Waste-to-Energy from Organic Feedstocks: Optimizing Resiliency for Eugene Water and Electric Board – **Phase III**

A collaborative investigation of opportunities to develop locally-based electricity generation across the distribution system of a publicly-owned utility to improve power system disaster resilience.

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TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

Background

The purpose of this research was to assist the Eugene Water and Electric Board (EWEB) to examine the feasibility of using organic waste material as a feedstock for local energy generation. This involved researching opportunities and barriers to the expansion of local energy production sources, specifically the ability for local policies to better facilitate the development of waste-to-energy (WTE) generation. This local electricity supply would be one element of an overall community disaster readiness plan for Eugene to help protect the operational functions of critical infrastructures, such as police, fire, communications, and healthcare services, and promote community resiliency in the event of a disaster.

Objectives

The Oregon State University OPAL team had four main objectives: (1) Interview Eugene city officials to determine how this policy could be employed; (2) identify any barriers to flow control mandates; (3) review the tipping fee structure for the City of Eugene and more broadly Lane County; (4) interview Eugene City officials and Lane County officials to discuss the potential for adjusting tipping fees to divert organic waste streams to a WTE facility. Another area to explore included Eugene's residential food waste collection pilot program. In order to address these objectives and determine the possibility of food waste as a potential feedstock for energy generation, OPAL interviewed Eugene public officials and representatives from market actors involved in the food waste stream.

Key Findings

Interviews conducted with market actors and government officials revealed very different perspectives on flow control mandates and tipping fees as policy options for diverting organic waste to a WTE facility. Elected government officials had more overtly positive feelings towards the idea of manipulating tipping fees or employing flow control mandates, especially in order to promote local WTE generation. However, these officials (2 city councilors, 1 mayor, and 1

county commissioner) also had less in-depth knowledge of these specific policies. In contrast, market actors (5 waste processors) had a deeper understanding of both flow control mandates and tipping fees, but were more wary of both. Market actors were concerned with how changes in these local policies may impact their profits and operations. Interviewees from the City's Waste Management division expressed concern that waste haulers in particular would be uneasy about alterations to the waste system. Interviews from city waste management and prevention employees revealed that while the residential food waste pilot collection program is running smoothly thus far, data is currently limited. The City of Eugene is working to collect more data on how much food waste is being collected in the pilot program but it is presently unknown if there is potential to divert some of this food waste to a WTE facility. An interview with a representative of the City of Gresham's waste programs highlighted the potential for wastewater treatment plants to produce significant energy from food waste.

Recommendations Based on Findings

- Collaborating with Market Actors on Local Policy Changes: Future efforts could interview waste haulers to find out more about their opinions around adjusting tipping fee structures and flow control as part of a larger plan to support energy resilience. Involving waste haulers and other market actors in the discussion around setting tipping fees would allow EWEB to leverage existing expertise in the industry, and may allay possible displeasure or resistance and ensure the system can be sustained.

- Continue Research on Eugene's Residential Food Waste Collection Program: As the pilot program continues, more data will become available. Currently, the City of Eugene is developing metrics to measure how much waste is being collected through the residential program. Researchers could check in again in the future with the city's Waste Prevention office to see how the residential pilot program progresses and if this new source of separated organic waste offers the potential for use in a community-based power generation system.

- Estimate Quantity of Available Organic Feedstock in Eugene: Through interviewing waste producers and obtaining relevant data from the City of Eugene and Lane County,

future researchers would be able to estimate the quantity of available organic feedstock in Eugene. The focus of research has been on food waste, but findings from this research have identified waste from construction (woody debris), animal agriculture, and breweries as currently available and underutilized feedstocks. The potential of these options could be investigated further.

- Metro Commercial Waste Collection Program as a Case Study: Metro is potentially going to make it mandatory for businesses to participate in their commercial food waste collection program. If this happens, it sounds like a new WTE facility may be built to accommodate this additional feedstock. Metro may also use flow control mandates to direct new waste flows to a new WTE facility. It would be useful for future research to investigate the challenges and successes of implementing flow control mandates, expanding the commercial program while limiting contamination of the food waste stream, building a new WTE facility, and any other changes to the waste system.

- Investigate the Eugene-Springfield Water Pollution Control Facility (WPCF): One of the short term recommendations of Phase II research was to collaborate with the Metro Wastewater Treatment Plant (also known as the WPCF) to see if the facility uses all of its available feedstock material to produce energy. Taking this a step further, future researchers could also use the case study of the Gresham Wastewater Treatment Plant to see if there is potential for the WPCF to also become energy net neutral.

- Further investigate the costs and feasibility of anaerobic digestion: Our preliminary research on anaerobic digestion suggests that digesters are commercially available and that the payback period for installation is relatively fast compared to other forms of waste management and other forms of renewable energy. Overall cost of disposal appears to be comparable to disposal in a landfill, and less than WTE incineration (World Bank 2012). Further research on the particular kind and scale of digester that would be used is necessary before drawing conclusions about how an anaerobic digester would be implemented as part of a food to waste system in the Eugene area. More information on anaerobic digestion can be found in the appendix.

- Building Transportation Resiliency: In the event of a natural disaster, it would be important that waste haulers can still bring feedstocks to WTE facilities. Otherwise, WTE facilities would be unable to continue generating electricity to power critical infrastructures. Several interviewees mentioned that gas-for-fuel programs to power vehicles could be a solution. It sounds like some places in California may use food scraps to power their transportation fleet, which could yield valuable case studies.

II. INTRODUCTION

This document serves to summarize the findings of Phase III in a research partnership between Oregon State University's Policy Analysis Laboratory (OPAL) and the Eugene Water and Electric Board (EWEB). The larger goal of this ongoing research is to analyze the potential options for increasing local energy resilience in Eugene, Oregon. Phase III builds off of the information about Eugene's organic waste stream acquired in Phase II and follows some of the related research recommendations laid out in the Phase II final report. This Phase (III) explores the feasibility of using organic waste as a feedstock for local electricity generation, which would be one piece of the overall Eugene community disaster readiness plan. Phase III research focuses on flow control policy, tipping fee manipulation, and the progress of pilot food waste collection programs in order to ascertain acceptance or support of possible policy changes. This research was guided by four main objectives:

- **Objective 1:** Interview Eugene city officials to determine how this policy could be employed.
- **Objective 2:** Identify any barriers to flow control mandates.
- **Objective 3:** Review the tipping fee structure for the City of Eugene and more broadly Lane County.
- **Objective 4:** Interview Eugene City Officials and Lane County officials to discuss the potential for adjusting tipping fees to divert organic waste streams to a WTE facility.

In order to achieve these goals OPAL has conducted interviews with city and county officials as well as market actors in the greater Eugene waste stream, including waste haulers and

processors. This report summarizes the research findings that emerged from interviews around these core objectives, as well as other policy options, barriers and recommendations that also arose. The results of this study hope to build on potential ideas for energy resilience and inform future research efforts to explore options that are most feasible and appropriate for the Eugene area.

