The economics of recycling

by Susan Bogert
and Jeffrey Morris.

In four cities, the average net cost per ton of recycling in 1992 was lower than the cost of disposal.

Recycling need not cost more than waste collection and disposal. In fact, recycling can make good economic as well as environmental sense, according to our recently published study The Economics of Recycling and Recycled Materials (1). The study documents 1992 costs of residential curbside recycling versus disposal systems in four Washington State cities - Seattle (2), Spokane, Bellingham and Vancouver - which are geographically diverse, use different collection and materials marketing approaches and different disposal methods, and range in population size from 47,000 (Vancouver) to 535,000 (Seattle).

The study also compares costs and prices for using five recycled materials in manufacturing or composting against their common, typically virgin, material substitutes. The study provides a factual and objective report that could serve as an information base for discussing and formulating policies to improve the economics of recycling.

Recycling can cost less than disposal

Based on 1992 cost data from the four Washington cities, recycling can be less expensive than disposal, especially considering the revenues that may be obtained from selling recycled materials. Figure 1 shows recycling and disposal system net costs (total costs less any revenues from selling recycled materials or selling electricity from incineration).

Disposal costs exceeded recycling costs per ton in all four cities studied. $13 per ton at the lower end in Spokane, to $65 per ton at the higher end in Bellingham, with Vancouver and Seattle in between at $25 and $41 per ton, respectively. Excluding revenue from selling materials, curbside recycling’s total costs still were less than disposal system costs in three of the cities. In Spokane, curbside recycling’s total costs were about the same.


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One of the major findings of this study is that with smart management and efficient operations, cities can minimize costs for both recycling and disposal. Understanding the components of their recycling and disposal system is critical for cities to achieve route, truck and labor efficiencies. For example, Seattle’s curbside recycling contractors receive a combination of market revenues plus a per-ton fee for collection and processing. This gives the contractors substantial incentive to maximize both handling efficiency and material quality. On the disposal side, cities that arrange their operations and contracts so that costs vary directly with tonnage will be able to realize savings when switching material tonnage from disposal to a lower cost recycling system.

### Recycling and disposal system component costs

Table 1 summarizes the cost components for recycling in the four cities, by comparing collection costs (including administrative overhead, publicity and education), processing costs, revenues and net costs (total costs less revenues).

In Table 2, disposal system costs for each of the four cities are depicted in terms of collection costs (including overhead), transfer/disposal costs, revenues and net costs.

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### Table 1 - Recycling costs per ton, 1992

<table>
<thead>
<tr>
<th>City</th>
<th>Collection cost</th>
<th>Processing cost</th>
<th>Revenue (1)</th>
<th>Net cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellingham</td>
<td>$91</td>
<td>$25</td>
<td>$116</td>
<td></td>
</tr>
<tr>
<td>Seattle</td>
<td>89</td>
<td>42</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Spokane</td>
<td>199</td>
<td>-</td>
<td>24</td>
<td>175</td>
</tr>
<tr>
<td>Vancouver</td>
<td>137</td>
<td>-</td>
<td>6</td>
<td>131</td>
</tr>
</tbody>
</table>

(1) Processing costs and revenues are netted in all cities except Seattle because of the other cities’ practice of delivering materials to a third-party processor, not the city or the hauler.


### Table 2 - Disposal costs per ton, 1992

<table>
<thead>
<tr>
<th>City</th>
<th>Collection cost</th>
<th>Transfer/disposal cost</th>
<th>Revenue</th>
<th>Net cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellingham</td>
<td>$90</td>
<td>$91</td>
<td>$181</td>
<td></td>
</tr>
<tr>
<td>Seattle</td>
<td>67</td>
<td>70</td>
<td>137</td>
<td></td>
</tr>
<tr>
<td>Spokane</td>
<td>101</td>
<td>97</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>Vancouver</td>
<td>85</td>
<td>71</td>
<td>156</td>
<td></td>
</tr>
</tbody>
</table>


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Only Spokane enjoys revenues from disposal, because it sells electricity generated by its waste-to-energy facility. Looking at the collection component, curbside collection cost more for recyclables than for garbage in all four cities in 1992. This is to be expected. Recycling’s goal is to produce marketable materials. Careful handling and separation of materials during collection maintains material quality and value. Densities in the recycling truck are usually less because compaction is avoided, resulting in trucks being able to collect less weight before filling up. Also, in recycling, multiple materials typically must be segregated. For example, in Spokane recyclables are sorted at the curb by the collection truck operator into seven different truck compartments for newspaper, corrugated containers, three colors of glass, cans (aluminum and tin), and plastic bottles (PET and HDPE). As a result Spokane’s recycling collection costs are almost double (197 percent) its garbage collection costs.

For the other three cities, which use stack
Paying for recycling and disposal

- In cities where disposal systems are expensive, recycling systems are costly, too.
- Most residents pay for all curbside or disposal costs through rates charged for mandatory garbage collection.
- Households that divert materials for recycling may save money through reduced frequency or lower volume of garbage collection.

In cities where disposal systems are expensive, recycling systems are also costly. However, factors elevate Spokane’s per-ton recycling collection costs as well. The other three cities collect mixed paper; Spokane does not. Mixed paper composes a large portion of the volume and weight in recycling programs where it is collected. As a result, Spokane’s trucks collect less material per stop, but spend more time per stop, increasing costs per ton collected.

