Economic Feasibility 101 – Understanding The “Tools Of The Trade”

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Comments

The story goes like this: Thomas Carlyle, a 19th century historian termed economics the “dismal science” after the gloomy predictions of early economists such as T.R. Malthus that human population would always grow faster than food, dooming mankind to unending poverty and hardship. Rather than reviled as a “dismal science”, I would argue passionately that economics allows society to help manage limited resources through a careful analysis of revenues and costs for particular societal needs. That being said, this article provides a brief overview, an abbreviated “Economics 101” for the solid waste professional providing tools and methodologies, which can enable analysis of new or enhanced solid waste programs. First, let’s review some basic fundamentals.

Understanding Cost Analysis

There are a variety of different costs that every solid waste management program incur and it is important to understand how cost analysis can help in determining the feasibility of a new or enhanced program. The following paragraphs highlight some of the major cost categories and how they impact a specific cost analysis for a program.

Direct and Indirect Costs

In the world of cost analysis, if a cost can be directly linked to a particular recycling service provided by a community or agency, then is usually considered a “direct cost”. These are usually classified into major categories such as labor, equipment, and materials.

To illustrate, a recycling center or composting site will have hourly employees to man these facilities, require utilities such as electricity and fuel, and have public information materials to educate the public about the facility’s operations. Further, the typical benefits paid to the employees are also considered a direct cost because they can be tied “directly” to the employees working at the facility.

However, salaried employees are treated differently. For example, if the Solid Waste Director splits his or her time among various operations of the department. Let’s say there are four different areas that time are spent. If the Director spends approximately 25 percent of his total time between recycling, landfill, collection, and code enforcement, then 25 percent of his salary would be allocated as a direct cost to the recycling program.

“Indirect costs” are those costs, which cannot be easily linked to the particular new program or service. Typically, these are costs where it is usually or too time consuming for the analyst to link to the new service. Table 1 provides some typical costs, which can be found in most municipal budgets.

Table 1. Types of Costs

Category	Examples in Agency Budgets
Fixed	Salaried employees
	Rent
	Depreciation expense
Variable	Hourly employees
	Benefits
	Utilities
	Fuel
	Maintenance
	Landfill tipping charges
Overhead	Human resources, legal, payroll, purchasing and similar administrative costs for organization
	Internal phone and mail system
	Security
	Management information system
	Billing services
	Copier lease
Capital	Debt service for loans and bonds
	Lease payments

Fixed or Variable Costs

Fixed costs are those which remain constant regardless of the level of solid waste or recycling service. For example, salaried employees are typically not eligible for overtime pay in most municipal and private agencies. Consequently, their pay does not increase even if they work additional hours in a week on a project, or if recycling tonnages increase dramatically. Similarly, the depreciation expense for equipment or vehicles does not usually vary as the level of recycling increases.

In comparison, variable costs change as the volume or activity level increases. Fuel for machinery or vehicles is a good example. Also, if your charges for processing from a MRF are set at a per ton basis, then as you collect more recyclables from a curbside program, your overall costs increase.

Marginal Costs or Savings

Marginal costs are an important concept in evaluating the cost-benefit of making a change in any solid waste or recycling program. Figure 1 illustrates a marginal cost evaluation conducted for a community, which was considering a change from manual to automated collection of solid waste. In this case, a number of fixed costs were assumed not to change such as salaried and municipal overhead services. However, variable costs are assumed to change such as fuel, the time it is expected to drive between stops, and the number of potential insurance claims due to worker injuries with the move to automated vehicle collection. Based on this model, the marginal monthly homeowner savings with a change from manual to automated collection was projected to be $2.37, a significant savings.

