Chapter 5
Reporting FCA Data

The annual tax bill often might be the primary mechanism your local government uses to communicate the costs of solid waste management to citizens. But tax bills frequently do not itemize the municipal services that taxpayers are funding. Combining solid waste management costs with the costs of other municipal services that are funded through property taxes can obscure what residents and businesses are paying for MSW management. They might believe that solid waste management costs virtually nothing and does not depend on how much MSW they generate. As a result, they have no incentive to engage in source reduction or recycling. Reporting the full costs of solid waste management not only reveals what those costs are, but also can provide a basis for a system of FCA-based rates (e.g., unit-based fees). These fees, in turn, have a direct impact on generator behavior and can create incentives for source reduction and reuse.[14]

In reporting FCA information to the public, you might wish to:

- Tailor the report to the audience. Overly complicated reporting formats can confuse the audience and obscure the message.
- Adjust full cost estimates to recognize certain offsetting revenue streams.
- Consider different ways of putting the full cost of MSW into perspective.

This chapter discusses each of these topics.

Case in Point
Munster, Indiana

Munster, Indiana, was one of three local governments in Indiana that volunteered to demonstrate FCA under the new state law.[13] Munster (population 19,949) provides collection services to about 7,100 residential and commercial customers. Private vendors also collect waste from multi-family residences and commercial customers. Munster supplements weekly curbside MSW pickup with curbside sorting and pickup of recyclables. The town also contracts with a private vendor for a drop-off center, which handles about 2,000 tons per year. In addition, over 4,500 tons of yard waste are composted. The town owns its landfill, where 8,000 tons of MSW are brought per year. Munster reported the full cost of garbage/recycling services in 1991 as:

Garbage Collection	$196,647
Garbage Disposal	$765,761
Recycling	$233,145
Yard Waste Composting	$196,647
Full Cost	$1,392,200

Subtracting $50,000 of revenues from sales of recyclables and compost yields a bottom line of $1,342,200.

Tailoring the Report to the Audience

The public, management, and politicians are all potential "customers" for FCA reports. Different audiences are likely to have different interests and information needs. In deciding how to present information to these customers, you can focus on the cost questions they likely care most about:

- What does solid waste management cost the community?
- How much cash must be raised to cover the costs?
- What does recycling cost?
- How much money does recycling save?
- Why does (fill in the blank) cost so much?

Your community is likely to have other specific solid waste management questions as well. FCA will not provide answers to all of these questions. Concerns about how to pay for the costs and how to handle MSW, for example, go beyond the scope of FCA.

Overly complicated reporting formats can confuse the audience and raise more questions than answers. Keeping detailed back-up data can enable you to respond to more specific inquiries if they arise. The following criteria are important in producing good FCA reports:

- Brevity
- Readability
- Logical format
- Lack of jargon
- Use of charts
- Description of scope

A full cost report can be as simple as the following:

Full Cost Accounting

Solid Waste Management in Fullcostville

Full Costs in 1994 equal $1,072,147

This might be an adequate level of detail for your customers. If not, you might want to disaggregate the bottom line. Disaggregating full costs can have the following potential benefits:

- Enhances managerial and public understanding
- Highlights the resource mix used (e.g., labor vs. physical assets)
- Allows comparison of costs of component services
- Answers questions likely to be asked

If taken too far, however, disaggregating costs can obscure the big picture with too many details. Regardless of level of detail, it is important to carefully define what is included in the cost numbers so that people understand what the numbers mean. Accompanying text or footnotes can be helpful.

Keeping in mind the difference between costs and outlays, as described in Chapter 4, you might want to report outlays and costs separately, as follows:

Full Cost Accounting

Solid Waste Management in Fullcostville, 1994

	Total		Recycling		Landfilling
Cash Outlays	905,866		201,332		704,534
Non-Cash Cost	166,281		12,006		154,275
	$1,072,147	=	$213,338	+	$858,809

The distinction between (cash) outlays and (noncash) costs might be confusing for the general public, however. In addition, communities that purchase disposal services from vendors—whether businesses or other communities—and do not own their disposal facilities are not likely to have major noncash costs. Such communities might see less value in reporting cash outlays separately from non-cash costs.

