	90%
Siloxanes	5	14%	1	11%	43	90%
Carbon Dioxide	4	11%	1	11%	4	8%
Hydrogen Sulfide	1	3%	1	11%	4	8%
Compressed gas	1	3%	0	--	3	6%
VOCs	1	3%	0	--	0	--

*: Percentage out of 35 stand-alone digesters providing data on constituents removed.
†: Percentage out of 9 on-farm digesters providing data on constituents removed.
§: Percentage out of 48 WRRFs providing data on constituents removed.

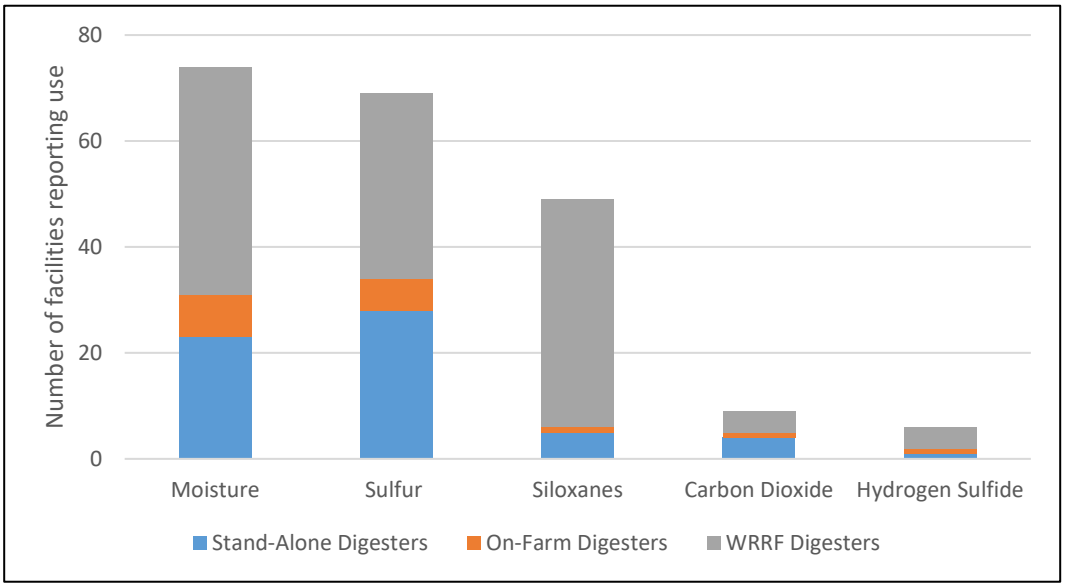

Figure 9: Top Five Constituents Removed by Digester Type

N. Solid Digestate Uses

EPA asked how facilities used the solid digestate they produce, allowing respondents to provide more than one answer. Respondents from 44 of 46 stand-alone facilities (91%), all 16 farm co-digesters (100%), and 71 of 72 WRRF digesters (99%) provided data on the uses of solid digestate. According to the survey responses, there are six WRRFs that landfill all the solid digestate produced. The following uses/destinations of solid digestate were reported for the three digester types surveyed at the

frequencies specified in Table 23 below. Figure 10 shows the top five uses of solid digestate by digester type.

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

- Picked up by composter (one respondent - verbatim);
- Digestate remains in liquid form and it is land applied (four respondents);
- No solid digestate produced (three respondents);
- Digestate is sold to other facilities (two respondents); and
- Solid onion remains are sold as cattle feed (one respondent - verbatim).

On-farm co-digester operators also reported the following other uses, summarized from survey responses:

- No solid digestate (only liquid) which is land-applied (two respondents).

WRRF digester operators also reported the following other uses for biosolids produced, summarized from survey responses:

- Struvite harvesting process is utilized (one respondent - verbatim);
- Sent to a biosolids recycling facility (one respondent - verbatim);
- Processed into fertilizer by a third-party (two respondents);
- Transported to drying beds and land applied by a third-party (one respondent - verbatim).;
- Used as backfill material in exhausted gypsum mines (one respondent - verbatim).; and
- Dewatered and land disposed on site (one respondent - verbatim).

Out of the responses received from WRRF digester operators, 68 facilities out of 72 (94%) indicated that they produce a Class A or Class B biosolid.[21] Thirty seven percent of the responding facilities produced Class A biosolids, and 63% produced Class B biosolids.

The federal biosolids rule is contained in 40 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.

