

Eugene Solid Waste Management Market Analysis



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About the UO EDC

The University of Oregon Economic Development Center is a partnership between the Community Service Center, the Center for Sustainable Business Practices, the Sustainable Cities Initiative, and UO faculty. The UO Center provides technical assistance to organizations throughout Oregon, with a focus on rural economic development. The UO Center seeks to align local strategies to community needs, specifically with regards to building understanding of the benefits of sustainable practices and providing technical training to capitalize on economic opportunities related to those practices. The EDC is partially funded through a grant from the U.S. Department of Commerce, Economic Development Administration.

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EXECUTIVE SUMMARY

This study examines the economic impact of the solid waste management system in Eugene and Lane County. Solid waste management encompasses all activities surrounding the collection, transportation, processing, disposal and re-sale of solid materials that pass through the refuse, recycling, composting, or re-use waste streams. We examine the employment, wage, and output patterns of solid waste management activities within Eugene. Considering each of these indicators, we look at how the solid waste management system of Eugene has changed over time, what role it plays in the economy relative to other industries, and how it is structurally different than the solid waste management system of Oregon as a whole.

Findings

Four industries dominate the solid waste sector in Eugene: (1) Collection; (2) Processing and Disposal; (3) Material Wholesale; and (4) Used Merchandise. Table S-1 summarizes the economic impact of the solid waste sector in Eugene and Lane County. The data indicate that the solid waste sector contributes \$13.1 million in total receipts to Eugene's economic, and \$24.5 million to Lane County's economy. Eugene has 25 establishments with just over 500 employees, while Lane County has 66 establishments with just over 1,000 employees. The average wage in Eugene and Lane County is considerably lower than the state average, due in large part to the large concentration of employment in the Used Merchandise industry.

Table S-1. Summary of Economic Impacts of the Solid Waste Management Sector, Eugene and Lane County, 2010

Indicator	Eugene	Lane County
Number of Establishments	25	66
Total Employment	504	1,005
Average Wage	\$23,966	\$25,607
Total Receipts	\$13,060,402	\$24,436,277

Source: Quarterly Census of Employment and Wages, 2010; Economic Census-

The solid waste management system in Eugene is structurally very different from the rest of Oregon. Eugene has a very strong Used Merchandise industry (about 80% of Eugene's employment is in this industry). As a result, the overall waste management system reflects trends seen in the Used Merchandise industry: low absolute wages, but high employment, employment growth, and wage growth. Eugene likely exports many of the high-output, high-pay segments of the waste management supply chain, such as recyclable material processing, to the rest of Oregon.

- The sorting, processing, disposal, and post-consumer sale of refuse and recyclable materials in Eugene employs few workers and offers low wages

relative to the rest of Oregon. These activities employ roughly one-fourth as many workers in Eugene as in Oregon.

- Across all geographies, employment in the waste management industry as a whole grew considerably between 2005 and 2010, even as employment across all industries combined was essentially stagnant. This suggests **waste management as a whole as a somewhat “recession proof” industry in Oregon.**
- Across most waste management industries in Lane County and Oregon, waste management wages are rising at roughly the same rate as wages across all industries, with the exception of Material Wholesale in Lane County. In Eugene, wages in waste management industries have been rising much faster than wages in other sectors of the economy.

The remainder of this section breaks down each of the four waste management industries according to their wage, employment, and total receipts data. For the sake of comparison, total employment across all industries in Lane County amounts to 145,282, and these workers earn an average wage of \$35,895.

Waste Collection

The waste collection industry includes waste haulers, drop boxes and waste collection at transfer facilities for all waste streams; including materials from commercial and residential sources. The local transfer facility is Glenwood Central Receiving station, and local haulers include Sanipac, Lane Apex, and others.

- Within Lane County, the Collection industry employs 251 employees earning a combined \$9.5 million in wages. Establishments in this industry collected \$39.9 million in total receipts.
- **Employment in this industry saw 13% growth between 2005 and 2010 in Lane County**, and the employment location quotient¹ was 1.2.
- In 2010, the average wage for this industry was \$37,767; which was 9.2% higher than it was in 2005. **This wage is 17% less than the average wage for Collection workers in the rest of Oregon.**
- **Collection workers enjoy 2.1% higher average wages than other workers across all industries in Lane County.**
- The Collection industry is the largest employer of the recycling, refuse, and composting waste streams in Lane County, accounting for 73% of employment within these waste streams. It accounts for 25% of all waste

¹The location quotient compares the regional share of economic activity in a particular industry to the statewide share of economic activity in the same industry. The result reveals the degree of regional specialization in each industry. The employment location quotient for Lane County is calculated by the following formula:

$$\text{LQ} = \% \text{ of Total Employment in Lane County for the given industry} \div \% \text{ of Total Employment in Oregon for the same industry}$$

management employment. **Collection also pays the highest average wages for all waste management industries.**

- The Collection industry in Lane County appears to be healthy, with strong employment, employment growth and wages, even through a period of national recession.
- Overall, Collection employment and wage patterns are fairly typical for Oregon as a whole.

Solid Waste Processing and Disposal

This industry comprises all processes between waste collection and its eventual end, be that disposal in a landfill or processing through a Material Recovery Facility (MRF) or resale as a post-consumer product. Local examples include Lane County's Short Mountain Landfill and the MRF, EcoSort.

- Within Lane County, the Processing and Disposal industry employs 44 people earning a combined \$1.4 million in wages.
- Employment in this industry declined by 8.3% between 2005 and 2010 in Lane County, and **the employment location quotient was 0.23 showing a very low degree of specialization.**
- In 2010, the average wage for this industry was \$31,577; which was a 15% increase from 2005. This wage is 43% less than the average wage for Processing and Disposal workers in the rest of Oregon.
- Processing and Disposal workers receive 12% lower wages than other workers across all industries in Lane County.
- Processing and Disposal has the lowest employment of the four waste management industries.
- Lane County's Processing and Disposal industry accounts for 12% of employment within the recycling, refuse, and composting waste streams, and pays the lowest average wages within these waste streams. Processing and Disposal accounts for only 4.3% of employment across all waste management industries.
- The Processing and Disposal industry in Eugene has drastically lower employment and wages compared to Oregon as a whole. Employment growth has been slightly lower and wage growth has been slightly higher than in the rest of Oregon.
- Overall, the Processing and Disposal industry in Lane County is weaker than in the rest of Oregon. Many of the activities within this industry may be exported to the Portland area due to economies of scale. For example, most hazardous waste in Eugene is likely shipped outside of Eugene for disposal, since Eugene does not produce enough of these materials to justify developing the specialized capabilities required for their disposal locally.

Material Wholesale

This industry contains the production of recycled, non-virgin, raw materials that are sold to be used again in manufacturing. A common example is the smelting of scrap iron into useable ingots, which may be sold to manufacturers.

- Within Lane County, the Material Wholesale employs 49 employees earning a combined \$1.7 million in wages.
- **Employment in this industry saw a 55% decline between 2005 and 2010 in Lane County, and the employment quotient was 0.33.**
- In 2010, the average wage for this industry was \$34,879; which was 31% higher than in 2005. However, this wage is 43% lower than the average wage for Material Wholesale workers in the rest of Oregon.
- Material Wholesale workers have 2.8% lower wages than workers across all industries in Lane County.
- The Material Wholesale industry in Lane County has drastically lower relative total employment and employment growth than in Oregon as a whole. Relative wages are slightly lower than in the rest of Oregon, though they have been growing more quickly.
- Overall, Lane County's Material Wholesale industry is weak relative to the rest of Oregon. The most concerning trend within the Material Wholesale industry is the 55% decline in employment that occurred between 2005 and 2010, even as the industry saw a 29% rise in employment in Oregon as a whole. Much like the Processing and Disposal Industry, the Material Wholesale industry's profit per unit of output may be at its maximum. Eugene may not produce enough of many recyclable materials (e.g. aluminum) to make it economical to turn these materials into useable feedstock for manufacturers (e.g. smelting aluminum) at local facilities. As recently as 2005, Lane County had twice as many employees engaged in Material Wholesale activities, so there may still be some potential for re-growth in this industry.

Used Merchandise

This industry contains the resale, whether as-is or after repair, of used products. These include, but are not limited to: used books, appliances, furniture, antiques, and clothes. This industry closely compares with the re-use waste stream. As a note, used automobiles are not part of this measurement.