III. REVIEW OF PREVIOUS WORK

Phase I of this research conducted by Oregon State University's Policy Analysis Laboratory (OPAL) for the Eugene Water and Electric Board (EWEB) began in 2015. These efforts examined the potential for a microgrid system in Eugene as a way to create energy resilience in case of a disaster, especially the Cascadia Earthquake. The Phase I study considered solar, biomass, waste-to-energy, and energy storage options as well as the policy incentives and barriers to each. They found that Eugene does have microgrid potential but further research was needed to determine the feasibility and details of implementation. Recommended goals for EWEB resulting from Phase I include further exploration of the potential for a multiple microgrid system in the Eugene area, engaging with stakeholders to educate them about microgrids as well as to attract customers to renewable and/or resilient sources of energy, and establishing policies and infrastructure to facilitate renewable and resilient energy.

Motivated by the recommendations presented in Phase I, Phase II research was completed in August of 2016. Phase II took a closer look at identifying critical infrastructure in Eugene within different sectors such as public health, transportation systems, energy, and more. Findings from interviews revealed that critical infrastructures were generally interested in further exploration of public-private energy resiliency partnerships despite concerns about the details of costs and benefits. Phase II findings around the topic of organic waste streams also suggested that there could be an opportunity for using organic waste as a feedstock for an existing or future WTE facility. Recommendations from Phase II include further investigating and clarifying potential partnerships with critical infrastructure businesses, collaborating with Metro Wastewater Treatment Plant and Seneca Sawmill, instituting a flow control policy, and changing tipping fees to promote the flow of waste to WTE facilities.

Phase II identified flow control mandates and tipping fee manipulation as key areas of further research, which this Phase III study centers on. In general, Phase III continues the examination of waste streams and local energy generation in order to advance the overall OPAL/EWEB energy resilience research project. Major topics researched within Phase III are flow control policies, tipping fees, perceptions of WTE systems, and food waste collection programs.

IV. METHODOLOGY

This study used qualitative research methods to identify and conduct interviews with relevant stakeholders. The first step was to identify potential interviewees. The research team drew from the Phase II final report and related documents which identified the pertinent market actors, including waste haulers and processors. Additionally, contact information for City of Eugene and Lane County officials was found through internet searches. Further investigation of city and county websites led researchers to find other significant public officials and employees (such as Waste Prevention and Green Building Analysts). One set of interview questions was created for market actors and another for city and county officials. Both sets of interview questions can be found in Appendix A. A set of interview questions was also created for waste producers, but was not used as the researchers did not end up having time to contact and interview waste producers as well.

Potential interviewees were initially contacted by the research team either over email or by cold-calling. Cold-calling was used more towards the beginning, but potential participants were not reached over the phone were then contacted by email. In all cases a description of the research project was given to appropriately inform the potential participant. A detail record was kept of when participants were contact, in what way, and by whom.

The majority of interviews were conducted over the phone. Rather than create recordings of the phone conversations, one researcher conducted the interview over speakerphone and at least one other researcher typed out the conversation. For most interviews, there were two note takers to ensure greater accuracy.

All of the eligible participants in each category were contacted by the research team at least once. If a phone number and email address had been identified, then the research team tried

both calling and emailing. It is certainly possible that the phone numbers or email addresses were incorrect. Not all companies displayed clear contact information on their websites. Additionally, some of the contacts from Phase II may no longer work for the same company or have otherwise changed their phone numbers. However, it is most likely that those who did not respond were simply too busy.

Table 1 below summarizes the different types of interviewees, total number of eligible participants, how many participants could not be reached, how many declined to participate, and how many were interviewed.

Table 1. Total number of eligible, unreached, and interviewed participants by type of interviewee

Type of Interviewee	Total Number of Eligible Participants within category	Number Unable to Reach	Number Declined to Participate*	Number Interviewed
Lane County Commissioner	6	5	0	1
Eugene City Councilor	8	5	1	2
Other Public Officials	6	2	0	4
Waste Hauler	5	5	0	0
Waste Processor	6	1	0	5
Waste Hauler and Processor	2	2	0	0

*The only reason a potential interviewee declined to participate was due to their limited familiarity with waste issues

Of the six Lane County Commissioners, only one was interviewed. One of the Lane County Commissioners, Faye Stewart, had recently resigned and no information about their replacement was found. Of the eight Eugene City Councilors, only two were interviewed. Another declined to participate due to their extremely limited knowledge of waste issues. The category of "Other Public Officials" found in Table 1 includes a variety of positions. The research team was able to interview the Mayor of Eugene, two Waste Prevention and Green Building Analysts for the City of Eugene, and a Waste Management Manager. The research team

identified but was unable to reach to interview the City of Eugene's Sustainability Liaison and a Waste Prevention and Green Building Coordinator.

Out of the six waste processors, five were interviewed. However, for the waste haulers, all five were unable to be reached. Similarly, neither of the two companies that are both waste haulers and processors were reached for an interview.

V. FINDINGS

Flow Control Policies

One of the main focuses of this research was to investigate the possibility of using flow control policies to incentivize moving organic waste to a waste-to-energy facility. Flow control policies have faced two significant legal challenges resulting in Supreme Court cases due to conflicts with the Commerce Clause: *Carbone v. Clarkstown (1994)* and *United Haulers Association, Inc. v. Oneida-Herkimer Solid Waste Management Authority (2007).* In the *Carbone* case, the court ruled against an ordinance that limited the flow of solid waste into or out of the state on the basis that it would "deprive competitors, including out-of-state firms, of access to a local market" (EPA Office of Solid Waste 1995, Leavitt and Hadfield 1998, Beveridge & Diamond, P.C. 2007). In *United Haulers,* the court came to a different conclusion, arguing that local flow control ordinances do not discriminate against out-of-state firms. More specifically, the ruling supported a local flow control ordinance that benefited a public facility and further generated public benefits by contributing to solid or hazardous waste and recycling goals (Beveridge & Diamond, P.C. 2007). In spite of this ruling, flow control policies may face some arguments from the public that they create monopolies and unfairly interfere in the market.

Flow control policies have been used by local municipalities to promote consistency in waste flows and generate funding for waste management programs (Berenyi 2009, EPA Office of Solid Waste 1995). In this case they would allow the City of Eugene the ability to mandate that organic waste streams go to particular facilities. However, the political feasibility and likelihood of successfully implementing such policies was uncertain. From this, we had two specific research objectives. The first was to identify barriers to flow control mandates (Objective 1) and the second was to explore how to employ flow control policy (Objective 2).

Interviews with city and county officials as well as waste haulers and processors have been reviewed to inform the following findings.

