Assessment of Financial Viability of the Materials Management Enterprise

Portland State University

School of Business Administration

MSFA Graduate Capstone Project

By Nisha Ahuja & Shreya Goyal

Advisor: Dr. William. M. Jones

Executive Summary

As Masters of Science in Financial Analysis (MSFA) Capstone team at Portland State University, we assessed the financial viability of the two proposed business alternatives (Centralized Collection and Floor rate) that would not only serve to efficiently manage waste in the district but also serve as a source of revenue for Lloyd Ecodistrict (LED).

The team utilized the following methodologies to move the project forward. The project was divided into phases:

- secondary research,
- primary research/interviews,
- financial analysis
- sustainability analysis,
- alternatives development/comparison, and finally
- identification of strategic recommendations for LED to move forward.

Secondary research was conducted using several library & on-line databases. CES also provided data to identify key waste generators and valuable, sellable commodities in the district. In the primary research phase, interviews with key LED members were conducted, which provided the team with the information about district waste management practices, existing hauling contracts and members' willingness to participate in LED's material management initiatives. The team also toured two local waste/materials management programs, PDX Airport and Providence, taking a first-hand look at working materials management programs that could act as a model for the LED program.

The team performed detailed analysis of two alternatives based on critical factors such as risk, sustainability impacts, and volatility of commodity prices in addition to financial analysis. The financial metrics considered were investment value (NPV) and payback period. The last phase analyzed the sustainability impacts of each of the two proposed alternatives in order to recommend the alternative that would not only be operationally viable but also achieve the highest sustainability impacts possible (e.g., lowering waste/materials management carbon footprint, reducing landfill volumes, improving air quality, lowering truck traffic congestion, etc.).

Key assumptions for both the models were as follows:

- All members within the LED agree to participate in the program,
- One hauler services the entire LED who agrees in return for a monopoly on the district to a hauler rate no greater than the current rate charged to LED members and to give up revenue from the "floor-rate" typically received when depositing the comingled materials at the MRF, and
- Revenues from the sale of recyclables to vendors go to fund LED management and not to LED members.
-

Brief description of the two models analyzed are as follows:

***Centralized Facility Model*:** A centralized collection system within the EcoDistrict, owned and run by LED in collaboration with Community Environmental Services (CES). This facility would aggregate the potentially valuable materials (i.e., recyclables) in the waste stream of

district members. It would sort and prepare these materials in an effort to increase the marketability of the identified commodities.

Floor Rate Model: It is similar to LED's current waste/materials management operation except a single hauler would be given an exclusive contract for all LED members. The hauler would perform its usual activities of collection, transportation and disposal. The hauler would receive hauling fees no greater than members currently pay for waste/materials management and would agree to also return the floor rate to LED management for the commingled recyclables for the exclusive right to all LED members' waste/materials management hauling.

Key Results of Financial Analysis: Discounted cash flow approach was used to evaluate the proposed models for different landfill diversion rates. The key results are as follows:

Centralized Facility Alternative: Key Results				
Landfill Diversion Rate				
	50%	**75%**	**90%**	**Hybrid**
	Worst Case	Expected	Best Case	Most Likely
NPV	($252,014)	$183,730	$420,304	$80,770
Payback Period	N/A	14 Months	5 Months	41 Months

Floor Rate Alternative: Key Results				
Landfill Diversion Rate				
	50%	**75%**	**90%**	**Hybrid Model**
	Worst Case	Expected	Best Case	Most Likely
NPV	$ 33,076	$ 62,384	$ 119,959	$100,526
Payback Period	N/A			

Floor rate alternative has positive NPV for all the scenario mainly because of zero upfront investment and low operating costs in comparison to the centralized facility model.

In addition, the team also compared each alternative to the following four non-quantitative critical parameters:

Parameters	Centralized Model	Floor Rate Model
Risk	-Risk of entering an unknown territory -Risk of quality of recyclables	-No such risk -Almost no responsibility
Associated Costs	-Upfront investment -High labor costs -High insurance liabilities -More time & effort	-No upfront investment -Less labor costs -Low insurance liabilities -Less time & effort
Sustainability impacts	-Increased landfill diversion -Reduced carbon emissions	-Increased landfill diversion -Reduced carbon emissions
Revenues	-Volatile commodity prices	-Fixed Floor Rate -Volatility is reduced

Strategic Recommendation: Based on the above analyses we recommend LED implement the floor rate model. The recommendation is based on the combination of the financial model and the key parameters.
To implement the recommendation, we suggest that the model be rolled out in three phases over five years.

Phase I (one year): To test the validity of the model LED begin with a pilot project involving a few key members in the district. This initial phase will last for one year during which LED will monitor the results.

Phase II (two years): If evolving as planned, LED, will introduce a limited number of new members to participate in the pilot project. In addition, LED may consider adding other valuable commodities to remove and recycle from transfer station bound waste. If so, LED would negotiate a new floor-rate plus for these commodities. Again, LED will monitor progress.

Phase III (two years): if the model continues as planned, LED will implement an educational program to train/assist members in additional source sorting to increase landfill diversions to the comingled materials. LED may need to negotiate another floor rate plus for higher volumes of commingled materials. Again, LED will monitor the progress and evaluate results at the end of Phase III.

LED needs to conduct a formal evaluation and monitoring at the end of 5 years, and may have to make one of the following decisions:

1. Drop the model
2. Continue to implement Phase 3 at the same scale
3. Scale up Phase 3 to include all district.
4. Implement Centralized Model

Conclusion: The floor rate model captures the economic, social and environmental characteristics important to LED, and will eventually lead to higher waste diversion rate and possibly lower carbon emission. This model successfully meets LED's dual goals of both managing waste efficiently in the district and of generating revenue for LED.

We believe that the proposed business model is a critical step towards building a material-efficient district and is in line with the district's vision of "building the most sustainable district in North America."

Table of Contents

Contents

Abbreviations

CES - Community Environmental Services

EPA - U.S. Environmental Protection Agency

IRR - Internal Rate of Return

LED - Lloyd EcoDistrict

MIRR - Modified Internal Rate of Return

MM - Materials Management

MSFA - Master of Science in Financial Analysis

MSW - Municipal Solid Waste

NPV - Net Present Value

OCED - Organization for Economic Co-operation and Development

OEDQ - Oregon Department of Environmental Quality

PI - Profitability Index

RFP - Request for Proposal

Definitions

Discount Rate: The discount rate refers to the interest rate used in discounted cash flow (DCF) analysis to determine the present value of future cash flows. In this project discount rate is equal to Weighted Average Cost of Capital.

Discounted Cash Flow Approach: A valuation method used to estimate the attractiveness of an investment opportunity. Discounted cash flow (DCF) analysis uses future free cash flow projections and discounts them (most often using the weighted average cost of capital) to arrive at a present value, which is used to evaluate the potential for investment. If the value arrived at through DCF analysis is higher than the current cost of the investment, the opportunity may be a good one.

Floor Rate: Floor rate is a certain percentage of the rate that a hauler receives from dropping the commingled at Material Recovery Facilities (MRFs). MRFs pay a certain floor rate for the commingled (sellable materials) to the haulers and the haulers keep some of that rate and pass on the rest to their customers (from where they hauled those commingled). These rates are passed on only to the special customers who have higher volumes of waste generation.

Internal Rate of Return: The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. IRR is the rate of growth a project is expected to generate.

Modified Internal Rate of Return: While the internal rate of return (IRR) assumes the cash flows from a project are reinvested at the IRR, the modified IRR assumes that positive cash flows are reinvested at the firm's cost of capital, and the initial outlays are financed at the firm's financing cost. Therefore, MIRR more accurately reflects the cost and profitability of a project.

Monte Carlo Simulation: Monte Carlo simulation performs risk analysis by building models of possible results by substituting a range of values—*probability distribution*—for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. Depending upon the number of uncertainties and the ranges specified for them, a Monte Carlo simulation could involve thousands or tens of thousands of recalculations before it is complete. Monte Carlo simulation produces distributions of possible outcome values.

Net Present Value: The difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project. NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield. NPV compares the value of a dollar today to the value of that same dollar in the future, taking inflation and returns into account.

Profitability Index: It is the ratio of payoff to investment of a proposed project. It is a useful tool for ranking projects because it allows you to quantify the amount of value created per unit of investment.

Probability Distribution: According to Probability distribution the variables can have different probabilities of different outcomes occurring. It is a realistic way of describing uncertainty in variables of a risk analysis.

Triangular Distribution: It is a common type of probability distribution. The user defines the minimum, most likely, and maximum values. Values around the most likely are more likely to occur. Variables that could be described by a triangular distribution include past sales history per unit of time and inventory levels.

Weighted Average Cost of Capital: It is the rate that a company is expected to pay on average to all its security holders to finance its asset.

1. Report Overview

This report presents an analysis of the financial viability of a materials management enterprise for Lloyd EcoDistrict (LED). The report focuses on developing financially sustainable business alternatives for the district and it also recommends preliminary steps for implementation of these alternatives.

As PSU's Master of Science in Financial Analysis (MSFA) Capstone team, we assessed the long-term financial viability of the two proposed business models that would not only serve to efficiently manage waste in the district but also serve as a source of revenue for LED. The proposed business models will capitalize on scaling and monetizing identified commodities (approved by CES and LED) from the multiple material streams within the LED and selling these commodities to downstream vendors. The team analyzed comprehensive dataset compiled by CES and utilized their industry knowledge to develop the business models. The report also took into account current secondary commodity market conditions and successful 'waste to business' models and expert opinions.

The City of Portland's new goal of raising the recycling rate to 75 percent by 2015 and achieving zero growth in the waste stream, has created an increasing need for higher landfill diversion rates, driving companies to develop resources for efficient waste sorting and recycling.

The recommended business plan for materials management enterprise within LED supports increased waste diversion rate goals set by the city. This enterprise capitalizes on the fact that there is an inherent marketable value in commodities in the waste stream in order to maximize revenues. The business models have captured the economic, social and environmental characteristics important to LED, for increasing landfill diversion rate.

1.1Lloyd EcoDistrict Background

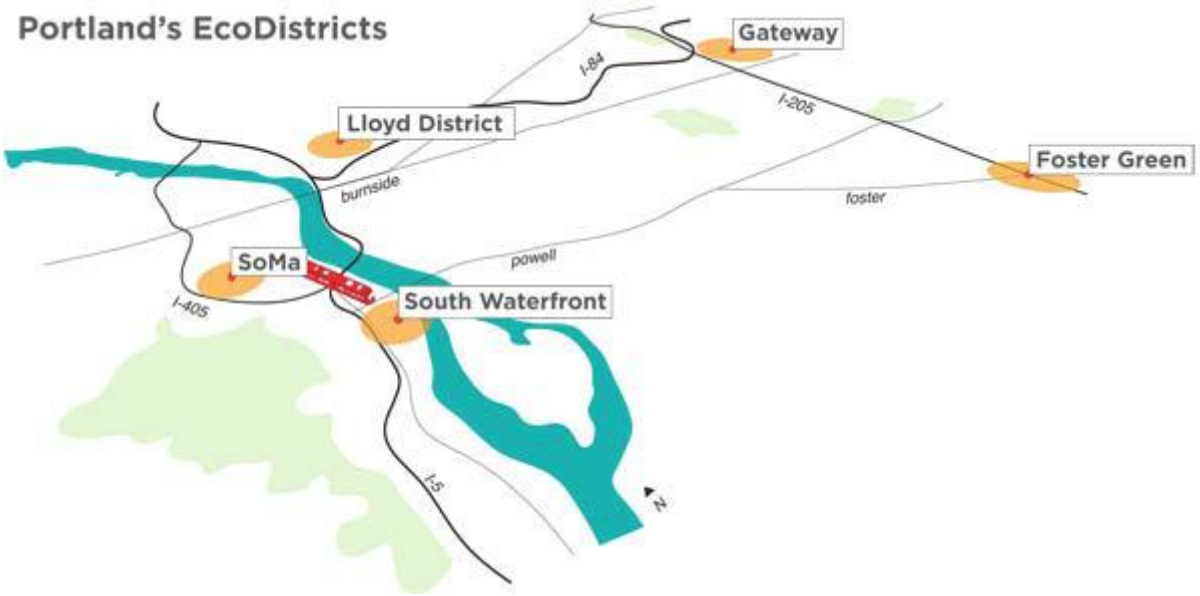
1.1.1 What is EcoDistrict?

An EcoDistrict is a new model of public-private partnership that has emerged as a result of urban planning aimed to integrate objectives of sustainable development and reduce the negative impact of ecological footprint. In an EcoDistrict neighborhood stakeholders, property developers, utilities and municipal jurisdictions come together to invest, innovate and deploy district-level best practices that create neighborhoods that are resilient, vibrant, resource efficient, and just. The scale of the EcoDistricts help accelerate sustainability as concentrated resources make size and risk more manageable. They are small enough to be able to innovate and implement, yet big enough to make a meaningful impact.

Aspects of successful EcoDistrict

While every EcoDistrict maybe unique, ecodistricts do share some common characteristics that make them successful. Below these characteristics are listed in order of importance:

1. Actively involving stakeholders across neighborhood as they bring disparate interest and scales of impact. Inculcating a sense of community is important.
2. Developing and testing comprehensive decision tools to measure and understand projects' performances.
3. Attracting private capital by developing joint ventures and financial outreach for bringing innovative green buildings, new technologies and their implementation to the district.
4. Developing public policies that inspire people and regulate actions to reduce energy and water demand and also reduce waste.
5. The Portland Sustainability Institute (PoSI) in partnership with the City of Portland, launched the EcoDistricts initiative, a comprehensive enabling strategy to accelerate neighborhood-scale sustainability that integrates building and infrastructure projects with community and individual action. The five pilot EcoDistricts in Portland include Lents, Gateway, South Waterfront, Lloyd District, and South of Market (Figure 1).