On the other hand, on-route sorting allows Spokane to sell materials directly off the collection truck to local processors in essentially a ready-to-market condition at an average price of $24 per ton. In the other three cities, separation of materials and removal of contaminants is done at a processing facility rather than on the collection route.

Although Bellingham and Vancouver also sell materials from the collection truck to local recyclers, they receive lower prices because more sorting and removal of contaminants is required at these recyclers’ privately owned processing facilities. Vancouver receives an average of only $6 per ton and Bellingham pays its private processor an average $25 per ton to accept recyclables. In the Seattle-Northend recycling program, where the same contractor does collection, processing and marketing of materials, processing costs exceed materials revenues by just $1 per ton.

Allocation of system costs by material

The study also examined recycling versus disposal system costs by material collected. Costs allocated simply by weight collected may not adequately reflect the cost of handling relatively lightweight, bulky materials. For example, trucks fill up more quickly with bulky materials, requiring more frequent unloading. On the other hand, costs allocated simply by volume (cubic yards) collected may not adequately reflect costs of handling heavy, dense materials. For example, heavy materials may require heavier handling and processing equipment.

Our study compared recycling and disposal costs for each material, using both cost allocation methods – first by tons collected, then again by cubic yards collected. In Seattle, a third method is considered as well, using volume for collection and allocating processing costs according to the National Solid Wastes Management Association’s recent materials recovery facility cost study.

With the exception of glass and tin in Spokane, recycling was cheaper than disposal in 1992 for all materials in all cities for weight-based costs. Conversely, in all cities except Bellingham, recycling was more expensive than disposal for some materials when costs are allocated on the basis of volume in the collection truck. Even recycling aluminum cans in some cities was not cheaper than throwing them in the garbage, due to processing charges for separating commingled food and beverage containers.

Looking at Seattle’s costs in particular, in the weight-based analysis for aluminum cans and PET and HDPE plastic bottles, revenues from selling these recycled materials exceed their collection and processing costs, result-
In a “negative” net cost, or revenue. For the volume/NSWMA-based analysis, the net cost of recycling mixed scrap paper and HDPE bottles was higher than disposal costs. Also, lightweight, bulky containers such as plastic bottles and aluminum cans bear higher costs for both recycling and disposal when volume-based costs are used.

These results indicate the cost of inefficiencies in collecting low-density materials. Although attention has been drawn to the cost of these inefficiencies in collecting recyclables, many of the same inefficiencies are encountered in curbside collection of low-density materials for disposal as well.

Costs measured in this study are a function of the mix of materials collected in a particular program and geographic area during a specific time period. Much more work needs to be done to determine how a material’s weight, volume and handling time on the collection route interact to determine the actual cost of collecting that material for either recycling or disposal. As a result, extreme caution should be used when making calculations regarding which specific materials are, and which are not, profitable to recycle in an existing curbside recycling program. Adding or deleting materials affects the mix of factors that determine the cost of a program and the specific costs for a material.

Finally, the average cost of collecting mixed paper in the Seattle-Northend program is about the same for recycling and disposal under either cost allocation method. This does not necessarily imply that one should be indifferent between recycling or disposal. Whether mixed paper is economical to recycle depends not only on its markets, but also on how collection routes for both recycling and disposal might change when a large quantity of this low-density material is moved from one collection system to the other. If large quantities of mixed paper can be recycled, then there may be substantial opportunities to restructure garbage collection routes and reduce garbage collection costs when that material is transferred to curbside recycling. There also may be opportunities for reduced per-ton recycling collection costs when mixed waste paper is picked up at each participating household on a curbside recycling route.

Who pays and how?

One central issue in recycling collection and processing today is “Who should pay and how?” This study demonstrates that recycling can make economic sense in comparison with disposal. There are two obvious sources of funding to pay for recycling: materials markets and disposal customers. However, while market revenues from recycled materials may at times cover processing costs, they are unlikely to pay for collection costs.

At the same time, garbage collection is a service that households have come to expect. Until recently, most materials were recycled by the private sector, and then only if their market price covered collection and processing costs. Thus, in most cases, materials were self-hauled to buy-back centers, and materials with low market prices were not diverted from disposal.

A recycled commodity’s market price as an industrial feedstock will generally be set by prices for competing materials that sell in larger quantities and are more established in the marketplace. As a result, the market price for a recycled commodity cannot much exceed prices for substitute materials. These prices for substitute materials represent what the feedstock user is accustomed to paying, though users will usually seek to pay the lowest price possible. The higher the price at which a recycled material can be sold, the greater the revenue available from this source to pay for collection and processing.

Disposal costs (collection plus landfill or incineration) represent a large expense that households, at least to date, are willing to pay, typically through public sector agencies. When materials are recycled rather than thrown away, certain costs of disposal are not spent; these are often called the “avoided costs” of waste disposal. Since this amount would otherwise be spent to get rid of waste, communities can afford to contribute it toward the cost of recycling materials.

Thus, avoided disposal costs provide the other revenue source to cover costs of recycling materials with low market value. Avoided disposal costs plus market prices can pay for recycling, provided that citizens who in the past have been willing to pay for garbage collection and disposal are willing to pay to cover the costs of curbside recycling, and manufacturers who have been willing to pay for virgin materials are willing to pay similar prices for recycled materials.