Organics Recycling Study for Dutchess County

Final

Prepared for NYSERDA

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Notice

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Steering Committee

The Steering Committee members for this project provided insight and perspective, related to their area of expertise or constituents, which helped refine information gathered and advised future efforts. The Steering Committee members represent municipalities, organizations, and businesses in Dutchess County with particular interest in increasing organic recycling, as well as those with particular expertise in this topic. The Project Team thanks the Steering Committee for all the feedback and time provided, specifically:

- **NYSERDA -** Sharon Griffith, Principal contact
- **Jansen Engineering, PLLC** – Jolanda Jansen, Principal Engineer and Owner*
- **RRT Design and Construction -** Dave Weitzman, Vice President*
- **Allred Consulting, In**c. – Shorna Allred, Principal*
- **Independent Contractor** – Tammy Morgan, North Elba Digester Project Leader*
- **Rutgers EcoComplex** – Serpil Guran, Director and Dave Specca, Assistant Director*

- **Dutchess County Regional Chamber of Commerce** – Loren Hoffman, Marketing and Communications Coordinator
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- **Dutchess County Environment Management Council** – Vicky Kelly, Member
- **Central Hudson** – Stephanie Genesee, Assistant Engineer, Electric Distribution and Planning and Arnold Anchante, Engineering Technician
- **Dutchess County** – Lindsay Carille, Deputy Commissioner, Division of Solid Waste Management
- **Town of Red Hook** – Laurie Husted, CAC Chairperson
- **Village of Wappingers Falls** – Matt Alexander, Mayor

(* Indicates that the person is also a subcontractor for this project.)

Table of Contents

Executive Summary

This report summarizes the results of the Cleaner Greener Communities Program Project: 'Feasibility Study to Expand Organics Recycling in Dutchess County.' Through this study, the Project Team completed the following tasks:

- Documentation of previous organics recycling education, outreach and information gathering (Task 2.0)
- An in-depth organic waste stream analysis (Task 4.4)
- A study of existing and potential organics recycling technologies and business models suitable for Dutchess County (5.4)
- An economic analysis of scenarios for implementation of new organics recycling facilities and activities in Dutchess County (Task 6.3)
- A spatial analysis to identify preferred locations for potential organics recycling facilities and other useful maps (7.3)
- Outreach to key stakeholders and the public to promote organics recycling and gauge attitudes and perceptions about implementing new organics recycling facilities and activities in Dutchess County (Task 8.2)

The study began by drawing from and documenting past organics recycling and composting efforts conducted by the Project Team funded by Dutchess County Agency Partner Grants. This information was summarized into the *Existing Organics Recycling Conditions Report (Task 2.0)*. A key takeaway from this reflective effort was that some sectors, like the agricultural and horticultural sectors, were managing organics on site. Takeaways from this work helped guide the direction of the project.

Next the Project Team investigated five different sectors in Dutchess County (municipal, commercial, institutional, residential and industrial) to assess organic waste generated and opportunities for organics recycling. The Project Team determined that there are three high priority sectors in Dutchess County for organics reduction and recycling; institutions (schools), residential and municipal wastewater treatment plants (WWTPs). The Project Team also began to research methods and technologies for organics recycling. The results of this analysis are compiled in the *Dutchess County Organic Waste Stream Report (Task 4.4)*.

Following that, the Project Team built upon existing research by further examining the specific technologies available for organics recycling, focusing on biosolids from WWTPs as the main feedstock. Options for the schools and residential sectors were also explored. This subsequent report, the *Summary of Organics Recycling Technologies and Business Models for Dutchess County (Task 5.4)*, provided details on organics recycling options, specifically small and large-scale composting, anaerobic digestion (AD) and pelletizing and drying, and the processes, preliminary costs and byproducts of each method.

Within each of these high-priority sectors, opportunities for organic waste reduction and recycling, including the economic feasibility of those options, were assessed and described in detail in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3)*.

In the Task 6.3 report, a full economic analysis of four outcome scenarios was completed for the municipal WWTPs sector, revealing that composting, and then selling the digestate produced from anaerobically digesting biosolids is the most economical option. However, the Project Team determined that at this point in time, due to current energy markets and availability of low-cost energy fuels, anaerobic digestion is not a viable or incentivized approach to

reusing and reducing organic waste, or generating biogas, when compared with other scenario solutions.[1] Exploration of the residential and school sectors revealed existing waste reduction and organics recycling initiatives, and opportunity for and interest in increased organic waste reduction and recycling. For both sectors, it was found that regardless of organic waste recycling technologies, material characteristics or sector, cost-savings correlate with reduced organic waste material volume and reduced waste hauling frequency.

The Project Team determined that at this time, organic waste recycling can be most successfully accomplished in Dutchess County through a combination of approaches further detailed in this report, including:

- Educational programs focused on organic waste reduction and composting, which can be directed towards schools, residents and municipalities.
- Home, municipal, community, or privatized compost site development.
- Education about product sell-by labeling for consumers and commercial entities, like grocery stores, to help reduce amounts of organic waste generated at the source and entering the waste stream.
- Local planning decisions: for example, updating or adjusting local municipal zoning codes to allow for installation of composting and other organics management facilities.
- Incorporating retrofits to existing WWTPs and designing new WWTPs to increase percent solids of biosolids and composting of biosolids to reduce hauling weight and costs.
- Value-added product development and marketing of compost, etc.
- Developing market uses for biosolids and mixed materials compost end-product and continuing to expand markets for food waste compost.

All of these approaches require support from municipalities, residents, schools, and businesses that identify as local stakeholders. Throughout the study, outreach to stakeholders was conducted to better understand various perspectives and levels of interest in pursuing organics recycling opportunities. Outreach methods included a residential survey conducted in the Town and Village of Rhinebeck, Town and Village of Red Hook, Village of Tivoli and Village of Wappingers Falls, meetings with municipal officials, a public meeting, informal surveys of commercial and school sectors, and more. These efforts are summarized in the *Documentation of Public Outreach Activities (Task 8.2)*.

Additionally, throughout the course of this project, Geospatial Information Software (GIS) was utilized to develop maps relevant to the project, including to identify preferred locations for organics recycling facilities in Dutchess County. The maps were distributed throughout all the previous reports, and the *Final Maps (Task 7.3)* are included in this report.

This report summarizes the results of earlier project reports and recommends next steps for Dutchess County.

[1] U.S. Department of Energy. (2017, September). *Fuel Prices*. Retrieved from Alternative Fuels Data Center: https://www.afdc.energy.gov/fuels/prices.html

Chapter 1: Introduction

About Cornell Cooperative Extension Dutchess County

Cornell Cooperative Extension Dutchess County (CCEDC), a subordinate governmental agency associated with Cornell University and its land-grant mission since 1869, provides research-based resources, tools and education for the residents and officials of Dutchess County. CCEDC's mission is: through quality educational programs, Cornell Cooperative Extension Dutchess County builds strong, healthy youth, adults, families and communities while enhancing the economic, social, agricultural and natural resources of Dutchess County.

Composting outreach at the Dutchess County Fair

For this project, CCEDC relied on past experience leading initiatives focused on organics recycling in Dutchess County as part of Dutchess County Agency Partnership Grants between 2013 and 2016. For more information on home composting and organics recycling activities completed as part of these grants, please refer to CCEDC's *Existing Organics Recycling Conditions Report (Task 2.0)*, available by contacting CCEDC. These previous efforts laid the groundwork for CCEDC to expand organics recycling efforts through funding under the Cleaner Greener Communities Program.

Project Overview

The New York State Energy Research and Development Authority (NYSERDA) administers the Cleaner Greener Communities (CGC) program. CGC is focused on increasing the overall sustainability of communities in New York State. NYSERDA funded CCEDC's proposal titled 'Feasibility Study to Expand Organics Recycling in Dutchess County to develop a comprehensive feasibility study centered on reducing and recycling the organic component of Dutchess County's solid waste stream to reduce the overall volume of waste generated in the County. The project intends to advance the solid waste management goals of Dutchess County while also increasing the sustainability of how Dutchess County manages its solid waste, specifically organic waste. By better managing its solid waste, including organics, the County may reduce resultant greenhouse gas emissions. This project examined methods to decrease the amount of organic waste generated; provided recommendations for how to increase recycling of organic waste; and sought to divert organics from disposal in out-of-county landfills. For a more in-depth overview of the project, view the *Organic Waste Stream Analysis Report (Task 4.4)*. For a more in-depth view of the technologies for managing organic waste, view the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4)*. For more information on the economic feasibility of different types of organics management technologies, view the *Final Economic Analysis Report (Task 6.3)*. For a compilation of maps created to inform the project, view *Final Maps and Preferred Locations (Task 7.3)*. To view public outreach and education conducted as part of the project, see the *Documentation of Public Outreach Activities (Task 8.2)*. For a list of definitions for terms used in this report, view Appendix I.

Dutchess County Background Information[2]

Dutchess County has a land area of approximately 801.6 square miles and is located in the center of the Mid-Hudson Valley, halfway between New York City and Albany. Dutchess is one of seven counties that make up the Hudson Valley Region, along with Westchester, Putnam, Orange, Rockland, Ulster and Sullivan. The County has 30 incorporated municipalities, including 20 towns, 8 villages, and 2 cities. Please refer to the end of this chapter for regional maps including municipalities, population density in Dutchess County, and major trucking routes.

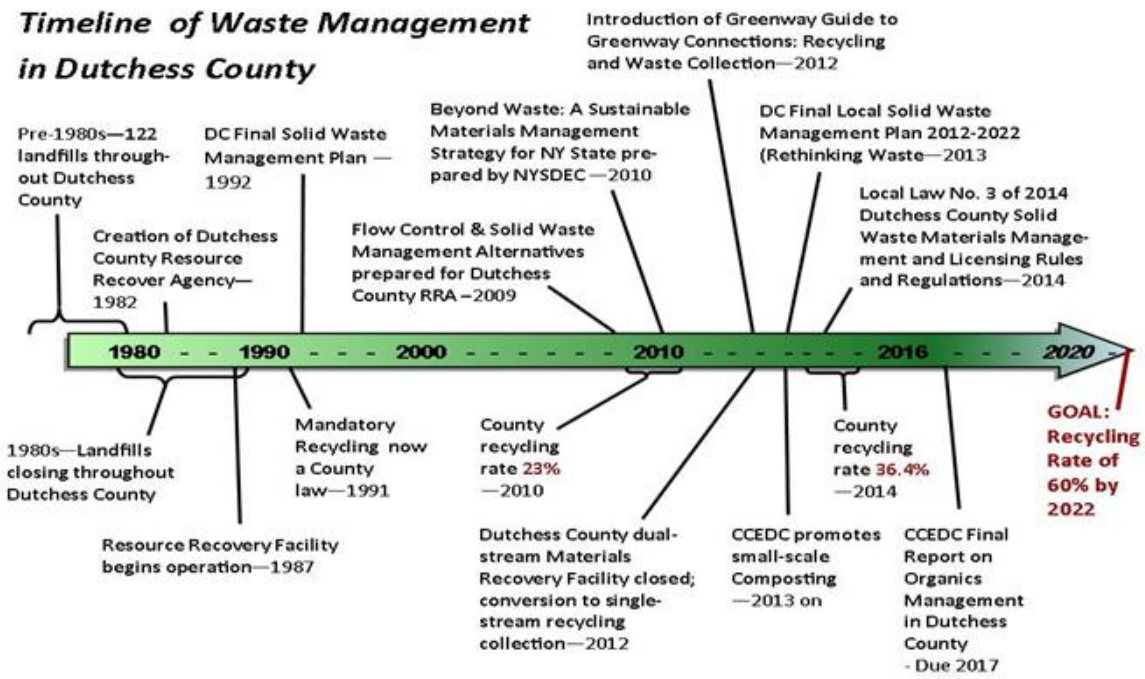
With an estimated population of 296,916 in 2013 according to U.S. Census data, Dutchess County is a combination of urban, suburban, and rural areas. Land use is primarily residential and commercial, with open space areas and some industrial uses. Residential and commercial activity is mainly centered in the cities and villages in the Southwestern portion of the County. Outside of those areas are concentrations of open space, including for agricultural uses.

Solid Waste Management in Dutchess County

The expense and complexity of waste disposal in Dutchess County has increased in recent decades as traditional disposal methods (e.g. landfills) are becoming more expensive, are fossil-fuel intensive (from transportation costs), and are less feasible due to landfill closures and the difficulty of creating new ones.

In Dutchess County, each municipality individually determines collection practices, whether it is municipal curbside collection, transfer stations, private collection or a combination of these methods. While recycling of paper, plastics, glass, and metal has become more commonplace across the county, organics recycling (food scraps, yard waste, biosolids) is still not widespread.

[2] [*Dutchess County Final Local Solid Waste Management Plan 2012-2022: Rethinking Waste (2012) and Dutchess County Local Solid Waste Management Plan 2015 Biennial Compliance Report (2015)]*



Current Organic Waste Regulations/Systems for Dutchess County

Curbside Pickup

Within Dutchess County, residents who live in municipalities that have transfer stations, but do not wish to use them, may contract with private haulers for curbside pickup of garbage and recycling. None of these haulers are currently engaged in a curbside organics collection program. Currently, the cities of Beacon and Poughkeepsie, Town of Poughkeepsie, and Villages of Fishkill, Millbrook, Red Hook, and Wappingers Falls have seasonal curbside pickup of yard waste, but the rest of the County does not. The Town of Poughkeepsie currently contracts with Duffy Layton Inc. to grind and haul the collected yard waste to Duffy Layton's facility in Stanfordville for composting.