Source: http://www.pdx.edu/planning-sustainability/ecodistricts

Figure 1: Portland's EcoDistricts

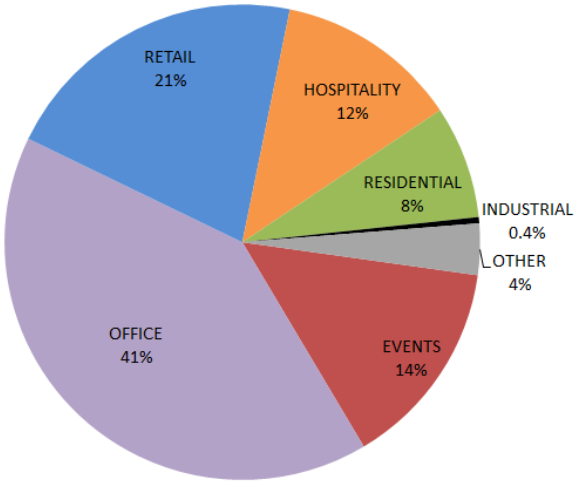
1.1.2 Lloyd EcoDistrict (LED)

Lloyd EcoDistrict started in 2009 as one of the Pilot EcoDistricts because of its potential to create a new model for sustainable neighborhood development. It is located in the east of Portland's Central business district across the Willamette River (Figure 1). LED is a non-profit entity. It is a place where businesses, residents, government agencies and non-profits all share a vision to build the most sustainable living and working EcoDistrict in the country. LED wants to develop a marketing brand strategy to communicate the difference and advantages of doing the business in the district. It plans to create 20,000 new jobs, at least 4,000 housing units and 20

million new square feet of commercial, retail, institutional and residential development by 2030. It plans to achieve its goals by implementing projects like shared thermal energy systems, energy retrofits, and high performance buildings, zero waste program. It recommends strategies that serve a triple bottom line: one that is good for the people who live and work there, good for the planet they share, and good for the profit businesses need to stay economically strong.

District Composition

Ninety two percent of the district consists of commercial buildings and remaining eight percent includes industrial and residential properties (Figure 2). Its area includes over 400 acres and more than 16,000 employees most of whom live outside the district.



Source: CES waste audit data, 2013

Figure 2: District Composition, 2013

1.2Community Environmental Services (CES)

Community Environment services, founded in 1989, is a student-staffed research and services unit within the Center for Urban Studies in the College of Urban and Public Affairs is a student-staffed research and service unit at Portland State University. CES provides high quality research, technical assistance and data collection and educational outreach services in areas of solid waste minimization, recycling, waste reduction and resource sustainability. It has implemented nearly one hundred projects for dozens of partners and has bagged many renowned public and private sector clients like Portland International Airport, city of Portland and Metro regional government, New Seasons etc. Projects range from conducting long-term data collection, completing business recycling outreach, and engaging in long-term partnerships to improve waste diversion.

1.3CES and LED Partnership

LED has collaborated with CES to get a picture of waste being generated and/or diverted in the district. CES is hired by LED management as a technical and research consultant who is responsible for collecting waste data by conducting waste audits for the LED members. These

waste audits will provide a detailed analysis of the composition of the waste stream for different buildings in the district. CES will provide its hands-on support and expertise in developing a materials management enterprise. It will help in operationalizing the pilot programs and initiatives that will encourage maximum waste diversion and facilitate LED in achieving its goal of becoming the most sustainable eco-district in North America.

1.4Client Goals

LED and CES have come to a consensus and their expectations from this project are as follows:

1. Develop business alternatives that capture economic, social and environmental characteristics for LED to spin off materials management entity that is a source of revenue generation for district operations. The alternative material management scenarios identified are: Centralized Facility model and Floor Rate Alternative.
2. Propose a preliminary business case for the implementation of the recommended alternative.

1.5Purpose

The purpose of the capstone project is to assess the financial viability of the proposed business alternatives utilizing the waste audit data provided by CES.

1.6Consultant's Goals

The goals of the project is to determine the financial viability of both Centralized and Floor rate alternatives and to recommend the most appropriate alternative along with preliminary steps to implement it. Capstone project team will support the Lloyd EcoDistrict with the following activities aimed at assessing the feasibility of the models:

1. Conduct interviews with LED members to understand the landscape of materials management in the district.
2. Complete a market assessment/landscape analysis that includes other similar models/initiatives, current waste generation and diversion rates globally, nationally, in the state and in the city, and current secondary commodity market conditions.
3. Prepare a high level feasibility/financial analysis to support selected model: Centralized facility and Floor rate alternative.

1.7Tasks

The following tasks were undertaken for this project:

1. Data Review
    a. General overview of LED's waste stream
    b. Agreement on commodities
    c. Forecast the commodities

2. Understanding LED's material management landscape
    a. Target interviews with LED members
    b. Look at similar materials management models in the city
3. Financial Model
    a. Identify the capital investment and annual expenses
    b. Forecast the model for 5 years
    c. Scenario building for both the alternative
    d. Recommend one of the alternatives
    e. High level implementation plan for the recommended alternative

1.8Challenges

The team faced several project challenges related to the project timeline and access to important data and concerns regarding the number of stakeholder interviews and information sensitivity. While the project team devised methods to work around these challenges and believe that the final report results do not reverse the team's strategic recommendations, it is important that project team let the reader understand the conditions of their work.

Delayed receipt of the data on actual LED waste sorts until 17th December, 2013 meant that the team had no specific data related to actual materials in the LED waste stream. The team did receive LED data later and were able to incorporate it into the analysis, though the delay meant not all of the analysis could be performed.

Interviews with key stakeholders and their facilities were critical components to achieving the team's project goals. Vendors and haulers, while considered key stakeholders could not be interviewed due to the sensitivity of what the project team was investigating.

The sample size of LED members while extremely valuable, was small and represented in most cases a more narrow range of organizations who were in most cases some of the highest waste volume generators and highest volume recyclers. Ideally, the number of participants interviewed could have been more evenly distributed across players with different waste volumes generation, but this was limited by both stakeholder access to sensitive information and the narrow project timeline.

2. Research Goals and Methodology

The Capstone consulting team formed and utilized the following methodologies to move the project forward.

The project was divided into phases:

Phase 1: Secondary research

- Library database, journals, articles
- Toured existing models at PDX Airport and Providence

Phase 2: Primary research/interviews

- Interviews with LED members
- Interviews with Metro and Providence

Phase 3: Analysis

- Financial Analysis
- Sustainability Analysis
- High-level implementation

Secondary research was conducted using several sources such as library databases, journals, articles and reports on existing material management models. The team utilized data provided by CES to identify key waste generators and valuable commodities in the district. The next phase was to perform primary research and conduct interviews with key assigned stakeholders. This provided the team information on consumer waste management behavior of players, existing hauler contracts and willingness of players to participate in LED's material management initiatives. The team had the opportunity to visit PDX Airport and Providence to take a first-hand look at similar materials management models currently in place. With primary and secondary research knowledge in hand, the team proceeded to perform detailed financial analysis within well-reasoned inputs and assumptions. The last phase was to analyze sustainability impacts of each of the two proposed models and recommend an alternative that was not only operationally viable but also had high sustainability impacts. This phase also included high level implementation strategy.

3. Introduction to Solid Waste Management

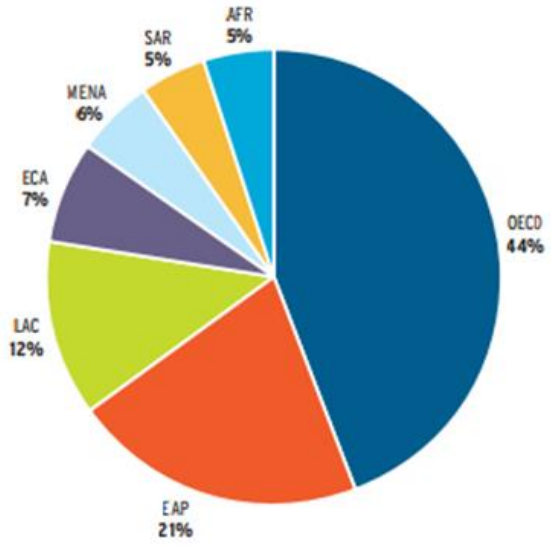
It is important to begin with an overview of solid waste generation as what LED faces is not unique. Waste generation and the corresponding growing interest in materials management is also reflected in global waste/materials management trends.

With rapid economic development, urbanization, increased business activity and growing population, the amount of municipal solid waste (MSW) generated is also rapidly increasing. There is a direct correlation between rising disposable income and living standards, consumption of goods and services and the amount of solid waste generated. Currently the world cities generate 1.3 billion tons of MSW every year. This volume is expected to increase to 2.2 billion tons by 2025. If this current trends continue, there will be three times as much waste by the end of this century as we have now, warns the World Bank.

3.1 Global Municipal Solid Waste Generation by Region

Figure 4 illustrates global solid waste generation per region, where OECD countries, of which the USA is a member, make up almost half of the world's waste, while Africa and South Asia as the regions that produce the least waste. The OECD countries generate approx. 580 million tonnes of solid waste per year of which more than 40% is contributed by USA alone.

It is interesting to note, however, that the US Solid waste industry grew 2% in 2011, or $55 billion in revenue according to the latest research from Waste Business Journal. While still growing this percentage represents actual slowing of the landfill waste stream. Correspondingly, there has been an increasing demand for removing recyclable materials from the landfill bound waste stream. What the USA has begun to witness is increasingly higher prices being paid for recyclable materials in the waste stream including paper, plastics and steel. This has encouraged companies to divert a higher volume of these materials away from landfills.



Source: A global review of solid waste management, WorldBank

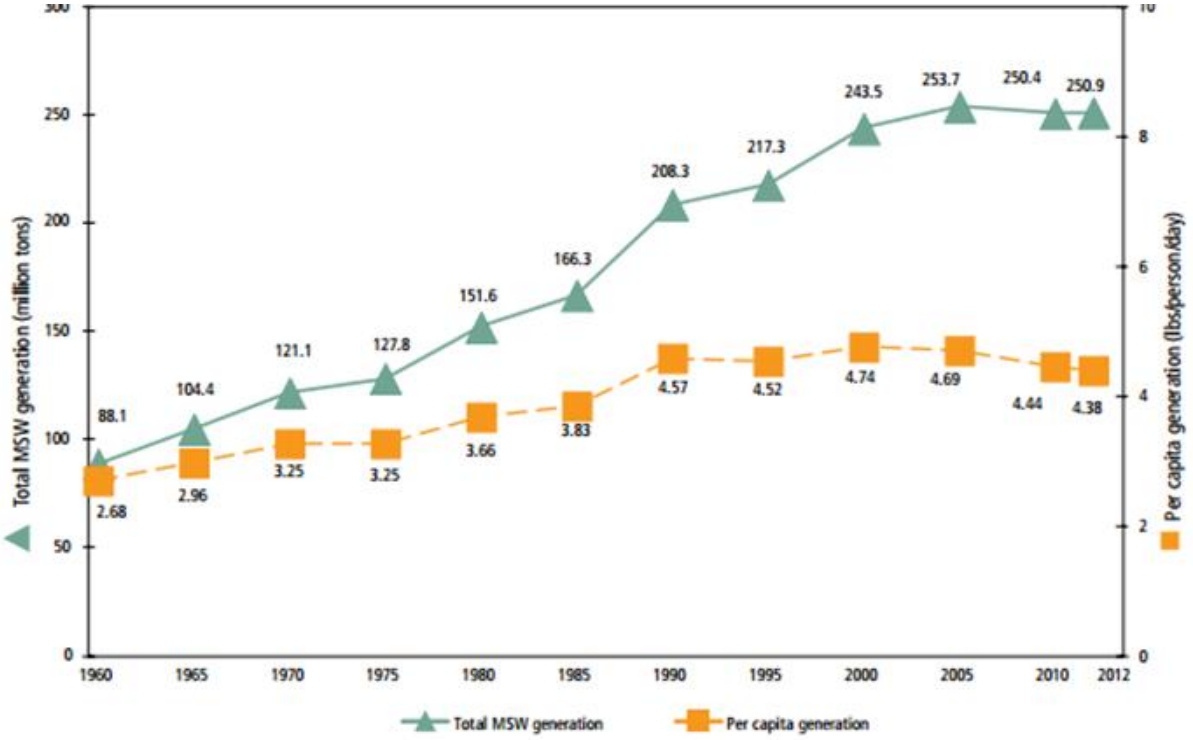
Figure 4: Global waste generation by region

3.2 Municipal Solid Waste Generation and Recycling Rates in USA

According to the U.S. Environmental Protection Agency (EPA), in 2012, Americans generated about 251 million tons of trash and recycled and composted almost 87 million tons of this material, equivalent to a 34.5 percent recycling rate (See Figure 5 and Figure 6). On average,

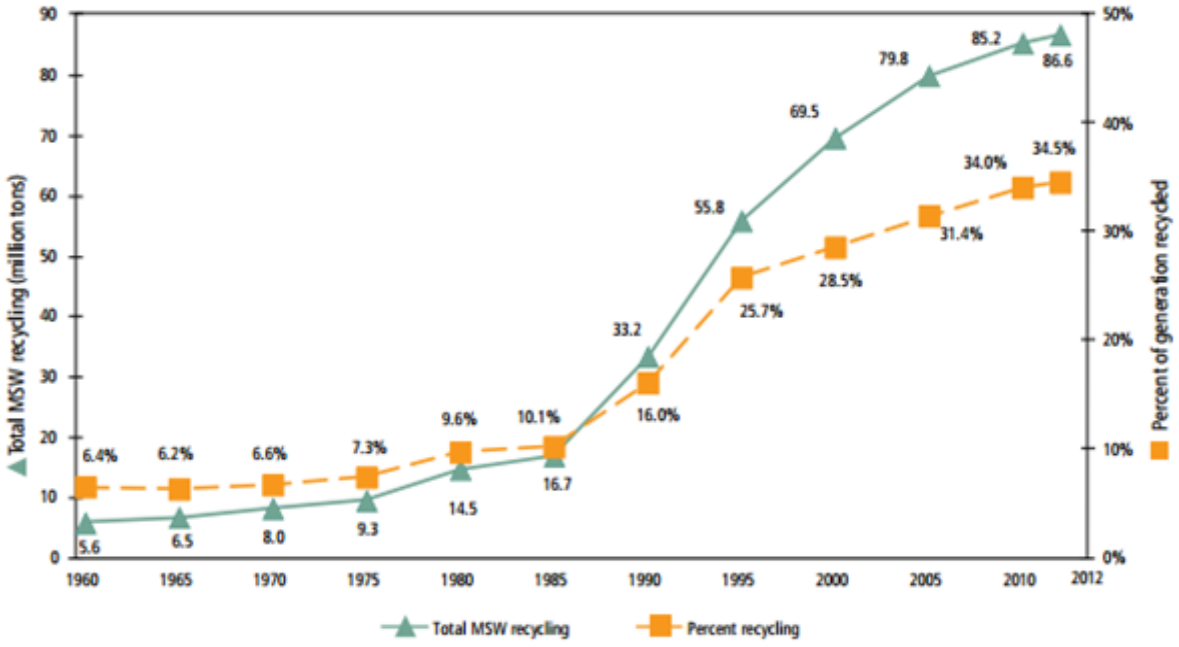
Americans recycled and composted 1.51 pounds out of our individual waste generation rate of 4.38 pounds per person per day.

