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AN INTEGRATED ORGANIC WASTE MANAGEMENT SYSTEM

From the Perspective of Commercial Waste Generators
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Background & Overview

Anaerobic digestion is a biological process in which biodegradable organic materials (e.g., food waste, plant waste, non-recyclable paper, items high in moisture) are broken down by bacteria into biogas and a stable solid (compost). The Ramsey/Washington County Resource Recovery Project (Project) is working with the Saint Paul Port Authority to explore the site, design and construction of a local anaerobic digester that would be supported by source separated organic waste materials (organics) and serve Ramsey and Washington Counties. At this time, the Project's primary targets to supply organics are from food-rich commercial waste generators such as retail grocers, food processors and institutional kitchens.

The focus of this report is to analyze anaerobic digestion as a new organic waste management concept from the perspective of commercial waste generators located in Ramsey and Washington Counties by exploring the:

1. Logistics of daily operations for commercial waste generators participating in an anaerobic digestion program.

2. Types of upfront costs commercial waste generators could incur for collection of organic waste for management in an anaerobic digestion program.

3. Changes in the configuration of garbage, recycling and/or other waste management services for a commercial waste generator participating in an anaerobic digestion program.

A summary of this analysis follows. An outcome of this work is a vision for an integrated waste management system for the Twin Cities metropolitan area.

Commercial Waste Generators

For the purpose of this analysis, commercial waste generators are food-rich businesses and organizations located in Ramsey and Washington Counties and divided into two categories: (1) large kitchen operations; and (2) large food waste volume generators.

Examples of large kitchen operations include:

- Caterers & foodservice vendors
- Corporate & culinary kitchens
- Hospitals
- Correctional facilities & shelters
- School districts & private schools
- Colleges & technical institutions
- Event centers
- Long-term care & senior housing
- Restaurants & hotels

Examples of large food waste volume generators include:

- Food manufacturers
- Food processors
- Wholesale produce companies
- Retail grocers

Many commercial waste generators have been managing organic waste separately from the waste stream for years.

Organic Waste Management Options

The current end-use market options for food-rich businesses and organizations in the Twin Cities metropolitan area to manage organic waste include:

- Food rescue (food to people)
- Rendering
- Hog feeding
- Cattle feeding
- Manufacturing livestock feed
- Composting

Table 1 lists these end-use market options, the types of organic waste they manage and their materials supply specifications expressed as "acceptable" and "unacceptable" materials. Food packaging is highlighted in bold because it is a significant part of the organic waste stream and requires labor to sort it away from acceptable materials to meet materials supply specifications on a daily basis. Food waste is the most versatile type of organic waste managed and has the greatest number of end-use market options. When fiber waste is added to food waste, the number of end-use market options is reduced to two (manufacturing livestock feed and composting). When fiber and plant waste are added to food waste, there is only one end-use market option left (composting).

Table 1. Organic Waste Management End-Use Market Options

End-Use Market Options	Types of Organic Waste Managed	Acceptable Materials	Unacceptable Materials
Food Rescue	Edible Surplus Food	Prepared & Perishable, Un-served Food	Inedible & Dated Food **Food Packaging** All Other Trash
Rendering	Food Waste	Meats, Fat, Bones Cooking Oil & Grease	All Other Food Waste **Food Packaging** All Other Trash
Hog Feeding	Food Waste	Produce Meats & Seafood Dairy Products Bakery & Dry Goods Deli & Frozen Foods Fat & Bones Cooking Oil & Grease	**Food Packaging** All Other Trash
Cattle Feeding	Food Waste	Produce	All Other Food Waste **Food Packaging** All Other Trash
Manufacturing Livestock Feed	Food Waste Fiber Waste (paper & cardboard)	Produce Dairy Products Bakery & Dry Goods Deli & Frozen Foods **Food Packaging (paper, cardboard, plastic, cans)**	Meats & Seafood Fat & Bones Cooking Oil & Grease **Food Packaging (glass & wood)** All Other Trash
Composting	Food Waste Fiber Waste (paper & cardboard) Plant Waste	Produce Meats & Seafood Dairy Products Bakery & Dry Goods Deli & Frozen Foods Fat & Bones Cooking Oil & Grease **Food Packaging (paper, cardboard & wood)**	**Food Packaging (plastic, glass & cans)** All Other Trash

Materials Supply Specification for Anaerobic Digestion

The materials supply specification for organic waste to be supplied from commercial waste generators for anaerobic digestion is the same materials supply specification currently being used by composting programs. This materials supply specification expressed as "acceptable" and "unacceptable" materials is provided in Table 2.