- **In Lane County, the Used Merchandise industry employs 661 employees earning a combined \$13.2 million in wages. A total of 443 of these employees work in Eugene.**
- In Lane County this industry experienced 60% employment growth between 2005 and 2010, and the employment location quotient in 2010 was 4.6. **The Eugene employment location quotient in 2010 was even higher at 5.5. This suggests a very high degree of specialization in this sector.**

- In 2010, the average wage for this industry was \$19,967; which was 12% higher than it was in 2005. This wage is 11% high than the average wage for Used Merchandise workers in the rest of Oregon.
- Used Merchandise workers receive 44% lower average wages than other workers across all industries in Lane County.
- The **Used Merchandise industry in Eugene accounts for 88% of employment in the waste management system as a whole.** However, the average wage for Used Merchandise workers is substantially lower than workers in other waste management industries. Many of the Collection, Processing and Disposal, and Material Wholesale establishments that service Eugene are located outside of the Eugene city boundaries, so 88% of employment likely overestimates the true impact of Used Merchandise compared to other solid waste management industries.
- The Used Merchandise industry in Eugene accounts for a larger portion of total sales receipts than in the rest of Oregon, though this difference is not as great as the difference in employment between the two geographies. This implies that the output per worker in Eugene is less than in the rest of Oregon, even though Eugene employees are paid more.
- Eugene has a very robust **Used Merchandise industry, with an employment location quotient of 5.5 and a receipts quotient of 1.59.** Eugene clearly specializes in this industry, even if it is small relative to the economy as a whole, employing 0.55% of all workers in Eugene. Initially, we hypothesized that this might be due to Eugene's lower than average income and high unemployment rate, driving up the demand for used goods. However, our statistical analysis did not find evidence that these factors influenced Used Merchandise employment systematically across the United States. There are likely to be legislative and cultural factors fueling the used good market that our model does not account for. This may be a by-product of a community preference for environmentally friendly goods or for a particular aesthetic which used merchandise appeals to.

I. INTRODUCTION

In 2001, the State of Oregon passed legislation HB 3744, which set statewide waste management targets for 2005 and 2009. The 2005 targets aimed to achieve a diversion rate of 45% and no increase in per-capita waste generation. The 2009 diversion rate target was 50 percent, with no annual increase in waste generation. The diversion rate is the percentage of total waste that is diverted from disposal through recycling, yard debris and composting programs.

To achieve these statewide goals, Oregon wastesheds were charged to set their own voluntary rates. A wasteshed is defined as an “[area] of the state that shares a common solid waste disposal system, or an appropriate area in which to develop a common recycling system.”² The boundaries of the Lane County wasteshed coincide with the boundaries of Lane County itself. The Lane County wasteshed set diversion rate goals of 45% and 54% for the years 2005 and 2009, respectively.

In 2009, Oregon fell short of the statewide recovery goal of 50% by 1.7 percentage points. This goal, however, was met in 2010. Lane County also failed to meet its own county-level target of 54% by 1.6 percentage points. Due to this failure to meet the targeted rate, Lane County was required, by HB 3744, to make a technical review of all their existing programs in order to determine where improvement might be possible.

Purpose

As a part of this broader, technical review, the Eugene Solid Waste and Green Buildings Program asked the Community Planning Workshop (CPW) at the University of Oregon to carry out a system review of all waste-related business in the city of Eugene and the Eugene-Springfield Metropolitan Statistical Area.

As part of this larger system review, our study analyzes the economic impact of the current solid waste management system in Eugene and Lane County. Specifically, our study examines the waste management system in four waste streams: (1) disposal; (2) recycling; (3) reuse; and (4) composting, and how they contribute to total waste generated in the City of Eugene. Using the North American Industry Classification System,³ this study attempts to separate out the economic impact of different industries based on how they contribute to these industries within the waste management system.

Understanding the extent and impact of the different solid waste management industries within Eugene can help policy-makers better analyze how to create a

² Oregon Department of Environmental Quality, "Wasteshed Rates." <http://www.deq.state.or.us/lq/sw/recovery/rates.htm>.

³ The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

more efficient system, meet diversion rate goals, and identify opportunities for economic use of materials which can create jobs.

Organization of this Report

The remainder of this report is organized as follows:

Section I: Framework. This section includes a discussion of previous studies, an overview of the waste streams that are considered in this study, and a discussion of our methodology. The methodology portion of this section includes information about data sources and the limitations this study faces due to data availability and other constraints.

Section II: Findings. In this section we present data on the number of establishments, employment, wages and receipts for various industries within the solid waste management system. We examine trends in these indicators over time, across various geographies, and relative to the rest of the economy, in order to quantify and contextualize the impact of Eugene's solid waste management system on the local economy.

Section III: St. Vincent de Paul of Lane County Case Study. Here we take a look at the St. Vincent de Paul Society of Lane County, and examine the re-use and recycling programs that they carry out. St. Vincent de Paul provides a good example of local efforts, as they represent a substantial part of the re-use and recycling industry in Eugene.

Section IV: Statistical Analysis. In this section we perform a multi-variate, linear, least-squares regression to determine whether the waste management employment patterns of Lane County can be explained based on the county's economic and demographic characteristics. We estimate trends across all U.S. counties for which data is available, and also examine whether or not Lane County fits in with these trends.

Section V: Closing Remarks. Here we extract the most salient observations from the data and our case study to describe the solid waste management system of Eugene. We examine the characteristics that make this industry unique, deficient, or exceptional within Eugene and the rest of Lane County.

Appendix. Additional information is provided for the limitations of the data available.

The report also includes two appendices:

Appendix A: Limitations describes limitations of the methods used for this study.

Appendix B: Glossary defines key terms used in this report.

II. FRAMEWORK FOR THIS ANALYSIS

This study examines the economic impact of the solid waste management system in Eugene and Lane County. Solid waste management encompasses all activities surrounding the collection, transportation, processing, disposal and re-sale of solid materials that pass through the refuse, recycling, composting, or re-use waste streams. It examines the employment, wage, and output patterns of solid waste management activities within Eugene. Considering each of these indicators, this study analyzes how the solid waste management system of Eugene has changed over time, what role it plays in the economy relative to other industries, and how it is structurally different than the solid waste management system of Oregon as a whole.

Solid waste management can be divided into four general waste streams: (1) refuse and disposal; (2) recycling; (3) composting; and (4) re-use. Refuse and disposal describes waste material that is not recycled, composted or reused; such as household garbage. Material is labeled as recycling if it is diverted from disposal and converted into non-virgin raw material, including the breakdown of cardboard and aluminum. Composting is made up of biodegradable material diverted to a composting facility, for example yard debris. Re-use is made up of material or other products diverted from disposal that can be re-inserted into the market as-is or after repair. Used clothes, furniture and antiques are all re-useable products.

In 2010, Eugene reported the following tonnages for collected solid waste:

- 88,016 tons of refuse composed of 27,724 tons from residential sources and 60,292 tons from commercial sources.
- 20,376 tons of recycling composed of 10,859 tons from residential sources and 9,517 tons from commercial sources.
- Residential yard debris amounted to 14,339 tons.

Material within each of these waste streams is collected, transported, sorted, processed, discarded and/or re-sold in a variety of ways. This study breaks down the activities involved in the management of this waste material using the North American Industrial Classification System (NAICS). NAICS codes allow us to parse out waste management activities from the rest of the economy. We separate these activities into four industries:

1. Collection
2. Processing and Disposal
3. Material Wholesale
4. Used Merchandise

Solid waste management contains all activities involved in the collection, processing and disposal, material wholesale and used merchandise retail for the four waste streams. Solid Waste in Eugene is generated primarily in the

residential and commercial sectors. There are currently seven active waste hauling companies operating in and around Eugene that offer trash, recycling and comingled recycling, and yard debris collection services throughout all of Eugene and Springfield.

Description of Waste Streams

A foundational element of estimating the economic impacts of the solid waste management system is defining the system and its waste streams. Each of the following is considered a waste stream within the solid waste management system of Eugene, and contains a portion of total solid waste generated.

Refuse and disposal

The refuse and disposal waste stream describes all solid waste material that is not recycled, composted or reused. In 2010, refuse amounted to 27,724 residential tons and 60,292 commercial tons of solid waste.

In Eugene, refuse is collected through commercial haulers, self-haul and Glenwood Central Receiving station. Material that is not diverted is sent to Short Mountain Landfill. Currently, Short Mountain is the only municipal solid waste landfill in Lane County and is only open to approved commercial haulers.

Recycling

Material is considered part of the recycling waste stream if it is diverted from disposal and broken down to non-virgin raw material to be used again in manufacturing or other processes. In 2010, recycling amounted to 10,859 residential tons and 9,517 commercial tons of solid, diverted waste.