How to Employ Flow Control Mandates & Potential Barriers (Objectives 1 & 2)

Local policies regulating the flow of solid wastes have been allowed in Oregon since 1981. Marion County, for instance, has used a flow control policy to direct solid wastes to an incinerator operated by Covanta (Berenyi 2009). After discussing this policy option with our interviewees, it seems that although it may be technically very easy to employ flow control mandates but there may be some backlash from market actors. Notably, an interviewee from the City of Eugene's Waste Prevention department mentioned that while flow control would hypothetically work, there is a significant concern about how waste haulers would react to this change. She warns that "Flow control is a way that could work, if your end goal is only to capture material, but you have to keep in mind the political backlash from haulers who don't want to be told where to take things. It might not be so feasible politically." In her view, the waste hauling companies may be upset about mandated changes to the system. This may be due in part to the way waste collection is structured in Eugene as a closed competitive market (discussed further as a part of Objective 3 in Section III.I). When this same interviewee was asked if waste producers may also have concerns about flow control mandates, she said that this "could be another potential problem… they [waste processors] want to know what's coming to them and care about contamination". It is clear that the waste haulers and processors have built relationships with each other and changing current routes could alter the system in an undesired way. While the system is closed to a limited number of companies, the competitive market has already sorted out the efficient and/or preferred flow. Interference with market competition and the creation of monopoly-like waste processing entities have long been major critiques of flow policies across the US, although the legality of flow control was established in the *United Haulers* Supreme Court case (Beveridge & Diamond, P.C. 2007)

Unfortunately, the research team did not hear back from any waste haulers and thus was unable to interview any company representatives. Thus it is uncertain exactly how waste haulers would feel about a change in flow control mandates. From the interview discussed above it seems there would be significant backlash, however further discussion directly with waste haulers would give more insight on their reaction to flow control mandates. It seems that in order to be successful, a new flow control mandate would need to be discussed and approved by the

involved market actors. Collaboration between market actors and government officials would produce the most favorable outcome without building resentment among waste haulers and/or producers. Even from these preliminary interviews there is evidence that market actors would want to work together as this project advances. For example, the interviewee from the JC Compost Yard, a waste processor, was very interested in communicating further with government officials to support local renewable energy efforts.

It is important to note that city and county officials did not seem to be very familiar with the details of either flow control mandates or tipping fees. For example, when asked about how flow control mandates might work one city councilor said "I think that it's an excellent idea, but I don't know how it would work." The other city councilor who was interviewed also was a supporter of local renewable energy efforts, but their responses focused on public support and opposition rather than the flow control policies themselves. One city councilor said that he would be willing to speak with us, but said that waste was not his expertise and he really did not know anything about flow control or tipping fee policies. The only county commissioner interviewed responded mostly with concerns around the net energy benefit of a hypothetical WTE facility as well as the contract that Lane County already has with EPUD (discussed in Further Recommendations, section VIII.IV). Although only three elected government officials were interviewed, these findings seem to suggest that the issue of flow control mandates will receive the most pushback from market actors.

As noted below in the Gresham Case Study section, there may be other Oregon examples of the use of flow control mandates to promote WTE facilities. An interviewee from the City of Gresham describes how Metro, a regional government of the Portland metro area, may use flow control mandates. Metro has a food scrap collection program for business already but is considering making the program mandatory. Doing so may justify building a new WTE facility and the knowledge that there would be this new flow might be enough to incentivize the construction of such a facility. Though this is currently hypothetical, this and possibly other examples around Oregon and the United States more broadly may serve as useful case studies to inform best practices.

Tipping Fees

Objectives 3 & 4 of this research effort were to identify the tipping fee structure for the City of Eugene and the potential for adjusting these tipping fees, respectively. We began with the knowledge that both the City of Eugene and Lane County have the authority to set and alter the tipping fees that waste processors can charge customers. Tipping fees are fees charged at the processing facility, charged by the processor to the hauler. The hauler then charges a collection fee to residential or commercial waste producers. Some commercial waste producers, such as construction companies and other waste-intensive industries, haul directly to the producer and are then charged he tipping fee directly. Before this research it was uncertain exactly how the details of this structure worked and what the process for adjusting tipping fees was like in Eugene, particularly with respect to tipping fee differences between recycling, organic, and mixed wastes. Findings show that there are some incentives for waste sorting implemented through tipping fees or curbside collection fees, and that changes to these fees would result in complex effects on multiple groups of stakeholders including the general public, waste haulers, and waste processors.

Tipping Fee Structure for the City of Eugene (Objective 3)

The way the City of Eugene's tipping fees are structured is unique due to the way the Lane County's waste system is configured. An interviewee from the City of Eugene's Waste Prevention department described the model as not an open market or a franchise system, but rather is a closed competitive market. The City of Eugene has allowed eight companies to haul waste as long as they buy an annual license fee. As the interviewee further explained, the City of Eugene has the authority to set minimum collection rates collection. Disposal sites can charge up to 10% above that minimum, and can charge based on weight (3 sites in Lane County) or volume (several smaller sites). Currently the minimum tipping fee in Lane County is $27.40, plus a $17.60 "System Benefit Fee" that is used to support other Lane County waste management programs (Ferguson 2002).

Two interviewees noted that different fees for different kinds of waste currently act to incentivize separating recyclables and organic material from mixed waste. For example, trash costs the most since it is the most impactful and recycling costs about 20-25% less than trash. The intent behind this is to incentivize commercial clients to reduce their total trash. The

commercial Love Food Not Waste program similarly charges a fee that is lower for organic waste than for mixed waste to participating businesses.

Potential for Adjusting Tipping Fees (Objective 4)

Given the tipping fee structure as described above in Objective 3, the City of Eugene is able to set tipping fees at their discretion. Our interviewee from the City of Eugene's Waste Prevention department described that a policy analyst works on setting rates that will be reasonable to create a "fair and equitable system." One of the factors that is considered in setting rates is that the waste haulers must make at least 11% return on investment (ROI) in order to keep their company afloat. The Zero Waste Community Outreach Analyst also said that normally rates are only raised if there is a change at the county level or with landfill practices. The spring is rate setting season and this interviewee speculated that rates may be set to increase this year. This is because, beginning in July, waste haulers will no longer be able to take trash to the Lane County transfer station and instead will have to go directly to the landfill. This change is expected to increase their gas costs, which would be the motivation for increasing rates. In this way, the connection between flow control and tipping fees is clear. An upcoming change in flow control will likely result in an increase in tipping fees.

The potential of changing tipping fees garnered mixed reactions, and revealed that such a change would be politically complicated and result in a variety of nuanced implications to different stakeholders. Many public officials appeared to have positive perceptions overall of the use of tipping fees to incentivize organic waste separation. However, there were caveats to these reactions. As one interviewee said, "Homeowners might support this. It really depends on socioeconomic level. Those with higher socioeconomic status might support it. Renters [pause] I'm less confident." Reasons for this hesitation included convincing landlords and apartment owners to participate in the program. Of the interviewees that stood opposed to the potential for adjusting tipping fees, one suggested that implementing such a change "would be challenging. The tipping fee has to sustain the system." That is to say, market actors are concerned about changes to tipping fees because they are directly related to their profits.

