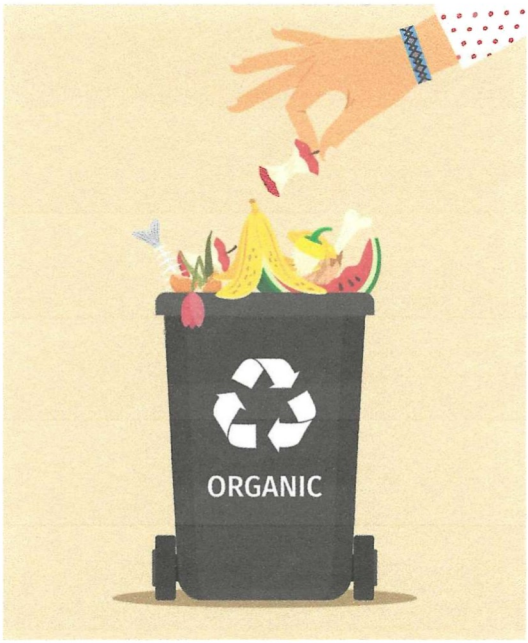
Town of Riverhead
Anaerobic Digester Feasibility Study
September 2023

Town of Riverhead Town Board
Town Hall
200 Howell Avenue
Riverhead, NY 11901



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September 24, 2023

Dawn Thomas, Esq.
Community Development Director &
Planning Department Administrator
Town Hall-200 Howell Avenue
Riverhead, NY 11901

RE: Town of Riverhead Anaerobic Digester Feasibility Study

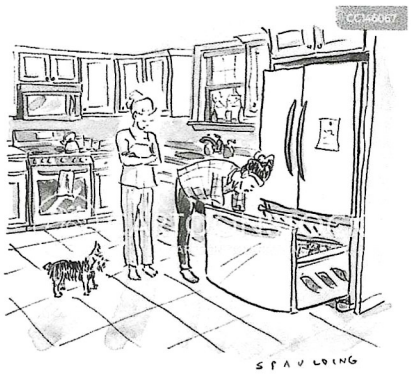
Dear Mrs. Thomas,

Please find attached, the Anaerobic Digester Feasibility Study, dated September 2023 in response to the Town Board's request for an assessment of how these types of facilities might be integrated into the Town's land use and solid waste management initiatives.

Please feel free to contact me directly if you have any comments or questions regarding the Study. Thank you for this opportunity to provide the Town with professional environmental services.

Very truly yours,

Jeffrey L. Seeman, CGCS/CEP
Certified Environmental Professional



"I freeze all my leftovers until I feel less guilty about throwing them away."

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Anaerobic Digester Facilities
Feasibility Study
Town of Riverhead, New York
September 2023

1.0 INTRODUCTION

New York State Food Donation and Food Scraps Recycling law became effective on January 1, 2022, and requires businesses and institutions that generate an annual average of two tons or more of food waste per week to donate excess edible food; and recycle all remaining food scraps if they are within 25 miles of an organic recycling facility (composting facility, anaerobic digester, etc.).

This Feasibility Study outlines the possibilities of managing recyclable food scraps and organics through anaerobic digester technology, a type of solid waste management facility, approvable by New York State Department of Environmental Conservation, Division of Materials Management. Currently there are no anaerobic digester facilities (ADFs) located within the Town of Riverhead, and there are no zoning use districts that expressly permit construction of ADs.

1.1 Purpose and Objectives

The Town of Riverhead requested a study to determine the feasibility of permitting an anaerobic digester facility within the Town. The purpose of this study is to:

Describe anaerobic digester technology processes and by-products.

Identify potential sources of feedstock necessary to support an anerobic digester facility (ADF). One category of ADF is a "Local ADF" developed for accepting Town generated food waste (or a specific local area) would accept a maximum of 50 tons of food and organic waste per day; and a "Regional ADF" developed for accepting food and organic waste from Long Island and New York City. A Regional ADF accepts 50-250 tons or more of food and organic waste each day. Based on an operating period of 300 days per year (accounting for holidays and typical maintenance), a Local ADF could process up to 15,000 tons per year, and a Regional ADF could process an estimated 75,000 tons per year (based on 250 TYD) or more. The two categories are also relevant to NYSDEC approval processes, and the evaluation of potential environmental impacts (such as traffic, packing waste disposal, biogas-methane and carbon dioxide generation, quantities of fertilizer, compost and waste water generated, etc.).

Identify current New York State Department of Environmental Conservation (NYSDEC) regulations and businesses and institutions that generate more than two tons (2) of food waste and shall comply with current regulations.

Identify the quantity of food waste and organic waste generated within Riverhead as reported in the 2021 Solid Waste Management Plan Update (through 2028) adopted by the Town.

Discuss Source Separated Organics (SSO) collection methods and transportation of SSOs to an ADF.

Identify potential for Town of Riverhead Zoning Use District(s) and Town Code amendments necessary for ADF siting(s).

Describe the NYSDEC, Suffolk County Department of Health Services (SCDOHS) and Town of Riverhead required steps for ADF siting approvals.

Describe the State Environmental Quality Review Act (SEQRA) and Town of Riverhead Environmental Quality requirements for Town Code and Zoning Use District amendments as needed to accommodate siting of an ADF.

Develop standards for design and operations for ADF(s) if sited within a designated Town of Riverhead Zoning Use District.

1.2 Methodology

The primary method of research was conducted through literature review. These sources included university research papers, solid waste industry journals, manufacturer's websites and technical brochures, municipal and governmental laws, regulations and publications, Town of Riverhead's Updated Solid Waste Management Plan 2019-2029, and interviews with Town of Riverhead personnel. Locally (Nassau and Suffolk Counties) there are no constructed and operating ADFs (although American Organic Energy has an approval to construct a facility in Yaphank, Town of Brookhaven, NY.)

Three "Case Studies" were conducted to report on the status of the Quantum Biopower ADF located in Southington, CT and the American Organic Energy ADF, located in Yaphank, NY and Nexus Bioenergy proposing a facility in Riverhead, NY.

2.0 ANAEROBIC DIGESTER FACILITY DESCRIPTION

2.1 General Advantages of AD

The primary benefit of anaerobic digestion of MSW is twofold: 1) to divert organic solid waste from municipal landfills, and 2) to mitigate climate change; energy production is only a secondary benefit while enhancing the attractiveness of this technology.

2.2 General Municipal Solid Waste (MSW) Management

According to the EPA, in 2010, Americans generated about 250 million tons of trash (EPA, 2010). This trash, also referred to as municipal solid waste (MSW), is primarily composed of paper (28.5%) and yard trimmings and food scraps (27%), followed by plastics, metals, rubber, leather, textiles, wood, and other miscellaneous and non-hazardous materials. Generally, about half of this waste is managed through landfilling (EPA, 2004). By diverting these organic wastes to separate facilities, we are saving considerable space from landfills.

Besides saving space from landfills, there are additional MSW management benefits from anaerobic digestion. Natural decomposition of waste causes odor and water pollution issues. The controlled process of anaerobic digestion reduces odor and liquid waste disposal problems (Anaerobic Digestion, 2013).

Anaerobic digestion creates solid and liquid products (digestate) that contain nutrients such as nitrogen. In an anaerobic digestion process, the energy embedded in food waste is captured and used to produce energy, rather than released as heat. Generally, the process takes between two to six weeks, not including the time required to compost or cure digestate.

An ideal anaerobic digestion system, or responsible AD, will create both digestate that can be used to make soil amendments (“closing the loop” by returning carbon and nutrients to soil) and energy products (a secondary benefit).

2.3 Town of Riverhead and ADF Status

The Town of Riverhead has considered the applicability of ADFs as a component of its solid waste management program. ADFs are not listed among the Town’s permitted land uses within any of the Town’s zoning use districts and ADFs are not defined within the Riverhead Town Code. Nexus, a company seeking approval to construct an ADF in Riverhead has presented its proposed development to the Riverhead Zoning Board of Appeals.

Essentially there is no means or methods for the Town to process an application to construct an ADF; and any application would first need a change of zone to a yet undefined use. The zoning amendment would necessitate either an applicant to petition for a change of zone (to a use that does not presently exist) or for the Town Board, which has authority to amend the Town’s land use code, initiate the zone code amendment at its own discretion. Each of these scenarios requires compliance with reviews mandated by the New York State Environmental Quality Review Act (SEQRA).

SEQRA requires a series of procedures, which include classifying the action as a Type 2 (requiring no further environmental reviews); a Type I (requiring additional environmental

review and commonly leading to preparation of a Draft Environmental Impact Statement or DEIS); or an Unlisted action, meaning it is neither defined under SEQRA as a Type I or Type II.

SEQRA is discussed in discussed in greater detail elsewhere in this study. In summary, any zone change request by an applicant that meets or exceeds thresholds listed under SEQRA is a Type I action as per 617.4 (b) (3). A zone change effecting greater than 25 acers, initiated by a municipality is also a Type I action pursuant to 617.4(b) (2).

An ADF located on a publicly operated landfill and accepting less than 150 wet tons per day of feedstock can be classified as a Type II action under 617.5 (c) (41). This option is not available to Riverhead because its capped landfill will be used for construction of a land-based commercial solar facility. The Town of Riverhead Town Code Chapter 225 Environmental Quality includes a list of Town designated Type One Actions. Section 225-11-Type I Actions B. (3) New or expansion of, solid waste management facilities classifies an ADF (because it is a solid waste management facility) as Type One, and therefore all ADFs fall within this category.

The Town of Riverhead is in the process of updating its Comprehensive Land Use Plan. The Plan requires preparation of a Generic Environmental Impact Statement (GEIS), which could address generalities of ADFs, however it would likely fall below thresholds and the details needed to address both amendments to zoning district potential environmental impacts and the specific potential environmental impacts generated by the ADFs as a standalone solid waste facility. This is predicated upon the precedent setting nature of constructing an AD because no Town land use codes address ADs, and no AD exists within Riverhead or elsewhere in the region. Currently there is one Long Island facility approved for construction in the Town of Brookhaven. The facility is expected to accept 180,000 to 200,000 tons per year of a mix of food waste and grass clippings. Another facility in Southington, CT, has been constructed and is operated by Quantum Biopower. Aspects of the Southington AD and the Yaphank facility will serve as micro-scaled "case studies" for this feasibility study.