Table 2. Materials Supply Specification for Anaerobic Digestion & Composting Programs

Acceptable Materials	Unacceptable Materials
Food Waste of All Types Produce Dairy Products Bakery Goods Deli Foods Frozen Goods Dry Goods Meats & Seafood Fats, Cooking Oils & Grease Fiber or Paper-Based Packaging Paper Cardboard Other Organic Material Plant Waste Brewer's Wastes	Cans Glass Plastics Metals All Other Trash

Anaerobic Digestion & Composting Programs Are "Equal"

Typically, the list of "acceptable" and "unacceptable" materials is the framework from which commercial waste generators will perceive a new organic waste management concept and how it may change the way they do business on a daily basis. Because anaerobic digestion and composting programs share the same materials supply specification, there is no obvious difference between these two programs from the perspective of commercial waste generators. It is suggested that commercial waste generators will approach these two programs as "equal" when analyzing the logistics of daily operations and upfront costs required to separate, collect and consolidate materials for shipment to an end-use market whether it is an anaerobic digester or composting site. This is a first step towards the concept of an integrated organic waste management system.

Logistics of Daily Operations & The Least Cost Fit

The logistics of daily operations for commercial waste generators to recover organics from the waste stream requires an internal and external "materials transfer system" (see Table 3). The elements of a materials transfer system are: (1) space; (2) collection containers and equipment;

(3) shipping containers and equipment; (4) truck access; (5) truck transportation to end-use markets; and (6) receipt of trucks and materials by end-use markets. When these elements fit together well, they operate efficiently and provide commercial waste generators organic waste management solutions that are the Least Cost Fit.

Table 3. Elements of a Materials Transfer System

	Internal Operations	External Operations
Space (Amount, function, location, space adjacencies)	COLLECTION CONTAINERS & EQUIPMENT 1. Generate & separate organics from garbage 2. Collect & consolidate organics in collection containers (intermediate consolidation) 3. Prepare & transfer collection containers to external operations	SHIPPING CONTAINERS & EQUIPMENT 1. Transfer organics from collection to shipping containers (final consolidation) 2. Interface between shipping containers & organics service provider trucks TRUCK TRANSPORATION 3. Transfer organics to end-use markets 4. Receipt of organics by end-use markets
Truck Access: Loading Dock		1. Standard loading docks (4 feet high) 2. Nonstandard loading docks (various heights less than 4 feet high)
Truck Access: Street Level		1. Overhead doors 2. Service doors

Upfront Costs

Types of upfront costs commercial waste generators could incur to separate, collect, consolidate and ship organics to end-use markets may include, but are not limited to:

1. Staff time to research, develop and implement a materials transfer system that is the Least Cost Fit.

2. Additional internal collection containers and equipment required to separate organics from garbage including the potential ongoing use of compostable bags.

3. Additional external shipping containers and equipment required to interface with organics service provider trucks including the potential use of custom-designed containers and/or equipment.

4. The reconfiguration of internal and external space required to store additional collection containers and equipment and shipping containers and equipment.

5. Modifications to loading docks, overhead doors and service doors to provide more efficient truck access.

Additional ongoing costs include: (1) the labor required to separate organics from garbage by sorting out unacceptable materials; (2) the labor required for intermediate and final consolidation of organics; and (3) the hauling and disposal costs to transfer organics to end-use markets.

Fundamental Financial Strategy

Commercial waste generators in Ramsey and Washington Counties pay a Minnesota state solid waste management tax (Tax) and the County Environmental Charge (CEC) on garbage hauling and disposal services. The Tax and CEC are collected by trash haulers on garbage bills and are directly related to the volume and weight of garbage generated. The amounts of the Tax and CEC in Ramsey and Washington Counties are summarized in Table 4.

Table 4. Solid Waste Management Tax (Tax) & County Environmental Charge (CEC)

County	Tax on Garbage Services Collected on Garbage Bills	CEC on Garbage Services Collected on Garbage Bills	Total on Garbage Services Collected on Garbage Bills
Ramsey	17%	53%	70%
Washington	17%	37.5%	54.5%

If materials from the garbage stream are separated from garbage and managed as recyclables and/or organic waste, recycling and organic waste management services are exempt from the Tax and CEC. A reduction in the amount of Tax and CEC paid by minimizing garbage hauling and disposal services is a fundamental financial strategy for commercial waste generators to offset upfront costs and/or ongoing costs required to participate in organic waste management programs.