[21] For additional information on biosolids, please see: https://www.epa.gov/sites/production/files/2018-12/documents/plain-english-guide-part503-biosolids-rule.pdf"

Table 23: Solid Digestate Uses

	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	10	23%	6	38%	41	58%
Composted into a reusable/ salable product	16	36%	3	19%	8	11%
Landfilled	4	9%	0	--	11	15%
Other	14	32%	3	19%	9	13%
Processed into animal bedding	0	--	10	63%	0	--
Dried into a reusable/ salable product (e.g., fertilizer)	0	--	0	--	9	13%
Land applied as is with no dewatering or drying	3	7%	0	-	10	14%
Incinerated	0	--	0	--	1	1%

* Percentage calculation based on 44 stand-alone facilities providing data on use of solid digestate.
† Percentage calculation based on 16 farms providing data on use of solid digestate.
§ Percentage calculation based on 71 WRRFs providing data on use of solid digestate.

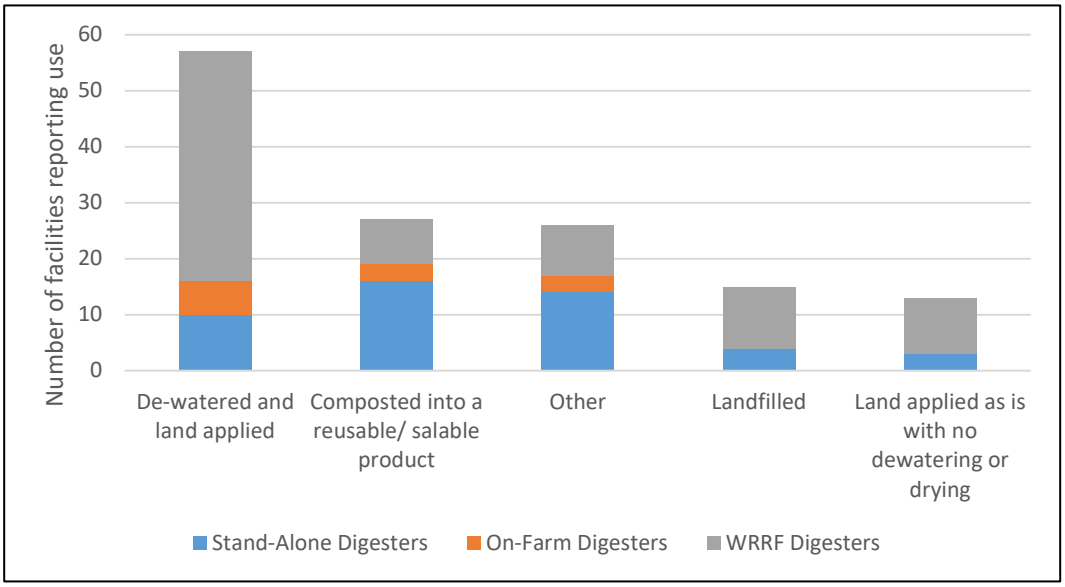

Figure 10: Top Five Uses of Solid Digestate by Digester Type

O. Liquid Digestate Uses

EPA asked how facilities manage liquid digestate, allowing respondents to provide more than one answer. Respondents from 39 of 46 stand-alone facilities (96%), all 16 on-farm co-digesters, and 71 of 72 (99%) WRRFs provided data on the management of liquid digestate, as summarized in Table 24.

Of the 17 stand-alone digesters that used digestate as fertilizer via land application, only two facilities further processed it prior to application (12%). All 16 on-farm co-digester operators indicated that liquid digestate was land applied. Two of these on-farm co-digester operators indicated that the liquid was further processed prior to application (13%). Seven WRRF digesters indicated that the liquid digestate they produced was land applied, and three of these facilities further processed it prior to application.

Table 24: Liquid Digestate Uses

	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 of using Liquid Digestate as Specified†***	***Number of Facilities Reporting Use***	***Percentage of using Liquid Digestate as Specified§***
Recirculated through digester	10	26%	7	44%	60	85%
Reused as fertilizer via land application	17	44%	16	100%	7	10%
Discharged to a wastewater treatment plant	20	51%	0	--	0	--
Other	3	8%	0	--	11	15%

* Percentage calculation based on 39 stand-alone facilities providing data on use of liquid digestate.
† Percentage calculation based on 16 farms providing data on use of liquid digestate.
§ Percentage calculation based on 71 WRRFs providing data on use of liquid digestate.