The Town of Riverhead adopted an Updated Solid Waste Management Plan 2020-2029 (SWMP), March 15, 2021, to assess the Planning Unit's (PU) described as the Town of Riverhead, solid waste management goals. The current MSW management includes six (6) Garbage Districts within the Town that are periodically bid, and where carting contractors provide curbside collection services for residential MSW, and source separated recyclables.

The Town operates a yard waste storage and processing facility at its former (capped) landfill site on Youngs Avenue and at the Highway Department facility located at County Road 58/Osborn Avenue. The Highway Department provides curbside collection of leaves and small branches in the autumn and spring, and residents are encouraged to self-haul yard waste to the Youngs Avenue location. Residents are entitled to use the mulch at no charge, generated by these operations. The Town has a New York State Department of Environmental Conservation Part 360 Solid Waste Management Facility (NYSDEC) Registration for these operations which limit the onsite storage to 10,000 cubic yards (CY) of yard waste.

The Town requires the Garbage District carters and all carters of commercial waste collection to report waste loads on a quarterly basis. Waste categories are reported in tons and include:

- Mixed Paper
- Co-mingled Glass, Metal and Plastics
- Bulk Recyclables (white goods, furniture, machinery, etc.)
- Yard Waste
- C&D Debris
- General Non-recyclable Waste

SSO food wastes and other bio-organics are not reported for either residential or commercial (restaurants, food wholesalers, wineries, breweries, supermarkets, institutions) generators.

For this Feasibility Study the data available for potential feedstock availability included the Town's Updated SWMP, *Table of Municipal Solid Waste (MSW) Detailed Composition Analysis* (page 55). The Table uses NYSDEC modeling guidelines to assume waste composition analysis. The analysis includes existing and projected waste characteristics based on the PU population (pounds of waste per person per day) and time period of the projected waste generation (2020 to 2029). The ADF feedstock potential generated within the PU is discussed in other sections of this study.

NYSDEC, Division of Materials Management provided the 2023 List of Designated Food Scrap Generators pursuant to the application of the Food Donation and Food Scraps Recycling Law {ECL 27-2211 (1)}. The List designates the businesses and institutions that generate two (2) tons or more of food scraps per week and are required to comply with the law by donation of food scraps, recycling or both. The List was refined to entities in Suffolk County, and then highlighted for facilities within "Eastern Suffolk" that may provide feedstock. The List is shown as Appendix 1. It is noted that a dominant number of these entities are required to donate food scraps (which diminishes the available feedstock for an ADF) and are not required to recycle food scraps.

In New York, the NYSDEC regulates ADFs pursuant to 6NYCRR Part 360 Solid Waste Management Facilities Regulations. There are three primary categories of regulations based on feedstock quantities, waste generation and processed material use. These categories are classified as facilities that are Exempt from the regulations; facilities that require a NYSDEC Registration; and facilities that require a NYSDEC Permit.

A NYSDEC Part 361 Permit is required for AD facilities accepting more than 50 Tons of organic waste per day, such as a "Regional ADF." A Registration is required for AD facilities accepting less than 50 Tons per day, such as a "Local ADF."

An Anaerobic Digester (meaning "without oxygen") is a method of organics recycling in which organic materials such as food waste and grass clippings are subjected to controlled breakdown in an enclosed chamber in the absence of oxygen.

Microorganisms that thrive in an anaerobic environment break down the organic material into an energy-rich biogas primarily composed of methane (CH_4) and carbon dioxide (CO_2) and hydrogen sulfide (H_2S). Methane can be used to generate electricity or heat. Some ADF employ a combustion flare to "flare off" methane gas impurities and/or flare off methane to reduce

storage during periodic facility shutdowns for maintenance. An alternative to the flare is a mechanical biogas filtration system.

Biogas filtration systems can be implemented to remove particulates, hydrogen sulfide, water and carbon dioxide. The CO_2 can be cleaned to qualify for reuse as compressed gas. Methane gas quality can be sufficient to enter the distribution system once a fragrance is added to the gas.

Anaerobic digestion is a biological process called biomethanation, or methane fermentation. The pH level and temperature should be kept between 5.5 and 8.5 and 30-60 C (86-140 degrees Fahrenheit) to maximize digestion rates ("Briefing", 2007).

The amount of biogas and the quality of digestates obtained will vary according to the feedstock used. This is an important characteristic for all types of AD reactors. As one article by Natural Resource Defense Council (NRDC) dated May 30, 2023, by Darby Hoover stated,

"Garbage in, garbage out applies to actual waste too, not just computer science: if highly contaminated or "mixed waste" feedstock is placed in a digester, highly contaminated digestate will be produced. Using feedstock that has been separated at the source (SSOs), rather than relying on inefficient and incomplete processes to separate waste at the AD facility, can help ensure that you achieve actual recycling and don't have to landfill or incinerate all or part of the digestate."

Researchers Nikita naik, Ekaterina Tkachenko and Ry Wung at the University of California, Berkely conducted a study on anaerobic digestors back in May 2013. The following are summaries and excerpts from their study.

2.4 General AD Process Description
Biomethanation or methane fermentation process can be divided into four phases.

Phase 1. Hydrolysis: This is the hydrolytic phase, where complex organic molecules (cellulose, proteins and fats) are broken down into simple sugars, amino acids, and fatty acids by hydrolase, an exoenzyme. Hydrolysis of carbohydrates takes place within a few hours while proteins and lipids take a few days to break down.

Phase 2. Acidogenesis: The monomers formed in the hydrolytic phase are taken up by acidogenic bacteria to be further degraded into short chain organic acids, alcohols, hydrogen and carbon dioxide.

Phase 3. Acetogenesis: In this stage, acetogenic micro-organisms further break down the hydrogen and carbon dioxide gas to produce mainly acetic acid, organic acids and where alcohol is converted into acetate. The acetate serves as a substrate for methane-forming bacteria and the acetogenic bacteria grow in a symbiotic relationship with methane forming bacteria.

Phase 4. Methanogenesis: Lastly, bacteria called methanogen convert acetic acid into methane, CO_2 and water. This phase is under strict anaerobic conditions. Digestate is also a byproduct formed during this process (Chandra et al., 2012).

2.5 Types of AD Systems

There are three categories of AD systems:

A. One-stage Continuous including low-solid "wet" and high-solid "dry" ones.
B. Two-stage Continuous represented by dry-wet and wet-wet systems.
C. Batch (either one-stage or two-stage) (Vandevivere et al., 2002).

A prepared feedstock stream with less than 15 percent Total Solids (TS) is considered wet. Feedstocks with TS greater than 15-20 percent are considered dry.

Continuous process AD reactors require regular inputs of food scraps and organic wastes at scheduled intervals. These reactors require an equal quantity and rates to remove digestate and biogases. This AD reactor type requires a minimum of 20% solid material in the tank and would be considered a dry system.

Batch systems make up a smaller portion of the marketplace than continuous process reactors and are better at processing dry plant matter, (such as leaves, and grass clippings known as *lignocellulosic biomass*). The plant biomass input can range from 30-40% total solids and is digested in a gas-tight container. Finished digestate is used to inoculate the dry stackable waste. This system would be defined as dry system. Advantages of the batch system include simplicity of the reactor, minimal maintenance requirement, and minimal capital cost (Li et al., 2011).

Single-stage digesters are simple to design, build, and operate and are generally less expensive. They represent about 90 percent of the installed AD capacity in Europe (Rapport et al., 2008). The organic loading rate of single-stage digesters depends on the ability of methanogenic bacteria to tolerate the decline in pH that results from acid production during the hydrolysis step. The pH of the single-stage digester must be continuously monitored.

Another important design parameter is the total ratio of solids to water in the prepared feedstock, which allows to classify one-stage continuous systems as high solids "dry" or low solids "wet."

Two-stage digesters separate the initial hydrolysis and acid-producing fermentation steps from methanogenesis allowing for higher loading rates, however, this requires additional reactors and handling systems.

Drawing on statistical data, the UC, Berkley researchers concluded that *one-stage dry continuous AD systems* are the most feasible for the organic MSW management. Their research determined about 55% of the overall AD capacity in Europe is made up of one-stage dry continuous AD systems.

2.6 By-Products and End Use

Raw biogas is typically 60-70% methane and 30-40% carbon dioxide (Rutledge, 2005). Depending on the end use, the biogas can be "cleaned up" through a variety of processes to remove carbon dioxide and other contaminants, resulting in biomethane which can reach 99% methane. Biogas filtration systems can be implemented to remove particulates, hydrogen sulfide, water and carbon dioxide. The CO_2 can be cleaned to quality for reuse as compressed gas. Methane gas quality can be sufficient to enter the distribution system once a fragrance is added

to the gas. The two most common applications are combustion to generate heat and electricity or purified and compressed to be used as fuel.

- Biogas

The biogas from an ADF can be used in a combined heat and power (CHP) plant. Power capacities for typical AD/CHP plants range from 75KW- 1.5MW.

- Biomethane

Due to its purity, biomethane is essentially equivalent to natural gas and can be used in place of natural gas, including distribution for industrial and to household uses or for natural gas vehicles. The uses have gas standards to prevent the corrosion or degradation of equipment. Processing the biogas into biomethane takes considerable energy as well.

Anaerobic digestion also produces a solid and liquid residue called digestate which can be used as a soil conditioner to fertilize land. Often the digestate requires further processing to remove potentially harmful microorganisms. Some facilities compost the materials onsite and outdoors, using the heat generated by the composting step to destroy microorganisms, or use ultra-violet light or induced heat.