PAYT/SMART (Pay As You Throw/Save Money And Reduce Trash)

The Village of Rhinebeck had a municipal collection program which required residents to buy tags for their garbage. However, many residents did not want to purchase tags and switched to private haulers instead, and the Village ended municipal collection in 2013. The Villages of Red Hook and Tivoli have municipal collection using a tag system, where recycling is offered free of charge. Both municipalities have successfully used this type of trash collection system for years. Most of the transfer stations in Dutchess County employ a "pay as you throw" system by charging for bagged garbage, while recycling is free of charge.

Transfer Stations

There are currently 18 transfer stations in Dutchess County, which serve as drop-off locations for municipal solid waste and offer recycling collection, except for the Town of Poughkeepsie transfer station which accepts yard waste and some bulk items and metals. In addition, several municipal transfer stations accept yard waste from residents of that municipality (most of which is composted on site), including: Amenia, Beacon, Pawling, City of Poughkeepsie (via curbside pickup), Town of Poughkeepsie, Wappinger, and Washington. However, some transfer stations that accept yard waste only have space for small amounts. Some municipalities make compost available to residents, such as the City of Beacon and City of Poughkeepsie (which offer curbside pickup of yard waste). There are no transfer stations that accept food waste separately. A list and information on transfer stations is available here: www.co.dutchess.ny.us/CountyGov/Departments/ResourceRec/TSRprg.htm or view the map of Dutchess County transfer stations at the end of this chapter.

Legislation on Organics Diversion

The following sections summarize salient state and regional actions and regulations impacting organic waste management. The Project Team provides these in order to place Dutchess County's efforts in the framework of momentum toward efforts to address waste stream concerns, and to understand some of the pathways toward improvements already established. For more information on these efforts, please see the links below or the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 4-6.*

State Level Regulation

Organics Processing Facilities

Currently, organics recycling facilities of a certain size are regulated at the state level under NYS solid waste regulations. Organics recycling facilities include composting, anaerobic digestion, land application and other technologies. Under New York State solid waste regulations, there are three levels of regulatory oversight for facilities: exempt, registered and permitted. Depending on the type of organic waste managed, facilities fall into one of these categories. Importantly, any facilities producing organic waste derived products generated from biosolids must obtain a permit from NYSDEC. For more information on regulatory oversight of organic recycling materials and facilities, see http://www.dec.ny.gov/chemical/97488.html.

The NYSDEC has proposed amendments to its 6 NYCRR Part 360 solid waste regulations which would increase composting capacities for exempt, registered or permitted facilities. For more information, visit: http://www.dec.ny.gov/docs/materials_minerals_pdf/part360proreg.pdf.

Farms

Food Scraps as Animal Feed

Some pre-consumer food scraps such as fruits and vegetables from supermarkets can be distributed to farms in New York State for use as animal feed, which reduces waste material, saves farms money, and supplies livestock with supplemental nutrition. Food scrap generators that plan to send food scraps to animal feeding operations must seek a Beneficial Use Determination from the NYS DEC. Under New York State Department of Agriculture and Markets, Article 5 Section 72-a, feeding animals certain food scraps (garbage) is prohibited, while certain types are allowed.[3]

[3] *Food Scraps as Animal Feed*. Retrieved from New York State: http://www.dec.ny.gov/chemical/98112.html

Surplus Produce

Section 606 of the NY State Tax Law, as part of Budget Bill 5A3009-C, was amended in 2017 to grant taxpayers who are eligible farmers to be allowed a credit against certain taxes for taxable years beginning on and after January 1, 2018 for farm donations to food pantries. The credit is for twenty five percent of the fair market value of the taxpayer's qualified donations made to eligible food pantries during the taxable year.[4]

Organic Waste Generators

In both the 2016 and 2017 NYS legislative sessions, Senate Bill No. 3418 was introduced, which would phase in a requirement that large generators of food waste divert organic waste from landfills and WTE facilities. The bill was referred to the Senate the Senate Environmental Conservation Committee, where it did not advance.[5]

Governor Cuomo included food waste reduction and sustainability measures in his FY 2018 Executive Budget. However, the provisions were not a part of the Final FY 2018 State Budget, signed on April 10, 2017.[6][7]

New York City Policies and Regulations

New York City (NYC) has a goal to send zero waste to landfills by 2030. To meet this goal, NYC passed legislation and programming to support organic waste reduction and recycling efforts. These efforts began in 2013, with the adoption of Local Law 77, which requires the New York City Department of Sanitation (DSNY) to establish a voluntary curbside organics collection program for residents and schools as a pilot. The DSNY Organics Collection pilot program currently serves more than 1.6 million residents and over 720 schools in all five boroughs, and is expanding to meet the goal of reaching all residents within all five boroughs by 2018.[8]

In January 2016, new rules were put into effect by the New York City Department of Sanitation (DSNY) requiring certain businesses that serve large numbers of people (stadiums, food service establishments in large hotels, and food manufacturers and food wholesalers greater than a certain size) to separate the organic waste they generate for collection and processing.[9] The new rules were expected to double the amount of organic waste that is diverted and collected by the NYC to approximately 100,000 tons a year. Dutchess County is within practical hauling distances to NYC to consider as a processing location for this potential increase in organic waste material.

Composting Codes

In investigating the regulatory structures and limitations on larger-scale composting in Dutchess County through the zoning codes for each municipality in the county, the Project Team found that municipalities fell into one of three categories (see Appendix VI in the *Organic Waste Stream Analysis Report (Task 4.4), pages 52-53*:

Category 1 – Codes prohibit commercial composting

Category 2 – Codes do not mention composting (most define "garbage" as including food waste)

Category 3 – Codes specifically allow composting, often with certain specifications

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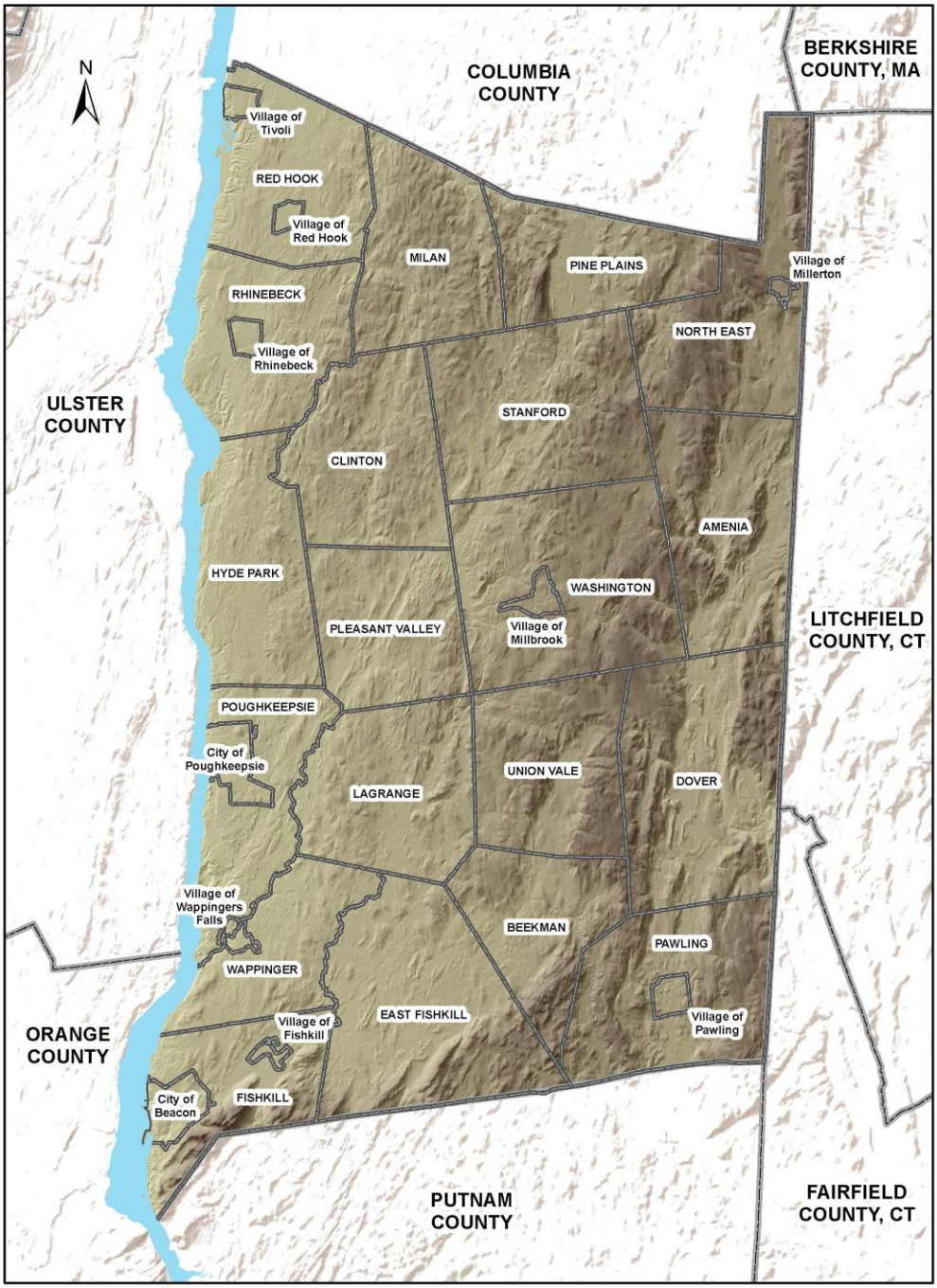
[4] Chapter 59 of the Laws of 2017, pp 132-134.
[5] Senate Bill S3418 (Senate 2017). https://www.nysenate.gov/legislation/bills/2017/S3418
[6] Ellsworth, K. (2017, June 21). Questions regarding New York State Organic Waste. (M. Gluck, Interviewer)
[7] FY 2018 New York State Executive Budget, Transportation, Economic Development and Environmental Conservation, Article VII Legislation, Pg. 289, Section KK
[8] Goldstein, N. (2017, January). Big Apple Goes Big On Organics Recycling. *Biocycle*.
[9] NYC Sanitation. (2017). *New Business Organics Rules.* Retrieved from NYC Sanitation: http://www1.nyc.gov/assets/dsny/docs/commercial-organics-notice-english.pdf

DUTCHESS COUNTY, NY



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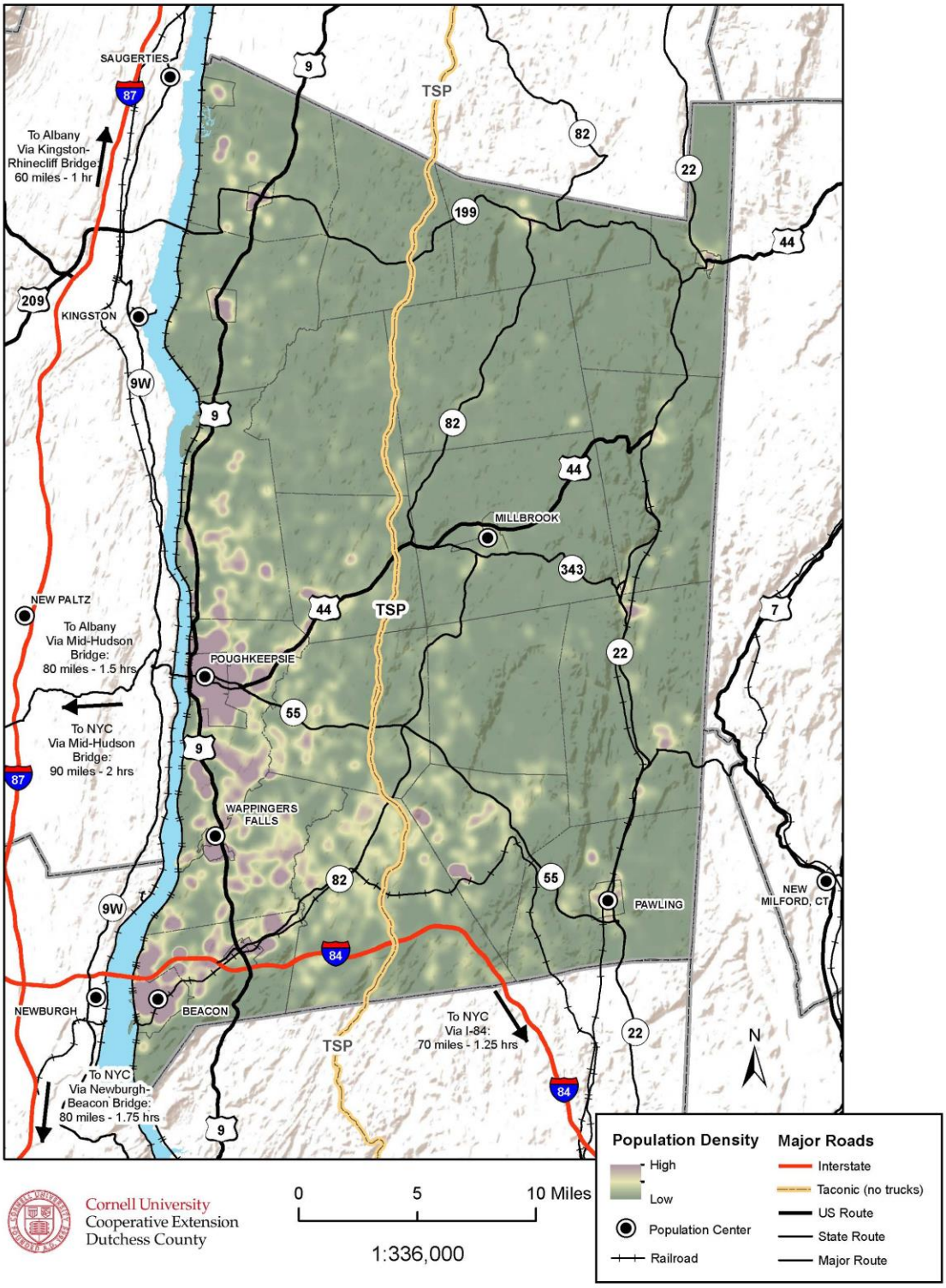
Population Density and Major Roads