Recycling in Eugene is collected by commercial haulers, self-haul and from transfer stations before being sent to Material Recovery Facilities (MRFs) for processing. Eugene has had a policy of comingled recycling since December 2003. Comingled recycling includes, with some exceptions: plastics, paper and cardboard, and metal and aluminum. Glass recycling is collected separately.

EcoSort is currently the only MRF in Eugene. Accepted materials include: wood, concrete, asphalt, metal, aluminum, and new construction sheet rock. Not acceptable materials include: hazardous waste, batteries, paint, garbage, chemicals, oil, mattresses, and asbestos. Sanipac handles all of the hauling of recycling and construction debris to this facility, as it is not open to the public.

While comingled recycling exists throughout most of the state of Oregon, most comingled materials are processed at "five comingled recycling processing facilities in the greater Portland Metro area," although a sixth facility has recently begun operation.⁴ Other than these facilities, Smurfit Recycling has a facility that handles a small amount of processing at Grants Pass, and a small amount of comingled recycling is handled out-of-state.

⁴ State of Oregon Department of Environmental Quality: *Composition of Comingled Recyclables Before and After Processing*, 2011.

Composting

Material is considered part of the composting waste stream if it is biodegradable and diverted from disposal to a composting facility. Composting is an important alternative to simply disposing of organic matter in a landfill. Estimates by the City of Eugene indicate that about 10,000 tons of commercial food waste goes into Short Mountain Landfill each year, and Sanipac estimates that 23% of the commercial waste stream is made up of food waste.

Serviced removal for residential compost is currently limited to organic yard debris, which is usually taken to Rexius Sustainable Solutions and Lane Forest Products for composting. Residential yard debris amounted to 14,339 tons in 2010.

The City of Eugene is currently piloting a “Food Compost Program” for businesses, which allows for the composting of food waste such as eggs, meats, baked goods, and dairy. Since November 2011, waste haulers have been collecting food waste from restaurants, grocery stores and other commercial enterprises and taking it to Rexius Sustainable Solutions and Lane Forest Products. The city hopes to reduce the 10,000 tons of food waste by a third by this year.

Re-use

Material is considered part of re-use if it is diverted from disposal to be used again without decomposing it to its raw materials. This is accomplished by direct re-sale, refitting and/or partial breakdown and reassembly. A used refrigerator resold after repairs or mattress springs used to make another mattress both constitute re-use.

Old clothing, used books, old household appliances, old toys, antiques, furniture, and old mattresses are all examples of what the re-use market takes from the waste stream. These goods are then re-inserted into the market to provide utility for others at a lower price and without the expenditure of resources producing new products. Antique shops, thrift stores and used parts all fall within this category.

Methodology

This study examines four categories of activity within the solid waste management system: Collection, Processing and Disposal, Material Wholesale, and Used Merchandise. We use these categories to analyze the structure of the waste management system in Eugene, both in absolute terms and relative to the solid waste management systems of Lane County and Oregon. These industries, as well as the aggregate industries we compare them to, are defined by NAICS codes as shown in Table 1.

Table 1: Definitions of Waste Management Industries

Industry	NAICS Code(s)	Activities	Local Examples
Collection	56211	Collecting and transporting refuse, recycling, and compost materials	Sanipac, Lane Apex
Processing and Disposal	562 (excluding 56211 and 562910)	Operating landfills and material recovery facilities. Composting and incineration.	Short Mountain Landfill, EcoSort
Material Wholesale	423930	Selling of automotive scrap, industrial scrap , textile scrap, and other recyclable material	St. Vincent de Paul, Schnitzer Steel
Used Merchandise	453310	Retail sale of used goods including books, clothes, antiques, furniture etc. Excludes used automobiles and auto parts.	St. Vincent de Paul, Oregon Antiques Mall
All Waste Management	423930, 453310, and 562 (excluding 562910)	Any of the activities mentioned above	Any of the companies listed above
All Industries	All	All formal economic activity	

We used NAICS codes to identify firms and activities related to the solid waste industry. The NAICS categorizes establishments based on the primary activities they engage in. This system assigns the same industry code to each establishment that performs the activities described by that NAICS code. These codes provide a useful system for separating the economic activity of the waste management system from the rest of the economy.

The 562 NAICS code encompasses most Waste Management and Remediation activities besides re-use. Within the broader 562 code, we examine Waste Collection (code 56211) separately, in order to gain a more detailed picture of the solid waste management system’s structure.

We exclude Remediation Services (code 562910) from our analysis. Remediation Services include hazardous and mining waste cleanup, wastewater treatment, toxic material abatement, and similar services. These services do not primarily manage solid materials from the waste streams that this study examines; namely disposal, recycling, composting, and reuse.

Within the 562 code, there are several sub-codes such as Solid Waste Landfills and Remediation Services. Ideally, we would like to study the structure of each of these codes individually, but that is not possible due to disclosure issues (see discussion of limitations below). The data allow us to parse out Waste Collection (code 56211) and to exclude Remediation Services (code 562910), but all other activities within the broader 562 code are grouped together, because each of these sub-industries on its own is too small to meet disclosure standards. We report data (e.g. total employment figures) on this group of activities by subtracting the data for Waste Collection and Remediation Services from the

same figures for Waste Management and Remediation services as a whole (code 562).

The formal re-use waste stream is mostly captured by Used Merchandise activities. Used Motor Vehicle Parts Merchants (code 42314) and Tire Retreading Services (code 326212) are not included within Used Merchandise measurement due to unavailability of data. This will bias our estimates for the Used Merchandise industry downward, since some activities are excluded.

The bulk of the economic impact data for this study comes from the Quarterly Census of Employment and Wage (QCEW), conducted by the Bureau of Labor Statistics (BLS) and the U.S. Department of Labor. We also draw from the Economic Census, conducted by the U.S. Census Bureau.

Manufacturing with recycled material

Past studies have examined the economic impact of “recycling manufacturing,” meaning the employment and output that is created by manufacturing facilities that use recycled feedstock. However, it is unclear how much of the employment and revenue generated by these activities can justly be attributed to the recycling industry. For example, if a paper mill uses 30% post-consumer waste in their production of new paper, R.W. Beck (2001) would attribute 30% of that mill’s employment to the recycled manufacturing sector, and include that as employment generated by the recycling sector. However, in the absence of a recycling industry, that same paper mill would still have employees and equipment and distribution networks with which to make paper, and would likely substitute virgin material for all or most of that 30% of feedstock. If employment at a company would be mostly unchanged in the absence of a solid waste market, it seems unfair to attribute that employment to the recycling industry. By contrast, establishments such as landfills and waste collectors rely entirely on the existence of solid waste for their continued operation.

Estimating the percentage of manufacturing within Eugene that uses recycled feedstock is beyond the scope of this study, and it is unclear how to estimate the marginal benefit those operations receive from the use of recycled material rather than virgin material. Therefore, this study will not account for any economic impact recycled material may have after it has been processed into useable raw material and sold.

Limitations

The data sources used in this study create some limitations on what can be reported. Data describing the solid waste management market is limited for several reasons.

- Eugene is a relatively small aggregation to find data for. In a few specific NAICS designations, there are too few businesses to meet disclosure standards for exact data to be available.
- Data describing the re-use waste stream experiences some give and take due to the nature of NAICS code 453310, Used Merchandise Stores. Since this designation is based on stores that “primarily” engage in re-use

business, there is overestimation from businesses included, and underestimation from businesses that do engage in re-use, but not “primarily.”

- Used Motor Vehicle Parts Merchants (code 42314) and Tire Retreading Services (code 326212) are omitted from re-use. They are missing employment and revenue data, because there are too few facilities for data to be available.
- There is no simple way of separating out the effects of recycling from total waste disposed, because the NAICS system has all waste collection and processing and disposal activities in one category. As a result, employment and revenue cannot be divided between the collection of refuse, recycling, and yard debris.
- Since there are limited data available at the city level, county level data is used as an alternative measure. This confers some issues of geography, due to Lane County data capturing more than Eugene alone represents.

Despite these limitations, we feel the data presented in this report provide a reasonably accurate and reliable overview of the solid waste management system. A more detailed description of each of these issues is available in Appendix A.