	Number	Unit Cost	Subtotal	Annual	2008 Budget	Variance			
Labor									
ASL Drivers (II)	9.0	$ 47,706.66		$ 429,360					
REL Yard Waste Drivers (II)	4.0	$ 45,435.96		$ 181,744					
Residential Grapple Drivers (II)	6.0	$ 47,706.66		$ 286,240					
Swing Drivers (II)	3.0	$ 47,706.66		$ 143,120					
REL YW Crew (Collector)	8.0	$ 36,485.33		$ 291,883					
Swing Crew	2.0	$ 36,485.33		$ 72,971					
Subtotal	32.0			$ 1,405,317	2,559,945	(1,154,628)			
Equipment									
ASL Vehicles (front line)	9.0	$ 239,000.00	$ 2,151,000	$ 430,200					
ASL Vehicles (spares)	3.0	$ 239,000.00	$ 717,000	$ 143,400					
REL YW Vehicles (front line)	4.0	$ 197,146.00	$ 788,584	$ 112,655					
REL YW Vehicles (spares)	2.0	$ 197,146.00	$ 394,292	$ 56,327					
Grapple Vehicles	7.0	$ 106,349.00	$ 744,443	$ 106,349					
ASL Containers	45000	$ 45.00	$ 1,985,000	$ 185,500					
ASL Containers (spares)	2250	$ 45.00	$ 98,750	$ 13,821					
Subtotal			$ 6,827,069	$ 1,056,253	459,548	596,705			
Operating Costs									
Maintenance									
ASL	12.0	$ 2,744.80	$ 32,938	$ 395,251					
REL	6.0	$ 1,700.75	$ 10,205	$ 122,454					
Grapple	7.0	$ 1,220.00	$ 8,540	$ 102,480					
Subtotal				$ 620,185	654,622	(34,437)			
Fuel	25.0	$ 1,700.10	$ 42,503	$ 510,031	530,432	(20,401)			
Disposal	54619.00	$ 29.35	$ 1,599,042	$ 1,599,042	1,573,146	25,896			
Administration Allocations									
Residential				$ 1,435,304					
Grapple / Appliance				$ 253,421					
Administration allocation adjustments provided by City				$ 167,553					
Potential Reduction in Self-Insurance Fund			-30%	$ (197,394)					
Subtotal				$ 1,749,766	2402762.46	(653,996)	current		
Total				$ 6,940,612	$ 8,161,404	$ (1,220,862)	$ 15.75	$ 2.50	$ 1,186,58
	Fully Loaded Administrative Costs (FY2009)			$ -					
Cost Per Household							Potential Savings		
Annual				$ 161.41	$ 189.80		savings	monthly	annual
Estimated Monthly Cost per Household				$ 13.45	$ 15.80		$ (2.37)	$ (101,739)	$ (1,220,86

Figure 1. Example of Marginal Cost Analysis Comparing Collection Program Changes

Time Value of Money

The economic concept of the time value of money is an important one to grasp because it allows the recycling coordinator or analyst to compare the feasibility of different alternative solid waste program alternatives. Essentially it is based on the simple rule: a dollar invested tomorrow is worth less than a dollar received today.

To illustrate this concept, let’s look at a typical example for a recycling project. If the income stream today from a MRF project is $500,000 a year, the agency could earn some interest on this cash income. At five percent interest, this cash income would earn about $25,000 a year or approximately $70 a day. So, at a five percent interest rate, the opportunity cost of receiving your $500,000 tomorrow rather than today is $70. As the interest rate increases, the more the agency gains by deciding to take the cash flow today.

The time value of money concept plays out in many purchasing decisions such as making an investment such as purchasing new vehicles, baling equipment, a tub grinder, or public informational materials. Typically, the upfront investment for these expenditures are paid in today’s dollars while the cash flows from the potential savings are paid in future dollars, which are worth less than today’s dollars because of the time value of money.

Capital and Operating Costs

Capital costs are the big ticket expenditures for a solid waste and recycling program. These include such items as vehicles, equipment, and buildings, which have an expected life span of several years. In typical cash accounting systems, these expenditures will be recorded as the full expense for the first year and zero dollars for the remaining life of the item. Under accrual or full cost accounting, depreciation comes into play, which is a method of allocating these purchase costs over the useful life of the asset. Depreciation takes into account consideration of three different variables such as the initial purchase price of the asset, its expected useful life, and an estimated salvage value at the end of its life. There are several different depreciation methods dependent on potential tax code implications. However, the simplest is straight line depreciation which follows the following formula:

$$\textit{Depreciation} = (\textit{Cost} - \textit{Salvage Value}) / \textit{Life in Number of Periods}$$

In comparison, operating costs are the normal reoccurring costs that are used or consumed over a short period of time, typically less than one year. These include such budget items as wages and benefits, rent and lease payments, fuel, maintenance costs, and interest or debt service payments.