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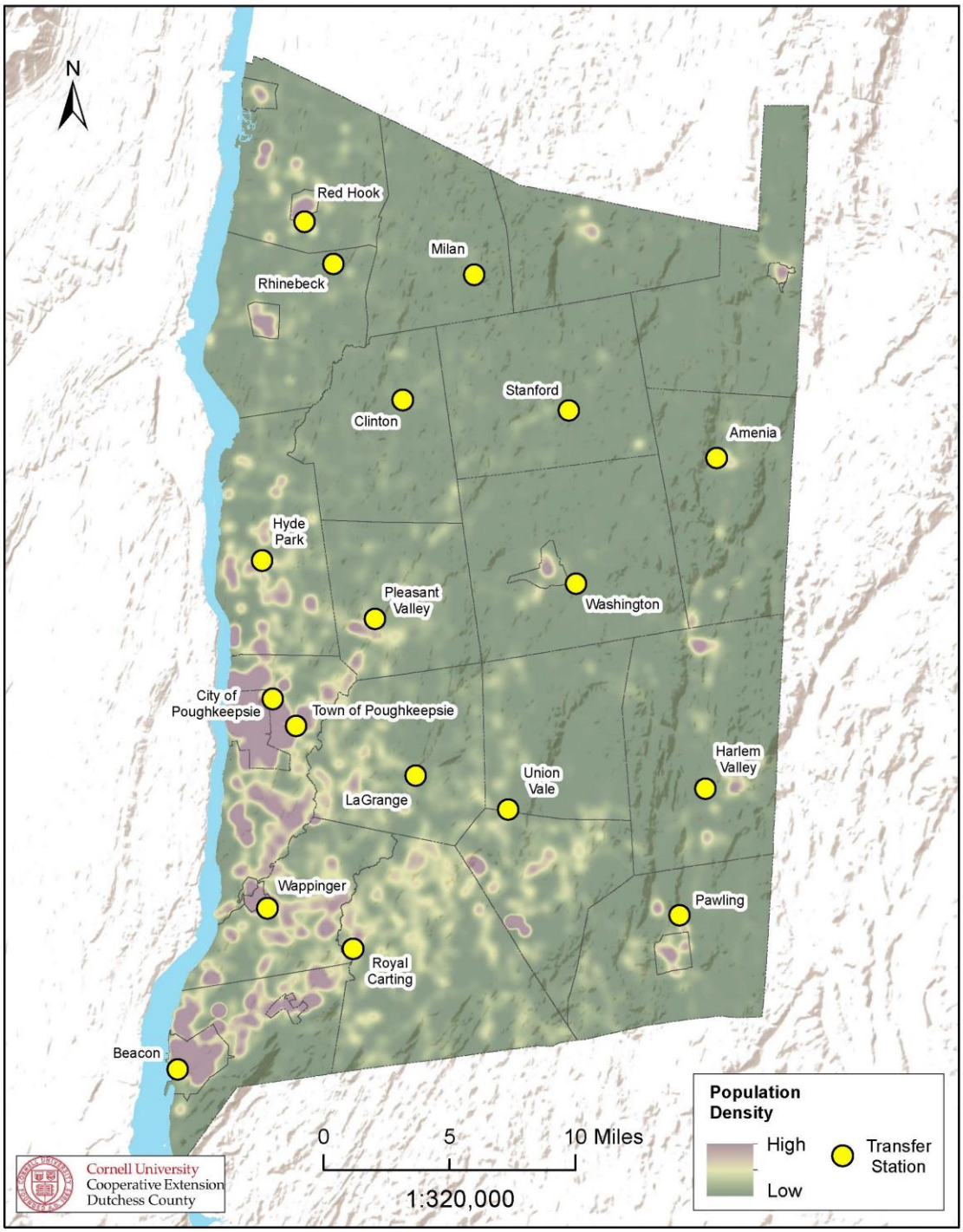
Dutchess County Transfer Stations



Chapter 2: Dutchess County Organic Waste Stream Analysis

Organic Waste Sectors Considered

CCEDC examined the following sectors of potential organic waste creation to understand if and how the people and businesses involved might be included in larger-scale reduction proposals.

In conducting research, the Project Team composed a target list of businesses, organizations, and institutions in each of the sectors below, and directly contacted them via phone, e-mail, in-person meetings, or a combination of the three. The database was compiled through internet searches of businesses and institutions, local knowledge of institutions and of existing organics management facilities in the County, and businesses, organizations and institutions included in Dutchess County's Local Solid Waste Management Plan (LSWMP), *Rethinking Waste*. The Project Team spoke with individuals who were able to provide information regarding organic waste processes and quantities whenever this information was available.

The **Municipal** sector relates to the municipalities in Dutchess County and how they manage their organics. This includes organics that are produced and/or managed on a municipal level. This is primarily municipal wastewater treatment facilities, but also includes some transfer stations or municipal leaf pickup.

The **Commercial** sector consists of businesses that produce and dispose of organics. This includes grocery stores, restaurants, and solid waste and septic waste haulers, among others.

The **Institutional** sector consists of public or private run institutions, such as colleges and schools, correctional facilities, hospitals, or other healthcare facilities.

The **Residential** sector refers to residents in Dutchess County (i.e. households) that are producing and disposing of organic waste.

The **Industrial** sector which consists of major production companies and industries in the County, such as IBM.

Research and outreach revealed three sectors in Dutchess County that have the highest opportunity to achieve increased organic waste reduction and recycling at a county scale. These sectors are municipal, institutional, and residential. Within these sectors, focus is given to organic waste from wastewater treatment plants (WWTPs) in the form of biosolids (municipal), organic waste from schools in the form of food waste (institutional), and organic waste from private residencies in the form of food waste and yard debris (residential). This report focuses on the three priority sectors. For more detailed information, including descriptions of each sector as it exists in Dutchess County, the quantity of organic waste material produced by each sector, and options for reduction and recovery efforts by sector, view the *Organic Waste Stream Analysis Report (Task 4.4)*.

Chapter 3: Organics Recycling Technologies and Business Models for Dutchess County

Through this study, the Project Team explored the feasibility of several different types of organics management technologies based on available feedstocks in Dutchess County for the three priority sectors mentioned in Chapter 2. These technologies are anaerobic digestion (AD); composting (large and small scale); and pelletizers and dryers.

Anaerobic Digestion

Anaerobic digestion is a process where microorganisms digest organic feedstock in an oxygen-free environment. This process produces biogas and digestate (liquid and solid). The gas and digestate may be used for heat, energy, transportation fuel and potentially marketable products. Anaerobic digesters can handle numerous types of organic wastes at a large scale (including sewage sludge/biosolids, difficult-to-compost food products such as dairy, meat, fats, oils, or greases, and feedstocks that contains a high percentage of liquids) with few to no odor or pest problems. AD tanks are kept warm, in the range of 20°C (68°F) to 60°C (140°F) to promote bacterial activity. For AD systems to work efficiently, they need balanced conditions in the tank, including appropriate water to solids ratio, carbon:nitrogen ratio, temperature, and pH. Some pre-processing and contaminant removal may be required depending on the feedstock. There are many types of digesters, each designed with particular operating configurations tailored to certain feedstock characteristics to optimize digestion.

For more detailed information on the process of anaerobic digestion and types and operation of anaerobic digestion technology and equipment, view the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 22-26*.

Composting

Composting is the controlled decomposition of organic waste (usually aerobically), which can be implemented on several different scales, from small-scale, backyard composting to large-scale composting facilities, which occupy several acres. Composting can be a low-technology option, and is typically less expensive than anaerobic digestion facilities to implement. However, large scale composting facilities can require a significant footprint, which can make them difficult to implement depending on land availability and zoning regulations. When done properly, composting creates a nutrient-rich soil amendment that can be used to help grow plants and increase soil health and quality. Proper compost management involves proper carbon:nitrogen ratios, adequate airflow, and appropriate moisture levels.

Small-scale Composting

Small-scale composting
www.motherearthnews.com/homesteading-and-livestock/sustainable-farming/compost-pile-ze0z1501zhur

Through small-scale composting, many homeowners, institutions, commercial entities and municipalities can manage their own organic waste on site. Well-managed, small-scale composting is preferred, where possible, because it is low to no cost and has a small carbon footprint, since waste is managed on site. Small-scale composting consists of low amounts of feedstock, typically several hundred pounds to a few tons of food waste per year per compost operation. For more on different types and equipment for small-scale composting, view the table below and the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 8-12*.

Estimated Costs/Maintenance of Composting Technologies

On-Site Composting Technology	Estimated Cost	Estimated Gallons per week	Additional Needs/Maintenance
"No maintenance" compost pile	$0 ($50 for pitchfork, gloves)	2-15	Kitchen collection. Possible nuisance issues with pests/odors.
Maintained backyard compost pile for 4 people	Pallets or mesh wire - $80 Pre-made 90 gal compost bin - $120 (May work best with two bins) Three bin wooden model - $150 Pitchfork - $30	2-15	Kitchen collection, adding carbon bulk, forking pile over, extraction after 8 months to a year.
Plastic bins	$120 - $150 each. May work best with two	2-8	Kitchen collection, adding carbon bulk, extraction
Tumbler - 90 gallon	$120 - $150 each. May work best with two	2-8	Kitchen collection efforts; adding carbon bulk; turning; extraction
Ridan	$7,000 - $10,000	20-100	Manual turn; add carbon bulk; extraction

North Country School prototype	Est $12,000 - $17,000	80-150	Automatic turn (possible add-on hammermill and auger)
Rocket	$22,000 (- $520,000)	50 (-9,400)	Automatic turn, add carbon bulk; extraction

Large-scale Composting

For large-scale composting, the Project Team considered three common large-scale composting technologies: aerated windrow composting, aerated static pile composting, and in-vessel composting. For more information on large-scale composting options, including descriptions for each method, equipment needed, composting duration, and pricing, view the table below and the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 13-18*.

Aerated Static Pile Composting
www.o2compost.com/projects.aspx?nv=7&c=757

Table: Comparison of large-scale composting options

Technology	Aerated Windrow Composting	Aerated Static Pile Composting	In-vessel composting
Composting duration	3 - 9 weeks	3 – 5 weeks	1 – 2 weeks
Additional equipment required	Loaders / Turners	Loaders / Blowers	Not required
Protection from certain climate conditions needed	Yes	Yes	No
Pricing	Least expensive	Roughly half as expensive than in-vessel, with 20% more management costs	Most expensive. Lower management / handling costs

Pelletizing and Drying

Pelletizing and drying refers to a process where organic material, most often biosolids from WWTPs, is dried into granules, or more typically, pellets. For both processes, the drying phase involves heating the sludge to remove moisture by evaporation, leaving behind the solids. Instead of 20% solids, pellets or granules are over 90% solids.

Having lost much of its water weight, the material is much lighter and easier to transport. The dried material can be bagged, stored in bulk, or transported without leaking liquids and with few odors. Pellets are suitable for use as a fuel or fertilizer and typically have lower dust content, resulting in easier transportation and use. For more information on the process of pelletizing and pelletizer and dryer technologies, view *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 41-45*.

Chapter 4: Three Priority Sectors

Based on earlier project tasks (see Chapters 2 and 3), the Project Team identified three sectors with the highest potential for improved organics management and increased organics diversion: Institutional (Schools), Residential, and Municipal (Biosolids). This chapter outlines each of the three priority sectors in greater detail, as well as their opportunities for organics recycling.

Schools

Background Information on Dutchess County Schools

There are five colleges, 16 school districts with seventy public schools, and thirty-four private schools in Dutchess County (see map of Dutchess County Public Schools and Districts at the end of this chapter).[10] Most colleges in the area do some level of food waste processing already. Although activities of K-12 schools are mostly unknown, the County identified working with these secondary schools to develop organics diversion programs as a goal in the LSWMP.[11]

K-12 Schools

There are approximately 46,000 K-12 age students in Dutchess County. The majority of organic waste generated at both public and private schools in Dutchess County is disposed of as refuse. However, there are some K-12 schools that are composting some food scraps, including Mill Road School in Red Hook.

There are approximately 11,960 pounds of food waste being generated per day by schools or 46 pounds per student, annually. Between elementary, middle and high schools, there is fluctuation in food waste amounts, depending on variables such as student age, and how many meal and snack periods are provided at each school.

Prioritizing K-12 school organics recycling education offers an opportunity to engage individuals at a young age before traditional disposal habits set in, and ingrain concepts of material management composting and recycling, systems thinking, and environmental responsibility. These educational opportunities serve as a learning experience for students, school administration and teachers, families, and is extended into communities, thereby having a greater impact.