Full Cost Accounting

Solid Waste Management in Cleancounty, 1994

Total		Collection		Disposal		Recycling
$2,936,937	=	$1,109,272	+	$1,326,885	+	$500,780

Some information can be difficult to interpret. For example, the format above might be confusing for a community that has collection programs for both mixed waste and recyclables.

The above example obscures how much of the collection cost of $1,109,272 is for recyclables collection and how much is for mixed waste collection. Because paths are mutually exclusive, reporting collection activities as a subtotal can be confusing whenever collection applies to solid waste intended for more than one path: recycling, composting, WTE, and landfilling. The same is true for activities such as transfer stations and transport, which might be used for solid waste heading toward different destinations, such as MRFs, composting facilities, WTE facilities, and landfills.

What Is the Necessary Level of Detail? If the purpose of presenting disaggregated information is to facilitate comparisons within your community about different programmatic options, then the full costs are better presented in terms of MSW paths. In that way, discussions about whether to expand or reduce recycling, composting, or WTE programs will be based on the actual economics of each path. If the purpose of presenting disaggregated information is to facilitate discussions about whether a service can be performed for your community at a better price by a different provider, then the full costs might be better presented in terms of MSW activities.

Adjusting Full Cost Estimates for Offsetting Revenue Streams

To be useful, FCA should recognize certain revenues associated with MSW management. Adjusting for revenues gives a more accurate picture of the net costs of MSW services. Net costs are the full costs of solid waste management minus revenue derived from the sale of by-products such as recyclables, compost, energy from waste, and landfill gas.

There are four types of revenues associated with MSW management:

- **By-product revenues** are generated from the sale of marketable products created as a by-product of solid waste management. Revenues derived from the sale of recycled materials, compost, and energy generated by a WTE facility and recovered landfill gas are by-product revenues.
- **Service revenues** are derived from fees charged for the amount of MSW services used, such as unit pricing for solid waste collection or landfill tipping fees. Local governments control the fee rate for services provided (e.g., the fee per trash container collected), but residents are charged only for the level of service they receive (e.g., the number of containers collected).
- **Assessed revenues** are derived from taxes or fees assessed in a manner that is unrelated to the level of service provided, as when property taxes or flat fees are used to fund solid waste management activities.
- **Transfer revenues** are funds provided by the state or federal government, whether as grants or some form of revenue sharing.

By-product revenues are an integral part of the economics of solid waste management because they are determined by market forces beyond the control of local governments. Market forces do not determine the other types of revenues; service revenues and assessed revenues result from fee and tax rates controlled by local governments. Similarly, transfer revenues are controlled by state and federal governments. Once the full costs and by-product revenues are known, you can calculate the level of service rates, assessed revenues, and transfer revenues needed to fund solid waste management.

By-Product Revenues. Exhibit 5-1 presents a format for recording the by-product revenues of solid waste management. By-product revenues should be available from sales records. Detailed information about the amount of each by-product material sold (e.g., tons per year) and the revenues per unit amount (e.g., dollars per ton) is not essential for FCA. You need to identify only the total by-product revenues (the shaded area in Exhibit 5-1) for recycling, composting, WTE, and landfill gas.

Exhibit 5-1

Full Cost Accounting: By-Product Revenues

Item	Units	Revenue/Unit	Total By-Product Revenue
Aluminum	#	$/#	$
Clear Glass	#	$/#	$
Colored Glass	#	$/#	$
Old News Print	#	$/#	$
Old Corrugated Cardboard	#	$/#	$
HDPE	#	$/#	$
PET	#	$/#	$
Steel	#	$/#	$
Total Recycling Revenues			$
Compost Revenues	#	$/#	$
Energy Revenues	#	$/#	$
Landfill Gas Revenues	#	$/#	$
TOTAL BY-PRODUCT REVENUES			$

Exhibit 5-2 illustrates the by-product revenues for a large community resulting from the sale of recycled materials, leaf compost, and WTE energy production.