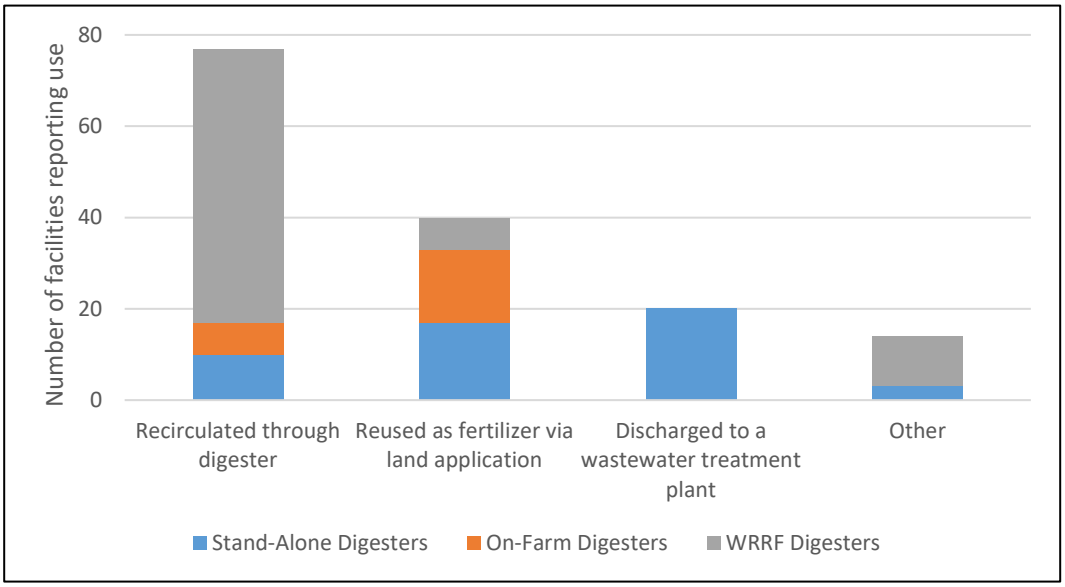

Figure 11: Uses of Liquid Digestate by Digester Type

IV. Conclusion

The 2018 survey (results summarized in this report) helped EPA estimate how many AD facilities were processing food waste in the U.S., where those facilities are located, and their processing amounts and available capacity. EPA 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, which will be critical to tracking growth in capacity over time as future reports are developed.

Based on information received directly from facilities that responded to the survey, the total processing capacity for food waste at these AD facilities is nearly 24 million tons per year. The total amount food waste reported to be processed (in 2016) was over 10 million tons and the total amount of non-food waste reported to be processed (in 2016) was over 490 million gallons and nearly 104,000 tons. The total amount of biogas produced (in 2016) was over 40,000 SCFM. Additional information on AD facilities is summarized in Table 25.

The extent to which the results of the 2018 survey can be compared with the 2017 survey should be caveated by the fact that the individual facilities responding from year to year are not identical. It should also be noted the facilities voluntarily chose to submit data. For example, although the results of the survey show an increase in capacity for stand-alone digesters, it may be because a facility with a high capacity did not respond in the 2017 survey. Furthermore, due to the fact that the 2018 report had different facilities respond to the survey, the report cannot be used to express how the state of AD is increasing or decreasing. EPA will continue to gather data and seek to verify data received in 2017 and 2018 to clarify this information in these reports over time. Data collected during the 2019 survey will be summarized in the anticipated third report in this series targeted for publication in 2020.

Table 25: 2018 Survey Results

Area of Data Collection	Result
Total Processing Capacity	23,993,122 tons per year
Total Food Waste Processed (2016)	10,691,756 tons
Total Non-Food Waste Processed at Co-Digesting Facilities (2016)	491,972,700 gallons and 103,952 tons
Total Biogas Produced (2016)	40,304 SCFM
Top-Three States with the Most Digesters	California; Wisconsin; Ohio
Top-Three Feedstock Types	FOG; Food Processing Industry Waste; Beverage Processing Industry Waste
Top-Three Feedstock Sources	Food/Beverage Processors; Restaurants & Food Services; Grocery Stores/Supermarkets
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 Constituents Removed	Moisture; Sulfur; Siloxanes
Top-Three Uses of Solid Digestate	De-watered/dried and Land Applied; Composted into a Reusable/Salable Product; Other
Top-Three Uses of Liquid Digestate	Recirculated Through Digester; Reused as Fertilizer via Land Application; Discharged to a Wastewater Treatment Plan

Appendix A – Operational Digesters and Co-Digestion Systems

This appendix lists the facilities for which survey responses were received in 2018 and 2017 for each digester type. Tables 1A, 3A and 5A list facilities that provided survey responses in 2018 and were operational as of December 2018. Tables 2A, 4A and 6A list facilities that provided survey responses in 2017 and were operational as of December 2017. These tables are not identical to the corresponding tables in Appendix A of the report issued in 2018. The table descriptions are as follows:

Table 1A: Stand-Alone Anaerobic Digestion Facilities Digesting Food Waste in the U.S. (2018)
Table 2A: Stand-Alone Anaerobic Digestion Facilities Digesting Food Waste in the U.S. (2017)
Table 3A: On-Farm Digesters Co-Digesting Food Waste in the U.S. (2018)
Table 4A: On-Farm Digesters Co-Digesting Food Waste in the U.S. (2017)
Table 5A: WRRF Digesters Co-Digesting Food Waste in the U.S. (2018)
Table 6A: WRRF Digesters Co-Digesting Food Waste in the U.S. (2017)