Outreach to Schools

[10] Rethinking Waste: Dutchess County Final Local Solid Waste Management Plan (2012) pg. 13.
[11] Rethinking Waste: Dutchess County Final Local Solid Waste Management Plan (2012) pg. 49

To better understand the potential for schools to pursue organic waste reduction and recycling initiatives, and to document existing school efforts, the Project Team conducted outreach to Dutchess County public school districts. The Project Team contacted eight school districts by email as priorities for school organics pilot programs based on location and demographics, and urban/rural density. School districts contacted include Arlington, Hyde Park, City of Poughkeepsie, Beacon, Wappingers, Red Hook, Rhinebeck, and Spackenkill. The Project Team set up meetings with 3 districts: Hyde Park, Beacon, and Red Hook. When hosting these meetings, the Project Team contacted key stakeholders to ensure representation of departments involved in establishing a successful organics reduction and recycling program. Outreach to school districts provided valuable insight into the interests in and priority incentives of schools to implement organics recycling initiatives. As a result of these meetings, some schools are now interested in hosting food waste reduction campaigns, after hearing about the success of Red Hook Mill Road School's initiative. There is high potential in the schools sector to implement organic waste reduction and recycling actions, which additionally provides an educational opportunity. See the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 8-9* for more information.

Attitudes and Perceptions

Many school districts, and independent schools, do not have staffing capacity and knowledge about organic waste recycling. One major takeaway from meetings with schools is that many school districts are not currently diverting food waste out of the refuse stream, however, are interested in doing so, especially if supported by organizations that can offer training and assistance. Challenges and concerns regarding implementation of organic waste reduction and recycling include perceived lack of commitment or support from administration, budgeting and procurement, capacity of space for organics collection and processing, and staffing. Incentives include environmental stewardship, student engagement and learning opportunities, potential for cost- savings or cost neutral operations, and opportunities for hauling of organic waste to be processed off-site. One school lunch director stated, "If you explain to us how to collect it, and where to bring it, we are on board."

In addition to organizing meetings with schools, the Project Team also hosted a public meeting, which was attended by parents of students that attend local schools and a Montessori School teacher, who reiterated that there is interest in organic waste recycling in schools. There was a request to receive information on grant funding opportunities for schools in Dutchess County (for more on funding options, see page 31).

Organic Waste Reduction and Recycling Options for Schools

Schools have many options for reducing and recycling organic waste material generated onsite:

- Education for students and faculty through signage, programming, developing curricula, and conducting waste audits or zero-waste competitions
- Diverting organics from the solid waste stream by having separate, organics-specific waste bins
- Waste reduction methods through lunchroom procurement and purchasing decisions and cafeteria operations and design choices

Onsite Options for Organics Management for Schools

http://www.ridan.co.uk/our-composters/

- Static aeration composting using pallets, wire bins, windrows, containerized systems or rough-cut lumber bins
- Vermicomposting (worm composting)
- In-vessel composting (for example the Rocket® or Ridan composters - see the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), page 10*.
- Small-scale anaerobic digesters (like ZEROrganics – see Appendix II in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 45-48*)

Offsite Options for Organics Management for Schools

- Contract with a private hauler or a municipality
- Utilize own operational resources and staffing to haul organic waste

Case Studies

Edgemont School District, Westchester County

Photo by Michelle Sterling and Ron Schulhof

The Edgemont School District started small with its composting program in 2015, piloting it in one elementary school, before introducing it to another elementary school and the junior/senior high school, and extending into places of worship and the residential sector. Currently the Edgemont School District has a 90% diversion rate. For more information on this case study, see the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 12-13*.[12]

[12] Rachel Carpitella, J. M. (2017, April 19). Edgemont School District Organcis Recycling Program. (M. Gluck, Interviewer)

Residential

Dutchess County Demographics

As of 2013, there were nearly 300,000 people in Dutchess County living in 118,638 housing units located in the 30 municipalities. These households are contributing to organics in the waste stream; however, it has proven difficult to both track and manage household organic waste, as each municipality is traditionally responsible for waste management. For some rural residents, a compost pile in the backyard may be used to reduce mass and volume of garbage. Some urban residents may have difficulty composting given space constraints, local laws, concerns about odors/pests from neighbors, etc. and may benefit from an offsite organics diversion program, such as a community compost site. However, it is not known how extensive backyard composting is within Dutchess County.

Although it is difficult to determine accurate amounts of organic waste produced residentially in Dutchess County, it is estimated that approximately 33,000 tons of food waste is generated annually by Dutchess County residents.[13] The Project Team completed a residential survey assessing current food waste generation, environmental stewardship, sentiments about anaerobic digestion, and level of composting efforts, knowledge and interest, which can be found in the *Documentation of Public Outreach Activities (Task 8.2), Appendix 1*. The survey was distributed to 6 municipalities (Town and Village of Red Hook, Town and Village of Rhinebeck, Village of Tivoli, Village of Wappingers Falls), in Dutchess County that had already expressed interest in composting. 800 surveys were distributed through both mail and web, with a response rate of 28.4% (210 completed surveys). The survey revealed insights into the residential sector and helped inform recommendations and realistic solutions for increasing organics recycling in the county.

Attitudes and Perceptions

A surprising 31% of survey respondents reported that they "already compost at home" and were not interested in any sort of food scrap pickup or drop-off program. 75% of respondents expressed no "Willingness to Pay" for a curbside pickup program for compostables. 55% of respondents answered that they would be likely to support having an anaerobic digester facility located nearby their home and 51% of respondents would be likely to support a large-scale composting facility. Many respondents reported knowing very little about anaerobic digestion prior to taking the survey. The survey results showed a positive correlation between knowledge of and participation in composting efforts and support for large scale composting facilities. Residents who attended a public meeting hosted by Project Staff expressed a desire for more community-based or localized composting initiatives, and funding opportunities. Additionally, some Town of Red Hook residents began a process to apply for funding through a NYSDEC Municipal Waste Reduction and Recycling grant opportunity to fund waste reduction and recycling. Many meeting attendees were not knowledgeable about biosolids composting or anaerobic digestion, and were surprised to learn that biosolids are trucked such far distances for disposal. Attendees were engaged throughout the meeting, and used it as an opportunity to learn from each other. Many attendees already composted at home, and had basic knowledge about organics recycling. A challenge voiced was how to reach residents who are not knowledgeable about or participating in organics recycling efforts. See the *Documentation of Public Outreach Activities (Task 8.2), Appendix 1* for more information.

[13] Calculation formulated using the EPA average for food waste generated per capita per day in the United States at .6 lbs and the Dutchess County population for 2016 at 294,473.
(https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/)
(https://www.census.gov/quickfacts/fact/table/dutchesscountynewyork/PST045216)

Onsite Organics Management Options for Residents

- Through small-scale, backyard composting, many homeowners can manage their own organic waste on site. Well-managed, backyard composting is preferred, wherever possible, because it is low- to no-cost for homeowners and has a small carbon footprint, since waste is managed on site.

For more on backyard composting methods, view the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 8-9*.

Off-site Organics Management Options for Residents

- Many residents, especially those in urban and suburban areas in the Southwestern part of Dutchess County (e.g. the City of Poughkeepsie), may not have the space or means to compost. Another option for residents is to have curbside pickup, which can be run by either a private hauler or municipality.
- There is also the option for an organics drop-off program at a transfer station or community compost site. Through this method, residents can collect food scraps in a bin at their home and then bring it to a local drop-off site

For more on organics management options for residents, view the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 17-18*.

Case Studies

Pay-As-You-Throw (PAYT) and Save-Money-And-Reduce-Trash (SMART)

Several municipalities in New York State and surrounding states have initiated Pay-As-You-Throw (PAYT) programs, some of which have been combined with a food waste organics collection program. In these combined programs, PAYT is viewed as a motivational factor for participation in the food waste collection program. These programs attempt to incentivize residents to reduce the amount of trash generated by offering free recycling and composting, if included, and increase diversion of materials such as recyclables and organics. In researching, the Project Team found that there are three types of PAYT programs currently being implemented in New York, including:

- Curbside pick-up with specific town-identified bags
- Curbside pick-up with specific garbage tags (e.g. Villages of Red Hook and Tivoli)
- Drop-off at transfer stations with required town bags, permits or coupons

For more information on PAYT/SMART programs, including case studies, view the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), page 18*.

Municipal (Biosolids)

Background Information on WWTPs and Septic in Dutchess County

Dutchess County WWTPs collect sewage, treat water, and typically send biosolids to regional landfills or to a biosolids incinerator. According to Dutchess County's LSWMP, there are 21 WWTPs in Dutchess County (Arlington, Beacon, Country Club Estates, Dover Ridge Estates, Fishkill, Fleetwood Manor, Greenfields, Midpoint, Millbrook, Noxon Knolls, Pawling, Pleasant Valley, City of Poughkeepsie, Rhinebeck, Rombout, Titusville, Tivoli, Tri Municipal, Valley Dale, Vanderburgh Cove, and Wildwood).

The Project Team estimated that over eight million gallons (roughly 35,000 tons) of biosolids are produced annually from WWTPs in Dutchess County. The majority of biosolids generated in Dutchess County are hauled from WWTPs to out-of-county landfills and biosolids incinerators hundreds of miles away (see Trucking Distance and Drive Times to Biosolids Disposal Sites map at the end of this chapter). Some WWTPs have already found alternative solutions to treat and/or reduce volume of biosolids, and generate an end product that can be land applied or have another alternative use to landfilling (see map of Composting and WWTPs in Dutchess County and Surrounds at the end of this chapter).

- **Tri Municipal WWTP:** Utilizing biosolids to produce compost onsite
- **Tivoli WWTP:** Treats wet sludge by placing it onto reed beds located onsite
- **Kingston WWTP:** Passes biosolids through an anaerobic digester and then to a pelletizer
- **Camden County WWTP:** Installing an anaerobic digestion system to reduce daily tons of biosolids produced

For more on these biosolids organics recycling case studies, see the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), page 43* and the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 21-23*.

Septic Haulers

Septic haulers take collected septage to Albany, or one of several WWTPs in the area, including the Cities of Poughkeepsie and Beacon, Torrington, CT and Middletown in Orange County (where the septage is then added to the treatment process). The vast majority of the septage is water weight (approximately 3-4% solids).

Total septic amounts for Dutchess County are estimated to be over 4 million gallons per year (over 18,000 tons). Exact estimates are difficult as many haulers work outside of Dutchess County and will also drop off septage outside of the county.

Composting Options for Biosolids

After wastewater is processed at a facility, the resultant biosolids need to be disposed of somehow. One method is to compost biosolids using several different large-scale composting techniques mentioned in Chapter 3. Composting WWTP biosolids is worth considering further, as there may be potential for marketing the product to landscapers and highway departments, and for construction and green infrastructure projects. Other markets for biosolid-derived compost are still being examined. The compost can be given away or sold for about $5 per cubic yard at first, and increased to about $10 per cubic yard once a market has been established.[14] The EPA and NYSDEC regulate uses for biosolids on a case-specific basis.

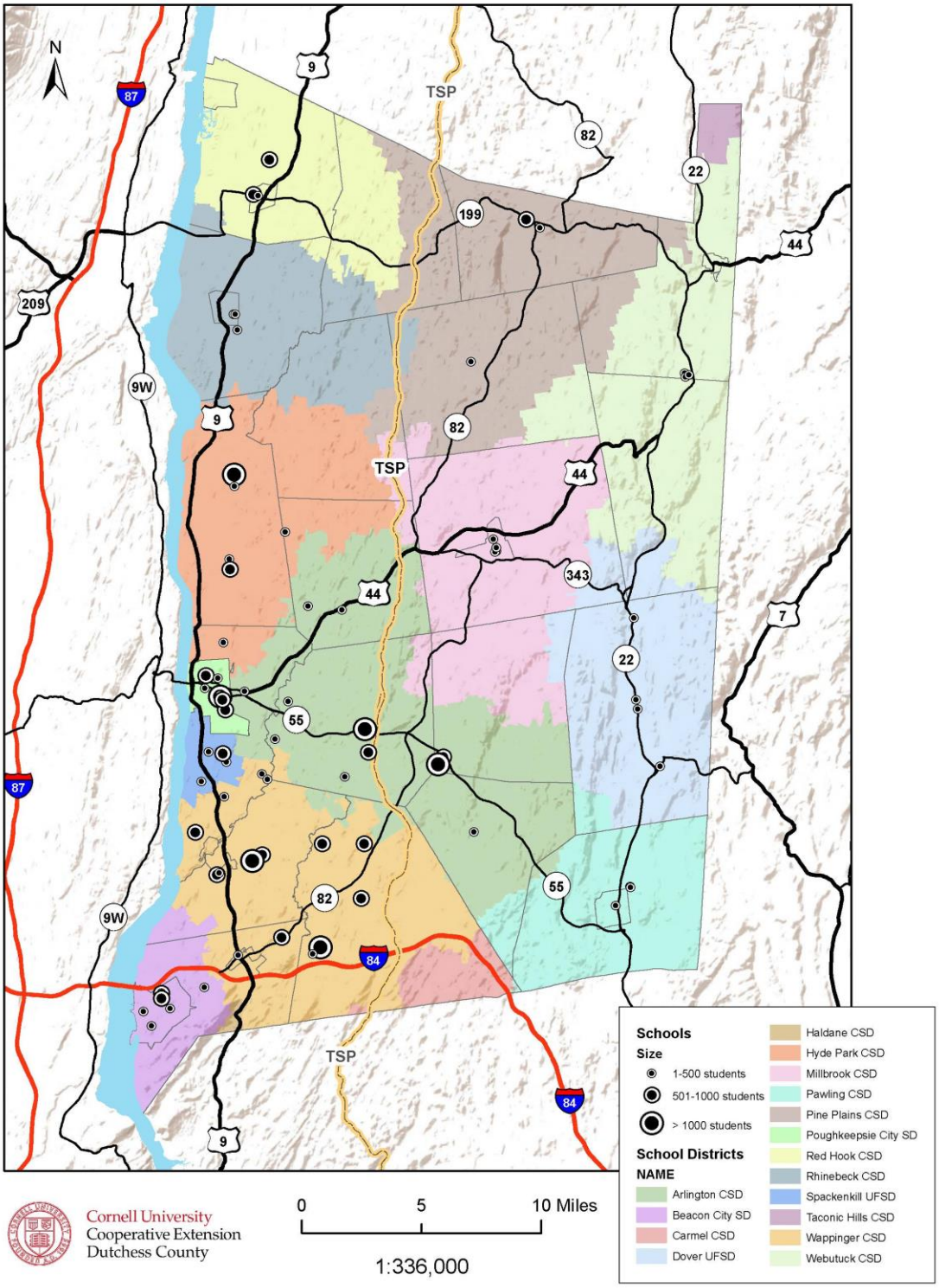
[14] Taylor, J., Gaudette, L., Kuter, G., and Nicoletti, R. After 40+ Years Successfully Composting Biosolids, Merrimack, NH Plans for the Future Presentation at NES Conference. October 19, 2015.