2.7 Potential Hazards

There are a number of potential hazards associated with anaerobic digester facilities. The most common are general safety practice precautions. These include hazards such as drowning in storage tanks, falls from high spaces, burns from hot equipment such as pipes or engines, exposure to high voltage and electrical fire.

The specific hazards associated with storage of hazardous materials (needed to adjust the digester pH level), and biogas (generated by the process) are of greater interest to Riverhead. This is because there zoning use districts (including Industrial A and Planned Industrial Park) within the Town which prohibit production and storage of hazardous materials, explosive gases, and or require additional approvals by the Fire Marshal's Office (Town of Riverhead Town Code). These issues will be further evaluated in the Town Code section of this study.

- Asphyxia

Asphyxia occurs when the body suffers from a supply of oxygen. Asphyxiants are gases which prevent the uptake of oxygen into human cells. The resulting products of biogas from anaerobic digestion - mainly methane, carbon dioxide, hydrogen sulfide - are all asphyxiants. The Occupational Safety and Health Administration (OSHA) has determined concentrations of these gases which pose an "immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with the individual's ability to escape from a dangerous atmosphere" (Occupational Safety and Health Administration (OSHA), 2008) which are listed below:

• Oxygen deficiency – less than 19.5 percent by volume air
• Carbon dioxide – more than 40,000 ppm
• Hydrogen sulfide – more than 100 ppm

- Explosion

As the main component of biogas, methane has a high explosion potential. The upper and lower explosion limits help determine the range of concentrations that will produce a flash fire when an ignition source is present. The upper and lower explosion limits for methane are 5% and 15% by volume air, respectively (Linde Gas LLC, 1995).

- Feedstock and Digestate Spills

Biomass spills have the potential for land, water and environmental contamination and should be treated as swiftly and safely as possible. The first step involves identifying and controlling the source of spillage. Next, isolating the spill will minimize contamination potential and help with site clean-up and restoration. Finally, the incident should be properly documented, and state and local authorities should be notified (US EPA, 2011).

3.0 LAND USE AND ZONING

The Town has suggested Article XXXIX Planned Industrial Park District (PIP) would be a potential zoning use district that could accommodate an ADF. This section of the Feasibility Study outlines specific sections of the PIP zoning that need to be considered prior to adding ADFs as a permitted use or use by Special Permit. Please note, that only relevant sections of the PIP are annotated here, with the full text included as Appendix 2.

The PIP is located within the hamlet of Calverton. This zoning use district is described as the Camelot Subdivision area within the EPCAL. The total acreage of the PIP is more than 493.1 acres, exceeding the 25-acre threshold identified under SEQRA as a Type 1 Action, requiring completion of a Full Environmental Assessment Form and coordinated review if the Town Board initiates a zoning code amendment. The Town's Zoning Map is included as Appendix 3.

Article XLIII Planned Industrial Park Zoning Use District specific sections that are impacted by additions to permit anaerobic digesters as a permitted use via a zoning change requested by an applicant, or an amendment to the zoning district initiated by the Town are noted herewith.

3.1 PIP § 301-183. Purpose

"The purpose of the Planned Industrial Park (PIP) District is to encourage industrial and office development in a comprehensively planned and designed environment which will attract private investment, increase the tax base of the Town and provide new employment opportunities, while preserving and maintaining the existing character of the environment."

With exception of the Town of Riverhead's municipal Calverton Sewer District wastewater treatment plant, there are no known significant waste treatment facilities or solid waste management facilities in the PIP that justify adding ADFs that "preserve and maintain the existing character of the environment. True, the PIP is an industrial park, which is designated for the purpose to encourage industrial and office development, however a solid waste management facility is a specific use as regulated by NYSDEC.

3.2 PIP § 301-185 Permitted Uses

In the Planned Industrial Park (PIP) District, no regularly scheduled or unscheduled passenger service, air taxi, air charter or fixed-based operator as currently defined by the FAA shall be permitted. Notwithstanding the prohibition of a fixed-based operator, nothing herein shall preclude management and maintenance operations necessary to support any principal or accessory aviation uses permitted hereunder. No building, structure or premises shall be used, arranged or designed to be used, and no building or structure shall hereafter be erected, constructed, reconstructed or altered, unless otherwise provided in this chapter, except for the following permitted uses and their customary accessory uses:

Permitted uses.

1. Industrial uses, including component design, manufacturing, processing, fabrication, repair, testing and assembly, but prohibiting those uses specifically set forth at § 301-114A (6), provided that all uses permitted hereunder are conducted within enclosed

buildings, and when not within enclosed buildings, are suitably screened to an extent that provides adequate sound and visual buffers as may be determined to be necessary by the Town Board as part of site plan approval.

2. Warehousing, indoor storage, distribution and wholesaling of nonhazardous and nonflammable materials.
3. Research and testing laboratories.
4. General, executive, administrative, governmental, business and professional offices.
5. Public utility and service facilities, excluding incinerators, shall not be permitted.
6. Extraordinary aircraft and engine maintenance, such as aircraft, airframe and aircraft system overhaul, conversion, modification, reconfiguration and refurbishment, including annual inspections, but excluding minor or routine maintenance such as oil changes, refueling, minor repairs and inspections, provided that such uses are conducted within enclosed buildings, and when not within enclosed buildings, are suitably screened to an extent that provides adequate sound and visual buffers as may be determined to be necessary by the Town Board as part of site plan approval and, if appropriate and necessary, subject to the grant of a runway use agreement and consistent with the Rules and Regulations on the use of the runway as adopted and/or amended from time to time.
7. Aircraft component design, fabrication, manufacture, and assembly, provided that such uses are conducted within enclosed buildings, and when not within enclosed buildings, are suitably screened to an extent that provides adequate sound and visual buffers as may be determined to be necessary by the Town Board as part of site plan approval.
8. Audio, radio, television video and film studios and broadcast stations.
9. Business, technical and vocational schools.
10. Outdoor and indoor recreational uses and facilities.
11. Food and agricultural product processing, including canning, preserving, drying and freezing.
12. Overnight and express mail package and postal sorting and distribution by surface transport.

A. Special permit uses.
1. Reserved

3.3 PIP Prohibited Uses

As described in Article XXIII. Industrial (IA) Zoning Use District § 301-114A (6) prohibited uses that may be relevant to ADFs as a use (and as a solid waste facility) include: dumps; fertilizer manufacturing; garbage disposal dumps; landfills, incinerators, or transfer stations; storage of noncontainerized combustible materials and; warehousing, storage, wholesaling or sale of hazardous, dangerous, and explosive materials such as acids, gases, ammunition, fireworks, and explosives**.**

A change in permitted uses that permits ADFs within the PIP zoning use district, must also address the prohibited uses listed under § 301-114A (6).

3.4 Fertilizers and Soil Amendments

A by-product of the AD reactor is digestate which is marketed as "fertilizer." A fertilizer is defined as "any material, organic or inorganic, natural or synthetic, which supplies one or more of the chemical elements required for plant growth." (source: USU Extension). Although the intended land "use" of an ADF is for processing solid waste, the end product is a form of fertilizer.

Soil is comprised of four components: minerals, air, water, and organic matter. A soil amendment is defined as any material added to soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. The purpose of a soil amendment is to improve soil conditions for the root system.

The type of ADF permitted for use is also significant. For example, yard waste generally does not break down completely in a digester; while some types of dry AD benefit from the addition of landscaping waste as a bulking agent, that type of lignin-rich waste will not fully decompose in the digestion process and will need to be "finished" after the AD process by composting or another method of curing.

Wet ADFs generally cannot process woody waste (or paper, or compostable service ware) and are best suited for separated food scraps or similar materials. Consequently, composting will nearly always be needed as part of a responsible organics recycling system, both to break down materials that do not decompose in the anaerobic process (such as woody waste and compostable plastics) to create a usable soil amendment, as well as to remove pathogens from AD digestate (depending on the AD system, pathogens may not be fully destroyed in the anaerobic digestion process).

3.5 Biogas

Methane gas is hazardous, dangerous, and explosive. As the main component of biogas, methane has a high explosion potential. The upper and lower explosion limits help determine the range of concentrations that will produce a flash fire when an ignition source is present. The upper and lower explosion limits for methane are 5% and 15% by volume air, respectively (Linde Gas LLC, 1995).

Methane is considered hazardous by the OSHA Communication Standard (29 CFR 1910.1200). Warehousing, indoor storage, distribution and wholesaling of nonhazardous and nonflammable materials is permitted in the PIP zoning use district. Production, storage, distribution and wholesaling of methane gas does not qualify as permitted.

3.6 Transfer Stations/Import & Export of Solid Waste

One could view the importation of food waste and organic waste, and export of unwanted feedstock (packaging materials, types of yard waste) as a transfer station, however this activity does not clearly fit the traditional transfer station definition. Packaged food scraps have organic waste separated from boxes, plastic and carboard containers, glassware and then this discarded packaging stored, until shipped of site. Some types of packaging are combustible. The

secondary processing of digestate is sometimes further treated through composting (to destroy harmful microorganisms). Compost, under certain conditions, can be combustible.

3.7 PIP § 301-189. Additional requirements

A. Performance criteria.

(1) All development subject to the provisions of Article 6 of the Suffolk County Sanitary Code shall meet the applicable requirements of the Suffolk County Department of Health.

(2) As determined by the State of New York or the County of Suffolk, any new public or private sewage treatment plant discharge shall be outside of the Core Preservation Area and shall be located north of the groundwater divide, as defined by the Suffolk County Department of Health Services, as site conditions permit.

(3) All development shall comply with the provisions of Articles 7 and 12 of the Suffolk Sanitary Code.

(4) All development involving significant discharges to groundwater and located proximate to public water supply wells shall require measures to mitigate impacts upon water quality as required under Article 17 of the New York State Environmental Conservation Law. The Suffolk County Department of Health Services' guidelines for private wells should be used for private wellhead protection.