Over the last few decades, the generation, recycling, composting, and disposal of Municipal Solid Waste (MSW) have changed substantially. Solid waste generation per person per day peaked in 2000 while the 4.38 pounds per person per day is the lowest since the 1990's. The recycling rate has increased–from less than 10 percent of MSW generated in 1980 to over 34 percent in 2012. Disposal of waste to a landfill has decreased from 89 percent of the amount generated in 1980 to under 54 percent of MSW in 2012.



Source: www.epa.gov

Figure 5: MSW Generation Rates, 1960 to 2012

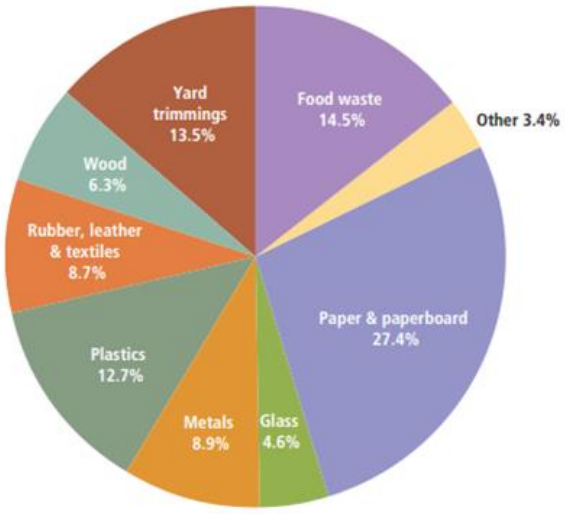


Source: www.epa.gov

Figure 6: MSW Recycling Rates, 1960 to 2012,

3.2.1 Sources of Municipal Solid Waste in USA, 2012

Sources of MSW include residential waste (including waste from apartment houses) and waste from commercial and institutional locations, such as businesses, schools, and hospitals.

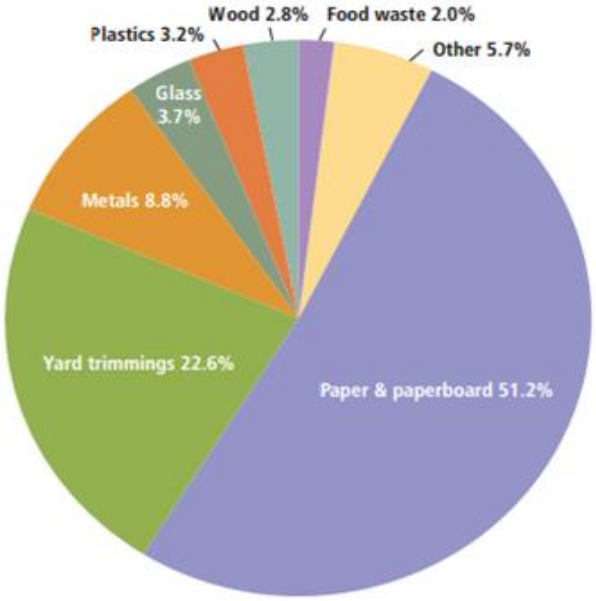


Source: www.epa.gov

Out of the 250 million tons of waste generated, paper and paperboard continued to be the largest component at over 27% and yard trimmings and food waste accounted for another 28%. Plastics comprised about 13%; metals made up 9%; and rubber, leather, and textiles accounted for almost 9%. Wood followed at over 6% and glass at almost 5%. Other miscellaneous wastes made up approximately 3% of the MSW generated in 2012 (Figure 7).

Figure 7: US MSW Generation by material, 2012

Total MSW recovery in 2012 was almost 87 million tons. The highest recovery rates were achieved in paper and paperboard (over 51%) and yard trimmings accounted for over 22%, while metals comprised about 9%; glass about 4%; and plastic and wood about 3% each (Figure 8).



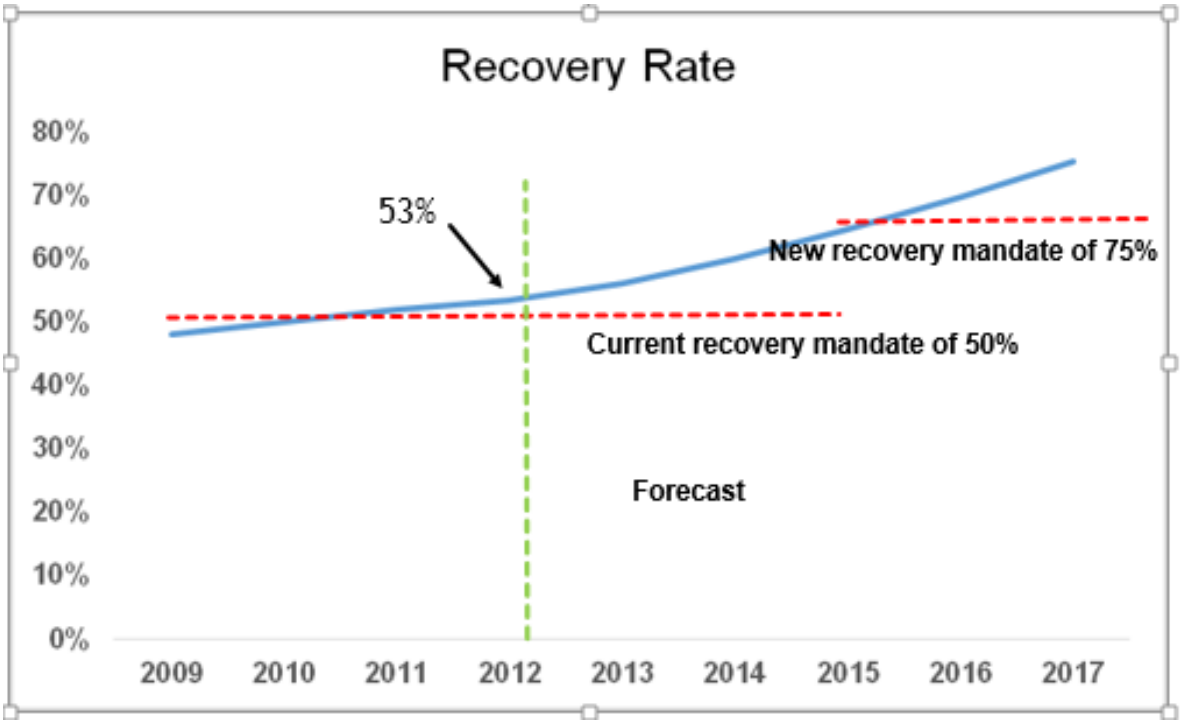
Source: www.epa.gov

Figure 8: Total MSW Recovery by material, 2012

3.3 Oregon's Municipal Solid Waste generation and recycling rate, 2012

Oregonians recovered 2.3 million tons or 53.4% of the solid waste generated in the year 2012 (Oregon Department of Environmental Quality). This was an increase from 52.3% recovery rate in 2011 and the 3rd straight year that Oregon met its goal of 50% recovery goal. Most of this increase was due to increase in organics recovery followed by increase in paper and plastics.

Waste generation, though, totaled 4.8 million tons, or 1.7% more than 2011. The per capita waste generation increased by 1% from 2011. With these slight increases, the state narrowly missed the state goal of no increase in total or per capita increase in waste generation (Figure 9).



Source: ODEQ Report, 2012

Figure 9: Oregon waste recovery rate, 2012

3.3.1 Portland's Municipal Solid Waste generation and recycling rate, 2012

The DEQ report, based on the state's survey of garbage haulers and private recycling and composting companies, recorded the Portland region's recovery rate at 62 percent, up from 59 percent in 2011. While the region has consistently had a slightly higher recycling rate than the state, 2012 marks the first year that figure has reached the 60 percentile.

The City of Portland has a goal to reduce waste and to raise the recycling rate to 75 percent by 2015 and achieve zero growth in the waste stream.

3.3.1.1 Factors Increasing Recycling Rate

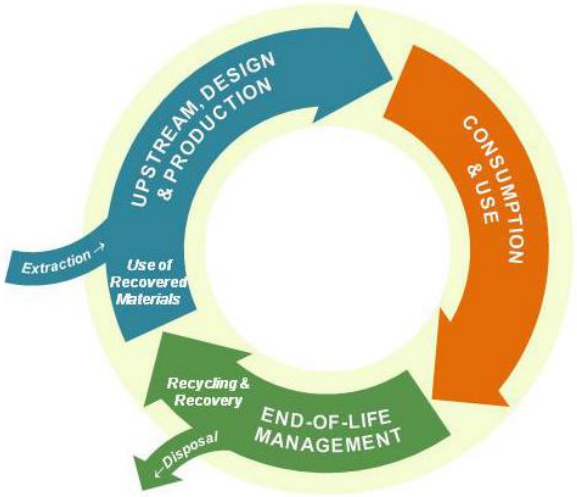
Portland's successful recycling program has been influenced, in part by supporting public policy and overall public sentiment to reduce landfill bound waste and increase recycling. Two factors are representative of this change – Portland's Climate Action Plan, and the shift to materials management.

In 2009, City Council adopted the Climate Action Plan, a strategy to put Portland and Multnomah County on a path to achieve a 40 percent reduction in carbon emissions by 2030 and an 80 percent reduction by 2050 (compared to 1990 levels). The plan included three goals for 2030 relating to consumption and solid waste and identified a number of actions to achieve these goals: Reduce total solid waste generated by 25 percent, recover 90 percent of all waste generated and reduce the greenhouse gas impacts of the waste collection system by 40 percent.

4. Materials Management

While this report largely focuses on efficiently managing end-of-pipe materials within the Lloyd Ecodistrict, the ultimate goal is to eventually shift from waste management to materials management.

US EPA defines materials management as an approach "to using and reusing materials most efficiently and sustainably throughout their life cycle." It seeks to minimize the materials used and all associated environmental impacts (Figure 10).



Source: http://www.oregon.gov/deq/LQ/Pages/SW/MaterialsManagement.aspx

Figure 10: Materials management cycle

Materials management encourages reduction in the amount of material extracted, and selection of non-virgin over virgin resources, where appropriate. Materials management also encourages changes in product design to use less material, reduce toxicity, and make products more reusable and/or recyclable.