Table 1A: Stand-Alone Anaerobic Digestion Facilities Digesting Food Waste in the U.S. (2018)

	Stand-Alone Facility Name	Location	Multi-Source (MS)/Industry-Dedicated (ID)/Other*
1	Ralphs Recovery System	Compton, CA	ID
2	Fairfield Brewery BTS	Fairfield, CA	ID
3	MillerCoors Brewery	Irwindale, CA	ID
4	Zero Waste Energy - Monterey	Marina, CA	MS
5	North State Rendering Co. Inc./John S. Ottone Renewable Energy Project	Oroville, CA	MS
6	Gills Onions	Oxnard, CA	ID
7	CleanWorld SATS	Sacramento, CA	MS
8	Kompogas SLO LLC	San Luis Obispo, CA	MS
9	Zero Waste Energy Development Company	San Jose, CA	MS
10	Blue Line Biogenic CNG Facility	South San Francisco, CA	MS
11	LA BTS	Van Nuys, CA	ID
12	Quantum Biopower	Southington, CT	MS
13	Harvest Power Orlando	Bay Lake, FL	MS
14	Jacksonville BTS	Jacksonville, FL	ID
15	Cartersville BTS	Cartersville, GA	ID
16	City of Waterloo Anaerobic Lagoon	Waterloo, IA	OTHER
17	Waste No Energy, LLC	Monticello, IN	MS
18	Stop & Shop Freetown Distribution Center	Assonet, MA	ID
19	Garelick Farms	Franklin, MA	ID
20	CRMC Bioenergy Facility	New Bedford, MA	OTHER
21	Generate Fremont Digester, LLC	Fremont, MI	MS
22	Hometown BioEnergy	Le Sueur, MN	MS
23	St. Louis BTS	St. Louis, MO,	ID
24	Full Circle Recycle	Zebulon, NC	MS
25	Merrimack BTS	Merrimack, NH	ID
26	Newark BTS	Newark, NJ	ID
27	Lassonde Pappas	Seabrook, NJ	ID

Stand-Alone Facility Name		Location	Multi-Source (MS)/Industry-Dedicated (ID)/Other*
28	AB-Inbev Baldwinsville	Baldwinsville, NY	ID
29	Buffalo BioEnergy	West Seneca, NY	MS
30	Generate Niagara Digester	Wheatfield, NY	MS
31	Emerald BioEnergy	Cardington, OH	MS
32	Collinwood BioEnergy	Cleveland, OH	OTHER
33	Central Ohio BioEnergy	Columbus, OH	MS
34	Columbus BTS	Columbus, OH	ID
35	Dovetail Energy	Fairborn, OH	MS
36	Campbell Soup Supply Company	Napoleon, OH	ID
37	Three Creek BioEnergy, LLC	Sheffield Village, OH	MS
38	Buckeye Biogas, LLC	Wooster, OH	MS
39	Zanesville Energy, LLC	Zanesville, OH	MS
40	Stahlbush Island Farms	Corvallis, OR	OTHER
41	Yuengling Beer Company	Pottsville, PA	ID
42	Bush Brothers and Company Process Water Recovery Facility	Dandridge, TN	ID
43	Houston BTS	Houston, TX	ID
44	Magic Hat Resource Recovery Center	South Burlington, VT	MS
45	FCPC Renewable Generation	Milwaukee, WI	MS
46	Urban Dry Digester – UW Oshkosh	Oshkosh, WI	MS
* "OTHER" represents two industry dedicated digesters that accept outside feedstocks periodically.			

Table 2A: Stand-Alone Anaerobic Digestion Facilities Digesting Food Waste in the U.S. (2017)

