Final Report

Metro Transfer System Ownership Study

Prepared for

METRO
PEOPLE PLACES • OPEN SPACES

June 2006

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Acknowledgements

The authors would like to recognize the following individuals and organizations that provided their opinions on the Metro transfer system and possible ownership options.

1. Metro Council
   - David Bragdon
   - Rod Park
   - Carl Hosticka
   - Brian Newman
   - Susan McLain
   - Rex Burkholder
   - Robert Liberty

2. COO/Staff

3. Local Gov.
   - Rob Guttridge, Waste Reduction Specialist, Clark County
   - Jack Hanna, Code Enforcement, City of Troutdale
   - JoAnn Herrigel, Community Services Director, City of Milwaukie
   - Scott Keller, Auxiliary Services Program Manager, City of Beaverton
   - Leslie Kochan, Waste Reduction Specialist, Oregon DEQ
   - Matt Korot, Recycling & SW Program Manager, City of Gresham
   - Anita Larget, Solid Wate Manager, Clark County Government
   - Sally Puent, Manager SW/NW Region Environmental Partnership, Oregon DEQ NW Region
   - Ken Spiegle, Community Environment Manager, Clackamas County
   - Patricia Vernon, Oregon DEQ
   - Bruce Walker, Solid Waste & Recycling Program Manager, City of Portland OSD
   - Robert Weeks, Interim Solid Waste Manager, Washington County
   - Rick Winterhalter, Waste Reduction Coordinator, Clackamas County
   - Alice Norris, Mayor, Oregon City
   - Larry Patterson, City Manager, Oregon City
   - Judge Laura Pryor, Gilliam County

4. Private Transfer Station Owner-Operators
   - Dean Spady, Allied Waste Systems
   - Ray Phelps, Allied Waste Systems
   - Todd Irvine, Allied Waste Systems
   - Mike Leichner, Pride Disposal
   - Eric Merrill, Waste Connections
   - Dean Large, Waste Connections
   - Adam Winston, Waste Management
   - Mike Dewey, Waste Management

- Will Spear, Waste Management

5. Independent Commercial Haulers
   - Dave McMahon, Cloudburst Recycling
   - Jack Deines, Deines Brothers Disposal
   - Randy Burbach, Flannery's Drop Box Service
   - Mike Borg, Oak Grove Disposal Company
   - David White, Oregon Refuse and Recycling Association
   - Dave Cargni, Portland Disposal & Recycling,
   - Steve Borgens, Portland Disposal & Recycling
   - John Romero, West Slope Garbage Service
6. Independent Facility Operators
   - Ralph Gilbert – East County Recycling
   - Terrell Garret – Greenway Recycling
7. Business Self-haul Customers/Homeowner Self-haul Customers
   - 314 customers participated in gatehouse survey
8. General Public
   - Participated in "Let's Talk Trash" public outreach program

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Background

The Disposal System Planning Project (DSP) is a component of the Regional Solid Waste Management Plan update. The project will be completed in two phases. Phase 1 began in 2005. Phase 2 is expected to begin in FY 2006-07. The primary purpose of Phase 1 is to answer the question: *What is the best way to deliver safe, environmentally sound and cost-effective disposal services to this region?* An important component of this question is Metro's role in the disposal system. The primary purpose of Phase 2 will be to implement the decisions of Phase 1.

Over time, the private solid waste industry has become more concentrated, both nationally and locally. Since 1998, Metro has recognized the public and political interests in relaxing its role as the primary provider of services, and has begun to franchise limited private transfer operations throughout the region for commercial haulers. Given growing pressure from transfer station interests within the industry to accelerate the pace of private facility authorizations, this project will take a step back and take a comprehensive look at what is the best course for the region as a whole for the long-run.

Project Purpose

The purpose of this transfer system ownership study is *to analyze different transfer station ownership options to provide information for the Metro Council to decide what Metro's role should be in the disposal system*. The analysis has four essential elements:

1. The project team worked with the Council and various stakeholders to identify the criteria to be used for evaluating the quality of the disposal system—cost, material recovery, equity, flexibility, etc.
2. The project team worked with stakeholders to construct different ownership options that address the transfer component of the regional solid waste system. Options investigated include public ownership of all transfer facilities, mixed public and private ownership, and a totally privately owned system.
3. The ownership options were analyzed against the performance criteria listed above.
4. Finally, the Metro Council will make a decision. A choice, for example, of a totally private system implies that Metro should ultimately exit the disposal business. The choice of a mixed public-private system, on the other hand, implies that Metro should remain in the business. The choice of a public system implies an increased role for Metro in the provision of transfer system services.

Approach

The choice of system ownership option is dependent upon a number of factors that relate to the ultimate objectives and values of the region's residents, businesses, and industry stakeholders. The Metro Council is responsible for making decisions about the transfer system that best meet these objectives and values. It is important to consider the environmental, social, and financial aspects of different system ownership options, and to be aware of risks that may need to be managed should changes to the current system be implemented. Thus, the analysis of different system ownership options was conducted from the following perspectives:

- Documentation and consideration of stakeholder input
- Analysis of Metro solid waste system economics
- Definition of system options
- Value Modeling of non-monetary aspects of system options
- Economic analysis of system options
- Risk Assessment of system options

Results and Conclusions

Competition in the Metro Disposal System

The Metro disposal system can be viewed as a series of inter-related elements: collection, transfer/processing, transportation, and disposal (waste reduction, recycling, and source-separated processing are not typically considered to be part of the disposal system). Economic theory and the results of the analysis of the system suggest the following conclusions about competition in the Metro disposal system:

- Collection: Commercial collection in the City of Portland is arranged by subscription i.e., multiple firms compete for business in a competitive market. Residential collection, and commercial collection outside the City of Portland, is provided under a system of exclusive franchises. Thus, there is no competition for the majority of collection services in the Metro region.

  It is estimated that collection accounts for 81 percent of the total cost of residential disposal, and a very high percentage of the total cost of commercial disposal. As a result, the greatest opportunity to inject competition into the Metro disposal system is in collection, which is the responsibility of local government and outside the control of Metro.

- Transfer/processing: A fundamental fact about transfer stations is that there is little competition in the provision of transfer/processing services regardless of whether these services are provided by the public or private sector. This occurs for a number of reasons. First, it is only economic to deliver waste to a facility relatively close to the collection route resulting in a type of "natural geographic monopoly". Second, collection firms that are vertically integrated (i.e., they own transfer stations and/or landfills) gain an additional margin of profit by delivering waste to a station they own: it often makes economic sense for such firms to drive past a transfer station they don't own and

continue on to deliver waste at a station they do own. Finally, transfer and processing per-ton costs decline as more tons are received; this results in a seeming paradox in which prices paid for transfer can ***increase*** as more transfer stations are put in place.

Metro injects one important element of competition into the transfer/processing market in the region by bidding out the operation of their stations. This helps lower the total cost of disposal for local governments that use the Metro transfer rate as a benchmark for establishing the disposal component of the collection rates charged by the franchised collection firms they regulate.

- Transportation: Transportation of waste from a transfer/processing facility to a disposal facility is generally done at competitive market prices. There are few barriers to entry and many trucking firms willing to compete for this business. Barge and rail transport also have the potential to be competitive with trucking for transportation of waste from Metro to distant landfills.

- Disposal: At least 90 percent of the wet waste in the region is disposed of at a Waste Management landfill under the terms of a contract that was procured years ago using a competitive process in a market with few options for disposal. The price paid by Metro is equal to or lower than that paid by other jurisdictions in the Pacific Northwest that have long-term contracts for disposal at regional landfills. Today, however, there are multiple firms with regional landfills that would be interested in providing disposal services to Metro. It is possible that the disposal price paid by Metro is higher than the price it would pay in a competitive market for disposal, or if its disposal contract were re-bid. Metro is legally bound to this contract through 2014, and the contractor can extend the contract until 2019. After this contract expires, it is possible that Metro would realize a reduction in the price paid for disposal.

Metro as Regulator and Competitor

During the conversations with stakeholders conducted as part of this project, one concern expressed by private transfer station operators is that Metro is both their regulator and a competitor. This concern exists for a couple of reasons. First, as tons flow to private facilities rather than a Metro-owned facility, Metro's per-ton cost of transfer increases. The transfer station operators believe that this provides an incentive for Metro to limit the amount of wet waste delivered to the private stations thus limiting private sector growth and revenue-generating potential. Second, Metro establishes fees and taxes that must be paid by private facility owners: some private facility owners feel that those fees and taxes are too high. They particularly dislike paying for Metro general government and paying for certain services and costs associated with the Metro transfer stations.

A very different perspective is held by the independent collection firms that were interviewed. They were of the unanimous opinion that there should be no private wet waste transfer stations in the region: their interests would be best served by a system in which Metro owns all transfer stations ***and*** disposal facilities. This is mainly because vertically integrated firms that provide collection and transfer and/or disposal services have a competitive advantage over firms that provide only collection services. The vertically integrated firms are both competitors and service providers to smaller independent firms. It is safe to conclude that continued Metro ownership of transfer stations will result in a

collection market that includes more small independent collection companies than would be the case if Metro did not own any transfer stations.

The independent dry waste processing facility owners interviewed felt the Metro should continue to both own and regulate facilities.

Surveys of both commercial and self-haul customers (households and businesses) indicated a high degree of satisfaction with the level of service provided by Metro. When asked where they would take waste should the Metro station they were using close, the majority of self-haul customers said they would use the other Metro facility or had no idea where they would go.

Metro Disposal System Economics

The analysis of the economics of the Metro solid waste system results in the following conclusions and recommendations:

- The greatest potential for cost savings is in collection; which is outside Metro's control.
- Metro rates are used in setting collection fees, which is good, particularly when Metro competitively procures transfer station operation services. This injects an important element of competition in a market that otherwise would not have many characteristics of a competitive market. Therefore, Metro should try to maximize competition in contracting for each of these services. For example, it could consider evaluating price as a function of distance in its disposal contract, or perhaps jointly procuring transfer, transport, and disposal or transport and disposal.
- In recent years, national solid waste firms have increased market share in the local solid waste industry. These firms seek to achieve vertical integration to maximize profits. Without measured steps by Metro and/or local government to preserve competition, vertical integration, profitability, and prices are likely to increase in the Metro region.
- Economies of scale are significant in transfer, thus, adding transfer stations increases per-ton costs. Also, handling small loads increase per-ton costs compared to handling large loads. Therefore, Metro should be careful to not allow too much excess capacity in the region's transfer system: adding stations reduces throughput at existing facilities and thereby, other things equal, increases the cost of transfer.
- Significant unused transfer capacity exists in the region.
- Transfer is the smallest cost component of the transport, transfer, and disposal system.
- On average, Metro transports waste to landfills a greater distances than does the private sector.
- The private sector typically earns its highest profit margins on disposal.

Evaluation of Different Ownership Options

The advantages and disadvantages of private, public, or a hybrid public-private ownership of the Metro region transfer system were analyzed from a variety of perspectives, including:

- An analysis of how well each option met the Metro Council's stated values
- The estimated cost of each option
- The risk associated with each option

A variety of methods including in-person interviews, surveys, and focus groups were used to elicit the opinions of key stakeholders such as private facility owners, independent waste collection firms, independent dry waste facility owners, local government representatives, Metro staff members, and Metro transfer station users. The opinions of stakeholders were used to help define the system options and analyze the performance of the options in meeting Council objectives.

A brief summary of the results of the value modeling, economic analysis, and risk assessment follow.

Value Modeling

The Metro Council outlined the following values associated with the disposal system:

1. Protect public investment in solid waste system
2. "Pay to Play"- Ensure participants pay fees/taxes
3. Environmental Sustainability- ensures system performs in an sustainable manner
4. Preserve public access to disposal options (location/hours)
5. Ensure regional equity- equitable distribution of disposal options
6. Maintain funding source for Metro general government
7. Ensure reasonable/affordable rates

These values were reworded slightly to facilitate analysis. One value (ensure reasonable/affordable rates) was captured in the economic analysis, and one additional value was added: Ensuring support from system participants.

The results of the value modeling analysis indicate that the public system is clearly preferred to the other ownership options. The results of a sensitivity analysis of the relative importance of each Council value indicate that this result is not sensitive to the relative importance assigned to each value.

One additional sensitivity analysis was performed that incorporated challenges associated with implementation. That analysis showed that as more importance is placed on the difficulties associated with acquiring existing private transfer stations, the hybrid system eventually becomes preferred to the public system.

Economic Analysis

The cost of the three systems is not likely to have a large impact on the cost of the Metro solid waste system. Regardless of the option selected, costs are not expected to increase or decrease by more than about two percent. Other findings of the economic analysis include:

- The hybrid is the only option with the potential to reduce system costs.
- Both the public and the private options are projected to increase system costs (i.e., collection, transfer, transportation and disposal). The cost increase for the public option is estimated at 0.1% to 0.7% and the increase for the private option is estimated at 1.4% to 2.2%.

- The largest cost impacts occur in the collection market; although Metro does not control collection, collection costs can be affected by Metro's actions.
- Increasing the number of transfer stations tends to increase the cost of transfer, but these increases can be more than offset by decreases in collection costs.
- These cost estimates depend on a series of assumptions that are of course subject to variance; while different assumptions would result in different cost estimates, it is not likely that the relative ranking of the options would change.
- The key impact of the Private option is the likely further concentration of the collection industry, increased vertical integration, a probable reduction in the number of small independent collection firms, and probable cost-plus price creep.

Risk Assessment

There is considerable uncertainty at this time about exactly how any of the system options would be implemented and exactly how aspects of the system would develop through time. When considering major new programs or system changes, it is important that organizations such as Metro evaluate the risk associated with such changes by identifying, assessing, and develop strategies to manage those risks.

Risks were identified by the project team during a brainstorming exercise during which 10 risks and 6 related uncertainties were identified that may be relevant to the choice of ownership option. Once identified, a qualitative assessment of these risks was performed. The assessment was done using a qualitative risk signature approach in which the signature for each risk was determined by first assessing the likelihood and impact for each risk, then using a risk matrix to determine if the risk is low, medium, high, or critical.

The assessment of risks is shown in Exhibit E-1. The results of the assessment indicate that there is more risk associated with implementing the private system than the public or hybrid system. However, the only risk scored as critical is challenges associated with implementation in the public system. The hybrid system has relatively low risk.

EXHIBIT E-1
Risk Assessment

Risk	Risk Signature		
	Private	Public	Hybrid
1. More difficult politically to collect regional system fee and excise taxes	High	Low	Low
2. Metro's credit rating could worsen if it is perceived to be less able to collect taxes	High	Low	Low
3. It could be more costly and more difficult administratively for Metro to respond to future changes in state-mandated Waste Reduction requirements	High	Low	Low
4. It could be more costly and more difficult administratively for Metro to deliver new WR/R initiatives	High	Low	Low
5. Potential increase in vertical integration and potential resulting increases in transfer station tip fees	High	Low	Low
6. Reduced ability to meet dry waste recovery targets	Medium	Low	Low
7. Additional cost to Metro of fulfilling Disposal contract	Medium	Low	Low
8. Inability or added cost to maintain current level of self-haul and HHW service	Medium	Low	Low
9. Likelihood of successful flow control challenge	High	Low	Low
10. Political challenges or protracted legal proceedings resulting from condemning private transfer stations or allowing wet waste franchises to expire	Medium	Critical	Low

Summary of Results

A summary of the results of the value modeling, economic analysis, and risk assessment are shown in Exhibit E-2. The results for each option are as follows:

- The private option has the lowest value score, has the highest projected cost increase, and the most risks that would need to be managed.
- The public option has the highest value score, small projected cost increases, and one critical risk that would need to be managed.
- The hybrid system has a value score between the two other options, neutral or possibly decreased cost, and no significant risk.

EXHIBIT E-2
Summary of Results

	Private	Public	Hybrid
Values – Results of value modeling analysis. Normalized scores where the best score =1, worst score =0.	0.35	0.62	0.49
Cost – Estimated long-run percent change in system cost (i.e., collection, transfer, transport, disposal).	Low: 1.4% High: 2.2%	Low: 0.1% High: 0.7%	Low: -0.5% High: 0.1%
Risk – 10 measured risk signatures that incorporate likelihood and criticality. Each risk rated low, medium, high, or critical.	6 High 4 Medium	1 Critical 9 Low	10 Low

SECTION 1

Introduction

Background

The Disposal System Planning Project is a component of the Regional Solid Waste Management Plan update. The project will be completed in two phases. Phase 1 began in 2005. Phase 2 is expected to begin in FY 2006-07. The primary purpose of Phase 1 is to answer the question: *What is the best way to deliver safe, environmentally sound and cost-effective disposal services to this region?* An important component of this question is Metro's role in the disposal system. The primary purpose of Phase 2 will be to implement the decisions of Phase 1.

Metro has been the primary provider since the early 1980s, and led the region through the transition from local landfills to the modern transfer-long haul-remote disposal system in the late 1980s and early 1990s. Metro's activities during that time procured private investment for the development of one of the first Subtitle D landfills in the nation, Columbia Ridge Landfill in Gilliam County, Oregon.

Over time, the private solid waste industry has become more concentrated, both nationally and locally. Since 1998, Metro has recognized the public and political interests in relaxing its role as the primary provider of services, and has begun to franchise limited private transfer operations throughout the region for commercial haulers. Given growing pressure from transfer station interests within the industry to accelerate the pace of private facility authorizations, this project will take a step back and take a comprehensive look at what is the best course for the region as a whole for the long-run.

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4. Finally, the Metro Council will make a decision. A choice, for example, of a totally private system implies that Metro should ultimately exit the disposal business. The

choice of a mixed public-private system, on the other hand, implies that Metro should remain in the business. The choice of a public system implies an increased role for Metro in the provision of transfer system services[1].

Approach

The choice of system ownership option is dependent upon a number of factors that relate to the ultimate objectives and values of the regions residents, businesses, and industry stakeholders. The Metro Council is responsible for making decisions about the transfer system that best meet these objectives and values. It is important to consider the environmental, social, and financial aspects of different system ownership options, and to be aware of risks that may need to be managed should changes to the current system be implemented. Thus, the analysis of different system ownership options was conducted from a number of different perspectives, including:

- Documenting and clarifying Council values
- Documentation and consideration of stakeholder input
- Analysis of Metro solid waste system economics
- Definition of system options
- Value Modeling of non-monetary aspects of system options
- Risk Assessment of system options
- Economic analysis of system options

Documenting and Clarifying Council Values

In analyzing the transfer system it is important to know what the objectives are for that system. In 2003, the Metro Council established the following values for the transfer system:

1. Protect public investment in solid waste system
2. "Pay to Play"- Ensure participants pay fees/taxes
3. Environmental Sustainability- ensures system performs in an sustainable manner
4. Preserve public access to disposal options (location/hours)
5. Ensure regional equity- equitable distribution of disposal options
6. Maintain funding source for Metro general government
7. Ensure reasonable/affordable rates

The project team translated those values into objectives that could be measured for each disposal system option, and used a value modeling approach to evaluate the extent to which each ownership option met the objectives.

Documentation and Consideration of Stakeholder Input

System users and stakeholders were interviewed about their objectives for the Metro transfer system. Information about stakeholder objectives was obtained in a number of ways including:

- One-on-one interviews with private transfer station owners

[1] While the public option was defined having Metro as the provider of wet waste transfer services, this role could also be provided by local government or a combination of Metro and local government.

- A workshop with local government representatives and one-on-one interviews with select local government leaders
- A focus group with independent waste collection firms
- Interviews with two independent dry waste facility operators
- Two user surveys at Metro transfer stations (commercial and self-haul customers)

Stakeholders were asked a series of questions to elicit their opinions about features of the Metro system that worked well or did not work well, how the system could be improved, and whether they would prefer public, private, or a mix of public-private transfer station ownership. The answers to these questions were used to inform the development of system options and the analysis of the non-monetary aspects of the Metro system. A summary of the stakeholder outreach process is provided in Appendix A.

Analysis of Metro Solid Waste Market

The Metro solid waste market was analyzed for the system components of collection, transfer and processing, transportation, and disposal. The analysis includes:

- A review of economic principles that apply to the solid waste industry.
- An analysis of competition, incentives, and the market structure of each component of the Metro system and how the Metro system compares to other systems in the U.S.
- A cost analysis of system components.

The results of this analysis were used to help develop the system ownership options for subsequent analysis, and to clarify the economic drivers of the Metro solid waste market.

Definition of System Options

There are many different ways the Metro system could be organized with the involvement of the private and public sectors. The current ownership structure was documented and the major aspects of the system were carefully defined in order to ensure that each option is a feasible way of providing transfer services to the Metro region. The project team considered input from key stakeholders and successful elements of other systems in the U.S. when defining each of the different ownership options.

Value Modeling of Non-Monetary Aspects of System Options

The question about which transfer system ownership option is best suited for the Metro region is in many ways a subjective policy question. There are many unknown variables which make it difficult to know the likely costs of each option with much certainty, and many of the differences between the options result from environmental, social, and other non-monetary factors for which the relative importance of those factors is a matter of preference. Thus, this analysis includes an evaluation of the extent to which each option is consistent with the objectives and values of the Metro Council using value modeling, which is also known as multi-criteria decision analysis.

Value modeling evaluates how well each option rates against a chosen set of objectives. It is a particularly useful tool when important non-monetary values and objectives exist,

stakeholder input must be considered, and clear documentation of methods and results is important. The value modeling approach consists of the following six elements:

- Establish the decision goal
- Identify and specify fundamental objectives
- Develop performance measures to assess project performance against objectives
- Add technical detail to the performance measures, and assign scores to the performance measures
- Assign weights to the objectives
- Calculate value scores and conduct sensitivity analysis

Risk Assessment

There is considerable uncertainty at this time about exactly how any of the system options would be implemented and exactly how aspects of the Metro solid waste system would develop through time. When considering major new programs or system changes, it is important that organizations such as Metro evaluate the risk associated with such changes by identifying, assessing, and developing strategies to manage those risks.

The project team conducted a brainstorming session to identify uncertainties about the different ownership options. A risk matrix approach was used to conduct a qualitative assessment of the risks of each option.

Economic Analysis of System Options

Economic models were developed for each element of the Metro system: collection, transfer, transport and processing, and disposal. These models were developed using detailed information about the operations of the Metro system to calibrate existing cost models that have been developed using national data. The models were used to estimate the cost implications of changing from the current system to the private, public, or hybrid system.

There is considerable uncertainty about exactly how each of the three ownership options would evolve through time. The actual costs would depend on the actions of many different firms, industry trends, and regional and national economic trends. Thus, the project team carefully documented a series of key assumptions, and used range estimates of the cost of each system to characterize the likely economic effect of each option.

SECTION 2

Economics of the Metro Solid Waste Industry

This section presents the results of an analysis of the economic principles that apply to the solid waste industry, and an analysis of the economic forces at work in the Metro solid waste system. A more in-depth discussion of basic economic principles is provided in Appendix B, and more information about how solid waste markets function in the Metro region is provided in Appendix C.

Solid Waste Industry Economic Principles

Market Structure

The term **market structure** refers to the number and size of participants in a market -- those firms or institutions producing a good or providing a service for sale. Market performance refers to the extent to which the prices and quantities exchanged in the market reflect an efficient allocation of resources and avoid excessive profits to any single or group of producers. In other words, market performance refers to the level, quality and price of goods and services produced.

As an example, consider the two extreme examples of market structure. The first example has a single producer, and hence no competition among producers; this is called a monopoly. The second extreme example has a very large number of competitors each producing the same product (homogeneous or undifferentiated product) with no individual impact over the market price; this is called perfect competition. While these extreme market structures are seldom actually observed in modern industrial economies, they provide a useful set of bookends for discussing all other market structures where the number of producers ranges from two to many.

In general, competitive industries have the following characteristics:

- Many buyers and sellers
- Few barriers to entry
- No major capital investment required
- No significant economies of scale
- Prices and profits are low

A classic example of a competitive industry is agriculture and the production of crops such as corn or wheat where there are many buyers and sellers of an undifferentiated good or service. There are no technical, regulatory, or financial barriers to entry, and no significant economies of scale, such as those that exist with a railroad. As a result, no seller has the ability to set the price, and prices and profits are low.

Conversely, monopoly or monopolistic competition industries can be characterized as:

- Occurring when competitive characteristics are not present

- Prices and profits are high
- Products are generally differentiated from one another

When competitive characteristics are not present – industry tilts towards monopoly or monopolistic competition. The highest profits occur in monopolistic industries (such as patented drugs, 19th century canals and railroads, wildlife tourism), where there can be markups over costs as high as 100 percent.

Depending on specific conditions in a local market, the solid waste industry can vary widely on the spectrum between competitive and having elements of monopoly.

Vertical Integration

In solid waste, profits vary by component – it's much harder to enter the disposal market than collection market, because of regulatory, capital, and "not-in-my-backyard" (NIMBY) siting difficulties – thus, the industry typically receives its highest percentage profits in disposal.

Firms with disposal sites like to use their own disposal sites for waste they collect – called vertical integration. Waste Management, for example, cites the benefits of vertical integration in its 10K report for 2004, saying ***"All solid waste management companies must have access to a disposal facility, such as a solid waste landfill. We believe it is usually preferable for our collection operations to use disposal facilities that we own or operate, a practice we refer to as internalization, rather than using third party disposal facilities. Internalization generally allows us to realize higher consolidated margins and stronger operating cash flows."*** Vertical integration results in higher margins and stronger cash flow because the vertically integrated company earns profits on multiple elements of a solid waste system.

In the Portland Metro market, 56 percent of tons collected are delivered to transfer stations or landfills owned by the collector i.e., complete vertical integration is achieved. For companies that own both a transfer station and a landfill, 100 percent of the tons from their transfer station go to the landfill they own except one firm that sends 76 percent of its transfer station waste to its own landfill. Without regulation, it is likely that all waste would be internalized by transfer station owning firms.

The Relative Cost of Different System Components

A solid waste system has multiple system components, typically characterized into collection, transfer/processing, transportation, and disposal. Using Metro's residential system as an example, the percent of total cost associated with collection is by far the largest component – 81 percent of the total. The other components consist of transfer (4%), long-haul transport (7%) and disposal (8%). For commercial waste collection, the percent of cost associated with collection is lower than 81%, but is still well above the sum of transfer, transport, and disposal. For dumpster service, for example, collection is about two-thirds of the fee, with the rest going to transfer, transport, and disposal.

Solid Waste Markets in the Metro Region

The Size of the Metro Solid Waste Market

Garbage in the Metro region is big business. As shown in Exhibit 2-1, it is estimated that the region spends approximately $325 million per year to manage its solid wastes.

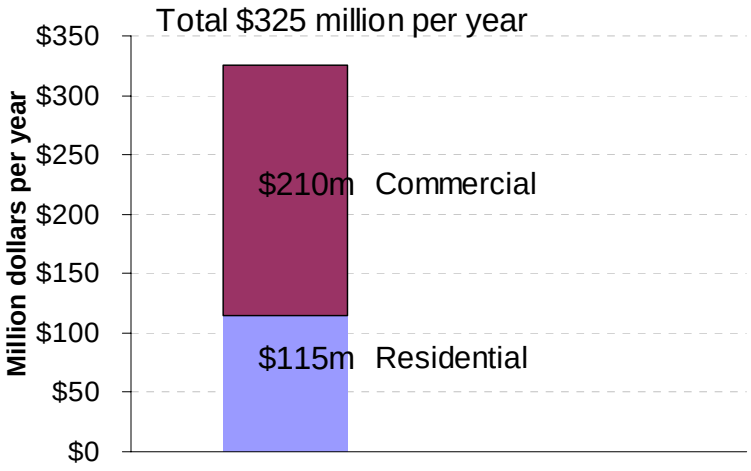

EXHIBIT 2-1
Annual Cost of Solid Waste Management in the Metro Region

Distinctive Features of the Metro Solid Waste System

In comparison to other systems in the United States, Metro has a fairly unique system that can be characterized by:

- Complex regulatory mechanism
- Significant recent consolidation
- Cost-plus regulation
- Competitive contracts
- Metro is regulator and price leader

While there is probably no system in the U.S. just like Metro's (most major urban areas have their own unique features), individual aspects of the Metro system are similar to those found in other communities, such as:

- Public and private transfer stations with public rates used in setting fees (Seattle, WA.).
- A distinction is made between wet and dry waste, with some transfer stations authorized to receive only one type (Clark County, WA; New York).
- Franchise rate setting with cost-plus rate regulation for collection (San Francisco, CA; many communities in Washington State).
- A series of generator fees, five transfer stations owned by the public, and public regulation of the rates charged by private collectors (Palm Beach County, FL).

- Many firms involved in transportation with easy entry into trucking (Los Angeles, CA; New York, NY).
- Opposition to siting new disposal facilities, large capital requirements and long-term contracts are barriers to entry (Seattle, WA; Vancouver, B.C.)
- Recognized leadership in waste reduction, recycling and HHW services (Seattle, WA; San Francisco, CA.)

In recent years, the local market has experienced significant recent consolidation and vertical integration which have, in turn, led to higher private sector profits.

Residential Collection

Collection Practices in the U.S.

In the U.S., residential collection is usually regulated or provided by local government through one of the following four methods:

- Municipal collection by local government – Generally high cost, prevalent in older eastern cities, with strong mayors (New York City, NY; Los Angeles, CA; Chicago, IL).
- Contract between local government and private firm(s) –Typically least costly option, large bargaining power of local government, and few fee collection issues. Average price for contract collection is 25% less than for municipal collection. Municipal and contract the most popular options for residential collection services (San Jose, CA; Seattle, WA; New Orleans, LA.)
- Franchise granted by local or state government to private firm(s) – Cost depends on how franchises acquired; can have utility type review of costs, as in Portland; or, can let the franchise by competitive bid, as is common in the counties in Florida for non-residential service. Prices typically are somewhere between contract and subscription (Portland, OR; San Francisco and Alameda, CA)
- Subscription, where residents subscribe to services provided by one of many collection firm(s). Prices are about the same as for municipal service; rates not regulated by local government (Westport, CT; Sarasota, NY).

Entry into the residential collection industry is usually easy except where government regulation such as an exclusive franchise system makes entry possible only by purchase of an existing firm. Exclusive franchise systems essentially provide a lifetime employment opportunity. San Francisco, for example, has in its charter that haulers will remain in perpetuity unless a majority of customers on a route complain about the quality of the service.

Metro Region

In the Metro region, residential collection can be characterized as including:

- Exclusive franchises: popular throughout the region– all areas covered.
- Cost-plus rate regulation: via examination of costs of several firms (utility type rate regulation). Smaller firms as well as larger ones are included in the cost sample: because

there are some economies of scale, this tends to result in higher fees than if only larger firms were evaluated. Metro transfer station rates are typically used to set the transfer, transport, and disposal portion of rates.

- Container based rates, which provide an economic incentive to recycle: common in the Northwest with containers as little as 18 gallons, but uncommon elsewhere.
- Typically "free" recycling; charge for garbage
- Recycling programs typically result in 50%+ diversion, which is among the highest rates in the country.
- Self haul is a popular option: over 20% of waste collected this way, which is relatively high compared to most areas of the country.

Non-Residential Collection

Collection Practices in the U.S.

In the U.S., non-residential collection is usually not rate regulated or provided by local government. Non-residential collection is typically provided by one or more of the following methods:

- Municipal – provided is the least common arrangement (Garland, TX;, Tacoma, WA.)
- Contract – large bargaining power of local government; lack of fee collection issues; often the least costly option (Seattle, WA; Babylon, NY; Redondo Beach, CA.)
- Franchise – usually rates regulated by utility type review of costs; prices between contract and subscription; community gets franchise fees as source of revenues (Portland Metro area (excluding Portland); San Francisco, CA.; Plano, TX.)
- Subscription – rates not regulated by local government. This is the most prevalent system for commercial service. Local government usually does not know what prices are; easy to enter market i.e., just buy a truck and solicit customers (New York City, NY; Chicago, IL; Houston, TX; Los Angeles, CA.)

Unlike residential collection, subscription service often leads to low cost service in the non-residential sector because non-residential customers generate more waste on average than do residential customers. Typically, non-residential collection markets are characterized by strong competition except when provided by municipal crews or when a regulatory system inhibits entry.

Metro Region

In the Metro area, commercial solid waste rates are set by local government, using a traditional utility-type rate regulation system for exclusive franchises (the exception is the City of Portland, which uses the subscription system). Rates from Gresham, Tigard, Washington County, Beaverton, Clackamas, and Hillsboro were reviewed, and for dumpster service (one to eight yard containers) the price per cubic yard per pickup was

computed.[2] The disposal component was removed from the fees (using 135 pounds per cubic yard)[3] to yield a pickup fee per cubic yard ranging from a bit over $13 for once a week pickup of a one cubic yard container to a bit over $7 per cubic yard for twice a week collection of a six cubic yard container. So, apparently for dumpster service, the prevailing price per pickup of a cubic yard is $7-$13.