Materials management is different from current waste management approaches in several important ways:

1. Materials management seeks the most productive use of resources, while waste management seeks to minimize and/or manage wastes or pollutants.
2. MM focuses on impacts from both upstream considerations as using less material, using less environmentally intensive materials, or making products more durable, as well as downstream solutions such as reuse and recycling. Waste management usually focuses only on what to do with wastes once they are generated.
3. Materials management is concerned with inputs and outputs from/to the environment, including use of materials, energy and water, plus multiple environmental impacts; it is not

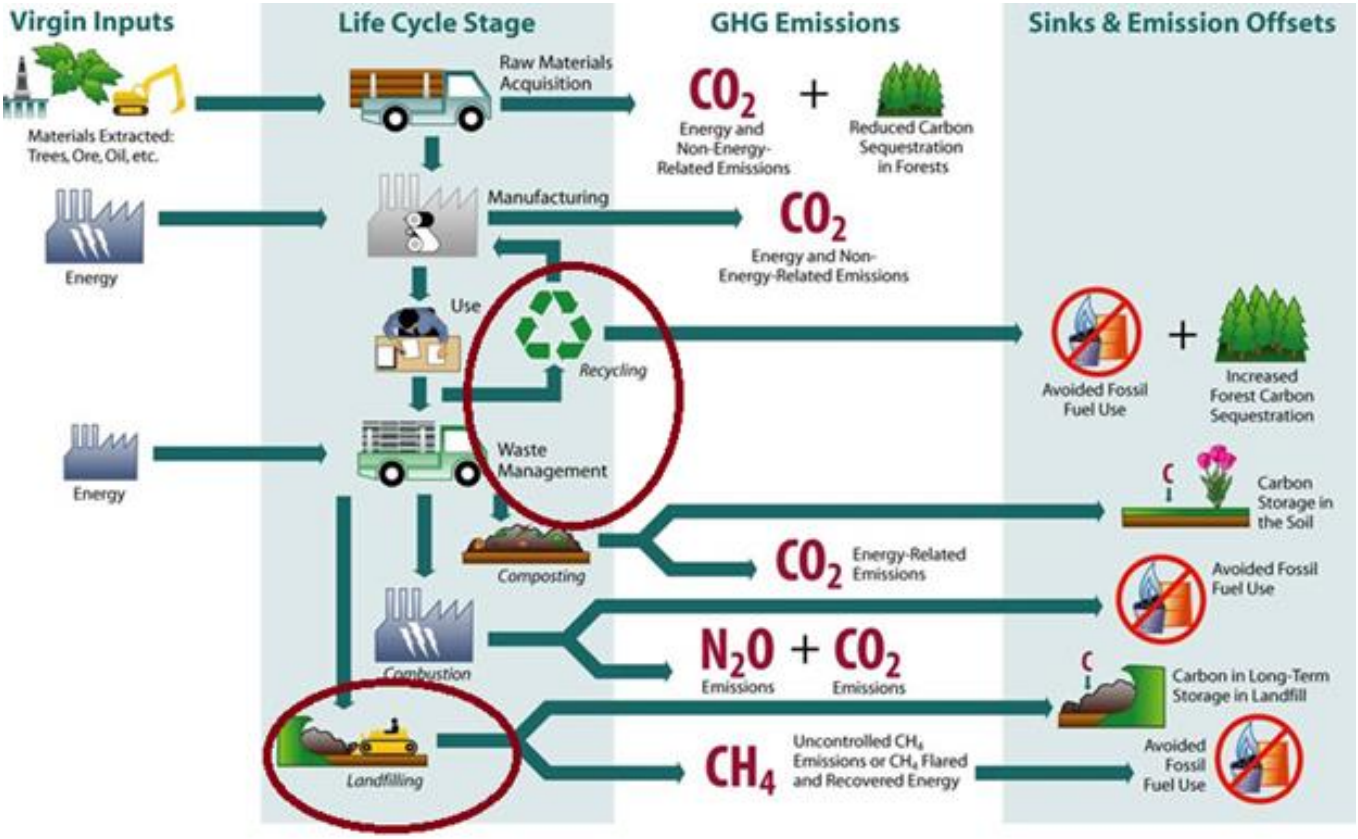
geographically constrained. Waste management is concerned mainly with outputs to the environment (air, water, land) and usually only those from waste and only where the waste is managed.

4. The goal of materials management is overall long-term system sustainability, while the goal of waste management is often focused on managing a single set of environmental impacts.

5. Materials management counts as responsible parties all those who are involved in the life cycle of a material or product, including industry and consumers. In contrast, waste management usually counts as responsible parties only those who generate waste.

4.1 Shift from Waste Management to Materials Management

While this report largely focuses on efficiently managing end-of-pipe materials within the Lloyd EcoDistrict, the ultimate goal is to eventually shift from waste management to materials management. Though this report addresses downstream solutions of managing waste (highlighted in dark red in figure 11 below), we believe that the proposed business model is a critical step towards building a material-efficient district and is in line with the district's vision of "building the most sustainable district in North America."



Source: http://www.icleiusa.org/blog/archive/2011/06/16

Figure 11: Lifecycle of a product

5. Primary Research and Key Findings

This section lays out the key findings of the interviews conducted with LED members and the sustainability experts. The primary research was done to gain insights on the major players in LED and materials management. The information gathered from the interviews was used to develop both the alternatives i.e. Centralized and Floor Rate. The questionnaire is attached in Appendix C.

The list of sixteen interviewees (LED members) was provided by our clients. Eleven interviewees responded to the questionnaire either through email/phone/ one on one meeting. Overall the response rate was sixty nine percent. The respondents included both big and small players and belonged to the following sectors: Office, events, hospitality, retail and residential (Figure 12).

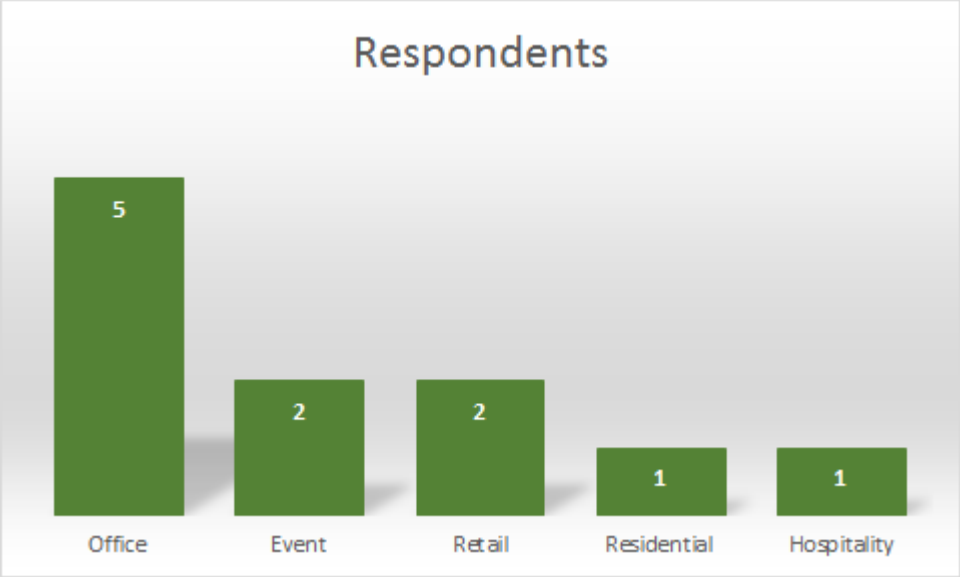


Figure 12: Number of respondent from the different sectors

The interview questions were compiled by the PSU Capstone team and approved by the clients. The interview questions were framed to obtain the information regarding current waste management practices in their companies and their willingness to participate in a new materials management program of the district.

Apart from the interviews with the members, the team had the opportunity to tour Providence and take a first-hand look at the working materials management model at the hospital which is managed by Mr. Mike Geller.

Outcomes & findings

- Multiple Haulers

There are multiple haulers servicing LED members. The contracts are renewed month by month or annually. Most of the contracts are signed after negotiating with multiple haulers.

- More landfill diversion
  The members in the district have waste management practices in place at their companies. Some of the members had dedicated labor to sort and dispose the waste while other members relied on the tenants to do the same.

- No extra effort/labor
  The members are willing to participate in the proposed materials management model provided it would not add extra labor time and effort in sorting and preparing the materials. Members such as Great Wine Buys and other small companies expressed their inability to store or prepare materials at their premises.

- No additional cost burden
  The respondents are apprehensive of additional cost burden that they might need to bear by storing materials or higher hauling fees.

- Quality of service of haulers
  It was important to the members that the quality of service provided by the hauler is maintained. Reliability and frequency of pick-ups of waste is important to the members.

- No rebates are expected
  Most of the members do not receive rebates for recyclables. Also, it seemed like members do not expect any rebates from the haulers.

- Interested in food waste management
  There is lot of food waste generated in district and members (especially residential and retail spaces) seemed interested in food waste management as well.

6. LED's Waste & Materials Management: Current and Alternatives

This section discusses the waste management system in the LED as it exists today followed by introduction of two different alternatives i.e. centralized collection model and the floor rate alternative, as a solution to maximize the benefits from waste, for all the constituents involved.

6.1Current Solid Waste Management Structure

Solid waste management encompasses all activities surrounding the collection, transportation, processing, disposal and resale of solid materials that pass through the recycling and composting of waste. District members have contracts with waste haulers for collection and disposal and recycling of waste. The waste is composted, recycled or disposed in landfills. Different members have contracts with different waste haulers. The members pay hauling fees based on waste

volume. Very few of the members receive floor rates on the recyclables which is at the floor rates (Figure 13).

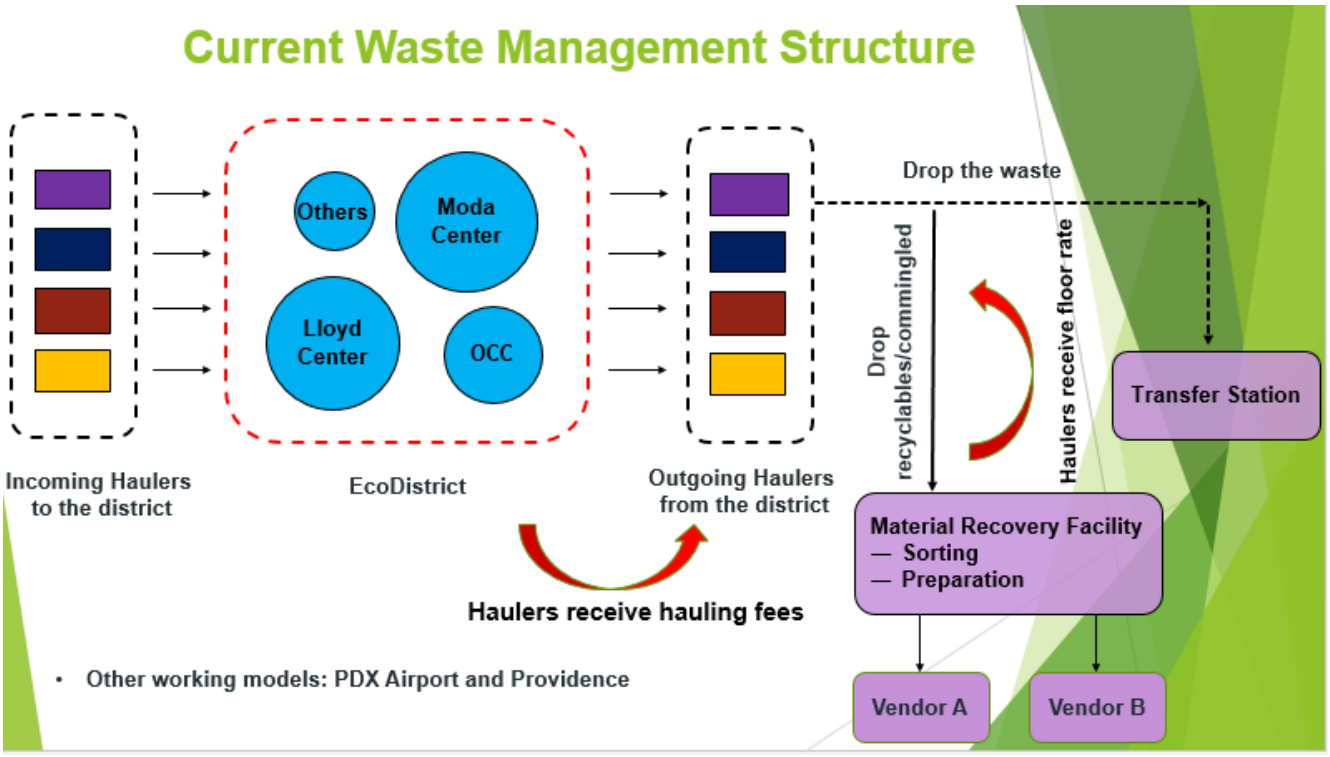


Figure 13: Current waste management in the district

6.2LED Project Stakeholders

This section introduces the stakeholders involved in the materials management at LED.

LED is reliant on a number of important stakeholders who provide services; shop, work and/or reside in LED; and help manage the LED management office. Below is a brief description of the main stakeholders in the capstone project:

LED: It is a funded not-for profit entity and is looking for avenues to become financially self-sustainable. Therefore, LED is assessing the feasibility of developing a sustainable business model to manage waste in the EcoDistrict and also its ability to generate revenue. This business model will monetize the identified commodities by selling it to downstream vendors. If successful, this business model can help LED in branding and marketing itself.

CES: CES will assist LED in assessing and developing the model through data collection, innovative ideas and their professional expertise. If they succeed in developing the model they can replicate this model for their multiple clients looking for waste management plan.

LED Members: LED members are the people working or living in LED like building owners, retailers, residents, mall, event spaces etc. At present, there are multiple haulers hauling waste in the district. Every day number of trucks circle around the district and pollute the environment.

This business model proposes effective management of waste by negotiating a deal with single hauler who will haul the waste for whole district reducing the number of hauling trucks circling the district and reduce the carbon emission in the district. This in turn will reduce the health risks associated with contaminants in the air. It will also reduce the hauling fees for the members. This model will help in increasing the waste diversion from landfill in the district. Members will be able to capitalize from the brand that will be created for being present in the most sustainable EcoDistrict.

***Vendors**:* Vendors are the businesses that purchase secondary/recyclable materials from the Material Recovery Facility (MRF) or other sources. They use these secondary materials as a raw material and process them to make products that they further sell in the market. These vendors help keep the valuable waste out of landfill. For example Denton Plastics is one of the vendor located in Portland are. It buys secondary plastics from MRFs and turns them into pellets and sell it to automotive, construction and horticulture industries.

Through this project vendors can compete to get the business of the whole district. They can get a continuous supply of secondary raw materials and a long term business relationship with the district. The waste stream is quite varied and will be of interest to many.

***Haulers*:** The hauling business in the district is highly fragmented. In Portland, commercial garbage and recycling companies operate in an open and competitive market. There are multiple haulers in the district and are getting different hauling fees from different members. The project proposes negotiating a deal with the one or two haulers for the district. The hauler who gets the deal will get the business of the whole district.

The following section introduces and examines two separate alternatives for Lloyd EcoDistrict which require a single hauler serving all the members instead of current arrangement of multiple waste haulers circling the district.

6.3Centralized Facility Alternative

The team proposes a collection system within the EcoDistrict, owned and run by LED in collaboration with CES. This facility will aggregate the potentially valuable materials in the waste stream of businesses in the district. It will sort and prepare these materials in an effort to increase the marketability of the identified commodities. Deploying this model will fundamentally change the way members manage their recyclables and would also change the current hauler arrangements (Figure 14).

The proposed model takes into account many variables that determine what prices vendors pay for these materials.