Weight-based Tipping Fee Structure

One option for adjusting tipping fees to incentivize separation of organic wastes would be to use a weight-based structure for tipping fees and collection rates. According to one waste and

recycling expert with the City of Eugene, the current system is based on volume, and research by University of Oregon showed that a weight-based system could strongly motivate diversion of organic wastes. According to the Lane County waste management website, only three disposal sites currently use weight-based fees. Because organic wastes is significantly heavier than other mixed waste, separating it could be financially beneficial (or not separating it detrimental) to customers producing large amounts of organic waste. Research Skumatz (1989) and Bauer and Miranda (1996) shows that weight-based collection rates combined with optional smaller cans and education regarding waste disposal options and waste reduction can contribute to waste reduction. A pilot project in Seattle, Washington, however, showed that weight-based collection fees can induce an additional cost on waste haulers due to the time required to weigh the cans (Skumatz 1989). There may now be other technologies for weighing cans that could reduce this cost.

Other Suggestions and Barriers

Beyond our main four objectives address above, interviewees brought up other ideas as well as challenges for building local energy resilience in Eugene. This section will include other suggestions and barriers to WTE potential in Eugene. These topics fall under the categories of establishing a market and additional feedstocks, building WTE facilities, available land, and siting, externalities/environmental impacts, transportation threats to resilience, and the Lane County contract with EPUD.

Establishing a Market and Additional Feedstocks

A common concern expressed by a variety of stakeholders was the need to establish a market. This included both a market for the actors within the waste stream system to encourage diversion to WTE facilities as well as ensuring there is a market for the power being created. First, there needs to be an established market in order to create a demand for collecting and hauling those feedstocks that would be used in the WTE system. As summed up by one interviewee, “At the end of the day we take materials we can make a profit...either that waste will go to a landfill or you give some sort of incentive for diversion.” Incentives were discussed as an important aspect of establishing such a market. In addition to tipping fees, which are

discussed in Section III, other ideas were also discussed to promote the collection of organic waste. For example, the city of Eugene has designated enterprise zones in which there are community benefit criteria for receiving tax exemptions. One of these criteria requires that appropriate facilities explore the Love Food Not Waste Program (the commercial food waste collection program discussed in more detail later) so they are at least exposed to it and receive the information. Similar incentives could be considered in order to promote participation in such programs.

In discussing the creation of this feedstock demand, several interviewees suggested additional feedstock sources. One mentioned was urban wood waste, such as pallets, fences, and construction waste. There is currently not a market for this material and while companies such Rexius collect it as a service to their customers, they do not actively seek collection or have any use for this waste. This type of wood waste was noted to have high potential for energy, although it is not absolutely clean as debris such as paper, plastic, and nails are often mixed in. However, the problem of contamination is not unique to urban wood waste. Yard waste was noted to be relatively clean, however there seems to already be a market consuming all yard debris, therefore additional incentives would be necessary to divert to WTE facilities. Because Eugene is an agricultural center, waste from sheep and chickens was also noted as having potential. Australia was mentioned as a model of successful use of animal wastes for energy production. However, similar to yard waste, it was noted that manure has value for composters and farmers, making the economics for using it for energy more difficult. Lastly, one city councilor mentioned the potential of the brewery industry as it produces high-quality waste, many brewers value sustainability, and Eugene is working to get a brewery district off the ground.

While establishing the demand for the collection and hauling of feedstocks was noted as an important aspect, at least five interviewees also stressed the need to ensure there is a demand for the energy being generated in order to complete the cycle. Establishing a market for the energy and getting it back on the grid is imperative and can be a significant barrier for developing a WTE system. It was noted that there is current "glut in electricity" and cheap natural gas prices and lowering costs of wind and solar are making the economics of WTE more difficult. While one interviewee noted the value of resilient energy, they were uncertain if that would resonate with the public if it meant higher prices. Biomass energy is not always cost competitive, and the "ebb and flow of the energy mix and prices plays a large role in what can be done." As a result, several interviewees suggested incentives such as subsidizing biomass

generation, improving premiums for green power, relaxing environmental regulations for biomass, or disincentivizing fossil fuels another way. The importance of establishing power contracts was also noted, as one interviewee noted a minimum of a 20-year contract to make it viable.

Building WTE Facilities, Available Land, and Siting

While our interviewee at JC Biomethane indicated that their facility likely has enouch capacity for a greatly expanded food waste to energy system in Lane County, some interviewees discussed the option of building new WTE facilities if the organic WTE stream is to grow. One city counselor suggested considering a number of small facilities to be more resilient, also noting that locals often have better perceptions of smaller scale changes and facilities than larger ones. Anaerobic digesters are available on multiple scales, including very small scale facilities intended for family farms and even homes (e.g. biogasworld.com). Incineration-type WTE facilities have also been implemented in several European countries (Ellyin 2012). The recommendation for small facilities was followed by a recommendation to build capacity in incremental phases that are relatively easy to understand or afford. Another stakeholder highlighted the issue of building a facility close to feedstocks to minimize risk of the stream being disrupted if a disaster were to damage transportation systems.

Siting facilities was expressed as a potential barrier. One elected official stated that there is a shortage of industrial land in Eugene, making available land the biggest problem. Another interviewee, representing a waste processor, added that siting is expensive and difficult to permit, explaining there are many "pieces of that puzzle" and "that it would be hard to get excited about" building a WTE facility. Among these pieces is environmental impact and local perceptions of facilities. As discussed in the following section, a sense of "Not In My Backyard" (NIMBY) can be a major hurdle for some kinds of WTE facilities. It was also suggested that the existence of the JC Biomethane facility may make it unnecessary to build another facility as the capacity is already there.

Externalities/Environmental Impacts

Several interviewees noted the importance of examining the full range of impacts, including environmental ones. Understanding the by-products, carbon footprint, air-quality, and water-quality impacts of a WTE facility is important for the protection of public and

environmental health, and contributes to a greater understanding of potential challenges facing WTE facilities. Furthermore, different kinds of organic waste have different impacts when used for energy generation, which should be considered when determining the details of implementing a strengthened WTE system in Eugene. The issue of differing environmental impacts arose in two interviews in which interviewees contrasted public reactions and siting challenges for WTE from mixed waste and woody organic waste using incineration, and those for WTE from food waste using anaerobic digestion. Incineration facilities elicited greater resistance from the public due to air quality concerns, and appeared to face a more severe barrier from environmental regulations. While wastewater from anaerobic digestion has been noted as a concern, some facilities (e.g. University of Wisconsin Oshkosh dry digester) have minimal wastewater because the water is cycled back into the digester to maintain the proper level of moisture (Kleinheinz 2012). Further research is needed to determine which environmental regulations would apply to each kind of biomass energy facility and how strict these regulations are compared to typical outputs from the facilities.

