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Food Waste Digester
Phase 1 Feasibility Report

Executive Summary

This report presents the results from Phase 1 of the Food Waste Digester Feasibility Study conducted for Dane County, Wisconsin. The project scope for Phase 1 included an evaluation of the available food waste as feedstocks for anaerobic digestion (AD) and completion of a preliminary economic analysis. Findings from Phase 1 provide the County with data for assessment of whether to move forward with additional feedstock or economic analyses (Phase 2) and initial siting and design of a food waste digester (Phase 3).

Waste characterization studies have found that food waste is a significant portion of material currently being generated and disposed at landfills. Increased diversion of food waste from the landfill can provide benefits of extending the landfill site life, reducing greenhouse gas emissions, and producing valuable resources such as renewable energy and nutrient-rich compost.

Phase 1 of the project was focused on:

- An assessment of available feedstocks based on pre-consumer organic waste sources in the County and surrounding area.
- An AD facility would be located at the currently operating Rodefeld Landfill that is owned and operated by Dane County.
- Biogas generated from the digester would be conveyed to the existing gas to energy system at the site.

The intent of the County is to develop an economically feasible model for a food waste digester to assess whether to continue with design and construction of a facility.

A pre-consumer waste survey was conducted to gather information from candidate industries and haulers that generate and handle food processing by-products and organic residuals in the Dane County area. A list of 43 companies was identified and targeted for a paper survey to collect data on:

- Type of waste generated; including a breakdown into categories of paper, wood, and organics;
- Volumes generated, current and past year and anticipation of increase or reduction of waste;
- Costs for handling and disposal of waste;
- Collection or hauling methods; and
- Interest in diverting organic materials/waste to Dane County digester.

Limited data were generated from the pre-consumer waste survey. Waste quantity data were obtained from six companies in the area. These data showed that local industries currently divert a large portion of their waste streams from landfill disposal. An average of 86 percent of the organic waste is currently diverted for other uses such as animal feed, compost/digestion, or rendering. Of the remaining 14 percent being landfillled, less than 50 percent is organic waste, or only 6 percent of the total waste stream is organics being landfilled. The diversion of organic waste from landfilling is primarily driven by cost. Other disposal options such as diversion for animal feed and rendering is inexpensive or the company receives revenue for the waste product.

Because of the limited response to the survey, the Project Team gathered additional information from generators of post-consumer waste. Preliminary discussions were conducted with the larger waste haulers in the area and other potential sources such as cities and institutions. Sources of post-consumer waste may include schools/colleges, hospitals, grocery stores, restaurants, and residential. Post-consumer waste may likely have to be a component of the feedstock to an AD for Dane County to increase the disposal tonnage and for potential revenue.

A preliminary economic analysis was completed to assess the viability of Dane County financing and operating an AD system. The economic analysis is preliminary because the available feedstock and type of digester required were not finalized prior to the analysis. The preliminary economic model was based on a system that would generate approximately 1 megawatt (MW) of electric power. The base case analysis with the accompanying assumptions provides a negative net present value (NPV) of $3.2 million over a 20-year analysis period. Key project variables include tipping fee revenues and facility capital and O&M costs. The model is sensitive to changing these variables or a combination of these variables. A statistical risk analysis calculated a certainty of a NPV less than or equal to zero at approximately 81 percent. Other benefits to the landfill (e.g., diverting waste, extending site life) and the environment (e.g., reducing greenhouse gas (GHG) emissions) are important considerations, but do not impact the current economic analysis.

The conclusions from Phase 1 of the feasibility analysis for a food waste digester in Dane County provide gainful information on whether to continue the project and if so, which areas to focus additional work. The following alternatives are available to the County for this project:

1. Discontinue evaluation based on the findings that less pre-consumer feedstock is readily available than originally anticipated and preliminary economic analysis results show a substantial NPV deficit to overcome to make the project feasible.

2. Continue the project to Phase 2 to continue to further evaluate the feasibility of a food waste digester with emphasis on tasks to define the quantity and type of feedstocks, selecting a digester technology, evaluating cost savings measures, and refining the economics. The AD facility should be tailored to the available feedstocks and quantities available to provide an accurate economic analysis.

3. If Phase 2 determines a food waste digester is economically viable, advance the project to Phase 3 which includes site planning and conceptual layout, schematic design, and design development.

If the County proceeds, knowledge gained from the Phase 1 evaluation should be applied to follow-up work in Phase 2, including:

- The feedstock evaluation should focus on the primary generator(s) versus a large survey of many generators. A large survey and contact list of companies was time consuming with little data collected. A focused data collection and evaluation of select companies, haulers, institutions, and municipalities will be more efficient.