	Stand-Alone Facility Name	Location	Multi-Source (MS)/Industry-Dedicated (ID)/Other*
1	Ralphs Renewable Energy Facility	Compton, CA	ID
2	Fairfield Brewery BTS	Fairfield, CA	ID
3	MillerCoors Brewery	Irwindale, CA	ID
4	Monterey Regional Waste Management District	Marina, CA	MS
5	North State Rendering	Oroville, CA	MS
6	Gills Onions	Oxnard, CA	ID
7	CR&R Material Recovery Facility	Perris, CA	MS
8	Sacramento BioDigester	Sacramento, CA	MS
9	ZWEDC	San Jose, CA	MS
10	Blue Line Biogenic CNG Facility	South San Francisco, CA	MS
11	LA BTS	Van Nuys, CA	ID
12	Quantum Biopower	Southington, CT	MS
13	Jacksonville BTS	Jacksonville, FL	ID
14	Harvest Power Orlando	Lake Buena Vista, FL	MS
15	Cartersville BTS	Cartersville, GA	ID
16	Waste No Energy, LLC	Monticello, IN	MS
17	Stop & Shop Freetown Distribution Center	Assonet, MA	OTHER
18	Garelick Farms	Franklin, MA	ID
19	Garelick Farms	Lynn, MA	ID
20	Ken's Foods Inc	Marlborough, MA	ID
21	CRMC Bioenergy Facility	New Bedford, MA	MS
22	Exeter Agri-Energy	Exeter, ME	MS
23	Michigan State Univ. – South Campus Anaerobic Digester	Lansing, MI	MS
24	Hometown BioEnergy	Le Sueur, MN	MS
25	St. Louis BTS	St. Louis, MO,	ID
26	Merrimack BTS	Merrimack, NH	ID
27	Newark BTS	Newark, NJ	ID
28	Lassonde Pappas	Seabrook, NJ	ID
29	CH4 Generate Cayuga LLC.	Auburn, NY	MS
30	AB-Inbev Baldwinsville	Baldwinsville, NY	ID
31	Buffalo BioEnergy	West Seneca, NY	MS
32	Niagara BioEnergy	Wheatfield, NY	MS
33	Emerald BioEnergy	Cardington, OH	MS
34	Central Ohio BioEnergy	Columbus, OH	MS
35	Columbus BTS	Columbus, OH	ID
36	Dovetail Energy	Fairborn, OH	MS
37	Haviland Energy	Haviland, OH	MS
38	Quasar	Independence, OH	MS
39	Buckeye Biogas LLC	Wooster, OH	MS
40	Zanesville Energy	Zanesville, OH	MS
41	Stahlbush Island Farms	Corvallis, OR	MS
42	D.G. Yuengling and Son, Inc.	Pottsville, PA	ID
43	Kline's Services	Salunga, PA	MS
44	Houston BTS	Houston, TX	ID
45	Vermont Tech Community AD	Randolph, VT	MS
46	Purpose Energy Digester at Magic Hat Brewery	South Burlington, VT	OTHER

Stand-Alone Facility Name		Location	Multi-Source (MS)/Industry-Dedicated (ID)/Other*
47	Bush Brothers & Company	Augusta, WI	ID
48	Montchevre – Betin	Belmont, WI	ID
49	Forest County Potawatomi Community Digester	Milwaukee, WI	MS
50	UW-Oshkosh Urban Dry Digester	Oshkosh, WI	MS
* "Other" reflects an industry dedicated digester that accepts outside feedstocks periodically, and a facility that processes feedstocks from several of their own internal retail supermarkets.			

Table 3A: On-Farm Digesters Co-Digesting Food Waste in the U.S. (2018)

Farm Name		Location
1	Green Cow Power	Goshen, IN
2	BioTown Ag	Reynolds, IN
3	Rutland AD1	Rutland, MA
4	Exeter Agri-Energy/Stonyvale Farm	Exeter, ME
5	Patterson Farms Inc	Auburn, NY
6	Noblehurst Green Energy	Linwood, NY
7	Oregon Dairy Farm LLC	Lititz, PA
8	Reinford Farms	Mifflintown, PA
9	Oak Hill Farm	Nottingham, PA
10	Chaput Family Farms	North Troy, VT
11	Vermont Technical College Anaerobic Digester	Randolph Center, VT
12	Vander Haak Dairy	Lynden, WA
13	Qualco Energy	Monroe, WA
14	Holsum Elm Dairy	Hilbert, WI
15	Holsum Irish Dairy	Hilbert, WI
16	Allen Farms	Oshkosh, WI

Table 4A: On-Farm Digesters Co-Digesting Food Waste in the U.S. (2017)

Farm Name		Location
1	Link Energy	Riceville, IA
2	Bar-Way Farm	Deerfield, MA
3	Pine Island Farm	Sheffield, MA
4	Kilby's Inc.	Colora, MD
5	Exeter Agri-Energy/Stonyvale Farm	Exeter, ME
6	Patterson Farms Inc	Auburn, NY
7	Noblehurst Green Energy	Linwood, NY
8	CH4/Synergy Biogas	Wyoming, NY
9	Kish-View Farm	Belleville, PA
10	Schrack Farms	Loganton, PA
11	Reinford Farms	Mifflintown, PA
12	Monument Farms Three-Gen	Weybridge, VT
13	Clean Fuel Dane, LLC	Dane, WI
14	Five Star Dairy, LLC	Elk Bridge, WI
15	Allen Farms	Oshkosh, WI

Table 5A: WRRF Digesters Co-Digesting Food Waste in the U.S. (2018)