(5) Development proposals for sites containing or abutting freshwater wetlands shall be separated by a non disturbance buffer area which shall be in accordance with Article 24 of the New York State Environmental Conservation Law, the Wild, Scenic and Recreational Rivers Act (the Rivers Act) Editor's Note: See Environmental Conservation Law § 15-2701 et seq. and Chapter 107 of the Code of the Town of Riverhead, whichever is most restrictive. Distances shall be measured horizontally from the wetland edge as mapped by the New York State Department of Environmental Conservation, field delineation or local ordinance. Stricter buffer areas may be established for wetlands as appropriate. Buffer areas shall be delineated on development plans with conditions imposed to assure the preservation of the freshwater wetland resource. Said conditions shall be set forth in a declaration of covenants, conservation easement or similar instrument.

(6) Development proposals for sites within the regulated area of the New York Wild, Scenic and Recreational Rivers Act shall conform to the standards of the Act. Variances from the Act shall meet all requirements imposed by the State of New York in order to be deemed to have met the requirements of this standard. Additional relief from the Town of Riverhead Zoning Board of Appeals shall not be required.

(7) All stormwater generated by development shall be recharged on site unless surplus capacity exists in an off-site drainage system. In the review of development plans, the Town Board shall encourage the use of natural recharge areas or drainage system design which result in minimal disturbance of native vegetation with the use of natural swales and depressions as an alternative to excavated recharge basins where feasible. Development plans should include the use of ponds only if such ponds are designed to retain stormwater and are not merely constructed for aesthetic purposes. Adequate measures should be employed to control soil erosion and stormwater runoff during

construction, as per guidelines promulgated by the New York State Department of Environmental Conservation.

It is expected that an ADF will comply with the aforementioned "Additional Requirements" pursuant to Town Code Section 301-189. The proximity of a solid waste management facility to public drinking water wells, shallow and special groundwater protection areas and freshwater wetlands are of concern. The Suffolk County Department of Health Services and the NYSDEC would be involved agency under SEQRA, and each would review an application to construct an ADF.

3.8 Approval by Town Board Special Permit

It was hypothesized that an ADF permitted within the PIP zoning use district might be proposed as a Specially Permitted use under section 301-185 B.

Because the actual "use" (ADF) is not currently defined in any section of the Town Code (whether the ADF use is contemplated within the PIP zoning or elsewhere; as a permitted use; or use by Special Permit) an amendment to the Code would first need to be initiated by the Town Board. A use by Special Permit can only be approvable if the use is defined and conforms to the minimum standards and the requirements set forth in the Town Code for Special Permit approval. Until the Town can define the use, which is a solid waste management facility, and the zoning district(s) where such use is permitted by the Special Permit requirements, one cannot apply for a Special Permit or seek an approval of an ADF, without identification of the zoning use district where it is permitted. Conflicts with the prohibited uses listed in 301-114A (6) would need to be resolved regardless of any Special Permit conditions. As outlined above, there are multiple steps and sections of the Code that need to be considered to amend the PIP to permit ADFs, whether as permitted use or specially permitted use.

The PIP zoning district uses require similar development standards to the special permit requirements. If an ADF is considered as a use pursuant to the Special Permit conditions, within the PIP district, it may be redundant to require the Special Permit. Furthermore, this Study will provide recommendations for ADF application requirements (SEQRA classification, standards for approvals, etc.), which are specific to solid waste facilities, the facility operations and regulatory oversight and will likely exceed the typical special permit requirements.

As outlined in the Introduction, there are two categories of ADFs, a Local ADF, which accepts less than 50 TPD and a Regional ADF, which accepts 50-250 TPD or more. Zoning amendment considerations should account for the size and feedstock capacity when regulating any type of ADF. Each category also produces greater quantities of digestate, fertilizer, compost, wastewater, biogas, and exportation of packaging. The daily feedstock thresholds also impact NYSDEC approval procedures, although the Town, through its local zoning controls, could apply the State's "Permit" requirements even to a "Local ADF" (which would require only a "Registration" by NYSDEC regulations.

3.9 Proposed Zoning Article LIIE Anerobic Digesters

The Town has drafted zoning amendments to address anerobic digesters (Appendix 10).

Although the proposed regulations provide a working draft upon which to build upon, no specific Zoning Use District has been identified where ADFs could be located. As stated in the previous section, a new or expansion of a solid waste management facility is classified as a Type I Action pursuant to Town Code Section 225-11 B. (3).

4.0 FEEDSTOCK SOURCES

This section attempts to identify potential sources of feedstock necessary to support an anerobic digester facility (ADF).

New York State Department of Environmental Conservation (NYSDEC) regulations and businesses and institutions that generate in excess of two tons (2) of food waste and shall comply with current regulations. The NYSDEC has organized the generators into the following categories:

- Colleges and Universities
- Correctional Facilities and Jails
- Grocery & Specialty Food
- Hospitality
- Supercenters
- Other Generators: Amusement and Theme Parks, Casinos & Racetracks, Malls, Military Bases, Sporting Venues, and Wholesale & Distribution.

A review of the list identified 131 facilities in Suffolk County. Only two facilities are required to recycle the food waste and would provide a potential feedstock to an AD. The other 129 Suffolk facilities are required to donate their foods scraps.

A review of the Town of Riverhead 2020-2029 Updated SWMP predicted the quantity of food scraps and organics generated within the Planning Unit using a population density model provided by NYSDEC (no actual quantity counts were reported). Based on the modeling the SWMP estimated total organics comprised 22.5% of the total municipality's solid waste, or approximately 23.3 tons per day (TPD) of mixed food scraps and organics (such as yard waste). By 2029 this quantity (food waste and yard waste) is expected to increase to approximately 26 TPD, according to the modeling. The Town conducted a voluntary food scrap recycling program, which included source separation of the waste, drop off at a designated center and disposal by composting. The results indicate one-half pound of food scraps per person per day was generated. This quantity matches the model provided by NYSDEC. The +/- 34,000 Riverhead residents are estimated to generate 17,000 pounds of food scraps per day, or approximately 8.5 TPD.

A review of the Town of Riverhead Zoning Board of Appeals April 14, 2022 transcript provided testimony regarding available feedstock. Mr. Mark Haubner (Chairman Town of Riverhead Environmental Committee) testified that Riverhead only generates 10 TPD of food scraps, the Town of Southold generates 6 TPD and all combined, the Five East End Towns (Riverhead, Southold, East Hampton, Southampton and Shelter Island) generate 75 TPD.

Using the NYSDEC regulations to define "large or Regional" and "small or Local" ADFs, one could describe a large-Regional operation as requiring a NYSDEC Permit because it accepts greater than 50 TPD of organics (typically 250 TPD or more), and a small-Local facility, which requires a NYSDEC Registration as accepting less than 50 TPD.

Using the Town's SWMP estimates and combing this with the two Suffolk County facilities required to recycle (each with a minimum of 2 tons per week generated) the gross estimated feedstock is between 25 and 30 TPD, well below the 50 TPD ADF description of a small-Local, registered facility. Furthermore, the Town of Riverhead requires commercial enterprises to arrange for their own waste disposal, independent of the Town's residential collection system. Although all carters operating within the Town are required by the Town's permit procedure to report quarterly breakdowns of waste collected, neither the residential nor commercial carters are required to identify food scraps as an independent category. Yard waste is identified.

Additional feedstock from nearby municipal sources could become available, and this quantity is open to additional study. Factors impacting the supporting feedstock of a "Regional Facility" include each municipality's waste management plans and operations, transportation of wastes, cost of disposal, applicability of the food waste/organics reduction regulations within each municipal planning unit, ability to administer a SSO program and overall public/private participation. Among these unknowns, the ability to implement flow controls is also in question. For example, the Town of Riverhead's SWMP has not implemented flow control. Flow control is a method of waste disposal, where the planning unit requires waste to be disposed of at a particular location and disposed of in a particular way. Typically, a flow control system includes a fixed cost of tipping and disposal, supports a municipal operated or co-operated and funded disposal facility and is identified in collection and disposal bid documents when private carters are solicited for bids (as it is with the Town of Riverhead's Residential Six District carter collection program).

The current information available makes the quantity of feedstock an issue, but one that is imperative to understand. Daily feedstock directly effects the size of the ADF, determines the quantities of digestate and biogas produced as by-products, categorizes the facility's required NYSDEC approvals, sets forth SEQRA determinations of significant impact potential and additional transportation issues of imparted and exported solid wastes.

Feedstock also impacts the feasibility of a facility's construction cost, operating expenses and income generated from tipping fees, biogas digestate sales.

It is recommended that because of the critical significance of ADF feedstock, the generators of the organic biomass and frequency throughput be verified early in the review process.

NYSDEC maintains a list of transporters that handle SSO food scraps and make the list available on or before June 1 of each year, beginning 2021.

In Suffolk County the listed Food Scraps Transporters are:

- Organix Recycling: http://www.organicsrecyscling.com
- National Waste Services, LLC: http://www.national-waste.com
- Winter Bros.: http://www.winterbros.com
- Waste Management: http://www.wm.com

A proposed ADF and the amendment to the Town Code for its development must carefully assess the collection of food scraps and transportation to the facility to determine appropriate size, location and assess other potential impacts.

5.0 NYSDEC SOLID WASTE MANAGEMENT FACILITY REGULATORY APPROVALS

Pursuant to the NYSDEC Solid Waste Management Facilities regulations (March 15, 2022) ADFs are subject to the requirements of 6NYCRR "Part 361.3.3 Anaerobic Digestion Facilities." These regulations are included as Appendix 4. Sections of particular interest are discussed below. These regulations identify facilities that are categorized as exempt, registered or permitted.

5.1 Exempt Facilities

The following facilities are exempt from this Subpart when operated in a manner that does not produce vectors, dust or odors that unreasonably impact neighbors of the facility, as determined by the department. The digestate must be stored and used in a manner that is protective of the environment.

An anaerobic digestion facility located at a site controlled by the waste generator, in accordance with section 360.14(c)(1) of this Title.