More information on these uses can be found, here: https://www.epa.gov/biosolids/plain-english-guide-epa-part-503-biosolids-rule and http://www.dec.ny.gov/chemical/8797.html.

Anaerobic Digestion Options for Biosolids

The most consistent, readily available supply of anaerobic digester feedstock for Dutchess County is biosolids from WWTPs. Thus, it is likely that an anaerobic digester system for Dutchess County would predominantly process biosolids, and have the potential and capacity to add some food waste as collection efforts throughout the county show success. For more on the economics of anaerobic digestion for biosolids and best options, view Chapter 5.

Dutchess County Public Schools & Districts



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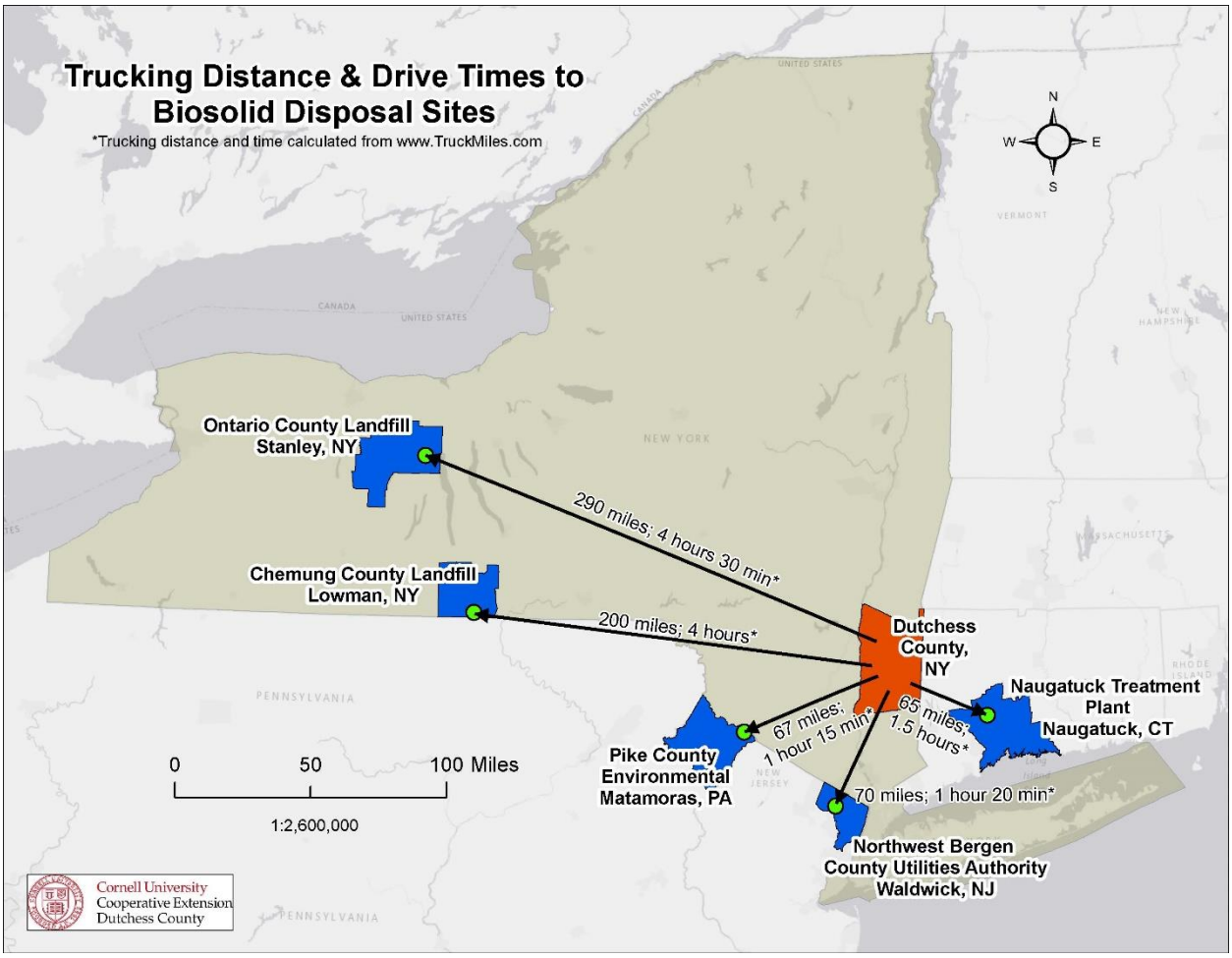
Trucking Distance & Drive Times to Biosolid Disposal Sites
*Trucking distance and time calculated from www.TruckMiles.com
N
W
E
S
Ontario County Landfill
Stanley, NY
290 miles; 4 hours 30 min*
Chemung County Landfill
Lowman, NY
200 miles; 4 hours*
Dutchess County, NY
Naugatuck Treatment Plant
Naugatuck, CT
65 miles; 1.5 hours*
67 miles; 1 hour 15 min*
Pike County Environmental
Matamoras, PA
70 miles; 1 hour 20 min*
Northwest Bergen County Utilities Authority
Waldwick, NJ
0
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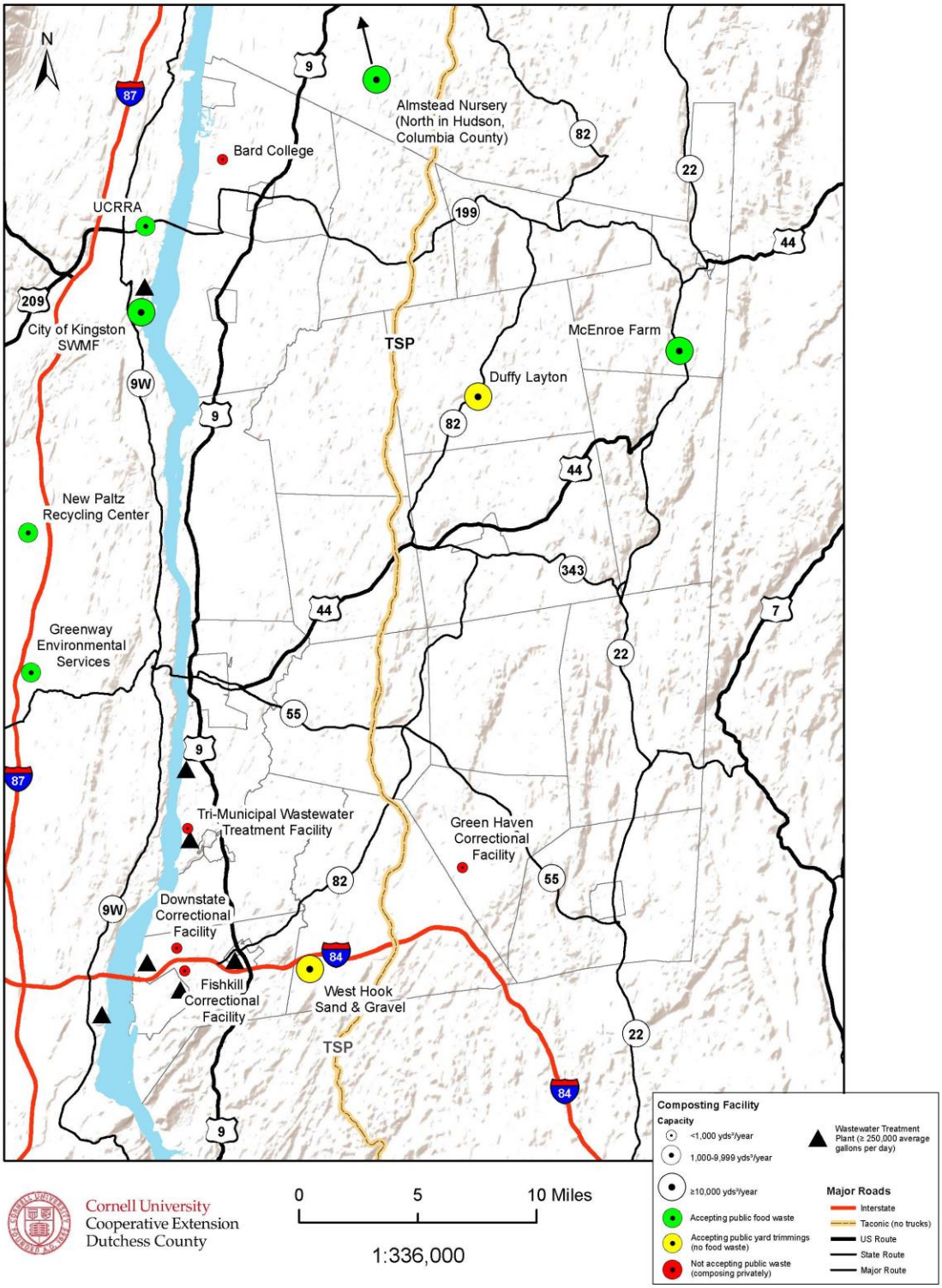
Composting & Wastewater Treatment Facilities in Dutchess County and Surrounds



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Chapter 5: Economic Analysis Scenarios

Feedstock Analysis

The Project Team explored the economic feasibility of several different types of organics management technologies, potentially in combination with one another, based on available feedstocks in Dutchess County (detailed below).

Given the Project Team's findings in the *Organic Waste Stream Analysis Report (Task 4.4)*, it is estimated there is strong potential for biosolids from WWTPs to be recycled locally with additional septage from septic haulers, and food scrap collection from schools, residences, and elsewhere would not be a major contributor to available feedstock until pilot programs are successful. The Project Team created a baseline scenario as a model for what amounts may be currently available for reclamation. This was the basis for considering appropriate technologies for Dutchess County and the economic feasibility of the scenarios.

The economic scenario involved primarily biosolids from the major WWTPs in Dutchess County and from WWTPs within a 30-40 mile radius of the county, plus some food waste and sludge from some area septic haulers. The total gallons per day of waste included as a feedstock for the AD facility was 10 million gallons per year of primarily biosolids (or 27,397 gallons per day) at 20% solids.

Project subcontractor RRT Design and Construction ran an economic analysis of installing a new anaerobic digester in Dutchess County using the aforementioned feedstock. RRT ran the scenario over a ten-year period for four different digestate end disposal methods after the feedstock had gone through the AD system: landfilling the resultant digestate, composting and then selling the resultant digestate, composting and then landfilling the resultant digestate, and pelletizing the resultant digestate. The Project Team provided RRT with baseline numbers to run the economic analysis regarding gallons per year of sludge, and RRT also provided baseline numbers for operations and staffing costs.[15]

Results of Economic Analysis

The economic analysis began with compiling assumptions for WWTP operations, energy costs, tipping/hauling fees, percent solids of biosolids, land area needed for siting an anaerobic digester and composting facility, and labor (Appendix V in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 50-56*). This information was gathered through literature review, professional interviews, and consultation with RRT.

When conducting the economic analysis, RRT used averages for operational costs and staffing costs for system operators and administrative and management staff. For detailed spreadsheets on operational and staffing costs, view Appendix V in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 50-56*.

With the digestate produced, the Project Team explored the economics of four different disposal pathways for the digestate, detailed below.

Scenario 1: Landfill Digestate: This disposal method consists of landfilling the digestate as it comes out of the anaerobic digester. This method is most similar to the current disposal method in Dutchess County of landfilling biosolids, with the added step of anaerobically digesting them.

[15] Capital costs were not included in the economic assessment because this analysis was not defined by a specific site location, and capital costs vary greatly depending on site location and specific characteristics.

Scenario 2: Compost Digestate and Sell Compost: Composting is a preferred method of managing organic waste according to the EPA Food Recovery Hierarchy. Composting the digestate reduces its volume. The ideal situation would be to sell the resultant compost as a value-added product for permitted uses to generate revenue.

Scenario 3: Compost and Landfill Digestate: As mentioned above, composting the digestate reduces its volume. While the ideal situation would be to sell the resultant compost, if for some reason a market for the compost could not be established, the compost could be landfilled.

Scenario 4: Pelletize Digestate: Another disposal method would be to add a pelletizer system to the anaerobic digester to process the resultant digestate into pellets. These pellets could be sold for permitted uses, given away for free, used as energy onsite, landfilled, or some combination of the above.

The economic analysis results showed that composting and then selling the digestate was the most economical option, resulting in income (Scenario 2). Landfilling the resultant digestate (Scenario 1) is the most expensive disposal option. Composting and then landfilling the digestate (Scenario 3) is still positive, but not as economical as selling the compost (Scenario 2). Pelletizing the digestate (Scenario 4) is almost cost neutral as a disposal method. Scenarios 2 - 4 are all options that significantly reduce hauling costs. For more on the specifics of the economic analysis, including numbers and calculations associated with each disposal method, view Appendix V in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 50-56*.