Exhibit 5-2

Full Cost Accounting: Sample By-Product Revenues

Item	Units	Revenue/Unit	Total By-Product Revenue
Sales of Recyclables			
Aluminum	104	$801	$83,304
Glass	546	28	15,288
Steel	182	36	6,552
Newspaper	1,690	0	0
Plastic	78	108	8,424
Total Recycling Revenues			**$113,568**
Compost Revenues	**5000**	**2**	**10,000**
Energy Revenues	**260,000**	**27.5**	**$7,150,000**
Landfill Gas Revenues	**-**	**-**	**0**
TOTAL BY-PRODUCT REVENUES			**$7,273,568**

By-product revenues can be reported as a line item following the full cost estimate. In its simplest form, the FCA report can be presented as follows:

Full Cost Accounting

Solid Waste Management in Combustown, 1994

Full Costs	$9,290,073
By-Product Revenues	($7,273,568)
Net Costs	$2,016,505

If you report both the full cost total and subtotals for solid waste management paths, then the by-product revenues can be linked appropriately. Using the by-product revenue numbers from Exhibit 5-2 would produce a report based on MSW paths like the following:

Full Cost Accounting

Solid Waste Management in Combustown, 1994

	Recycling	Composting	WTE	Landfill	Total
Full Costs	$678,940	$49,283	$7,633,850	$928,000	$9,290,073
By-Product Revenues	(113,568)	(10,000)	(7,150,000)	0	(7,273,568)
Net Costs	$565,372	$39,283	$483,850	$928,000	$2,016,505

Reporting Costs of Solid Waste Management

There are countless ways to report FCA information. You can report the costs of your entire MSW program or its various paths and their associated revenues, as described above. You can report the net costs of managing solid waste per household or per ton of waste. Which method you choose will shape how residents understand the costs of MSW management in your community. Each method offers a different way of putting the costs of MSW management into perspective.

Although average costs, such as cost per household or cost per ton of waste, are a useful means of reporting costs, care should be taken in comparing the average costs of various activities or paths. Such comparisons must be made with caution so that they do not lead to erroneous and/or misleading conclusions.

Cost Per Household

Net cost per household is the net cost of MSW management per year divided by total households served. It can be used to indicate the amount of service fees and assessed taxes that must be collected on average from each household to pay for the full costs of solid waste management, taking into account by-product revenues. For example, you can estimate the number of mixed waste containers set out per household on average each year (i.e., average containers per collection times the average number of collections per year). Then, you can divide the annual net cost per household by the number of mixed waste containers per year per household. The result indicates the unit pricing fee per mixed waste container that would be needed to cover the full costs of solid waste management, assuming no reduction in the number of containers because of fee-induced increases in source reduction or recycling.

Case in Point
Franklin, Indiana

Based on its FCA report, Franklin, Indiana, calculated that garbage collection and disposal were costing $112.12 per household per year; after privatizing, the cost was estimated at $71.28 per household per year.[15]

Adjustments. If you are handling waste generated by other communities, you must adjust the full cost numbers to estimate the per household cost of managing your own wastes. For example, if 20 percent of the waste disposed of in your landfill is generated from outside your community, then the cost per household would be misleading if it includes costs for handling other people's waste. The adjustments do not eliminate the cost of managing other people's MSW; those are still real costs. These adjustments should not take into account any revenues received for handling waste from outside your community; from

Funding Needs Per Household

If your community receives transfer revenues from state and/or federal sources earmarked for solid waste services (e.g., grants for planning or implementing recycling), then it makes sense to recognize these revenues in determining the funding needs for the program. A similar logic applies to revenue derived from fines. However, it is appropriate to recognize these revenues only when estimating funding needs, however. Likewise, certain costs recognized in FCA may not be relevant for a community's assessment of its financing needs.

the FCA perspective, it is appropriate to back out these costs, regardless of how much is reimbursed. The cost of MSW management and the net cost per household are not affected by such payments and therefore should be offset by by-product revenues alone.