An anaerobic digestion facility that accepts only animal manure and bedding.

An anaerobic digestion facility that accepts no more than 1,000 pounds or 1 cubic yard, whichever is greater, of SSO per week on a monthly average. No more than 2,000 pounds can be accepted in any week.

An anaerobic digestion facility located on a Concentrated Animal Feeding Operation (CAFO) or a farm with an approved Comprehensive Nutrient Management Plan (CNMP) provided that the waste accepted is limited to manure, food processing waste, fats, oil, grease, and other organic wastes without sanitary content. The non-manure waste received must not exceed 50 percent, by volume, of waste placed in the anaerobic digester on an annual basis. Anaerobic digestion facilities that are not owned by the farm must be covered by the farm's CAFO approvals. Digestate is managed as follows:

land application of the digestate, provided the nutrient loading is addressed in a CNMP is exempt. Otherwise, registration under section 361-2.3(b) of this Part is required;

use of dewatered solids for animal bedding is exempt;

use of blended dewatered solids as a topsoil (no more than 50 percent digestate in the mix), provided the material does not cause odors when stored or used is exempt;

a composting facility for the dewatered solids located on a farm is exempt. Otherwise, registration under section 361- 3.2(b)(4) of this Subpart is required; and storage of liquid digestate, other than at a CAFO or a farm that otherwise has an approved CNMP, must be in compliance with National Resource Conservation Service (NRCS) code NY313.

5.2 Registered Facilities

In addition to the Town of Riverhead land use requirements, all ADFs proposed as a Registered facility must apply to the NYSDEC, Region One, Division of Materials Management for review and approval.

Registered facilities can only accept less than 50 TPD and all waste received must be stored in a vessel or in an enclosed area. A typical garbage packer truck holds about 10 tons of MSW. Although some specialized vehicles are designed for food scraps and organic wastes, using a standard carting vehicle, about five (5) trucks per day is expected to be the maximum number of trucks entering a registered facility.

Key operating standards for a registered AD are summarized below:

- All waste received must be source separated.
- Waste received in its original packaging (or example off specification packaged drinks) that will be de-packaged prior to digestion is allowed.
- All materials accepted cannot remain at the facility for more than 24 hours.
- All materials accepted and removed must be identified along with the dates of its receiving and shipping as part of the required record keeping.
- Odors generated at the facility must be controlled and cannot unreasonably disrupt sensitive receptors.
- Set-back from the nearest residences and businesses is a minimum 200 feet.
- Digestate must be stored in a manner that does not cause negative animal health or environmental impacts.
- Digestate used as a soil amendment must follow agronomic rates.

5.3 Permitted Facilities

ADFs that accept 50 TPD or more must comply with 361-3.3 (d) Permit application requirements. Additional NYSDEC regulations also apply which are referenced within Part 361-3.3 (d). permit requirements. These added requirements and cross references are not included in the text below, but can be further researched through the Westlaw website (govt.westlaw.com Part 360 Solid Waste management Facilities General Requirements) or through NYSDEC (dec.ny.gov)

<u>The application must include the following:</u>

A detailed description of the source, quality, and quantity of all waste to be digested, including the source, quality, and expected quantity of any seed material. The description must include the annual input and any seasonal variations in the waste type and quantity, and the appropriate quality data, as determined by the department. If SSO is accepted:

A detailed description of the source-separation program at the point of generation, including how unacceptable wastes are separated from the SSO stream. For residential SSO, this must include a copy of all educational literature or other information provided to residents, and a description of the container(s) that will be used. For commercial and institutional SSO, this must

include a copy of any agreements or information concerning what can be accepted from the generator and the collection containers that will be used.

An operation plan that includes:

a description of how the facility will comply with the operating requirements in Part 360 of this Title and subdivision (e) of this section;

a description and the capacity of the storage structures and the digesters;

a description of all preprocessing and post-processing methods and equipment used to identify and remove all non-processible materials and a copy of all agreements or educational activities that will be used to outline acceptable materials for the facility;

a description of the storage and disposal location for non-processible materials;

a process flow diagram of the entire process, including all major equipment and flow streams. The flow streams must indicate the quantity of material on a wet weight, dry weight, and volumetric basis;

an outline of the processing duration, including the time period from acceptance of waste to completion of digestion and to distribution of the product;

a description of the air emission collection and control equipment, if used; and

a description of the method used to control surface water run-off and to manage leachate, including the method for treatment or disposal of leachate generated.

An odor control and response plan. The plan must describe how odors will be monitored and how any odor problems will be addressed.

A digestate use plan that includes:

a description of the use(s) for the digestate (liquid, solids, or combined), including the approximate quantity of each type of user, the frequency of distribution, the expected use of the material, and the source of this information (such as contract or phone survey);

the method for removing digestate from the facility and any off-site storage;

a description of the proposed management of digestate that cannot be used in the expected manner due to poor quality or change in market conditions; and

a copy of the label or other information source for the digestate.

A detailed description of the proposed processes to reduce pathogenic organism content and to reduce vector attraction including:

the methods that will be used for pathogen reduction and vector attraction reduction; and

the monitoring and data gathering that will be used to demonstrate compliance including type, location, and frequency.

Biosolids, septage, and other sludges. In addition to the requirements outlined in paragraphs (1)-(5) of this subdivision, the application must include the following information. Wastewater and partially treated biosolids or septage that are generated at one wastewater treatment facility and treated at another wastewater treatment facility before digestion are not considered separate waste sources subject to the criteria in this paragraph. The resultant biosolids or sludge generated for digestion are subject to this paragraph.

A description of each proposed source of waste including the name of the generator, the annual quantity of waste produced, the amount of waste to be digested, and any seasonal variations in the quantity or quality during the year. Also, a description of the Federal or State pretreatment program, if required; and

A description of the quality of the waste, including analytical results, as outlined below:

the required parameters for analysis are in Table 1 of section 361-3.9 of this Subpart;

the minimum number of analyses for each waste source that must be submitted with the application is dependent upon the amount of waste that will be digested annually, outlined in Table 2 in section 361-3.9 of this Subpart;

for each analysis, the sampling date, location, and protocol used to obtain representative samples must be indicated;

a minimum of six months of waste production must be represented by the analytical results submitted. With the exception of pH and total solids, all results must be reported on a dry weight basis;

analyses for other pollutants can be required by the department, on a case-specific basis, based on the characteristics of the waste and information from the pretreatment program and other sources;

each analysis must be performed by a laboratory certified by the Department of Health for that type of analysis, using methods acceptable to the department, unless use of an alternate laboratory is authorized by the department. Copies of the original laboratory results must be included with the permit application;

the analysis requirement can be satisfied in part or in whole by recent samples analyzed for and reported to the department;

analyses performed more than one year before the date the permit application is submitted are not acceptable;

all samples must be representative of the waste to be processed; and

a table summarizing the analytical results must be provided, including the mean and range of results found.

Municipal solid waste.

In addition to the requirements outlined in paragraphs (1)-(5) of this subdivision, the application must include:

a description of the recyclables separation and reuse program, the management of household hazardous waste (HHW), and the radioactive waste detection program, including:

the methods used for removing recyclables, at the point of generation and at the facility;

the method and length of storage for recyclables;

the markets for recyclables;

the method used to remove HHW from the waste stream, at the point of generation and at the facility;

the ultimate management method for HHW collected;

a radioactive waste detection plan that includes procedures for detecting prohibited radioactive material; operation and maintenance documents for radiation detectors including investigation alarm setpoint settings and calibration methods; and response procedures to be implemented when radioactive waste is detected.

Design and operating requirements.

An anaerobic digestion facility required to obtain a permit must, in addition to the requirements identified in Part 360 of this Title, design, construct, maintain, and operate the facility in compliance with the following criteria.

Facility criteria.

Stormwater must be diverted away from the operating area.

All leachate must be collected and disposed in a manner approved by the department. All leachate storage facilities must be completely emptied, cleaned, and inspected every 12 months.

The waste storage area, processing area, leachate storage and liquid digestate storage area must be located in tanks or on surfaces that minimize leachate release into the groundwater under the facility and the surrounding land surface, such as asphalt (except for leachate storage), concrete, or drying beds that have underdrains for leachate collection. All leachate or liquid digestate storage structures, other than tanks, must be designed in accordance with Subpart 361-2 of this Part or code NRCS NY313, as incorporated by reference in section 360.3 of this Title. The following criteria also apply.

If low permeability soils are used, the liner must be a minimum of two feet of compacted soil having a maximum remolded coefficient of permeability of 1×10^{-7} centimeters per second. The soil material particles must be able to pass through a one-inch screen. The applicable criteria in Part 363 of this Title must be met.

If a geomembrane is used, the liner system must be designed and built in accordance with the applicable criteria in Part 363 of this Title.

If a surface impoundment is used for leachate storage, a minimum of two feet of freeboard must be maintained. In addition, the bottom of the liner system must be a minimum of five feet above both seasonal high groundwater elevation and the top of bedrock.

Dewatered digestate solids must be stored in a manner that will minimize run-off. All run-off generated must be contained on-site.

All incoming waste must be stored in a tank or in an enclosed storage area.

The facility must be operated in a manner to control the generation and migration of odors to a level that is to be expected from a typical facility operated in compliance with the regulatory criteria of this Subpart, as determined by the department.

The minimum horizontal separation distance as measured from the facility to the nearest residence, place of business or public contact area (except turf farms and plant nurseries) is 200 feet for SSO, and 500 feet for other wastes. In addition:

the separation distance requirement from a public contact area can be reduced for totally enclosed facilities or other mitigating landscape features, as determined by the department;

the separation distance requirement applies at the time the permit application is submitted to the department. The facility is not required to comply with the separation requirement with respect to construction of nearby residences, places of business or public contact areas subsequent to the permit application; and

the separation distance requirement for a residence does not apply to the residence of the facility landowner or operator. For a municipal permittee, land owned by any agency or department of the municipality is considered to be owned by the municipality.