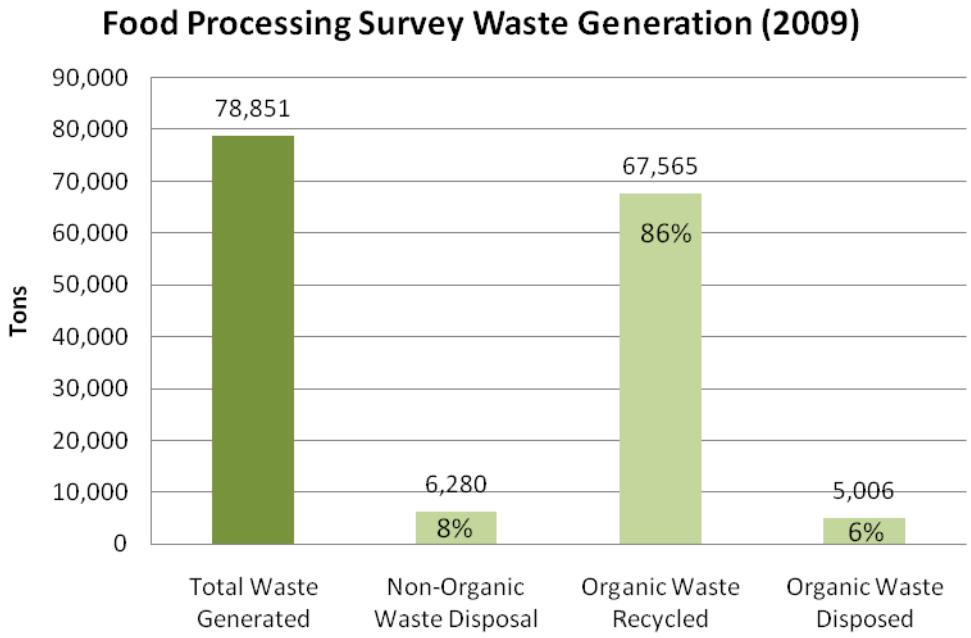
- The economic analysis conducted was very preliminary and conservative, and the feedstock quantity in the end was not representative. The economics must be refined to be tailored to the waste stream (quantity, quality, AD technology). Cost saving measures (e.g., co-digestion, smaller batch system) may change the economic analysis, which can be evaluated to define conditions to generate a positive NPV.

Table 2-1
Food Processing Survey Results Waste Generation (2009)

Company	Total Waste Generated (tons)	Non-Organic Waste Disposal (tons)[1]	Organic Waste Recycled (tons)[2]	Organic Waste Disposal (tons)[3]
A	13,400	2,150	9,100	2,150
B	7,441	NA	7,441	NA
C	44,410	50	44,360	NA
D	13,600	4,080	6,664	2,856
E[4]	NA	NA	NA	NA
F[4]	NA	NA	NA	NA
Total	78,851	6,280	67,565	5,006

Notes:
[1] General municipal solid waste and packaging from facility plus organic waste that is not recycled.
[2] Recycling includes material sent for rendering, animal feed, composting/AD. Minor amounts include recycling of paper, cardboard and wood pallets.
[3] Organic waste disposal may include soiled paper and cardboard that cannot be recycled or organic waste that is not recycled because of lack of equipment or space.
[4] Information provided in phone interview indicates facilities recycle 40 to 95 percent of their entire waste stream.
NA Information was not specifically provided by survey respondent. However, a placeholder was included in the table because survey response was received but information provided was incomplete.

The total waste generated by the four companies that responded to the survey was estimated to be 78,851 tons for Year 2009. Of the total waste generated, the respondents to the survey reported that 67,565 tons or 86 percent of the total waste generated is organic waste currently being diverted from disposal. Of the diverted material, 77 percent (51,801 tons) is being used as cattle feed and the remaining 23 percent (15,764 tons) is being composted/digested/rendered. Only 14 percent (11,286 tons) of the total waste generated is currently going to landfill disposal. Of this amount disposed, less than 50 percent is organic waste, or only 6 percent (5,019 tons) of the total waste stream.