To make this adjustment, you can subtract the marginal costs of managing other people's waste from the full costs before dividing by the total number of households. Alternatively, you can subtract the average cost of managing other people's waste from the full cost before dividing by the total number of households. Dividing the full cost of the activity (e.g., landfilling) by the total number of units handled (e.g., tons) yields the average cost per unit. This cost can be multiplied by the total number of units of other people's waste to determine the average cost of managing other people's waste.

Although net cost per household gives a useful perspective on the full costs of solid waste management, it is not necessarily a meaningful basis for comparing solid waste management activities or paths. One reason that such comparisons might be inappropriate is that net cost per household is heavily influenced by the proportion of waste managed along a particular path. For example, if your recycled waste (say 25,000 tons) is one-half of your land disposed waste (50,000 tons), and the cost per ton is the same for both activities (say $100 per ton), then the net cost per household for recycling will be one-half of the net cost for land disposal (i.e., half as many tons times the same net cost per ton). Therefore, "net recycling cost per household" will be one-half of the "net land disposal cost per household" only because recycling manages half as much waste. This sheds no light on the inherent economics of either recycling or land disposal. Thus, while net cost per household can be useful in putting total costs into perspective, net cost per ton is a better basis for comparing solid waste management activities or options.

Cost Per Ton

Cost per ton is the net cost divided by the tons of waste managed. Cost per ton can be used in evaluating whether to perform an activity in-house or contract out. It can help you compare different bids or proposals from outside contractors to perform a waste management activity. Cost per ton also is a handy benchmark for similar activities that can be accounted for separately. For example, a municipality might track and compare costs for two or three separate transfer stations; a county using several haulers might want to compare their costs. On the other hand, making comparisons of different activities within the solid waste system on the basis of cost per ton (or otherwise) is not recommended because the results often will be incomplete or biased.

- Comparing the cost per ton of a MRF to a landfill activity omits the significant costs of collection (and transfer and transport costs, if any) that must be incurred to bring MSW to those facilities.

- Comparing the costs per ton of recyclables collection to mixed waste collection omits the costs of transfer, transport, and processing the materials. Moreover, because recyclables might differ significantly from mixed waste in volume, weight, and quantity per household, interpreting collection cost comparisons of recyclables to mixed waste should be done with care.
- Comparing landfills and alternative MSW facilities should recognize that costs are incurred to dispose of non-recyclable residues from recycling, composting, and WTE facilities.

Therefore, this *Handbook* recommends that comparisons that cut across the activity columns in Exhibit 2-1 be made on the basis of complete paths. Because paths are mutually exclusive, cost per ton is a very useful basis for comparing full costs. Comparing the average cost of one path to another should be done with care, recognizing that average costs reflect economies of scale.

Whether used for activities or paths, however, cost per ton is a one-dimensional yardstick that might need to be supplemented by other appropriate considerations, particularly when making projections about the cost impacts of changes to how you manage MSW. Full cost data must be used with care in making projections of what waste management will cost if your community significantly changes its current waste management strategy. Moreover, while full cost statistics reveal what waste management costs your community, it does not reveal what waste management should cost.

Exhibit 5-3 illustrates how to calculate the net costs per ton of solid waste management paths. This format allows you to evaluate the total costs and net costs of each solid waste management path. The total cost of each path can be calculated by adding overhead costs to activity costs. You can adapt this format to examine or report the comparative costs of different solid waste management paths, both with and without overhead costs.

Using Cost Per Ton for Projections. You should exercise caution when drawing management or planning conclusions (e.g., budget projections) from net cost per ton comparisons. Cost per ton information should not be the sole basis for making projections of costs or cost savings expected from *changes* in the way you deal with solid waste. For example, if the net cost per ton of the recycling path (including recycling collection and residual disposal costs) is $90, and the net cost per ton of the land disposal path (including mixed waste collection, transfer, and transport) is $95, then you should not assume that you can save $5 per ton in the short run by recycling more tons and sending less waste to a landfill. At a minimum, you need to estimate variable and fixed costs to make such projections. Variable costs include primarily operating costs that can be avoided in the short run. Fixed costs include primarily capital costs that cannot be avoided in the short run.