While capital costs were not included in the analysis run by RRT, the Project Team did solicit capital cost estimates from three different companies (BIOferm, quasar, and Yield Energy) during an earlier phase of the project for a capacity of 10.6 million gallons (of primarily sludge with minimal additions of food waste) per year for scenario 1 and 14.6 million gallons per year (of primarily sludge with minimal additions of food waste) for scenario 2. See the chart below for more information. Bioferm and quasar's detailed proposals are included in Appendices VI and VII in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 57-62*.

Table: Comparison of Pricing Structures

Company	Proposal	Category	Scenario 1	Scenario 2
BIOferm	Plug flow digester w CSTR digester	**Initial Cost**	$4.65M capital	$6.04M capital
		Power Generated	Expected Methane Production (ft^3/yr): 57.5 Million Average Annual Electrical Energy (kWh/yr): 6.9 Million	Expected Methane Production (ft^3/yr): 75.7 Million Average Annual Electrical Energy (kWh/yr): 8.7 Million
		Annual Maintenance	$540k annual OPEX	$890k annual OPEX
quasar	Mixing tank	**Initial Cost**	$10M capital	$13M capital

energy group	with single digester	**Power Generated**	Expected Methane Production (ft^3/yr): 65.3 Million Average Annual Electrical Energy (kWh/yr): 7.0 Million	Expected Methane Production (ft^3/yr): 79.5 Million Average Annual Electrical Energy (kWh/yr): 8.5 Million
		Annual Maintenance	$490k rough estimate	$520k rough estimate
Yield Energy	Not Available	**Initial Cost**	$11M - $22M capital	$15M - $30M capital
		Power Generated	Not Available	Not Available
		Annual Maintenance	$3M - $4M	$4.2 - $5.8M

Capital costs for building, installing and maintaining a composting facility were not included in the economic analysis by RRT, although as part of earlier research, the Project Team solicited proposals for creating a new large-scale composting operation in Dutchess County based on 10 million gallons of primarily biosolids with small additions of food waste as the feedstock. The Project Team received a proposal from one company, Engineered Compost Systems (ECS) which estimated capital costs for their ASP system to be $5-$7 million, and for its in-vessel system to be $10-$13 million. For more information on the specifics of its proposal, view the *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 20-22*.

Marketing Biosolids Compost

According to Composting News, August 2016, the biosolids compost average prices in the Northeast United States were:

Biosolids Compost Average Prices	Average	Range
Bulk retail sales ($/yd^3)	$30	$20-40
Bulk wholesale ($/yd^3)	$15.33	$10-20
Compost #40 bag ($/bag)	$6.25	$4.5-8

Based on conversations with NaturCycle, a reasonable starting price for biosolids compost was assessed to be $5 per cubic yard, which was incorporated into the economic analysis as revenue from compost sales. For more on

marketing biosolids compost, view the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 37-38*.

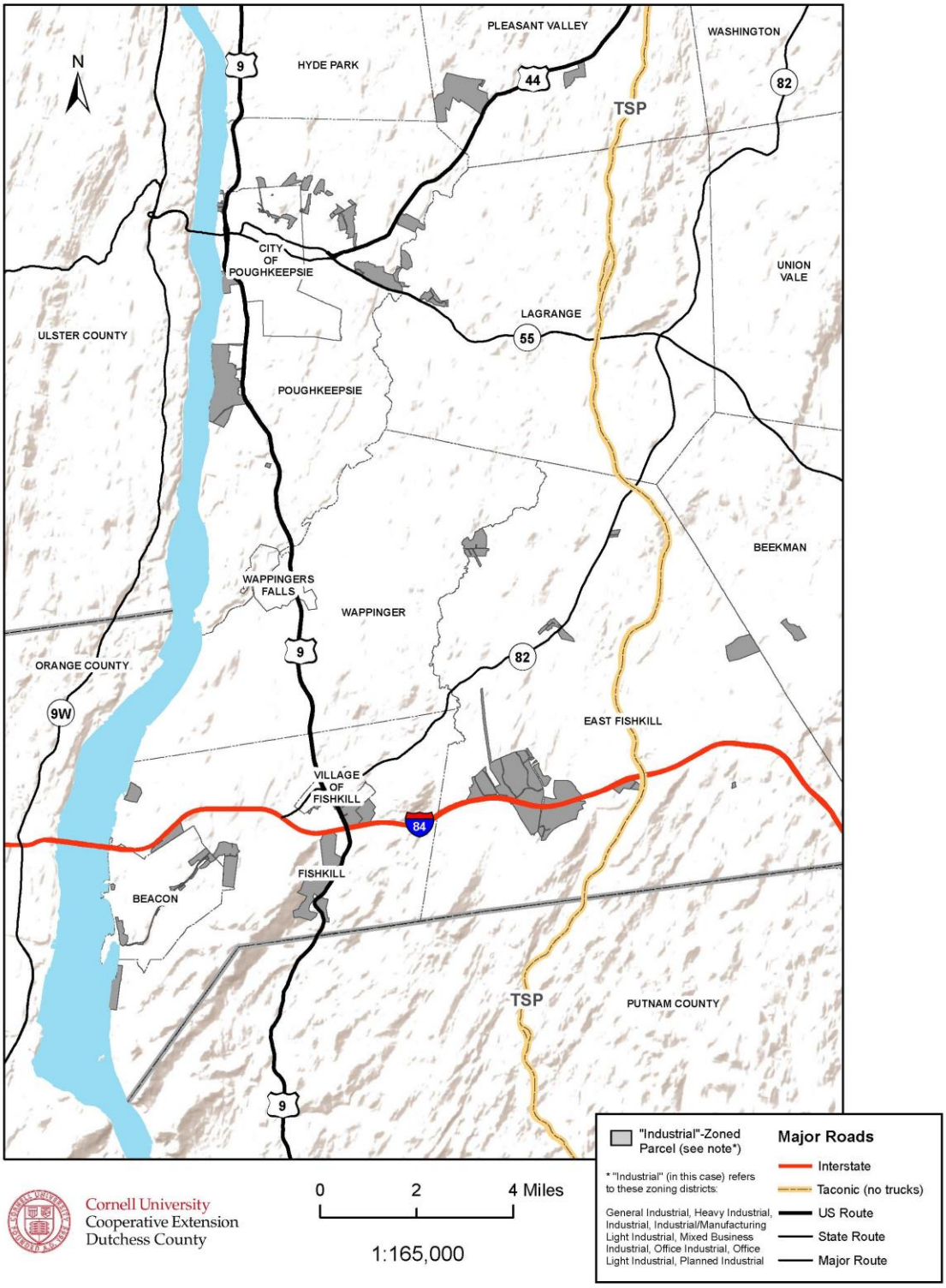
Business Models

The Project Team detailed four business models of current successful organics management facilities listed below. More details on the business models for each of these companies is included in the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), pages 28-30*.

- **American Organic Energy:** American Organic Energy (AOE) decided to expand its operations, investing in a $50 million anaerobic digester project in 2015, tapping into the approximately one million tons of organic waste generated annually in NYC. Biogas produced through anaerobic digestion will mostly be used for AOE's electrical demand, and the rest will be purchased by a local utility. The solid and liquid portions of the digestate produced will be sold as potting soil and fertilizer, respectively.[16]
- **Almstead Nursery and Mulch:** Almstead Nursery and Mulch Company operates two processing facilities in New Rochelle, NY (Westchester County) and Hudson, NY (Columbia County). Almstead processes organics from its tree care and nursery operations, as well as organic waste from outside generators, like schools, restaurants, and Hannaford Supermarket, into compost.
- **Community Compost Company:** Community Compost Company (CCC) picks up food scraps and organic materials from businesses and institutions in Ulster County, NY and Northern, NJ for composting. Processed CCC compost is marketed through its brand Hudson Soil Company, and sold in bags at garden centers and in bulk for approximately $9-$12 per cubic foot bag.[17]
- **McEnroe Organic Farm:** McEnroe Organic Farm, located in Millerton, NY, composts food and yard waste from institutions and other sources, including the Omega Institute, NYC Department of Sanitation, and some Dutchess and Westchester County horse farms. McEnroe produces different grades of compost and potting soil, and finished compost is sold for approximately $50 per yard in bulk. McEnroe retains approximately 60-70 percent of the compost for use onsite as a soil amendment.

[16] Royte, E. (2017, February 15). Retrieved from New York Times: https://www.nytimes.com/2017/02/15/magazine/the-compost-king-of-new-york.html
[17] Lindsay, M. J. (2017, June 8). Compost Service Business Model Inquiry. (M. Gluck, Interviewer)

"Industrial" Zoned Parcels in Southwest Dutchess County



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Funding Sources

Below are some potential funding sources for all types of organics recycling projects and technologies, including organics recycling programs in schools and colleges and composting.

NYSERDA

https://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities.

New York State Department of Environmental Protection (NYS DEC) NYS Climate Smart Communities Grants

http://www.dec.ny.gov/energy/109181.html.

Municipal Waste Reduction and Recycling State Assistance Program

http://www.dec.ny.gov/chemical/105608.html

https://grantsgateway.ny.gov/IntelliGrants_NYSGG/module/nysgg/goportal.aspx?NavItem1=2

New York State Pollution Prevention Institute (NYSP2I)

https://www.rit.edu/affiliate/nysp2i/community-programs/community-grants.

New York State Association for Reduction, Reuse, and Recycling (NYSAR3)

Green School Grant Program: https://www.nysar3.org/page/green-school-grant-program-16.html.

Grant Program for NY Colleges: https://www.nysar3.org/page/grant-program-for-ny-colleges-28.html.

Syracuse University Environmental Finance Center (EFC)

http://efc.syr.edu/resources/funding/.

Chapter 6: Other Stakeholder Attitudes and Perceptions

Municipalities

Municipalities in Dutchess County were generally open to learning about new ways to manage organics within their communities, including biosolids at their WWTPs. They were also open to sharing information about current amounts of organics, mostly biosolids, and organics disposal methods. Throughout the course of the study, the Project Team met with 9 out of 30 Dutchess County municipalities. The Towns and Villages of Red Hook and Rhinebeck and Village of Tivoli, as well as the Village of Wappingers Falls, were of particular focus as these municipalities expressed interest in organics recycling opportunities from the beginning of the project. Municipalities were interested in organics recycling options, such as developing community compost sites, food scrap drop-off at transfer stations and curbside pick-up of organics. Hurdles to implementing these programs are

logistics of working with haulers, locating sites for organics recycling facilities, contamination and odor issues, and need for education of residents on organics recycling.

Two presentations were held for Dutchess County Division of Solid Waste Management and Department of Planning where the Project Team shared updates on the study and received feedback from attendees. These two presentations were very helpful in guiding the study and dictating content for project reports. The major takeaway is that the County is interested in options for better managing organics, but options need to be economically viable.

All of the conversations with and feedback from municipalities provided direction for the study and influenced focus areas and report content.

Commercial Sector

As part of CCEDC's Agency Partner Grant in 2014-2015, staff separately surveyed landscapers and farmers to gauge amounts of organic waste produced, current disposal methods and interest and/or need for diverting and better managing organic waste. The results showed that both landscapers and farmers have locations to dispose of the organic waste produced, and that most of it is not entering Dutchess County's solid waste stream. Farmers and landscapers were not interested in learning more about organics recycling, with some exceptions (McEnroe Farm, Duffy Layton, Inc., and Almstead Nursery and Mulch). For a copy of the surveys and results, view Appendixes III and IV in the *Organic Waste Stream Analysis Report (Task 4.4), pages 47-49.*

The Project Team also reached out to restaurants and food processing businesses, but received limited responses. From the responses received, businesses are either managing their organics already or the challenges to doing so were too great to be a focus for this study.

For more information on public outreach conducted by the Project Team and stakeholder attitudes and responses, view the *Documentation of Public Outreach Activities (Task 8.2).*

Chapter 7: Organic Waste Material Diversion and Recycling Benefits: Current and Future Community Needs

Meeting County and Regional Solid Waste Management Goals

Dutchess County has three main solid waste management goals:[18]

- Decrease solid waste generation
- Increase reuse and recycling
- Minimize the use of landfills for solid waste disposal

This project addressed all three of the goals to help move Dutchess County forward in achieving these goals by examining methods to decrease the amount of organic waste generated; providing recommendations for how to

[18] Rethinking Waste: Dutchess County Final Local Solid Waste Management Plan (2012)

increase recycling of organic waste; and seeking ways to divert organics from disposal in out-of-county landfills. The County also has the goal of reaching a 60 percent recycling rate by 2022. Since organics make up such a large percentage of the County's solid waste stream (22% in 2010), diverting them to better uses can provide resources for the County, more than double the County's recycling rate, and help meet the goal of eliminating waste from Dutchess County going to landfills. See Trucking Distance and Drive Times to Landfills from Dutchess County map at the end of this chapter.

Stewardship and Education

Education and training on organics recycling opportunities, methods and programs, including home composting, can help reduce organic waste entering Dutchess County's MSW stream, and reduce the overall generation of organic waste materials. Organics recycling education also serves as a teaching tool for better waste management and foments greater environmental awareness, community engagement, and citizen stewardship. When people become more aware of the impacts their current methods of disposal have on the environment and how easy it can be to divert organics from the waste stream, the result is behavior change towards more environmentally conscious choices about waste generation and disposal. Education about how and why to recycle organic waste for any organic waste reduction or recycling program is vital to a program's success.

Revenue

Finished compost from Duffy Layton, Inc.