1. Markets tend to be available for materials aggregated and concentrated in large quantities not small quantities. The centralized collection system will enable **aggregation of materials** at one location, thus maximizing the marketability of these materials.

2. Another variable determining value of the materials is the degree to which the materials are sorted, segregated, and prepared for the market. The proposed facility will employ labor for **sorting and preparing** the materials for the market. Balers, utilities, furniture and other equipments will be required to fulfill sorting and processing needs.

3. Finally, success of this model requires centralized facility managers to work closely not only with 'traditional' supply chain partners in waste management, including LED members and haulers, but also forging new **strategic alliances and innovative partnerships** with new vendors and haulers.

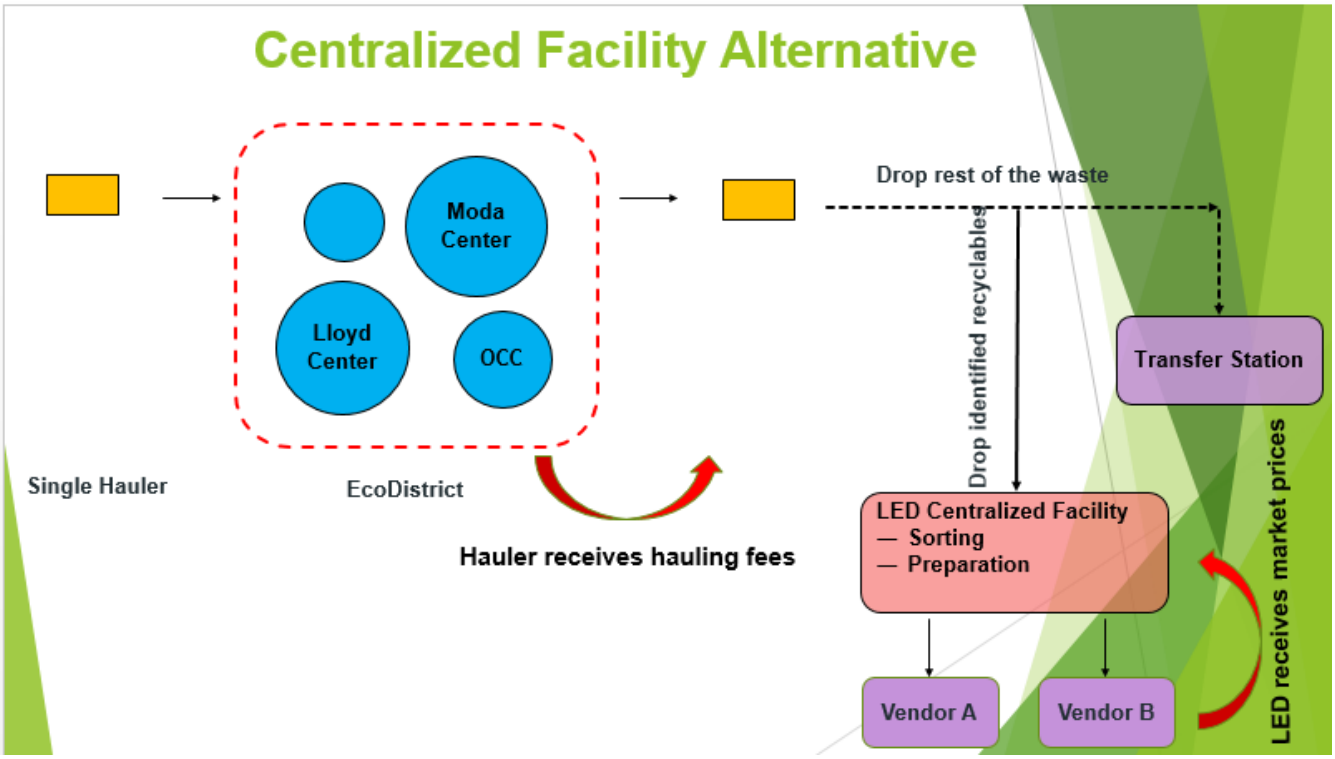


Figure 14: Centralized Facility Alternative

6.3.1 Assumptions and Inputs

There were several assumptions and inputs made to assess the feasibility of the centralized alternative and they are:

1. ***One hauler for the whole district:***

   In return for giving a hauler an exclusive contract to haul all LED member's waste/comingled materials, LED management believes it will be able to negotiate a rate that will be no greater than any member currently pays, but more likely able to actually negotiate a lower rate even if the selected hauler will also give up the floor rate.

2. ***Local vendors are available for the recyclables:***

The highest bidders who are licensed and are reliable partners agree to pay an appropriately determined price for the recyclables. The model assumes that the identified vendor/s haul the recyclables from centralized facility at zero hauling cost.

The best way to evaluate the initial set of identified vendors is to compare them on the following characteristics:

1. Necessary licenses and insurance
2. Reliability of services
3. Volume and / quality requirements for the materials
4. Hauling arrangements
5. Quality of service of the vendor
6. Past performance
7. Agreed prices for the materials

3. *LED members identified for the pilot project:*

For the pilot project, we have identified members who have high volumes of waste generation and have overlapping vendorable materials in the waste stream. The collection route will not be restricted to one material or one sector. We have identified Lloyd Centre Mall (Retail space), Rose Quarter (Events space) and Oregon Convention Center (Events space) for the pilot.

4. *Members identified in the pilot project will agree to participate:*

The model requires increased sorting of the landfill waste at source. Members agree to improve their recycling behaviors. They agree to collect, sort and process (bale, compress etc.) the recyclables in order to maximize the revenues from the recyclables. They also agree to change their current hauler to the "identified" hauler.

5. *The revenues from the recyclables will not be transferred to the members:*

LED will use the revenues to cover the operating costs of the business unit. The members will realize cost savings from 1. Reduced hauling fees 2. Reduced membership fees eventually.

6. *The selling prices of the recyclables may not be equal to the market prices:*

We understand that the recycling markets are not consistent and that the markets fluctuate. We also understand that the prices depend on the quality of the recycled materials and the extent to which materials are processed (sorted, baled, crushed, and compacted). In our model, we used the commodity rates provided by CES.

7. *Discount rate* is calculated at 12.03%.This rate was chosen after performing Weighted Average Cost of Calculation (WACC) calculations.

8. This facility will require significant effort, time and capital investment to set up and maintain. The cost of balers or other related equipment are borne by the members. **Capital investment calculated is at $41,000**. (Calculations shown in appendix)

9. We have extracted information from the waste audit data provided by CES to calculate secondary commodity value (called as "**revenue**" in the model).

10. The fixed and variable costs of operation are calculated taking data provided by Mike Geller of Providence who runs a similar 2000 square feet facility as a benchmark.

6.3.2 Pros and Cons for Centralized Alternative

The following table(Table 1) lists the pros and cons of the Centralized Alternative:

Pros	**Cons**
1. Aggregating, sorting and preparing the materials increases the marketability of the materials and thus maximizes the revenues.	1. The facility requires time effort and investment to set up and run such a facility.
2. This model will motivate the members to change their behaviors and increase their recycling rates.	2. The responsibility of preparing and maintaining the quality of the secondary materials lies with LED. Thus, increasing LED's risk.
3. Will help reach the states' new recovery goal of 75%.	3. Running a waste management facility is not LED's core competency.
4. The number waste hauling vehicles in the district will reduce fuel costs and carbon footprints.	4. This alternative requires LED members to change their waste management behavior, however old habits die hard.
5. Overall operating costs for the vendor/buyers will reduce.	5. Setting up a new contract with one hauler instead of multiple haulers can prove to be an arduous task.
6. This makes for a great PR story.	6. Establishing strategic relationships with vendors is complex.
7. Fosters job creation.	7. Market prices of recyclables are inconsistent.

Table 1: Pros and Cons for Centralized Alternative

The centralized alternative seems an attractive long-term alternative. However, the team recognizes that this alternative is costly to implement and requires LED to venture into a business area which is outside its core competency. The team thus proposed a new alternative called the Floor Rate.

6.4Floor Rate Alternative

In this alternative, one hauler will serve the district and will perform its usual activities of collection, transportation and disposal. The hauler will receive hauling fees and pay the **floor rate** it receives to LED for commingled recyclables.

Unlike the centralized model, deploying this model will not require LED to identify, evaluate and establish vendor relations. Essentially the activities performed by the hauler will not change from haulers currently working within LED. The main difference, however, is a single instead of multiple haulers. In order to ensure lower/same hauling costs and increased floor rates, it is imperative that the district give exclusive hauling rights to a single hauler who would be willing to trade floor rate revenue for the increased volume of waste/materials an exclusive contract will guarantee.

The success of the proposed model requires negotiating a lower/same hauling costs and **guaranteed** floor rates for the commingled. In the previous model, the value of the commodities are based on the market prices (which are not consistent) of the identified commodities and not on guaranteed floor rate, which makes centralized model a riskier bet (Figure 15).

Importantly, unlike the Centralized Model the Floor Rate Model will:

1. Not require LED to sort and prepare the materials for the market as in the centralized model,
2. Not require capital investment and other operating costs (e.g., labor, rent, electricity, utilities etc.) to run such a facility.
3. Save the often complex vendor negotiations and their quality control requirements to sell the recycled materials.

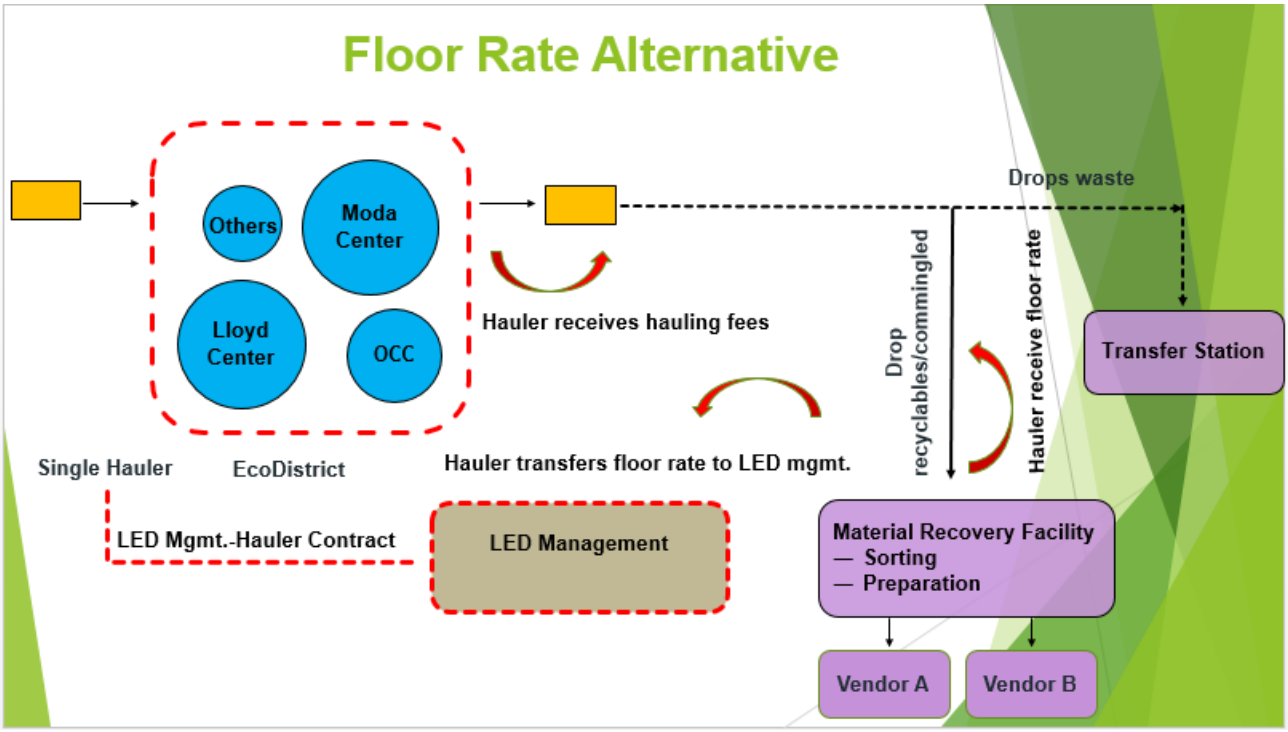


Figure 15: Floor Rate Alternative

6.4.1 Assumptions and Inputs

There were several assumptions and inputs made to assess the feasibility of the floor rate alternative and they are:

1. ***One hauler for the whole district:***

   LED can negotiate the hauling costs based on guaranteed business to the identified hauler. Lower landfill volumes but increased total volumes would result in same hauling costs for the members. Long term guaranteed business to the haulers, will empower LED to negotiate a floor rate plus going forward. However, there may be a disincentive for the single hauler to reduce the landfill volumes since they give up the floor rate; the only way they make money is by hauling landfilled bound waste.

2. ***LED members identified for the pilot project:***

   For the pilot project, we have identified members who have high volumes of waste generation. We have identified Lloyd Centre Mall (Retail sector) and Moda Center (Events sector) and Oregon Convention Center for the pilot.

3. ***Members identified in the pilot project will agree to participate:***

   The model requires that the members eventually increase sorting of the landfill waste at source. Members agree to sort additional recyclables from the landfill waste. This increased volume of recyclables will increase the revenues. Members also agree to change their current hauler to the "identified" hauler.

4. ***The floor rate of the recyclables will not be transferred to the members:***

   LED will use the floor rate from commingled as a source of the revenue and also to cover the operating costs of the business unit. The members will realize cost avoidance from eventual reduction in membership fees. Over time, the hauling costs might also decrease due to lower landfill volumes.

5. ***Discount rate*** is calculated at 12.03%. (Calculations and related inputs are shown in the exhibit).

6. This model does not require establishment of a facility which thereby will not require any capital investment to set up or any operating costs for running the facility. Man hours required will also be reduced.