Another concern relates to the energy efficiency of a WTE system. Beyond the efficiency of the WTE facility itself, it is important to take into account the energy utilized in order to divert waste to a facility. One county commissioner questioned whether such a system would have "positive energy or even carbon footprint with all of that transportation going on." Once at the facility, efficiency of energy generation depends on the type of feedstock as well as contamination of the feedstock. Contaminated loads can diminish the efficiency of the system, and can also require additional investments by the processor or the customer in order to supplying a clean load. Overall, it was evident that a more comprehensive analysis of costs and benefits would be needed for several stakeholders and public officials before making any final decisions.

Stakeholder Perspectives

Market Actor Perspectives

Market actors were open to the possibility of a strengthened WTE system in the Eugene area, but support was contingent on profitability and having a seat at the table. One market actor noted that they are aware of public demand for organic waste management programs: "when we do a public event the first question we get asked is when are you doing food scraps and yard

debris." Market actors, especially, were concerned that people would want the waste collected and support WTE programs because they are good for the environment, but at the same time those same people would not want the waste processed in a facility in their neighborhood. This can present liability issues for the processor even after a site has been established.

Other market representatives expressed interest in working with EWEB and other organizations to plan for and establish the potential WTE program, including building facilities and structuring the waste collection program. Market actor concerns related to maintaining profitability of operations. One waste processor was particularly skeptical: "They [WTE facilities] are expensive, they are hard to permit, need an offtake for power outlet. There are so many pieces of that puzzle it would be hard to get excited about that. Premiums for green power aren't great and there aren't a lot of long term contracts. It's not going to compete in a power market."

More specifically, transportation costs and demand for energy are major concerns, but efficient feedstocks could also present a challenge. According to a 2012 World Bank estimation of solid waste management costs, the entire collection process from pick up to transport to its final destination costs 85-250 USD/ton in high income countries. Disposal in a landfill costs 40-100 USD/ton, WTE incineration costs 70-200 USD/ton, and anaerobic digestion costs 65-150 USD/ton. Thus, collection accounts for anywhere between 30% (assuming high incineration costs) and 68% (assuming low landfill costs) of total waste management costs depending on the type of disposal and other factors such as local geography, policies, and fuel prices. Boskovic et al. (2016) similarly estimated that in Europe collection and transportation can account for up to 70% of municipal solid waste system costs. The cost estimate of these stages was €71,852 (85,007 USD) per truck per year, or €816.5 (965 USD) per collection point per year. Estimating transportation costs specifically is challenging due to local variations and uncertainties, and can require complex econometric or algorithmic modeling (Boskovic et al. 2016, Yadav et al. 2017).

Policy-Maker and Public Perspectives

Most interviewees were cautiously optimistic of community support for some type of resilient energy. Furthermore, most interviewees thought that the public would support a waste-to-energy (WTE) program. One interviewee responded simply with "more biogas now." However, there were some concerns about how a WTE program would compare with community investment in microgrids for solar and wind. Other concerns centered on limited public

knowledge. Two interviewees suggested that public support could be generated through increased public education of what a WTE energy program would entail. Additionally, interviewees communicating the benefits of a WTE facility may be challenging when they are not easily tractable to the public. As one public official put it, "Public knowledge on this topic is limited. The public also thinks about the short term. You need to draw a connection between the project and the impact it would have on their lives."

One of the biggest concerns expressed among both sets of interviewees was making sure that NIMBY issues did not become serious a problem. In addition to siting challenges, one public official with waste management expertise discussed a potential problem with using waste-to-energy terminology in lieu of biogas: "The term waste-to-energy means burning garbage in waste management. Call it a biogas facility." Our research did not reveal whether the general public is also aware of this distinction, but the interviewee strongly believed that any program that directly burns any type of waste would be thoroughly rejected by local communities. As mentioned previously, another public official suggested avoiding NIMBYism by promoting smaller facilities. The interviewee did not foresee public support issues in pursuing a biogas facility, although odor could result in a NIMBY issue. This prediction is supported by the experience of JC Biomethane, which did not experience major public resistance or NIMBYism barriers during their siting process.

Commercial Food Waste Collection Program

General Information

Love Food Not Waste is a program established in 2011 that reduces the tipping fee for food waste disposal by commercial customers 20% from set commercial garbage rates. There were approximately 300 participants in the program as of May 2017. One of the largest barriers to the program's success is the propensity for food waste contamination caused by improper material sorting on the customer end.

Contamination

Certain items, particularly bioplastics, are not compostable through the program. Food waste in the US is particularly contaminated, thus requiring a significant contaminant removal

effort for minimal gain for waste collectors. Eugene Waste Prevention and Green Building has identified milk cartons, bathroom waste, and corrugated cardboard, and plastic bags as common contaminants found in the Love Food Not Waste stream. Rexius, a commercial composter, has worked with the city to develop a fee schedule for removing contaminants delivered through the program by hand (called a "picking fee"). There is an escalating fee based on the number of contaminants over 25 individual pieces, providing an economic incentive to deliver clean loads. The impact of such a policy seems to depend on the size and priorities of the haulers. One interviewee noted that some larger haulers simply absorbed the cost, while some of the smaller haulers used it as an opportunity to educate and train their customers, using resources from Eugene's Zero Waste Program. Another interviewee expressed that other haulers don't pursue education of customers because they "don't want to bug them." The amount of contamination can also depend on where the waste originated. Interviewees indicated that organic waste from the Portland area is sometimes more contaminated than that from Eugene, and that certain customers, particularly large events like football games, produce highly contaminated loads. Events and locations producing high volumes of waste that continue to be contaminated could be an interesting opportunity to strengthen WTE streams.

Residential Food Waste Collection Pilot Program

General Information

In September of 2016, the City of Eugene started 2 year pilot program for residential food waste collection. The pilot program plans to service four neighborhoods with 300-500 voluntary participation households. The services are being established in each neighborhood at different times, with three neighborhoods currently being serviced.

Currently, two local waste haulers, Sanipac and Lane Apex, volunteer one truck every second week to collect food waste from participating neighborhoods. Participants dispose of the waste in yard debris cans, then haulers take it to the commercial composter Rexius. Rexius also collects organic waste from the commercial food waste program. Metrics are currently being developed to measure how much waste is being collected through the residential program.

Public Reception

The first neighborhood serviced by the pilot program received over 50% participation by eligible members. The second and third neighborhoods explored have had lower participation rates. The reason behind decreased participation is unclear, and the City of Eugene has suggested a weather related response correlated with the beginning of service availability. Further data is being collected to understand the discrepancies in participation rates.

Contamination

As discussed in relation to the commercial food waste program, contamination can significantly impact the success of a food waste collection system. When a similar residential food waste began in Portland, contamination levels were high, mostly in the form of corrugated cardboard. Waste collectors have cited clear communication regarding eligible waste items as the cause of decreased contamination levels in Portland waste over time.