The operation of the facility must follow acceptable methods of anaerobic digestion that results in the biochemical decomposition of the organic material received.

If the facility accepts SSO, the generator must have active collection programs designed to collect organic waste separate from other recyclables and waste materials and to remove inorganic and non-processible materials from the SSO generated. The facility must also have provisions for inspection and removal of non-processible materials received.

The facility is prohibited from accepting wastes that do not positively contribute to the digestion process or the quality of the product, as determined by the department. Prohibited waste includes, but is not limited to, C&D debris, and ash from the combustion of municipal solid waste.

Storage of digestate at the facility must not exceed 12 months.

Non-processible waste and unacceptable product must be disposed at least weekly.

For facilities accepting municipal solid waste:

a recyclables separation program and a HHW collection program must be in place in the generating community(ies) and at the facility;

recyclables must be removed from the waste stream before digestion;

a fixed radiation detection unit must be installed and operated at a location appropriate for the monitoring of all incoming waste. In addition:

the investigation alarm setpoint of the radiation detector must be set at least two times but no greater than five times background radiation levels;

the concentration of radium-226 in any waste digested at the facility can not exceed 25 pCi/g;

background radiation readings at the facility must be measured and recorded at least daily;

field checks of the radiation detector utilizing a known radiation source must be performed and recorded at least weekly;

the radiation detector must be calibrated at least annually or more often as recommended by the manufacturer, and documentation describing the calibration must be maintained at the facility; and

each instance in which the radiation detector is triggered by a waste load must be documented and reported to the department within 24 hours. Recorded information must include the date the waste was received, transporter name, origin of the waste, truck number or other identifying marking, detector reading, disposition of the waste, and date of disposition.

The anaerobic digestion facility must comply with the pathogen and vector attraction reduction criteria outlined in section 361-3.7 of this Subpart unless the potential for pathogen content is very low compared to biosolids, as determined by the department, or a facility that accepts sanitary waste operates as Class B pathogen reduction in conjunction with a permit for land application under Subpart 361-2 of this Part.

Digestate that does not meet the criteria in this section is considered a waste and must be disposed.

Digestate can be distributed for use for food crops, feed crops, and fiber crops.

Digestate must not contain pollutant levels greater than those found in Table 6 of section 361-3.9 of this Subpart. The addition of materials to the process or digestate for dilution purposes is not allowed.

The digestate must not contain more than two percent total gross contaminants by weight (dry weight basis).

The digestate must be able to pass through a one-inch screen.

If distributed to the public, the material product must be mature and must be used in a legitimate manner as a soil amendment.

Digestate derived from sanitary waste or other waste with pathogen content that has not met Class A pathogen reduction and vector attraction reduction standards can only be land applied in accordance with a permit under Subpart 361-2 of this Part or composted under a permit according to section 361-3.2 of this Subpart.

Use of the digestate, other than the scenario outlined in (d)(20) of this section, is subject to the following criteria:

land application of the solids and/or liquid produced by the anaerobic digestion facility is exempt, provided the nutrient loading is addressed in a CNMP. Otherwise, registration under section 361-2.3(b) of this Part is required;

use of the dewatered solids for animal bedding is exempt;

use of the blended dewatered solids as a topsoil (no more than 50 percent digestate in the mix) is exempt, provided they do not cause odors when stored or used; and

composting of the dewatered solids at an exempt composting facility is also exempt provided the solids do not exceed 25 percent (by volume) of the incoming waste annually. A composting facility for the dewatered solids with an amendment or bulking agent requires registration under section 361-3.2(b)(4) of this Subpart.

An information label must be affixed to the packaging or, for bulk, an information sheet, sign, or brochure must be used, containing:

the name and address of the generator of the material;

the type of waste from which the material was derived; and

recommended safe uses, application rates and storage practices.

For anaerobic digestion facilities that accept biosolids, septage, or other sludges, each waste source must not exceed the pollutant concentrations found in Table 6 of section 361-3.9 of this Subpart, unless the waste source is a minor (less than 10 percent of the total dry weight of sludges accepted) component of the input to the facility and a program is developed to identify and reduce the pollutant(s) that exceed the limits for that waste source. This requirement does not apply to digestate that will be used outside New York State.

If a waste input, other than a minor source, contains metals at concentrations greater than those set forth in Table 6 of section 361-3.9 of this Subpart, the waste cannot be accepted at the facility until the generator has implemented a pollutant identification and abatement program and compliance with the requirements of this paragraph has been demonstrated for waste representing a period of at least six continuous months. At least six analyses for total solids and the parameter of concern must be provided to demonstrate compliance. This requirement does not apply to products used outside New York State.

Wastewater and partially treated biosolids that are generated at one wastewater treatment facility and are further treated at another wastewater treatment facility before digestion are not considered separate waste sources subject to the criteria in this paragraph. The resultant biosolids or sludge generated for digestion are subject to this paragraph.

Any material added to the process must not contain pollutants in concentrations that exceed the levels found in Table 6 of section 361-3.9 of this Subpart.

Analysis of the digestate is required for the parameters in Table 1 of section 361-3.9 of this Subpart. The frequency of sampling is specified in Tables 4 and 5 of section 360-3.9 of this Subpart. All samples must be representative of the material that will be distributed. With the exception of pH and total solids, all results must be reported on a dry weight basis. Copies of the original laboratory results must be included.

Each sample must be a composite of at least five grab samples.

After the digestate has been monitored for two years at the frequency outlined in this paragraph, the department can reduce the annual number of analyses required if the material quality consistently meets the standards in Table 6 of section 361-3.9 of this Subpart.

For digestate derived from non-sanitary waste, the required analyses can be reduced depending on the use of the material, as determined by the department.

Sufficient monitoring data must be obtained to demonstrate compliance with the pathogen and vector attraction reduction requirements, if applicable. The frequency and type of monitoring necessary, based on the methods employed to achieve pathogen and vector attraction reduction, will be determined by the department.

The department can require analyses of the material for maturity before distribution. This can include, but is not limited to, organic matter reduction, plant growth impact, or oxygen consumption.

Each biosolids, septage, and sludge source must be analyzed in accordance with the following:

The required parameters for analysis are found in Table 1 of section 361-3.9 of this Subpart.

The minimum number of analyses required depends on the quantity of waste digested, as outlined in Table 3 of section 361-3.9 of this Subpart.

Except for pH and total solids, all results must be reported on a dry weight basis. After the waste has been monitored for two years at the frequency outlined in this paragraph, the department can reduce the annual number of analyses required if the waste quality consistently meets the quality standards.

Wastewater and partially treated biosolids or septage that are generated at one wastewater treatment facility and treated at another wastewater treatment facility before beneficial use are not considered separate waste sources subject to the criteria in this paragraph. The resultant biosolids or sludge generated for beneficial use are subject to this paragraph.

For other wastes, analyses of the input waste can be required, as determined by the department, based on the characteristics of the waste. The extent and frequency of sampling will be determined by the department.

The annual report must include:

all information and analyses required by this Subpart;

the type and quantity of the waste digested, including the source of the material;

process operational information including monitoring data and significant facility operational problems and any actions taken to correct problems;

for facilities that accept biosolids, the following certification statement must be signed by an authorized representative of the facility, with an indication of the name and title of the individual signing:

"I certify, under penalty of law, that the information that will be used to determine compliance with the requirements in Subpart 361-3 of 6 NYCRR Part 361 has been prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that false statements made herein are punishable pursuant to section 210.45 of the penal law."

the quantity, by weight and volume, of digestate generated at the facility and the quantity of material removed.

6.0 ENVIRONMENTAL REVIEWS: SEQRA

The State Environmental Quality Review Act (SEQRA) classifies anaerobic digester projects as a Type II action, requiring no further environmental reviews ONLY under the following 6NYCRR Part 617.5 (c) (41) conditions, "construction and operation of an anaerobic digester, within currently disturbed area at an operating publicly owned landfill, provided the digester has a feedstock capacity of less than 150 wet tons per day. And only produces Class A digestate (as defined in Section Part 361-3,7 of this Title) that can be beneficially used or biogas to generate electricity or to make vehicle fuel, or both."

The SEQRA Type II classification does not apply to Riverhead for three primary reasons. First, the Town of Riverhead's capped landfill is scheduled for accommodating a ground based commercial solar facility, and use of the site for an anaerobic digester is therefore not feasible. Second, there is no definition of an ADF or an existing zoning use district that would permit or allow by Special Permit, and anerobic digester. Third, a new or expansion of a solid waste management facility is classified as a Type I Action pursuant to Town Code Section 225-11 B. (3).

The State Environmental Quality Review Act (SEQRA) and the Town of Riverhead Town Code Chapter 225 Environmental Quality Review require review of proposed zoning amendments that would include ADFs to existing land use codes.

In the first case, SEQRA applicability is expressly described under 6NYCRR Part 617.4 (b) (2) "the adoption of changes in the allowable uses within any zoning district, affecting 25 or more acres in the district." The adoption of the zoning amendment would be initiated by the municipality without a petition filed for the change of zone by an applicant. This municipal generated change in allowable uses is classified as a Type I action and requires filing of a Full Environmental Assessment Form, establishing Lead Agency (such as the Town Board) and for the Lead Agency to coordinate review with all involved agencies (SCDOH, SCPC, NYSDEC, NYSDOT, etc.). The Lead Agency is required to render a Determination of Significance to specifically support whether there is potential for adverse and significant environmental impacts, or if the impacts are minor in nature and magnitude. It is generally assumed that a Type I action will result in the preparation of a Draft Environmental Impact Statement (DEIS) and a DEIS is mandatory if even a single impact is identified as potentially significant or potentially moderate.