WRRF Name		Location
1	Fourche Creek Water Reclamation Facility	Little Rock, AR
2	Wildcat Hill Wastewater Treatment Plant	Flagstaff, AZ
3	Delta Diablo WWTP	Antioch, CA
4	Bakersfield Wastewater Treatment Plant # 2	Bakersfield, CA
5	Bakersfield Wastewater Treatment Plant # 3	Bakersfield, CA
6	Hill Canyon Wastewater Treatment Plant	Camarillo, CA
7	Encina Wastewater Authority (EWPCF)	Carlsbad, CA
8	Joint Water Pollution Control Plant	Carson, CA
9	Sacramento Regional Wastewater Treatment Plant	Elk Grove, CA
10	Fairfield-Suisun Sewer District	Fairfield, CA
11	Fresno-Clovis RWRF	Fresno, CA
12	City of Hayward Water Pollution Control Facility	Hayward, CA
13	Napa Sanitation District	Napa, CA
14	East Bay Municipal Utility District Main Wastewater Treatment Plant	Oakland, CA
15	Silicon Valley Clean Water	Redwood City, CA
16	Oro Loma Sanitary District	San Lorenzo, CA
17	Central Marin Sanitation Agency	San Rafael, CA
18	El Estero WWTP	Santa Barbara, CA
19	Santa Rosa Regional Water Reuse Plant (Laguna Treatment Plant)	Santa Rosa, CA
20	Victor Valley Wastewater Reclamation Authority	Victorville, CA
21	City of Watsonville WWTP	Watsonville, CA
22	Santa Rita Wastewater Reclamation Plant (City of Durango WWTP)	Durango, CO
23	South Cross Bayou Advanced Water Reclamation Facility	St. Petersburg, FL
24	Thomas P Smith Water Reclamation Facility (TPS Treatment Plant)	Tallahassee, FL
25	F. Wayne Hill Water Resources Center	Buford, GA
26	South Columbus Water Treatment Facility	Columbus, GA
27	Lower Poplar Street Water Reclamation Facility	Macon, GA
28	Ames Water Pollution Control Plant	Ames, IA
29	Davenport Water Pollution Control Plant	Davenport, IA
30	Des Moines Metropolitan Wastewater Reclamation Authority	Des Moines, IA
31	Dubuque Water & Resource Recovery Center	Dubuque, IA
32	Downers Grove Sanitary District Wastewater Treatment Center	Downers Grove, IL
33	Rock River Water Reclamation District	Rockford, IL
34	Urbana & Champaign Sanitary District	Urbana, IL
35	West Lafayette Wastewater Treatment Facility	West Lafayette, IN
36	DLS Middle Basin Wastewater Treatment Plant	Overland Park, KS
37	Greater Lawrence Sanitary District	North Andover, MA
38	Lewiston-Auburn Water Pollution Control Authority	Lewiston, ME
39	Delhi Charter Township Wastewater Treatment Plant	Holt, MI
40	Flint Biogas Plant	Flint, MI
41	St. Cloud Nutrient, Energy and Water Recovery Facility	St. Could, MN
42	City of Springfield Southwest Wastewater Treatment Plant	Springfield, MO
43	Joint Meeting of Essex & Union Counties	Elizabeth, NJ
44	Rahway Valley Sewerage Authority	Rahway, NJ
45	Landis Sewerage Authority	Vineland, NJ
46	Newtown Creek Wastewater Resource Recovery Facility	Brooklyn, NY

WRRF Name		Location
47	LeRoy R. Summerson Wastewater Treatment Facility	Cortland, NY
48	Gloversville Johnstown Joint Wastewater Treatment Facility	Johnstown, NY
49	City of London Wastewater Treatment Plant	London, OH
50	City of Wooster Water Resource Recovery Facility	Wooster, OH
51	Gresham Wastewater Treatment Plant	Gresham, OR
52	City of Pendleton Wastewater Treatment Facility	Pendleton, OR
53	Clean Water Services - Durham Advanced Wastewater Treatment Facility	Tigard, OR
54	Hermitage Municipal Authority	Hermitage, PA
55	Derry Township Municipal Authority	Hershey, PA
56	Milton Regional Sewer Authority	Milton, PA
57	New Castle Sanitation Authority	New Castle, PA
58	Mauldin Road Water Resource Recovery Facility	Greenville, SC
59	Southside Wastewater Treatment Plant	Dallas, TX
60	Waco Metro - Area Regional Sewage System	Waco, TX
61	North River Wastewater Treatment Facility	Mt. Crawford, VA
62	Opequon Water Reclamation Facility	Winchester, VA
63	Village of Essex Junction Water Resource Recovery Facility	Essex Junction, VT
64	Appleton Wastewater Treatment Plant	Appleton, WI
65	Fond du Lac Regional Wastewater Treatment & Resource Recovery Facility	Fond du Lac, WI
66	City of Kiel Wastewater Facility	Kiel, WI
67	MMD South Shore Water Reclamation Facility	Oak Creek, WI
68	City of Port Washington Wastewater Treatment Plant	Port Washington, WI
69	City of Rice Lake Wastewater Treatment Plant	Rice Lake, WI
70	Stevens Point Wastewater Treatment Plant	Stevens Point, WI
71	City of West Bend Wastewater Treatment Plant	West Bend, WI
72	Wisconsin Rapids Wastewater Treatment Facility	Wisconsin Rapids, WI