Following this knowledge, the Eugene based food waste collection program included an early emphasis on communication of eligible food waste items. This communication may be the cause of limited contamination in the first months of the program. Additionally, an interviewee from the Waste Prevention office mentioned that increases in the size of the food waste collection program are expected to correlate with increased contamination.

Market Actor Involvement

Rexius is a commercial composter that takes curbside yard debris from Eugene based haulers. The residential food waste program allows participants to place privately generated food waste in their yard debris carts. All other materials are considered contaminants, not eligible for the program.

A waste to energy facility is necessary to convert food waste for energy generation. JC Biomethane is a biogas plant in Junction City with a capacity of 25,000 - 30,000 tons per year. This capacity is likely adequate to accommodate the needs of Eugene food waste, however the waste must be separate from yard waste, which could damage equipment if comingled.

Gresham Case Study

The research team was able to speak with someone at the Gresham Wastewater Treatment Plant as a case study. An OPAL researcher working on a different project has a relative who works for the City of Gresham and was able to connect the research team to a representative from Gresham's Recycling and Solid Waste Program. This representative also has some familiarity with other City of Gresham waste programs and waste-related programs at Metro, a regional government in the greater Portland metro. This section highlights the main findings from the conversation with this contact.

Gresham Wastewater Treatment Plant

As a little background, the Gresham Wastewater Treatment Plant has a cogenerator for food waste and currently makes the same amount of energy that it consumes each year. This is achieved through using biosolids from wastewater treatment as well as fats, oils, and grease to produce energy using an anaerobic digester. The plant also uses solar energy to reach net zero energy. According to a 2015 article about the facility, "organic matter from wastewater now fuels 92 percent of the Gresham plant's power- right on site- using a process that turns sludge into biogas. The City has doubled its biogas production since 2012, when haulers started trucking wastewater filled with fats, oils, and grease from Portland-area restaurants and food service establishments" (Veolia, 2015). This is similar to the process described in the Phase II report that the Metro Wastewater Treatment Plant (also known as the Eugene-Springfield Water Pollution Control Facility) uses to produce energy with an anaerobic digester (Shultz et al., 2016). Phase II research recommended that "future research could involve further investigating the WPCF in order to learn if the facility utilizes all its available feedstock materials to produce energy" (Shultz et al., 2016, pg. 29). This study did not reach out to the WPCF, but future research could look into this topic further and even compare it to the Gresham facility. For example, it does not seem like the WPCF is net neutral in terms of its energy usage. Perhaps lessons learned from the Gresham facility could help the WPCF improve its energy production. This topic is definitely worth further investigation since the Gresham representative thinks that "the future of food waste is anaerobic digesters".

Gresham Commercial Food Waste Collection Program

Since the interviewed representative from Gresham is a part of the Recycling and Solid Waste Program, he also works with the food waste collection and yard debris. He said that they would like to expand but "if Beaverton, Portland, and Gresham all came together with food scraps at once, we'd overwhelm the system. One problem we have is contamination, which is increasing costs. So one of our main focuses is educating people on contamination… so that when we do create these composts there is a good quality product on the market." It is interesting that contamination is once again a major barrier. Looking forward, he said that Metro is considering "making food scrap collection for businesses mandatory, because our programs have plateaued." In order to do this, Metro would use flow control mandates. In his words, "if we were to make it mandatory, Metro would control flow to that facility. It would provide an incentive to build that facility, knowing there would be new flow." It would be useful for future researchers to keep an eye on how things progress with Metro. If they do begin to require businesses to participate in the food waste collection program, it would be very interesting to see how that unfolds. If Metro uses flow control mandates to help achieve this, it would be a useful to see what challenges and successes arise.

Additional Suggestions

This interviewee was also asked if he had any additional recommendations for building energy resiliency. One idea he mentioned is building a transportation resiliency through food fuels in case of an emergency. As he said, "If we have a major earthquake on the west coast, we're going to have a major fuel shortage, so food fuels can support that. Even at places in California they collect food scraps onsite because they have a digester and it goes into their transportation fleet." This suggestion is similar to concerns that one of our waste processor interviewees mentioned in regards to transportation options in the event of a disaster (discussed further in the further research section). Another market actor interviewee also mentioned that gas-for-fuel programs using gas to power vehicles or busses are the "best bang for the buck environmentally" in terms of organic waste used for energy resilience.

Although one of our public official interviewees had mentioned that smaller facilities may be more politically palatable for Eugene, our Gresham contact warns that smaller facilities are often much more expensive. He also said that he knows some grocery stores are trying to

develop their own digesters and he had heard something about the Market of Choice in Eugene possibly pursuing this option.

The Gresham interviewee also recommended that the research team reach out to one of his contacts at Metro in order to get more of this regional perspective. The research team was unable to reach out to the potential participant due to time restrictions, but recommends that future investigations consider pursuing this contact at Metro to find out more. This may be especially relevant if Metro goes ahead to make the commercial food waste program mandatory and/or build a new WTE facility to accommodate the increase in feedstock. In general, case studies can inform best practices and demonstrate what happens when innovative ideas are actually put into practice. This study hopes that future research will consider this and other case studies.

VI. FURTHER RESEARCH

This section is intended to highlight areas for further research. Many interviewees brought up new topics and ideas that this research was not able to fully explore. As such, this study hopes to illuminate areas for future investigation. This section will begin with topics and stakeholders to follow-up with and then go into the main project recommendations.

Follow-Up

One of the limitations of this study is that the research team was unable to connect with and interview all of the relevant stakeholders. The biggest issue was simply not hearing back from potential interviewees. The research team tried a variety of approaches including emailing, cold calling, and even visiting City Hall in Eugene. The team also made sure to reach out several different times and through different methods. Email seemed to be the best way to connect, so this study would suggest that future research begin with this method before cold-calling.

Government Officials

Government officials were particularly difficult to reach, which was undoubtedly exacerbated by their busy schedules. This study was only able to interview two out of the eight Eugene City Councilors and one of the Lane County Commissioners. While interviewing more city and county officials may be helpful in providing more perspectives, there also was a sense that many officials felt that their knowledge on the topic was perhaps too limited. For example, one county commissioner agreed to be interviewed but said they really could not speak at all to the topic of waste or local energy production. Due to this, it is uncertain what exactly more interviews with government officials would yield.

Other City Employees

Besides elected government officials, there are also a few city employees that researchers were recommended to speak with but could not reach. The City of Eugene Solid Waste Analyst, Michael Wisth, is responsible for setting rates such as tipping fees and is very involved in the policy aspects of the waste stream in Eugene. The research team was unable to schedule an interview with him, but perhaps future efforts could reach out again and get his in-depth perspective. The interviewee from the City of Gresham also provided contact information for an employee with Metro who he recommended we contact for more information. This could also be a valuable follow-up to see how other governments in Oregon are approaching the topic of local energy resilience.