III. FINDINGS

This section presents the core findings of this study: the number of establishments, employment, wages, and total receipts for each solid waste management industry (see Table 1: Definitions of Waste Management Industries above). For each industry, we analyzed how these indicators have changed over time, how they compare to the rest of Eugene’s economy, and how they compare to the same industry in Lane County and Oregon as a whole

Number of Establishments

Table 2 presents data on the number of solid waste management establishments in Eugene, Lane County and Oregon in 2010. Data for the number of establishments involved in each industry at the state and county level comes from the QCEW database provided by the BLS. The BLS does not publish data at the city level. Brian Rooney, regional economist for Douglas and Lane Counties, provided QCEW data at the Eugene level.

Table 2: Number of Establishments in the Solid Waste Management System for Eugene, Lane County, and Oregon (2010)

Industry	Eugene	Lane County	Oregon
Collection	n/a	13	162
Processing and Disposal	n/a	11	118
Material Wholesale	n/a	5	118
Used Merchandise	19	37	318
All Waste Management	25	66	716
All Industries	6,155	10,526	126,858

Source: *Quarterly Census of Employment and Wages, 2010*

Entries labeled “n/a” are not available, to protect firms’ confidentiality

The number of establishments alone does not reveal much about the economic impact of each industry, since one large company could have more impact than two or three smaller companies. However, these data are useful for determining the structure of each industry when combined with the employment and receipt data below.

Employment

One key consideration when assessing the impact of the Eugene solid waste management system is the number and quality of jobs that are produced. Table 3 and Figure 1 present data on the number of jobs in Eugene, Lane County and

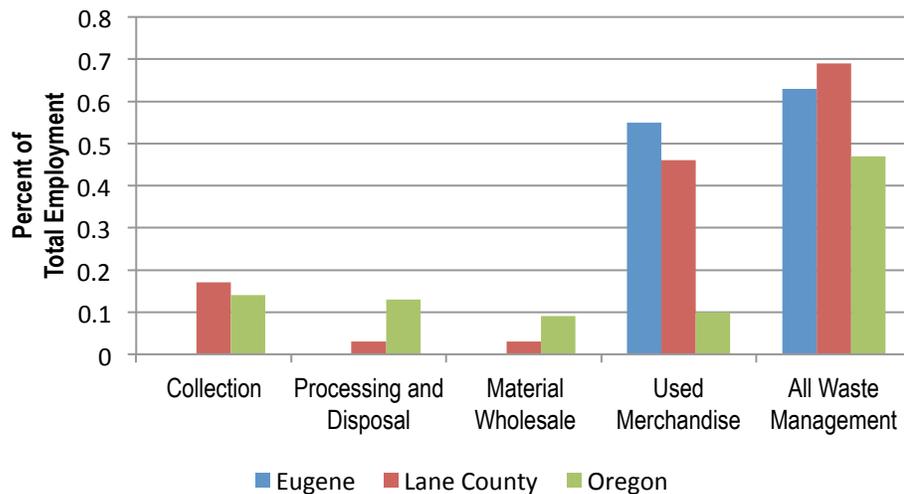
Oregon in 2010, and shows the distribution of jobs that are attributed to each waste management industry.

Table 3: Solid Waste Management System Employment for Eugene, Lane County, and Oregon (2010)

Industry	Eugene	Lane County	Oregon
Collection	n/a	251	2,496
Processing and Disposal	n/a	44	2,131
Material Wholesale	n/a	49	1,919
Used Merchandise	443	661	2,232
All Waste Management	504	1,005	8,778
All Industries	80,045	134,545	1,598,173

Source: Quarterly Census of Employment and Wages, 2010
 Entries labeled “n/a” are not available, to protect firms’ confidentiality

Figure 1: Waste Management Employment by Industry (2010)



Industry Employment Relative to Total Employment

To provide context for the scope of Eugene’s solid waste management system within the broader economy, here we compare the most recent employment figures available (2010) for each solid waste management industry in Eugene to the same industries in Lane County and Oregon as a whole. Table 4 presents data on relative employment figures for Eugene, Lane County and Oregon in 2010.

Table 4: Relative employment for Eugene, Lane County, and Oregon (2010)

Industry	Percent of total employment			Location Quotients		
	Eugene	Lane County	Oregon	Eug./Lane	Eug./OR	Lane/OR
Collection	n/a	0.17%	0.14%	n/a	n/a	1.21
Processing and Disposal	n/a	0.03%	0.13%	n/a	n/a	0.23
Material Wholesale	n/a	0.03%	0.09%	n/a	n/a	0.33
Used Merchandise	0.55%	0.46%	0.10%	1.19	5.50	4.60
All Waste Management	0.63%	0.69%	0.47%	0.91	1.34	1.47

Source: Quarterly Census of Employment and Wages, 2010

Entries labeled “n/a” are not available, to protect firms’ confidentiality

Percent of total employment is calculated by dividing the employment for a given industry and geography by the total employment for all industries within that same geography. The location quotients are calculated by dividing the percent of total employment for each industry in one geography by the associated percentage of total employment of a different geography. For example, the “Eug/OR” location quotient for Used Merchandise is calculated by dividing the percent of total employment for Used Merchandise in Eugene by the percent total for Oregon.

The Eugene location quotient for each industry is an indicator of whether that industry plays a large or small role in Eugene’s overall employment relative to other geographies. Where Eugene data is not available, we will use Lane County as an approximation in our analysis.

Employment Change Over Time

We were also interested in the employment trends for each industry within Eugene. Table 5 displays data concerning the change in employment in Eugene, Lane County and Oregon between the years of 2005 and 2010.

Table 5: Change in employment for Eugene, Lane County, and Oregon (2005-2010)

Industry	Eugene	Lane County	Oregon
Collection	n/a	13.57%	5.18%
Processing and Disposal	n/a	-8.33%	-1.93%
Material Wholesale	n/a	-55.45%	29.14%
Used Merchandise	40.63%	60.05%	30.22%
All Waste Management	23.59%	26.89%	11.57%
All Industries	-0.07%	-0.07%	-0.03%

Source: Quarterly Census of Employment and Wages, 2010

Entries labeled “n/a” are not available, to protect firms’ confidentiality

Due to the small number of firms operating in each industry and the issues with time-series QCEW data, a high degree of variability in the Eugene and Lane County data is expected. However, from this data we observe several trends that are great enough in magnitude that they are unlikely to simply be data collection abnormalities.

Employment Observations

Several clear trends emerge from the QCEW data on employment in solid waste management industries in Eugene and Lane County. We focus first on the information that can be gleaned from the available Eugene data. Where these data are unavailable, we use Lane County as a best approximation for what is happening in the economy of Eugene, since most of the population of Lane County lives in or near the City of Eugene. We observe:

- Solid waste management accounts for a larger share of employment in Eugene and Lane County than it does in Oregon as a whole. Most of this difference is driven by the Used Merchandise industry. **In Eugene, Used Merchandise employs 5.5 times as many workers** relative to total employment as are employed in Oregon as a whole.
- Across all geographies, employment in the waste management industry as a whole grew considerably between 2005 and 2010, even as employment across all industries combined was essentially stagnant. This suggests **waste management as a whole is a more or less “recession proof” industry in Oregon**. This trend exists even though the total tons of refuse, recyclables, and yard debris collected fell between 2005 and 2010⁵

⁵City of Eugene, Waste Prevention & Green Building: *Eugene Reported Tonnages 1998-2010*, 2012. Provided by Nancy Young.

- Within the waste management industry as a whole, **employment grew more rapidly in Eugene and Lane County than in Oregon as whole.** Again, this impressive growth was driven primarily by the Used Merchandise industry, which saw a 40% increase in employment between 2005 and 2010 in Eugene.
- The **Material Wholesale and Processing and Disposal industries are relatively weak employers in Lane County.** Material Wholesale industry in particular saw a 55% decline in employment between 2005 and 2010. This trend is especially alarming when compared with the 29% rise in the number of Material Wholesale employees in Oregon as a whole.

Overall, the employment structure of the Eugene and Lane County solid waste management system is very different from that of Oregon. Lane County enjoys very robust relative employment and employment growth in the Collection and Used Merchandise industries. However, Lane County employs relatively few workers in the Material Wholesale and Processing and Disposal industries, and both of these industries exhibit a trend of declining employment.

Average Wages

Table 6 shows data describing the average wage for Eugene, Lane County and Oregon in 2010. Not surprisingly, there are clear differences in wages across different industries and geographies. Lane County offers lower average wages than Oregon across most industries, and use merchandise is the lowest paying industry across all geographies.