Table 6A: WRRF Digesters Co-Digesting Food Waste in the U.S. (2017)

WRRF Name		Location
1	Fourche Creek Water Reclamation Facility	Little Rock, AR
2	Wildcat Hill Wastewater Treatment Plant	Flagstaff, AZ
3	Delta Diablo WWTP	Antioch, CA
4	Bakersfield Wastewater Treatment Plant # 2	Bakersfield, CA
5	Bakersfield Wastewater Treatment Plant # 3	Bakersfield, CA
6	Hill Canyon Wastewater Treatment Plant	Camarillo, CA
7	Encina Wastewater Authority (EWPCF)	Carlsbad, CA
8	Joint Water Pollution Control Plant	Carson, CA
9	Sacramento Regional Wastewater Treatment Plant	Elk Grove, CA
10	Fairfield-Suisun Sewer District	Fairfield, CA
11	Fresno-Clovis RWRF	Fresno, CA
12	City of Hayward Water Pollution Control Facility	Hayward, CA
13	Napa Sanitation District	Napa, CA
14	East Bay Municipal Utility District Main Wastewater Treatment Plant	Oakland, CA
15	Silicon Valley Clean Water	Redwood City, CA
16	Oro Loma Sanitary District	San Lorenzo, CA
17	Central Marin Sanitation Agency	San Rafael, CA
18	El Estero WWTP	Santa Barbara, CA
19	Santa Rosa Regional Water Reuse Plant (Laguna Treatment Plant)	Santa Rosa, CA

WRRF Name		Location
20	Victor Valley Wastewater Reclamation Authority	Victorville, CA
21	City of Watsonville WWTP	Watsonville, CA
22	Santa Rita Wastewater Reclamation Plant (City of Durango WWTP)	Durango, CO
23	North Regional WWTP	Pompano Beach, FL
24	South Cross Bayou Advanced Water Reclamation Facility	St. Petersburg, FL
25	Thomas P Smith Water Reclamation Facility (TPS Treatment Plant)	Tallahassee, FL
26	F. Wayne Hill Water Resources Center	Buford, GA
27	South Columbus Water Treatment Facility	Columbus, GA
28	Lower Poplar Street Water Reclamation Facility	Macon, GA
29	Ames Water Pollution Control Plant	Ames, IA
30	Davenport Water Pollution Control Plant	Davenport, IA
31	Des Moines Metropolitan Wastewater Reclamation Authority	Des Moines, IA
32	Dubuque Water & Resource Recovery Center	Dubuque, IA
33	Downers Grove Sanitary District Wastewater Treatment Center	Downers Grove, IL
34	Rock River Water Reclamation District	Rockford, IL
35	Urbana & Champaign Sanitary District	Urbana, IL
36	West Lafayette Wastewater Treatment Facility	West Lafayette, IN
37	DLS Middle Basin Wastewater Treatment Plant	Overland Park, KS
38	Greater Lawrence Sanitary District	North Andover, MA
39	Lewiston-Auburn Water Pollution Control Authority	Lewiston, ME
40	Delhi Charter Township Wastewater Treatment Plant	Holt, MI
41	City of Springfield Southwest Wastewater Treatment Plant	Springfield, MO
42	Theresa Street WRRF	Lincoln, NE
43	Joint Meeting of Essex & Union Counties	Elizabeth, NJ
44	Village of Ridgewood Water Pollution Control Facility	Glen Rock, NJ
45	Landis Sewerage Authority	Vineland, NJ
46	Newtown Creek Wastewater Resource Recovery Facility	Brooklyn, NY
47	LeRoy R. Summerson Wastewater Treatment Facility	Cortland, NY
48	Gloversville Johnstown Joint Wastewater Treatment Facility	Johnstown, NY
49	City of Watertown Pollution Control Plant	Watertown, NY
50	City of London Wastewater Treatment Plant	London, OH
51	Gresham Wastewater Treatment Plant	Gresham, OR
52	City of Pendleton Wastewater Treatment Facility	Pendleton, OR
53	Clean Water Services - Durham Advanced Wastewater Treatment Facility	Tigard, OR
54	Hermitage Municipal Authority	Hermitage, PA
55	Derry Township Municipal Authority	Hershey, PA
56	Milton Regional Sewer Authority	Milton, PA
57	New Castle Sanitation Authority	New Castle, PA
58	Mauldin Road Water Resource Recovery Facility	Greenville, SC
59	Southside Wastewater Treatment Plant	Dallas, TX
60	Waco Metro - Area Regional Sewage System	Waco, TX
61	North River Wastewater Treatment Facility	Mt. Crawford, VA
62	Opequon Water Reclamation Facility	Winchester, VA
63	Village of Essex Junction Water Resource Recovery Facility	Essex Junction, VT
64	Appleton Wastewater Treatment Plant	Appleton, WI
65	Fond du Lac Regional Wastewater Treatment & Resource Recovery Facility	Fond du Lac, WI
66	City of Kiel Wastewater Facility	Kiel, WI
67	MMD South Shore Water Reclamation Facility	Oak Creek, WI
68	City of Port Washington Wastewater Treatment Plant	Port Washington, WI