This rate is at the high end of that prevailing in ten other communities; their price per cubic yard per pickup for dumpster service ranges from $3.15 to $13.67, with four under $4, four in the $5 to $10 range, and two at $10-$13.67.[4] In the City of Portland, the average price paid for dumpster-only customers is $5.55 per cubic yard. [5] Though representing less than 10 percent of the customers in the generator survey, Portland can/cart customers constitute perhaps one quarter of all Portland service. Including the can/cart customers along with dumpster service customers brings the average Portland commercial rate paid from $5.55 to $7.24 per cubic yard.

The non-residential market is becoming more concentrated and national firms are increasing market share: the number of collection firms in the Metro region declined from 104 firms in 1995 to 60 firms in 2004. National firms have increased market share from 6 percent in 1995 to 39 percent in 2004. Also, the five largest collection firms controlled 60 percent of the market in 2004, up from 33 percent in 1995.

Transfer

Modern transfer stations have several of the following characteristics of monopolistic competition:

- Capital requirements of several million dollars.
- Regulatory permit requirements and other siting difficulties can limit entry.
- Significant scale economies – L-shaped average cost curve, with price per ton decreasing until it levels out at about 200,000 tons per year.

Rates typically are not regulated and are often determined by competitive bids (for large municipal contracts). The per-ton cost of transfer increases with increased numbers of transactions (small loads, self haulers). What this means for private sector operators of transfer stations – low cost operations are enhanced by high throughput, large transactions (truck loads rather than car loads), short hours of operation, and minimal processing.

In other words, the cost per ton of transfer:

- Decreases with increases in scale
- Increases with the number of transactions

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[2] The price per cubic yard per pickup is the annual fee for service (monthly charge * 12) divided by the product of the container size in cubic yards, the number of pickups per week and 52 weeks.

[3] This is the density specified by Tigard in their rate setting posting on their web site; it is also the density obtained from time and motion observations of multiple commercial routes in the City of Portland.

[4] The communities are Babylon, NY; Hillsborough County, FL, Plano, TX, Redondo Beach, CA, Seattle, WA, Palm Beach County, FL, San Jose, CA (two rates, one for multi family and another for commercial), Lee County, FL, and Portland, OR. All rates are net of disposal.

[5] These Portland rates are derived from a 2004 Commercial Cost of Service Study conducted by Merina & Co and analyzed by Neal Johnson of Sound Resource Economics.

- Increases with hours of operation
- Increases with increased processing for diversion

There is a clear relationship between load size and the cost per ton for transfer. As load size increases, cost per ton decreases. The self- haul customer in the Metro system has an average load of about 0.4 tons – compared to 7 to 11 tons in a compaction vehicle. As shown in Exhibit 2-2, the Metro station average is 1.7 tons per customer compared to 5.8 tons per customer for the private stations.

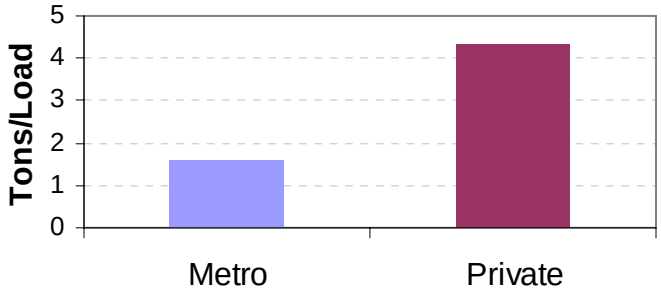


EXHIBIT 2-2
Comparison of Metro and Private Transfer Station Load Size

Other factors that influence the cost of transfer include:

- Dry waste processing methods
- Unloading method
- Compaction method

Most Metro area waste is delivered to a transfer station, reload facility, or MRF:

- 87 percent of waste is delivered to 12 transfer facilities
- 13 percent of waste hauled directly to 5 landfills
- Ownership -- 2 public and 10 private facilities

The transfer stations in the Metro region can be summarized as follows:

- Annual tons per station range from 55,000 to 307,000.
- Average tons per station = 166,000.
- Metro stations averaged 286,000 tons in 2004 compared to 106,000 for the private stations (see Exhibit 2-3).
- 56 percent of tons collected are delivered to a transfer station owned by the collection firm (69 percent if WMI deliveries to Metro are counted as if being delivered to a WMI Transfer Station; all tons from Metro stations are delivered to WMI landfills).
- Firms owning transfer stations or reload facilities deliver 77% to 100% of tons they collect to their own landfills.
- Only one transfer station is too small to capture most available economies of scale.

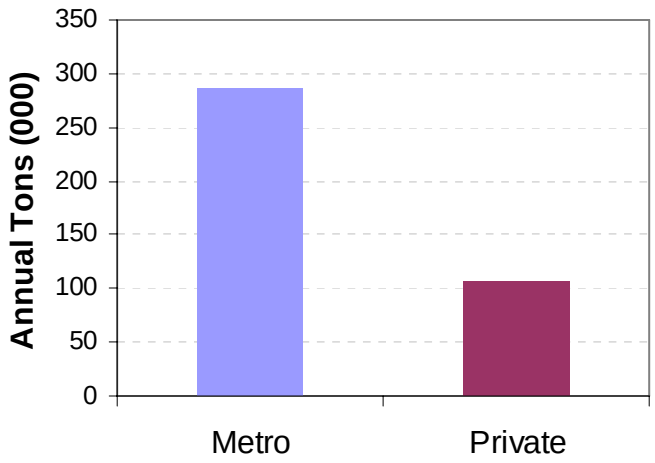


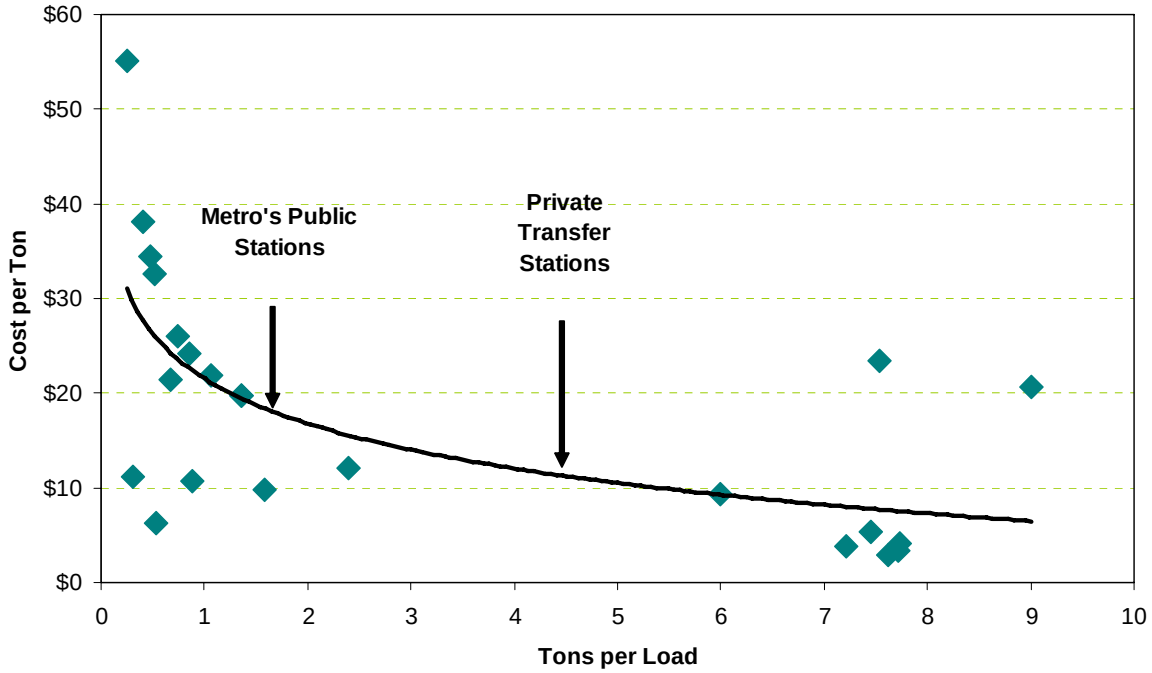
EXHIBIT 2-3
Comparison of Metro and Private Transfer Station Throughput

- Ownership of the facilities – 2 public and 10 private; of the official transfer stations – 2 public and 4 private.
- Operation of the Metro transfer stations is done by a private firm selected by competitive procurement. Metro's price for operation of transfer station injects an important note of competition into the transfer market.

The 25 percent dry waste recovery target is a unique feature of the Metro system. This target will tend to increase the cost of transfer in the region. Transfer stations in the Metro region achieved a 24.9 percent diversion rate in FY2005. One important consideration is that it is more profitable for a vertically-integrated operator that owns a landfill to dispose of waste than it is to process materials for recycling. Thus, such companies have less incentive to recycle than do others. Other aspects of material recovery efforts at transfer stations in the Metro region include:

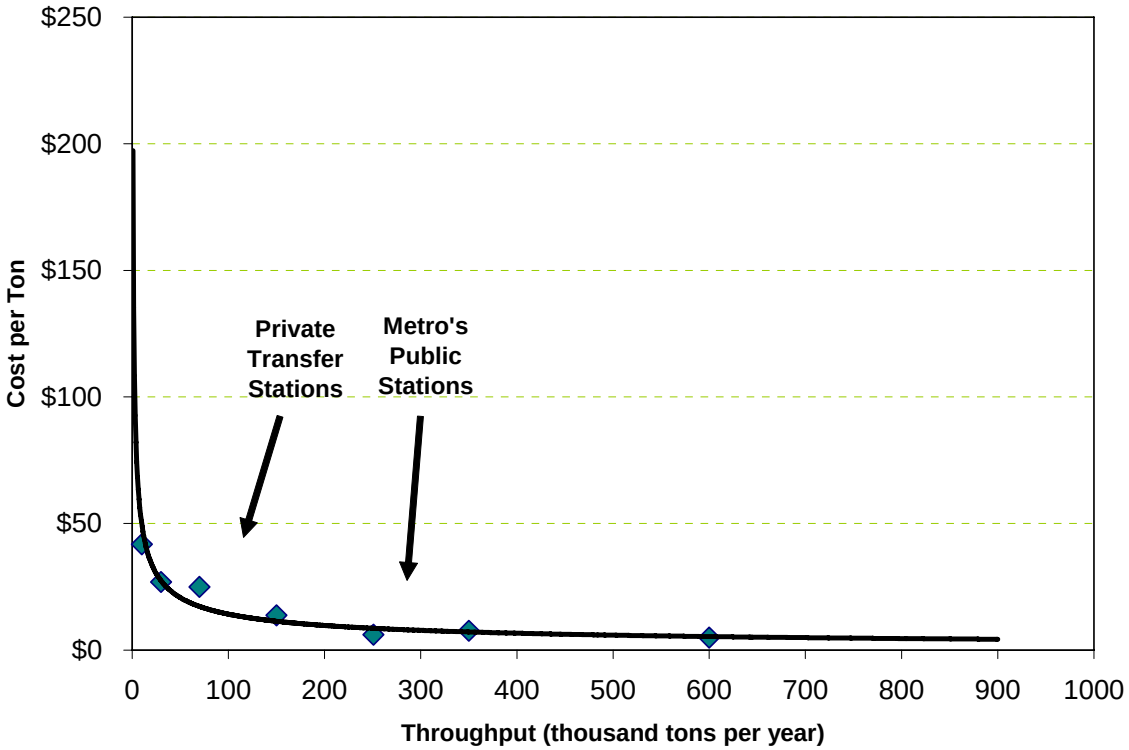
- Stations recover materials such as wood, metal, etc.
- Some stations have floor operations in which laborers retrieve items from the tip floor. Others have pick lines where waste is conveyed and materials removed by laborers as it passes by.
- The cost of processing is recovered through tip fees and material sales.
- Costs of diverting materials increase with decreases in load size.

The joint impacts of the drivers of transfer station costs were modeled using a three-variable multiple regression model. The model relates transfer station costs to scale (annual throughput), size of load, and extent of processing. This model explains 81 percent of the variation in cost among stations. A graphic representation of the relationship between cost and load size and cost and throughput from a sample of 23 transfer stations is shown in Exhibits 2-4 and 2-5.



Source: Ecodata sample of 23 transfer stations.

EXHIBIT 2-4
Transfer Station Costs as a Function of Load Size



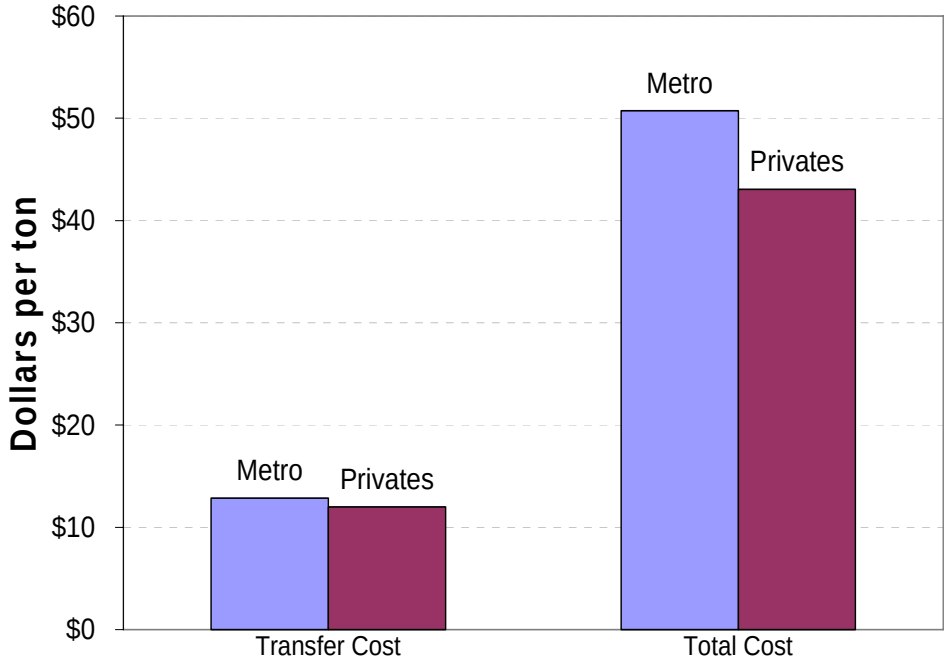
Source: Ecodata sample of 23 transfer stations, grouped into 7 size categories.

EXHIBIT 2-5
Transfer Station Costs as a Function of Throughput

In terms of component costs, the model suggests that the cost of transfer for Metro and the private stations is almost identical (no statistically significant difference) – the three factors balance out: Metro is predicted to be $12.84 per ton, compared to a weighted average of $11.99 per ton for the private stations. Metro has a slight cost advantage in terms of scale, and a cost disadvantage in terms of load size and processing.

For the total cost of transfer (including transfer, transport, and disposal), the model predicts that Metro's average cost (not price) is $50.73 per ton (before regional system fees and excise taxes). The model predicts that private transfer costs for transfer, transport, and disposal would be 85 percent of Metro's cost. From a total cost perspective, the biggest difference between private transfer stations and Metro is in transport – on average, waste from the Metro stations is transported a greater distance. Metro pays just under $38 for transport and disposal, compared to an average of $31 for the privates. Thus, most of the total cost difference is in the transport cost.

A comparison of Metro and private transfer, transport, and disposal costs is shown in Exhibit 2-6.



Source: Predicted costs to Metro Region transfer stations based on regression model estimated on data from survey of 24 transfer stations.

EXHIBIT 2-6
Comparison of Metro and Private Transfer Costs and Total Costs
(Transfer, Transport, and Disposal)

Transportation to Landfills

For transportation of waste from transfer stations to landfills, the cost per ton decreases as the:

- Size of load increases
- Time required to travel from transfer station to landfill decreases
- Backhaul opportunities increase
- Scale of operations increase (allowing better use of backup vehicles, etc.)

Transportation is one component for which the private transfer stations have a cost advantage compared to the Metro stations. On average, the private stations transport waste to less distant landfills, thus resulting in lower per-ton costs for transfer.

Metro contracts for transportation separately from disposal – most communities have a combined procurement which may result in somewhat lower costs. However, Metro appears to have one of the lowest priced trucking services ever experienced by the consulting team.

In its transportation contract, Metro pays for fuel so the transportation contractor does not earn profit on these expenses.

In the future, Metro will have considerable flexibility because it has access to truck, rail, and barge as methods of transportation to local regional landfills.

Disposal

Disposal is also characterized by an L-shaped cost function: the per-ton costs drop quickly, down to about $20 per ton at 500 tons per day. The daily tons at the large landfills taking waste from Metro are generally off the scale in size, with tons from 1,600 to 9,000+ per day. Costs at largest landfills are $6.64 per ton for four landfills that averaged 6,000 tpd[6].

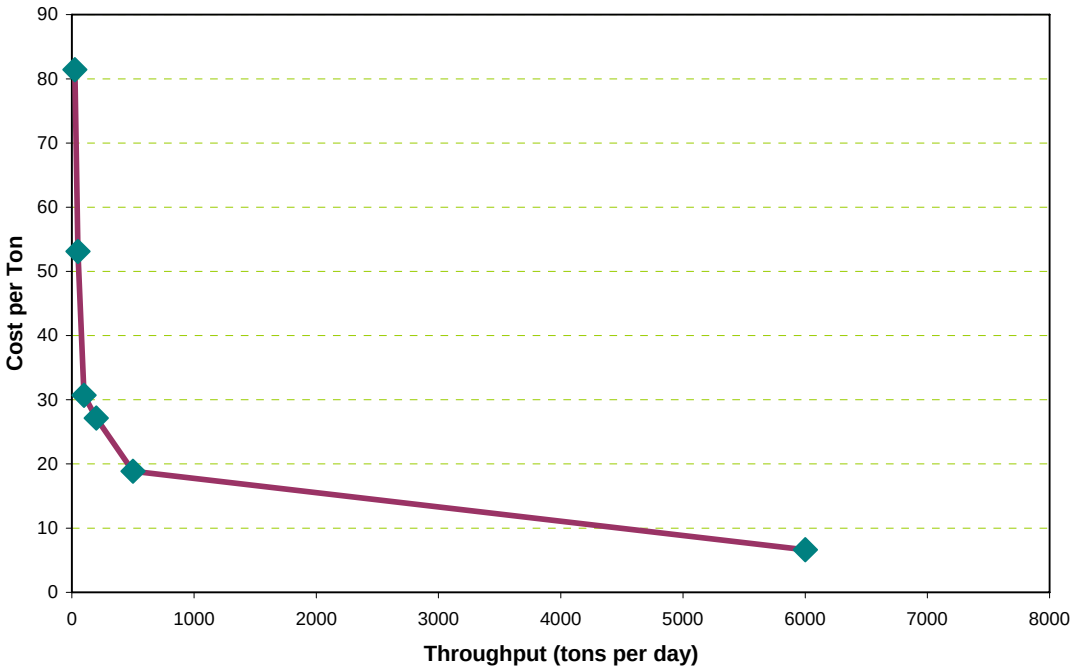
An estimated cost curve for disposal from a sample of 18 landfills is shown in Exhibit 2-7. The graph ends long before the size of many of the landfills that take waste from the Metro region:

- Columbia Ridge – about 2,000,000 tons/year -- about 7,000 tons per day
- Roosevent – about 3,000,000 – 9,000+ tons per day
- Finley Buttes – 500,000 – 1,600+ tons/day
- Hillsboro – 175,000 – 600 tpd

In the Metro region, the large regional landfills enjoy maximum economies of scale and the companies that operate the landfills have extensive vertical integration. Other aspects of disposal in the Metro region include:

- Wet waste goes 90+ percent to WMI landfills per contractual agreement.
- Direct haul to 4 landfills & one waste-to-energy facility. The facilities include Coffin Butte, (Allied); Hillsboro (WMI), Lakeside (Independent); Marion County Waste-to-Energy facility, and Wasco (Waste Connections).

[6] Source: Ecodata, Inc. analysis of the costs of 18 landfills.



Source: Ecodata analysis of the costs of 18 landfills grouped into six size ranges.

EXHIBIT 2-7
Landfill per-ton Costs as a Function of Tonnage

- Transfer to 8 landfills and 1 waste-to-energy facility. (Additional landfills: Columbia Ridge (WMI); Coffin Butte landfill (Allied); Finley Buttes (Waste Connections); Riverbend (WMI)).
- Price is $17 - $30 per ton (exclusive of taxes and fees).
- There are only a few participants in the disposal market; thus profits should be consistent with the monopolistic competition model.

Summary

The analysis of the economics of the Metro solid waste system results in the following conclusions and recommendations:

- The greatest potential for cost savings is in collection; which is outside Metro's control.
- Metro rates are used in setting collection fees, which is good, particularly when Metro competitively procures transfer station operation services. This injects an important element of competition in a market that otherwise would not have many characteristics of a competitive market. Therefore, Metro should try to maximize competition in contracting for each of these services. For example, it could consider evaluating price as a function of distance in its disposal contract, or perhaps jointly procuring transfer, transport, and disposal or transport and disposal.

- In recent years, national solid waste firms have increased market share in the local solid waste industry. These firms seek to achieve vertical integration to maximize profits. Without measured steps by Metro and/or local government to preserve competition, vertical integration, profitability, and prices are likely to increase in the Metro region.
- Most of the diversion in the region occurs via collection of source separated materials, not at the transfer stations (in 2004, 3.9 percent of regional recovery occurred at the transfer stations).
- Economies of scale are significant in transfer, thus, adding transfer stations increases per-ton costs. Also, handling small loads increase per-ton costs compared to handling large loads. Therefore, Metro should be careful to not allow too much excess capacity in the region's transfer system: adding stations reduces throughput at existing facilities and thereby, other things equal, increases the cost of transfer.
- Significant unused transfer capacity exists in the region.
- Transfer is the smallest cost component of the transport, transfer, and disposal system.
- On average, Metro transports waste greater distances to landfills than does the private sector.
- The private sector typically earns its highest profit margins on disposal.

SECTION 3

The Private, Public, and Hybrid System Options

The Disposal System Planning project specifications approved by the Metro Council required an analysis of disposal system options. The analysis included investigating three different transfer station ownership options: private, public, and hybrid (a mix of private and public). In this analysis, the project team carefully defined each of the options in order to ensure that each option is a feasible way of providing transfer services to the Metro region.

The project team used a strategy table as a means of thinking creatively about how to best define each of the options. This tool places the key decisions or features of a problem at the top of columns in a table, and the project team brainstorms possible options for each decision or feature. An abbreviated example of this table is shown in Exhibit 3-1.

EXHIBIT 3-1
Example Strategy Table

Metro Station Ownership	Metro Station Operation	Private Station Ownership/ Operation	Metro Regulation of Waste Flow to Private Stations
No change	No change	No change	No change - tonnage caps
Private - sell for use as transfer station	Private	Metro ownership and private operation (purchase some; for others, let franchises expire and stations become dry waste or reload)	Establish Franchise Areas Around All Existing Stations based on "adjusted" travel time to facility
Private - sell to highest and best use	Private using RFP; Operator must bid for tons	Metro franchises or licenses all facilities	Metro and local governments require waste delivery to closest station
Retain self-haul and HHW and sell the rest of stations		Metro franchises or licenses all facilities and monitors tonnage flows (90% guarantee) and dry waste recovery targets	None. Haulers go where they please
			No non-system licenses
			Tonnage caps with caps set by bid process

The definition of each system option selected by the project team is summarized in Exhibit 3-2. This was based on both use of the strategy table tool and the economic analysis presented in Section 2 of this report.

EXHIBIT 3-2
Summary Definition of System Options

System Feature	Private	Public	Hybrid
Metro Station Ownership	Private - sell to highest and best use	No change	No change
Metro Station Operation	Private	No change	No change
Private Station Ownership/ Operation	Metro franchises or licenses all facilities and monitors tonnage flows (90% guarantee) and dry waste recovery targets	Metro ownership and private operation (purchase some; for others, let franchises expire and stations become dry waste or reload)	Metro franchises or licenses all facilities
Metro Regulation of Waste Flow to Private Stations	None. Haulers go where they please	Metro and local governments require waste delivery to closest station	No change - tonnage caps
Transfer Rate Setting	Metro regulate rates	No change	No change
New Entry of Transfer Stations	Open - comply with local land use requirements	Metro determines whether any future entry is warranted	Metro determines whether any future entry is warranted
90% Guarantee	Bid out the 10 percent	Bid out the 10 percent	Bid out long-haul transport of 10% wet and all dry waste residuals
Provision of Self-Haul Waste and Recycling Service	No Metro - Local governments decide how to provide transfer or bulky waste	Metro work with local governments to decide the extent to which self-haul will be provided at stations	Privates pay or provide service
Provision of Self-Haul HHW Service	Metro provide new HHW facilities (lease existing or site new facilities)	Metro work with cities to decide the extent to which HHW can be provided at stations	Privates pay or provide service
Materials Recovery Targets and Compliance Monitoring	No change	No change	No change
Disaster Response	No Metro. Responsibility of cities, state, and federal	No change (Metro coordinates with local jurisdictions)	No change (Metro coordinates with local jurisdictions)

A description of each system option follows.

Private System

The private system is defined to have the following characteristics:

1. Metro would sell Metro Central and Metro South for the highest and best use i.e., no requirement that they need to continue to function as transfer stations.
2. All stations would be owned and operated by private companies.
3. Metro would issues licenses for operating all facilities. Those agreements would address:

- The 90 percent guarantee
- Dry waste recovery targets
- Service delivery options, such as self-haul

4. Waste collection companies in the region would be free to deliver waste to any licensed station in the Metro region, consistent with any requirements placed on them by local jurisdictions.

5. To ensure reasonable prices for the region's ratepayers, Metro would regulate the rates charged by private transfer station operators. Rates would reflect the cost of providing services; thus rates would differ at each station.

6. Metro would issue licenses to any new operator that receives required permits from the host jurisdiction.

7. Metro would provide household hazardous waste (HHW) services either by leasing space at privately-owned facilities or by developing new HHW facilities.

8. Metro would bid out the 10% of wet waste that does not need to be delivered to a Waste Management landfill (see the description of this process in the hybrid system definition).

9. There would be no substantive change to dry waste management methods.

Public System

The public system is defined as follows.

1. All transfer stations would be publicly owned. The existing privately-owned stations would either be purchased by Metro, or franchises would be allowed to expire and the stations would become dry waste stations or reload facilities.

2. Stations would be privately operated under contract to Metro.

3. All stations would be operated to environmental standards similar to those in effect at Metro Central and Metro South.

4. Metro would work with local governments to:

   - Ensure that waste is delivered to the closest transfer stations.
   - Decide the extent to which self-haul would be provided at each station.
   - Decide the extent to which household hazardous waste services would be provided at each station.

5. Non-system licenses for wet waste would be considered if needed to comply with federal law.

6. Metro would decide if any new stations should be built in the region, but it is unlikely that any new capacity would be needed for the foreseeable future.

7. There would be no substantive change to dry waste management methods.

Hybrid System

The hybrid system is defined as follows.

1. Generally the same as the current system except it would include:

   – Sustainability standards required at all transfer stations

   – Performance standards enforced at all transfer stations

   – Pricing changes at Metro stations that would give appropriate price signals back to communities that regulate collection

   – The 10 percent of wet waste that can be disposed of at landfill not owned by Waste Management would be allocated using a bid process.

   This option would retain the caps on private transfer station wet waste receipts and Metro would continue to own Metro Central and South. No substantive change would be enacted to dry waste standards.

2. Phase in enhanced sustainability standards that would apply equally to all transfer stations. The standards could address subjects such as material recovery, renewable energy, fair wages, hazardous waste spotters, the clean exhaust program etc.

3. Performance standards for regional transfer stations and local transfer stations would be enforced. Stations could apply for exceptions that would allow them to operate at a lower level of service (e.g., hours, self-haul, Forest Grove). Metro would establish a schedule of payments that would be made by station operators to Metro in exchange for opting out of various service standards. The payments would be set to approximate the decrease in cost achieved from providing a lower level of service.

4. In 2009 when Metro Central and Metro South are rebid, rather than the current single price, Metro would request prices for transferring waste from the following three vehicle types:

   – Price #1: Route trucks, compacted drop boxes, and transfer trailers
   – Price #2: Uncompacted drop boxes
   – Price #3: All other vehicles

   This would provide price signals that would assist local jurisdictions responsible for regulating the collection rates of franchised collection firms.

5. In recent years, there has been a pronounced trend toward consolidation of collection services in the Metro region. Should this trend continue in the future, there will be more pressure on Metro to develop a "fair" method of allocating the 10 percent wet waste that can be disposed of at other than a Waste Management landfill.

   Thus, in 2009 when non-system licenses are up for renewal, Metro would establish caps that would apply to all non-Metro owned facilities. All of the "capped" waste would need to be delivered to a Waste Management landfill.

Metro would bid out the right to dispose of the 10 percent wet waste available to go to a landfill not owned by Waste Management (although Waste Management could also submit a bid).

- High bid wins.
- The bid would be set up so that proposers could bid on taking all or part of the 10 percent available.

SECTION 4

Value Model Analysis of Options

The question about which transfer system ownership option is best suited for the Metro region is in many ways a subjective policy question. There are many unknown variables which make it difficult to know the likely costs of each option with much certainty, and many of the differences between the options result from environmental, social, and other non-monetary factors for which the relative importance of those factors is a matter of preference. Thus, this analysis includes an evaluation of the extent to which each option is consistent with the objectives and values of the Metro Council, using multi-criteria decision analysis, or value modeling.

Value Modeling Overview

Value modeling is a quantitative technique for making decisions that involve multiple financial, environmental, and social objectives. Value modeling is referred to in the decision making literature as multi-criteria decision analysis, and the specific approach used for this analysis is SMART, the Simple Multi-Attribute Rating Technique[7].

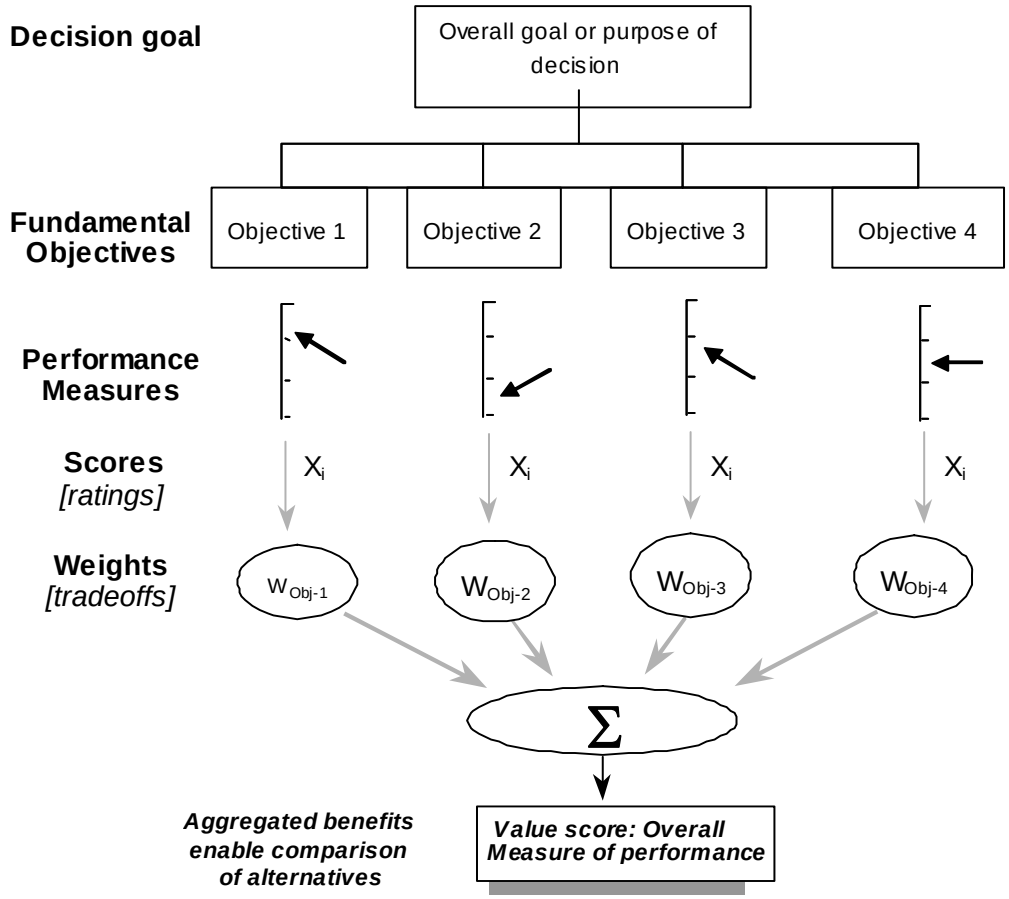
Value modeling proceeds through a series of defined steps. To clarify the discussion of steps in this introduction, a simple example is developed. The steps, illustrated in Exhibit 4-1 below, are:

- Establish the decision goal
- Identify and specify fundamental objectives
- Develop performance measures to assess project performance against objectives
- Add technical detail to the performance measures, and assign scores to the performance measures
- Assign weights to the objectives
- Calculate value scores and conduct sensitivity analysis

A discussion of these steps follows.