Most communities currently pay tipping and transportation fees to private companies to remove refuse and recyclable material. It is estimated that 30% of the total waste generated in Dutchess County can be converted into valuable soil amendment or renewable energy through composting or anaerobic digestion.[19] Tipping fees at landfills and other waste management facilities across the country have been steadily increasing, placing an ever-increasing burden on local communities. Through establishing a well-managed composting program, municipalities can potentially reduce the dollar amount spent on refuse disposal by reducing material volume hauled to landfill and waste-to-energy (WTE) facilities, and by reducing the frequency of waste material collected, if their municipality directly contracts with haulers, or manages waste collection "in house." Lastly, there is potential revenue through selling the finished compost product and potential cost savings through using compost product generated on municipal sites for landscaping purposes, instead of purchasing compost through another source.

Job Creation

Based on the economic analysis performed by project consultant RRT Design and Construction (Chapter 4), both an anaerobic digester and aerated static pile composting facility would create jobs. For more information on exact numbers of jobs that would be created for each facility, view the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), page 24*.

[19] In 2010, Dutchess County's Municipal Solid Waste from residential and commercial/institutional sectors consisted of an estimated 14.6% food scraps by weight, which is equal to 37,200 tons of food scraps (Rethinking Waste: Final Local Solid Waste Management Plan 2012-2022(2012)).

Energy Generation

The biogas (also known as "digester gas") produced in the process of anaerobic digestion is a mixture of gases (mostly methane), which allows the biogas to be utilized for many beneficial purposes, including energy generation. Biogas from anaerobic digesters is most commonly used as fuel in boiler and CHP (Combined Heat and Power) units, but it can be injected into the gas grid or processed into transport fuel after a biogas upgrade sufficient to meet purity standards.

Value-Added Products

Digestate from Anaerobic Digestion

Digestate is the end product of the feedstock after it undergoes anaerobic digestion. With its nutrient rich properties, digestate can be directly spread onto land, or separated into a solid and liquid fraction. Providing appropriate testing and permitting, the solid byproducts may be land-applied themselves, composted or used as a soil amendment, processed into organic fertilizer, or used for animal bedding, thereby displacing its fossil-based counterparts. Separating the liquid from digestate allows the liquid, which is rich in organic-based plant nutrients such as nitrogen, to be more easily land-applied. Digestate can also be dried and pelletized for use as a fuel source for heating.

Composted Biosolids

Composted biosolids are marketable as a soil amendment or fertilizer. There are a number of examples of biosolids compost being sold throughout the Northeast, both in bulk, and bagged as retail. For more on biosolids composting, see the *Final Economic Analysis of Organics Recycling Scenarios for Dutchess County (Task 6.3), page 20*.

Rendering Companies

Three rendering companies servicing Dutchess County (Darling International, MOPAC and Western Mass Rendering) remove organic waste from the waste stream through the collection and recycling of meat byproducts, kitchen grease, and waste cooking oils from grocery stores and restaurants. These companies annually turn over 600 tons of collected fats, oils, and proteins into biofuels, animal feed, and a variety of other industrial products.

Greenhouse Gas (GHG) Emission Reductions

Implementing localized efforts and facilities for composting or anaerobic digestion can result in greenhouse gas (GHG) emissions reductions by diverting organic waste from landfills and reduced trucking of organic waste material to landfills.

The Project Team's research demonstrated the following:
1. Well-managed anaerobic digestion does not leak biogas into the atmosphere and gas recovery efficiency is almost 100%, reducing the amount of greenhouse gases released into the atmosphere. Furthermore, utilizing the methane to generate thermal and electrical energy reduces the dependence on nonrenewable sources, such as fossil fuels. In addition, anaerobic digestion provides digestate, which can be used as fertilizer that replaces fossil fuel based fertilizer.

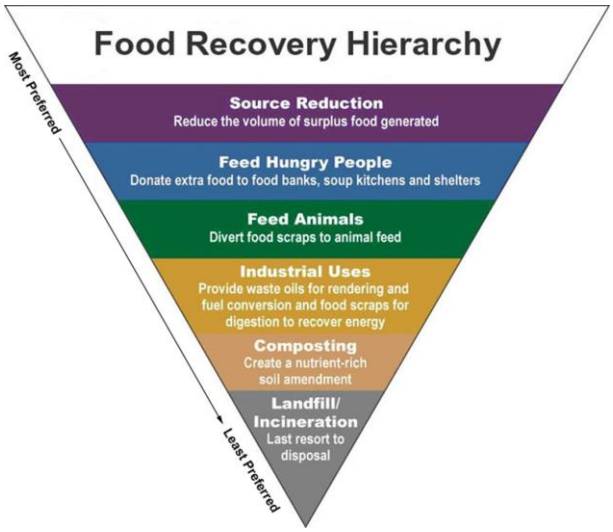
2. Landfilling generates a similar amount of gas as AD; however, landfill gas collection efficiency is not 100%. The best gas collection efficiency is reported to be 75%.[20] Also, landfilling does not provide an end product of digestate and the county transports biowaste to landfills which are located 200 miles away on average. However, the landfilling option does provide some carbon sequestration.
3. Composting generates a compost end product, which can be used to displace fossil fuel based fertilizer, resulting

in carbon credits. A well-managed and operated composting operation does not emit CH4 or nitrous oxide (N2O) into the atmosphere. It also provides a small amount of carbon sequestration. However, composting does not generate biogas, as anaerobic digestion does.

For a detailed comparison of GHG emissions from landfilling, anaerobic digestion, and composting, view *Summary of Organics Recycling Technologies and Business Models for Dutchess County Report (Task 5.4), pages 51 - 57*.

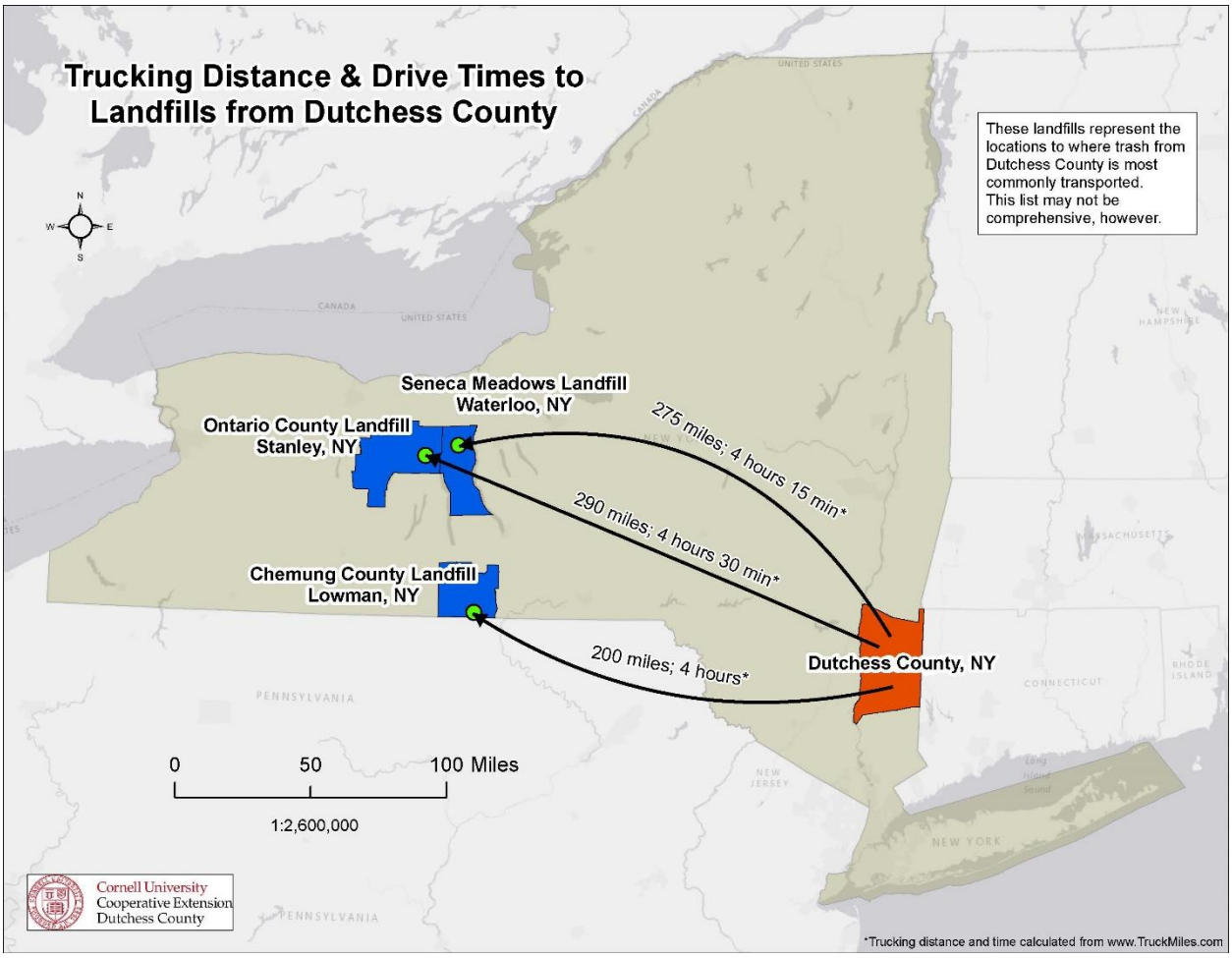
Food Donation

The United States Environmental Protection Agency (EPA) publishes the "Food Recovery Hierarchy" which suggests an order of preference for food waste management, based on how each tier's strategy benefits society, the environment and the economy. The second tier of the food recovery pyramid focuses on food donation, which is the second most preferred option following overall source reduction.



https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy

Many small- to large-scale organizations and companies, such as food banks and food pantries, service organizations, gleaning groups, restaurants, and grocery stores currently operate in and around Dutchess County, diverting still-edible food from becoming waste. CCEDC maintains a list of the food banks and food pantries in existence throughout Dutchess County, which can be found here: http://ccedutchess.org/nutrition/food-assistance-programs.



Chapter 8: Conclusion and Recommendations

Conclusion

Based on the results of the economic analysis and research conducted over the past two and half years, the Project Team has come to the following conclusions regarding the economic feasibility and potential of different organics management technologies, options and programs:

Schools:

The majority of schools in Dutchess County are not diverting organics from the municipal solid waste stream. Countywide, there is approximately 1,000 tons of potential food waste, annually, that is currently being disposed of in the refuse stream and not being diverted to localized composting facilities and turned into a beneficial use product.

Education plays a key role in developing a strong composting program. School districts, such as Edgemont School District in Westchester County are investing in future composting trends and opportunities through pilot programs and grant funded proposals. In the community, there are plans for a local sanitation company to open a composting processing facility. The school district is prepared to benefit from the facility, potentially making their organics diversion program more economically feasible due to reduced hauling and tipping fees.

Edgemont School District is not alone in the ability to begin these efforts now. If schools, especially elementary schools, in Dutchess County develop and build upon existing programs to teach students how to separate out organics, and reduce waste generated, students can then bring that education home and provide an impetus for home-based systems and behaviors that can be further extended into their communities.

Residential:

There are opportunities for residents to divert their organics from the municipal solid waste stream in Dutchess County. The biggest hurdle for implementing residential programs is ensuring hauling costs remain cost-neutral for residents, or result in cost-savings, along with other potential benefits of access to finished compost and reduced emissions from reduced hauling. Another big hurdle is the need for increased education and outreach to residents to make sure they know what to include in organics bins and what cannot be included, so the facilities processing the organics have minimal contamination. One consideration of residential organics diversion programs is population density, specifically urban versus rural. Where there is space available, home composting is the preferred method. However, curbside pickup may be more appropriate in densely populated areas. Each municipality will need to determine its own preferred method of organics collection, whether it be a centralized drop-off site or curbside pickup program. Many municipalities contract with private haulers and can discuss options with them. Municipalities where residents directly contract with private haulers will need to address issues with having multiple active haulers within one municipality. Successful residential organics management programs provide many benefits to communities, including greater awareness of sustainable waste management, cost neutral or cost savings to taxpayers for waste disposal, and a soil amendment product that can help restore marginal soils.

Municipal (Biosolids):

Currently, biosolids are being transported hundreds of miles for disposal in landfills or biosolids incinerators. There are options for managing biosolids within the County, which would reduce transportation costs and distances, which were explored throughout this study. While not all of the options proved economical, there is potential to better manage biosolids locally for beneficial uses. Anaerobic digestion of most of Dutchess County's biosolids, plus additional input from nearby, out-of-county WWTPs is not economical when building a new facility. The upfront costs of installing the facility are high enough (average capital cost estimate is $10.4 million) that it makes most sense to retrofit an existing facility or to incorporate an anaerobic digester into an already planned new facility, rather than adding an anaerobic digester onto an existing WWTP. When using an anaerobic digester as a method to manage organics, it is most economical to compost the resulting digestate from the AD and to sell the finished compost as composting was the only option shown to generate revenue over the ten-year period.

Composting biosolids is the most economical option, as it does not require as large an expense to install composting equipment. Biosolids composting has rough capital cost estimates of $5-$7 million for aerated static pile composting and $10-$13 million for in-vessel composting compared with anaerobic digestion capital costs estimated to be $5-$22 million (average of $10.4 million). However, composting can require a larger land footprint than an anaerobic digestion facility. Depending on the WWTP, there may or may not be space for a composting facility onsite. However, within many of the rural and urban communities in Dutchess County, there are opportunities for community composting sites, combining biosolids with food waste collected from schools and/or residents through

partnerships.