Market Actors

The research team was also not able to speak with representatives from all of the market actors that have been identified in Phase II research. Out of the five identified waste processors in Eugene, this study was able to interview representatives from all except for McKenzie Recycling. While this study includes a fairly good representation of waste processors, researchers were unable to reach any of the identified waste haulers. Waste haulers that were unable to be interviewed include: Ecosort, Royal Refuse, Sanipac, Lane Apex, and Cottage Grove. Two companies are both waste haulers and waste processors, but the research team could not reach any representatives from either company (Sequential Biofuels and City of Eugene Bloomberg). Although waste processors discussed their relationships with haulers and

government officials and city employees mentioned how they thought haulers might feel about certain ideas, it is important that future research connects directly with waste haulers.

Waste Producers

Although the research team created a set of interview questions for waste producers, there ended up not being sufficient time to reach out to these stakeholders. Further research is needed to approximate how much unused food waste is in Eugene's waste stream. About 300 commercial businesses are currently participating in the Love Food Not Waste program. Future research could interview or do a survey of both participants and nonparticipants to find out more about motivations. For example, some companies may want to participate but be limited by other factors. This kind of research could also provide an estimate of how much organic matter is not currently being collected in the Love Food Not Waste stream.

A necessary part of the overall research efforts will be to identify the quantity of food waste and other potential feedstocks in Eugene. Other potential feedstocks mentioned by interviewees as worth looking into include urban wood waste, yard waste, agricultural waste, brewery waste, as detailed above in section IV.I. This research, limited by time, was unable to interview waste producers to ascertain the quantity of waste they produce.

The General Public

The Eugene Waste Prevention Office is already addressing the general public as waste producers (i.e. a source of organic feedstocks). Future research from EWEB and partners could focus on the general public perception of WTE facilities and processes, rather than their role as waste producers. Coordinating with waste prevention officials to optimize data collection would allow for a fuller picture capturing the extent to which the general public would effectively utilize programs like Love Food Not Waste, as well as questions of public support for downstream steps including feedstock transportation and facility siting.

Contract Between Lane County and EPUD

The research team was informed by a county official about a contract that exists between Lane County and the Emerald People's Utility District (EPUD). According to the county official, there may be a provision in the contract that says Lane County cannot divert organic waste to other facilities not owned by EPUD. Technically the commercial and residential programs would

violate this piece of the contract. While it does not seem like EPUD is concerned about this, it could still be useful to look into the exact terms and conditions of the contract.

Main Recommendations for Future Research

- Collaborating with Market Actors on Local Policy Changes: Future efforts could interview waste haulers to find out more about their opinions around adjusting tipping fee structures and flow control as part of a larger plan to support energy resilience. Involving waste haulers and other market actors in the discussion around setting tipping fees would allow EWEB to leverage existing expertise in the industry, and may allay possible displeasure or resistance and ensure the system can be sustained.

- Continue Research on Eugene's Residential Food Waste Collection Program: As the pilot program continues, more data will become available. Currently, the City of Eugene is developing metrics to measure how much waste is being collected through the residential program. Researchers could check in again in the future with the city's Waste Prevention office to see how the residential pilot program progresses and if this new source of separated organic waste offers the potential for use in a community-based power generation system.

- Estimate Quantity of Available Organic Feedstock in Eugene: Through interviewing waste producers and obtaining relevant data from the City of Eugene and Lane County, future researchers would be able to estimate the quantity of available organic feedstock in Eugene. The focus of research has been on food waste, but findings from this research have identified waste from construction (woody debris), animal agriculture, and breweries as currently available and underutilized feedstocks. The potential of these options could be investigated further.

- Metro Commercial Waste Collection Program as a Case Study: Metro is potentially going to make it mandatory for businesses to participate in their commercial food waste collection program. If this happens, it sounds like a new WTE facility may be built to accommodate this additional feedstock. Metro may also use flow control mandates to

direct new waste flows to a new WTE facility. It would be useful for future research to investigate the challenges and successes of implementing flow control mandates, expanding the commercial program while limiting contamination of the food waste stream, building a new WTE facility, and any other changes to the waste system.

- Investigate the Eugene-Springfield Water Pollution Control Facility (WPCF): One of the short term recommendations of Phase II research was to collaborate with the Metro Wastewater Treatment Plant (also known as the WPCF) to see if the facility uses all of its available feedstock material to produce energy. Taking this a step further, future researchers could also use the case study of the Gresham Wastewater Treatment Plant to see if there is potential for the WPCF to also become energy net neutral.

- Further investigate the costs and feasibility of anaerobic digestion: Our preliminary research on anaerobic digestion suggests that digesters are commercially available and that the payback period for installation is relatively fast compared to other forms of waste management and other forms of renewable energy. Overall cost of disposal appears to be comparable to disposal in a landfill, and less than WTE incineration (World Bank 2012). Further research on the particular kind and scale of digester that would be used is necessary before drawing conclusions about how an anaerobic digester would be implemented as part of a food to waste system in the Eugene area. More information on anaerobic digestion can be found in the appendix.

- Building Transportation Resiliency: In the event of a natural disaster, it would be important that waste haulers can still bring feedstocks to WTE facilities. Otherwise, WTE facilities would be unable to continue generating electricity to power critical infrastructures. Several interviewees mentioned that gas-for-fuel programs to power vehicles could be a solution. It sounds like some places in California may use food scraps to power their transportation fleet, which could yield valuable case studies.

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VIII. APPENDICES

Interview Questions

These questions formed the basis for our interviews, although most interviews deviated from the script in a "semi-structured" interview style. We asked some additional questions not included in the script, and in some interviews did not ask all scripted questions if we found the question irrelevant, the question was already answered, or we ran out of time.

<u>For market actors (haulers and processors of organic waste)</u>

1. In what ways could we incentivize organic waste haulers to reroute their waste to a WTE facility?
    a. (If we want to be more specific) What could be an optimal tipping fee to incentivise organic waste haulers to WTE facilities as opposed to compost facilities?

2. How do changes in fees affect your business?In your experience, how often does the tipping fee change?

3. Do you charge for picking up waste? For people dropping waste off?
    a. What do you charge?
    b. Would you be willing to alter those charges to incentivize a WTE system?

4. What might motivate you and other processors to establish a waste-to-energy system?

5. What kinds of waste is your facility capable of processing?
    a. Have you thought about expanding to process other kinds of waste? (i.e. wet waste)
    b. What challenges and costs would be associated with expanding to other kinds of waste?

6. How much volume of wastes are processed/hauled?
    a. Where are your processing facilities?
    b. What is the market like--enough supply from the Eugene area?
    c. Capacity to process more?

7. If you were to organize/design a waste-to-energy network, what would it look like? E.g. Hauler and processor same org, separate drop-off location, etc.
    a. What would be the best way to capture the waste stream? (What else do we need to capture the waste stream?)
    b. Would it be possible to have one window/facility for collecting, sorting, and processing organic waste and finally converting it to energy?