Determining Economic Feasibility

All of the economic concepts discussed in the paragraphs above can be used by the Solid Waste Manager or Recycling Coordinator to help determine the economic feasibility of a particular recycling project. Most financial analysts utilize individual spreadsheets or linked spreadsheets to automate the feasibility process. These are briefly described using a few examples from the author's consulting experience.

Simple Mathematical Analysis

Financial and economic analysis for project feasibility encompasses a range of tools from simple mathematical calculations to those using computer applications. These will be briefly discussed with a number of specific illustrations.

Breakeven Analysis

Breakeven analysis is defined as the point in a solid waste or recycling project when its total cost equals the money saved in such things as waste collection, transportation, and ultimate disposal costs. That is, the point in the project when there is zero loss. The usual formula for calculating the breakeven point is as follows:

Fixed Costs / (Revenue Per Item – Cost Per Item)

Typically, most recycling programs are designed to produce savings from solid waste disposal by diverting recyclables from the community's waste disposal containers. For example, consider the situation where a community implements a curbside recyclables collection program. Its collection contract with a private waste hauler is $1,000,000 per year. The materials collected go to a regional MRF facility with a tipping fee of $50 a ton. This figure includes all disposal costs of the residue. The community receives an average revenue of $25 per ton. The breakeven level for the community can be calculated as follows:

Breakeven @ $55/ ton = 18,181 tons

In this specific case, the recycling program will reduce the cost of the community's solid waste disposal if more than 18,181 tons are collected.

Payback Period

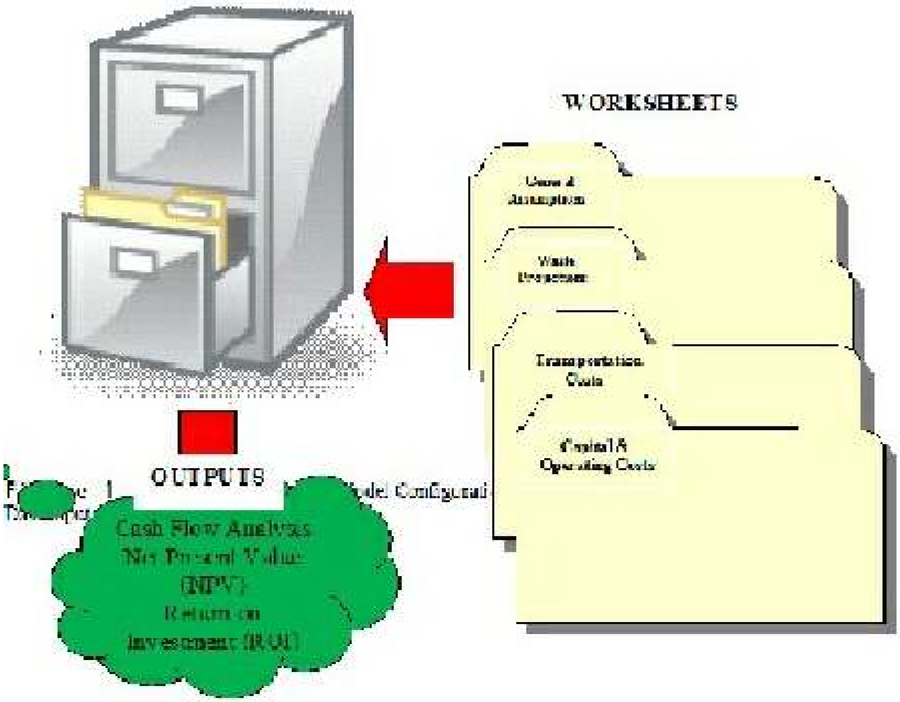
While breakeven analysis takes into account the number of unit that must be recovered to return an investment, the payback period tells how soon this investment will be paid back. This is extremely important where there is a significant capital investment for a project and the cash flow revenue stream is extended over a long period of time.