7. We have taken commingled floor rate received by PSU at $20/ton as our proxy which is the basis of revenue in our model.

8. The only identifiable operating cost includes salary of a project manager to supervise this program.

6.4.2 Pros and Cons for Floor Rate Alternative

The following table (Table 2) lists the pros and cons of the Floor Rate Alternative:

Pros	Cons
1. The facility does not require time effort and investment to set up and run such a facility. 2. The responsibility of preparing and maintaining the quality of the secondary materials does not lie with LED. 3. Operating such model is not as complex as centralized alternative. 4. This alternative does not require LED members to change their waste management behavior. 5. It reduces uncertainty of fluctuating market prices.	1. In this model the revenues are lower in comparison to centralized facility model. 2. Quality of materials can't be guaranteed which reduces LED's ability to get a better floor rate.

Table 2: Pros & cons for Floor Rate alternative

6.5Value Proposition for stakeholders in both Alternatives

After understanding both the alternatives and analyzing their pros and cons, the following table lists the value proposition for the stakeholders in Centralized and Floor Rate alternatives (Table 3).

Stakeholders	Factors	Centralized Facility	Floor Rate
Members	Achieve 75% landfill diversion sooner	Yes	Yes
	Reduce carbon footprint	Yes	Yes
	Cost neutral at minimum	Yes	Yes
Hauler	Exclusive contracts for one or two haulers for the entire district.	Yes	Yes
LED Management	Cover operating expenses	Yes	Yes
	Additional source of revenue	Yes	Yes
	Great PR story	Yes	Yes
Vendors	Exclusive vendor contracts	Yes	No

Table 3: Value proposition for stakeholders

7. Financial Analysis

Financial Analysis was conducted in order to assess the financial viability of both the alternatives. The first step was to identify the commodities from the waste audit data provided by CES. The second step was to understand the price volatility of commodities in the market. The third step was to evaluate the alternatives based on the discounted cash flow method.

7.1 Commodity Identification

Six commodities were identified based on their weight and their monetary value to the district from the waste audit data provided by CES. The list of those commodities is as follows:

1. Mixed Paper
2. Plastic Film
3. Rigid Plastic
4. Plastic bottles & Tubs
5. Corrugated Cardboard
6. Mixed Metals

The weight of mixed paper is highest because of large number of office spaces and retail spaces located in the district. These spaces also contribute to the amounts of plastic bottles and tubs generated in the district. Corrugated cardboard, plastic film, rigid plastics are generated by retails spaces and event spaces in the district. Amount of mixed metals in the waste stream is very low because of the lack of industries in the district. Mixed metals produced mostly consists of the consumer driven items like soda cans, packaging wires etc.

Commodities not included in further analysis includes glass, food fibers, e-waste, batteries, wood, fluorescent lights, office reuse and contaminants because of their low volumes and no monetary value to the district. Food fibers and composting are beyond the scope of this project. Glass is an expensive commodity to recycle therefore there is no market for it in US which makes it of zero value to us.

7.2 Commodity Price Volatility

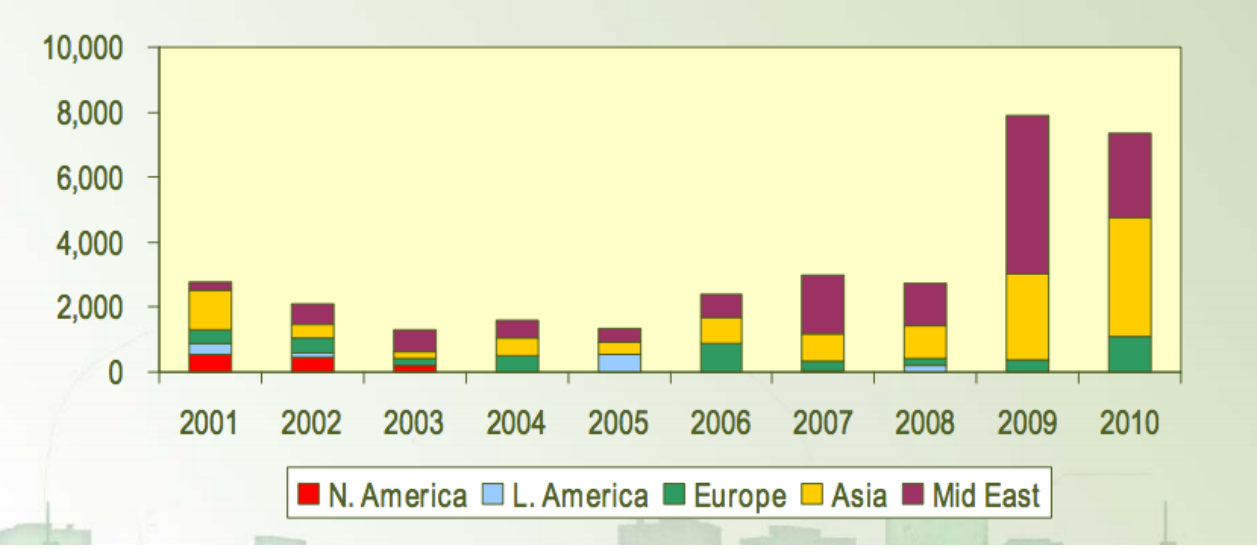
The prices of secondary materials are very volatile in US. One of the main reason for the volatility is its dependency on China. Since 2007, America's top exports to china has been waste that includes plastic, paper, cardboard, scrap metal, soda cans etc. The reason for exports are the low labor costs and processing costs in the developing countries. These exports are indispensable to the waste management in US unless it starts expanding its recycling infrastructure. Figure 16 shows that how reliant we US is on China. US has not built a recycling center since 2003 whereas Asia and Middle East have built thousands of them.

China has recently launched operation 'Green Fence' due to which thousands of tons of waste has been rejected by Chinese. According to operation Green Fence China will import only the

quality materials from other countries. As a result, Oregon recycling centers have stopped accepting clear plastic "clamshell" containers used for berries, plastic hospital gowns and plastic bags. The prices of these materials have gone to zero which we can see in the chart below.

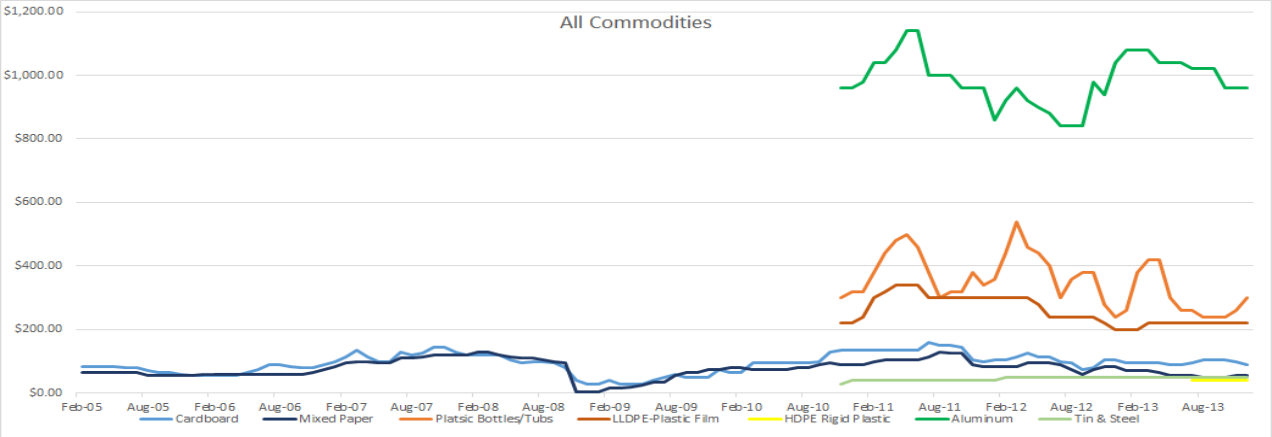
The prices of secondary materials are very sensitive to the economy (Figure 17). During economic downturn, recycling centers go out of business as the demand for their product decreases which in turn reduces the demand for recyclables and the prices of the secondary materials go down.

The models described below are sensitive to the prices of the commodities as they are the key inputs to generate revenue for the district.



Source: http://www.washingtonpost.com

Figure 16: Number of recycling centers built



Source: CES

(Notes: Historical prices data was not available for some of the commodities before 2010.)

Figure 17: Historical prices of secondary commodities

7.3Commodity Price Volatility

For the two proposed model we took four scenarios into consideration based on the landfill diversion rates. Landfill diversion rates are taken based on the range in which current members of the district recycle their waste.

Worst case scenario (50% Landfill Diversion rate)

This is the scenario where only half of the waste is recycled and half it goes to landfill. Most of the members of the district are at this rate which our assumption is mainly due to the government regulation of meeting the fifty percent recycling rate for the commercial sector in Portland and ninety percent of the district fall in this sector. In this scenario five year forecast was made assuming that landfill diversion rate will remain same at fifty percent for next five years.

Required Scenario (75% Landfill Diversion rate)

This is the scenario where only twenty five percent of the total waste generated goes to the landfill remaining 75% is recycled. One of the players close to this rate is Oregon Convention Center (OCC). Most of the player who are this rate of landfill diversion rate are striving to reach ninety percent goal. In this scenario five year forecast was made assuming that landfill diversion rate will remain same at seventy five percent for next five years.

Best case Scenario (90% Landfill Diversion Rate)

This is the ideal scenario where only ten percent of the total waste generated is going to the landfill. Rest ninety percent of the waste is recycled or put to reuse. Moda Center is the only member close to this landfill diversion rate. This is the upper limit as 100% percent of the waste generated cannot be recycled as total waste consists of contaminants that are bound to go to landfill. In this scenario five year forecast was made assuming that landfill diversion rate will remain same at ninety percent for next five years.

Most likely Scenario (Hybrid)

All the scenarios described above are ideal scenarios where landfill diversion rate does not increase or decrease for the next five years which is an unrealistic assumption. Therefore, we considered a hybrid scenario where we took the landfill diversion rate at 50% for the first year then increased it to 65% for the second year and 75% third year onwards. According to us, this was the more realistic approach as we cannot reach 75% landfill diversion rate in the very first year of this model when the whole district is still at 50%. The model will become more efficient with time and the landfill diversion rate will improve too. So instead of taking the flat rate for every in our cash flow we took incremental rates for forecasting the cash flows.

The financial parameters used to evaluate the models are Net Present Value (NPV), payback period and Internal Rate of Return (IRR). These parameters assess if it would be financially worthwhile to invest in the models. The floor rate model is assessed on the basis of NPV only as there is no upfront capital investment involved.

After performing the DCF calculations the key results for the two models are as follows (for calculations refer Appendix A):

7.4Key Results

7.4.1 Centralized Facility

This model is not financially viable for the landfill diversions rate at 50% as NPV is negative and the facility will not be able to start paying for itself in the next five years. NPV is positive in the case of 75%, 90% and hybrid scenario. The payback period ranges from 5 Months for 90% to 41 Months for hybrid. IRR is the highest for 90% diversion rate (Table 4).

Centralized Facility Alternative: Key Results				
Landfill Diversion Rate				
	50%	**75%**	**90%**	**Hybrid**
	Worst Case	Required	Best Case	Most Likely
NPV	($252,014)	$183,730	$420,304	$80,770
Payback Period	N/A	14 Months	5 Months	41 Months
IRR	N/A	118%	260%	32%

Table 4: Key results of Centralized Facility alternative

7.4.2 Floor Rate Model

This model has positive NPV for all the scenarios mainly because there is no upfront investment and also the operating costs are low in comparison to centralized facility model (Table 5).

Floor Rate Alternative: Key Results				
Landfill Diversion Rate				
	50%	**75%**	**90%**	**Hybrid Model**
	Worst Case	Required	Best Case	Most Likely
NPV	($33,076)	$ 62,384	$ 119,959	$ 100,526

Table 5: Key results of Floor Rate alternative

8. Qualitative Analysis

Based on the financial analysis, both the alternatives seem attractive. However, we considered other critical factors as well in our analysis, which play a significant role in our decision-making (Table 6).

Parameters	Centralized Model	Floor Rate Model
Risk	-Risk of entering an unknown territory. -Risk of quality of recyclables	-No such risk -Almost no responsibility
Associated Costs	-Upfront investment -High labor costs -High insurance liabilities -More time & effort	-No upfront investment -Less labor costs -Low insurance liabilities -Less time & effort
Sustainability impacts	-Increased landfill diversion -Reduced carbon emissions	-Increased landfill diversion -Reduced carbon emissions
Revenues	-Volatile commodity prices	-Fixed Floor Rate -Volatility is reduced

Table 6: Key parameters for comparison

Based on the combination of the above qualitative factors and financial analysis, it was prudent to select floor-rate alternative.

9. Strategic Recommendation and Implementation Steps

We recommend that LED implements the floor rate model. The recommendation is based on the combination of the financial model and the key parameters:

- Less risky and easier to implement,
- No upfront investments
- Less labor costs and other liabilities
- Landfill diversion rates will eventually increase, carbon emissions are reduced

- Fixed floor rates reduces the risks associated with volatility in market prices of commodities.
- No additional cost burden to LED members.
- In the most likely scenario (hybrid), the investment value is higher than the centralized facility due to lower operating costs.

To implement the recommendation, we suggest that the model be rolled out in three phases over five years.

Phase 1 (Year One): To test the validity of the model LED begin with a pilot project involving three key members (Oregon Convention Center, Lloyd Center & Moda Center) in the district. This initial phase will last for one year during which LED will monitor the results.

Phase 2 (year two): If evolving as planned, LED, will introduce a limited number of new members to participate in the pilot project. In addition, LED may consider identifying valuable commodities from the waste stream. If so, LED would negotiate a new floor-rate plus for these commodities. Again, LED will monitor the progress.