Table 6: Average Wage for Eugene, Lane County, and Oregon (2010)

Industry	Eugene	Lane County	Oregon
Collection	n/a	\$37,767	\$45,674
Processing and Disposal	n/a	\$31,577	\$55,413
Material Wholesale	n/a	\$34,879	\$40,738
Used Merchandise	\$22,354	\$19,967	\$17,965
All Waste Management	\$23,966	\$25,647	\$39,607
All Industries	\$36,898	\$35,895	\$41,675

Source: Quarterly Census of Employment and Wages, 2005 and 2010

Entries labeled "n/a" are not available, to protect firms' confidentiality

Relative to Average Wages of All industries

First, we examine the average wage in each solid waste management industry relative to the average wage across all industries in the same geography. This provides a good indicator of whether jobs within each industry offer high or low wages compared to other jobs in the same local economy. Table 7 presents data on average wages relative to the all-industries average for Eugene, Lane County and Oregon in 2010.

Table 7: Average wage relative to average for all industries for Eugene, Lane County, and Oregon (2010)

Industry	Eugene	Lane County	Oregon
Collection	n/a	2.1%	9.6%
Processing and Disposal	n/a	-12.0%	33.0%
Material Wholesale	n/a	-2.8%	-2.2%
Used Merchandise	-39.4%	-44.4%	-56.9%
All Waste Management	-35.0%	-28.5%	-5.0%

Source: Quarterly Census of Employment and Wages, 2010

Entries labeled “n/a” are not available, to protect firms’ confidentiality

Relative average annual wages is the percentage difference between the average wages for a given industry and the average wage for all industries within the same geography. For example, the -12.0% relative wage for Processing and Disposal employees in Lane County means that the average employee in that industry earns approximately 12.0% less each year than other Lane County workers across all industries.

The data show dramatic differences in the average pay between industries within waste management. They range from Used Merchandise jobs, which in Eugene pay 39.4% less than the average for all jobs in Eugene, to Waste Collection, which in Lane County pays 2.1% more than other jobs.

Average Wage Change Over Time

Table 8 shows data for the change in wages in each sector in Eugene, Lane County and Oregon between the years of 2005 and 2010. Of particular interest is whether wages in each waste management industry are rising faster or slower than the wages of all industries combined. The average wage for all waste management industries combined was calculated as the total wages for all waste management divided by the total employees in all waste management industries.

Table 8: Change in average wage for Eugene, Lane County, and Oregon (2005-2010)

Industry	Eugene	Lane County	Oregon
Collection	n/a	9.2%	12.5%
Processing and Disposal	n/a	15.1%	10.0%
Material Wholesale	n/a	31.1%	17.0%
Used Merchandise	21.6%	12.7%	13.6%
All Waste Management	17.8%	5.6%	8.0%
All Industries	9.6%	11.1%	13.9%

Source: Quarterly Census of Employment and Wages, 2005 and 2010

Entries labeled “n/a” are not available, to protect firms’ confidentiality

The low rate of increase in average wages for all waste management industries combined in Lane County is due at least partially to a compositional shift. The

number of people employed in relatively high-wage industries, such as Material Recovery, is declining while the number of people involved in low-wage jobs, such as Used Merchandise, is rising. This means that the average wage for all employees involved in waste management as a whole is rising more slowly than the wages of any one of its component industries.

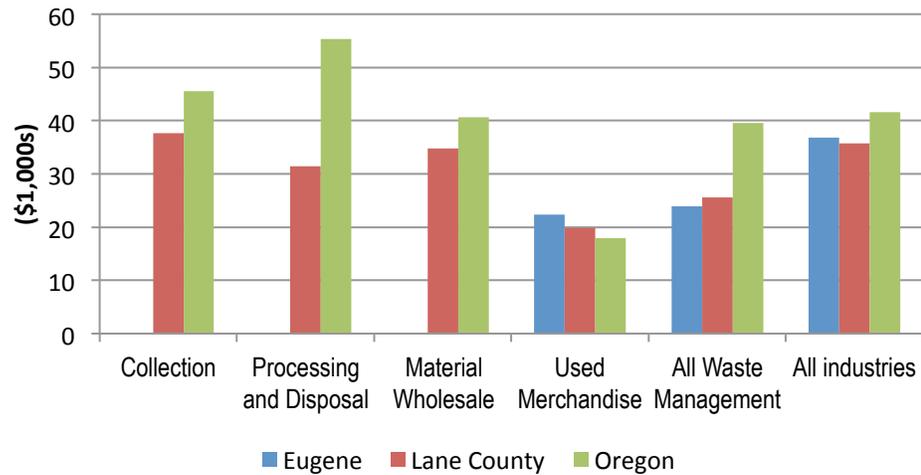
Average Wage Observations

Some of the most striking trends that emerge analysis of the average annual wage data are:

- In Eugene and Lane County, employees in waste management earn 35% and 28.5%, respectively, less on average than workers in non-waste management industries. In Oregon as a whole, waste management employees earn only 5% less on average than their non-waste management counterparts.
- In Eugene, the Used Merchandise industry pays 24.4% higher absolute wages, pays higher relative wages, and has seen wages grow 8 percentage points more quickly than the Used Merchandise industry in Oregon as a whole. No other solid waste management industry has similar positive, wage trends in Lane County.
- Across most waste management industries in Lane County and Oregon, waste management wages are rising at roughly the same rate as wages across all industries in the same geography, with the exception of Material Wholesale in Lane County. However, in Eugene, wages in waste management industries have been rising much faster than wages in other sectors of the economy.

The overall wage patterns within the solid waste management systems of Lane County are not dramatically different than wage patterns within Oregon as a whole (see Figure 2). The two exceptions to this similarity are (1) a rapid growth in the average wages of Material Wholesale employees in Lane County, and (2) relatively low pay for Collection and Processing and Disposal employees in Lane County. Though detailed wage data for Eugene is unavailable, we do see the Used Merchandise industry in Eugene paying high and rapidly growing wages compared to the rest of Oregon, though these wages are still low when compared to the average wage for all industries.

Figure 2: Average Wage by Solid Waste Industry, Eugene, Lane County and Oregon, 2010



Total Receipts

The number and quality of jobs within an industry is an important measure of its place in the local economy, but we are also concerned with the output these workers produce. Total Receipts is an indicator of the total value an establishment creates for its customers. Data for total receipts by industry comes from the Economic Census, conducted and published by the U.S. Census Bureau. Total receipts data from the 2007 Economic Census is only available for the Collection and Used Merchandise industries at the Lane County level and only for Used Merchandise for Eugene.

The data available are sparse due to disclosure issues, so the conclusions we can draw are limited. Table 9 describes the total receipts data for Eugene, Lane County and Oregon in 2010.

Table 9: Total receipts for Eugene, Lane County, and Oregon (\$1000) (2007)

Industry	Eugene	Lane County	Oregon
Collection	n/a	39,867	648,878
Processing and Disposal	n/a	n/a	388,161
Material Wholesale	n/a	n/a	1,081,590
Used Merchandise	16,168	26,101	219,741
All Waste Management	n/a	n/a	2,338,370
All Industries	13,060,402	24,436,277	326,360,624

Source: Economic Census, 2007

Entries labeled "n/a" are not available

Waste Management Receipts Relative to receipts for all Industries

Table 10 presents data showing the proportion of total receipts that are generated by each industry within Eugene. These are then compared to similar figures for Lane County and Oregon as a whole.

Table 10: Relative receipts for Eugene, Lane County, and Oregon (2007)

Industry	Percent of total receipts			Location Quotients	
	Eugene	Lane County	Oregon	Eug./ Lane	Lane/ Oregon
Collection	n/a	0.163%	0.199%	n/a	0.82
Processing and Disposal	n/a	n/a	0.119%	n/a	n/a
Material Wholesale	n/a	n/a	0.331%	n/a	n/a
Used Merchandise	0.124%	0.107%	0.067%	1.16	1.59
All Waste Management	n/a	n/a	0.716%	n/a	n/a

Source: Economic Census, 2007

Entries labeled "n/a" are not available

The location quotient in Table 10 is the percent of total receipts profits dividing the value of receipts within an industry by the receipts for all industries within the same geography. Note that the location quotients calculated in this table are different than those calculated in Table 4, due to the scarcity of Eugene data.

Receipts Observations

Missing data limits the opportunities for observation, but we can see:

- The **Used Merchandise industry in Eugene and Lane County brings in a larger portion of the total local receipts for all industries** than the Used Merchandise industry in Oregon as a whole. However, the location quotient for receipts is far less descriptive than the location quotient for employment.
- For all of Oregon, the entire waste management system makes up a larger portion of total receipts than total employment. The data are insufficient to reasonably extend this observation to Eugene or Lane County.