8. Are you currently involved in the residential organic waste collection pilot program?
    a. If so, what is your role?
    b. How much waste do you collect?
    c. Where does it go?
    d. Do you like this program/think it's a good idea/should continue?
    e. Would you like to be involved in the future if you aren't currently?

9. What kinds of relationships or partnerships do you have with other companies involving the waste stream?
    a. Would you be interested in creating new partnerships? E.g. with EWEB and/or other processors/haulers to coordinate routes, filling gaps in capacity for different kinds and amounts of waste.
    b. If EWEB partners with a company, would that be something that your company will welcome?

10. Are you concerned about the effects of a disaster like the Cascadia earthquake on your transportation and processing?

11. Who else should I be talking to about this?

City & County Officials

1. The market for organic waste is competitive, however, it is regulated by the county. Can the county officials fix a tipping fee to promote WTE facilities?
    a. How flexible is changing the tipping fee?
    b. Would you expect public support or public opposition?
    c. Is this different for residential and commercial?

2. If we were to promote WTE, does the city/county/state govt currently offer any kind of incentives (such as tax credits or tax cuts, third party recognition such as trade group awards) to haulers/sorters/processors/WTE facilities? Elaborate.
    a. If so, is there anyone you would recommend we talk to in order to find out more?
    b. If not, is there any future possibility or plans to create such incentives?

3. If you were to design a new flow control policy, what information would you need?
    a. What challenges would you expect? From residents? From haulers/processors?
    b. What are some barriers that you foresee? From residents? From haulers/processors?

4. Can you share success/hurdles/challenges to residential food waste collection program?
    a. How did the pilot program work in 2016?
    b. What do you know about the commercial food waste collection program?
    c. Do you know where does that waste go? Who collects that waste?

5. Who else should I be talking to about this?

Suggested additional question if time and interviewee seems knowledgeable about the subject:

With Flow Control Policy in place, do you have in mind any particular facility capable of handling organic waste?

Unused Interview Questions

We wrote interview questions for major producers of organic waste but did not interview these stakeholders. Organizations that result in large amounts of organic waste could be valuable interviewees for future research, or valuable stakeholders to have at the table when implementing an organic WTE system.

For producers of organic waste (e.g. Restaurants, Hospitals, Cafeterias, Contractors etc.)

1. About how much organic waste do you produce within a given time frame (per week? per month?). What kinds of waste do you produce the most of? (wet/dry, food/woody)

2. Do you currently participate in an organic waste collection and recycling/composting program?
    a. If no, would you be interested in participating in one?
    b. If no, why not? If the charge for organic waste collection per can is less than that for mixed waste and recycling, would that change your answer?
    c. If yes, what are some pros and cons of the program?

3. Do you pay anything for that service separate from your typical garbage and recycling service?
    a. Where does that waste go?

4. Would you support an initiative to use this organic waste to produce energy for the City of Eugene?

5. How feasible (is it or) would it be for you to separate your organic waste?
    a. How much time would this take? Money? Are either a barrier?

6. Would a collection rate reduction be an incentive to make the change to separate organic waste?
    a. If so, how much of a reduction? (Would it need to be free?)
    b. If not, why not? (Is separation too expensive even if no collection fee?)

7. Who else should I be talking to about this?

More Information on Anaerobic Digestion

Anaerobic digestion (AD) is a process in which organic waste is composted in a low-oxygen system to produce "biogas" (primarily methane and carbon dioxide), as well as solid and liquid residues. AD can be used to produce electrical power by combusting biogas, a substitute for natural gas, or a liquid fuel for vehicles. The biogas produced also contains hydrogen sulfide, siloxanes, moisture and other contaminants that must be at least partially removed before use (Moreno 2012). Possible feedstocks for AD include manure, municipal wastewater, "FOGs" (fats, oil and grease), and food waste (energy.gov 2013).

The solid and liquid residues are considered byproducts of the system, but can be used for fertilizer on agricultural land if there is demand and the residues are not too contaminated. Alternatively, liquid residues or "percolate" can feed back into the system to maintain desired water content and bacterial community in the digester (Kleinheinz 2012. Fig. 1). AD can be "wet" or low-solids, with less than 15% solid material, or "dry," with greater than 15% solid material. Wet systems are more common in the U.S. where they are used to treat municipal wastewater.

U.S. EPA provides several online resources with more information on AD, which are listed below. The Co-Digestion Economic Analysis Tool (CoEAT) may be of particular interest if EWEB is to pursue further research on the Gresham wastewater codigestion facility and the potential for implementing such a system in the Eugene area. This tool assists in conducting a preliminary assessment of the economic feasibility of co-digestion of food waste and FOG at and wastewater (Moreno 2012).

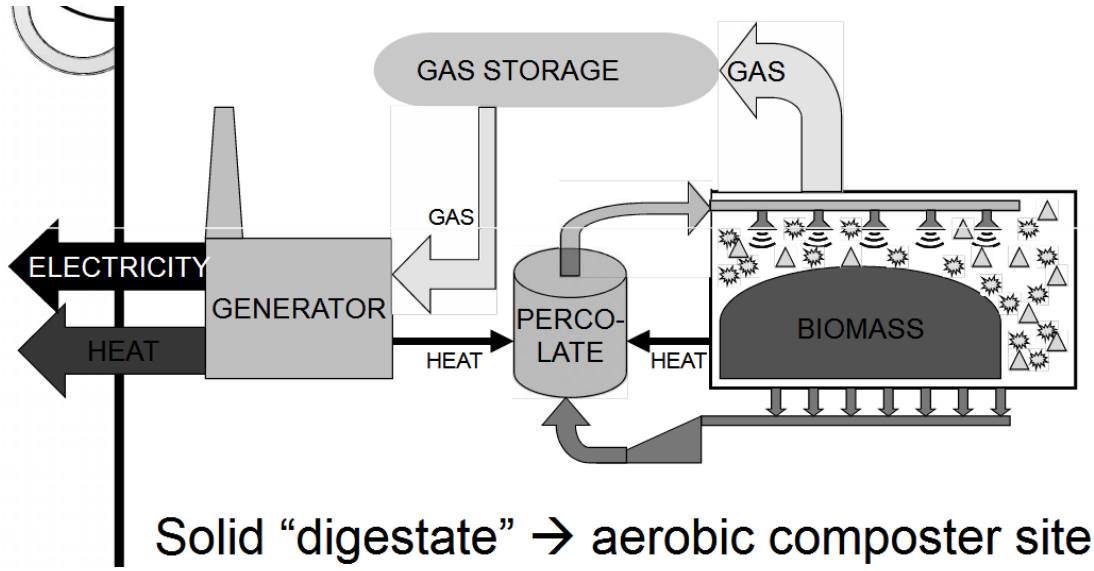

Figure 1. Diagram of "dry" anaerobic digester facility at University of Wisconsin Oshkosh. This facility uses food and yard waste as feedstocks. New material and partially digested material are mixed to improve pH and bacterial inoculation. Heat must be applied to maintain the system at 38°C (Kleinheinz 2012).

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