



# **Source Separated Organic Materials Anaerobic Digestion Feasibility Study**

## **Executive Summary**

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The following study examines the feasibility of an anaerobic digestion (AD) facility for source separated organic materials (SSOM) in the eight county Minneapolis/St. Paul Metropolitan area. The study examines current anaerobic digestion technologies, availability of source separated organic materials and utilizing AD technology to convert the organic material to methane for thermal or electric power generation.

The scope of work was developed with input from the Ramsey/Washington Counties Resource Recovery Project Board and the Saint Paul Port Authority. In general the scope of work includes:

- ◆ Overview of AD processes
- ◆ Current AD development
- ◆ Examples of large scale AD plants
- ◆ Option for biogas generation and use
- ◆ Energy market status
- ◆ Availability and composition of SSOM in the 8 County Area
- ◆ AD Facility Design Considerations
- ◆ Permitting and Environmental Considerations
- ◆ Economic Analysis

AD in the broadest sense is a process to degrade organic material in the absence of oxygen. AD occurs naturally in low-oxygen environments including marshes, wetlands, sediments, landfills, and within the digestive tracts of some animals and insects. Degradable organic material refers to carbohydrate, protein, and fat molecules. The degradation that occurs during AD is the result of microorganisms transforming these molecules into water, carbon dioxide and methane. These by-products are formed as a result of the respiration and digestion activities of the microorganisms.

When discussed in terms of SSOM, AD is a waste pre-treatment process, as opposed to a waste disposal option. The typical organic fraction of municipal solid waste (OFMSW) is comprised of textiles (cloth and paper products), yard waste (grass, leaves, and brush), food waste (commercial, residential) and other organic waste. On average, OFMSW comprises approximately 50% of MSW by volume, and only approximately 50% of the OFMSW is readily degradable in most AD facilities. However, SSOM may be more organically rich than OFMSW, but SSOM also comprises a smaller portion of the total waste stream, about 25%.

During the AD process the degradable portion is broken down into what is referred to as biogas and can be used for thermal or electrical energy. The non-degradable portion is referred to as

digestate and is typically used for composting, as a soil amendment, or as landfill alternative daily cover. The study analyzed the various AD processes and vendors to provide a frame of reference on the state of AD technology. Most AD processes used on MSW feedstocks are located in Europe. Of the over 70 AD suppliers, four vendors were highlighted that have the proven capability of developing an AD system to process 100,000 TPY of SSOM. The size of the AD process was determined from the anticipated availability of SSOM in the eight county metro area.

The primary output from AD processes is the production of biogas. The amount of biogas produced from AD processes ranges from about 2 cubic feet per pound of input to 5 cubic feet per pound of input.

Utilizing the biogas typically requires some treatment of the biogas. The type of treatment (and cost) will depend on the ultimate use of the biogas. Potential biogas options include direct use, electric generation, fuel cells and pipeline quality. Each option has advantages and disadvantages, with the direct use option being the most economical as long as the user is in close proximity to the AD facility and is willing to use the biogas with minimal clean up.

A challenge to developing an SSOM plant in the metro area is sourcing a supply of SSOM large enough to support an AD facility. A wide variety of studies have been completed that have information on the quantities and qualities of SSOM collected from residents and commercial establishments. Several pilot and city wide collection programs have been initiated in the eight county area.

In addition, several national studies have been conducted on SSOM collection. The studies provide a background for estimating the potential volume of SSOM that may be collected in the eight county metro area and used at an AD facility.

Based on the data reviewed and provided for this study, potential SSOM supply for an AD facility ranges from 38,900tons per year ( TPY) to 97,300 TPY. If SSOM is also combined with yard waste and smaller wood waste, the anticipated volumes increase to 44,900 TPY to 112,300 TPY.

However, collection of SSOM in the eight countymetro area has complexities that would need to be addressed, including:

- ◆ SSOM collection systems economics and financing
- ◆ Potential legal and political constraints due to legal definitions
- ◆ Policy considerations from counties and cities responsible for collection.

These considerations are further explored in the report and are included to spur dialogue on these issues.

An AD facility design capable of processing 100,000 TPY was developed using known components and process flow requirements for typical AD facilities. The facility includes a receiving area, processing area, digesters and a potential biogas conversion facility. The total facility area required is 7 to 8 acres including support facilities.



With a general facility design, capital costs were developed using two methods. Method 1 used published sources of AD facility capital cost information. Method 2 used a cost estimating method based on the capital and installation costs for the components that make up an AD facility.

For a 100,000 TPY facility a capital cost of \$30 to \$45 million is likely based on published sources.

From using the plant buildup method to estimate capital costs, an estimated capital cost for a 100,000 TPY facility was \$39 million to \$44 million depending on the biogas use option selected.

Operation and maintenance (O&M) costs were estimated using a similar approach as capital costs estimates; published sources and a plant build up approach.

Published sources for O&M costs ranged from \$10/ton to \$100/ton depending on the complexity of the AD facility, siting, and potential biogas revenues that were used to reduce O&M costs.

The plant build up estimate for O&M resulted in an estimated cost per ton ranging from \$53 to \$60 per ton.

An estimate of debt service was developed by the St. Paul Port Authority that provided an estimate of \$30 per ton. With energy revenue estimates ranging from \$24 to \$42 per ton, the net cost per ton was projected to be in the range of \$55 to \$60 per ton for a 100,000 TPY facility.

To build such a facility an estimated schedule to permit, design and build would be 24 to 48 months. The time frame is dependent on the permitting process. For example, if an Environmental Impact Statement is required for the facility, that process could add 6 to 12 months to the project schedule. However, if plant siting and permitting is not contested an AD facility could be operational by 2012.