From the available data, we see that Used Merchandise in Eugene has low receipts per employee compared to the rest of Oregon, even though Eugene Used Merchandise employees earn higher wages. This anomaly may be caused by the type of re-use activities that Eugene engages in, some of which are considered in the St. Vincent de Paul Society of Lane County case study.

IV. CASE STUDY OF ST. VINCENT DE PAUL SOCIETY OF LANE COUNTY

In this section we examine the St. Vincent de Paul Society of Lane County, the largest nonprofit human services organization in Lane County. Of particular interest to this study are the various re-use and recycling programs that St. Vincent de Paul runs. However, the organization also provides affordable housing, emergency services, homeless services, and self-sufficiency services to the community.

Material Recovery Specializations

Used Merchandise Specialization

Data on Eugene's Used Merchandise industry prompts some interesting questions. The location quotient for relative employment between Eugene and the state of Oregon is 5.5, a ratio which suggests a prominent specialization of this industry. Between the years of 2005 and 2010, Eugene's Used Merchandise employment increased by 40%, compared to a 0.07% decrease for the All Industries average during the same years. In addition, while the Used Merchandise average wage was still quite a bit lower than the All Industries average, the Used Merchandise average wage increased by 21% compared to a 9% increase in the All Industries average, between the years of 2005 and 2010. Even through the recession, the Used Merchandise industry seems to have grown.

St. Vincent de Paul of Lane County operates nine retail thrift stores in Eugene and 12 in Oregon as a whole. These establishments are categorized under Used Merchandise, and, in Eugene, represent more retail thrift space than any other thrift retailer; making St. Vincent de Paul one of the largest contributors to the Eugene Used Merchandise industry. In addition to their re-use programs, they also operate innovative recycling programs, making St. Vincent de Paul an interesting example of waste diversion in Eugene.

Waste Diversion and Products

St. Vincent de Paul of Lane County operates a multitude of programs that emphasize diverting as much of the waste stream as possible into re-use and recycling. The organization's waste management success likely stems from the wide material coverage of their programs and the continued innovation that allows for many different materials and products to be diverted from the waste stream.

From the most general point of view, St. Vincent de Paul's programs function by separating out what can be re-used and recycled from waste, and then selling refitted or remanufactured products. St. Vincent de Paul operates nine retail thrift stores in the Eugene-Springfield area, and has four attended collection trailers around Eugene. Their retail thrift stores sell used clothing, used and

repaired furniture, appliances, books, shoes, mattresses and box springs, used electronics, and other various products.

Beyond goods that can be sold as-is, or after repair or refit, St. Vincent de Paul operates recycling programs. Table 11 lists St. Vincent de Paul's current programs and gives a short description of each.

Table 11: Description of St. Vincent de Paul Programs

Mattress Recycling	Used mattresses that are too damaged to repair and re-use are cut apart and separated into their components. These materials are then shipped out for recycling. Approximately 85% of the mattress is recyclable.
Appliance and Propane Recycling	Appliances too damaged to be repair and re-used are taken apart and separated into the various metals and components. The oil and CFC's are also removed.
Aurora Glass	Aurora Glass takes recycled window glass and melts and recasts it to create useable products like award plaques, bowls, and cabinet handles.
Dogma Pet Beds	Dogma Pet Beds are assembled from recycled mattress materials and cotton batting.
EcoFire Starters	EcoFire Starters are created from post-consumer cotton and recycled paraffin from candles.
Mattress Manufacturing	St. Vincent de Paul takes mattresses and boxesprings with damaged covers and other parts and reassembles new mattress.
Recycled Wiping Rags	Wiping rags are made from old, damaged clothing and sold.
Styrofoam Recycling	Block of Styrofoam are shredded and then compressed into dense logs. Styrofoam peanuts are resold or used at Aurora Glass.
Woodshop	Cut-offs from furniture manufacturers are turned into simple furniture for low-income families.

Source: <http://www.svdv.us/what-we-do/recycling-and-manufacturing/>

To give a sense of St. Vincent de Paul's contribution to waste diversion, Table 12 presents data comparing St. Vincent de Paul's waste diverted from Short Mountain Landfill to the recorded amount of waste diverted in Lane County.

Table 12: Waste Diverted by St. Vincent de Paul Waste and Lane County (2010)

Type of Waste	St. Vincent de Paul		Percent diverted by St. Vincent
	Paul	Lane County	
Scrap Metal	2,500	22,633	11%
Textiles	110	113	97%
Wood Waste	180	43,494	0%
Glass	1450	10,843	13%
Total Weight	5,005	190,879	3%

Source: 2009 Oregon Material Recovery and Waste Generation Rates, and St. Vincent de Paul Annual Report 2008-2009

Table 12 shows the weight diverted by St. Vincent de Paul of Lane County is not insubstantial, especially for a single business. It should be noted that the numbers above for St. Vincent de Paul represent weight diverted from Short Mountain Landfill, which services all of Lane County.

Mattress Recycling and Manufacturing

Mattress recycling is St. Vincent de Paul’s most successful program. Their DR3 Oakland facility was the first commercially viable process in the world. They estimate between 5% and 10% of used mattresses can be resold right away, another 5% to 10% need minor repairs, and the remaining 80% to 90% require disassembly to separate the re-useable components. Terry McDonald, the executive director of St. Vincent de Paul of Lane County, estimates that this process currently nets a 15% rate of return. This is impressive, considering that St. Vincent de Paul sells a mattress and box spring set for under 200 dollars. While their mattress recycling program has been replicated many times now, St. Vincent de Paul of Lane County is the largest recycler of used mattresses in North America. In 2010, St. Vincent de Paul’s DR3 facility recycled 118,706 mattresses, with their Eugene facility recycling around 30,000.

Interconnected Programs

The breadth of different materials that St. Vincent de Paul handles is perhaps their greatest strength within their recycling programs. All of their programs are intertwined with each other, as most would not individually be viable as the focus for a business. For example, St. Vincent de Paul takes in post-manufacturer textile waste and converts it into cotton batting. This batting is used as stuffing for their Dogma Pet Beds, and also as mattress padding for recycled mattress assembly. Other recycled cotton is used as a component with reclaimed paraffin, from waste candles and wax, to create their Eco-Fire starters, and waste textiles are sold in the form of bulk rags. Additionally, the excess wax is made into “ingots” for sale at their stores and also to candle manufacturers. Another example is transportation efficiency. Compressed, recycled Styrofoam is a product taken by truck south to the Port of Oakland for shipping to China. The truck can then be loaded with something like waste candles for transportation back to Eugene.

Summary

Due to the varied materials and products that St. Vincent de Paul deals with, they are able to more efficiently collect, transport, sort, process, repair, refit, and sell numerous products and stay competitive. This allows the organization to fill a niche in the re-use and recycling industry that is not easily challenged. St. Vincent de Paul does not need to directly compete with companies focused on a few profitable products, such as scrap wood re-use or electronics recycling, because they produce products that require invested time in sorting useful material from the waste stream, such as paraffin.

St. Vincent de Paul's wide coverage of various materials and products to be re-used and recycled may help explain the specialization occurring in Eugene. Terry McDonald believes that it is also at least partially due to culture, and it is also likely due to innovations on the part of St. Vincent de Paul and simply how the re-use market has been developed over time. Eugene might also favor a culture of re-use, which is cheaper, more practical and uses less virgin resources, over a culture of new and presentable goods. However, measuring the influence of culture on a market is difficult, even for so strong an industry as Used Merchandise. All of these factors probably play a part.

V. STATISTICAL ANALYSIS

Comparing employment and wages in Lane County to employment and wages in the rest of Oregon revealed many abnormal patterns in Lane County, such as abnormally high employment in the Used Merchandise industry and low employment in Material Wholesale and Processing and Disposal industries. This section examines how several measurable characteristics of Lane County, such as population and income, may explain these patterns. We perform a linear, multi-variable regression to quantify the effect of various demographic and economic conditions within a county on the relative employment in each waste management industry within that county.

We are particularly interested in how a county's average income, poverty rate, education level and political affiliation affect its demand for used goods, and therefore its employment in the Used Merchandise industry. We expect that used merchandise appeals to both people who cannot afford new products, and people who buy used products to conserve natural resources, even if they could afford new goods. With this in mind, we hypothesize that a county with high poverty, a left-leaning political ideology, and high educational attainment (such as Lane County) would have high employment in Used Merchandise.