Exhibit 5-3

Full Cost Accounting: Summary of Costs per Ton for MSW Paths

Costs	Recycling Path	Composting Path	WTE Path	Disposal Path	Total
Activity Costs:					
Collection					
Transfer Station(s)					
Transport					
Facility					
Residuals Disposal					
Education/Outreach					
Overhead Costs					
Total Costs					
By-Product Revenues (subtract)	( )	( )	( )	( )	( )
Net Costs					
Tons Received (divide)					
Net Cost Per Ton					

Role of Variable vs. Fixed Costs in Near-Term Cost Projections. FCA results can be used to estimate the cost or savings of changes in the near term in the mix of waste flows through the solid waste management system only if all costs are variable.

- When you pay a per-ton tipping fee for land disposal at a landfill owned by another entity (e.g., a private waste management firm), then land disposal can be (depending on contract terms, if any) an entirely variable cost because disposal costs to the local government vary directly with waste disposal tonnage.
- However, if you own your landfill, then only a portion of land disposal costs actually will be reduced when waste is diverted (e.g., through recycling), because variable costs account for only a portion of total land disposal costs. The remainder is fixed costs.

The variable cost portion of land disposal costs includes outlays for operation and maintenance and other outlays that could be reduced quickly in response to lower waste disposal tonnage, thus reducing costs. The fixed cost portion includes interest, depreciation, and amortization for landfill capital outlays, up-front, and back-end costs, and other outlays (e.g., security) that could not be reduced quickly in response to lower waste disposal tonnage. In fact, the outlays represented by depreciation already have been paid in full, which is why

they are fixed costs. Interest payments on capital assets also are fixed costs, because they are not reduced or deferred when those assets are used at less capacity or left idle. In the short run, by definition, there is no way to avoid fixed costs.

A similar logic applies to the other activities involved in the recycling and landfilling paths. For example, when you franchise or contract for waste collection, then collection costs might be entirely variable (depending on the terms of the franchise or contract). When you own the trucks and perform collection yourself, there might be fixed costs that are incurred regardless of the amount of waste actually collected.

Role of Variable vs. Fixed Costs in Long-Term Cost Projections. Although there generally is no way to avoid fixed costs in the short run, a permanent and predictable extension in the expected life of a landfill (e.g., through waste diversion) can produce both accounting and economic benefits. Planners are developing methodologies for valuing the economic benefits of extending landfill capacity, which is a topic beyond the scope of this handbook. A program (e.g., recycling, composting, WTE) that can be expected to significantly extend landfill life in a reasonably predictable way can be recognized in FCA terms.

Although accountants frown on making frequent adjustments to depreciation and amortization schedules, they would likely view extending landfill depreciation schedules to reflect waste diversion as legitimate, unless the landfill life extension were due to reduced waste disposal volumes resulting from cyclical downturns (e.g., recessions) that are neither permanent nor predictable. GASB 18,[16] summarized in Chapter 4, currently requires recognition of future closure and post-closure costs based on annual use of landfill capacity. Waste diversion would reduce the amount of closure and post-closure costs appropriately recognized in a given year. Lengthening depreciation schedules has the effect of "reducing" some of the fixed costs by spreading them over a longer period. Alternatively, if depreciation schedules are not extended to match the lengthened useful life of the landfill, the fixed costs due to interest and capital depreciation will disappear for the final years of the facility's extended life, once they have been fully recognized. In long-term cost projections, therefore, all landfill costs can be treated as variable, because their magnitude can be affected by the level of operations at the land disposal facility.

This means that you can use FCA numbers for making rough projections of the long-run cost implications of different MSW paths without needing to take into account variable vs. fixed costs. In making projections, keep in mind that FCA numbers may reflect a mix of both current operating costs and current costs of the use of assets purchased in the past, which do not reflect inflation-adjusted replacement costs. Moreover, there are better bases for making cost projections for significant changes in MSW programs (see pages 53 through 58).

Fixed vs. Variable Costs and Overhead. Overhead costs might have a relatively smaller fixed cost component or might be treated as fully variable and assigned using formulas that reflect variable costs (budgets, personnel, waste quantities, number of vehicles, etc.). On the other hand, overhead costs might be treated as largely fixed, because they will not be reduced by changes in how waste is managed. While overhead might be viewed as fixed in the short run, in the long run, as overhead functions are made more efficient or perhaps eliminated, overhead costs may be variable.