If the Riverhead Town Board initiated a zone change within the PIP zoning district, which is greater in land mass than the SEQRA 25-acre threshold, to allow any size ("Local" or "Regional") ADFs as a permitted use, it would qualify as a Type I action. Furthermore, it is expected that there is strong potential for exceeding non-significant environmental impact thresholds, resulting in a Positive Declaration of Significance, triggering preparation of a required DEIS. At least the prohibited uses identified under 301-114 A (6) and specifically the warehousing and sale of explosive methane gas and fertilizer manufacturing along with the general land use to allow construction of a solid waste management facility would be precedent setting (with potential for growth inducing impacts).

It may be plausible that preparation of a standalone Generic Draft Environmental Impact Statement (GEIS) or a Supplement to the Supplemental Final GEIS prepared for the EPCAL land use and subdivision SEQRA review be an approach.

A GEIS is subjected to the full SEQRA procedures as a site specific/project specific EIS, however a GEIS is broader in scope and study and typically results in a set of "standards" that must be met by any proposed project subjected to review. In the matter of the ADFs, a GEIS could provide a list of conditions that must be met as a condition of the permitted use or use allowed by Special Permit. The NYSDEC Part 361-3.3 regulations would still apply with respect to exempt, registered and permitted facilities. The standards set forth as the result of a GEIS, could exceed the NYSDEC requirements, and for example all or some of the NYSDEC requirements for an ADF accepting more than 50 TPD might be applied to all ADFs within the PIP, regardless of daily input.

A change of zone within any zoning use district to permit AD facilities should carefully consider the Part 361-3.3 regulations as to avoid conflicts and redundancy.

In the second case, SEQRA applicability is expressly described under 6NYCRR Part 617.4 (b) (3), "the granting of a zoning change, at the request of an applicant, for an action that meets or exceeds one or more of the thresholds given elsewhere in this list." The list referred to includes all items listed under 617.4 (b) and any additional items listed by a locally involved agency, to determine if the applicant's request is greater than any of the listed thresholds (NYSDEC SEQRA Handbook 4th ed.).

One issue with an applicant's request for a zone change to allow ADFs, is that ADFs are not listed as a "permitted" land use in any zoning district, and no description of such facility exists in the Town Code. It is uncommon at best for an applicant to seek a zone change for a land use that does not currently exist.

In both cases, any zone changes to permit ADFs within the PIP must be evaluated with respect to "spot zoning." Spot zoning occurs when a property owner or applicant for zone change receives special zoning that allows for a different use than exists in the surrounding zoning use district or general area. The fact is, there is no solid waste management facility located or permitted as a use within the PIP; and with exception of yard waste/mulch facilities operating within the Town (but operating without a discernable "permitted use" for yard waste processing identified under the Town Code), there are no types of solid waste management facilities that are listed as a "permitted use" or "use" by Special Permit identified in any zoning use district of Riverhead Town. As stated in the previous section, a new or expansion of a solid waste management facility is classified as a Type I Action pursuant to Town Code Section 225-11 B. (3).

A primary SEQRA issue (whether the Town or an applicant initiates a zoning amendment for ADFs) is that an ADF as a solid waste management facility. By definition and regulatory oversight, ADFs are not methane gas refineries or soil amendment production plants. ADFs are not manufacturing facilities. ADFs are solid waste management disposal and organics recycling facilities and regulated by NYSDEC.

Therefore, any "permitted use" to allow ADFs within a zoning use district can set precedent for a petitioner or others to request additional solid waste management facilities be added to the list of permitted uses or special permit list. Under a proposed zone change the SEQRA review would assess the potential impacts of additional solid waste management facilities.

A review of the Town of Brookhaven Code revealed that within the L-Industrial-2 Zoning Use District (Heavy Industry) nearly every *Prohibited Use* listed in the Town of Riverhead's Code under Section 301-114 A (6) is permitted by Special Permit. Among these uses by Special Permit in Brookhaven are Transfer stations, Explosives manufacture or storage, Fertilizer manufacture, Acetylene, natural or any type of gas manufacture and the storage thereof, and Garbage, offal or dead animals reduction, dumping or incineration. The list is included as Appendix 5.

A SEQRA timeline and process flow diagram is included in Appendix 6.

7.0 CASE STUDIES

7.1 Case Study 1: Quantum Biopower: Southington, CT
Quantum Biopower operates Connecticut's only ADF, located in Southington. According to a letter to Connecticut Department of Energy & Environmental Protection (DEEP) from Quantum Biopower dated April 14, 2023, in response to the department's request for information. The food digester facility manages 40,000 tons of food waste per year.

The letter states the facility is, "making renewable energy, nutrient rich fertilizer and mulch products from food waste materials. In addition, our Southington facility recaptures and diverts packaging, like cardboard, glass and aluminum cans, and sends those to companies that recycle and reuse them."

The letter also addressed obstacles with increasing the digester's food scrap feedstock.

"*Connecticut's main problem is, before the gas can be captured, the organic waste itself has to be captured and accumulated. Quantum's lived experience with organic waste generators over the past several years of operations has given our team unique insight into the barriers to organic diversion as they exist today. Connecticut can take a few different forms to encourage generators to participate but each is tailored to the size generator, the ease with which residents can adjust to ne separation behavior and the cost and availability of pick up and drop off service. Today, less than fifteen percent of the food waste that enters the Southington facility's is from Connecticut. In fact, it is not a stretch to imagine that the Southington facility could be augmented to manage most if not all of the state's food waste stream-certainly over the next 10-15 years. Digestion capacity is not our problem. Getting the food waste material from the generator is the problem."*

Quantum also recommended to Connecticut DEEP that it*, "should not consider new procurements for digesters because there isn't enough waste collected to justify procurement. The state has enough capacity to manage source separated organics and, unless more organic waste is generated, existing facilities will end up cannibalizing on another.* This is not the ideal outcome if the goal is a robust system of well-functioning facilities."

The Southington facility is undergoing an expansion of 25,000 SF to accommodate the volume of packaged food waste, and adding equipment that will separate packaging from the waste. A "slide show" depicted at Quantum's website showed large quantities of food waste received was stored outdoors. The expansion should provide some relief to the material handing problem. (https://www.quantumbiopower.com)

7.2 Case Study 2: American Organic Energy: Yaphank, NY
American Organics Energy, a sister company of Long Island Compost, recently broke ground on an approved anaerobic digester facility at Yaphank, Town of Brookhaven, NY. The facility is designed to annually convert between 180,000 to 210,000 tons of food waste and fats, oils, and grease, plus 10,000 tons of grass clippings into renewable energy (hhtp://www.vhb.com and hhtp://www.usbiopower.com).

The facility is expected to produce between 2.0 megawatts and 4.0 megawatts (MW) of electricity, fertilizer and clean water nutrients (recyclingtody.com).

The process could produce up to 500,000 MMBtu of natural gas, 260,000 gallons of liquid fertilizer and 45,000 tons of compost according to an April 23, 2023 article published by Joseph D'Alessandro and J.D Allen (http://www/wshu).

7.3 Case Study 3: Proposed Nexus Bioenergy Anaerobic Digester, Riverhead, NY
Nexus Bioenergy (http://www/nexusbioenergy.com) has proposed an anaerobic digester facility for location in Riverhead, providing the zoning is appropriate for the use. According to discussions and project descriptions offered by Nexus representatives, the proposed facility has a throughput capacity of 200-250 TPD, a feedstock capture zone of not less than a 50-mile radius and would be a "regional facility." The ADF would accept food scraps, grease, fats, and oils, but would not accept yard waste.

In April 2022 a land use interpretation was sought by an applicant "Taliesin East LLC" for an AD proposed for siting in the PIP Zoning Use District (Chapter 301-section 185 A). The Riverhead Zoning Board of Appeals denied the use by unanimous decision. The ZBA concluded the proposed ADF "falls within the prohibited uses in the PIP Zoning Use District, including those that prohibit the warehousing, indoor storage, wholesaling, or sale of hazardous, dangerous, and explosive materials such as acids, gases, ammunition, fireworks, and explosives, dumps and garbage dumps, landfills, incinerators, or transfer stations." In its conclusions, the ZBA recommended for the, "Town Board as the legislature for the Town, to consider adding this use to the PIP Zoning Use District. The testimony revealed that the use could be beneficial to the taxpayer and provide renewable energy as well as additional opportunity for recycling, as such we encourage the Town Board to give it due consideration."

Nexus Bioenergy has proposed a site within the EPCAL PIP Zoning Use District. This selection was based on available utilities, existing zoning regulations, location of the rail spur at EPCAL and the ability to connect to the Calverton Sewer District for wastewater disposal. A review of the Nexus Bioenergy website described the "Nexus Advantage" BIO1 Digester as a zero-wastewater discharge facility, producing revenue from the sales of fertilizer and compost. Based on this type of AD technology, the location near a connection to a wastewater treatment plant would appear unnecessary.

The Nexus Bioenergy website includes a chart outlining outputs of various sized facilities. For example, an ADF located on 2.5 acres and accepting 150 TPD of feedstock, produces 1,800 gallons per day (GPD) of liquid fertilizer and generates 40 tons per day (TPD) of compost.

An ADF located on 8 acres, accepting 740 TPD of feedstock would generate 9,000 GPD of liquid fertilizer and 200 TPD of compost.

The Nexus Bioenergy ADF would generate biogas, refined to capture methane for use in energy production. Other gases generated at the facility (carbon dioxide-CO_2 and hydrogen sulfide-H_2S) would be vented to the atmosphere.

No existing/active AD facilities were listed or described on the Nexus-Bioenergy website.

For the Town of Riverhead, (based on preliminary interviews with Nexus Bioenergy representatives) the developer/operator would construct a $60 million facility and offer as a "Community Benefit" to the Town an unspecified amount of income from the tipping fees (the cost calculated per ton to a disposal company seeking to "tip" the food scrap waste at the Nexus Bioenergy facility). The representatives described the employment opportunities as limited, except for waste haulers, that Industrial Development Agency applications would, if appropriate, be limited to construction of the facility and PILOT programs would not be requested.