WRRF Name		Location
69	City of Rice Lake Wastewater Treatment Plant	Rice Lake, WI
70	Stevens Point Wastewater Treatment Plant	Stevens Point, WI
71	City of West Bend Wastewater Treatment Plant	West Bend, WI
72	Wisconsin Rapids Wastewater Treatment Facility	Wisconsin Rapids, WI

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 and temporarily shut-down. No on-farm co-digesters have been identified that are currently under development. The lists in Table 1B and 2B are current as of December 2018. The table descriptions are as follows:

Table 1B: Stand-Alone Anaerobic Digestion Facilities Under Development in the U.S.
Table 2B: WRRF's with Co-Digestion Systems Under Development in the U.S.

Table 1B: Stand-Alone Anaerobic Digestion Facilities Under Development in the U.S.

Stand-Alone Facility Name		Facility Status	Location
1	CleanWorld/UC Davis Renewable Energy Anaerobic Digester (READ)	Temporary Shut-Down	Davis, CA
2	Agromin Organic Recycling Compost Facility	Planning stage; Design stage; Permitting Process	Oxnard, CA
3	Organic Energy Systems (OES)	Procurement	San Bernardino, CA
4	Tajiguas Resource Recovery Project	Planning stage; Design stage; Permitting Process	Santa Barbara, CA
5	Turning Earth LLC	Fully permitted, seeking construction financing	Southington, CT
6	BTS Biogas LLC - Maryland Food Center	Under Construction	Jessup, MD
7	Orbit Energy Charlotte	Start-up Mode	Charlotte, NC
8	Linden Renewable Energy	Planning stage; Design stage; Permitting Process	Linden, NJ
9	Gloucester City Organic Recycling	Under Construction	Marlton, NJ
10	Point Breeze Renewable Energy	Planning stage; Design stage; Permitting Process	Philadelphia, PA
11	Orbit Energy Rhode Island	Start-up Mode	Johnston, RI
12	Freestate Farms Integrated Facility	Planning stage; Design stage; Permitting Process	Manassas, VA

Table 2B: WRRF's with Co-Digestion Systems under Development in the U.S.

WRRF Name		Facility Status	Location
1	South Slope Wastewater Treatment Plant	Planning stage; Design stage; Permitting Process	Moline, IL
2	Kinross Township Wastewater Treatment Plant	Under Construction	Kincheloe, MI
3	Western Lake Superior Sanitary District	Planning stage; Design stage; Permitting Process	Duluth, MN
4	Empire Wastewater Treatment Plant	Under Construction	Farmington, MN
5	Village of Ridgewood Water Pollution Control Facility	Temporary Shut-down	Glen Rock, NJ
6	Rome Water Pollution Control Facility	Planning stage; Design stage; Permitting Process	Rome, NY
7	City of Newark Wastewater Treatment Plant	Temporary Shut-down	Newark, OH
8	Green Bay Metropolitan Sewerage District	Under Construction	Green Bay, WI

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

This appendix lists the facilities for each digester type that have ceased operations. This list is current as of December 2018.

Table 1C: Facilities that Have Ceased Operation in the U.S.

Stand-Alone Digesters		
	Digester Name	**Location**
1	Heartland Biogas	LaSalle, CO
2	CR&R	Perris, CA
3	Garelick Farms	Lynn, MA
Farm Co-digestion Systems		
	Digester Name	**Location**
4	Zuber Farms	Byron, NY
5	George Deruyter Dairy	Outlook, WA
6	Wild Rose Dairy	LaFarge, WI
WRRF Co-Digestion Systems		
	Digester Name	**Location**
7	Hyperion Treatment Plant	Playa Del Rey, CA
8	Metropolitan Syracuse Wastewater Treatment Plant	Syracuse, NY
9	Struthers Wastewater Treatment Plant	Struthers, OH
10	Janesville Wastewater Treatment Plant	Janesville, WI
11	Sheboygan Wastewater Treatment Plant	Sheboygan, WI

Appendix D – Survey Questions

This appendix provides the lists of questions asked via a survey 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. When the 2019 survey is available, it will be posted at the same location.

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