We expect that the Material Wholesale and Processing and Disposal industries will be closely linked to the total amount of recyclable material that is produced by a county and its ability to profitably process those materials locally. We expect the production of residential recycling per person to be fairly homogenous across counties, but the amount of recyclable industrial scrap generated may vary widely depending on the prevalence of local manufacturing. We also suspect that small counties might not have the ability to increase production efficiency as the number of goods produced increases. This production efficiency is necessary to justify some types of material processing operations, such as smelting scrap metal. We therefore hypothesize that small counties with low manufacturing employment (such as Lane County) would have low employment in the Material Wholesale and Processing and Disposal industries.

We expect collection employment to be fairly homogenous across counties. Regardless of income, politics, or occupation, most households across the U.S. will need their trash picked up once a week. However, when households combine their trash for pickup, such as households within an apartment, the ease of collection might mean that fewer employees are required to collect the same amount of trash. We therefore hypothesize that the percentage of households living in apartment buildings will have a negative effect on employment in the collection industry.

Methodology

In order to parse out the effect of demographic and macroeconomic conditions on employment in waste management industries, we perform an ordinary least-squares (OLS) regression on data for counties across the United States. We

perform four separate OLS regressions, one for each of the waste industries we have been considering throughout this study: Collection; Processing and Disposal; Material Wholesale; and Used Merchandise. We assume a linear relation, between employment in each of these industries and a county's characteristics, of the following structure:

$$[industry]\%employment_i = \alpha + x_i\beta + \varepsilon_i$$

Where $[industry]\%employment_i$ is the employment in a given waste management industry for county i divided by total employment across all industries for county i . For example, from our findings above, we see $collection\%employment$ for Lane County is 0.17.

On the right hand side of our regression, x_i is a (1 x 11) vector which contains the following data for county i :

pop_i : total population

inc_i : mean household income (in thousands)

inc^2_i : mean household income (in thousands) squared

age_i : median age of population

$\%unemploy_i$: percent of work force over the age of 16 without work

$\%manuf_i$: percent of total workers employed in the manufacturing industry

$\%highschool_i$: percent of population over 25 with high school diploma or equivalent

$\%bachelor_i$: percent of population 25 and over with a Bachelor's Degree

$\%Obama_i$: percent of voters who voted for Obama in the 2008 presidential election

$\%poverty_i$: percent of households below the poverty threshold

$\%apt_i$: percent of housing units contained in structures with 5 or more housing units

All of these are factors that may affect employment in one or more of our solid waste management industries. Counties with small populations might not produce enough refuse or recyclable materials to sustain the same processing and disposal activities as larger counties. Low average income, high poverty, and high unemployment might affect the consumption habits of a county's residents, decreasing the amount of material that enters households, and therefore decreasing the amount of material that exits as waste to be collected, processed, etc. High poverty and unemployment might also increase a county's demand for used merchandise. We would expect counties with a large percent of their work force employed in manufacturing to produce a greater quantity of industrial scrap that would need to be collected, processed, and possibly resold. Educational attainment and political leanings might influence participation in and funding of

recycling or other conservationist programs in a county. We use $\%apt_i$ as a proxy for the percentage of people living in multi-family housing, which might affect how easily refuse and recycling can be collected.

Our regression estimates values for β , the (11 x 1) vector of coefficients which weight the effect of each entry of the x_i vector.

Data and Sources

Data for dependent variables (each waste management industry's percent of total employment) comes from the BLS, which publishes employment figures annually at the county level. However, this data is subject to disclosure constraints (see Appendix). The number of observations we can make for each industry varies, since the BLS may be able to disclose information about some industries and not others in a given county.

Data for all of dependent variables (for example population, age), except for percent voting for Obama, come from the American Community Survey (ACS), conducted by the United States Census Bureau. The ACS publishes data on a wide variety of demographic and economic variables at the county level. This study uses 2010, one-year estimates from the ACS, which are available for all counties with a population larger than 65,000 people. Approximately 800 of the 3,000 counties in the United States meet this criterion, so our regression will only contain observations on relatively large counties. This restriction is not as significant as the disclosure restriction on our dependent variables. Few counties with a population of less than 65,000 have a sufficient number of establishments in each industry to disclose employment data.

Data for percent voting for Obama comes from the 2008 Presidential General Election Results from the Atlas of United States. Presidential Elections, which lists the percent that voted for each candidate for each county within each state.

Results

The results of our regression are given in Table 13. On average, each solid waste management industry is responsible for just over half of one percent of total employment on average across all counties. Due in part to this fact, the coefficient associated with any one dependent variable is quite small, typically less than 0.001. For the sake of clarity, we report only the sign and significance of the coefficients of our full model in the table below. We will interpret the values on our statistically significant coefficients in more detail below.

Table 13: Sign and significance of least-squares coefficient estimates for percent of total employment by U.S. counties (2010)

	Used Merchandise	Material Wholesale	Collection	Processing and Disposal
population	+	-	-	-
income	-	_ **	+	+
income ²	-	+ **	-	-
age	_ **	+	+	+
%unemployment	+	-	+	+
%manufacturing	+	+ ***	-	+
%highschool	+	-	-	-
%bachelor	+	-	-	_ *
%obama	-	+	+	+
%poverty	-	-	-	+
%apartment	-	+	-	+
Counties (n)	648	443	436	181
Goodness of Fit (R ²)	0.05	0.27	0.12	0.14

* p<0.05, ** p<0.01, *** p<0.001

A positive coefficient means that a higher value of the variable is correlated with a higher percentage of total employment employed in the given industry. Most of our coefficients were not distinguishable from zero at the 95% confidence level.

Interpretation of Results

For Used Merchandise our model estimates an age coefficient of -0.021. All else being equal, if County A has a median age that is five years greater than County B, we would expect County A to have 0.105% less of its work force employed in the Used Merchandise industry than County B. This is a fairly mild effect, since the standard deviation for age is 4.3 and the standard deviation for Used Merchandise employment is 0.74, so a county would have to have a median age that is over seven standard deviations away from normal before we would expect the age effect alone to lower the county's Used Merchandise employment by one standard deviation. No other coefficients were statistically significant. The signs on income and unemployment coefficients were in line with predictions, but signs on percent voting for Obama and poverty rate were both negative, contrary to our predictions.

For Material Wholesale the coefficient on income is -0.060, meaning that if the mean household income of County A is \$5,000 higher than County B, then we expect County A to have 0.30% less of its work force employed in Material Wholesale. The coefficient on manufacturing employment is 0.061, meaning a 5% increase in the number of people employed in manufacturing correlates with a 0.31% increase in the number of people employed in Material Wholesale. Both of these effects are substantial in terms of standard errors as well. No other coefficients were statistically significant.

For Collection, none of our coefficients were statistically significant. We expected this industry to have relatively consistent employment across counties, so a low R^2 (goodness of fit) term and a lack of statistically significant coefficients are not particularly surprising. The coefficient on the percentage of apartment buildings was negative, as we hypothesized.

For Processing and Disposal, only the percent of the population with a bachelor’s degree or higher was found to be a significant factor, with a -0.044 coefficient. This is substantial effect, implying that a county with 5% more of its population holding a bachelor’s degree would be expected to have a 0.22% less of its work force employed in the Processing and Disposal industry. These positions might require a lower level of education, and therefore a population with a higher proportion with bachelor’s degrees might have fewer employed in this industry.

Our model does very little to explain the percent of the work force employed in Collection, Processing and Disposal, and Used Merchandise, as is evident by the relatively low R^2 value on each regression. It would appear that the demographic and economic variables we have considered cannot consistently predict a county’s employment in each industry.

A Closer Look at Lane County

Next, we turn our attention specifically to Lane County. Although the explanatory power of our model is fairly weak, we would still expect it to provide a better estimate for employment in Lane County than simply comparing to the average employment in Oregon or the rest of the United States.

Table 14: Predicted and actual percent of total employment by industry for Lane County

Industry	Mean for all Counties (%)	Predicted Values for Lane County (%)	Actual Values for Lane County (%)	Standard deviations from predicted value
Collection	0.014	0.014	0.018	0.7
Processing and Disposal	0.011	0.010	0.003	-0.6
Material Wholesale	0.011	0.013	0.004	-0.7
Used Merchandise	0.011	0.013	0.049	5.1

The predicted percent of total employment in each industry is the value that our model would predict for a county with the same population, income, age, and other demographic characteristics as Lane County. These values are very close to the mean across all counties. This similarity is due to the fact that (1) Lane County’s demographic and economic conditions are fairly close to the average value across all counties for which we have data, and (2) the coefficients on most of our explanatory variables are quite low, so our model’s predictions do not change dramatically in response to small changes in these variables.