Changes in the Configuration of Services

The final topic of this report is to analyze the change in the configuration of garbage, recycling and/or other waste management services for a commercial waste generator participating in an anaerobic digestion program. It is suggested that a local digester supported by organics and positioned to serve Ramsey and Washington Counties has the potential to change the configuration of services in a manner that can provide the framework for an integrated organic waste management system in the Twin Cities metropolitan area.

For the purpose of this analysis, the changes in configuration of services will be centered around a single theme: "commingling." Commingle means to combine and mix together, and this discussion will include the: (1) commingling of materials; (2) commingling of organic waste management end-use markets; and (3) commingling of organic waste management services.

Commingling of Materials

For each type of material already collected and managed separately from the waste stream (e.g., recyclable paper, cardboard, bottles and cans and organics such as food waste), commercial waste generators have implemented a materials transfer system. Typically, multiple materials transfer systems operate side by side, and elements of the systems are shared and often limiting. Space and truck access (loading docks, overhead doors and service doors) are usually the two most limiting elements.

To add the separation, collection and consolidation of organics to pre-existing materials transfer systems, commercial waste generators may have to seek services that do not require significantly more space and use truck access judiciously. Service providers may need to respond by making changes in the configuration of services they provide. One change that will address issues of limited space and truck access is the commingling of materials. It is suggested that commingling will become an important strategy for commercial waste generators and their waste and recycling service providers to merge multiple materials transfer systems to make room for the source separation of organics from the waste stream.

Single stream recycling is an example of commingling and currently offered to commercial waste generators by some recycling service providers. Single stream recycling is where all recyclable materials are collected and commingled in a manner where there is no physical separation among types of recyclable materials such as paper, cardboard, bottles and cans. All recyclable materials are placed in collection containers and collection vehicles in a commingled state and transported to a material recovery facility where they are processed for sale to end-use markets. Single stream recycling has the potential of merging three materials transfer systems: paper, cardboard and mixed bottles/cans.

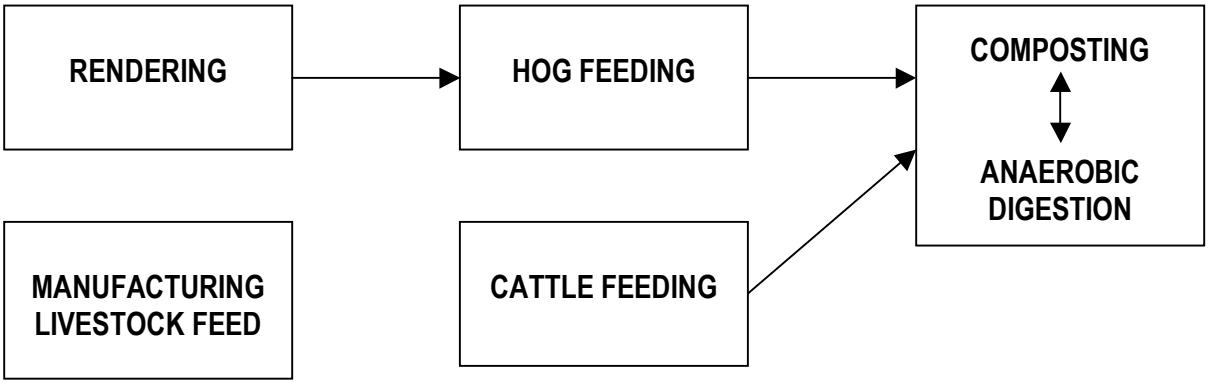
Another commingling strategy for consideration is to expand the organics materials supply specification to include recyclable fiber such as paper and cardboard. If a commercial waste generator can only implement one materials transfer system because of space and truck access limitations, a strategy to make room for organics is to commingle organics and recyclable paper and cardboard.