[7] Edwards, W. How to use Multiattribute Utility Theory for Social Decision Making, IEEE Transactions on Systems, Man, and Cybernetics 7,326-340, 1977, and Von Winterfelt, D. and W. Edwards. Decision Analysis and Behavioral Research, Cambridge University Press, 1986.

EXHIBIT 4-1
Generalized Representation of Value Modeling
See text for discussion of the figure. X_i represents the score of alternative "i" on the given objective. Weights are the relative importance assigned to each objective. $\sum$ is the rule for aggregating scores.



Decision Goal

The decision goal is the overall purpose of the evaluation. It is that which is to be accomplished by making a decision. It should clarify what is included and excluded from the scope of the evaluation.

Values, Objectives, and Criteria

Objectives are the important non-monetary aspects of a decision that are arrived at through careful thinking about issues. In essence, they reflect repeated efforts to answer a simple question: "Why is this issue important?" When the response becomes, "Because it *is*," a fundamental value or objective has been identified.

Values, objectives, and criteria are often used almost interchangeably in decision analysis. Although this is not strictly correct, it rarely affects the quality of the analysis. Simply stated, values underlie and motivate objectives. An example of a value statement is, "An ecologically diverse environment is essential." Such a value motivates the objective,

"reduce threats to the ecosystem." Fundamental objectives are the most basic elements in the model. They are also referred to as evaluation criteria and may be further characterized by the development of sub-criteria, which ultimately produces an objectives hierarchy (also called a value hierarchy).

Performance Measures

Once the objectives are fully developed and the decision-maker(s) agree that they fully represent the important issues in the problem, performance measures are required to determine how well alternatives perform against the objectives. In Exhibit 4-1, performance measures are represented as scales beneath the objectives. Performance measures may be quantitative or qualitative, depending upon the objective and the availability of data for each measure.

Each performance measure is arithmetically transformed to a scale of zero-to-one. For example, if a cost scale ranging from $1,000 to $2,000 were converted to a zero-to-one scale, then $1,000 would rate a "one" on the new scale; $2,000 would rate a "zero;" and $1,500 would rate a 0.5. This zero-to-one scale described above implies a linear relationship between cost and value. This means that increasing cost from $1,000 to $1,500 is as important as increasing cost from $1,500 to $2,000. The two incremental changes are of equivalent value. Scales can also be nonlinear when changes along the scale have different degrees of importance.

Alternatives

Alternatives are the actions that may be taken to accomplish objectives. A well-considered value model includes a complete set of alternatives. Care must be taken not to exclude or overlook alternatives that might meet the stated objectives.

Alternatives are often the first components identified when evaluating infrastructure solutions. As soon as a need or problem is identified, alternatives come to mind. Typically, alternatives are identified, then the attributes are compared. It is important to re-examine alternatives generated this way after the objectives hierarchy is well-defined so that the important values can be used to define the alternatives, instead of the other way around.

Weighting Objectives

Based on the value system of the decision-maker(s), some objectives may be more or less important than other objectives. For example, loss of an ecosystem may be more important to a particular decision-maker than the cost to protect that ecosystem. Obviously, different stakeholders faced with the same problem may have different underlying value systems, and, therefore, may have a different sense of what's most important in the given problem.

This leads to the concept of "weighting" objectives. Assigning weights to objectives is a subjective exercise based on the values of the stakeholder(s). This is typically done in a workshop setting where a trained facilitator ensures that participants think clearly about the relative importance of different values. Weighting is done after the performance measures have been developed, so stakeholders can include in their consideration the extent to which the full set of alternatives vary in performance.

There are a number of methods that can be used to assign weights to objectives. In this study, weights were assigned by allocating $1,000 dollars among the objectives. Weights are then converted to a 0-1 scale regardless of the method used to obtain weights.

Rating Alternatives and Aggregating Scores

Rating or scoring alternatives is the process by which the performance measurement scales are applied to the alternatives. This is essentially a weighted averaging process where scores are weighted by the value weights and summed for each alternative.

Interpreting Results

The results of any decision analysis are best regarded and applied as *decision aids*. Results should inform rather than dictate the decision. The analysis provides a way of organizing and comparing complex information. To the extent the decision-maker(s) believe that the structure of the value model represents the important issues, the weights and performance measures are appropriate, and the scores are accurate, they may be confident in the results.

It is also valuable to evaluate the model for sensitivity to weighting. If the results of the model do not change unless there are substantial changes in weights, then the decision-maker(s) may be confident in the results.

Council Values and Objectives Hierarchy

In 2003, the Metro Council identified it's most important values related to management of solid wastes. Those values include:

8. Protect public investment in solid waste system
9. "Pay to Play"- Ensure participants pay fees/taxes
10. Environmental Sustainability- ensures system performs in an sustainable manner
11. Preserve public access to disposal options (location/hours)
12. Ensure regional equity- equitable distribution of disposal options
13. Maintain funding source for Metro general government
14. Ensure reasonable/affordable rates

The project team translated those values into objectives that could be measured for each disposal system option. The team analyzed the types of questions that needed to be answered about system options, and discussed values and objectives with the Executive Steering Committee. The resulting objectives hierarchy is shown in Exhibit 4-2.

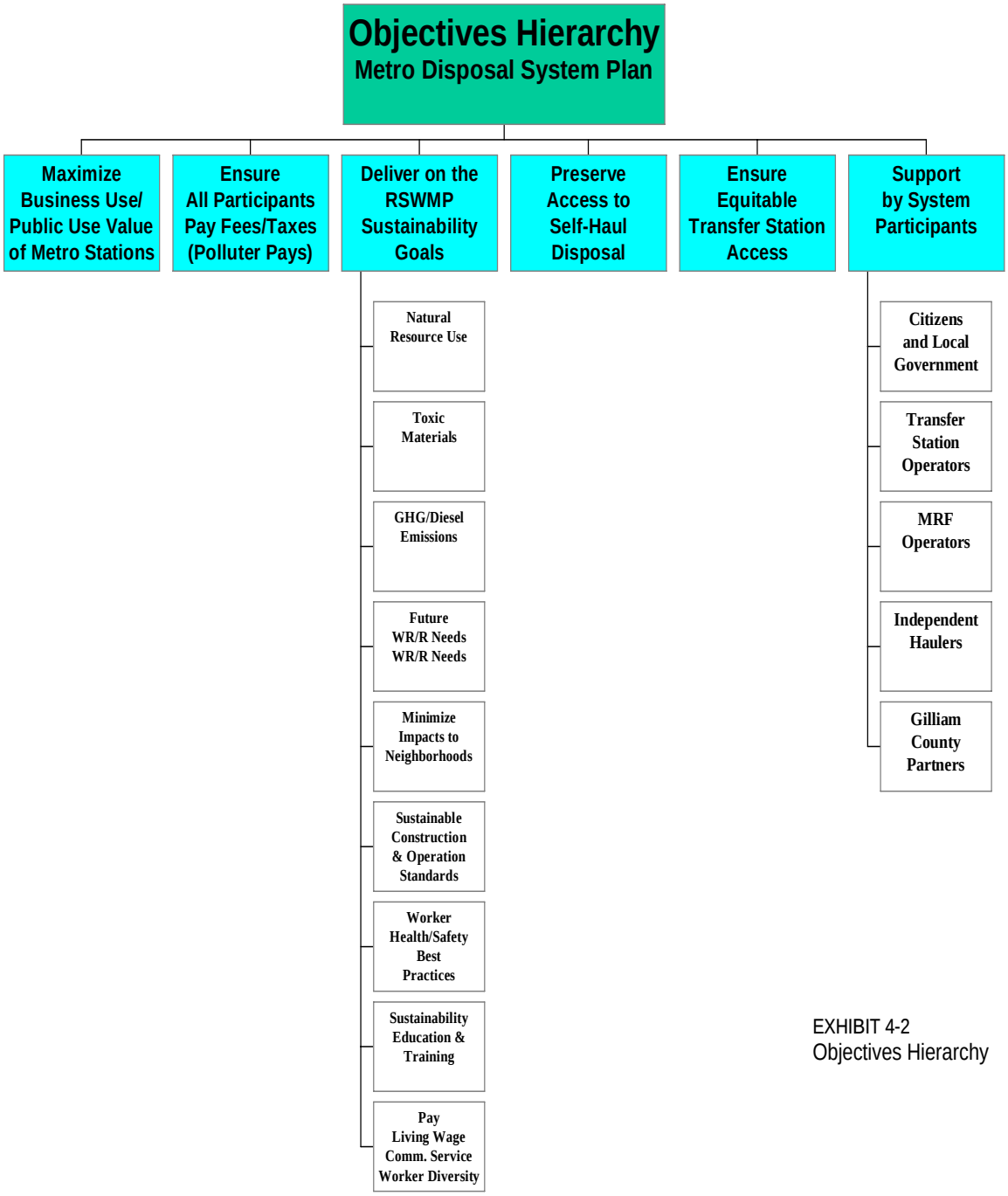


EXHIBIT 4-2
Objectives Hierarchy

These objectives are re-wording of the Council values with two exceptions:

- The objective "Support by System Participants" was added to ensure that the opinions of stakeholders are considered explicitly in the analysis.
- The Council value "Ensure reasonable and affordable rates" was excluded from the hierarchy. More accurately, there is a meta-level to the hierarchy with one objective being non-monetary value and the other being the cost of providing that value. This is a common technique that allows for a comparison of non-monetary value and cost for a set of options. An analysis of the cost of the different options is presented in Section 6.

As shown, secondary objectives were identified for the objectives of delivering on the RSWMP sustainability goals and support by system participants.

Performance Measures and Scoring

Performance measures for each of the primary and secondary objectives were developed by the project team. The performance measures and descriptions of the constructed scales are shown in Exhibits 4-3 and 4-4. As shown, most measures consist of constructed, numeric scales in which the best feasible outcome rates a 5, and the worst conceivable outcome rates a 1. The status quo, or midpoint rates a 3.

The project team scored how well each option met each of the objectives. The opinions of stakeholders about the Metro system were considered when developing the scores. The scores assigned to the primary and secondary objectives are show in Exhibits 4-5 and 4-6.

Weighting

CH2M HILL staff presented the value modeling methodology at a Council Work Session on February 28, 2006. At that work session, Council members were asked to express their opinions about the relative importance of the primary objectives. They were asked to assume that they had $1,000 to spend on the seven objectives and to spend the money in such a manner that represented the relative importance of each objective in making decisions about the ownership of the Metro disposal system. Five Council members participated in the work session and the opinions of the other two members were received after the work session.

The results of the weighting exercise are shown in Exhibit 4-7. As shown, sustainability is by far the most important Council objective followed by maintaining funding for Metro government and ensuring that all participants pay fees and taxes.

The column titled Final was used in the value model, which is a rounded average of Council member opinions. The secondary objectives were assumed to be of equal importance.

EXHIBIT 4-3

Performance Scales for Primary Objectives

				5	4	3	2	1
Objective	**Scale**	**Max**	**Min**	**Enhanced/ Advantaged**	**Improvement some of the time, in some cases**	**No change from existing conditions or offsetting impacts**	**Some negative impacts in some cases that may be fairly easy to resolve**	**Severe negative impact or some impact in many cases that are difficult to resolve**
1.1 Maximize ongoing business value and/or public use value of Metro stations. Note, assumes waste management contract remains in effect	annual tons of through-put, in 000s	800	400					
1.2 Ensure all participants pay fees and taxes (fairness, polluter pay principle, in a manner desired by Metro)	1-5	5	1	Significant improvement in the extent to which rate, tax, and fee structures link payments to generators of waste		No appreciable change in rate, fee, and tax structures		Significant decline in the extent to which rate, tax, and fee structures link payments to generators of waste
1.3 Ensure the transfer system is making progress toward compliance with the RSWMP sustainability goals (see Exhibit 4-4)								
1.4 Preserve current and future access to disposal services for self-haul customers (6 stations max, 0 stations min)	No. of stations providing self-haul	6	0	Currently, 3 transfer stations that accept wet waste 6-7 day/week service. Maximum service level estimated to be 6 such station in total. Minimum service level for systems as defined estimated to be two.				
1.5 Ensure equitable distribution of wet and dry waste delivery locations for all communities (equity referring to uniformity in travel time to closest facilities for communities in the region, but does not mean waste necessarily arrives at the closest facility.)	1-5	5	1	Ownership option results in new facilities that provide considerably more uniformity in travel time to closest facilities		No change in the uniformity in travel time to facilities		Ownership option results in new facilities that provide considerably less uniformity in travel time to closest facilities
1.6 Ensure funding is available for Metro general government	1-5	5	1	Ownership option increases Metro's control over the transfer system and results in less controversy associated with collecting fees for Metro general government		No change in Metro's ability to collect fees for Metro general government		Totally unregulated private system: Ownership option decreases Metro's control over the transfer system to the extent that Metro's ability to collect fees for Metro general government is lessened
1.7 System endorsed and supported by all system participants	1-5			Strong support for proposed changes. Letters of support and communictions to Council members and media.		Generally neutral or a mix of moderate support or opposition.		Strong opposition to proposed changes. Negative letters and other communications to Council members and media.

Exhibit 4-4

Performance Scales for Sustainability Secondary Objectives

Objective	Scale	Max	Min	5 Enhanced/ Advantaged	4 Improvement some of the time, in some cases	3 No change from existing conditions or offsetting impacts	2 Some negative impacts in some cases that may be fairly easy to resolve	1 Severe negative impact or some impact in many cases that are difficult to resolve
1.3 Ensure the transfer system is making progress toward compliance with the RSWMP sustainability goals								
1.3.1 Reduce natural resources use (dry waste recovery and waste reduction hierarchy consistency)	1-5	5	1	Ownership option results in >5 percentage point increase in dry waste recovery from transfer stations and/or pushes recovery up the waste reduction hierarchy	Ownership option results in <5 percentage point increase in dry waste recovery from transfer stations and/or pushes recovery up the waste reduction hierarchy	No change in dry waste recovery likely	Ownership option results in <5 percentage point decrease in dry waste recovery from transfer stations and/or recovery is less consistent with the waste reduction hierarchy	Ownership option results in >5 percentage point decrease in dry waste recovery from transfer stations and/or recovery is less consistent with the waste reduction hierarchy
1.3.2 Reduce use and discharge of toxic materials	1-5	5	1	Ownership option results in a substantial increase in Metro's ability to influence reduction in the use and discharge of toxic materials		No change in Metro's ability to influence reduction in the use and discharge of toxic materials		Ownership option results in a substantial decrease in Metro's ability to influence reduction in the use and discharge of toxic materials
1.3.3 Minimize GHG emissions (total system fuel use and type of fuel used)	1-5	5	1	Ownership option would result in a >20% reduction in fuel use and some conversion to alternative fuels		No change from today		Ownership option would result in a >20% reduction in fuel use and some conversion to alternative fuels
1.3.4 Minimize diesel particulate air emissions (total system fuel use)	1-5	5	1	Ownership option would result in a >20% reduction in total system fuel use		No change from today		Ownership option would result in a >20% increase in total system fuel use
1.3.5 Maximize flexibility to respond to future waste reduction and recycling needs	1-5	5	1	Metro increases its ability to implement new programs or increase recovery requirements		No change in Metro's ability to implement new programs		Metro loses the ability to implement new programs or increase recovery requirements
1.3.6 Minimize impacts to neighborhoods and sensitive receptors	1-5	5	1	Fewer transfer stations in the future and/or no expansion of self-haul services		No change likely in the number of stations or the provision of self-haul services		More transfer stations in the future and/or an expansion of self-haul services
1.3.6 Implement sustainability standards for facility construction and operation	1-5	5	1	Metro requires strong and comprehensive sustainability standards for facility construction (LEED) and operation at all stations		No change in sustainability standards		No significant sustainability standards likely to be adopted at any station for facility construction (LEED) and operation
1.3.7 Implement worker and employee Health and Safety best practices	1-5	5	1	Metro requires best practice worker health and safety requirements at all transfer stations		No change in current best practice worker health and safety requirements at transfer stations	Not applicable.	Not applicable.
1.3.8 Provide sustainability education and training	1-5	5	1	80% of all employees receive at least 8 hours/yr sustainability training		No change from existing system		No sustainability training
1.3.9 Pay living wage, promote community service, and workforce diversity	1-5	5	1	100% of employees meet living wage standard, diversity training, and an emphasis on community service		No change from existing system		No living wages, diversity training, or emphasis on community service

Exhibit 4-5

Performance Scales and Scoring for Primary Objectives

			Scores			Rationale		
Objective	**Max**	**Min**	**Private**	**Public**	**Hybrid**	**Private**	**Public**	**Hybrid**
1.1 Maximize ongoing business value and/or public use value of Metro stations. Note, assumes waste management contract remains in effect	800	400	400	650	525	Likely that other stations would be developed. Any purchaser would have some threshold tons it would be likely to attract	Metro would probably have another wet waste station or two in the system, implying less than max. at the two existing stations	Assumes no change from today
1.2 Ensure all participants pay fees and taxes (fairness, polluter pay principle, in a manner desired by Metro)	5	1	2.75	3.5	3.25	Rates more aligned to cost-of-service. Probably more difficult to ensure all pay their "fair share" of fees and taxes.	More tools to ensure fairness, but difficult at times to implement	Currently, self-reporting mechanism with Metro audit capability. Now, Metro customers paying higher price for the 10% not to WM, better rate info to collection regulators
1.3 Ensure the transfer system is making progress toward compliance with the RSWMP sustainability goals (see Exhibit 4-6)								
1.4 Preserve current and future access to disposal services for self-haul customers (6 stations max, 0 stations min)	6	0	2	4	3			
1.5 Ensure equitable distribution of wet and dry waste delivery locations for all communities (equity referring to uniformity in travel time to closest facilities for communities in the region. Does not mean waste necessarily arrives at the closest facility)	5	1	4	2.5	3	More stations and no requirement to use closest station	Public less likely to successfully develop new stations	Assumes no change from today
1.6 Ensure funding is available for Metro general government	5	1	2	4	3	Approx. half of excise tax collected at Metro stations. Collecting all fees from private stations is more challenging politically	Public system as defined still has private dry waste facilities	Assumes no change from today
1.7 System endorsed and supported by all system participants (see Exhibit 4-6)								

Exhibit 4-6

Performance Scales and Scoring for Secondary Objectives

Objective	Max	Min	Scores			Rationale		
			Private	Public	Hybrid	Private	Public	Hybrid
1.3 Ensure the transfer system is making progress toward compliance with the RSWMP sustainability goals								
1.3.1 Reduce natural resources use (dry waste recovery and waste reduction hierarchy consistency)	5	1	2.5	3.5	3.5			
1.3.2 Reduce use and discharge of toxic materials	5	1	2.5	3.5	3		Better load checking and more environmentally friendly product usage	
1.3.3 Minimize GHG emissions (total system fuel use and type of fuel used)	5	1	3	3.5	3			
1.3.4 Minimize diesel particulate air emissions (total system fuel use)	5	1	3	3.5	3			
1.3.5 Maximize flexibility to respond to future waste reduction and recycling needs	5	1	2	5	3			
1.3.6 Minimize impacts to neighborhoods and sensitive receptors	5	1	2	2	3	Probably more stations	Probably have self-haul in more locations	
1.3.6 Implement sustainability standards for facility construction and operation	5	1	2	5	4			
1.3.7 Implement worker and employee Health and Safety best practices	5	1	4	3	3	Private health and safety standards vary - some are quite high and less self-haul is inherently safer		
1.3.8 Provide sustainability education and training	5	1	1	4	3			
1.3.9 Pay living wage, promote community service, and workforce diversity	5	1	3	4	3	Private sector generally pays living wage and emphasizes community service	Metro assesses $0.50/ton community enhancement fee	Metro assesses $0.50/ton community enhancement fee
1.7 System endorsed and supported by all system participants								
1.7.1 Citizens and local government	5	1	2	4	3.5			
1.7.2 Transfer station operators	5	1	4	1	2			
1.7.3 MRF operators	5	1	3	4	3.5			
1.7.4 Independent haulers	5	1	2	3	3.5			
1.7.5 Environmental Groups	5	1	2	5	4			
1.7.6 Non-WM Landfill Owners	5	1	3.5	1.5	2.5			Bidding the 10% is worse than today
1.7.7 Other parties	5	1	2	5	3.5			

EXHIBIT 4-7
Council Weights Assigned to Objectives

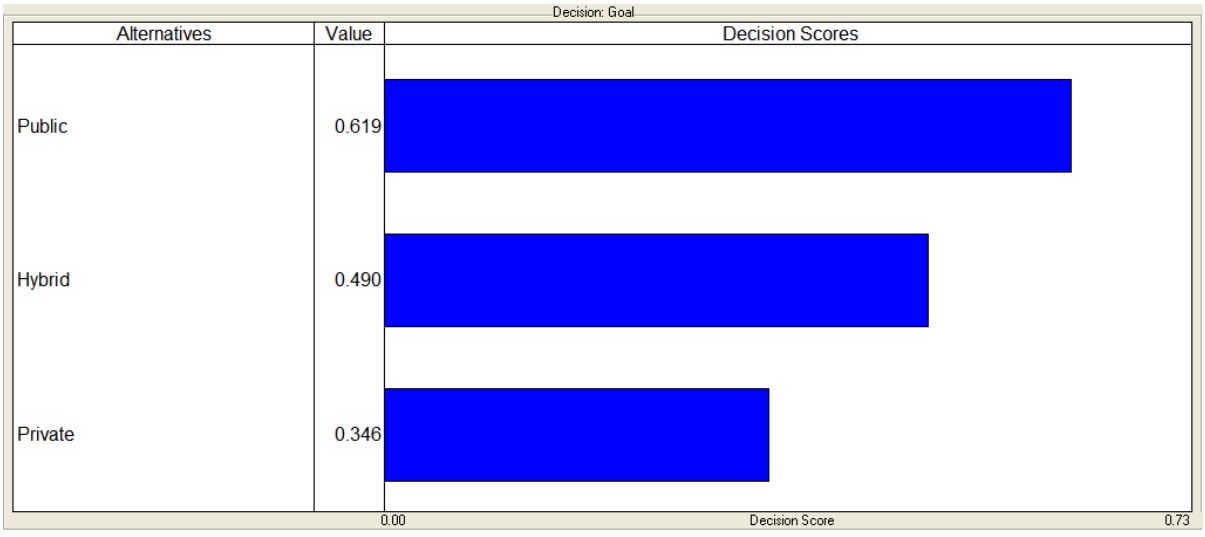
Objectives	Council Member 1	2	3	4	5	6	7	Final	Avg	Max	Min	St Dev
1.1 Maximize ongoing business value and/or public use value of Metro stations	150	150	100	60	50	150	100	110	109	150	50	43.0
1.2 Ensure all participants pay fees and taxes (polluter pay principle)	250	200	100	60	100	200	100	145	144	250	60	71.1
1.3 Ensure the system is making progress toward compliance with the RSWMP sustainability goals	50	350	200	600	200	250	400	290	293	600	50	176.6
1.4 Preserve current and future access to disposal services for self-haul customers (location and hours)	200	50	200	60	100	75	100	110	112	200	50	62.8
1.5 Ensure equitable distribution of wet and dry waste delivery options for all communities (current and future)	250	100	50	60	100	75	100	105	105	250	50	67.1
1.6 Ensure funding is available for Metro general government	50	100	300	100	300	200	100	165	164	300	50	102.9
1.7 System endorsed and supported by all system participants	50	50	50	60	150	50	100	75	73	150	50	38.6
	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000			

Results

Base Model

The performance scores and weights were entered in the Criterium Decision Plus software to compile the results. The results of the value model analysis are shown in Exhibit 4-8. Under the assumptions, scores, and values expressed in this analysis, the public option is clearly preferred, followed by the hybrid option and then the private option.

EXHIBIT 4-8
Value Model Results



Another way of viewing the results is shown in Exhibit 4-9 which shows how much each objective contributes to the total value score for each option. As shown, the public option provides more value toward each objective than the other options with the exception of the equitability of delivery options (the private system is likely to result in more transfer stations).

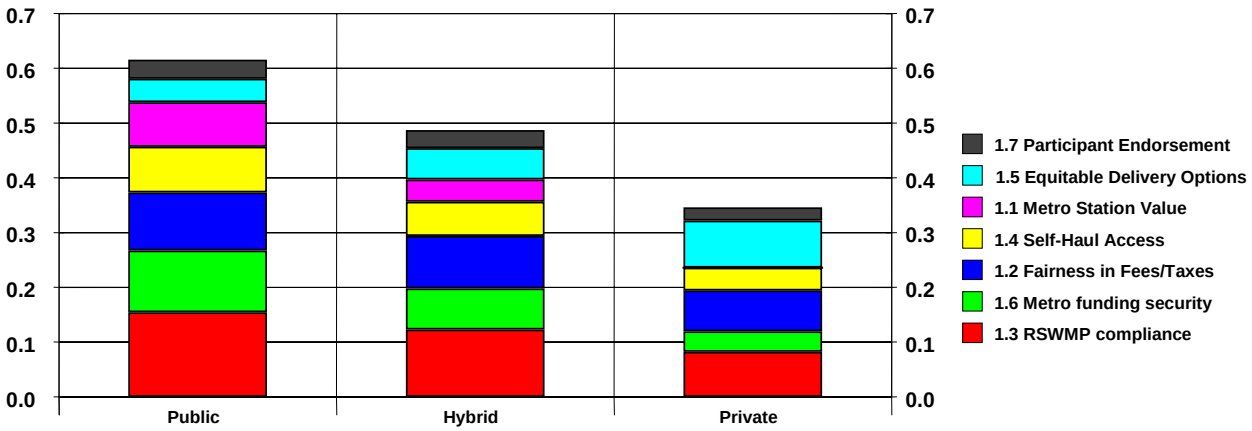


EXHIBIT 4-9
Objectives Contributions to Value Score

Sensitivity to Changes in Weights

The importance weights assigned to objectives are subjective. As shown in Exhibit 4-7, there were differences of opinion among different Council members about the relative importance of the objectives. For example, one Council member assigned 600 points (out of 1,000) to Objective 1.3, and another assigned only 50 points to this objective. This is common and expected with subjective weighting exercises.

In response, an analysis was conducted of the sensitivity of the results to changes in weights. The analysis showed that there was only one instance in which changing a weight could make the hybrid or private option preferred to the public option: if the objective Ensure Equitable Delivery Locations were assigned a weight of 48 percent (480 points) or higher, the private option would be preferred. For perspective, the highest weight any Council member placed on this objective was 25 percent, and the average of the weights assigned by Council members was 11 percent.

Implementation

The objectives established by the Council pertain to a future system that is in-place and operational. In other words, the objectives refer to aspects of the transfer system as if the system was already operational. Of course, any of the three options would require various actions to implement, and the public option in particular would require making some difficult decisions likely to be extremely unpopular with some stakeholders.

The main challenge with the public system relates to no longer allowing the privately-owned stations to transfer wet waste. This will require purchasing private stations and/or allowing franchises to expire, at which time the private stations could accept dry waste only. While there is a value established for stakeholder opinions, it is possible that this does not fully capture issues related to implementation. For example, many of the stakeholders interviewed during our analysis were skeptical that Metro could or would ever take such an action.

In response, a second value model was constructed with an additional level of objectives. Ensuring successful operations and ease of implementation were included as major objectives above the seven main Council objectives. In this model, the seven main Council objectives become sub-objectives to the objective of ensuring successful operations. Ease of implementation was modeled using a constructed scale from 1- 5 with performance measures defined as follows.

5 = Implementation likely to proceed smoothly. No opposition, no hassles.

3 = Some complex issues to address, and some opposition.

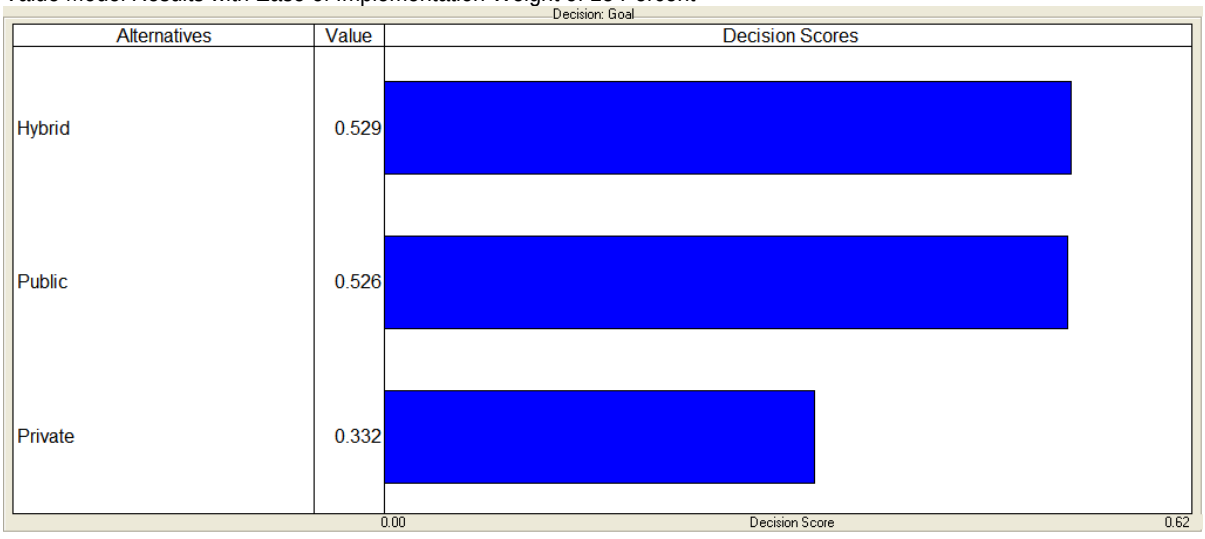
1 = Very complex with likely legal or regulatory hurdles to overcome. Implementation likely to be opposed strongly by some stakeholders.

The project team assigned scores for Ease of Implementation as follows:

Private: 2
Public: 1
Hybrid: 4

Then, a sensitivity analysis was conducted on the weight assigned to operations versus implementation. The results are that if the relative weight assigned to implementation is 15 percent or greater, then the hybrid option is preferred. The results of the value modeling with and weight on ease of implementation weight of 15 percent and a weight on operations at 85 percent is shown in Exhibit 4-10.

EXHIBIT 4-10
Value Model Results with Ease of Implementation Weight of 15 Percent



SECTION 5

Risk Analysis of Options

There is considerable uncertainty[8] at this time about exactly how any of the system options would be implemented and exactly how aspects of the system would develop through time. When considering major new programs or system changes, it is important that organizations such as Metro evaluate the risk associated with such changes by identifying, assessing, and develop strategies to manage those risks.

Risk Identification

Risks were identified by the project team during a brainstorming exercise in which an influence diagram was developed. Influence diagrams are helpful in identifying the relationships between monetary or non-monetary values (rounded rectangles), uncertainties (ovals), and decisions (squares, not applicable in this diagram). The influence diagram is shown in Exhibit 5-1.