For example, using a tipping fee of $50 per ton, operating a facility accepting 200 TPD generates $10,000 per day in tipping fees. Based on operations of a six-day week, for 50 weeks (assuming two weeks/year shut down for holidays, and maintenance), this generates an annual amount of $3.0 million. Income from sales of fertilizer, methane gas and compost are unknown as are operating costs and time to recover construction costs of the $60 million facility and land purchase or lease arrangements. Real estate taxes would need to be estimated by the Town Assessors Office, although with no ADFs that exist in Riverhead or Suffolk County to use as a comparison or model, further research is recommended.

The siting of the proposed Nexus Bioenergy facility would require a zone code amendment to permit solid waste management facilities limited to facilities producing green energy in the PIP zoning use district as a permitted or special permit use. The procedures are discussed in section 6.0 Environmental Reviews. The proposed Nexus Bioenergy (200-250 TPD) would require NYSDEC approval under the Permit requirements described in section 5.3.

8.0 RECOMMENDATIONS AND CONCLUSIONS

It is generally recommended by the solid waste industry, that before implementing a program for ADFs, municipalities ensure that overall reduction and waste prevention initiatives, including surplus food rescue, are in place to reduce the amount of organic waste produced.

Organics recycling should be right-sized to account for prevention measures, and municipal outreach to businesses and residents about organics recycling should include waste prevention tips too.

A crucial understanding of waste generators, SSO quantities and collection systems are necessary before sizing an ADF and integrating anaerobic digestion into the municipal waste plan. It is this framework of food scrap generation, daily tonnage, collection methods and disposal at an ADF that is currently absent in Riverhead. Although NYSDEC models and SWMP estimates are adequate for general waste management planning, decisions on zoning amendments, environmental reviews, agency approvals, registration, permits, collection areas and facility size require more finite information. These factors alone lead to a conclusion that an ADF at best is premature for the disposal of Riverhead's food waste until this information is available and scrutinized.

Additionally, the PIP zoning code prohibits the use. Warehousing, storage, and sales of explosive gases are not permitted, and fertilizer manufacturing is prohibited. The Town of Riverhead zoning code does not have solid waste management facilities as a permitted use or an allowable use by special permit in any zoning use district. The Town of Riverhead does not have an active or inactive municipal landfill, which could serve as a possible location for an ADF.

A change to the existing zoning to permit ADFs will be classified under SEQRA as a Type I action, initiate a mandatory coordinated review, with the preparation of an environmental impact statement highly probable. Uncoupling the PIP prohibited uses listed under Section 301-114 A (6) necessary for ADFs, and understanding ADFs are solid waste facilities, an environmental review of a zoning amendment would assess potential impacts on land use and environmental quality that reach well beyond anaerobic digesters. There is potential for either structuring zone change to permit ADFs as a limited standalone use, (which will be defined as "spot zoning") or structuring a much broader land use amendment resulting in potential for a variety of new uses including solid waste facilities, explosive material warehouse and sales and fertilizer production.

If some form of new or amended zoning is adopted, an applicant proposing an ADF would require either a NYSDEC registration (for a facility accepting less than 50 TPD) or a permit (for an ADF accepting 50 TPD or more).

Once the facility size and waste collection area are known, traffic impact assessments would be evaluated.

The proposed and permitted American Organic Energy facility under construction in Yaphank is located approximately 10-miles from Riverhead Town's EPCAL PIP zoning use district (where consideration is given to permit ADFs). The size of the Yaphank ADF is sufficient to accept

estimated food waste and organics (approximately 25 TPD) generated within Riverhead. Adding additional ADFs without increasing feedstocks was a significant concern stated to Connecticut's DEEP by Quantum Biopower (operators of the Southington ADF),

"The state (sic Connecticut) has enough capacity to manage source separated organics and, unless more organic waste is generated, existing facilities will end up cannibalizing on another."

The Southington facility is the only ADF in Connecticut and it accepts an average of 130 TPD. The population of Connecticut is 3.6 million. The population of Suffolk County is 1.5 million, Nassau County's population is approximately 1.4 million, and Riverhead Town is 34,000. The American Organic Energy facility is designed to accept an estimated 180,000 tons of food waste per year (approximately 600 TPD).

The American Organic Facility could potentially cannibalize the feedstock needed for a Riverhead only facility that is expected to be much smaller in capacity (less than 50 TPD). The additional transportation of SSO to Yaphank is feasible. Furthermore, the Town of Riverhead has no existing "flow control" mechanisms in place, that require carters operating within the Town to dispose collected solid wastes (residential and commercial) at select destinations. Implementing a local flow control law to direct food waste to an AD facility located within Riverhead is expected to meet with resistance from carters and commercial entities unless food waste tipping fees are securely a financial advantage and is acknowledged as a contract requirement prior to (residential Six District) soliciting waste disposal bidders.

Additionally, if the Town Board decides to include anerobic digesters the adopted Solid Waste Management Plan will need to be amended. The amendment will require a review and approval by NYSDEC, Division of Materials Management.

As described in Case Study 7.3 Nexus Bioenergy has proposed an ADF with a Community Benefit program generated by a revenue share between the operator and the Town and based on tipping fees. An "add on" cost to industry accepted tipping fees could disrupt competitive methods for disposal, and it is recommended this approach be more carefully evaluated. The Nexus Bioenergy facility described by its representatives would accept 200-250 TPD.

To address the needs of Riverhead only, considering the obstacles and unknowns, it is not recommended the Town of Riverhead pursue amendments to the Town Code to permit or permit by special permit, ADFs in any of its existing zoning use districts.

One alternative to address the Town's recycling of food scraps and other organic wastes is the development of an SSO program with potential for carters to collect the waste, with final disposal at an approved NYSDEC facility. As a component of this alternative, a public educational program would need to be developed to explain the SSO program. Adding SSO/food scraps to the Town's required solid waste quarterly reporting form generated by the carters operating within Riverhead is also recommended to better quantify SSO participation and waste quantities.

However, should the Town be interested in considering a Regional Facility it should take the following under advisement.

General Recommendations to Consider by Industry Researchers

Before implementing AD, ensure that overall reduction and waste prevention initiatives, including surplus food rescue, are in place to reduce the amount of organic waste produced. Organics recycling should be right-sized to account for prevention measures, and municipal outreach to businesses and residents about organics recycling should include waste prevention tips too. (Note that NRDC follows a modified version of the EPA hierarchy, which considers responsible AD and composting as being on the same organics recycling tier.)

A significant quantity of material entering a digester remains as liquids and solids at the end of the process, and this digestate should be processed through composting or curing to enable its incorporation into soil wherever possible. The primary benefits of recycling are not just diversion from disposal, but the resource savings and pollution avoidance that occur when recovered materials are returned to a production cycle; this applies as well to organics recycling, where primary benefits occur when carbon and nutrients are returned to the soil so they can be "recycled" into new growth. Any energy generation should be managed to ensure the primary goal of returning materials to soil can be maximized.

Potential benefits to soil from adding compost or appropriately-treated digestate also include increased water and nutrient retention, improved soil productivity and soil health, reduced reliance on fertilizer, and carbon sequestration.

Make AD part of a larger system of organics management. Processes and technologies for particular digesters should be selected to correspond to the types of feedstock (inputs) and projected outputs.

For example, yard waste generally does not break down completely in a digester; while some types of dry AD benefit from the addition of landscaping waste as a bulking agent, that type of lignin-rich waste will not fully decompose in the digestion process and will need to be "finished" after the AD process by composting or another method of curing.

Wet AD generally cannot process woody waste (or paper, or compostable service ware) and is best suited for separated food scraps or similar materials. Consequently, composting will nearly always be needed as part of a responsible organics recycling system, both to break down materials that don't decompose in the anaerobic process (such as woody waste and compostable plastics) to create a usable soil amendment, as well as to remove pathogens from AD digestate (since, depending on the system, these may not be fully destroyed in the anaerobic digestion process).

Many communities have more than one organic recycling system. The size of digesters can be tailored to fit a community's particular needs, and systems can be combined with each other.

Anaerobic digestion may work best for communities prioritizing recycling pre-consumer food waste or other organics which are typically less contaminated, and which easily break down in the anaerobic process.

Organic waste that contains significant amounts of food-soiled paper, compostable bioplastics, and/or landscaping waste may not break down sufficiently in an anaerobic digestion process and may need to be sent to an aerobic composting system (either after or in lieu of anaerobic digestion).

And with any organics recycling system, municipalities can help drive efficiency in the system by purchasing or selling finished compost products.

Select processes and technologies to correspond to the quantities of feedstock. Prioritizing prevention and reduction mean ensuring that proposed AD systems are not scaled too large, which can disincentivize reduction efforts. Ensure that the AD can handle loads of varying sizes (or intermittent use) and that any reduction in input does not necessarily mean needing to seek other feedstocks to meet capacity. Scope projected types and quantities of feedstocks out several years to ensure right sizing of the operation.

Ensure source-separated feedstock so as to maximize use of digestible components and reduce reliance on separation technologies and processes. Lower contamination will also help ensure technologies are operating at higher efficiency. “Garbage in, garbage out” applies to actual waste too, not just computer science: if highly contaminated or “mixed waste” feedstock is placed in a digester, highly contaminated digestate will be produced.

Using feedstock that has been separated at the source, rather than relying on inefficient and incomplete processes to separate waste at the AD facility, can help ensure that you achieve actual recycling and do not have to landfill or incinerate all or part of the digestate.

Make sure the AD employs the best available controls and procedures to prevent emissions to air and water. Particular concerns include nitrogen to groundwater and air pollutants including carbon dioxide.

Be certain to involve the other regulatory agencies early in the planning process, to avoid conflicts with existing and/or proposed regulations.

The above tips are only some of the factors that should be considered when optimizing a municipal organics recycling system; cost, job creation, and goals related to waste reduction, climate, and sustainability are some others.

Finally, as part of a holistic and effective organics recycling program, in addition to balancing industrial AD with industrial composting, promote small-scale composting options (community and/or home composting) to improve your organics recycling system resiliency, create jobs, and involve and benefit communities.