There are numerous examples in recycling that utilize this concept. For example, a regional mall, which generates a significant amount of food waste, decides to evaluate the feasibility of installing a food waste composting unit. Their current cost of contracting with a private waste hauler is $3,400 a month in hauling and disposal charges. The monthly cost of the composting unit is quoted by the manufacturer at $2,100 with maintenance (wood chips and microorganism solution), electrical, and additional water use is $140. The payback period is less than two months.

Pro Forma Economic Modeling

Any Pro Forma Model must be developed from a grasp of the dynamics of the market influencing the life cycle of the project. While software programs can be great tools, the programs are only as good as the assumptions that go into the program. Another common problem with most Pro Forma Models is the "one size fits all" syndrome. Every project is unique and the design of the pro forma financial model should reflect these differences. To accommodate the various types of business models needed to analyze the feasibility of recycling projects, the author has developed a variety of different types of Pro Forma Models that has allow him to tailor the financial statements to the specific project. This has provided clients with models with maximum flexibility to model multiple scenarios of facility size, biogas production/co-generation, and site locations.

Figure 2 illustrates the general configuration of a Proforma Model. As shown, a model is crafted to develop very flexible financial assessment, which incorporated major project feasibility factors, to help answer many “what if” questions.



Data Inputs

Using the cost assumptions and critical project assumptions (Figure 9), a multi-year (typically 5 to 20-year) projection of projected revenues, operating expenses, and debt service cwill be developed using Microsoft Excel. Assumption s are usually based on working knowledge of the solid waste industry, recently reported case history, and actual ranges in capital and operating costs for similarly-sized recycling facilities.

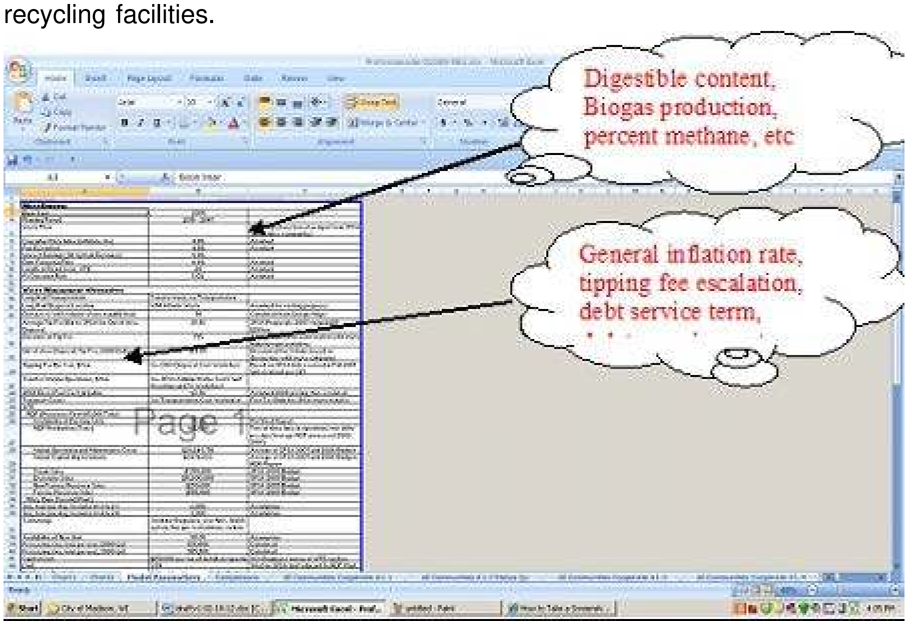


Figure 3. Typical Proforma Model AssumptionsWaste Received

Operating results will be based on the projected quantities of municipal waste and/or recyclables generated by the solid waste agency and possibly adjacent communities. The waste flows spreadsheet will help estimate the projected flows of solid waste and/or recyclables for the proposed recycling facility. These data can incorporate results from a community's pilot program as well as benchmarking available from similarly-sized municipalities.