Commingling of Organic Waste Management End-Use Markets

Table 1 reveals a "less" to "more" progression of acceptable materials in the list of current organic waste management end-use markets. This progression from less to more acceptable materials is based on the concept of commingling. For example, the materials supply specification for rendering allows the least variety of materials, accepting only meats, fat, bones, cooking oil and grease. However, hog feeding can replace rendering by commingling meats, fat, bones, cooking oil and grease with produce, meats and seafood, dairy products, bakery and dry

goods, deli and frozen foods. Figure 1 illustrates the commingling of materials among organic waste management end-use markets. The illustration flows from left to right based on the progressive commingling of materials as defined by the materials supply specifications of end-use markets. Anaerobic digestion has been included as equal to and interchangeable with composting. The manufacturing of livestock feed is included in Figure 1 but set apart as mutually exclusive in this illustration because meats, fat, bones, cooking oil, grease and seafood are unacceptable materials and this is the only end-use market that accepts metal and plastic food packaging.

Figure 1. Commingling of Materials Among Organic Waste Management End-Use Markets



The materials supply specifications for organic waste management end-use markets suggest a continuous flow of increasingly commingled materials with anaerobic digestion and composting having the potential to serve as "back ups" to rendering, hog feeding and cattle feeding. To take this step towards an integrated organic waste management system, it is suggested that composting and anaerobic digestion facilities are designed and constructed to: (1) seamlessly interface with the truck transportation provided to commercial waste generators by rendering, hog feeding and cattle feeding end-use markets (see Table 5); and (2) accommodate the unique physical nature of the loads of materials supplied by rendering, hog feeding and cattle feeding.

Commingling of Organic Waste Management Services

Organic waste management services include shipping containers and transportation services to end-use markets. Shipping containers are part of the external operations of a commercial waste generator's materials transfer system. They are the containers used for the final consolidation of organics and interface with truck transportation services. Typically, the contents of shipping containers are emptied on site and only organic waste materials are transported to end-use markets.

Table 5 summarizes the type of shipping containers and transportation services currently used to transfer organics to end-use markets. Shipping containers can be standard containers provided by the waste and recycling industry or custom containers and equipment uniquely designed for a specific end-use market. Services can be provided directly by the end-use market or a company that provides hauling services.

Most end-use market locations are scattered outside the periphery of the Twin Cities. Trucks must travel significant one-way distances to pick up organics from commercial waste generators and return them to end-use market locations. Lack of route density has been an ongoing challenge for service providers trying to cover the cost of serving their routes. For some end-use markets, pockets of service areas are scattered and trucks "leap frog" between clusters of customers.

A local digester positioned to serve Ramsey and Washington Counties significantly changes the geographical mix of end-use market locations and opens up opportunities for the commingling of organic waste management services by employing the same fleet of trucks to transport for more than one type of end-use market a day. For example, a truck could leave a remotely located end-use market early in the morning and serve an anaerobic digester route into the Twin Cities. When the truck is full, it would tip and empty at the digester. The truck could then be repurposed to serve a route for the originating end-use market in the afternoon as it heads out of the Twin Cities. Once full, the truck would return to its original end-use market destination and begin the process again the next day. The commingling of organic waste management services could double the productivity of trucks currently serving end-use markets.

Table 5. Organic Waste Management Shipping Containers & Transportation Services

End-Use Market Options	Type of Shipping Containers	Type of Transportation Services
Rendering	Rendering Containers	Rendering Truck
Hog Feeding	Barrels	Custom Tank Truck
Cattle Feeding	Custom Roll-Off	Roll-Off Truck
Manufacturing Livestock Feed	Totes, Trailers & Tanks Front-End Load Dumpsters Roll-Off Containers Compactors	Semi Truck Trailers Front-End Load Packer Truck Roll-Off Trucks
Composting	Front-End Load Dumpsters Rear-End Load Dumpsters Compactors	Front-End Load Packer Truck Rear-End Load Packer Truck Roll-Off Trucks

An Integrated Waste Management System

In summary, a local anaerobic digester supported by organics and positioned to serve Ramsey and Washington Counties has the potential to change the configuration of garbage, recycling and other waste management services in a manner that can provide the framework for an integrated waste management system in the Twin Cities metropolitan area. These changes are centered around the concept of commingling:

1. Commingling of materials

2. Commingling of organic waste management end-use markets

3. Commingling of organic waste management services

Where a commercial waste generator will place itself within this integrated system will be determined by a materials transfer system that is the Least Cost Fit. Instrumental to the Least Cost Fit is the fundamental financial strategy for commercial waste generators to reduce the amount of State Tax and CEC paid by minimizing garbage hauling and disposal services.