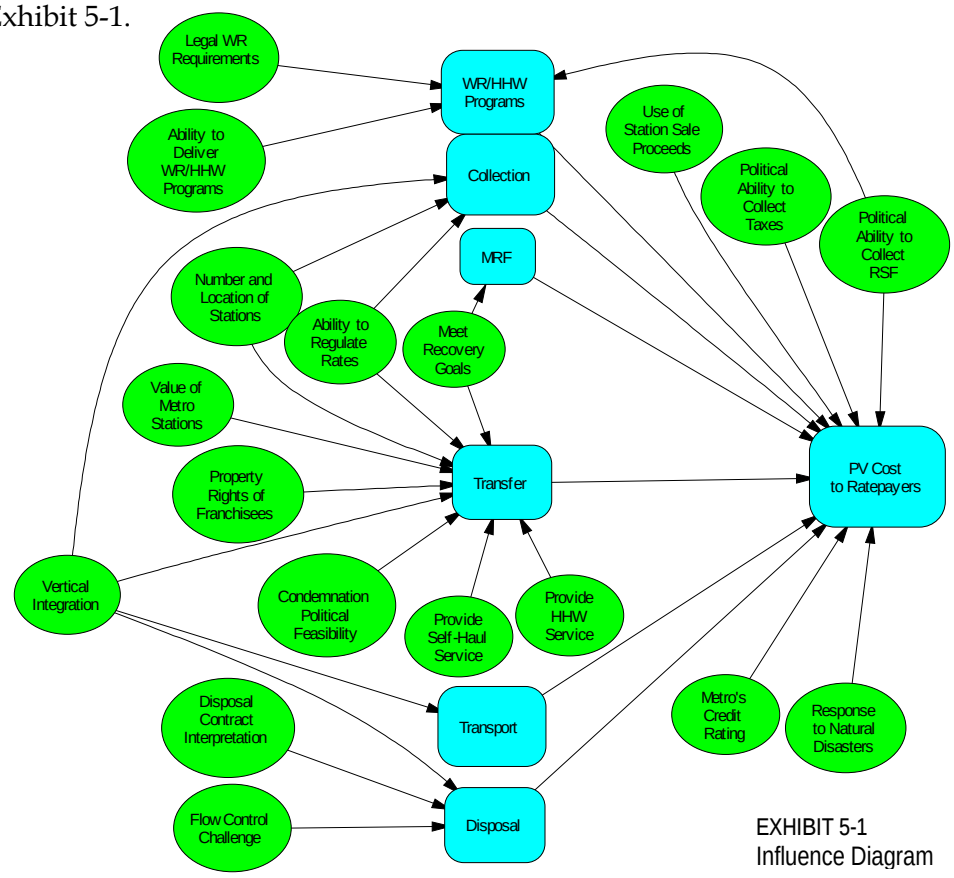


EXHIBIT 5-1
Influence Diagram

[8] Economists typically use the definition of risk and uncertainty established by Frank H. Knight (Risk, Uncertainty, and Profit, 1921.) in which risk is present when future events occur with measurable probability (such as drawing a diamond from a deck of cards or other events that can be insured against), and uncertainty is present when the likelihood of future events in indefinite or incalculable. In this analysis, we use the more common usage (Merriam-Webster Online) where risk refers to "possibility of loss or injury; peril" and uncertainty refers to "indefinite, indeterminate" and "not known beyond a doubt."

Risk Assessment

Once identified, an assessment of these risks was performed. Risk assessment refers to analyzing potential losses from a given hazard using a combination of known information about the situation. There are a number of techniques available for risk assessment including probabilistic analysis of cost and value outcomes using MonteCarlo simulation or decision trees. The nature of the unknowns associated with the three ownership options suggested use of a more qualitative approach to risk assessment. Thus, this assessment was done using a qualitative risk signature approach drawn from a number of sources, similar in many ways to a process used by Seattle Public Utilities to assess enterprise risk in their organization.

The risks identified in the influence diagram were grouped and defined more clearly into the following 10 risk, and 6 related uncertainties that may be relevant to the choice of ownership option. The risks can affect the realization of Council values and/or the cost associated with an option.

Risks Associated with Changing System Ownership

1. **More difficult politically to collect regional system fee and excise taxes.** Metro's legal authority to collect fees and taxes would not change, however, a system in which all stations are privately-owned would probably exert more downward pressure on fees than the current system or the other system options.

2. **Metro's credit rating could worsen if it is perceived to be less able to collect taxes.** In response to Risk 1., there is some chance that rating agencies would perceive an all-private system as a less secure funding source. If so, this would affect the interest rate paid by Metro on future debt issues.

3. **The extent to which it would be more costly and more difficult administratively for Metro to respond to future changes in state-mandated Waste Reduction requirements.** Under a private system, Metro would need to modify licenses and/or negotiate with private transfer station owners if any such future requirements require material changes in transfer station operations.

4. **The extent to which it would be more costly and more difficult administratively for Metro to deliver new WR/R initiatives.** Metro would need to negotiate with private transfer station owners to test new pilot programs or implement new waste reduction or recycling initiatives. This is likely to be more costly than the current system or the other system options.

5. **Increased transfer station tip fees resulting from increased vertical integration and cost-plus rate regulation.** A private system would be a monopolistic competitive market, and would be a more fertile environment for added consolidation of collection firms in the region. Economic theory and examples from other industries would predict that the profitability of integrated firms would increase and that transfer station tip fees would increase. As long as Metro's disposal contract with Waste Management is in effect, the impetus for vertical integration is less strong because regardless of how many wet waste tons a firm collects and transfers, most all of that waste must go to a Waste

Management landfill. Thus, the potential increase in profits from vertical integration would be small until conditions change to allow waste to go into other landfills.

In the private system, Metro would regulate transfer station rates. Examples from other jurisdictions indicate that it is likely that prices paid for transfer station services would be higher in this environment than under the current arrangement where the operations of the Metro stations are contracted out through a competitive procurement process.

6. **More difficult to meet dry waste recovery targets at stations.** While there are challenges with all systems, the private system would present the most challenges in monitoring and enforcing dry waste recovery targets. The extent of any such difficulties is hard to predict.

7. **Additional cost to Metro of fulfilling disposal contract**. It is likely that Metro would incur a small amount of added staff costs ensuring compliance its contract for disposal services.

8. **Ability to maintain current level of self-haul and household hazardous waste (HHW) service**. Under the private system, Metro and/or local government would need to make arrangements (or make a part of licensing requirements) for self-haul and HHW service. The existing private stations are not configured to accept significant numbers of self-haul customers. Exactly how self-haul and HHW service would be provided at what service level is unknown at this time, and it may prove to be more costly to achieve desired service levels.

9. **The likelihood of a successful flow control challenge.** It is impossible to predict whether Metro's flow control authority would be challenged in any of the ownership options, but it is probably more likely to occur under a private system in which there would be more privately-operated transfer stations than there is today.

10. **The challenges presented in acquiring private facilities.** In the public system, Metro has the legal authority to acquire private stations through condemnation, or to prevent them from accepting wet waste by letting franchises expire. Implementing either of these changes would likely result in legal costs and would be challenging politically. This is probably the main drawback to the public system.

Uncertainties Associated with Changing Ownership

During our discussions with stakeholders, there were a number of questions about how a new private, public, or hybrid system would ultimately operate. A discussion of some of the more important uncertainties and their possible implications follow.

1. **The number and location of stations.** The number of stations in the system and their location has broad implications to the cost and service level provided by the Metro system. It is unknown at this time how many stations would ultimately be built in the private system. In the public system, the number of stations is a choice that would be made by the Council.

2. **Where will haulers deliver waste?** In the private system, it is uncertain which haulers would deliver waste to which stations. This has implications for total vehicle miles traveled, air quality, and collection costs. This would also be the case for the public

system, but with Metro owning the stations, there would be less incentive for private collection firms to bypass a closer facility in favor of one that they operate.

3. **How much would cost-plus rate regulation increase transfer station tip fees?** Still, there is evidence that tip fees would be higher under a rate regulated private system, than under the current system or the other system options.

4. **How much would the Metro stations sell for?** The sales price for the Metro stations is uncertain and would depend on a number of factors.

5. **Would there be any impact on the disposal contract from bond covenant changes?** Metro's contract with Waste Management has some links to bond covenants. Once those bonds are retired, it is likely that the agreement with Waste Management would require some restructuring.

6. **How would the system respond to natural disasters?** The method with which Metro would respond to natural disasters such as a major earthquake or windstorm, would be different in the three options. For example, in the private option, Metro and/or the municipalities would do relatively more contracting directly with the private sector than it would under the other options.

Risk Signature

Exhibit 5-2 shows a risk matrix that can be used to develop a qualitative measure or "risk signature" for each risk based on its likelihood of occurrence and impact or consequence.

RISK SIGNATURE LEVEL DETERMINANT

	Impact				
Likelihood	Insignificant	Minor	Moderate	Major	Extreme
Almost certain	M	M	H	C	C
Likely	M	M	H	C	C
Possible	L	M	M	H	H
Unlikely	L	L	M	H	H
Rare	L	L	M	M	M

L	Low
M	Medium
H	High
C	Critical

Source: Seattle Public Utilities, 2004.

EXHIBIT 5-2
Risk Signature Matrix

The assessment of risks is shown in Exhibit 5-3. The signature for each risk is determined by first assessing the likelihood and impact for each risk, then using the matrix in Exhibit 5-2 to determine the risk signature. For example, for Risk 1 in the private option, a "major" impact with a "possible" likelihood results in a "high" risk signature.

The intent of Exhibit 5-3 is to assess the extent to which there are risks that will need to be managed during implementation and operation of each of the ownership options. As indicated, the private option has the most risk: all of the identified risks are rated as medium to high. The public option has low risks in all cases except for a critical risk associated with the challenge of acquiring the private transfer stations. The hybrid system has low risks.

Risk Management

Should Metro proceed with either the private or public options, it should develop strategies to manage the risks identified. Such strategies could include risk sharing arrangements, negotiations with private operators, outreach, or possible legal action.

EXHIBIT 5-3
Risk Assessment

	Risk Signature			Likelihood			Impact[a]
Risk	**Private**	**Public**	**Hybrid**	**Private**	**Public**	**Hybrid**	
1. More difficult politically to collect regional system fee and excise taxes	High	Low	Low	Possible	Rare	Rare	Major
2. Metro's credit rating could worsen if it is perceived to be less able to collect taxes	High	Low	Low	Possible	Rare	Rare	Major
3. It could be more costly and more difficult administratively for Metro to respond to future changes in state-mandated Waste Reduction requirements	High	Low	Low	Likely	Rare	Rare	Moderate
4. It could be more costly and more difficult administratively for Metro to deliver new WR/R initiatives	High	Low	Low	Likely	Rare	Rare	Moderate
5. Potential increase in vertical integration and potential resulting increases in transfer station tip fees	High	Low	Low	Likely	Rare	Rare	Moderate
6. Reduced ability to meet dry waste recovery targets	Medium	Low	Low	Possible	Rare	Rare	Moderate
7. Additional cost to Metro of fulfilling Disposal contract	Medium	Low	Low	Possible	Rare	Rare	Moderate
8. Inability or added cost to maintain current level of self-haul and HHW service	Medium	Low	Low	Possible	Rare	Rare	Minor
9. Likelihood of successful flow control challenge	High	Low	Low	Possible	Rare	Rare	Extreme
10. Political challenges or protracted legal proceedings resulting from condemning private transfer stations or allowing wet waste franchises to expire	Medium	Critical	Low	Rare	Almost certain	Rare	Major

[a]Minimal = No noticeable financial impact or impact to Council value(s).
Minor = Small short-term, but no noticeable long-term tip fee increase or impact to Council value(s).
Moderate = 1-4% short-term or up to 1% long-term tip fee increase or moderate negative impact to important Council value(s).
Major = 4-6% short-term or 1-2% long-term tip fee increase or major negative impact to important Council value(s).
Extreme = >6% short-term or >2% long-term tip fee increase or extreme negative impact to Council value(s).

SECTION 6

Economic Analysis of Options

This section presents an analysis of the economic impact of changing from the present status quo transfer system to one of three system options. This analysis must consider the impacts on each element of the solid waste management system – collection, transfer and processing, transportation to landfill, and disposal. The economic impact of switching from the Status Quo to the public, private, or hybrid options is discussed below. First, key assumptions are reviewed. Then, the estimated impact in costs is quantified for each of the solid waste elements: collection, transfer, transport, and disposal. The conclusions section contains a summary of results. Tables prepared in support of this analysis are provided in Appendix D.

Key Assumptions

In order to estimate the impact of these alternative organizational arrangements for transfer of waste in the Metro area, it is necessary to make certain assumptions. These are detailed in Exhibit 6-1. A key assumption is the number of transfer stations which would be present in each of the alternatives. Of course, it is beyond the scope of this analysis to model the actual tonnage which would arrive at each transfer station which is newly established. A simplifying assumption as to the waste delivered to each transfer station is needed. It is assumed that the self haul waste is divided equally among those transfer stations which offer self haul service. It is similarly assumed that waste delivered in commercial collection truck loads is equally divided among all the transfer stations. These assumptions tend to equalize the cost per ton of handling waste at the self haul stations, as the disadvantage of receiving small self-haul loads is somewhat off set by the larger scale of these operations, in comparison to that of facilities without self haul waste. The number of transfer stations and stations with self haul facilities is listed below:

- Status Quo: 6 stations; 2 self haul
- Public: 5 stations; 3 self haul
- Private: 9 stations; 2 self haul; and
- Hybrid: 7 stations; 2 self haul.

Regarding the use of the transfer stations, it is assumed that the same number of loads and tons that are presently received at transfer stations continue to be received in each of the options. In other words, those loads which are currently directly hauled to landfills and/or transferred at reload or dry waste transfer stations are considered to be unaffected by changes in the wet transfer station organization.

For the collection segment of solid waste services, the impact on collection costs will occur via changes in what we term the *disposal cycle time,* the time required to travel from a route to a transfer station, unload, and return to the route or back to the yard. When the number

EXHIBIT 6-1
Assumptions in Economic Analysis

Item	Status Quo	Public	Private	Hybrid
Basic:				
1. Number of stations	6	5	9	7
2. Number of loads to transfer stations	453,000	453,000	453,000	453,000
3. Tons to transfer stations	995,000	995,000	995,000	995,000
4. Tons per transfer station	166,000	199,000	111,000	142,000
5. Tons in system	1,303,000	1,303,000	1,303,000	1,303,000
Collection:				
1. Disposal Cycle Time	Unchanged	Increases	Decreases	Decreases
2. Percent of tons affected	0%	9%	26%	11%
3. Tons affected	0	116,000	333,000	142,000
4. Market integration	Unchanged	Unchanged	Increases	Unchanged
Price increase – minimum	na	na	2%	na
Price increase – maximum	na	na	5%	na
Transfer Stations:				
1. Number of stations with self haul	2	3	2	2
2. Self haul tons/self haul station	77,600	51,700	77,600	77,600
3. Hauler tons/ self haul station	140,000	168,000	93,300	120,000
4. Total tons/ self haul station	217,600	219,700	170,900	197,600
5. Total tons per non self haul station	140,000	168,000	93,300	120,000
6. Average tons per transfer station	166,000	199,000	111,000	142,000
7. Estimated cost from regression equation	Unchanged	Tiny decrease	Largest increase	Small increase
8. Costs of administration & regulation *	Unchanged	Unchanged	Likely increase	Unchanged
9. Flow of funds to Metro				
a. Excise taxes & Regional Service Fees	Unchanged	Unchanged	Unchanged	Unchanged
b. Capital flows				
Facilities changing hands:	0	3	2	0
Newly constructed facilities:	0	0	3	1
Receipts to Metro:	0	-$12,000,000	$8,000,000	$0
Receipts to private sector	0	$12,000,000	-$20,000,000	-$4,000,000
Net capital expenditures, system-wide	0	$0	-$12,000,000	-$4,000,000

EXHIBIT 6-1
Assumptions in Economic Analysis

Item	Status Quo	Public	Private	Hybrid
Amortize over 25 years and 995,000 tons				
Per ton increase	0	$0.00	$0.48	$0.16
10. Household hazardous waste relocation	Unchanged	Unchanged	Small change	Unchanged
Transport to Landfill:				
1. Existing system through 2019	Unchanged	Unchanged	Unchanged	Unchanged
Disposal:				
1. Through end of disposal contract	Unchanged	Unchanged	Unchanged	Small decrease**
2. Let contracts with multiple firms when disposal contract expires	May decrease***	May decrease***	May decrease***	May decrease***

* Self haul stations (Metro stations) used in rate setting as at present, except in private option, when cost-plus rate setting methodology must be established.

** Possible small decrease if bid out the 10% of the waste stream not presently committed to Waste Management.

*** Possible decrease due to increased number of landfills in area; no guarantees of price competition.

of transfer stations increases over the status quo number, disposal cycle times can be expected to decrease, and collection costs can be expected to decrease as well. Tons that continue to be delivered to transfer stations which are presently in existence will not be affected by changes in disposal cycle times; only those tons delivered to a different transfer station from the one presently used will be affected. Thus, for the private alternative, with three additional transfer stations, 333,000 tons would be delivered to these stations, and these would be the tons that would experience a decrease in disposal cycle time. The overall system wide impact of a change in disposal cycle time must be reduced to reflect the fact that not all tons in the system are experiencing a change in disposal cycle time. For the private alternative, a change in disposal cycle time is experienced by only 26% of the tons in the system as a whole. For the public system, where the number of transfer stations decreases relative to the status quo, disposal cycle time would increase for those tons delivered to the closed transfer station; for the purpose of this analysis, it is assumed that these tons are the number of tons delivered to Willamette Resources Transfer Station, 116,000 tons, representing 9% of the waste stream (This transfer station is assumed because it is the largest, and this would be the maximum number of tons affected by the closure.) The Hybrid alternative, with seven transfer stations (the current six plus Columbia Environmental), would also decrease disposal cycle time for some tons, an estimated 11% of the system wide tons.

The only other impact a change in transfer station arrangements is expected to have on collection costs is in the extent of vertical integration. In the all private arrangement, it is expected that more firms will be able to achieve vertical integration, and that small private

firms will find it increasingly difficult to compete against their vertically integrated competitors, as the small private firms, unlike the vertically integrated firms, will only be earning profits on collection costs, not transfer, transport and disposal as well. It is expected that in the Private alternative there will be exits from the industry of small private firms, and that prices will creep up over time, as prices of transport and disposal increase in response to cost plus rate regulation. There is no firm estimate of the magnitude of this impact – a guess is somewhere between 2% and 5% of costs, over time.[9]

With regard to the costs of transfer, changes in the number of transfer stations, other things equal, will change the scale of operations. When the average transfer station increases in size, the cost per ton can be expected to decrease slightly. Thus, the public alternative is expected to cost slightly less than the Status Quo. When the average transfer station decreases in size, some economies of scale are lost, and the cost per ton can be expected to increase slightly. This is the case in the Hybrid system and also in the Private system.

The Private system will also require implementation of a new utility-type cost-plus rate regulation system. This will no doubt involve audits of books of transfer station operations, report writing, review of reports from transfer stations, inspections, etc., and it can be expected to increase the present level of administrative and regulatory expenses.

Flows of regional system fees, excise taxes, and fees levied on behalf of other governments are not expected to be affected by changing the arrangements for transfer stations. Capital flows will be affected by the selected system. In changing from the Status Quo to the Public system, Metro would purchase three additional transfer stations, at an estimated cost of $12 million; this money would flow to the private sector, resulting in a net system impact of zero dollars. In the Private alternative, two of Metro's transfer stations would be sold, resulting in receipts to Metro of $8 million, and expenditures by the private sector of $8 million, again netting out system wide. In this alternative, however, there would also be construction of three additional transfer stations, so the net capital expenditures are $12 million, resulting in a per ton increase of $0.48, assuming a 25 year life of the facility. Similarly, in the Hybrid option, one additional facility is constructed by the private sector, at an estimated additional per ton cost of $0.16.

The final cost impact of changes in the structure of the transfer station market would affect the collection of household hazardous wastes. No change in present costs is expected in the Status Quo, Public, or Hybrid system. There might be some small increase in the Private system, based on having to contract for or construct new facilities.

The final set of assumptions includes transport to landfill and disposal. No change in the present costs of transport to landfill or disposal is expected, at least through the present term of the transport contracts. For disposal, one option being considered is to conduct a competitive disposal services procurement for the 10% of the waste which is not presently committed to Waste Management. If price competition occurs, this procurement may result

[9] These percentages are based on observed differences between commercial dumpster rates between the City of Portland, with subscription regulation of rates and the surrounding jurisdictions cost-plus rate regulation, and the study of cost-plus rate regulation in the commercial sector of Seattle. In both cases, cost-plus rate regulation was found to yield prices in excess of what would be expected in a market with active price competition.

in a small decrease in the per ton disposal fee for these tons. However, as many of the operators of landfills are governed by "most favored customer" clauses in their disposal contracts, which require that a price decrease offered to one jurisdiction be offered to another, there may not be any significant price competition resulting from this procurement.[10]

Collection Impacts

Time and motion models were constructed and used to determine the impact of changes in disposal cycle time on collection costs. Exhibit 6-2, below, presents the results of the time and motion models run for various increases and decreases in disposal cycle time. These decreases and increases in costs are system wide; they will apply only to the tons going to different transfer stations. For the residential sector, increases in disposal cycle times of 5 and 15 minutes are predicted to increase residential collection costs by 1.2% and 4.4%, respectively. Decreases in disposal cycle time for residential collection are not projected to reduce costs, as only a single load is modeled, and there is not sufficient time available to collect and dispose of a partial load in the remaining time available after collecting and tipping a full load. For the commercial sector, increases in disposal cycle time of 5 to 15 minutes are predicted to increase commercial collection costs by 2.6% and 15.6%, respectively. Because commercial solid waste collection vehicles typically make several loads per shift, decreases in disposal cycle time by 5 and 15 minutes is predicted to reduce commercial collection costs by 2% and 10.9%, respectively.

Of course, not all tons are affected by changes in disposal cycle time. For the public alternative, just 9% of tons are affected, and the overall impact ranges from $268,000 to $1,538,000—an increase in collection costs of 0.1% to 0.9%. For the Private alternative, 26% of the waste is affected by shorter disposal cycle times, and the decrease in collection costs is estimated to range from $508,000 to $2,840,000 – a decrease of 0.3% to 1.7%. The Hybrid also results in decreases in travel times, and the estimated decrease from this arrangement is from $215,000 to $1,202,000 – a percentage decrease of 0.1% to 0.7%.

The only other impact on collection costs occurs in the Private arrangement. With no public sector transfer stations, in this arrangement we believe that vertical integration will increase, small firms will exit the market, and prices will tend to creep upwards. Based on studies of cost-plus prices prevailing in Seattle with Washington Utility and Transportation Commission rate regulation, and on the comparative prices for dumpster service prevailing in the City of Portland as compared to surrounding communities, we have estimated this impact as ranging from 2% to 5% of the tons collected by haulers.[11] Of course, if prices increase in this manner, additional self hauling may occur. Differences in fees between the City of Portland and surrounding communities can be attributable to various factors, including differences in rate setting methodologies, differences in route density (distances

[10] One way to encourage price competition may be to procure transport to landfill and disposal as a unit. This means that an additional level of profit is earned on transport, but it may eliminate lack of flexibility in disposal pricing.

[11] A 2004-5 study of 134 commercial customers in Portland found that the monthly fee for weekly collection of a dumpster container was $34.38 in the City of Portland, compared with $39.29 to $47.79 in the surrounding communities of Beaverton, Clackamas County Urban, Gresham, Tigard, and Washington County.

EXHIBIT 6-2
Impact of Disposal Cycle Time on Residential and Commercial Collection Costs

	Residential Garbage Collection			
Collection Model Runs	**$/HH**	**Millions/Year**	**% Change from Status Quo**	**Change in $, Millions**
Status Quo (Estimated from Rates):	$82	$35.10		
Estimated from Model:	$80	$34.10	0%	0
Longer Disposal Cycle Times:				
Increase 5 minutes	$80.50	$34.50	1.2%	$0.40
Increase 10 minutes	$81.76	$35.00	2.6%	$0.90
Increase 15 minutes	$83.02	$35.60	4.4%	$1.50
Shorter Disposal Cycle Times:*				
Decrease 5 minutes	$79.67	$34.10	0.0%	$0.00
Decrease 10 minutes	$79.67	$34.10	0.0%	$0.00
Decrease 15 minutes	$79.67	$34.10	0.0%	$0.00
	Commercial Garbage Collection			
Collection Model Runs	**Cubic Yards/Truck Shift**	**Millions/Year**	**% Change from Status Quo**	**Change in $, Millions**
Status Quo (Estimated from Rates):	220	$132.4	0.0%	0
Longer Disposal Cycle Times:				
Increase 5 minutes	216	$135.0	1.9%	$2.6
Increase 10 minutes	211	$138.2	4.4%	$5.8
Increase 15 minutes	197	$148.0	11.8%	$15.6
Shorter Disposal Cycle Times:*				
Decrease 5 minutes	224	$130.5	-1.5%	-$2.0
Decrease 10 minutes	230	$126.7	-4.3%	-$5.7
Decrease 15 minutes	240	$121.5	-8.3%	-$10.9
	Residential & Commercial Garbage Collection			
Collection Model Runs		**Millions/Year**	**% Change from Status Quo**	**Change in $, Millions**
Status Quo (Estimated from Rates):		$167.52	0.0%	0
Longer Disposal Cycle Times:				
Increase 5 minutes		$170.49	1.8%	$2.97
Increase 10 minutes		$174.19	4.0%	$6.67
Increase 15 minutes		$184.61	10.2%	$17.09
Shorter Disposal Cycle Times:				
Decrease 5 minutes		$165.56	-1.2%	-$1.96
Decrease 10 minutes		$161.82	-3.4%	-$5.70
Decrease 15 minutes		$156.59	-6.5%	-$10.92

* No change in cost because they can only do one load, and there is not enough remaining time to collect and tip a partial load.

between customers), and local government fees and assessments. On balance we believe that over a several year period, prices would increase in the City of Portland if the City changed from the subscription system to the exclusive franchise system with cost-plus utility type rate regulation.

Transfer Impacts

Changes in the average scale of transfer stations in the three scenarios will affect transfer station operating costs. Exhibit 6-3 shows the estimated costs of those stations with self haul facilities and those accepting only commercial sized loads, and the total transfer station operating costs, for each scenario.

EXHIBIT 6-3
Summary of Transfer and Processing Costs

	Transfer and Processing			Difference from Status Quo:	
Scenario	No self haul	Self Haul	Total	$	%
Status Quo	$6,465,972	$6,629,310	$13,095,282	$0	0.00%
Public	$3,751,282	$9,335,039	$13,086,321	-$8,961	-0.07%
Private	$8,138,432	$5,699,387	$13,837,819	$742,537	5.67%
Hybrid	$7,129,370	$6,240,249	$13,369,619	$274,337	2.09%
Public -2*	$5,624,673	$7,152,600	$12,777,273	-$318,008	-2.43%

* With 2 self haul transfer stations.

Costs are only for the tons that are delivered to transfer stations. Costs are estimated by using the regression equation estimated for 24 transfer stations located throughout the United States. (presented in Appendix C). In computing the overall cost of transfer, the Metro tip fee was used for all tons, as this is the rate employed by local rate setting jurisdictions. Thus, those tons delivered to reload and dry waste transfer stations and those hauled directly to a landfill are included in the aggregate market as though they delivered materials to a Metro station for transfer, transport, and disposal. The Status Quo transfer and processing costs for tons delivered to the six wet transfer stations is $13.1 million; the aggregate estimate for transfer in the solid waste model is $16.7 million, allowing for all tons, not just those delivered to the wet transfer stations. As the Public alternative reduces the number of transfer stations, cost decreases slightly, in comparison to the Status Quo – a 0.07% decrease. If there were just 2 self haul facilities in the Public alternative, costs of transfer and processing would decrease by 2.4%. In the Private and Hybrid scenarios, where average transfer station size decreases, the costs of transfer increase, by 5.7% and 2.1%, respectively.

No other changes to transfer station costs are expected for either the Public or the Hybrid alternatives. For the Private alternative, there would be the costs of setting up and administering a cost-plus rate regulation system (estimated at $100,000 to $200,000 per year), the impact of cost-plus rate regulation on transfer prices (estimated to range from zero in the initial year to 2% over several years), capital impacts (from selling and building new transfer

stations), and changes in costs of providing household hazardous waste services (estimated to range from zero to $100,000 per year). In estimating capital expenditures, transfer stations are assumed to sell for $4 million each, and new transfer stations to cost from $3 million to $4 million each to construct. The net capital expenditures are amortized over 25 years; their impacts are estimated at zero for the Public alternative, between $0.3 and $0.5 million for the Private alternative, and between $0.1 and $0.2 million for the Hybrid alternative. All transfer impacts together are estimated as follows:

- Public Option: Decrease of $12,000 per year;
- Private Option: Increase of $1.2 million to $1.8 million per year;
- Hybrid Option: Increase of $0.4 million to $0.43 million per year.

Transport and Disposal

No cost impacts are predicted for transport in any scenario. Disposal for the 90% of the waste stream committed to Waste Management disposal sites is expected to continue as at present, at least until the end of the contract in 2019. In the Hybrid alternative, the 10% of the waste which is not committed will be put out to bid, and some price reduction may be achieved. Prices might come down because there are more competitors now in the disposal market than when the existing contract was bid and negotiated. However, because many of these disposal firms have most favored customer clauses in their government contracts, they may choose not to engage in active price competition. The decrease in the disposal component in the Hybrid system is thus estimated to range from zero to $0.3 million.

Summary

Exhibit 6-4 presents a summary of the economic impacts of the alternative scenarios. The following observations can be made:

- The Hybrid is the only option with the potential to reduce system costs.
- Both the Public and the Private options are projected to increase costs – with the cost increase for the Public estimated at 0.1% to 0.7% and that for the Private at 1.4% to 2.2%.
- The largest cost impacts occur in the collection market; although Metro has no direct control over collection, collection costs can be affected by Metro's actions.
- Increasing the number of transfer stations tends to increase the cost of transfer, but these increases can be more than offset by decreases in collection costs.
- These cost estimates depend on a series of assumptions that are of course subject to variance; while different assumptions would result in different cost estimates, it is not likely that the relative ranking of the options would change.
- The key impact of the Private option is the likely further concentration of the collection industry, increased vertical integration, a probable reduction in the number of small independent collection firms, and probable cost-plus price creep.

EXHIBIT 6-4
Summary of Economic Impacts

Factor	Status Quo	Estimated Dollar Impact	
		Minimum	Maximum
Public Option:			
Collection	$167,532,000	$268,000	$1,538,000
Transfer	$16,732,000	($12,000)	($12,000)
Transport & Disposal	$51,364,000	$0	$0
Subtotal	$233,628,000	$256,000	$1,526,000
Percent change	0%	0.1%	0.7%
Private Option:			
Collection	$167,532,000	$1,963,193	$3,337,984
Transfer	$16,732,000	$1,203,000	$1,766,539
Transport & Disposal	$51,364,000	$0	$0
Subtotal	$233,628,000	$3,166,193	$5,104,522
Percent change	0%	1.4%	2.2%
Hybrid Option:			
Collection	$167,532,000	($215,000)	($1,202,000)
Transfer	$16,732,000	$395,000	$431,000
Transport & Disposal	$51,364,000	$0	($298,500)
Subtotal	$233,628,000	$180,000	($1,069,500)
Percent change	0%	0.1%	-0.5%

SECTION 7

Summary and Conclusions

The Economics of the Metro Disposal System

Competition

The Metro disposal system can be viewed as a series of inter-related elements: collection, transfer/processing, transportation, and disposal (waste reduction, recycling, and source-separated processing are not typically considered to be part of the disposal system). Economic theory and the results of the analysis of the system suggest the following conclusions about competition in the Metro disposal system:

- Collection: Commercial collection in the City of Portland is arranged by subscription i.e., multiple firms compete for business in a competitive market. Residential collection, and commercial collection outside the City of Portland, is provided under a system of exclusive franchises. Thus, there is no competition for the majority of collection services in the Metro region.

  It is estimated that collection accounts for 81 percent of the total cost of residential disposal, and a very high percentage of the total cost of commercial disposal. As a result, the greatest opportunity to inject competition into the Metro disposal system is in collection, which is the responsibility of local government and outside the control of Metro.

- Transfer/processing: A fundamental fact about transfer stations is that there is little competition in the provision of transfer/processing services regardless of whether these services are provided by the public or private sector. This occurs for a number of reasons. First, it is only economic to deliver waste to a facility relatively close to the collection route resulting in a type of "natural geographic monopoly". Second, collection firms that are vertically integrated (i.e., they own transfer stations and/or landfills) gain an additional margin of profit by delivering waste to a station they own: it often makes economic sense for such firms to drive past a transfer station they don't own and continue on to deliver waste at a station they do own. Finally, transfer and processing per-ton costs decline as more tons are received; this results in a seeming paradox in which prices paid for transfer can ***increase*** as more transfer stations are put in place.