Capital Costs and Operating Expenses

The historical capital and operating costs for the different recycling systems under examination are the first step in estimating the costs of a proposed solid waste or recycling program. In cases, where there are limited capital and operating data, it is commonplace to collect data on similar recycling programs or facilities from both the literature and through formal manufacturer's quotes.

The capital costs should include all predevelopment and construction costs. Operating costs will typically include labor, maintenance, materials, testing, insurance, potable water, waste services, overheads, and training costs, as well as potential costs for residuals (contaminants) to waste disposal sites, including any transportation costs or required tipping fees at these facilities (Figure 4).

Operating Revenues

The end game of an economic feasibility assessment study is to prepare an estimate the cash flows of the project over its useful life and determine at what rate they should be discounted. After putting the projected revenue streams into the model as a starting point, the model must include assumptions about the future, including: future energy (electricity, biogas, or steam) revenues, tipping fees, and revenues from the sale of marketable products. All are elements that must be estimated to build the revenue side of the Proforma Model.

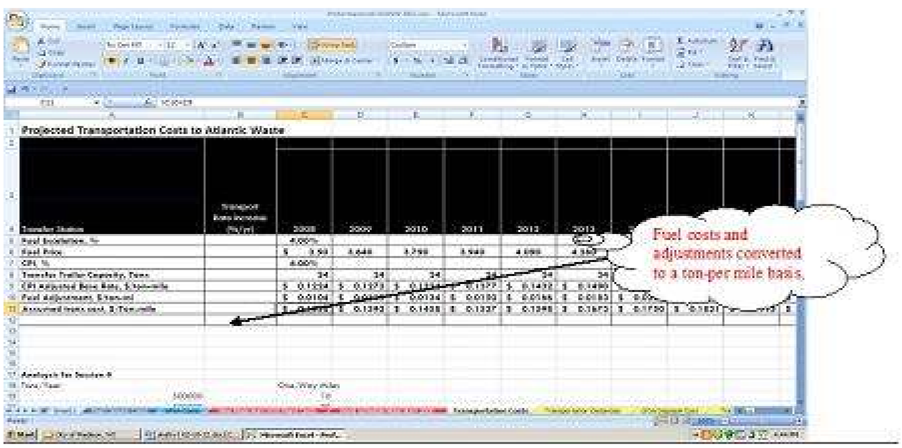


Figure 4. Transportation Cost Spreadsheet

Revenues for recycling projects can come from any combination of the following sources:

- Recyclables
- Energy (gas, heat, electricity)
- Secondary products (compost, water, liquid fertilizer, feedstock for City compost
- Renewable energy tax credits, carbon offset credits, grants, etc.

For example, an anaerobic digester facility sited at a waste treatment facility could offset the community's electricity demand, in which case the revenue for electricity would be based on the retail price of electricity which may be 25 to 40 percent higher than wholesale rates received from the utility. Also, since the facility can be expected to produce a large quantity of biogas there may be a possible option to upgrade the biogas to natural gas so that it could be injected into pipelines or can be used to produce compressed natural gas (CNG) for use by municipal fleet vehicles.

Life Cycle Analysis

To complete the valuation of the project, the reversion value or future project value must be calculated.

A Proforma Model should include two valuation pieces. The first is the net present value of the net cash flows during the period of projection. The second piece is the value of the asset at the end of that projection period, the so-called reversion value. This value should represent the capitalized value of the normalized net operating income of the project or the projected market revenue for the project less the normalized expenses, including improvements and capital reserves. A capitalization rate can then be applied to calculate the reversion value. This value must then be discounted to the net present value. These can then enable the feasibility engineer to provide a life cycle financial analysis of the project (Figure 11).

Presenting All The Numbers

All of the modeling and spreadsheets are meaningless if the analyst in unable to communicate the results to the decision-makers.