Phase 3 (years three-five): if the model continues as planned, LED will implement an educational program to train/assist its members in additional source sorting to increase landfill diversions increase the volumes comingled materials. LED may need to negotiate another floor rate plus for higher volumes of commingled materials. Again, LED will monitor the progress and evaluate results at the end of Phase 3.

LED needs to conduct a formal evaluation and monitoring at the end of 5 years, and may have to make one of the following decisions:

1. Drop the model
2. Continue to implement Phase 3 at the same scale
3. Scale up Phase 3 to include all district.
4. Implement Centralized Model

9.1Implementation Action Plan and Activities

Phase	Action Plan	Activities	Timeline
Phase I	Identify few key members in the district; one hauler serves all the identified players; LED gets floor rate for commingled recyclables.	• Define goals and objectives, pros and cons of the model. • Discuss value proposition of the program with LED members. • Identify members willing to who are willing to participate in this initiative. • RFP for haulers, negotiate a favorable	1 year

		arrangement with the identified hauler. • Hire Project Manager to oversee the project, assess, monitor and verify progress and outcomes.	
Phase II	More members participate in this initiative; LED will identify valuable commodities in the waste stream; will negotiate for floor-rate plus for the valuable commodities.	• Get feedback from LED members regarding hauling arrangements and overall program. • Identify valuable commodities and negotiate for floor rate plus. • Identify more members who are likely to participate and discuss the proposition with them. • Continue to closely assess, monitor and verify the results and benefits and gaps.	2 years
Phase III	LED will train/assist members in additional source sorting to increase landfill diversions; LED will negotiate floor rate plus for higher volumes of commingled. This phase will last for two years.	• Get feedback from participating LED members regarding hauling arrangements and overall program. • Train the participants in efficient source sorting. • Add valuable commodities and negotiate for floor rate plus. • Identify more members who are likely to participate and discuss the proposition with them. • Continue to assess, monitor, verify the results and benefits and gaps.	2 years

Table 7: Implementation plan

10. Conclusion

The team started with a goal of identifying a material management alternatives that improved landfill diversion rate also served as a source of revenue for LED mgmt. We developed two alternatives based on secondary and primary research and the data provided by CES. The team analyzed them quantitatively as well as qualitatively and reached a conclusion that floor rate model captures environmental, social, economic characteristics important to LED.

We believe that the proposed business model is a critical step towards building a material efficient district and is in line with district's vision of becoming the most sustainable EcoDistrict in North America.

Appendix A

Exhibit 1: Cost of capital calculations

Discount Rate Calculation	
Tax Rate	0%
Weight of Debt	0%
Weight of Equity	100%
Risk Free Rate	3.27%
Beta	1.75
Market risk premium	5%
Debt rate	8%
Cost of Debt	0%
Cost of Equity	12.02%
Cost of Capital	**12.02%**

Assumptions for Discount Rate Calculation
1) There will be no debt in the capital strcuture.
2) Risk free rate is the 30-year treasury rate.
3) Market risk premium is assumed at 5%.
4) Debt rate is the fixed lending rate that small business with average risk will get.

Peer Companies for Beta Calculation		
Companies	**Market cap.**	**Beta**
1) Casella Waste Systems Inc	208.39 M	1.65
2) Industrial Services of America	20.55 M	1.75

Exhibit 2: Financial Assumptions & Inputs for both alternatives

	Centralized Facility	Floor Rate
Discount rate	12.03%	12.03%
Time period	5 years	5 years
Revenue	Commodity market prices x recyclables	Floor rate x commingled
Floor rate	N/A	$20 (PSU's floor rate)
Capital investment	$41,000	$0
Operating costs	$318,000	$60,000
Depreciation	Straight line	N/A
Tax rate	0	0
Growth rate	2.1%	2.1%
Inflation	2%	2%

Exhibit 3: Centralized facility operating costs

Centralized Facility estimates **			
Capital Investment	Price	No.	
Balers	$10,000	4	$40,000
Furniture	$1,000	1	$1,000
Total Capital Investment			**41,000**
Operating Costs	**1 Month**	**No. Months**	**1 Year Cost**
Utilities	$500	12	$6,000
Space rent	$2,000	12	$24,000
Labor cost + Benefits	$18,400	12	$220,800
Trainer	$3,000	12	$36,000
Depreciation[a]	$167	12	$2,000
Supplies	$500	12	$6,000
Hauling Costs	$2,000	12	$24,000
Total Operating Costs	**$26,567**		**$318,800**
Total Costs			**$359,800**

Notes:

** We have taken these numbers from Providence Model as Proxy. These estimates are for runnign 200Sqft facility.

* Straight line depreciation with life 20 years.

All these estimates are for running a 2000 Sq.ft. facility

Exhibit 4: Commingled recycling estimates for LED

Commingled Recycling Estimates (Based on 1 day Generation in lbs)

Building Usage Type	*TOTAL MATERIAL GENERATION* [a]	Landfill [b]	*50% Recycling Rate* [c]	*75% Recycling Rate* [c]	*90% Recycling Rate* [c]
OFFICE	8,798	4,399	4,399	6,598	7,918
EVENTS	7,781	3,890	3,890	5,836	7,003
HOSPITALITY	1,651	825	825	1,238	1,486
RETAIL	8,510	4,255	4,255	6,382	7,659
RESIDENTIAL	3,665	1,833	1,833	2,749	3,299
LED (Totals)	***30,404.6***	**15,202**	***15,202***	***22,803***	***27,364***

Notes: [a] These estimates are based on the Oregon Department of Environment Quality (DEQ) data published in March 2011. The data was scaled to LED using waste audit data and DEQ data.

[b] These numbers are used from the waste audit data collected by CES.

[c] These are the scenarios considered based on the material recovery rate from the total generation.

Exhibit 5: Commingled recycling estimates under different scenarios

Lloyd EcoDistrict Materials Infrastructure Analysis (1 day of generation)
Commingled Recycling

			OFFICE	EVENTS	HOSPITALITY	RETAIL	RESIDENTIAL	TOTAL
		DEQ %	LBS	LBS	LBS	LBS	LBS	LBS
50%	Mixed paper	33%	1,452	1,284	272	1,404	605	**5,017**
	Cardboard	49%	2,155	1,906	404	2,085	898	**7,449**
	Plastic bottles and tubs	2%	88	78	17	85	37	**304**
	Mixed metals	3%	132	117	25	128	55	**456**
	*Film plastic	3%	132	117	25	128	55	**456**
	*Rigid plastic	2%	88	78	17	85	37	**304**
	*Contaminants	8%	352	311	66	340	147	**1,216**
	TOTAL	**100%**	**4,399**	**3,890**	**825**	**4,255**	**1,833**	**15,202**
			OFFICE	EVENTS	HOSPITALITY	RETAIL	RESIDENTIAL	TOTAL
		DEQ %	LBS	LBS	LBS	LBS	LBS	LBS
75%	Mixed paper	33%	2,177	1,926	409	2,106	907	**7,525**
	Cardboard	49%	3,233	2,860	607	3,127	1,347	**11,174**
	Plastic bottles and tubs	2%	132	117	25	128	55	**456**
	Mixed metals	3%	198	175	37	191	82	**684**
	*Film plastic	3%	198	175	37	191	82	**684**
	*Rigid plastic	2%	132	117	25	128	55	**456**
	*Contaminants	8%	528	467	99	511	220	**1,824**
	TOTAL	**100%**	**6,598**	**5,836**	**1,238**	**6,382**	**2,749**	**22,803**
			OFFICE	EVENTS	HOSPITALITY	RETAIL	RESIDENTIAL	TOTAL
		DEQ %	LBS	LBS	LBS	LBS	LBS	LBS
90%	Mixed paper	33%	2,643	2,338	496	2,556	1,101	**9,134**
	Cardboard	49%	3,841	3,397	721	3,715	1,600	**13,274**
	Plastic bottles and tubs	2%	149	132	28	144	62	**514**
	Mixed metals	3%	258	228	48	250	108	**892**
	*Film plastic	3%	206	182	39	199	86	**711**
	*Rigid plastic	2%	194	172	36	188	81	**670**
	*Contaminants	8%	645	570	121	623	269	**2,227**
	TOTAL	**100%**	**7,936**	**7,018**	**1,489**	**7,675**	**3,306**	**27,424**

Exhibit 6: Market prices for recyclable commodities

Key Inputs	
Commodity Prices Used[a]	
Commodities[b]	**Prices (per lbs)**
Mixed Paper	$ 0.025
Cardboard	$ 0.053
Plastic Bottles & Tubs	$ 0.180
Mixed Metals	$ 0.024
Film Plastic	$ 0.110
Rigid Plastic	$ 0.020

[a] These prices are provided by CES based on current market prices.

[b] These commodities are identified based on volume & monetary value

Exhibit 7: Discounted cash flow for centralized facility for LED

50% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(41,000)					
Revenue		$233,023	$237,917	$242,913	$248,014	$253,223
Operating Costs		318,800	288,456	294,225	300,110	306,112
EBIT	-	(85,777)	(50,539)	(51,312)	(52,095)	(52,889)
Taxes @ 0%		-	-	-	-	-
NOPAT		(85,777)	(50,539)	(51,312)	(52,095)	(52,889)
Add: Depreciation		2,000	2,000	2,000	2,000	2,000
Less: Change in WC		500	500	500	500	500
Net Cash Flow	(41,000)	(84,277)	(49,039)	(49,812)	(50,595)	(51,389)
Cumulative Cash Flow	(41,000)	(125,277)	(174,316)	(224,128)	(274,723)	(326,112)

Project Evaluation	
NPV	$ (252,014)
IRR	#NUM!
MIRR	-100%
Profitability Index	-5.15
Payback Period	#N/A

75% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(41,000)					
Revenue		$349,535	$356,875	$364,370	$372,021	$379,834
Operating Costs		318,800	288,456	294,225	300,110	306,112
Taxes @ 0%		-	-	-	-	-
Less: Change in WC		500	500	500	500	500
Net Cash Flow	(41,000)	32,235	69,919	71,645	73,412	75,222
Cumulative Cash Flow	(41,000)	(8,765)	61,154	132,799	206,211	281,433

Project Evaluation	
NPV	$ 183,730
IRR	118%
MIRR	57%
Profitability Index	5.48
Payback Period	1.13

Exhibit 7 contd……

90% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(41,000)					
Revenue		$412,792	$421,460	$430,311	$439,347	$448,574
Operating Costs		318,800	288,456	294,225	300,110	306,112
EBIT	-	93,992	133,004	136,086	139,238	142,462
Taxes @ 0%		-	-	-	-	-
NOPAT		93,992	133,004	136,086	139,238	142,462
Add: Depreciation		2,000	2,000	2,000	2,000	2,000
Less: Change in WC		500	500	500	500	500
Net Cash Flow	(41,000)	95,492	134,504	137,586	140,738	143,962
Cumulative Cash Flow	(41,000)	54,492	188,996	326,582	467,320	611,282

Project Evaluation	
NPV	$ 420,304
IRR	260%
MIRR	82%
Profitability Index	11.25
Payback Period	0.43

Hybrid Model

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(41,000)					
Revenue		$233,023	$309,292	$364,370	$372,021	$448,574
Operating Costs		$318,800	$288,456	$294,225	$300,110	$306,112
EBIT	-	$ (85,777)	20,836	70,145	71,912	142,462
Taxes @ 0%		$ -	$ -	$ -	$ -	$ -
NOPAT		(85,777)	20,836	70,145	71,912	142,462
Add: Depreciation		2,000	2,000	2,000	2,000	2,000
Less: Change in WC		500	500	500	500	500
Net Cash Flow	(41,000)	(84,277)	22,336	71,645	73,412	143,962
Cumulative Cash Flow	(41,000)	(125,277)	(102,941)	(31,296)	42,116	186,078

Project Evaluation	
NPV	$ 80,770
IRR	32%
MIRR	24%
Profitability Index	2.97
Payback Period	3.43

Exhibit 8: Discounted cash flow for Floor Rate alternative for LED

Key Inputs	
1 Tonne	2000 lbs
PSU floor rate (per tonne)	$ 20

50% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 51,049	$ 52,121	$ 53,216	$ 54,333	$ 55,474
Operating Costs		60,000	61,200	62,424	63,672	64,946
EBIT	-	(8,951)	(9,079)	(9,208)	(9,339)	(9,472)
Taxes @ 30%		-	-	-	-	-
NOPAT		(8,951)	(9,079)	(9,208)	(9,339)	(9,472)
Add: Depreciation		-	-	-	-	-
Less: Change in WC		0	0	0	0	0
Net Cash Flow	-	(8,951)	(9,079)	(9,208)	(9,339)	(9,472)
Cumulative Cash Flow	-	(8,951)	(18,029)	(27,237)	(36,577)	(46,048)

Project Evaluation	
NPV	$ (33,076)

75% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 76,574	$ 78,182	$ 79,824	$ 81,500	$ 83,212
Operating Costs		60,000	61,200	62,424	63,672	64,946
EBIT	-	16,574	16,982	17,400	17,828	18,266
Taxes @ 30%		-	-	-	-	-
NOPAT		16,574	16,982	17,400	17,828	18,266
Add: Depreciation		-	-	-	-	-
Less: Change in WC						
Net Cash Flow	-	16,574	16,982	17,400	17,828	18,266
Cumulative Cash Flow	-	16,574	33,556	50,956	68,783	87,049

Project Evaluation	
NPV	$ 62,384

Exhibit 8 contd…

90% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 91,969	$ 93,900	$ 95,872	$ 97,885	$ 99,941
Operating Costs		60,000	61,200	62,424	63,672	64,946
EBIT	-	31,969	32,700	33,448	34,213	34,995
Taxes @ 30%		-	-	-	-	-
NOPAT		31,969	32,700	33,448	34,213	34,995
Add: Depreciation		-	-	-	-	-
Less: Change in WC						
Net Cash Flow	-	31,969	32,700	33,448	34,213	34,995
Cumulative Cash Flow	-	31,969	64,669	98,117	132,329	167,324