Recommendations

Dutchess County is well positioned to increase its sustainability and resiliency by reducing and recycling organic waste and turning remaining waste into a beneficial resource. There is potential to divert approximately 40,000 tons of organics[21] in Dutchess County from the municipal solid waste stream. By utilizing the different options for organics management mentioned above, Dutchess County can meet its solid waste management goals by continuing to increase the County recycling rate and reduce the amount of organic waste being transported to landfills hundreds of miles away. The Project Team determined that at this time, organic waste recycling can be most successfully accomplished in Dutchess County through a combination of approaches including;

- Educational programs focused on organic waste reduction and composting, which can be directed towards schools, residents and municipalities.
- Collaboration between schools could be a powerful method of getting initiatives started through district meetings to discuss organic waste reduction and recycling solutions.
- Home, municipal, community, or privatized compost site development.
- Education about product sell-by labeling for consumers and commercial entities, like grocery stores, to help reduce amounts of organic waste generated at the source and entering the waste stream.
- Local planning decisions: for example, updating or adjusting local municipal zoning codes to allow for installation of composting and other organics management facilities.
- Incorporating retrofits to existing WWTPs and designing new WWTPs to increase percent solids of biosolids and composting of biosolids to reduce hauling weight and costs.
- Value-added product development and marketing of compost.
- Developing market uses for biosolids and mixed materials compost end-product and continuing to expand markets for food waste compost.

All of these approaches require support from municipalities, residents, schools, and businesses that identify as local stakeholders. The Project Team determined that at this point in time, due to current energy markets and availability of low-cost energy fuels, anaerobic digestion is not a viable or incentivized approach to reusing and reducing organic waste, or generating biogas, when compared with other scenario solutions.[22] However, there is still much potential for other organics waste management technologies and solutions to be implemented in Dutchess County. Stakeholders are supportive of better managing organic waste, so long as it is economical and that the negatives, like odor and pest attraction, are minimized.

These recommendations are meant to inform and help improve Dutchess County's organic waste management options for the future. The goal of Dutchess County's LSWMP is to consider solid waste as a resource, instead of garbage. As was detailed in this study, organics are well-suited to being used as a resource, as organics recycling has the additional benefits of stewardship and education, generating revenue, job creation, energy generation, creation of value-added products, GHG emission reductions, and food donation for those in need. By continuing to explore and investing in organics recycling technologies and programs, especially in the three high priority sectors (schools,

[21] In 2010, Dutchess County's Municipal Solid Waste from residential and commercial/institutional sectors consisted of an estimated 14.6% food scraps by weight, which is equal to 37,200 tons of food scraps (Rethinking Waste: Final Local Solid Waste Management Plan 2012-2022(2012)).

[22] U.S. Department of Energy. (2017, September). *Fuel Prices*. Retrieved from Alternative Fuels Data Center: https://www.afdc.energy.gov/fuels/prices.html

residential and municipal WWTPs), Dutchess County can acquire all of these benefits and meet its solid waste management goals.

Appendices

Appendix I: Definitions

Aerobic - With air (oxygen). Compost is usually created using aerobic decomposition, which releases carbon dioxide but few to no other biogases.

Anaerobic - Without air (oxygen). Biogas (methane) is a byproduct of anaerobic decomposition.

Anaerobic Digestion - Processing of organic materials [in absence of oxygen] by microorganisms which break down the material into biogas and a digestate. (Source: NYSDEC)

Anaerobic Digester - A system in which anaerobic digestion can occur to produce biogas and other useful coproducts. (Source: EPA)

Beneficial Use Determination (BUD) - A designation made by the New York State Department of Environmental Conservation that identifies certain solid wastes that, when used in a specific manner, are no longer subject to regulation under New York State's Solid Waste Management Facilities Regulations (Part 360). Once the Department grants a BUD, the waste material ceases to be considered a solid waste (for the purposes of Part 360) when used as described. The DEC maintains a list of BUDs granted in the State: www.dec.ny.gov/chemical/8821.html.

Biogas - Gas produced via the process of anaerobic digestion that is a mixture of gases, mainly (over 90 percent) methane and carbon dioxide.

Biosolid - Dewatered sewage sludge. (Source: *Rethinking Waste*)

BOD (Biochemical oxygen demand) - The amount of dissolved oxygen needed by aerobic biological organisms to break down organic matter at a certain temperature over a specific period of time.

CCEDC - Cornell Cooperative Extension Dutchess County

Class A Biosolids - Contain no detectable levels of pathogens. (Source: EPA)

Class B Biosolids - Treated but still contain detectable levels of pathogens, but do not pose a threat to human health or the environment as long as actions are taken to prevent exposure to the biosolids after their use or disposal. (Source: EPA)

Compost - Organic material that can be added to soil to help plants grow. (Source: EPA)

Composting - A controlled decomposition process which turns organic residuals such as food scraps, biosolids and yard waste into a beneficial soil amendment. (Source: *Rethinking Waste*)

Dewater/Dewatering - Removal of water from septage, biosolids, etc.

Digestate - Solid and liquid byproducts of anaerobic digestion that can be used as a soil amendment, fertilizer, pelletized, land applied or composted.

Diversion - Reusing or recycling materials rather than disposing of them. (Source: *Rethinking Waste*)

Dutchess County Resource Recovery Agency (DCRRA) - Operates the waste-to-energy facility in Dutchess County.

Food Waste - Both pre- and post- consumer food waste from different sectors, including commercial, institutional and residential/households.

Pre-Consumer Food Waste - Examples of pre-consumer food waste are expired items at a supermarket or unsold prepared food. Pre-consumer food waste is first redirected toward human or animal consumption. It is created by food manufacturing and processing facilities, supermarkets, prisons, hospitals, care facilities, event venues, restaurants, schools and households.

Post-Consumer Food Waste - Examples of post-consumer food waste are table-scraps and leftover food from a restaurant, household, event venue, institution, etc.

Greenhouse Gas (GHG) - A gas that contributes to the greenhouse effect by absorbing infrared radiation.

Landfill - A facility where garbage is buried in the ground with engineered environmental protection measures in place for air and water quality integrity. (Source: *Rethinking Waste*)

Lignin - An organic substance that is naturally produced by many plants and is found in their cell walls, causing them to be rigid and woody. Lignin is contained in plant debris (wood chips, straw) and a necessary addition to food scraps or biosolids to make compost.

LSWMP - Local Solid Waste Management Plan (Source: *Rethinking Waste*)

Methane - A potent greenhouse gas that traps heat in the atmosphere much more efficiently than carbon dioxide (20 times more potent). Organic waste in landfills can produce methane through anaerobic processes.

Methanogenesis - A stage of anaerobic digestion in which methane is produced by microbes.

Microorganisms - Microscopic organisms, such as bacteria.

Municipal Solid Waste (MSW) - The combined residential, institutional and commercial solid waste generated in an area. (Source: *Rethinking Waste*)

NYSDEC (New York State Department of Environmental Conservation) - The department of state government that oversees the conservation, improvement and protection of natural resources and the environment in New York State, and enforces environmental laws and regulations including state solid waste regulations and permitting for organics management facilities.

NYSERDA (New York State Energy Research and Development Authority) - A state public benefit corporation that promotes energy efficiency and the use of renewable energy sources aimed at reducing greenhouse gas emissions, accelerating economic growth and reducing customer energy bills.

Organic Waste (Organics) - Readily degradable organic material that has been separated from the non-compostable material at the point of generation including food waste, soiled or unrecyclable paper, and yard waste. (Source: *Rethinking Waste*) Also includes biosolids and septage.

PAYT (Pay-As-You-Throw) **-** Generators (e.g. households) pay only for the amount of garbage they create. As a result, waste minimization through reuse, recycling and composting increases. (Source: *Rethinking Waste*)

Reuse - Products and packaging that can be used over again several times for its original purpose. (Source: *Rethinking Waste*)

Septage - Sludge from septic tanks.

Slurry - The mixture of solids and water processed in an anaerobic digester.

Solid Waste - Any discarded materials. Solid waste can be solid, liquid, semi-solid, or containerized gaseous material. This includes durable goods, nondurable goods, containers and packaging, food waste and yard trimmings, and miscellaneous inorganic waste generated. (Source: *Rethinking Waste*)

Source Separation - Separating recyclable materials (including organics) from solid waste at the source. A source can be a residence, institution or place of business. (Source: *Rethinking Waste*)

Tipping Fee - The cost to haulers to unload material at a facility. (Source: *Rethinking Waste*)

Transfer Station - Facilities accepting solid waste for the purpose of subsequent transfer to another solid waste management facility for further processing, treating, or disposal. (Source: *Rethinking Waste*)

Windrows - Organic material arranged in rows of piles for uniform decomposition and easy turning. Typically found in large composting operations.

WTE (Waste-to-Energy) - A facility that destroys MSW through combustion. The steam generated from this process in Dutchess County is used to operate a turbine generator. This facility generates enough electricity to power approximately 10,000 homes per year, which is equivalent to saving about 160,000 barrels of oil per year. The facility recovers ferrous (steel) metal and recycles approximately 6,000 tons of metal per year. (Source: *Rethinking Waste*) Ash produced from combustion is hauled to landfills.

WWTP - Wastewater Treatment Plant

Yard Waste - Plant debris typically including leaves, trimmings, grass clippings, and smaller diameter wood.

Appendix II - Map Narrative and Methodology

For Task 7 (7.1-7.3), eight maps were created for use in identifying variables or factors associated with potential organics recycling facilities. This series of maps, created using ESRI ArcGIS software and a wide variety of federal, state, county, and local geospatial data, is designed to give an overview of Dutchess County and the conditions that were deemed important or useful in helping to identify and prioritize preferable locations for organics recycling facility placement.

Map 1 is a basic overview map of Dutchess County, showing it in the context of adjacent counties, its proximity to the Hudson River, its municipal (town, city, and village) boundaries, and its basic topography. Though not directly useful in determining preferred locations for organics recycling facilities, it provides an overview of Dutchess County's geography for those unfamiliar with it and puts it into context within the region.

Map 2 provides an overview of the county's population patterns and road infrastructure. This map contains a population density raster layer (developed by Dutchess County Department of Planning & Development), the county's major roads (interstate, state parkway, state highway, and some major county routes), and approximate trucking times to Albany and New York via various routes in the county. As the map demonstrates, the majority of Dutchess County's population is located in the southwest quarter of the county, and is focused most heavily around the cities of Poughkeepsie and Beacon and the Village of Wappingers Falls. Major road infrastructure, important to include when considering trucking routes for waste-hauling, is also somewhat concentrated in this southwest corner, although major truck roads can be found throughout all regions of the county. One last important thing to note is that the major north-south transportation corridor in Dutchess County, the Taconic State Parkway, is closed to all truck and trailered-vehicle traffic, and is therefore not a viable route for waste haulers.

Maps 3a and 3b are a pair of maps showing the approximate trucking distances and time to A) landfills in New York State to which Dutchess County waste is taken, and B) biosolid disposal sites used by Dutchess County. These distances and drive times were calculated using the Truck Miles website (www.truckmiles.com), which was used so as to design the route and calculate mileage avoiding routes on which trucks are not permitted. As seen in Map 3a, landfill sites utilized by the County are all at least 200 miles (and 4 hours) away, and are all located in western New York and the Finger Lakes regions. Map 3b shows the biosolid disposal locations for Dutchess County, showing a few of the same sites used for landfills (western NY), plus a few less distant, but out-of-state sites in Pennsylvania, New Jersey, and Connecticut. The closest of these is the Naugatuck Treatment Plant in Connecticut, which is about 65 miles from Poughkeepsie.

Map 4 is a simple map showing the locations of municipal and commercial transfer stations in Dutchess County. This dataset was laid over the municipal boundaries and population density so as to show the availability and service of these transfer stations to the communities in the county.

Map 5 shows the locations of composting facilities and wastewater treatment facilities in Dutchess County and adjacent areas. The composting facility locations are symbolized by two separate variables: 1) capacity and 2) what type of organic waste the facility accepts. Capacity was divided up into three classes: less than 1,000 cubic yards per year, 1,000-9,999 cubic yards per year and 10,000 or more cubic yards per year. Additionally, green circles symbolize facilities that accept public food waste, yellow symbolizes facilities that accept public yard trimmings but not food waste, and red symbolizes facilities not currently accepting public waste but rather composting privately. Lastly, the wastewater treatment facilities selected and mapped are those that have the ability to treat on average 250,000 gallons per day or more.

Map 6 is designed to show all the individual public schools in Dutchess County and their respective districts, as schools were a major component of this study. This dataset includes all public elementary, secondary, middle, and high schools in the county, and the symbology classifies the individual schools by size/number of students. The

three classes identified were schools with 500 or fewer students, schools with 501-1,000 students, and schools with greater than 1,000 students.

The final map, Map 7, focuses on the southwest corner of Dutchess County showing the Industrial-Zoned Parcels* in this area. The Project Team focused on the southwest quarter of the county, as this is both the most densely developed and has the largest density of industrial-zoned properties. These parcels were identified and mapped with the assumption that they had the potential to be or contain an organics recycling facility.

*For this study and map, Industrial-Zoned Parcels refer to any parcel that is zoned in Dutchess County as one of the following:

'GENERAL INDUSTRIAL', 'HEAVY-INDUSTRY', 'HEAVY INDUSTRIAL DISTRICT', 'INDUSTRIAL', 'INDUSTRIAL 1', 'INDUSTRIAL/MANUFACTURING', 'INDUSTRY', 'LIGHT INDUSTRIAL', 'LIGHT INDUSTRIAL BUSINESS', 'LIGHT INDUSTRIAL DISTRICT', 'LIGHT INDUSTRIAL/RETAIL', 'LIGHT INDUSTRY', 'MIXED BUSINESS INDUSTRY', 'OFFICE INDUSTRIAL', 'OFFICE LIGHT INDUSTRY', 'PLANNED INDUSTRY', or 'PLANNED INDUSTRY DISTRICT'.