  Metro injects one important element of competition into the transfer/processing market in the region by bidding out the operation of their stations. This helps lower the total cost of disposal for local governments that use the Metro transfer rate as a benchmark for establishing the disposal component of the collection rates charged by the franchised collection firms they regulate.

- Transportation: Transportation of waste from a transfer/processing facility to a disposal facility is generally done at competitive market prices. There are few barriers to entry and many trucking firms willing to compete for this business. Barge and rail transport

also have the potential to be competitive with trucking for transportation of waste from Metro to distant landfills.

- Disposal: At least 90 percent of the wet waste in the region is disposed of at a Waste Management landfill under the terms of a contract that was procured years ago using a competitive process in a market with few options for disposal. The price paid by Metro is equal to or lower than that paid by other jurisdictions in the Pacific Northwest that have long-term contracts for disposal at regional landfills. Today, however, there are multiple firms with regional landfills that would be interested in providing disposal services to Metro. It is possible that the disposal price paid by Metro is higher than the price it would pay in a competitive market for disposal, or if its disposal contract were re-bid. Metro is legally bound to this contract through 2014, and the contractor can extend the contract until 2019. After this contract expires, it is possible that Metro would realize a reduction in the price paid for disposal.

Metro as Regulator and Competitor

During the conversations with stakeholders conducted as part of this project, one concern expressed by private transfer station operators is that Metro is both their regulator and a competitor. This concern exists for a couple of reasons. First, as tons flow to private facilities rather than a Metro-owned facility, Metro's per-ton cost of transfer increases. The transfer station operators believe that this provides an incentive for Metro to limit the amount of wet waste delivered to the private stations thus limiting private sector growth and revenue-generating potential. Second, Metro establishes fees and taxes that must be paid by private facility owners: some private facility owners feel that those fees and taxes are too high. They particularly dislike paying for Metro general government and paying for certain services and costs associated with the Metro transfer stations.

A very different perspective is held by the independent collection firms that were interviewed. They were of the unanimous opinion that there should be no private wet waste transfer stations in the region: their interests would be best served by a system in which Metro owns all transfer stations ***and*** disposal facilities. This is mainly because vertically integrated firms that provide collection and transfer and/or disposal services have a competitive advantage over firms that provide only collection services. The vertically integrated firms are both competitors and service providers to smaller independent firms. It is safe to conclude that continued Metro ownership of transfer stations will result in a collection market that includes more small independent collection companies than would be the case if Metro did not own any transfer stations.

The independent dry waste processing facility owners interviewed felt the Metro should continue to both own and regulate facilities.

Surveys of both commercial and self-haul customers (households and businesses) indicated a high degree of satisfaction with the level of service provided by Metro. When asked where they would take waste should the Metro station they were using close, the majority of self-haul customers said they would use the other Metro facility or had no idea where they would go.

System Economics

The analysis of the economics of the Metro solid waste system results in the following conclusions and recommendations:

- The greatest potential for cost savings is in collection; which is outside Metro's control.
- Metro rates are used in setting collection fees, which is good, particularly when Metro competitively procures transfer station operation services. This injects an important element of competition in a market that otherwise would not have many characteristics of a competitive market. Therefore, Metro should try to maximize competition in contracting for each of these services. For example, it could consider evaluating price as a function of distance in its disposal contract, or perhaps jointly procuring transfer, transport, and disposal or transport and disposal.
- In recent years, national solid waste firms have increased market share in the local solid waste industry. These firms seek to achieve vertical integration to maximize profits. Without measured steps by Metro and/or local government to preserve competition, vertical integration, profitability, and prices are likely to increase in the Metro region.
- Economies of scale are significant in transfer, thus, adding transfer stations increases per-ton costs. Also, handling small loads increase per-ton costs compared to handling large loads. Therefore, Metro should be careful to not allow too much excess capacity in the region's transfer system: adding stations reduces throughput at existing facilities and thereby, other things equal, increases the cost of transfer.
- Significant unused transfer capacity exists in the region.
- Transfer is the smallest cost component of the transport, transfer, and disposal system.
- On average, Metro transports waste to landfills a greater distances than does the private sector.
- The private sector typically earns its highest profit margins on disposal.

Analysis of System Ownership Options

The advantages and disadvantages of private, public, or a hybrid public-private ownership of the Metro region transfer system were analyzed from a variety of perspectives, including:

- An analysis of how well each option met the Metro Council's stated values
- The estimated cost of each option
- The risk associated with each option

A variety of methods including in-person interviews, surveys, and focus groups were used to elicit the opinions of key stakeholders such as private facility owners, independent waste collection firms, independent dry waste facility owners, local government representatives, Metro staff members, and Metro transfer station users. The opinions of stakeholders were used to help define the system options and analyze the performance of the options in meeting Council objectives. A summary of the results of the analysis are shown in Exhibit 7-1.

EXHIBIT 7-1
Summary of Results

	Private	Public	Hybrid
Values – Results of value modeling analysis. Normalized scores where maximum =1, minimum =0.	0.35	0.62	0.49
Cost – Estimated long-run percent change in system cost.	Low: 1.4% High: 2.2%	Low: 0.1% High: 0.7%	Low: -0.5% High: 0.1%
Risk – 10 measured risk signatures that incorporate likelihood and criticality. Each risk rated low, medium, high, or critical.	6 High 4 Medium	1 Critical 9 Low	10 Low

A brief summary of the results of the value modeling, economic analysis, and risk assessment follow.

Value Modeling Results

The Metro Council outlined the following values associated with the disposal system:

1. Protect public investment in solid waste system
2. "Pay to Play"- Ensure participants pay fees/taxes
3. Environmental Sustainability- ensures system performs in an sustainable manner
4. Preserve public access to disposal options (location/hours)
5. Ensure regional equity- equitable distribution of disposal options
6. Maintain funding source for Metro general government
7. Ensure reasonable/affordable rates

These values were reworded slightly to facilitate analysis. One value (ensure reasonable/affordable rates) was captured in the economic analysis, and one additional value was added: Ensuring support from system participants.

The results of the value modeling analysis indicate that the public system is clearly preferred to the other ownership options. The results of a sensitivity analysis of the relative importance of each Council value indicate that this result is not sensitive to the relative importance assigned to each value.

One additional sensitivity analysis was performed that incorporated challenges associated with implementation. That analysis showed that as more importance is placed on the difficulties associated with acquiring existing private transfer stations, the hybrid system eventually becomes preferred to the public system.

Economic Analysis Results

The cost of the three systems is not likely to have a large impact on the cost of the Metro solid waste system. Regardless of the option selected, costs are not expected to increase or decrease by more than about two percent. Other findings of the economic analysis include:

- The Hybrid is the only option with the potential to reduce system costs.

- Both the Public and the Private options are projected to increase costs – with the cost increase for the Public estimated at 0.1% to 0.7% and that for the Private at 1.4% to 2.2%.
- The largest cost impacts occur in the collection market; although Metro does not control collection, collection costs can be affected by Metro's actions.
- Increasing the number of transfer stations tends to increase the cost of transfer, but these increases can be more than offset by decreases in collection costs.
- These cost estimates depend on a series of assumptions that are of course subject to variance; while different assumptions would result in different cost estimates, it is not likely that the relative ranking of the options would change.
- The key impact of the Private option is the likely further concentration of the collection industry, increased vertical integration, a probable reduction in the number of small independent collection firms, and probable cost-plus price creep.

Risk Analysis Results

There is considerable uncertainty at this time about exactly how any of the system options would be implemented and exactly how aspects of the system would develop through time. When considering major new programs or system changes, it is important that organizations such as Metro evaluate the risk associated with such changes by identifying, assessing, and develop strategies to manage those risks.

Risks were identified by the project team during a brainstorming exercise during which 10 risks and 6 related uncertainties were identified that may be relevant to the choice of ownership option. Once identified, a qualitative assessment of these risks was performed. The assessment was done using a qualitative risk signature approach in which the signature for each risk was determined by first assessing the likelihood and impact for each risk, then using a risk matrix to determine if the risk is low, medium, high, or critical.

The results of the assessment (Exhibit 5-3) indicate that there is more risk associated with implementing the private system than the public or hybrid system. However, the only risk scored as critical is challenges associated with implementation in the public system. The hybrid system has relatively low risk.

APPENDIX A

Stakeholder Opinions about Disposal System

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This appendix provides a summary of stakeholder opinions about the Metro Disposal System. The stakeholders represent groups of persons and companies that have a direct interest in actions that may affect the disposal system. In addition, individual interviews were conducted with each Metro Council member. The Metro Council is responsible for making decisions about the disposal system.

The following six stakeholder groups were identified and interviewed as part of this project:

- **Transfer station owners** - separate interviews with representatives of Allied Waste Systems, Pride Disposal, Waste Connections, and Waste Management.
- **Independent haulers** - a workshop with representatives of the following companies: Cloudburst Recycling, Deines Brothers Disposal, Flannnery's Drop Box Service, Oak Grove Disposal, Portland Disposal and Recycling, West Slope Garbage Service; and a representative from the Oregon Refuse and Recycling Association.
- **Independent dry waste facility owners –** separate interviews with representatives of East County Recycling and Greenway Recycling.
- **Local government staff members** - a workshop with representatives from the following jurisdictions: Portland, Clark County, Troutdale, Milwaukie, Beaverton, Oregon DEQ, Gresham, Clackamas County, Washington County, Clackamas County. Separate interviews were also held with senior executives from Gilliam County and Oregon City.
- **Metro staff members** - a workshop with representatives from a number of Metro departments.
- **Customers at Metro Transfer stations –** Intercept interviews of commercial customers (182 interviews) and a mail-in survey of self-haul homeowner and business customers (341 responses).

A summary of the top issues and concerns expressed by each group, and comparative responses to a series of questions about the transfer system follow for the first five groups (the customer surveys focused mainly on service level questions).

Key Issues and Concerns for Each Group

Transfer Station Owners

As anticipated, there were some differences of opinion between the transfer station owners, and some areas of consensus.

- Three of the four firms felt strongly that Metro should not be a regulator and a competitor. For example, they don't think it's fair that they have to compete with Metro when Metro establishes rules that protect it against competition, for example, Metro gets

75% of wet waste and privates get 75% of dry waste and it's much more costly to handle dry waste because of the 25% recovery requirement.

- One firm expressed that they thought the system was working pretty well and few changes needed to be made.
- They do not like the excise tax and the concept of assessing fees on waste that are then spent for other purposes.
- They all would like the opportunity to transfer more wet waste than allowed by their existing caps.
- They preferred the private or hybrid systems, and were strongly opposed to the public system.

Independent Haulers

There was strong consensus within this group about the following key issues:

- No collection company should be allowed to own a transfer station or landfill and/or Metro should own all transfer stations and landfills.
- The same rates should be charged to all customers at all facilities.
- The Metro stations work well for them operationally, and Metro does a good job providing recycling/recovery and HHW programs.
- Metro staffing levels are too high.
- Metro should build new stations: one in east and one in west.
- The public system was preferred, the hybrid would be OK, and they did not want the private system.

Independent Dry Waste Facility Owners

- Metro should not sell its transfer stations. Metro is in the system because they were needed 20 years ago, and that need continues today. Metro should own at least one facility otherwise they will be less able to influence future events.
- Vertical integration is a significant problem:
  - The system needs more dry waste facilities operated by companies that do not own landfills because landfill owners have an incentive to dispose of waste rather than recover waste. In response, Metro has to micro-manage the system.
  - As national companies increase market share, abuses will likely follow as they develop the economic power to control rates.
  - It adversely effects customer choices and limits creativity at facilities.
- Metro's reliance on solid waste taxes may have a negative effect on their decisions; Metro needs funding sources other than solid waste taxes.

- Even with mandatory MRFing, Metro should retain the 25% recovery requirement; without a minimum, recovery rates will decline.

Local Government

There was strong consensus among local government representatives about the following aspects of the disposal system:

- Metro should ensure predictable rates (as important as low rates), convenient transfer station access for all, continued focus on increased recycling/recovery and minimizing toxics, and consistency throughout region in rates and services offered at transfer stations.
- Metro should exert more control over dry waste facilities, and help ensure improved environmental controls and neighborhood mitigation at all private facilities.
- Metro does a good job coordinating with local government on proposed programs and provides good waste reduction/recycling and HHW programs.

Metro Staff

Metro staff had the following opinions about the disposal system:

- The system should be flexible and able to respond to industry changes and provides services and programs desired by the public.
- The system should have the same rules for all participants.
- Metro's decision making process should continue to consider environmental and social effects in addition to cost.
- Metro should provide reasonable geographic access to HHW and transfer facilities for all.
- There should be more clarity in Metro's role as regulator and operator.

Metro Transfer Station Customers

Commercial Customers

- Over 90 percent of commercial customers responded that Metro's transfer stations were good, very good, or excellent in providing the following objectives: efficiency, cleanliness, safety, and the ability of scalehouse operators to answer questions or address problems.
- Over 70 percent of commercial customers responded that Metro's transfer stations were good, very good, or excellent in providing the following objectives: courteous contract employees, and the ability of contract employees to answer questions or address problems.

Self-Haul Customers

- Twenty-one percent of the self-haul survey respondents do not have curbside garbage service.
- A variety of reasons were given for using transfer station instead of a local curbside garbage collector including, but the main reason stated was that there was too much debris for curbside service or the item was too large for curbside service (49%). Other reasons cited include: the transfer station costs less than curbside or dropoff; the hauler won't take this item or materials; no service in my area; transfer station is more convenient or easier than curbside.

Comparative Summary of Key Issues and Concerns

Issue 1: What are the most important feature(s) that should be included in the future Metro disposal system?	
Transfer Station Owners	• Franchise territories around the main 5 or 6 stations with ~200,000 tons each • All private ownership with cities regulating transfer station rates • Metro either sells stations and is regulator, or keeps stations and some other entity is regulator • Maintain 90% guarantee
Independent Haulers	• Break vertical integration: no collection company can own a transfer station or landfill and/or Metro owns all transfer stations and landfills • Metro should build new stations: one in east and one in west • Same rates at all facilities
Independent Dry Waste Facility Owners	• Metro should remain in system as "disposer of last resort" • Break vertical integration: Landfill owners may not own transfer facilities and haulers cannot own transfer facilities • More independent dry waste facilities (up to 8) to improve accessibility
Local Government	• Predictable rates (as important as low rates) • Convenient transfer station access for all (20 minute rule of thumb) • Continued focus on increased recycling/recovery and minimizing toxics • Consistency throughout region in rates and services offered at transfer stations
Metro Staff	• A flexible system that can respond to industry changes and provides services and programs desired by the public • Same rules for all participants • Decision making process considers environmental and social effects in addition to cost • Reasonable geographic access to HHW and transfer facilities for all • Clarity in Metro's role as regulator and operator

Issue 2: What are the main concerns about the current system i.e., what's broken?	
Transfer Station Owners	• It's not fair that we have to compete with Metro when Metro bends the rules to protect their waste flows • Excise tax should not be levied on garbage: taxes and fees assessed on solid waste should pay for solid waste activities • Caps should be higher at private stations • Portland commercial collection should be franchised
Independent Haulers	• Metro should staff the gate house at private stations • Same rate should be charged to all customers at stations • Portland commercial collection market should be regulated • Metro's solid waste programs and staffing levels have grown too large
Independent Dry Waste Facility Owners	• Lack of a level playing field: operating standards should be the same at all facilities • Vertical integration with national firms gaming the system causes an uneven playing field • Metro's reliance on solid waste taxes for funding
Local Government	• More control needed on dry waste facilities • Some facilities need better environmental controls and neighborhood mitigation: Metro should help do this • At times it seems that private sector lobbyists have the politician's ears and the public interest is left behind
Metro Staff	• Transfer station approval criteria and regional fee system are too complex • Metro SWR staff should work to ensure that decision makers have a better understanding of problems and issues • Leakage of waste out of the region

Issue 3: Should Metro sell its transfer stations?	
Transfer Station Owners	• Maybe sell Metro South, but Metro Central has most value in the system • Yes, sell them both • Sell them both and regulate, or keep them both and let some other entity be the regulator • If stations were sold, Metro would risk losing ability to collect regional system fee and excise tax
Independent Haulers	• NO!
Independent Dry Waste Facility Owners	• No. Metro should retain at least one transfer station
Local Government	• Do not sell the stations, or if they do, retain control of gate house
Metro Staff	• Depends on what the system looks like after a sale

Issue 4: What works well in the current disposal system?	
Transfer Station Owners	• Metro has best HHW facilities in the country • Current system has high recovery rates • System appears to meet Metro's goals of promoting reuse/recycling, funding other areas of Metro government, ensuring equitable access for multiple players, environmentally-sound disposal, cost-effective • Performance standards are good way to drive recovery • Metro is honoring its disposal contract
Independent Haulers	• Metro stations meet needs of haulers (separated from self-haulers, fast in-and-out, good hours, automated payment) • Stations in good locations • Metro does good job looking out for public interest (HHW, recycling, planning for capacity, rate setting)
Independent Dry Waste Facility Owners	• System does a good job of recovery, but could be better
Local Government	• High recycling and recovery • Good HHW program • Good interaction between local governments and Metro in determining services provided at transfer stations
Metro Staff	• Metro listens to its customers in determining waste reduction/recycling and HHW program needs • Metro honors its contracts

Issue 5: Which of the system ownership options do you prefer: private, public, hybrid?	
Transfer Station Owners	• Private model • Hybrid model • Either private or hybrid, but NOT public (see you in court)
Independent Haulers	• Public model: Hybrid OK, but NOT the private model
Independent Dry Waste Facility Owners	• Not directly assessed: appeared to favor hybrid model
Local Government	• Not directly assessed: appeared to favor public or hybrid model
Metro Staff	• Not directly assessed: appeared to favor public or hybrid model

APPENDIX B

Economic Theory

APPENDIX B

Economic Theory

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Introduction

The purpose of this appendix is to provide a non technical overview of basic economic theory regarding competition. Part 1 discusses the benefits of competition, and Part 2 discusses some of the reasons that certain industries are more likely to have higher levels of competition than others.

Part 3 characterizes the solid waste collection, processing, transfer and disposal markets related to the economic theory presented in the first two parts. The primary conclusion is that a lack of competition in the solid waste transfer and disposal markets can result in higher prices and lower quality of service.

Part 1: A Summary of Basic Economic Theory about Competition

This part of the appendix summarizes extensive economic literature about competition, or the impacts of market structure on market performance. The overriding conclusion of this summary is that increased competition results in lower prices and increased quality and levels of service. The term **market structure** refers to the number and size of participants in a market -- those firms or institutions producing a good or providing a service for sale (hereinafter the term "producer" refers to either a producer of a product or a provider of a service). Market performance refers to the extent to which the prices and quantities exchanged in the market reflect an efficient allocation of resources and avoid excessive profits to any single or group of producers. In other words, market performance refers to the level, quality and price of goods and services produced.

This discussion begins with an analysis of the two extreme examples of market structure. The first example has a single producer, and hence no competition among producers; this is called a monopoly. The second extreme example has a very large number of competitors each producing the same product (homogeneous or undifferentiated product) with no individual impact over the market price; this is called perfect competition. While these extreme market structures are seldom actually observed in modern industrial economies,

they provide a useful set of bookends for discussing all other market structures where the number of producers ranges from two to many.

Definitions of Economic Terms

To facilitate the discussion, we begin with some definitions of key terms (which are presented in a logical, rather than alphabetical, order). Producer markets consist of **firms** who are entities that produce the good or service being traded in the market. Firms employ labor, raw materials, capital goods, or land as **factors of production** to produce their product. The **industry** consists of all the firms involved in the production of the designated good or service. In theory, the definition of an industry is straightforward; in the real world, difficult decisions often must be made as to whether a firm is "in" or "out" of the industry. In general, to be a part of an industry, the firm must produce a **product** that is considered largely substitutable for products produced by all the other firms in the industry.

Profit maximization is considered by economists to be the objective of the firm. In employing the factors of production to produce its good or service, the firm incurs **production costs**. Production costs vary with the quantity of product produced. In the simplest case, **fixed costs** (such as those to construct a factory or to purchase land) can be added to **variable costs** (those costs which change according to the quantity produced, such as quantities of raw materials and energy and labor) to obtain **total costs.** It is obvious for a single firm that as quantity produced increases, and as the fixed costs are spread over more and more units of output, the **average cost**, or total cost divided by units of output produced, will decrease. As outputs increase, average costs tend to decrease, and this phenomenon is called **economies of scale**.

In some industries, average costs continue to decrease as quantity produced increases; these industries are termed **natural monopolies**, as it makes sense to have a single producer making all the goods if costs will be lowest in such a situation. Examples include utilities such as water and sewage. In other industries, average costs tend to plateau – once a producer reaches a certain level of output average costs neither increase nor decrease. Examples of such industries include **solid waste** collection.[12] In other industries, after decreasing over a certain range of outputs, costs tend to increase again, due to factors such as overuse of factory capacity that

[12] Stevens, Barbara J. "Scale, Market Structure, and the Cost of Refuse Collection," *The Review of Economics and Statistics.* Vol LX, # 3 (August 1978), p. 445.

might result in overtime wages or higher equipment maintenance. This u-shaped average cost function is the one typically assumed by economists as applying to most manufacturing and service industries.

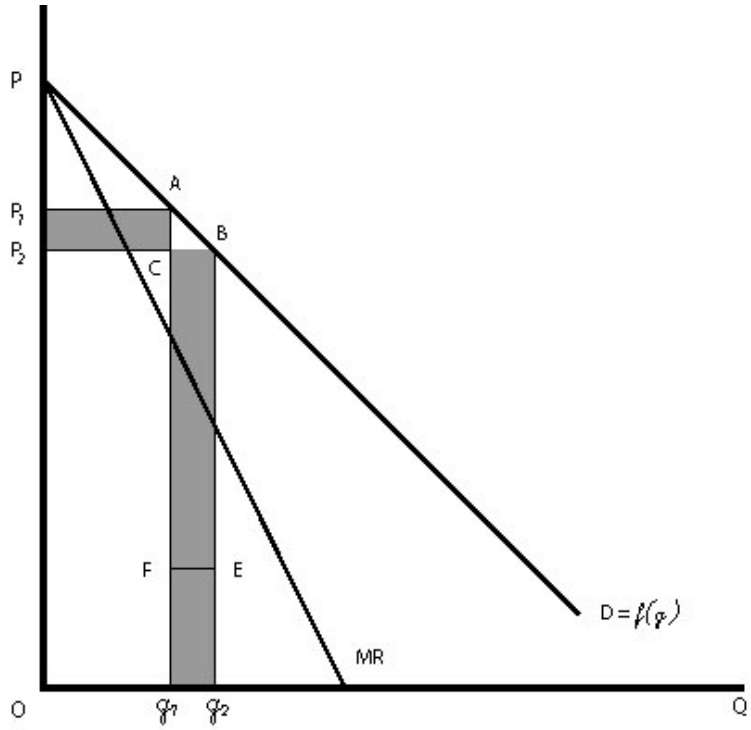
As production increases for any individual firm, total costs increase only by the amount of the variable costs incurred; fixed costs do not change. While average cost is defined as the quotient of total cost and quantity produced, there is another concept that is critical to economic analysis of the market. This concept is **marginal cost**, defined as the additional cost incurred in producing an additional unit of output. As fixed costs are not increasing along with output, marginal costs consist only of the increased variable costs incurred to produce a good or service. Like average costs, marginal costs may be constant, decreasing, or increasing. In most industries, marginal costs decrease at least as production is initiated. For example, factors of production like electricity may cost more when purchased in smaller quantities than in larger quantities, and such considerations, taken together, tend to make marginal costs decrease at least over some range of output. In manufacturing industries, marginal costs tend to decrease and then, at some point, to increase, for much the same reasons that average costs would tend to increase. Because marginal costs do not include fixed costs, they are lower than average costs as output is initially increased. Once marginal costs have turned upwards, they eventually exceed average costs, as, once again, the higher marginal costs are mitigated in the average cost function by the fixed cost element, which is allocated over increasingly large quantities of output.

The firm maximizes its profit by selecting an output at which the dollar amount between the total revenue of producing that quantity exceeds the total cost generated by selling that quantity by more than for any other output level. The **total revenue** received by the firm is the product of the price the firm can charge for selling that quantity times the quantity sold. The price the firm can charge is a function of the demand for the product. The **demand function** facing the firm is the representation of buyers' preferences – it tells how many units buyers in the aggregate will purchase at any given price. At higher prices, buyers will in the aggregate, purchase less. For example, as the price of gasoline increases, customers tend to cluster their errands or defer trips to conserve on gas purchases, and the number of gallons of gasoline purchased decreases. Thus, demand functions expressing price as a function of quantity purchased tend to be downward sloping.

An additional important concept relates to the demand function. This concept is called **elasticity of demand.** Elasticity of demand is defined as the percentage change in revenue resulting from a unit increase in quantity purchased. Although typically the number resulting from this computation would be negative, as demand curves tend to be downward sloping and, therefore, marginal revenue will be decreasing, in practice economists use the absolute value of elasticity. Thus, an elasticity of "1" is considered unitary, and it occurs when a one percent increase in quantity sold results in a one percent decrease in revenue. If revenues decrease by more than one percentage point for a one percent increase in quantity, the demand function is said to be elastic at this point, and the absolute value of elasticity is greater than one. If revenues decrease by less than one percentage point for a one percent increase in quantity, the demand function is inelastic. The more elastic a demand function is, the more demand is sensitive to prices changes.

As total revenue is the product of price multiplied by quantity, it follows that **average revenue** is total revenue divided by quantity. Like the total cost function, the total revenue function has a **marginal revenue** aspect. Marginal revenue is the additional revenue that the firm will receive from selling an additional unit. Figure 1 represents **marginal revenue** graphically. The figure shows a typical downward sloping demand function, and its associated **marginal revenue** function. Total revenues at price P1 are represented by the rectangle O-P1-A-Q1. When sales are increased to Q2, total revenues are represented by the rectangle O-P2-B-Q2. The change in revenues, or **marginal revenue**, consists of a loss represented by the shaded area (rectangle P2-P1-A-C), and a gain represented by the shaded area (rectangle Q1-C-B-Q2). Here, the gain exceeds the loss, and the marginal revenue is positive. The net gain is shown as the rectangle F-C-B-E. In general, as increments to sale occur, total revenues at first increase, meaning that **marginal revenue** is positive and that the **elasticity of demand** is less than one. Eventually, as sales increase, increments to total revenue become negative (the loss of revenue from selling all units at a lower price exceeds the gain in revenue from selling more units), and **marginal revenue** becomes negative. In this range of the demand function, the **elasticity of demand** exceeds one.

Figure 1: Marginal Revenue



For the firm, profits are maximized when the difference between total revenue and total costs is at a maximum. An equivalent way to express this is to say that profits are maximized when the additional revenue from selling an additional unit is just equal to the additional cost of producing that unit, or when marginal revenue equals marginal cost.[13] While firms in industries with very different levels of competition all seek to maximize profits, the degree of competition in an industry has a great impact on the quantity that will be produced and the price that will be charged at a profit maximizing equilibrium.

[13] For those with a mathematical background, P = TR - TC, where P=profit, TR=total revenue, and TC = total cost. The maximum of this function in q, quantity, is determined by setting the first derivative equal to zero, which is equivalent to setting marginal revenue (the first derivative of TR) equal to marginal cost (the first derivative of TC). The second derivative, of course, must be negative for this to be a maximum.

Competition, Monopoly, and Duopoly/Oligopoly

Perfect Competition

Perfect competition is defined as a large number of firms selling a homogeneous product and a large number of buyers. Markets for agricultural products, such as wheat, are common examples of perfectly competitive markets. In a perfectly competitive market, input and output prices are not affected by actions of any individual firm. As far as the individual firm is concerned, it faces a constant prevailing market price (or, in other words, a horizontal demand function). The firm maximizes profit by equating its marginal cost of production to the prevailing market price, as price equals marginal revenue (P=MR), as far as the individual firm is concerned. Of course, when all the production of all the individual firms is totaled, and when one looks at the industry as a whole, one can recognize that there is, indeed, a downward sloping demand function, but that each individual firm's small size relative to the market prevents it from perceiving the relationship between price and sales. Even if the firm did recognize this industry wide relationship, its own production is too small a percentage of the industry's for that individual firm to exert any impact on market prices. The perfect competitor would sell zero if he charged more than the going market price, and it does not make any sense to charge less than the going market price, as he can sell his entire profitable production at the going market price.[14]

It is important to note that economists consider that marginal costs include all the cost of capital, so that the equation of marginal cost to price does not mean that the perfect competitor is not considered to be earning appropriate returns on invested capital. However, the perfect competitor does not have the power over the market forces to earn above-normal returns on investment.

Monopoly

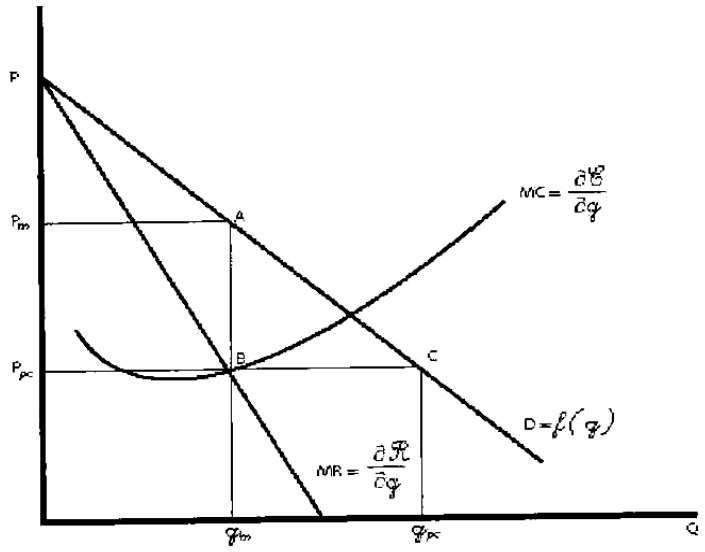
In a monopoly, there is a single producer, so the demand function facing the industry is the same as the demand function facing the producer. The monopolist's profits are maximized by setting marginal revenue equal to marginal cost (MR=MC), and determining the price the market will bear (the point on the average revenue curve) associated with the production quantity at which MR=MC. This

[14] Henderson, James M. and Richard E. Quandt. *Microeconomic Theory: A Mathematical Approach.* New York, NY: McGraw-Hill Book Company, 1958, p. 165

market clearing price is higher than marginal revenue. Marginal revenue equal to marginal cost equal to price is the equality that allows normal returns to capital. Price in excess of marginal cost allows excess returns to capital. These excess returns are typically earned by curtailing production – this means that some buyers who would be willing to buy at prices lower than that charged by the monopolist (while still in excess of marginal cost) are not satisfied. Their loss of satisfaction is one of the economic costs of monopoly. In other words, prices are expected to be higher for monopolies than they would be if there were competition for the products or services provided.

Figure 2 shows the relative prices and outputs expected in a perfectly competitive industry and monopoly. For simplicity, the demand functions for the perfectly competitive industry and the monopolist are shown as the same, and the marginal cost function for the monopolist is shown as the same as that for the perfectly competitive industry (the addition of all the marginal cost functions of all the individual firms in the market). Setting MR=MC results in an output quantity for the monopolist of $q_{m,}$ and a price of p_m, determined by the intersection of q_m and the demand function. Conversely, the perfectly competitive industry would result in a price set at the level of MR=MC, and an output of q_{pc}, significantly greater than that of the monopolist. Excess profits earned by the monopolist are represented by the amount $(p_m - p_{pc})^* q_m$. Aggregate loss in consumer satisfaction between the monopolist and the perfectly competitive industry market equilibria is the sum of the monopolist's excess profits plus the area included in the triangle, ABC, representing the satisfaction to those customers willing to buy at prices in excess of the perfectly competitive price yet below the monopolist's price. Note that another impact of monopoly over perfect competition is that in monopoly part of the consumer satisfaction that would accrue in perfect competition $(pm-ppc)^* q_m$ is shifted to the monopolist. So, monopoly results in curtailed output, compared to perfect competition. The monopolist garners excess profits, which would, in the case of perfect competition, have accrued to buyers in the form of consumer satisfaction.

Figure 2: Outputs and Prices in the Monopoly and the Perfectly Competitive Industry



Monopolists may occur in the market for final goods or services, or in the market for inputs. For example, producers of fabricated aluminum products may also own production facilities for aluminum ingots. Or, producers of refuse collection services may also own facilities for providing refuse disposal services. Firms that own the facilities for producing inputs are called **vertically integrated**. As Caves notes, integrated producers can put the "squeeze" on nonintegrated producers by raising the price of an input, while holding constant the price of the final good.[15] Further, monopolists at the input level may be able to extract all the available monopoly profit at that stage, leaving the final stage with many competitors.