Project Evaluation	
NPV	$ 119,959

Hybrid Model

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 51,049	$ 67,758	$ 79,824	$ 81,500	$ 99,941
Operating Costs		$ 60,000	$ 61,200	$ 62,424	$ 63,672	$ 64,946
EBIT	-	$ 60,000	6,558	17,400	17,828	34,995
Taxes @ 30%		$ -	$ -	$ -	$ -	$ -
NOPAT		60,000	6,558	17,400	17,828	34,995
Add: Depreciation		-	-	-	-	-
Less: Change in WC		500	500	500	500	500
Net Cash Flow	-	59,500	6,058	16,900	17,328	34,495
Cumulative Cash Flow	-	59,500	65,558	82,458	99,785	134,280

Project Evaluation	
NPV	$ 100,526

Exhibit 9: Sensitivity Analysis

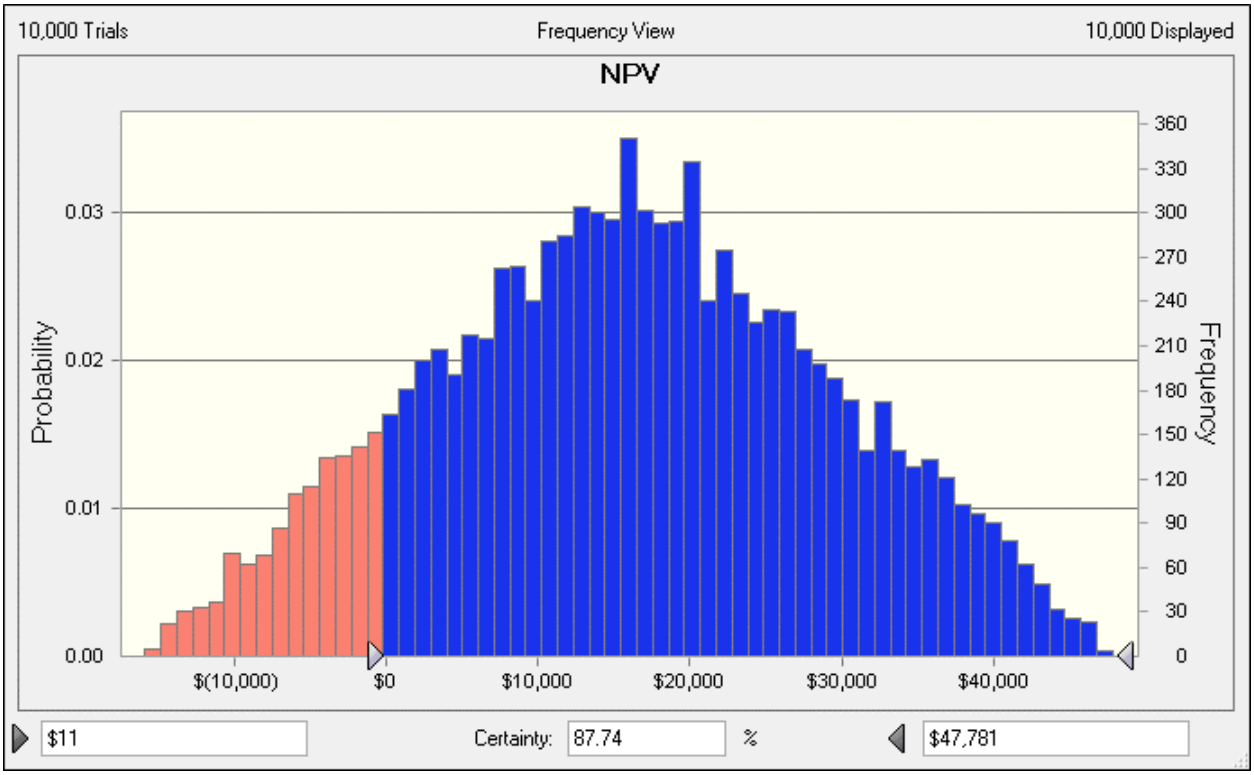
In order to analyze the inherent sensitivity of the Floor Rate model Monte Carlo simulation was performed using Crystal Ball software. Our first task was to identify the variables that affect the present value of our future cash flows. We identified that the floor rate that LED receives is the key variable that could affect the NPV of the project significantly. In order to assess how significant that impact could be on the NPV, this analysis was performed. We have assumed Portland State University's floor rate of $20 per ton of commingled waste as a proxy floor rate in our model. Through sensitivity analysis we tried to see how the NPV of the project will be impacted if we change the floor rate by +/- 25%. We used triangular distribution function. The inputs in simulation were as follows:

Least likely: $15 per ton

Likely: $20 per ton

Most Likely: $25 per ton

After running the simulation with key inputs described above we found that there is 87% probability that this model will have positive NPV if the floor rate in the model change by +/- 25%. Eighty Seven percent probability of positive NPV reinforces our confidence in the Floor Rate Model.



Appendix B: Pilot project (OCC, Moda Center & Lloyd Center Mall)

Exhibit 10: DCF for Floor rate alternative for pilot

50% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 22,816	$ 23,296	$ 23,785	$ 24,284	$ 24,794
Operating Costs		30,000	30,600	31,212	31,836	32,473
EBIT	-	(7,184)	(7,304)	(7,427)	(7,552)	(7,679)
Taxes @ 30%		-	-	-	-	-
NOPAT		(7,184)	(7,304)	(7,427)	(7,552)	(7,679)
Add: Depreciation		-	-	-	-	-
Less: Change in WC		0	0	0	0	0
Net Cash Flow	-	(7,184)	(7,304)	(7,427)	(7,552)	(7,679)
Cumulative Cash Flow	-	(7,184)	(14,488)	(21,915)	(29,467)	(37,146)

Project Evaluation	
NPV	$ (26,667)

75% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 34,225	$ 34,943	$ 35,677	$ 36,426	$ 37,191
Operating Costs		30,000	30,600	31,212	31,836	32,473
EBIT	-	4,225	4,343	4,465	4,590	4,718
Taxes @ 30%		-	-	-	-	-
NOPAT		4,225	4,343	4,465	4,590	4,718
Add: Depreciation		-	-	-	-	-
Less: Change in WC						
Net Cash Flow	-	4,225	4,343	4,465	4,590	4,718
Cumulative Cash Flow	-	4,225	8,568	13,033	17,623	22,342

Project Evaluation	
NPV	$ 15,999

90% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 41,105	$ 41,927	$ 42,766	$ 43,621	$ 44,494
Operating Costs		30,000	30,600	31,212	31,836	32,473
EBIT	-	11,105	11,327	11,554	11,785	12,021
Taxes @ 30%		-	-	-	-	-
NOPAT		11,105	11,327	11,554	11,785	12,021
Add: Depreciation		-	-	-	-	-
Less: Change in WC						
Net Cash Flow	-	11,105	11,327	11,554	11,785	12,021
Cumulative Cash Flow	-	11,105	22,433	33,987	45,772	57,792

Project Evaluation	
NPV	$ 41,459

Hybrid Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	-					
Revenue		$ 34,225	$ 34,943	$ 42,766	$ 43,621	$ 44,494
Operating Costs		30,000	30,600	31,212	31,836	32,473
EBIT	-	4,225	4,343	11,554	11,785	12,021
Taxes @ 30%		-	-	-	-	-
NOPAT		4,225	4,343	11,554	11,785	12,021
Add: Depreciation		-	-	-	-	-
Less: Change in WC						
Net Cash Flow	-	4,225	4,343	11,554	11,785	12,021
Cumulative Cash Flow	-	4,225	8,568	20,122	31,907	43,928

Project Evaluation	
NPV	$ 29,751

Exhibit 11: Operating costs for centralized facility for pilot

Centralized Facility estimates			
Capital Investment	Price	No.	
Balers	10,000	2	20,000
Furniture	1,000	1	1,000
Total Capital Investment			**21,000**
Operating Costs	**1 Month**	**No. Mont**	**1 Year Co**
Utilities	500	12	6,000
Space rent	2,000	12	24,000
Labor cost + Benefits	6,900	12	82,800
Trainer	3,000	2	6,000
Depreciation	83	12	1,000
Supplies	500	12	6,000
Hauling Costs*	1,000	12	12,000
Total Operating Costs	**13,983**		**137,800**
Total Costs			**158,800**

Exhibit 12: DCF for centralized facility for pilot

50% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(21,000)					
Revenue		$ 104,150	$ 106,337	$ 108,570	$ 110,850	$ 113,178
Operating Costs		137,800	134,436	137,125	139,867	142,665
EBIT	-	(33,650)	(28,099)	(28,555)	(29,017)	(29,487)
Taxes @ 0%		-	-	-	-	-
NOPAT		(33,650)	(28,099)	(28,555)	(29,017)	(29,487)
Add: Depreciation		1,000	1,000	1,000	1,000	1,000
Less: Change in WC		(1100)	0	0	0	0
Net Cash Flow	(21,000)	(31,550)	(27,099)	(27,555)	(28,017)	(28,487)
Cumulative Cash Flow	(21,000)	(52,550)	(79,650)	(107,205)	(135,222)	(163,709)

Project Evaluation	
NPV	$ (124,306)
IRR	#NUM!
MIRR	-100%
Profitability Index	-4.92
Payback Period	#N/A

75% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(21,000)					
Revenue		$ 156,224	$ 159,505	$ 162,855	$ 166,275	$ 169,766
Operating Costs		137,800	134,436	137,125	139,867	142,665
EBIT	-	18,424	25,069	25,730	26,407	27,102
Taxes @ 0%		-	-	-	-	-
NOPAT		18,424	25,069	25,730	26,407	27,102
Add: Depreciation		1,000	1,000	1,000	1,000	1,000
Less: Change in WC						
Net Cash Flow	(21,000)	19,424	26,069	26,730	27,407	28,102
Cumulative Cash Flow	(21,000)	(1,576)	24,493	51,223	78,631	106,733

Project Evaluation	
NPV	$ 69,467
IRR	106%
MIRR	50%
Profitability Index	4.31
Payback Period	1.06

90% Recycling Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Capital Investment	(21,000)					
Revenue		$ 184,497	$ 188,371	$ 192,327	$ 196,366	$ 200,490
Operating Costs		137,800	134,436	137,125	139,867	142,665
EBIT	-	46,697	53,935	55,202	56,499	57,825
Taxes @ 0%		-	-	-	-	-
NOPAT		46,697	53,935	55,202	56,499	57,825
Add: Depreciation		1,000	1,000	1,000	1,000	1,000
Less: Change in WC						
Net Cash Flow	(21,000)	47,697	54,935	56,202	57,499	58,825
Cumulative Cash Flow	(21,000)	26,697	81,632	137,834	195,333	254,158

Project Evaluation	
NPV	$ 175,204
IRR	237%
MIRR	75%
Profitability Index	9.34
Payback Period	0.44

Appendix C: Questionnaire

1. What is the size of the business & estimated number of employees?
2. What is the type of business?
3. Raw materials used for the business and who are the suppliers?
4. What is the finished product?
5. Do you have any waste management program in the company?
6. If answer of 5. is yes then:
    a. How many people are employed for the waste management?
    b. What secondary materials are managed?
    c. Who are the vendors?
    d. How the material is hauled and who is the hauler?
    e. Who picks up the recyclables?
7. Does the hauler provide both waste and recyclable and waste pick up?
8. Who is hauler?
9. Do you have any tie ups with the vendors of the recyclable materials?
10. Do you have any contracts with the haulers and if not then how it works?
11. What is the duration of contract?
12. When does the contract start and when it ends?
13. What is the hauling fees you are paying?
14. Do you get any rebates or discounts? (for example floor rate or any other rate)
15. Is the hauling fees fixed or variable?
16. What is the frequency of pick up?
17. For the recyclables: Is it pre-sorted or sorted by Vendor/Hauler/MERF?
18. Will you or your company be comfortable being part of the program that offers
    a. Rebates
    b. More frequent pick ups
    c. Less hauling fees

Bibliography

[1] http://www.deq.state.or.us/lq/sw/recovery/materialrecovery.htm

[2] https://www.portlandoregon.gov/bps/article/109782

[3] http://www.epa.gov/waste/nonhaz/municipal/pubs/2012_msw_fs.pdf

[4] https://www.portlandoregon.gov/bps/article/109782

[5] http://www.worldwatch.org/global-municipal-solid-waste-continues-grow

[6] What a Waste: A Global Review of Solid Waste Management

[7] http://www.deq.state.or.us/lq/pubs/docs/sw/2012MRWGRatesReport.pdf

[8] http://www.wastebusinessjournal.com/overview.htm

[9] http://ecolloyd.org/

[10] http://pages.uoregon.edu/recycle/Book/HTML/chapter_8.htm

[11] http://www.epa.gov/epawaste/nonhaz/municipal/

[12]http://www.epa.gov/epawaste/nonhaz/municipal/pubs/MSWcharacterization_508_053113_fs.pdf

[13] http://en.wikipedia.org/wiki/Ecodistrict

[14] http://ecodistricts.org/

[15]http://www.wsdot.wa.gov/NR/rdonlyres/6F915B3C-4206-437A-8798-C595D5729901/0/EcoDistrictsFrameworkMay2013.pdf

[16]http://ecolloyd.org/wordpress/wp-content/uploads/2013/02/lloyd_roadmap_FINAL_hires.pdf

[17] http://www.portlandoregon.gov/bps/article/110895

[18]http://www.washingtonpost.com/blogs/wonkblog/wp/2013/05/09/chinas-crackdown-on-trash-could-make-it-harder-for-u-s-cities-to-recycle/

[19]http://www.swanacalleg.org/downloads/SWANA%20LTF%20white%20paper%20on%20letterhead.pdf