Cost Per Ton

Cost per ton is a common economic benchmark reported in solid waste and recycling. It is easy to calculate and should include all costs and revenues to ensure that it accurately represents a number that can be compared to typical landfill and waste-to-energy costs. As shown in Table 2, the data attempts to account for transportation and processing costs of recyclables to the secondary market as well as anticipated revenues based on an assumption of projected delivery amounts.

Table 2. Example of Cost Per Ton Analysis

Capture Rate (%)	Total Recyclable Tonnage	Plastics (tons)	Glass (tons)	Steel Cans (tons)	Aluminum (tons)	Trips per Year if Baled (1)	Transportation cost per year to haul to Whitehorse (2)	Estimated Disposal Cost Charged by Raven ($200/ton processing fee for mixed	Estimated Revenue from Aluminum (3)	Total Yearly Cost to haul to Whitehorse	Net Cost per Ton of Recyclables
10	11	3	4	2	2	1	$590	$1,748	$821	$1,518	$144.19
20	21	5	8	4	4	1	$590	$3,497	$1,641	$2,445	$116.16
30	32	8	12	6	5	2	$1,180	$5,245	$2,462	$5,965	$125.50
40	42	11	16	8	7	2	$5,739	$6,993	$3,283	$9,450	$224.45
50	53	13	21	10	9	3	$7,174	$8,742	$4,103	$11,812	$224.45
60	63	16	25	12	11	3	$8,609	$10,490	$4,924	$14,175	$224.45
70	74	19	29	14	12	4	$10,044	$12,238	$5,744	$16,537	$224.45
80	84	21	33	16	14	4	$11,478	$13,987	$6,565	$18,900	$224.45
90	95	24	37	18	16	5	$12,913	$15,735	$7,386	$21,262	$224.45
100	105	27	41	20	18	6	$14,313	$17,432	$8,206	$23,539	$224.18

Cost Per Household

Cost per household is a popular economic benchmark for recycling coordinators as well as the general public. Table 3 illustrates a typical calculation of the cost per average household or customer for a new recycling program or improved service.

Table 3. Example of Use of Cost Per Residence or Customer

Revenue/Cost Items	Revenues/Cost of Service Annual	Monthly (per Residence)
Estimated Revenues		
Recyclables	$823,500	$2.15
Subtotal	$823,500	
Estimated Operating Expenses		
Labor	$0	$2.08
Transportation	$228,880	
Processing	$503,360	
Public Education	$65,000	
Subtotal	$797,240	
Estimated Capital Costs		
Vehicles	$0	$0.59
Carts	$226,633	
Subtotal	$226,633	
Total Net Cost of Service	$200,373	$0.52

Cost Per Household

Cost per household is a popular economic benchmark for recycling coordinators as well as the general public. Oftentimes, this benchmark is used in annual advertisements or public notices to provide the public with information on the cost of recycling and collection services (Figure 11).

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Diversion Rate

The diversion rate is a measure of how much material is diverted from disposal to recycling in a community program. These rates are usually calculated from agency or hauler records using the following formula:

Diversion Rate = (Tons of Recyclables Collected / Tons of Recyclables Collected) x 100

From purely a cost perspective, the more important benchmark is the percentage of recyclable materials diverted from the community’s disposal location.

Participation Rate

Oftentimes, the participation rate is the most quoted benchmark, but, in the author’s opinion, is the least reliable benchmark. While it measures how many households are participating in a curbside recycling program, it tells very little how much they are recycling. For example, a homeowner could only setout plastic bottles and aluminum cans, not all the materials desired in the recycling program, and be counted as participating in the overall program.

Some Final Thoughts

Getting a firm handle on costs is a challenge for any solid waste manager, but particularly so for solid waste leaders in this era of "lean and mean” local government. Elected officials tend to target solid waste because of perceived high labor, equipment, and capital costs – even though many communities allocate collection-and-disposal revenues to other municipal operations. Competition from the private sector remains intense, and politicians seeking ways to keep taxes and service costs low often make the threat of privatization. Given this current climate, I expect that economic analysis will continue to be even more important than ever to focus attention on critical financial and management issues.

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