Duopoly and Oligopoly

When the number of producers in a market is greater than one and less than many, each producer is aware that his actions have an impact on the market price and output. Each producer acts with an awareness that his actions have an impact not only on the market but also on other producers. Each firm's actions may elicit a response by other firms. The market with just two producers is called a duopoly. Oligopoly is the term used to refer to a market with more than one and fewer than many firms.

There are no generally accepted behavior reactions for oligopolists and duopolists. There are many different solutions– each based on a different set of behavior assumptions.[16] In turn, we will discuss the Cournot, collusion, Stackelberg, game theory, and monopolist competition theories of the oligopolist market.

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[15] Caves, Richard. *American Industry: Structure, Conduct, Performance.* (7th edition) Englewood Cliffs, NJ: Prentice Hall, 1992, p. 42.

[16] Henderson, James M. and Richard E. Quandt. *Microeconomic Theory: A Mathematical Approach.* New York, NY: McGraw-Hill Book Company, 1958, p. 176.

Cournot Solution. Augustin Cournot, a French economist published in 1838, was not really discovered until 45 years later.17 The basic assumption of his analysis is that each duopolist strives to set the quantity to produce, assuming that the quantity output of his rival is fixed. In other words, Cournot adopts the not very reasonable assumption that there will be no reaction to the actions of one firm operating in an industry with just two firms. Each firm, despite this myopic assumption, has a complete reaction function, which expresses its own profit maximizing output, given any output of its rival. In the Cournot world, a firm sets output repeatedly, assuming each time that it is maximizing profits in a world where the output of its rival is fixed at the then current level. As each firm has such a reaction function, equilibrium occurs when profit maximizing output A for firm A in the presence of output B for firm B is the same as the profit maximizing output B for firm B in the presence of output A for firm A.

The Cournot solution can be expressed as a function of price rather than quantity, a variable that most economists believe is more likely to be set by rivals than quantity.18 The model still results in sequential price cutting and profit decrease. As Scherer states, "by failing to recognize that rivals will react to its price initiatives, a firm conforming to the Cournot assumption is guilty of myopia, and economists have come to believe that the Cournot assumption is quite unrealistic when applied to pricing decisions involving only a few firms."19

Collusion Solution. A collusion solution occurs when duopolists or oligopolists agree to act together to maximize joint profits. This means that prices and quantities are set as if the firms are multi plant operations owned by the same entity. The marginal cost of each firm is set to equal the marginal revenue of the industry demand. Side payments between the firms can assure that each is better off after collusion (if not caught by the authorities) than in the absence of collusion. In general, colluding duoplists produce a smaller total output and a higher price for a larger total profit than in the Cournot case.20 The best example of the effects of collusion was the creation of the Organization of Petroleum Exporting Countries (OPEC) in the 1970's. There have also been a number of well-documented illegal cartels or price fixing scandals in the US solid waste market place.

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17 Scherer, F.M. *Industrial Market Structure and Economic Performance.* Boston, MA: Houghton Mifflin, Co., 1979, p. 152.

18 Scherer, F.M. *Industrial Market Structure and Economic Performance.* Boston, MA: Houghton Mifflin, Co., 1979, p. 154

19 ibid, p. 155

20 Henderson, James M. and Richard E. Quandt. *Microeconomic Theory: A Mathematical Approach.* New York, NY: McGraw-Hill Book Company, 1958, p. 180

Stackelberg Solution. Heinrich von Stackelberg was a German economist who came up with the leadership/followership analysis of duopolists. In his model, each firm computes the profits to be earned if he is a leader, assuming that the other firm will operate according to a Cournot type reaction function. Then, each firm computes its profits from followership by substituting its rival's leadership output into its own reaction function and solving for its profit maximizing output. There is a four way profit matrix for this model: (1) Firm A acts as a leader and Firm B acts as a follower; (2) Firm B acts as a leader and Firm A acts as a follower; (3) neither firm acts as a leader; and (4) both firms try to act as a leader. If Firm A chooses to act as a leader and Firm B chooses to act as a follower, or vice versa, there is a deterministic solution in the Stackelberg model. If Firm A and Firm B each choose to act as followers, the Stackelberg solution reduces to the Cournot solution. If Firm A and Firm B each choose to act as leaders, then their expectations will not be met, and price wars can result.

Game Theory. In the twentieth century, von Neumann and Morgenstern analyzed the duopolist's situation as a zero sum game and arrived at a deterministic solution. In a zero sum game, the profit earned by one firm is a loss to the other. Each firm is hypothesized to have a limited set of strategic alternatives, and it is assumed to know the profit payoff if it selects each one. The von Neumann Morgenstern assumptions are further modified to assume that firms want to minimize risk – Firm A will pick the alternative that will yield the best alternative out of the worst outcomes possible (maximin strategy), and Firm B will pick the minimum of the maximum that A can earn (minimax). This theory works if firms have perfect knowledge of each other's cost functions and if they are dealing with something that is truly zero sum, such as market share.21 The theory does not work very well in the real world with imperfect knowledge and when firms may be working with maximizing a variable, such as profits, which is not necessarily zero sum.

Monopolistic Competition

The many models based on a Cournot or Stackelberg type analysis all suffer from the fact that they assume that firms believe their rivals will not react to their price or output decisions. In 1929, Edward Chamberlain of the United States came up with the theory of monopolistic competition that expressly recognized that firms in a market with few sellers are fully aware of their interdependence.[22]

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21 Scherer, F.M. *Industrial Market Structure and Economic Performance.* Boston, MA: Houghton Mifflin, Co., 1979, p. 160

22 Chamberlain, Edward. *The Theory of Monopolistic Competition.* Cambridge, MA: Harvard University Press, 1933, 6th edition. p. 59.

The essence of Chamberlain's analysis is that firms in a mutually dependent market will act *without collusion* to obtain the monopoly solution. Chamberlain states that "for the monopoly price to emerge, it is essential only that the firms recognize their mutual interdependence and their mutual interest in a high price."[23] There is no reason for a duopoly to engage in explicit price agreements and other illicit activities – if the industry is conducive to a monopoly price, then this can arise without collusion.

Oligopolists tend to be aware that they may face buyers with differing elasticities of demand. When the inelastic and the elastic demand functions are summed to obtain the industry demand function, there tends to be a resulting "kink" in the industry demand function. Interestingly, this kink in the average revenue or demand function results in a vertical space in the marginal revenue function. This means that costs can change quite a bit, and the marginal cost function will still intersect the industry marginal revenue function in this vertical space – in other words, even when costs vary, profit maximizing oligopolists will find it sensible to maintain prices and output levels. This factor explains why oligopolists tend not to engage in price cutting. An oligopolist who cuts prices tends not to be followed; one who raises prices is more likely to be followed by his rivals.

Regulated Monopoly

Public policy in the United States has never tried to encourage competition in several areas, especially provision of utility services, such as electric power, gas, water, and sewer, where scale economies are large and sunk costs are high. In these markets, demand is generally inelastic, and a large profit could be earned by a monopolist. Recognizing the advantages of monopoly service provision in the presence of high capital costs and declining average costs, the public sector tends to step in and regulate the prices charged by the service provider. Caves cites three reasons for regulating such natural monopolies: 1) to correct market failure and avoid large monopolistic profits to the provider; 2) to resolve political conflicts and ensure that low prices are charged to specific groups such as residents; and 3) to provide political benefit to select groups – at a relatively low cost to the general public.[24]

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[23] Scherer, F.M. *Industrial Market Structure and Economic Performance.* Boston, MA: Houghton Mifflin, Co., 1979, p. 155

[24] Caves, Richard. *American Industry: Structure, Conduct, Performance,* (7th edition) Englewood Cliffs, NJ: Prentice Hall, p. 109

Rate regulation of utilities and other regulated monopolies often takes some form of establishing a fair rate of return on invested capital. While this sounds good, the formula provides an incentive for the firm to overinvest in order to increase returns. Economists expect that regulated companies will be more capital intensive than unregulated companies, in order to maximize aggregate profits. There is also little incentive for regulated companies to negotiate for the lowest price for their factors of production. If they pay above the minimum for capital goods, their rate base is increased by the overpayment, and so are their profits. There is similarly little incentive to negotiate for the lowest wages or fringe benefit packages or implement other cost saving initiatives, if a cost plus regulatory scheme, or variation thereon, is in effect.

This has been documented as the Averch-Johnson effect in regulated monopolies, who find that electric utilities, who need to maintain a capital plant capable of generating power sufficient to meet peak demand are reluctant to engage in peak load pricing, which would reduce the size of the plant needed, and, consequently, the capital invested and returns earned.[25] Similarly, when airline deregulation was legislated in the 1970's, new entrants arrived with lower fares and lower wages for workers, indicating that regulated firms had paid above market wages. Caves cites that fares had fallen by 1980 to 73% of the 1975 average fare as set by the Civil Aeronautics Board.[26]

As can be seen from this discussion, there is a wealth of economic literature on monopolies, oligopolies, and market concentration. **There is one overriding result: Greater competition results in:**

- Lower prices;
- More choices for the consumer;
- Higher levels of service; and
- Better quality of service.

[25] Averch, Harvey and Leland Johnson, "Behavior of the Firm Under Regulatory Constraints," *American Economic Review*, Vol. LII (December 1962), pp. 1052-1069

[26] Caves, Richard. *American Industry: Structure, Conduct, Performance*, (7th edition) Englewood Cliffs, NJ: Prentice Hall, 114-115.

Part 2. Market Structures and the Causes of Market Concentration and Decreased Competition

This section discusses factors that impact on the degree of competition and the number of competitors in a market. Key factors associated with reduced competition, each of which is discussed below, include barriers to entry or exit, product differentiation, and the essential cost structure of an industry are key determinants of industry structure and the extent of or lack of competition in the industry.

Michael Porter of the Harvard Business School lists the determinants of perfect competition as low entry barriers, absence of economies of scale, high transportation costs, high inventory costs or erratic sales fluctuations, no advantage of size, diseconomies of scale in some important aspect, high product differentiation, exit barriers, diverse market needs, local regulation, and government prohibition of concentration.[27] This list essentially reduces to entry barriers (or lack thereof), product differentiation, and the essential cost structure of the industry. Each is discussed in turn, as a key determinant of market structure. The greater the barriers to entry and the greater the product differentiation, other things equal, the greater the concentration in the industry and the more likely its pricing and output equilibria are to approach the monopolistic levels. Cost structures that have monotonically declining average cost functions create natural monopolies, which tend to elicit regulation. Finally, the impact of buyers on market prices is briefly discussed.

Barriers to Entry

Barriers to entry can be economic, as when an extremely large capital investment is necessary to enter the industry, as is true for aerospace or oil refinery industries. Barriers to entry can also be intellectual, as when a firm patents a product for a period of time, thus assuring the right to market the product as a monopolist for a fixed period, in return for having invested the research time and dollars to create the product in the first place. Drugs and technological advances often fall into this category. Capital requirements as a barrier to entry are particularly effective when

[27] Porter, Michael E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors.* New York, NY: The Free Press, 1998, p. 196-200. Porter refers to industries which approximate the conditions for perfect competition as fragmented industries.

the capital required is invested in items such as advertising campaigns attempting to create a new brand identity, expenditures that can not be recouped if the campaign is not a success.[28]

Additional barriers to entry may be created by the strategic decisions of business entities. Xerox, for example, chose to lease its copier machines rather than to sell them, as this created a higher capital barrier to entry to a competing firm. Switching costs from one competitor to another may affect entry. This has repeatedly been found to be a problem in the solid waste collection industry, where so called "evergreen" contracts make it extremely difficult and expensive for a customer to switch from one hauler to another.[29] Even where the suppliers do not inflict such costs directly, there are costs such as retraining personnel and installations that increase the cost to change from one supplier to another.

Barriers to entry can also be caused by government regulations. For example, an agency of the US Government limits access into cable television by auctioning a finite number of franchises. Entry into the legal profession is limited to those who pass the bar exam. Many local governments set insurance requirements as a prerequisite to doing business with a firm. As Caves succinctly states, absolute cost elements (such as patents and licenses to certain raw materials, e.g., ores) and product differentiation put the costs of a new firm above those of an established one.[30] Entry barriers can theoretically be measured according to how high the price of a good or service can be raised without attracting entry. In the long run, if prices are "too high" and government regulation does not forbid entry (as, for example, is the case in the solid waste industry, *de facto*, in San Francisco[31]) then one would expect entry to occur, driving prices back to a more competitive level.

Product Differentiation

[28] Porter, Michael E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors.* New York, NY: The Free Press, 1998, p. 9

[29] While evergreen contracts have differing provisions from one community to another, they typically allow for automatic renewal unless a notification is given sufficiently (often six or twelve months) in advance, or, without such notification, monetary penalties are assessed.

[30] Caves, Richard. *American Industry: Structure, Conduct, Performance,* (7th edition) Englewood Cliffs, NJ: Prentice Hall, p. 36

[31] The San Francisco City Charter forbids the entry of new firms unless 90% of the customers on any route complain about the *quality* [not the price] of service.

Product differentiation can also create a form of a barrier to entry. When one firm differentiates its product from another through an extensive advertising campaign, for example, product loyalty arises, and more and riskier capital investments from new entrants would be required to wrest market share from the entrenched competitor. Thus, product differentiation, for example, as practiced by Pepsi and Coca-Cola, serves to create a barrier to entry into the soft drink business.

One impact of product differentiation is that, as brand loyalty is created, the individual firm faces a much less elastic demand function. This endowing of the demand curve with inelasticity means that each producer has, to at least some degree, the ability to set its own price.

Natural Monopoly and Determinants of Market Structure

As has been discussed in part 1 of this report, a natural monopoly occurs when economies of scale accrue virtually continuously, and when there are definite cost advantages to having a single supplier of a good or a service. Such industries tend to maintain these characteristics over the long term. Indeed, it is generally true that no industry has high barriers to entry one year, followed by low barriers to entry the next. "The intensity of competition in an industry is rooted in its underlying economic structure and goes well beyond the behavior of current competition."[32]

Porter believes that industries differ fundamentally in their ultimate profit potential. This is attributable, he argues, to the strength of the competitive forces in a particular market. Industries such as tires, paper, and steel have intense competition, and no firms in these industries garner spectacular earnings. In contrast, firms in industries such as oil-field equipment and services, cosmetics, and toiletries commonly earn high returns, due to the lack of intense competition as reflected by high barriers to entry caused by product differentiation, capital requirements, and intellectual property rights.[33]

[32] Porter, Michael E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors.* New York, NY: The Free Press, 1998, p. 3.
[33] ibid.

Bargaining Power of Buyers

When buyers have detailed knowledge of a producer's cost structure, or when buyers represent a large portion of the industry, these buyers are often able to negotiate advantageous prices. General Motors, for example, self-manufactures some parts, and this knowledge of what the process costs gives them an advantage in negotiating with outside suppliers. When municipal governments retain some in-house production capability, as when public sector workers perform some water treatment whereas some water treatment is contracted to the private sector (e.g. in Raleigh, NC), the public sector can use its in house costs of production as a starting point in conducting negotiations with the private sector contractor.

Part 3. Assessment of Market Structure of Solid Waste Service Submarkets

This section provides a brief assessment of the extent to which there are barriers to entry, protected technology or methodology, natural monopoly elements, or bargaining powers among customers in five main solid waste markets: collection, processing, transfer, transport, and disposal. A key conclusion of this section is that lack of concentration in transfer, transport, and disposal markets, coupled with **vertical integration** into collection markets, can result in prices more like those of a monopolist than a perfect competitor. Lack of competition in the transfer, transport, and disposal sectors can result in fewer choices, higher prices, and lower quality of service.

Collection Market

Entry to the collection market in most communities in the United States is easy. All one needs is a business license and a commercial driving license. Capital requirements are quite low – a used truck can cost under $70,000. Commercial collectors must also provide containers. New ones range in price from $200 to $800 per dumpster type container, and from $2,000 to$10,000 per roll off container. Used ones are even less expensive. Thus, with an initial capital requirement of under $200,000, many individuals can and do enter the collection market each year. Entry through purchase of an existing collection firm is also possible, and expansion in this manner is a trademark of the publicly traded solid waste management firms. The only exception to these observations is where government has stepped in to make entry difficult, as, for example in San Francisco, CA, as mentioned previously, or in the State of Washington, where entry can occur only in response to a

municipal contract procurement or where there is no service provided by the existing certificated haulers (certificated by the State of Washington).

While there are some economies of scale, these are exhausted at the five to ten truck scale of operations, and there is no evidence that costs continue to fall beyond this point.[34] Thus, collection is not characterized by natural monopoly elements. Individual buyers generally have little bargaining power.

While entry to collection is easy, it is feasible only where there is equal access to disposal. For example, if a community lets a single contract for collection and disposal services, then only firms with access to a disposal site can effectively compete for the business. Vertically integrated companies can effectively forestall entry if large customers want a single contract for collection and disposal services. Communities can mitigate this exercise of market power by decoupling disposal services from collection services. This, for example, is how Seattle procures its collection services, i.e. separately from its disposal services.

In sum, barriers to entry in the collection market in most communities are low, and in these markets the industry has the hallmarks of a perfectly competitive one – there is no protected technology or methodology, the product is homogeneous, and capital entry requirements are low.[35] However, in some cases, governments can create barriers to entry into collection. As discussed below, regulations of the Washington Utility and Transportation Commission limit entry into the collection market in all the areas where they regulate collection.

Many local governments fear that if they contract for solid waste services, the bidders will "low ball" the contract (bid below costs) to obtain the business and then raise prices sharply when contract renewal occurs. This is never a problem on the collection side of the business, so long as there is a disposal site available to all bidders, and so long as contracts are not automatically renewed, but rather are rebid. If a firm is foolish enough to bid below cost then it is the local government who benefits, and when the contract is over, a new procurement will lead to another contract (presumably, the firms will not be willing to continue to bid below costs indefinitely). On the disposal side, there is more market power, and there is justification for the fear that an initially low price will be sharply increased at

34 Stevens, Barbara J. "Scale, Market Structure, and the Cost of Refuse Collection," *The Review of Economics and Statistics,* Vol LX, # 3 (August 1978), p. 445.

35 ibid, p. 439.

contract renewal time, unless the local government has taken appropriate steps to ensure continued competition in the disposal market.

Processing

Processing of waste includes composting and processing of recyclables. These processes require varying amounts of capital, typically several millions of dollars to construct a materials recovery facility (MRF). MRF operators or composters may have some proprietary techniques, as, for example how fast to blow the air through an air separator, or how high to drop the materials for separation, or how fast to run the conveyor belts. In general, however, these proprietary techniques are relatively unimportant in both composting and in materials recovery. Products are generally undifferentiated - indeed it is the goal of a MRF to produce commodities that are indistinguishable from those produced by other MRF's. Like most other manufacturing establishments, a MRF is likely to have a traditional U-shaped cost function, implying some economies of scale but no natural monopoly characteristics. In sum, while capital requirements for entry into waste processing are higher than for collection, the industry still has no technological barriers to entry, little product differentiation, and relatively small scale economies. The industry is quite competitive.

Transfer

As regulation of solid waste has become increasingly more stringent over the past several decades, many local disposal sites have closed, and municipal solid waste is increasingly frequently transferred via truck or rail to distant disposal sites. Construction of a transfer station to receive refuse collection vehicles and compact the waste into transfer trailer sized loads (typically, twenty to twenty-five tons) would vary according to location and throughput capacity, but would typically not cost more than approximately $20-$30 million. Equipment and technology is not proprietary, and the activity is not characterized by monotonically declining average costs. Typically, transfer stations are constructed by firms with a large and steady customer demand, as, for example a municipal contract or to service the collection vehicles owned by the operator of the transfer station (in other words, the transfer station is constructed as a part of vertical integration of the collection company). The product produced is not differentiated.

In sum, while capital requirements are not enormous, technology is non proprietary, the product is undifferentiated, and scale economies are limited, the advantages of

procuring a large customer base mean that entry into transfer is unlikely except among large collection firms, especially those owning disposal sites**. The transfer industry is likely to have few competitors, and to operate according to the monopolistic competition model.**

Transport

Transport of waste is accomplished via truck over highways, via rail, or via boat. There are many potential trucking firms, capable of accepting trailers loaded with solid waste and driving them to a disposal facility for landfilling or generation of energy. Entry into the trucking industry is not difficult; special licenses and vehicle insurance is required, but these are not difficult to obtain. A single transfer tractor can cost in the range of $120,000 to $150,000, and trailer containers can cost on the order of $65,000. Because of economies of using backup vehicles and administrative personnel, there would be scale economies up to about ten vehicles, whereupon the average cost per crew would tend to flatten out. **The truck transport industry is likely to have many competitors and to operate in a competitive manner.**

When transport is by rail, economies of scale are even more important than when transport is by truck. There are significant capital requirements for entry, in the order of hundreds of millions of dollars. Rails are a fixed investment installed along a right of way. The difficulty of acquiring this right of way and the large capital investment required to establish a railroad present a significant barrier to entry. There have been no new entrants into the rail industry in recent decades. The barriers to entry in the rail industry are very great and perhaps unsurmountable. **The industry in the metro region is a duopoly, and all the pricing power is in the hands of the railroads. The lid on prices is provided by the substitute – truck or boat transport.**

Disposal

Disposal in the United States is largely in landfills that are now required to have environmental safeguards including liners and leachate collection, treatment, and monitoring systems. Depending upon location and scale, establishing a landfill could be expected to require a multi year investment of tens of millions of dollars. The multi year

investment is required due to the generally lengthy permitting process. On the disposal side, entry can be made difficult not only by the expense of purchasing, designing, and permitting a facility, but also by the time and expense and risk of overcoming public opposition to siting disposal facilities. There may be significant public protests against siting a landfill or other disposal facility. Waste to energy facilities incinerate municipal waste to generate electricity; construction of such a facility today, assuming a size of about 1000 tons per day capacity, would require several hundreds of millions of dollars. As for the landfill, permitting and construction would be expected to be a multi year process. Also, the outcome of the effort would not be assured. New York City, for example, spent millions of dollars attempting to get a permit for a waste to energy facility sited at the Brooklyn Navy Yard. Its efforts came up empty, though, as public opposition caused elected officials to abandon the proposed project.

Capital barriers to entry to disposal are quite high, the product is not differentiated, and there are quite significant economies of scale. Landfill entry occurs as part of vertical integration among large solid waste collection firms. The firms are able to guarantee a flow of waste to their landfills. In sum, there are few rivals in the disposal sector of the solid waste industry. Government regulation of prices charged is not present. **The disposal sector appears to operate according to the monopolistic competition model, with firms earning profits close to the monopolist level.**

REFERENCES

Averch, Harvey, and Leland Johnson, "Behavior of the Firm Under Regulatory Constraints," *American Economic Review,* Vol. LII (December 1962), pp. 1052-1069.

Bailey, Elizabeth E, Daniel R. Graham, and Daniel P. Kaplan, *Deregulating the Airlines*. Cambridge, MA: MIT Press, 1985.

Caves, Richard, *American Industry: Structure, Conduct, Performance,* (7th edition) Englewood Cliffs, NJ: Prentice Hall, 1992.

Chamberlain, Edward, *The Theory of Monopolistic Competition,* Cambridge, MA: Harvard University Press, 1933.

Henderson, James M. and Richard E. Quandt, *Microeconomic Theory: A Mathematical Approach,* New York, NY: McGraw-Hill Book Company, 1958.

Porter, Michael E., *Competitive Strategy: Techniques for Analyzing Industries and Competitors,* New York, NY: The Free Press, 1998.

Scherer, F.M., *Industrial Market Structure and Economic Performanc,*. Boston, MA: Houghton Mifflin, Co., 1979.

Stevens, Barbara J., "Scale, Market Structure, and the Cost of Refuse Collection," *The Review of Economics and Statistics,* Vol LX, # 3 (August 1978), pp. 438-448.

Stiglitz, George J., "The Theory of Economic Regulation," *Bell Journal of Economics,* Vol II (Spring, 1971), pp. 3-21.

APPENDIX C

Solid Waste Markets in Portland Metro Area

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Solid Waste Markets in Portland Metro Area

Prepared by: Barbara J. Stevens, PhD, Ecodata, Inc.

Part 1. Introduction

The Metro region consists of most of three Oregon Counties: Clackamas, Multnomah, and Washington. Metro is responsible for solid waste planning for the Metro area's residents and businesses. These responsibilities include providing for reliable solid waste disposal and provision of state mandated programs such as household hazardous waste collection and disposal services. Metro has limited authority and policy making responsibilities over solid waste or recyclable commodities collection.

The purpose of this paper is to discuss the market structures and dynamics prevailing in the Metro region for the various segments of the solid waste industry – collection of solid waste and recyclable commodities; processing of commodities; transfer of solid waste and/or commodities; transport of solid waste; and final disposal. Each of these segments has differing economic characteristics, leading one to predict more or less competition and higher or lower profits. These characteristics are highlighted briefly below, in Part 2. The appendix to this paper contains a more elaborate, though still non technical, review of economic theory, market structure, and competition. Part 3 presents data specific to the Metro region, characterizing each segment.

Part 2. Assessment of Market Structure of Solid Waste Service Submarkets

Markets involve suppliers and customers. At one extreme is the provision of goods or services by a single firm, called a monopolist. The monopolist has great control over the quantity of goods or services it sells, and, consequently, is able to earn very

high profits, often on the order of 100% or more. At the other extreme is perfect competition, where there are many producers of an undifferentiated product. The classic example here is wheat, or another agricultural product. The producers have no control over pricing; they must accept the prevailing market price, which is set through supply and demand to yield a much lower profit than the monopolist can demand.

Monopoly is a more likely outcome, with monopolistic prices and profits, when there are:

- Large capital requirements for entry;
- Proprietary technologies or patented items required to produce a good or service;
- Regulatory obstacles to entry of new firms;
- Significant economies of scale – unit prices decrease significantly with increases in the quantity produced); and
- Customers lack significant bargaining powers.[36]

The less these elements are present in a particular market, the more likely that market is to be a competitive one, with lower profits and competitive prices. Competition is generally good for the customer, because they are able to purchase more of a good or service at a lower price than under monopoly.

Of course, some industries, such as traditional utilities like electricity, have strong natural monopoly elements. It does not make sense to have competitng sets of utility poles standing along every road, or to spend the capital to construct competing power plants. In these cases, local governments tend to award monopoly territories to public or private entities, to regulate rates to allow a "reasonable" rate of return on capital, and to allow reasonable operating expenditures for service provision. The prices paid by the consumer here are thought to be lower than those which would prevail if there were no local monopoly producer.

[36] When large customers, such as a large local government, procure solid waste services pursuant to a request for proposals or bids, significant competition among potential contractors often results in highly competitive prices.
Small customers, subscribing for solid waste services, are usually just price takers, and they may not receive competitive prices.

This section provides a brief assessment of the extent to which there are barriers to entry, protected technology or methodology, regulatory barriers to entry, natural monopoly elements, significant economies of scale, or bargaining powers among customers in five main solid waste markets: collection, processing, transfer, transport, and disposal. A key conclusion of this section is that lack of competition in transfer, transport, and disposal markets, coupled with **vertical integration** into collection markets, can result in prices more like those of a monopolist than a perfect competitor. Lack of competition in the transfer, transport, and disposal sectors can result in fewer choices, higher prices, and lower quality of service.

Collection Market

Entry to the collection market in most communities in the United States is easy. All one needs is a business license and a commercial driving license. Capital requirements are quite low – a used truck can cost under $70,000. Commercial collectors must also provide containers. New ones range in price from $200 to $800 per dumpster type container, and from $2,000 to$10,000 per roll off container. Used ones are even less expensive. Thus, with an initial capital requirement of under $200,000, many individuals can and do enter the collection market each year. Entry through purchase of an existing collection firm is also possible, and expansion in this manner is a trademark of the publicly traded solid waste management firms.

The only exception to these observations is where government has stepped in to make entry difficult, as, for example in San Francisco, CA, where new entry is allowed only if a majority of customers complain about the quality of service, or in the State of Washington, where entry can occur only in response to a municipal contract procurement or where there is no service provided by the existing certificated haulers (certificated by the State of Washington), or, in the Portland Metro area, where all service except for commercial collection in the City of Portland, is provided by firms with exclusive franchises. Entry into these communities requires the purchase of an existing firm, with prices for such purchase often on the order of twelve to fifteen months' revenues.[37]

[37] If collectors earn 10% profit on revenues, then a purchase price of twelve months' revenues is equivalent to a price/earnings (PE) ratio of 10, and a purchase price of fifteen months' revenues is equivalent to a PC ratio of 16.7. Of course, these profits apply to collectors; there may be more profits available to the purchasing firm if it also owns a transfer station, processing facility, or disposal facility. Such a firm would be able to pay more, thereby outbidding competitors.

While there are some economies of scale, these are exhausted at the five to ten truck scale of operations, and there is no evidence that costs continue to fall beyond this point.[38] Thus, collection is not characterized by natural monopoly elements. Individual buyers generally have little bargaining power.

While entry to collection is easy, it is feasible only where there is equal access to disposal. For example, if a community lets a single contract for collection and disposal services, then only firms with access to a disposal site can effectively compete for the business. Vertically integrated companies can effectively forestall entry if large customers want a single contract for collection and disposal services. **Communities can mitigate this exercise of market power by decoupling disposal services from collection services. This, for example, is one function that Metro provides to collection firms that do not own a transfer station or disposal facility; Metro's transfer stations and their implied access to disposal at prices negotiated by Metro, with its significant bargaining power are available to any franchised collector.**

In sum, barriers to entry in the collection market in most communities are low, and in these markets the industry has the hallmarks of a perfectly competitive one – there is no protected technology or methodology, the product is homogeneous, and capital entry requirements are low.[39] However, in some cases, governments can create barriers to entry into collection. As discussed above, the exclusive franchising system which prevails throughout the Metro areas in both the residential and the commercial markets, makes entry possible only by purchasing an existing firm (with the exception of the commercial market in the City of Portland).

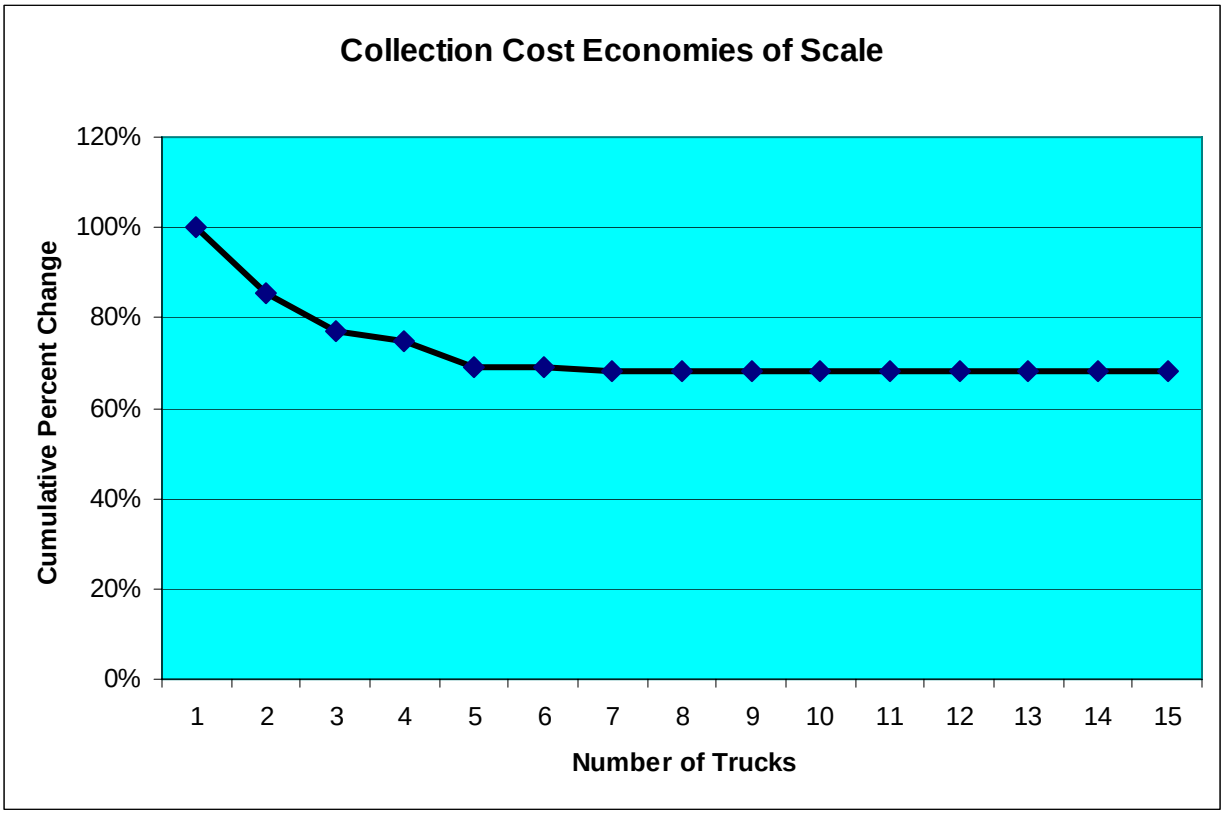
Many local governments fear that if they contract for solid waste services, the bidders will "low ball" the contract (bid below costs) to obtain the business and then raise prices sharply when contract renewal occurs. This is never a problem on the collection side of the business, so long as there is a disposal site available to all bidders, and so long as contracts are not automatically renewed, but rather are rebid. If a firm is foolish enough to bid below cost then it is the local government who benefits, and when the contract is over, a new procurement will lead to another contract (presumably, the firms will not be willing to continue to bid below costs indefinitely). On the disposal side, there is more market power,

38 Stevens, Barbara J. "Scale, Market Structure, and the Cost of Refuse Collection," *The Review of Economics and Statistics,* Vol LX, # 3 (August 1978), p. 445.

and there is justification for the fear that an initially low price will be sharply increased at contract renewal time, unless the local government has taken appropriate steps to ensure continued competition in the disposal market.