Dane County Anaerobic Digestion Study 07/07/11

Preliminary Review

Input Cells Shaded in Blue

General Assumptions	
Base Year (for Cost Estimates)	2011
Waste Received (tpy)	40,000
Digestible Content	90%
Biogas Production Rate (ncm/digestible ton)	110
Percent Methane	60%
Methane Heating Value (Btu/scf)	1,000
Availability	95%
Material Recovery Percent	0%
Soil Amendment Production Rate (% of waste)	30%
Inflation Rate (% per yr)	3%
Landfill Tip Fee Escalation Rate (% every 4th yr)	4%
Food Waste Tip Fee Escalation Rate (% every 4th yr)	4%
Electricity Price in 2020	$ 0.072
Electricity Price Escalation after 2020	2%
Debt Service Interest Rate	4.5%
Debt Service Term (years)	10
NPV Discount Rate	5.5%

Cost and Price Assumptions	Cost Basis Year
Base Year	2011
Food Waste Tip Fee ($/ton)	$ 45.60
Rejects Disposal Cost ($/ton)	$ 32.50
Electricity Purchase Cost ($/kwh)	$ 0.080
Electrical Energy Price ($/kwh)	$ 0.109
Soil Amendment Price ($/cy)	$ 3.00
Soil Amendment Price ($/ton)	$ 6.67
Water Cost ($/100 cubic feet)	$ 1.65
Sewer Cost ($/1000 gal)	$ -

Expense Assumptions	
General Expense	$ 200,000
AD System - Labor	$ 250,000
AD System - Other O&M	$ 200,000
ICE Genset O&M	$ 60,000
Capital Repair and Replacement	$ 200,000
Electric Usage (kw per ton)	50
Water Usage (gal per ton)	2

Capital Costs (in 2011) Dollars)	
Development Costs	$ 500,000
Extraordinary Site Costs	$ -
Waste Handling / AD System	$ 15,000,000
ICE Genset	$ 1,500,000
Interconnect	$ -
Start-up and Testing	$ 1,000,000
Capital Cost - 2011	$ 18,000,000
Capital Cost - 2014	$ 19,669,086
Interest During Construction	$ 737,591
Capital Investment Required	$ 20,406,677

Results Summary	2015
Tip Fee Revenue	$ 1,972,838
Energy Revenue	$ 697,658
Soil Amendment	$ 81,037
Total Revenue	$ 2,751,533
Expenses	$ 1,174,083
Debt Service	$ 2,578,972
Net Cash Flow	$ (1,001,523)

NPV - Net Cash Flow (20 yrs)	$ (3,170,213)

Sensitivity Analysis

Tip Fee	NPV - Net Cash
$ 45.60	$ (3,170,213)
$ 35.00	$ (9,177,734)
$ 52.00	$ 456,970

AD Capital Cost	NPV - Net Cash
$ 15,000,000	$ (3,170,213)
$ 12,000,000	$ 69,674
$ 20,000,000	$ (8,570,025)

Other O&M Cost	NPV - Net Cash
$ 200,000	$ (3,170,213)
$ 400,000	$ (6,600,704)
$ -	$ 260,278

3.2 Economic Model

Using the cost assumptions and estimates as described therein, a 20-year pro forma projection of revenues and expenses was developed in a spreadsheet model. Expenses and revenues were escalated and net revenues available for debt service were calculated for each year. Debt service was estimated and the net cash flow was calculated. To provide a single value to be used in the sensitivity analysis, the net present value (NPV) of the net cash flows over the 20-year period was calculated. The results of the base case analysis are presented in Table 3-5.

Table 3-5
Summary of Base Case Results

	2015$
Tip Fee Revenue	$1,972,838
Energy Revenue	$697,658
Soil Amendment	$81,037
Total Revenue	$2,751,533
Total Expenses	$1,174,083
Debt Service	$2,578,972
Net Cash Flow	$(1,001,523)
20 Year NPV of Net Cash Flow	$(3,170,213)

The economic spreadsheet analysis for the base case is presented in Appendix B. The base case analysis with the accompanying assumptions provides a negative NPV of $3.2 million over a 20-year analysis period or project life. The debt service was based on a 10-year term, therefore the analysis shows a negative net cash flow for Years 2015 through 2024 and then a positive net cash flow for Years 2025 through 2034.

3.3 Sensitivity and Risk Analysis

In order to understand the impact that various key assumptions have on project feasibility, a sensitivity analysis was performed by varying the inputs for the following parameters:

- Tip Fee (Revenue)
- AD Capital Cost
- O&M Costs (non-labor)

All other inputs were held constant in the sensitivity analysis. The results of the sensitivity analysis are summarized in Table 3-6.