The standard deviations from predicted values for each industry is calculated by measuring the difference between predicted and actual values for each county for which data is available, finding the standard deviation of these residual values across all counties, and then dividing the residual for Lane County by this standard deviation.

After adjusting for demographic and economic conditions in Lane County, we observe employment that is higher than expected in Collection, lower than expected in Material Wholesale and Processing and Disposal, and much higher than expected in Used Merchandise. This mirrors our findings when comparing Lane County to just the rest of Oregon.

Conclusions

Our regression suggests that, among larger counties (population greater than 65,000) in the United States, employment in the Collection, Processing and Disposal, and Used Merchandise industries does not vary in a substantial and systematic way with population, age, income, education or political affiliation. We have not yet found what factors *do* account for differences in employment across counties, but the factors we examined do not appear to have a significant, linear effect.

Our regression produced slightly more consistent estimates for Material Wholesale employment. Counties with low incomes and high employment in manufacturing industries have systematically higher employment in the Material Wholesale industry. However, Lane County is an exception to this trend. Our model predicts that Lane County would have higher than average Material Wholesale employment, when in fact it has lower than average.

We find that employment in Collection, Processing and Disposal, and Material Wholesale in Lane County all fall within one standard deviation of predicted values. Lane County's relatively low employment in Processing and Disposal and Material Wholesale is still concerning, and it is a sign that there may be room for local improvement in these areas. However, when compared to similar counties across the United States our level of employment in these industries is not drastically out of line with expectations.

In the Used Merchandise industry, we find Lane County to be a distant outlier. In fact, of the 648 counties for which data are available, Lane County has the second highest percent of total employment employed in the Used Merchandise industry, 5.1 standard deviations from its predicted value. Only St. Clair County, Alabama has a larger portion of its work force devoted to Used Merchandise. Having higher employment in this industry than 99.8% of United States counties is an interesting finding, and while we have not conclusively found the source of Lane County's success in this industry, there is clearly something exceptional that is attracting suppliers and consumers of used goods to the county.

V. CLOSING REMARKS

By far the most pronounced finding in our study, both in magnitude and consistency, is the strength of the Used Merchandise industry in Eugene and Lane County. Within this industry, employment, employment growth, wages, wage growth, and total receipts are all high in Eugene relative to the rest of Oregon. However, it is an industry that generally has low wage levels relative to average wages across all industries.

The Collection industry is also performing well in Lane County, with decent employment and wages compared to the rest of Oregon. However, the Material Wholesale and Processing and Disposal industries in Lane County exhibit more concerning trends. Employment in these industries is low and declining, and these workers earn much less than workers in other industries or in other parts of Oregon.

We were unable to explain the unique employment structure of Lane County's solid waste management system in terms of Lane County's broader demographic and economic characteristics.

Suggestions for Future Research

While conducting this study, we discovered many promising opportunities for further exploration of issues surrounding Eugene's solid waste management system.

Further investigate St. Vincent de Paul: Further research into this topic might compare this St. Vincent de Paul's to others across the county and to other similar organizations. Further study could also examine the local impact of St. Vincent de Paul's other charitable services, and the import/export impact of their programs that reach beyond Lane County.

Interview business managers in the Used Merchandise industry: Our statistical model failed to identify the source of Eugene's uncommon success in the Used Merchandise industry. We believe that talking to a wide array of used merchandise business owners within Eugene would be a useful exercise. We would want to know why they choose to operate in Eugene and why they choose to sell used goods.

Conduct regression analysis on panel data: Data for all of the variables we employed in our regression and more should be available on an annual basis at least as far back as 2005. Analyzing United States counties in a time-series context may yield more significant insights into how economic conditions affect a county's employment in waste management industries.

Analyze data from the 2012 Economic Census: Data from the 2012 economic census will soon be available. This data set may contain more thorough data on total receipts for waste management industries within Lane County. If these data prove to be more complete than the 2007 data were, additional dimensions of

analysis will open up, such as investigating differences in output per worker or output per firm across waste management industries.

APPENDIX A. LIMITATIONS

Appendix A describes limitations of the data and analysis presented in this study.

Disclosure

For many NAICS codes, the number of establishments, businesses, and employees is quite low, and exact information is not provided in the Census data due to confidentiality issues (data industries with few establishments or employees are not disclosed due to confidentiality). The disclosure problem is most pronounced when looking at the NAICS code 562, Waste Management and Remediation, which encapsulates waste collection, waste treatment and disposal, and remediation and other services. While aggregate data is available for employment, receipts, establishments, etc. at the three digit specification for the area in question, it becomes less so as the designation becomes more specific. For example, while data is available to describe the field of industries involved in 562, data is limited by disclosure rights when 562212 is chosen; which is Solid Waste Landfill. There are few such facilities in the Eugene-Springfield area, so supplying more descriptive information would be too revealing of a private establishment.

Reuse Give and Take

The main issue of measuring the reuse waste stream comes from a lack of data. However, the lack stems not from holes in receipts data or a small number of non-disclosable establishments, but instead from the categorization that makes up the reuse NAICS codes. NAICS code 453310 Used Merchandise Stores, the largest contributing code to our reuse calculations is comprised of establishments that qualify as "primarily engaged in" used wares. This is a proportional measure, which means that there are establishments that do not primarily sell used goods and are not part of this NAICS code, but do market used wares as part of their overall sales. Conversely, the establishments that do make up this code have small percentages that are not made up of used goods. Code 453310 therefore overcounts those markets that constitute it, and undercounts reuse that is categorized in others classifications.

Omitted Industries

Used Motor Vehicle Parts Merchants (code 42314) and Tire Retreading Services (code 326212) qualify as re-use, but there are too few currently operating establishments in each of these industries to obtain employment and revenue data for Eugene or Lane County. According to BLS, there is only one tire retreading facility and two used auto parts dealers in Lane County. If those facilities are typical for the State of Oregon, they would have approximately 30 employees combined. This figure is dwarfed by the 661 employees currently employed in the Merchandise Retail industry. Due to this omission, Used Merchandise underestimates the true economic impact of the re-use waste stream in Lane County, but this bias is likely to be small. Used Motor Vehicle Parts Merchants and Tire Re-treading Services are omitted from the re-use figures for

Oregon as a whole as well, even though that data is available, in order to maintain comparability with similar figures for Eugene and Lane County.

NAICS Code Specificity

This issue has to do with the information organized by NAICS codes. Unfortunately, from the data collected we have no way of separating out the effects of recycling from total waste disposed. The NAICS system has all waste collection in one category, and there is no simple way of determining how the employment and revenue of waste collection is divided between the collection of refuse, recycling, and yard debris. We can determine the number of employees involved in the collection of waste, as well as the composition of the waste collected, but we cannot determine how many employees were involved in the collection of each type of waste separately.

Geography

While the numbers for employment and establishments are likely adequate approximations at the county level, using this as a proxy for Eugene-specific data presents geography issues. Eugene does not possess the same characteristics of Lane County. Lane County data includes more people and businesses of different proportions than Eugene. Therefore, employment, establishments and receipts results are not perfect substitutes for city data.

APPENDIX B: DEFINITIONS

Coefficient: A multiplicative factor in some term of a mathematical expression.

Diversion rate: The percentage of waste materials diverted from traditional disposal such as landfilling or incineration to be recycled, composted, or re-used.

Goodness of fit: The goodness of fit of a statistical model described how well it fits a set of observations. Measures of goodness of fit typically summarize the discrepancy between observed values and the values expected under the model in question.

Least squares: A standard approach to the approximate solution of a set of equations in which there are more equations than unknowns. Least squares mean that the overall solution minimizes the sum of the squares of the errors in the results of every single equation.

Linear regression: An approach to modeling the relationship between a scalar dependent variable and one or more explanatory variables. The case of one explanatory variable is a simple regression. More than one explanatory variable is a multiple regression.

Location Quotient: A way to readily compare the concentration of a resource or activity levels among different areas of the country. In general location quotients are ratios that compare the concentration of a resource or activity, such as employment, in a defined area to that of a larger area or base.

Multivariable linear regression: When multiple correlated dependent variables are predicted rather than a single scalar variable.

Standard deviation: Shows how much variation or dispersion exists from the average. A low standard deviation indicated that the data points tend to be very close to the mean, whereas a high standard deviation indicates that the data points are spread out over a large range of values.

Vector: A physical quantities that have both magnitude and direction, in contrast to scalar quantities, which have no direction.