Figure 1, below, shows the economies of scale available in the collection market. Typically, most significant economies of scale have been achieved with the deployment of ten vehicles (on a daily basis). Costs to a collector with ten vehicles can be on the order of 30% less than those of a collector with just a single vehicle.

Figure 1: Average Collection Cost and Number of Trucks



Source: Ecodata spreadsheet models, based on data collected in several hundred communities. Also, econometric models of refuse collection, see footnote 3, above.

39 ibid, p. 439.

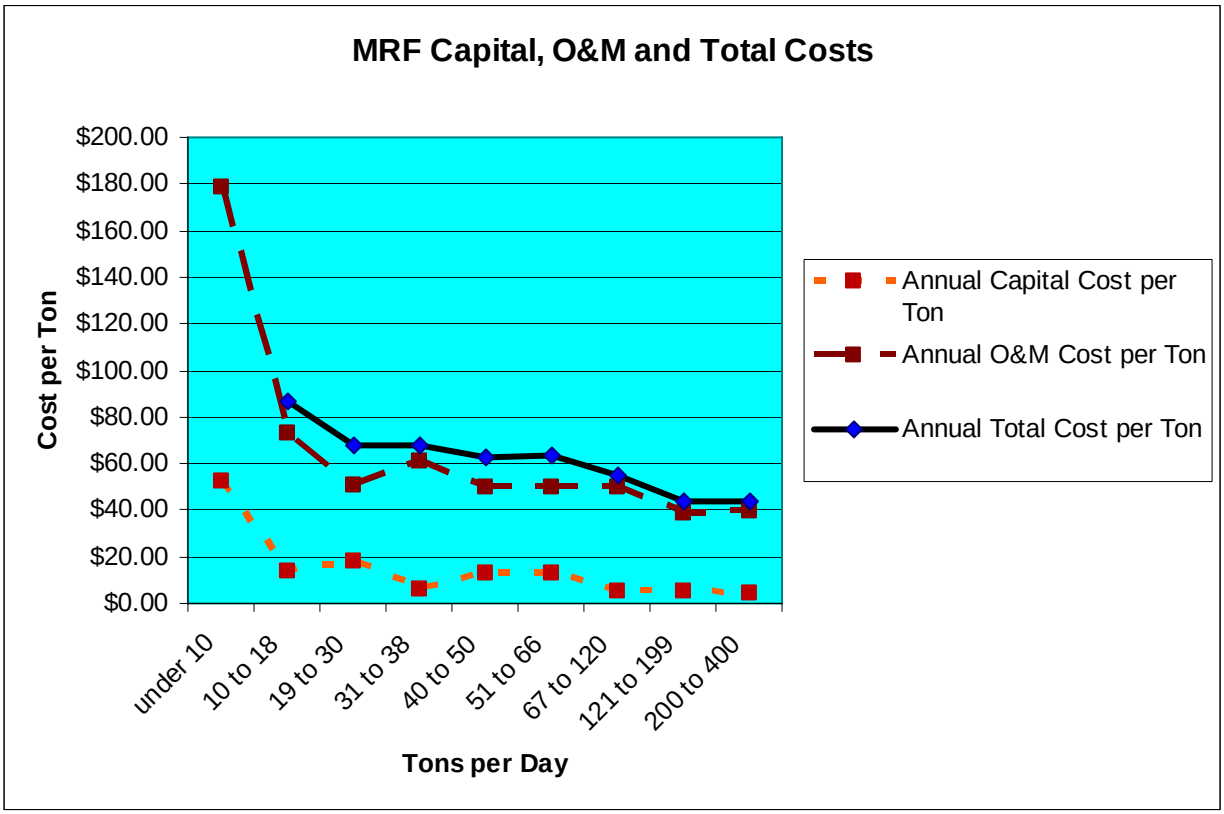
Processing

Processing of waste includes composting and processing of recyclables. These processes require varying amounts of capital, typically several millions of dollars to construct a materials recovery facility (MRF). MRF operators or composters may have some proprietary techniques, as, for example how fast to blow the air through an air separator, or how high to drop the materials for separation, or how fast to run the conveyor belts. In general, however, these proprietary techniques are relatively unimportant in both composting and in materials recovery. Products are generally undifferentiated - indeed it is the goal of a MRF to produce commodities that are indistinguishable from those produced by other MRF's. Like most other manufacturing establishments, a MRF is likely to have a traditional U-shaped cost function, implying some economies of scale but no natural monopoly characteristics. In sum, while capital requirements for entry into waste processing are higher than for collection, the industry still has no technological barriers to entry, little product differentiation, and relatively small scale economies. The industry is quite competitive.

Regulatory barriers to entry vary from jurisdiction to jurisdiction. Siting is usually confined to industrial zoned areas. Merchant MRF's (those seeking recyclables from the general market, rather than from large municipal clients) can be more or less viable in a community, dependingon the prevailing arrangements for collection. If recycling collection is contracted, then these materials are typically not available to a merchant MRF.

In the Metro area, dry waste delivered to transfer stations or to MRF's is subject to sorting requirements. Operators must recover 25% by weight of dry waste. Source separated recyclables, such as residential recyclables or commercial office paper or corrugated cardboard, are sorted and prepared for market at clean MRF's. Metro does not regulate processing facilities' fees. It does regulate entry and activities once in the system including the 25% requirement for dry waste at both private transfer stations and dry MRFs.

Figure 2: Average Costs and Quantity of Recyclables Processed



Source: GAA, Survey data for *Material Recovery and Recycling Yearbook, 2006.*

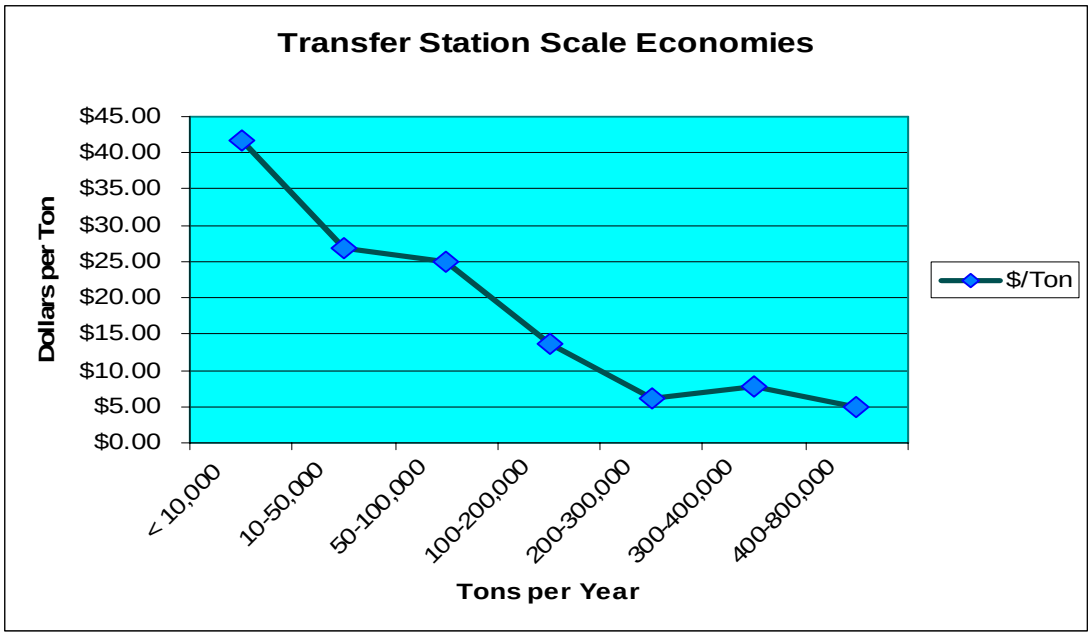
Figure 2 shows the economies of scale in the processing segment of the solid waste market. Economies of scale, with the average cost to process a ton as much as 49% less for a plant processing a hundred tons per day as compared to a plant processing under twenty tons per day, are fully captured at the 100 to 200 tons per day level. These costs are not net of revenues from sale of commodities.

Transfer

As regulation of solid waste has become increasingly more stringent over the past several decades, many local disposal sites have closed, and municipal solid waste is increasingly frequently transferred via truck or rail to distant disposal sites. Construction of a transfer station to receive refuse collection vehicles and compact the waste into transfer trailer sized loads (typically, twenty to thirty tons) would vary according to location and throughput capacity, but would typically not cost more than approximately $20-$30 million. Equipment and technology is not proprietary, and the activity is not characterized by continuously

declining average costs. Typically, transfer stations are constructed by firms with a large and steady customer demand, as, for example a municipal contract or to service the collection vehicles owned by the operator of the transfer station (in other words, the transfer station is constructed as a part of vertical integration of the collection company). The product produced is not differentiated.

Figure 3: Transfer Station Operating Costs and Tons Transferred



Note: Transfer station scale economies are depicted, holding other factors, such as the percentage of loads that are self hauled, constant. These other factors are significantly related to the costs of transfer.

Figure 3 shows the scale economies associated with transfer station operation. Costs per ton are as high as $45 for small transfer stations, those handling less than 10,000 tons per year. The cost per ton transferred decreases fairly regularly with increases in scale. The largest transfer stations, those which process 200,000 tons per year (the largest transfer station in the sample processed just under 800,000 tons per year) experienced costs in the $5 to $8 per ton range.

Transfer station costs are significantly affected by other characteristics than scale of operations. Key determinants of operating costs, in addition to scale of operations, include:

- Size of the average load, with smaller self haul loads associated with higher costs;
- Hours of operation; and

- Extent of sorting at the transfer station, for enhanced recovery and diversion from landfill.

Increases in size of the average load is associated with decreases in operating costs, while the latter two are associated with increases in the costs of operating transfer stations.

Figure 4: Transfer Station Operating Costs and Load Size

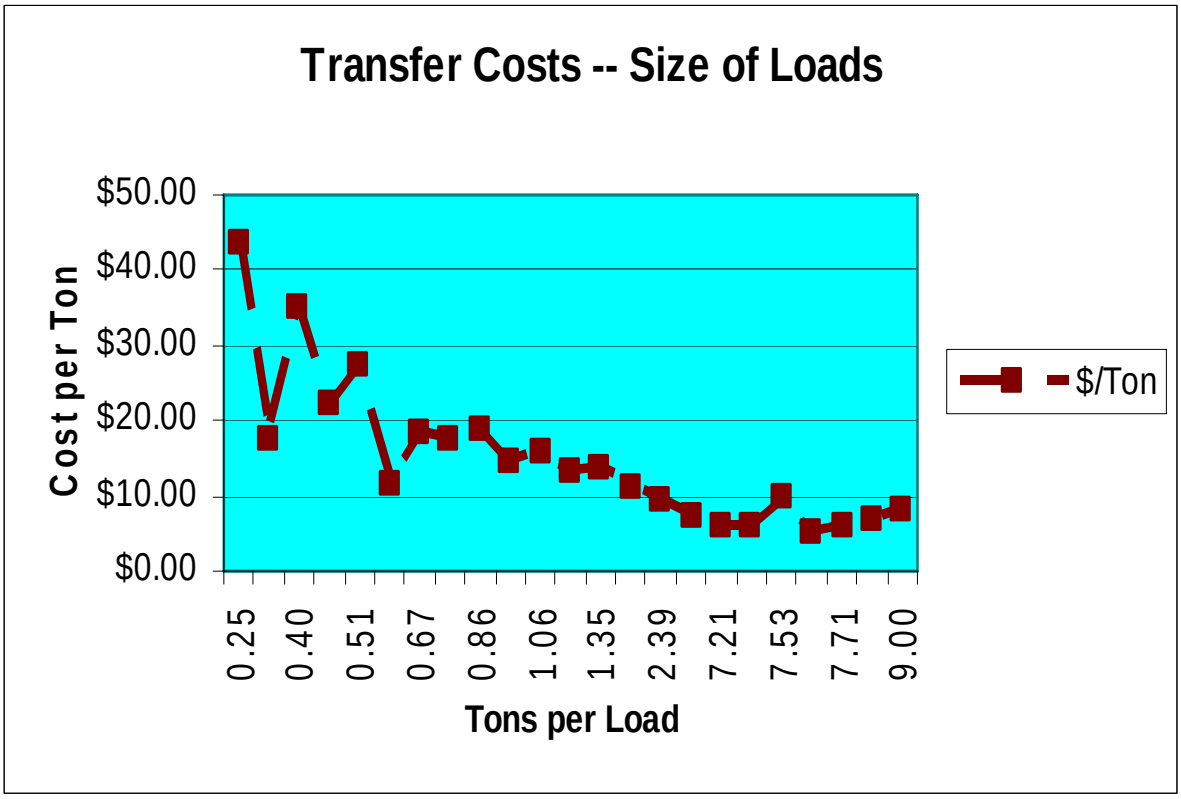


Figure 4 indicates how transfer station operating costs decrease with increases in the size of the load. Transfer costs per ton can be $40 or more when loads average less than half a ton. When loads arrive in packer truck quantities, of seven tons or more, the cost per ton drops to well below $10.

Using data from twenty-four transfer stations, a regression equation was estimated, relating the cost of transfer station operation to the tons processed at the facility, the size of the average load delivered to the facility, and the hours of operation. No data were available as to the extent of sorting activity at the transfer stations, so this variable was not included in the estimating equation.

Among the independent variables, there is a high degree of correlation between hours of operation and tonnage throughput (30% correlation), tons per vehicle arriving at the transfer station and percentage of waste delivered by self haulers (55% correlation),

and tonnage throughput and hours of operation (44% correlation). When independent variables are correlated with one another, the coefficient of each variable is typically estimated with less statistical precision than when the independent variables are not correlated with one another.

Thus, in estimating the equation, the correlated variables are dropped, and operating costs are related to tonnage throughput and the average tons per vehicle. The equation is displayed below:

(1) ln (OC) = 5.88 + 0.764 ln (TONS) + -0.5177 ln (tons/vehicle) + 0.55
(6.72)** (9.47)** (-3.20)**

$R^2 = 0.81$

F(2,21) = 45.81

Where:

Ln (OC) = the natural logarithm of the total operating costs

Ln(TONS) = the natural logarithm of the annual tonnage throughput

Ln (tons/vehicle) = the percentage of the waste arriving in self haul vehicles

( )** = t-statistics showing the statistical significance with which each coefficient is estimated. ** indicates significance at the 99% level of confidence.

R^2 = overall measure of goodness of fit. The equation explains 81% of the variance in the operating costs of these transfer stations

F(2,21) = an F statistic with 2 and 21 degrees of freedom, indicating with a 99% level of confidence that this equation is statistically significant.

This equation shows that operating costs are positively associated with increases in tonnage throughput, but that the relationship is not that of a straight line. As tonnage increases by 100%, operating costs increase by 76.4%; this indicates the presence of economies of scale in transfer station operation. Operating costs decrease as the size of an average load increases, implying more waste is delivered

in packer trucks rather than by self haulers. Holding scale of the transfer station constant, if the size of a load increases from two tons to six tons, then the operating costs decrease by approximately 43%.[40]

The costs of sorting waste to recover materials instead of sending them to the landfill is not included in this data file of 24 communities. However, based on the costs of operating a MRF, one can expect that the per ton costs of diverting tons from dry MRF would be on the order of $20-$60 per ton diverted.

In sum, while capital requirements are not enormous, technology is non-proprietary, the product is undifferentiated, and scale economies are large, but largely achieved at a scale of 550 or more tons per day, the advantages of procuring a large customer base to achieve economies of scale mean that entry into transfer is unlikely except among large collection firms, especially those owning disposal sites**. The transfer industry is likely to have few competitors, and to operate according to the monopolistic competition model. Prices can be expected to exceed the competitive level unless competition is injected into the system. Metro has inserted a bit of competition into the market by owning transfer stations, with competitive procurements for their operation. The prices procured by Metro serve as an effective lid to market prices for transfer.** Further, overcapacity in the transfer market can result in increased prices for transfer.

Transport

Transport of waste is accomplished via truck over highways, via rail, or via boat. There are many potential trucking firms, capable of accepting trailers loaded with solid waste and driving them to a disposal facility for landfilling or generation of energy. Entry into the trucking industry is not difficult; special licenses and vehicle insurance is required, but these are not difficult to obtain. A single transfer tractor can cost in the range of $120,000 to $150,000, and trailer containers can cost on the order of $65,000. Because of economies of using backup vehicles and administrative personnel, there would be scale economies up to about ten vehicles, whereupon the average cost per crew would tend to flatten out.

40 Computed as $(3)^{-0.5177} - 1$.

The cost per ton mile tends to decrease as the scale of operation increases. The smallest transport operations cost on the order of about $0.30 per ton mile, with decreases to about $0.15 per ton mile at an annual scale of 500,000 tons. These figures are of course highly sensitive to prevailing prices for fuel.

In addition to annual tons transported, per-ton-mile costs are also a function of average payloads (25-30 tons in WA and OR vs. less elsewhere because of GVW allowances of over 100,000 lbs.), availability of back-haul (as is available to Vancouver BC) ,and distance. Increases in average payload decrease the per-ton-mile costs, other things equal. Availability of backhaul decreases per-ton-mile costs. Distance affects the per-ton-mile cost in that the turnaround/waiting time to unload the transport trailer becomes an ever smaller percentage of total transport time as transport distance (and time on the road) increases. Also, as transport distance increases, there is an ever greater likelihood that driving is on superhighways at highest speeds, thus reducing the impact of distance on per-ton-mile costs.

The truck transport industry is essentially open to any trucking firm. Although the market may appear concentrated where the services have been procured on behalf of a large customer via competitive bid, there remain many potential competitors able to bid on future contracts. The truck transport industry is likely to have many competitors and to operate in a competitive manner.

When transport is by rail, economies of scale are even more important than when transport is by truck. There are significant capital requirements for entry, in the order of hundreds of millions of dollars. Rails are a fixed investment installed along a right of way. The difficulty of acquiring this right of way and the large capital investment required to establish a railroad present a significant barrier to entry. There have been no new entrants into the rail industry in recent decades. The barriers to entry in the rail industry are very great and perhaps unsurmountable. **The lid on prices is provided by the substitute – truck or boat transport.**

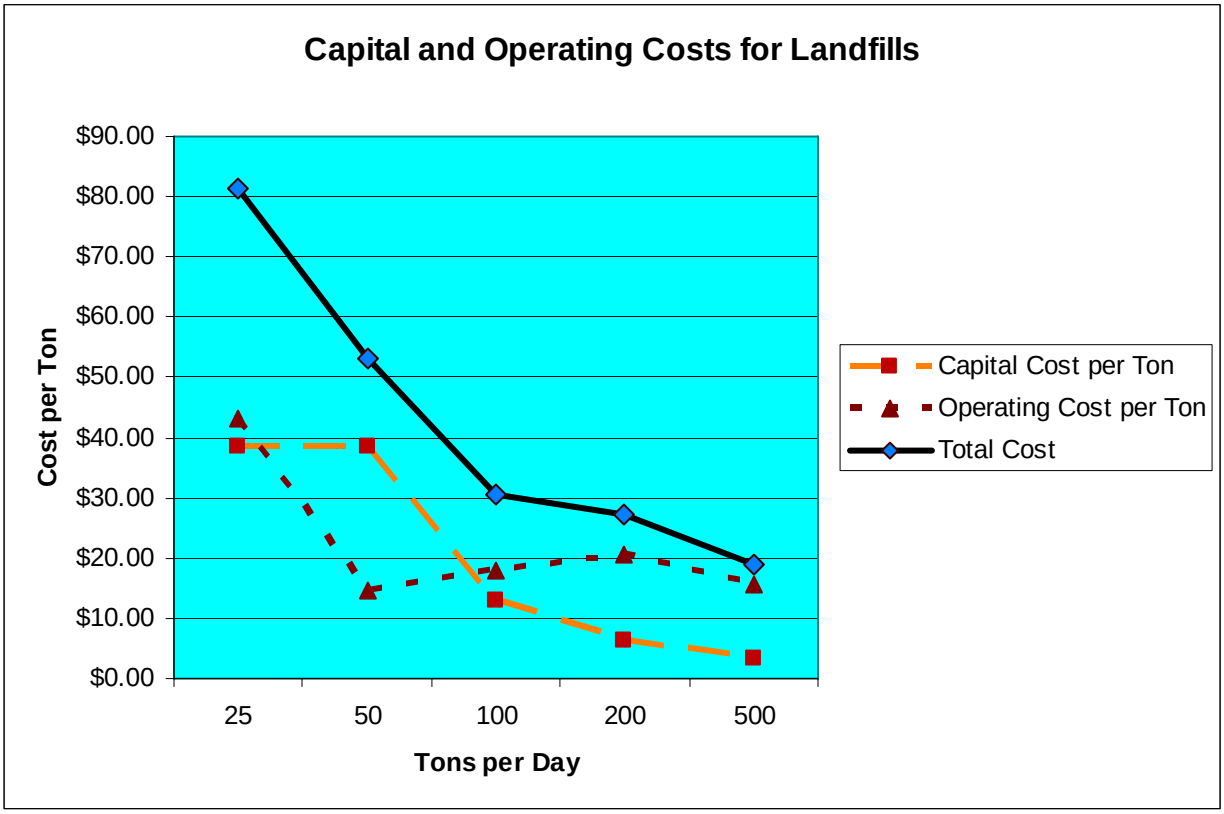
Disposal

Disposal in the United States is largely in landfills that are now required to have environmental safeguards including liners and leachate collection, treatment, and monitoring systems. Depending upon location and scale, establishing a landfill could be expected to require a multi year investment of tens of millions of dollars. The multi year investment is required due to the generally lengthy permitting process. On the disposal side, entry can be made difficult not only by the expense of purchasing, designing, and permitting a facility, but also by the time and expense and risk of overcoming public opposition to siting disposal facilities. There may be significant public protests against siting a landfill or other disposal facility.[41] Waste to energy facilities incinerate municipal waste to generate electricity; construction of such a facility today, assuming a size of about 1000 tons per day capacity, would require several hundreds of millions of dollars. As for the landfill, permitting and construction would be expected to be a multi year process. Also, the outcome of the effort would not be assured. New York City, for example, spent millions of dollars attempting to get a permit for a waste to energy facility sited at the Brooklyn Navy Yard. Its efforts came up empty, though, as public opposition caused elected officials to abandon the proposed project.

Figure 5 presents the economies of scale available to operators of landfills. These costs include the costs of site development (permitting and construction) as well as allowances for closure and post closure monitoring. There are evident significant economies of scale, with the cost per ton decreasing from $80 per ton at just 25 tons per day to below $20 per ton at 500 tons per day. For the very large landfills available to receive the solid waste from the Metro region, scale is significantly greater than is shown on this graph. An average of the estimated cost per ton for four landfills each receiving over 4,000 tons per day is significantly below $10 per ton.

[41] Waste to energy facilities incinerate municipal waste to generate electricity; construction of such a facility today, assuming a size of about 1000 tons per day capacity, would require several hundreds of millions of dollars. As for the landfill, permitting and construction would be expected to be a multi year process. Also, the outcome of the effort would not be assured. New York City, for example, spent millions of dollars attempting to get a permit for a waste to energy facility sited at the Brooklyn Navy Yard. Its efforts came up empty, though, as public opposition caused elected officials to abandon the proposed project.

Figure 5: Landfill Costs and Scale of Operations



Source: Ecodata cost data from eight large landfills, including Palm Beach County, FL, Tacoma, WA; Hillsborough County, FL; Sunshine Canyon, CA; Bradley West, CA; Altamont, CA; Cedar Grove, WA, and Columbia Ridge, OR, plus data from smaller landfills (inflated to 2005 price levels), from Gerald Doeksen, Joseph F. Schmidt, Kyle Goodwin, Gordon Sloggett, and Dave Cummins, *A Guidebook for Rural Solid Waste Management Services,* (Study for the Southern Rural Development Center, June 1993).

Capital barriers to entry to disposal are quite high, the product is not differentiated, and there are extremely significant economies of scale. Landfill entry typically occurs as part of vertical integration among large solid waste collection firms. The firms are able to guarantee a flow of waste to their landfills. In sum, there are few rivals in the disposal sector of the solid waste industry. Government regulation of prices charged is typically not exerted. In the Metro area, non putrescible landfills are rate regulated by Washington County. **The disposal sector appears to operate according to the monopolistic competition model, and firms operating large regional landfills earn profits close to the monopolist level.**

Part 3. Metro Region Market Segments

This section provides an assessment of the market structures prevailing in the Metro region for each of the segments in the solid waste industry. The five segments are collection, processing, transfer, transport, and disposal. For each, the conditions in the Metro region are contrasted with those in the rest of the United States.

Collection

Metro is charged with assuring environmentally acceptable reliable disposal for solid waste and also for household hazardous wastes. The region is quite unique among most in the United States in its reliance on the private sector for solid waste collection and in its manner of rate regulation. All communities in the three county Metro region (with the exception of the commercial sector in the City of Portland) oversee exclusive franchises for both residential and commercial solid waste and recyclables collection.[42] The rates charged for residential and commercial solid waste and recyclables collection are regulated by local governments, often with the input of accounting firms. The process involves an examination of the costs of several franchised collectors, and, after adjusting the costs for allowable items, pricing the services at cost plus an approved rate of return. This system is prevalent in the Northwestern part of the United States, notably in Washington (where the Washington Utilities and Transportation Commission (WUTC) employs a modified cost plus rate regulation in areas where incorporated cities have chosen not to contract for waste and recycling collection services), Oregon, and the northern part of California. San Francisco, CA notably employs such a rate regulation system. This rate regulation system is that which is typically seen across the United States for traditional utilities, such as water, gas, and electricity, which have a fixed capital structure and the essential characteristics of a natural monopoly.

[42] Even the commercial recycling, which is often open to competition (as, for example, is the case in the State of Washington) is exclusively franchised, with the opening for competition only for self hauling or hauling by a non franchised firm which will collect the materials at no charge (or a positive fee paid to) the customer.

Residential Solid Waste and Recyclables Collection

How do most other communities in the United States regulate collection of solid waste and recyclables? Typically, regulation of residential waste differs from that of commercial waste. Residential waste[43] is defined differently by different communities, but most generally, the community takes some control over determining the prices that residents pay for services:

- Many communities collect residential waste and recyclables with municipal employees, with or without a fee for service (the cost of service may be included in property taxes);
- Many other communities contract with a private firm for collection of residential solid waste and recyclables (in a contract, if there is a fee to the resident, it is billed by the community, and the private firm need submit only one invoice to the local government);
- A much smaller number of communities engage in the type of exclusive franchise arrangement which is prevalent in the Metro region – where rates are regulated in the traditional utility manner, and households are billed by their solid waste collector. A franchise fee may be payable to the community by the collector.
- The least prevalent system for solid waste collection from residents is the so-called subscription service, whereby residents are free to subscribe for solid waste services with any licensed collector, paying the collector a fee negotiated and agreed upon between the household and the collector This system is typical in rural areas in western Pennsylvania and upstate New York.
- In the latter two types of arrangements, service is usually not mandatory, and households are free to choose to self haul their recyclables and solid waste to a local transfer station or disposal facility.

Previous research has shown that, on average, contract collection of residential solid waste and recyclables is about 25% less expensive than municipal collection of these

43 The definition of what is residential varies from community to community. Some communities cut off residential at single families, others at multi family complexes ranging from duplexes to six-plexes. Seattle has traditionally included all multi family complexes in its residential contracts; New York City also includes all residences in its definition of residential customers, even those in high rises such as Trump Tower.

same materials. Franchise collection tends to be somewhat more expensive than contract collection, and subscription collection tends to have about the same cost as municipal collection. Of course, no community is necessarily average, so each community or group of communities much be evaluated individually.

Residential rates for Gresham, Washington County, West Linn, Tigard, Portland, Beaverton, and Lake Oswego were obtained, and the average monthly fee for once a week collection of a 32-35 gallon container (plus yard collection and recycling) and once a week collection of a 60-66 gallon container of solid waste (plus yard waste collection and recycling collection) were computed. The former average is just under $20 per month, and the latter is just under $30 per month. ($19.78 and $29.64, respectively). The range in rates is very small – from $18 to $20.55 for the one can service and from $26.50 to $32.55 for the two can service. An average rate per household was computed, assuming 75% of households choose the one can rate and 25% choose the more expensive rates, assumed to be represented by the two can rate. From this blended rate of $266.94 per year disposal, yard waste processing, and recyclables processing were subtracted, yielding a collection only annual fee of $225.08.[44] The monthly fee is $18.76.

Table 1, below, shows the annual market for residential solid waste collection and disposal in the Portland Metro region. The aggregate market is approximately $114 million, of which 30.7% is attributable to solid waste collection, 49.8% is attributable to curbside recyclables and yard waste collection, and 19.5% is attributable to transfer, transport, disposal and regional fees and taxes.

Communities in the Metro region typically price residential services based on container size, a practice which tends to encourage recycling. Local communities typically achieve a recycling diversion rate of 50% or more, which is at the highest end achieved by any group of local governments anywhere in the United States. The Metro region is nationally recognized as a leader in implementing successful recycling programs.

[44] Disposal was computed as $51.52 per household per year ($76.77 per ton * 0.67 tons); yard debris at $3.59 per household per year ($21 * 0.17 tons); and recycling processing at -$13.26 per household per year (haulers are being paid $38 per ton *0 .35 tons). The tons per household data are from the City of Portland.

Table 1: Residential Solid Waste Market Size

Item	$/HH/Year	Market (5)	Percent
Garbage, Recyclables & Yard Waste (1)	$267	$114,340,881	100.0%
Garbage collection	$82	$35,115,926	30.7%
Recyclables collection & processing (2)	$48	$20,555,664	18.0%
Yard waste collection & processing (2)	$85	$36,400,655	31.8%
Garbage transfer, transport & disposal (3)	$52	$22,268,636	19.5%
Garbage transfer (4)	$9	$3,685,070	3.2%
Garbage transport (4)	$13	$5,435,865	4.8%
Garbage disposal (4)	$13	$5,435,865	4.8%
RSF & Excise taxes (4)	$18	$7,900,511	6.9%
Component total	$52	$22,457,311	19.6%

Notes: (1) Rates are average of posted rates for Gresham, Tigard, Washington County, Portland, Beaverton, Lake Oswego, and West Linn, 75% of the average 32 gallon can rate ($19.78 per household per month), and 25% of the average 60 gallon can rate ($29.64 per household per month), for a weighted average of $22.25.
(2) Recyclables processing generates revenues of $13.26 per household per year, using City of Portland generation per household data (0.67 tons of solid waste; 0.35 tons of hauler collected recyclables; and 0.17 tons of hauler collected yard debris). Yard waste processing (net of sales of compost) costs $3.59 per household per year.
(3) Computed using the tip fee of $76.77 per ton, with quantities per City of Portland, 0.67 tons per household per year.
(4) Garbage transfer, transport, and disposal using rates for Metro stations.
(5) 428,243 single family households in three County area. US Census Bureau: http://quickfacts.census.gov/qqfd/States/41/41005.html; Other data from City of Portland web site.