4.0 Conclusions and Recommendations

4.1 Conclusions

The Phase 1 feedstock evaluation and economic analysis for Dane County was conducted to evaluate the available food wastes as feedstocks for AD and to complete a preliminary economic analysis. Completion of Phase 1 provides the County with data for assessment of whether to move forward with additional feedstock or economic analyses (Phase 2) and initial siting and design of a food waste digester (Phase 3). The primary findings from Phase 1 include the following:

- The pre-consumer waste survey showed that industries currently divert a significant portion of their waste stream including organic waste from landfill disposal. The diversion is based on existing low-cost or revenue-generating disposal options such as animal feed and rendering. While this finding is based on a limited survey response, the lack of response from other companies can be interpreted that in general organic waste disposal is not a significant issue (or cost) for their industrial operations.

- Procuring two or three primary sources of feedstock with fill-in from other small quantity generators could provide a baseload to operate an AD. To achieve this, the feedstock will likely need to include post-consumer waste in addition to pre-consumer waste. A targeted feedstock would include:

    - 10,000 to 15,000 tons pre-consumer waste from one or two primary sources

    - 10,000 to 15,000 tons post-consumer waste including 5,000 tons from various haulers (e.g., commercial, institutional, grocery) and 5,000 to 10,000 tons from residential SSO

- The procurement of feedstock at a tipping fee that provides a consistent revenue base for the County is a challenge considering other low cost disposal options and competition (e.g., animal feed, composting, other AD facilities).

- The base case economic pro forma provides a negative NPV of $3.2 million over a 20-year analysis period. However, this analysis is considered preliminary because the available feedstock and digester technology is not finalized. The statistical risk analysis calculated a certainty of a NPV less than or equal to zero at approximately 81 percent.

- Sizing an AD unit based on 40,000 tons per year does not appear feasible due to insufficient feedstock availability and preliminary economics. Sizing a system for a lower tonnage reduces the capital costs but also reduces the revenue from tipping fees, therefore not necessarily improving the economics.

4.2 Recommendations

The conclusions from Phase 1 of the feasibility analysis for a food waste digester in Dane County provide gainful information on whether to continue the project and if so, which areas to focus additional work. The following alternatives are available to the County for this project:

1. Discontinue evaluation based on the findings that less pre-consumer feedstock is readily available than originally anticipated and preliminary economic analysis results show a substantial NPV deficit to overcome to make the project feasible. The project and findings can be reevaluated in the future if the economic or regulatory policies are altered.

2. Given the existing economic conditions, a food waste digester does not appear very feasible. However, there may be options to improve the feasibility of such a system. As such, Dane County can continue to use existing staff and resources to perform Phase 2 tasks to evaluate food digestion opportunities. This work should focus on the following:

    a. Advance discussions with select companies to confirm availability of one or two pre-consumer feedstocks in the area and probability for disposal at an AD.

    b. Further evaluate post-consumer feedstock to the AD by continuing discussions with select haulers, commercial/institutions/grocery, and municipalities, to define quantities and types of waste.

    c. Select the appropriate digester technology based on the identified feedstock.

    d. Further evaluate the potential for co-digestion at MMSD or a manure digester.

    e. Further evaluate the scenario of using a smaller system (i.e., modular batch system), which would be lower capital cost and would allow the County to provide this technology to select generators as an initial step toward organics diversion. A smaller system would also allow the use of the existing engine capacity at the site without costs for new engines. The system at the University of Wisconson-Oshkosh is sized for 8,000 tons per year, is modular to allow expansion and operational flexibility, and reportedly has a 10-year payback period.

    f. Refine the economics based on the feedstock tonnage, type of waste, and digester technology. Investigate options for reducing capital costs for the AD. Research the economics for similar projects that claim a positive NPV. Consider expanding the economic analysis to encompass the larger solid waste management system versus only the AD facility to capture the identified indirect costs.

3. If the Phase 2 evaluation determines that a food waste digester is economically viable, advance the project to Phase 3 which includes site planning and conceptual layout, schematic design, and design development.

If the County proceeds, knowledge gained from the Phase 1 evaluation should be applied to follow-up work in Phase 2, including:

- The feedstock evaluation should focus on the primary generator(s) versus a large survey of many generators. A large survey and contact list of companies was time consuming with little data collected. A focused data collection and evaluation of select companies, haulers, institutions, and municipalities will be more efficient.

- The economic analysis conducted was very preliminary and conservative, and the feedstock quantity in the end was not representative. The economics must be refined to be tailored to the waste stream (quantity, quality, AD technology). Cost saving measures (e.g., co-digestion, smaller batch system) may change the economic analysis, which can be evaluated to define conditions to generate a positive NPV.