Commercial Solid Waste Collection

How are most commercial waste collection services regulated? Most communities have traditionally ignored the commercial solid waste industry, allowing licensed firms to solicit business directly from commercial (and, usually, multi family) establishments, an arrangement often called the subscription system. However, as this arrangement leaves the local government with no information regarding prevailing prices, recycling activities, or waste generation rates, many communities

are beginning to regulate this market. Communities with waste to energy facilities are also interested in regulating the commercial sector, to achieve desired waste flow controls. This is true throughout Florida, for example, where counties typically bid out commercial solid waste collection. The franchised haulers are selected via competitive bid, and they are awarded exclusive or semi-exclusive territories.[45] Other communities interested in encouraging recycling have also contracted for commercial waste collection, seeing the prices charged reduced as a result of reducing the number of firms serving an area and from enhanced competitive pressures. Communities such as Babylon, NY and Seattle, WA have recently contracted for solid waste collection services, at a significant price reduction.

In the Metro area, commercial solid waste rates are set by local government, using a traditional utility-type rate regulation system for exclusive franchises (the exception is the City of Portland, which uses the subscription system). Rates from Gresham, Tigard, Washington County, Beaverton, Clackamas, and Hillsboro were reviewed, and for dumpster service (one to eight yard containers) the price per cubic yard per pickup was computed.[46] The disposal component was removed from the fees (using 135 pounds per cubic yard)[47] to yield a pickup fee per cubic yard ranging from a bit over $13 for once a week pickup of a one cubic yard container to a bit over $7 per cubic yard for twice a week collection of a six cubic yard container. So, apparently for dumpster service, the prevailing price per pickup of a cubic yard is $7-$13.

This rate is at the high end of that prevailing in ten other communities; their price per cubic yard per pickup for dumpster service ranges from $3.15 to $13.67, with four under $4, four in the $5 to $10 range, and two at $10-$13.67.[48] In the City of Portland, the average price paid for dumpster-only customers is $5.55 per cubic

[45] In a semi-exclusive territory, some or all of the successful bidders for the franchise are allowed to operate in the same territory, Typically, this would mean that two to four haulers would be allowed to service the same area.

[46] The price per cubic yard per pickup is the annual fee for service (monthly charge * 12) divided by the product of the container size in cubic yards, the number of pickups per week and 52 weeks.

[47] This is the density specified by Tigard in their rate setting posting on their web site; it is also the density obtained from time and motion observations of multiple commercial routes in the City of Portland.

[48] The communities are Babylon, NY; Hillsborough County, FL, Plano, TX, Redondo Beach, CA, Seattle, WA, Palm Beach County, FL, San Jose, CA (two rates, one for multi family and another for commercial), Lee County, FL, and Portland, OR. All rates are net of disposal.

yard. [49] Though representing less than 10 percent of the customers in the generator survey, Portland can/cart customers constitute perhaps one quarter of all Portland service. Including the can/cart customers along with dumpster service customers brings the average Portland commercial rate paid from $5.55 to $7.24 per cubic yard.

Tables 2a and 2b present the estimated size of the commercial solid waste collection and disposal market for the Portland Metro region. Table 2a derives the estimated commercial tonnage by subtracting residential tons from total tons and estimating roll off tons as slightly less than half the non self hauled commercial tons. Table 2b applies average collection fees for roll off and dumpster service, allocating aggregate fees between collection and disposal based on a density of 135 pounds per cubic yard for dumpster service and 333 pounds per cubic yard for roll off or drop box service. The annual market is estimated at $132 million, of which 63% goes to collection and 37% goes to transfer, transport, disposal, and regional fees and taxes.

Table 2a: Commercial Solid Waste Market

Tons of Solid Waste, FY 2004-5	**Tons**
Total tons	1,303,274
Less: Residential Tons	287,405
Commercial Tons	
Hauler delivered tons	674,035
Self hauled tons	341,834
Charge customers	249,616
Cash customers	92,218
Total Commercial Tons	1,015,869
Roll off (1)	300,000
Dumpster	715,869

Notes: (1) Estimated at a bit less than half the hauler collected tons.

[49] These Portland rates are derived from a 2004 Commercial Cost of Service Study conducted by Merina & Co and analyzed by Neal Johnson of Sound Resource Economics.

Table 2b: Commercial Solid Waste Market				
Item	**Collection Type**			**Percent**
	Dumpster	**Roll Off**	**Total**	
Price/cubic yard/pickup (1)	$15.00	$15.69	$15.10	
Collection component	$9.82	$2.89	$8.81	
Transfer, transport, & disposal	$5.18	$12.80	$6.29	
Number of tons	715,869	300,000	1,015,869	
Pounds per cubic yard	135	333	164	
Number of cubic yards	10,605,467	1,801,802	12,407,268	
Collection and Disposal Expenses				
Collection	$104,145,683	$28,270,270	$132,415,953	63%
Transfer, Transport, & Disposal	$54,936,317	$23,063,063	$77,999,380	37%
Transfer	$9,194,206	$3,853,026	$13,047,232	6%
Transport	$13,562,419	$5,683,618	$19,246,037	9%
Disposal	$13,562,419	$5,683,618	$19,246,037	9%
Subtotal	$36,319,044	$15,220,261	$51,539,305	24%
Regional Service Fee & Excise Tax	$19,711,680	$8,260,595	$27,972,275	13%
Grand Total	$56,030,724	$23,480,856	$79,511,580	38%
Difference in two estimates	-1.95%	-1.78%	-1.90%	
(1) From rates in Gresham, Tigard, Washington County, Beaverton, Clackamas and Hillsboro.				

Taking residential and commercial solid waste markets as a whole yields an estimated annual market value of $325 million. Of this, $270 million is for solid waste collection and disposal (the difference is for residential recyclables collection and yard waste collection). Commercial recycling expenditures are not included in these totals. Of the $270 million, 62% is expended on collection, 6% of transfer, 9% of transport, 9% on disposal, and 13% on regional service fees and excise taxes. These data are displayed in Table 3. Of all the expenditures, about 79% are made by the commercial sector (which includes multi-family) and 21% by residential customers.

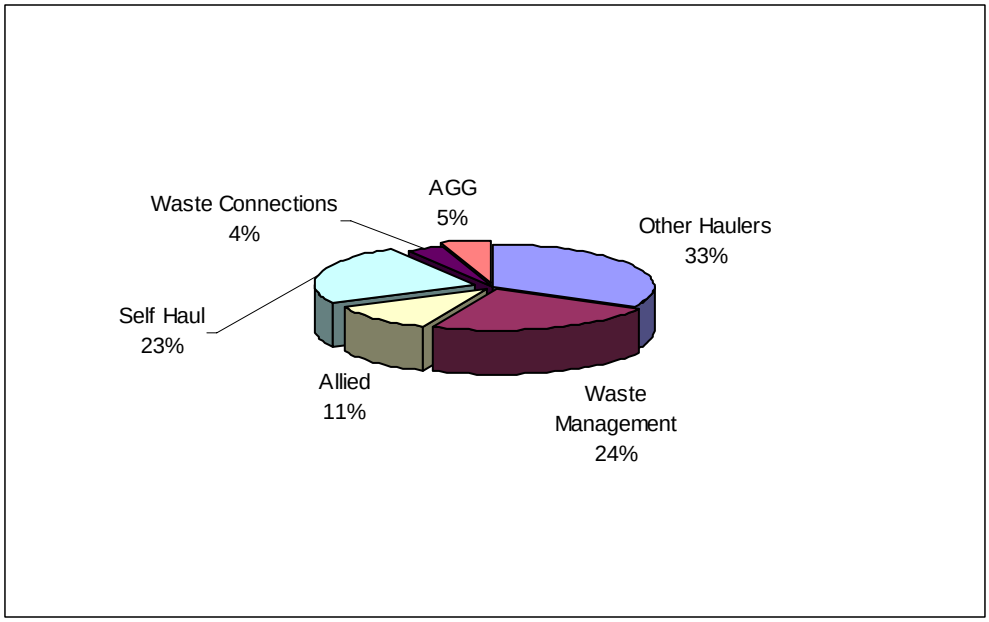
Table 3: Residential and Commercial Solid Waste Markets (Solid Waste Only)				
Item	Collection Type			Percent
	Commercial	Residential	Total	
Price/cubic yard/pickup (1)	$15.10	$13.34	$14.65	
Collection component	$8.81	$8.17	$8.65	
Transfer, transport, & disposal	$6.29	$5.18	$6.00	
Number of tons	1,015,869	287,405	1,303,274	
Pounds per cubic yard	164	134	156	
Number of cubic yards	12,407,268	4,300,243	16,707,512	
Collection and Disposal Expenses				
Collection	$132,415,953	$35,115,939	$167,531,892	62%
Transfer, Transport, & Disposal	$77,999,380	$22,268,645	$100,268,025	
Transfer	$13,047,232	$3,685,072	$16,732,304	6%
Transport	$19,246,037	$5,435,867	$24,681,904	9%
Disposal	$19,246,037	$5,435,867	$24,681,904	9%
Subtotal	$51,539,305	$14,556,806	$66,096,111	25%
Regional Service Fee & Excise Tax	$27,972,275	$7,900,514	$35,872,789	13%
Grand Total	$79,511,580	$22,457,320	$101,968,900	38%
Difference in two estimates	-1.9%	-0.8%	-1.7%	
Collection and Disposal	$211,927,533	$57,573,259	$269,500,792	100%
Collection, Recycing, Yard Waste & Disp	NA	$56,956,341		
Total with recycling	$211,927,533	$114,529,600		
Percentage of Market	78.6%	21.4%		

Concentration in the Collection Markets

In fiscal year 2005, a total of 1.3 million tons of wet and dry waste (excluding those materials which require a special DEQ permit) was collected in the three counties including Metro – Clackamus, Multnomah and Washington Counties. 77% of these tons were collected by licensed solid waste collection firms; the remaining tons were collected by self haulers, including small businesses such as roofers and individual households. Seventy-six firms were licensed solid waste collectors.

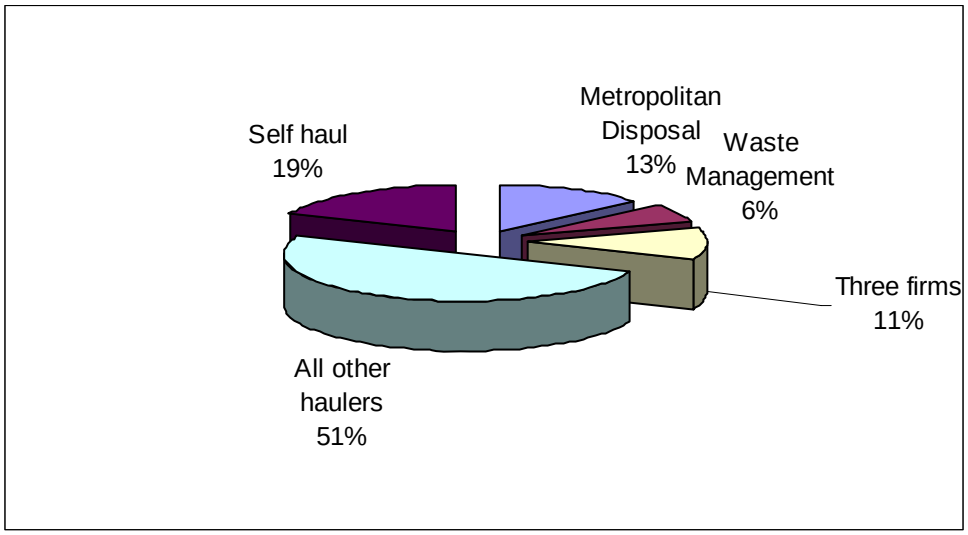
Figure 6, below, shows the percentage of the collection market for the top four individual collection firms, self haul, and the remaining 72 collection firms. The top four individual collection firms collect 44% of all the solid waste generated by residents and businesses in the Metro area. Three of these four firms are subsidiaries of publicly traded national companies. The remaining 72 collection firms collect 33% of the waste stream and self haulers collect the final 23% of the solid waste.

Figure 6: Market Share in Solid Waste Collection in Metro Area, FY 2005



Concentration in the collection markets has increased in recent years. In 1995, there were 104 licensed haulers, compared to the 76 licensed haulers in 2005. Waste Management, Inc. and other national firms controlled just 6% of the collection market at that time, compared to 39% of the market in FY 2005. During this period, the waste collected increased from 1.065 million tons to 1.300 million tons, and the percentage of that which was self hauled increased from 19.3% to 23.5%, a 22% increase in self hauling. Increased self hauling is typically observed when customers find that prices for service are relatively high.

Figure 7: Market Share in Solid Waste Collection in Metro Area, FY 1995



Vertical Integration

Profits earned in the various lines of activity in the solid waste field vary according to the structure of the market – ease of entry, capital required, regulatory requirements, siting issues. Firms with disposal sites like to use their own disposal sites for waste they collect. This is called vertical integration. Waste Management, for example, cites the benefits of vertical integration in its 10K report for 2004, saying:

> "All solid waste management companies must have access to a disposal facility, such as a solid waste landfill. We believe it is usually preferable for our collection operations to use disposal facilities that we own or operate, a practice we refer to as internalization, rather than using third party disposal facilities. Internalization [which economists call vertical integration] generally allows us to realize higher consolidated margins and stronger operating cash flows."
> Source: Waste Management 10K, December 31, 2004.

With vertical integration, profits are earned by the parent company at every stage of the solid waste management process – collection, transfer, transport, and disposal.

In the Portland, Metro market, 56% of the tons collected are delivered to transfer stations or landfills owned by the collector – implying complete vertical integration. Transfer station owners deliver 77 to 99% of the waste they receive to landfills they own, if they own a landfill. Without regulation, such as Metro's disposal contract with Waste Management, which specifies that 90% of regulated solid waste will be delivered to Waste Management landfills, one could expect that vertical integration would take a larger share of the collection market than the present 56%. It would not be unexpected for the degree of vertical integration to approach 100% in the absence of such regulations, resulting in the departure of many small hauling firms.

Transfer

The transfer segment of the solid waste industry has the characteristics of monopolistic competition – entry is somewhat difficult due to regulatory and siting issues, capital requirements are of the order of several millions of dollars, there are significant economies of scale and economies of load size, and there are no technical barriers to entry. Private sector operators of transfer stations have decreased costs as scale of operation increases, as load size increases, as hours of operation decrease, and as the extent of processing waste to recover recyclable commodities decreases.

In the Metro market, there are six wet waste transfer stations: Metro-owned Metro Central and Metro South, Waste Management owned Forest Grove and Troutdale, Pride Transfer Station, and Willamette Resources, owned by Allied Waste. Of the 1.3 million tons of solid waste in the Metro market, 0.6 million tons are first tipped at Metro stations, 0.4 million tons are first tipped at the four privately owned wet transfer stations, 0.13 million tons are first tipped at six other privately owned reload or dry waste transfer stations, and 0.17 million tons are first tipped at five privately owned landfills. Thus, 87% of the waste in the system is transferred prior to disposal.

The Metro market is also unusual in that transfer station operators are required to process dry waste to recover at least 25% by weight. This adds to the cost of transferring the waste, probably reducing the profits to those transfer station operators that also own landfills. The cost of processing dry waste to recycle additional materials is more costly when waste arrives in small loads than when it arrives in large loads. The annual tons per transfer station range from 55,000 to

307,000. All but one transfer station is large enough to capture available economies of scale.

Metro procures transfer station operating services by a competitive procurement. The prices determined by competition of private firms to operate Metro's transfer stations are then used by regulators of residential and commercial rates in the region (local governments, with the exception of the City of Portland for commercial collection) in setting rates. Thus, Metro's transfer stations perform the very important function of interjecting price competition into the transfer station segment of the solid waste market.

Table 4, below, summarizes the first tip location of Portland Metro Solid waste. Direct haul to landfills is assumed to occur in truck sized loads, of eight tons. Of the six regional transfer stations, Metro receives waste in much smaller loads, averaging 1.6 tons per load, as compared to the average size of 4.4 tons per load at the four regional transfer stations. The average scale of the Metro stations is greater than that of the four private transfer stations – 286,000 tons per year on average at Metro Central and South, compared to 106,000 on average at the four private stations. Metro and the private stations achieve a quite similar processing and diversion rate, with Metro diverting 16.4% of waste and the privates diverting 17.5%, on average.

Table 4: First Tip Location of Portland Metro Solid Waste

Solid Waste System Component	Status Quo			
First tip location	**Loads**	**Tons**	**Tons/Station**	**Tons/load**
Metro Central & South	356,188	572,611	286,306	1.6
Four Wet Transfer Stations	96,930	422,641	105,660	4.4
Six Reload and Dry Transfer Stations	101,446	135,448	22,575	1.3
Direct to Landfills	21,572	172,574	NA	8.0
Total	576,136	1,303,274		2.3

Using the information regarding scale of operations and size of load, and estimating based on equation (1) above, the transfer cost per ton for Metro stations was estimated. To this figure, estimated costs of processing dry waste (according to whether materials are processed on a floor or in a picking line) was added and

revenues from sale of commodities subtracted. This yields an estimated transfer and processing cost per ton at Metro transfer stations of $12.84. The comparable figure for the four privately owned and operated stations is estimated at $11.99. This difference is not statistically significant.

Transport and Disposal

The waste transferred at Metro stations is delivered to Columbia Ridge Landfill, located approximately 150 miles from the Metro stations. Waste from the privately owned transfer stations is typically not transported as far as waste from Metro stations. Waste from Forest Grove and Pride transfer stations is trucked to Riverbend Landfill, owned by Waste Management, and located approximately 35 miles from these transfer stations. Waste from Troutdale Transfer Station is trucked to a variety of landfills, including Columbia Ridge, Riverbend, and Hillsboro. It is estimated that the average distance this waste is transported is 139 miles, weighting the distance to each landfill by the percentage of waste going there. Willamette Resources sends the majority of its waste to Coffin Butte Landfill, with the rest to S&G, Marion County Burner, and Riverbend Landfill, for a weighted average transport distance of 65 miles.

Metro has a very competitive price in its contract for trucking of waste from its transfer stations to Columbia Ridge Landfill. The price per ton in 2005 was just under $19. Because the waste from private transfer stations is trucked a shorter distance, the average transport cost per ton for the private stations is estimated at just under $13.50. Disposal is at landfills, and waste from all these facilities is estimated to pay $18-$19 per ton at the various landfills used. The sum of the transportation and disposal estimated costs is $51 for Metro stations and $43 for the four private wet transfer stations. Most of this difference is in the transportation area. Note that these estimated figures do not include any profit on the transfer portion; profits are included in the fees charged at the landfills and transportation companies.

Metro currently charges $71.41 per ton, plus a transaction fee of $7.50 per vehicle. Included in the per ton fee is excise taxes of $8.33, a regional system fee of $14.54 and fees collected on behalf of other agencies of $1.74, for a total amount per ton of

$24.61. Thus, the estimated transfer, transport, and disposal charges at Metro transfer stations are $46.80 per ton, plus $7.50 per transaction. Using the average size transaction at Metro stations of 1.6 tons, the average per ton fee would be $51.49 at Metro stations. This compares closely with the estimate from the regression equation and the estimate for processing of dry waste, plus estimated payments for transport and disposal.

Metro's rates at their transfer stations reflect the many small self hauled loads arriving at these facilities. If Metro were to ask for a per ton bid for transferring waste arriving in commercial garbage collection vehicles, the rate would probably be substantially lower than the present rate. This reduced rate could be used by local regulators in setting residential and commercial garbage collection rates. As the estimated transfer cost per ton at Metro stations is just under $13, and it is not expected that rates would drop much be low $7 per ton, the potential impact of such a procurement and change in regulatory methodology would be on the order of $5 to $6 per ton decrease.

Part 4. Metro Region Solid Waste Market Summary

Most of the residential and commercial solid waste customers in the Metro region receive solid waste collection service from haulers with exclusive franchise territories.[50] Rates are set by local governments, using utility-type cost plus rate setting. The disposal portion of local rates is set from the fee charged at Metro Central and Metro South transfer stations. These rates are determined as a result of a competitive procurement, and the rates probably are responsible for maintaining a competitive price for transfer, transport, and disposal throughout the system.

The complicated regulatory system in the Metro region is not typical of other regions in the country, where municipal or contract or free market (subscription) service is more common for residential customers and where subscription or non-exclusive franchise service is more common for commercial customers. The Metro region is nationally recognized for its excellent recycling programs, which achieve a

[50] The City of Portland uses the subscription method for commercial solid waste collection.

very high diversion rate of 50+%. The success of the recycling programs is helped by the rate structure for residential collection, which is based on various container size options, thus providing a financial incentive to recycle.

The solid waste industry in the Metro region is becoming more concentrated. In 1995, there were 104 licensed haulers, compared to 76 in 2005. National firms controlled just 6% of the collection market in 1995, compared to 39% of the market in 2005.

Vertical integration occurs when a collection company can deliver the tons it collects to a transfer or disposal site owned by the collection company or an affiliate. This results in the collection company earning profits not just on costs of collection but also on each other element of service delivery – transfer, transport, and disposal. Small local firms without the ability to site and operate a disposal facility are at a disadvantage in competing against national firms who are able to earn the higher margins associated with vertical integration. Provision of public sector transfer stations is desirable to small local firms, as it allows them to compete against national firms on a relatively level playing field. 59% of tons collected in the Metro region were vertically integrated in 2005.

There are significant economies of scale in the transfer industry. Adding transfer stations can increase per ton costs, as the average throughput of transfer stations decreases, thereby increasing operating costs. Small loads increase the costs of transfer. There is significant unused transfer capacity in the region. Metro's transfer, transport, and disposal fees are set pursuant to competitive procurements. This helps to provide a lid on prices in a sector of the market not typically associated with price competition, but rather with significant profit margins associated with the monopolistic competition model.

The size of the solid waste market is estimated to be $114 million for residential customers and $212 million for commercial and multi-family customers. 62% of these fees go for collection, 6% for transfer, 9% for transport, 9% for disposal, and 13% for regional service fees and excise taxes. The greatest opportunities for cost savings are in collection, where the majority of the expenditures for solid waste

management are made, and over which Metro has no control. Metro's contribution to efficient solid waste markets would include continued efforts to obtain competitive bids from many firms for transfer station operation, transport, and disposal. Transport and disposal could be let together, evaluating prices for disposal as a function of transport plus disposal. The Metro region is fortunate that several additional large landfills have been sited since the last disposal contract was procured, and there is the possibility of more competition on disposal when that contract is reprocured.

APPENDIX D

Supporting Documentation for Economic Analysis of Options

APPENDIX D

Supporting Documentation for Economic Analysis of Options

This appendix provides support tables for the economic analysis of options presented in Section 6.

Table D-1: Transfer Costs -- Status Quo Option

Item	# of Transfer Stations	Per Transfer Station			Transfer $/Ton			
		#Loads	# Tons	Tons per Load	ln ()C)	OC/ton	Proces-sing $/ton	Total $/ton
All in Option	6							
With Self Haul	2							
Cash		121,362	52,589	0.4333				
Credit		12,251	25,036	2.0435				
Hauler waste		31,264	140,001	4.4780				
Total		164,878	217,625	1.3199	14.83676	$12.76	$2.47	$15.23
Without Self Haul	4							
Cash		0	0	0.0000				
Credit		0	0	0.0000				
Hauler waste		31,264	140,001	4.4780				
Total		31,264	140,001	4.4780	14.05484	$9.07	$2.47	$11.55
All	6							
Cash		242,724	105,177	0.4333				
Credit		24,503	50,071	2.0435				
Hauler waste		187,584	840,004	4.4780				
Total		454,811	995,252	2.1883		$10.69	$2.47	$13.16

Assume that self haul evenly distributed across stations with self haul service.
Assume that other tons are evenly distributed across transfer stations.

Table D-2: Transfer Station Costs -- Public Sector Option (3 Self Haul)

Item	# of Transfer Stations	Per Transfer Station			Transfer $/Ton			
		#Loads	# Tons	Tons per Load	ln (OC)	OC/ton	Proces-sing $/ton	Total $/ton
All in Option	5							
With Self Haul	3							
Cash		80,908	35,059	0.4333				
Credit		8,168	16,690	2.0435				
Hauler waste		37,517	168,001	4.4780				
Total		126,593	219,750	1.7359	14.75881	$11.69	$2.47	$14.16
Without Self Haul	2							
Cash		0	0	0.0000				
Credit		0	0	0.0000				
Hauler waste		37,517	168,001	4.4780				
Total		37,517	168,001	4.4780	14.19417	$8.69	$2.47	$11.16
All	5							
Cash		242,724	105,177	0.4333				
Credit		24,503	50,071	2.0435				
Hauler waste		187,584	840,004	4.4780				
Total		454,811	995,252	2.1883		$10.68	$2.47	$13.15

Assume that self haul evenly distributed across stations with self haul service.
Assume that other tons are evenly distributed across transfer stations.

Table D-3: Transfer Station Costs - - Private Sector Option

Item	# of Transfer Stations	Per Transfer Station			Transfer $/Ton			
		#Loads	# Tons	Tons per Load	ln ()C)	OC/ton	Proces-sing $/ton	Total $/ton
All in Option	9							
With Self Haul	2							
Cash		121,362	52,589	0.4333				
Credit		12,251	25,036	2.0435				
Hauler waste		20,843	93,334	4.4780				
Total		154,456	170,958	1.1068	14.7022	$14.20	$2.47	$16.67
Without Self Haul	7							
Cash		0	0	0.0000				
Credit		0	0	0.0000				
Hauler waste		20,843	93,334	4.4780				
Total		20,843	93,334	4.4780	13.7450	$9.98	$2.47	$12.46
All	9							
Cash		242,724	105,177	0.4333				
Credit		24,503	50,071	2.0435				
Hauler waste		187,584	840,004	4.4780				
Total		454,811	995,252	2.1883		$11.43	$2.47	$13.90

Assume that self haul evenly distributed across stations with self haul service.
Assume that other tons are evenly distributed across transfer stations.

Table D-4: Transfer Station Costs --- Hybrid Option

Item	# of Transfer Stations	Per Transfer Station			Transfer $/Ton			
		#Loads	# Tons	Tons per Load	ln ()C)	OC/ton	Proces-sing $/ton	Total $/ton
All in Option	7							
With Self Haul	2							
Cash		121,362	52,589	0.4333				
Credit		12,251	25,036	2.0435				
Hauler waste		26,798	120,001	4.4780				
Total		160,411	197,625	1.2320	14.78309	$13.32	$2.47	$15.79
Without Self Haul	5							
Cash		0	0	0.0000				
Credit		0	0	0.0000				
Hauler waste		26,798	120,001	4.4780				
Total		26,798	120,001	4.4780	13.93704	$9.41	$2.47	$11.88
All	7							
Cash		242,724	105,177	0.4333				
Credit		24,503	50,071	2.0435				
Hauler waste		187,584	840,004	4.4780				
Total		454,811	995,252	2.1883		$10.96	$2.47	$13.43

Assume that self haul evenly distributed across stations with self haul service.
Assume that other tons are evenly distributed across transfer stations.

Table D-5: Summary of Economic Impact of Public Alternative

Item	Status Quo Market ($)	Source of Estimate	Affected Amounts		System Impact	
			Tons	% of Tons	Minimum	Maximum
Collection						
Change in Disposal Cycle Time	$167,532,000	Time & motion models	116,000	9%	$268,000	$1,538,000
Increase in Vertical Integration	$167,532,000	Estimate *	0	0%	$0	$0
Subtotal collection	$167,532,000	NA	NA	NA	$268,000	$1,538,000
Transfer**						
Change in Scale of Stations	$16,732,000	Regression Equation	995,000	76%	-$12,000	-$12,000
Administration & Regulation	$16,732,000	Estimate	995,000		$0	$0
Price regulation impact*	$16,732,000	Estimate	995,000		$0	$0
Capital impacts	$16,732,000	$3 to 4 million/station	995,000		$0	$0
HHW Locations impact	$16,732,000	Estimate	995,000		$0	$0
Subtotal transfer	$16,732,000		995,000		-$12,000	-$12,000
Transport						
Subtotal transport	$24,682,000	NA	995,000	0%	$0	$0
Disposal						
For 90% of waste -- pre 2019	$24,682,000	Estimate	895,500	90%	$0	$0
For 10% of waste	$24,682,000	Estimate	99,500	10%	$0	$0
Subtotal disposal	$24,682,000	NA	NA	NA	$0	$0
Total	$233,628,000	NA	NA	NA	$256,000	$1,526,000
Percent change	0.0%	NA	NA	NA	0.1%	0.7%
Per ton	$179.30	NA	NA	NA	$0.20	$1.17

* Tons that are collected by haulers, not self hauled tons.

** The $16.7 million transfer fee includes all tons, not just those delivered to wet transfer stations.

The changes in the transfer station operating costs are based on transferred tons only; this is done to make market totals equal to those presented above.

Table D-6: Summary of Economic Impact of Private Alternative

Item	Status Quo Market ($)	Source of Estimate	Affected Amounts		System Impact	
			Tons	% of Tons	Minimum	Maximum
Collection						
Change in Disposal Cycle Time	$167,532,000	Time & motion models	333,000	26%	-$508,000	-$2,840,000
Increase in Vertical Integration	$167,532,000	Estimate *	961,000	74%	$2,471,193	$6,177,984
Subtotal collection	$167,532,000	NA	NA	NA	$1,963,193	$3,337,984
Transfer**						
Change in Scale of Stations	$16,732,000	Regression Equation	995,000	76%	$743,000	$743,000
Administration & Regulation	$16,732,000	Estimate	995,000		$100,000	$200,000
Price regulation impact*	$16,732,000	Estimate	995,000	76%	$0	$255,539
Capital impacts	$16,732,000	$3 to 4 million/station	995,000		$360,000	$468,000
HHW Locations impact	$16,732,000	Estimate	995,000		$0	$100,000
Subtotal transfer	$16,732,000		995,000		$1,203,000	$1,766,539
Transport						
Subtotal transport	$24,682,000	NA	995,000	0%	$0	$0
Disposal						
For 90% of waste -- pre 2019	$24,682,000	Estimate	895,500	90%	$0	$0
For 10% of waste	$24,682,000	Estimate	99,500	10%	$0	$0
Subtotal disposal	$24,682,000	NA	NA	NA	$0	$0
Total	$233,628,000	NA	NA	NA	$3,166,193	$5,104,522
Percent change	0.0%	NA	NA	NA	1.4%	2.2%
Per ton	$179.30	NA	NA	NA	$2.43	$3.92

* Tons that are collected by haulers, not self hauled tons.

** The $16.7 million transfer fee includes all tons, not just those delivered to wet transfer stations.

The changes in the transfer station operating costs are based on transferred tons only; this is done to make market totals equal to those presented above.

Table D-7: Summary of Economic Impact of Hybrid Alternative

Item	Status Quo Market ($)	Source of Estimate	Affected Amounts		System Impact	
			Tons	% of Tons	Minimum	Maximum
Collection						
Change in Disposal Cycle Time	$167,532,000	Time & motion models	142,000	11%	-$215,000	-$1,202,000
Increase in Vertical Integration	$167,532,000	Estimate *	0	0%	$0	$0
Subtotal collection	$167,532,000	NA	NA	NA	-$215,000	-$1,202,000
Transfer**						
Change in Scale of Stations	$16,732,000	Regression Equation	995,000	76%	$275,000	$275,000
Administration & Regulation	$16,732,000	Estimate	995,000		$0	$0
Price regulation impact*	$16,732,000	Estimate	995,000	76%	$0	$0
Capital impacts	$16,732,000	$3 to 4 million/station	995,000	76%	$120,000	$156,000
HHW Locations impact	$16,732,000	Estimate	995,000		$0	$0
Subtotal transfer	$16,732,000		995,000		$395,000	$431,000
Transport						
Subtotal transport	$24,682,000	NA	995,000	0%	$0	$0
Disposal						
For 90% of waste -- pre 2019	$24,682,000	Estimate	895,500	90%	$0	$0
For 10% of waste	$24,682,000	Estimate	99,500	10%	$0	-$298,500
Subtotal disposal	$24,682,000	NA	NA	NA	$0	-$298,500
Total	$233,628,000	NA	NA	NA	$180,000	-$1,069,500
Percent change	0.0%	NA	NA	NA	0.1%	-0.5%
Per ton	$179.30	NA	NA	NA	$0.14	-$0.82

* Tons that are collected by haulers, not self hauled tons

** The $16.7 million transfer fee includes all tons, not just those delivered to wet transfer stations.

The changes in the transfer station operating costs are based on transferred tons only; this is done to make market totals equal to those presented above.