Avoided Cost

The concept of *avoided cost* can arise when describing the costs of solid waste management activities and paths or making management decisions about future changes in the solid waste management system in your community. Avoided cost often is used in reference to land disposal. The avoided cost of (i.e., due to) MSW following the recycling, composting, or WTE path is considered to be equal to the cost reductions, if any, in MSW collection, transfer, transport, and land disposal (i.e., the land disposal path). Land disposal is the best basis for defining avoided cost, because only some portions of the waste stream are recyclable, compostable, or combustible, but all solid waste can be buried in a landfill. Therefore, every ton of waste that is recycled, composted, or combusted, less any residues, is a ton of waste that does not require land disposal. The avoided cost due to these other waste management paths can be thought of as the avoided cost of the land disposal path.

Avoided Cost Do's and Don'ts

If recycling costs $100 per ton and land disposal costs $90 per ton, it would be:

Correct to Say	Incorrect to Say
• Recycling costs an extra $10 per ton compared to land disposal	• Recycling costs only $10 per ton, given the land disposal costs avoided

Estimates of avoided cost can easily be misused. Much depends on whether the focus is on (1) specific MSW activities or paths, (2) the total costs of the entire system for handling MSW, (3) near-term marginal changes, or (4) longer-term major changes to the MSW program.

Costs of MSW Activities or Paths. With respect to a particular waste management activity or path, a common pitfall is to subtract the avoided cost of landfilling from the cost of an alternative to landfilling (e.g., recycling, composting, or WTE). For example, if the net cost of recycling is $100 per ton and the net cost of land disposal is $90 per ton, then it is incorrect to subtract $90 from $100 and conclude that "the net cost of recycling is $10 per ton after taking into account the avoided cost of landfill disposal." This mistake is a sure prescription for disappointing local governments and residents who must pay $100 per ton for the net cost of recycling, after taking into account by-product revenues received from the sale of recycled materials. The full costs per ton of recycling, composting, or WTE are not affected by any resulting avoided costs of landfilling. Any avoided costs of land disposal do not themselves reduce the costs of recycling, composting, or WTE. Therefore, avoided costs of land disposal should not be subtracted from the net cost of recycling in this example. This is true even when the costs of land disposal are fully variable, because land disposal is purchased from a vendor on a unit basis.

Total MSW System Costs. While it is misleading to adjust the costs of recycling, composting, and WTE to reflect land disposal costs avoided, the MSW system as a whole will incur reduced land disposal costs as a result of landfill diversion programs. These avoided costs are real. Any avoided costs of land disposal will be reflected in new calculations (or projections) of total MSW system costs following changes to the MSW program. Bear in mind that because avoided costs are not revenues, they do not necessarily reduce the total costs of MSW management or the fees and taxes that residents must pay for solid waste management. However, the total costs for managing solid waste in the community will reflect both costs avoided and costs incurred as a result of incorporating alternatives to land disposal into integrated solid waste management. The

difference between the total cost of managing solid waste with and without an alternative program is known as the incremental, or differential, cost of the program.

Short-Term Marginal Changes

For short-term marginal changes, better cost projections will result from consideration of fixed and variable costs than from using the full cost estimate alone. FCA can help you estimate fixed and variable costs using rough rules of thumb, which may be sufficient when considering short-term marginal changes in levels of activity.

Near-Term Marginal Changes. The avoided cost of marginal, short-term changes in land disposal can be estimated by analyzing the fixed and variable cost components of MSW collection, transfer, transport, and land disposal. The "avoided cost" in the short term will be no greater than the variable cost. In other words, fixed costs cannot be avoided in the short term. Using the term avoided cost in this context can lead to confusion, because it implies that costs have been avoided absolutely, thus reducing total MSW program costs. As noted above, this is not necessarily true. Rather, in the short term, one set of costs (e.g., landfilling) has been more or less replaced by another set of costs (e.g., recycling). Any potential total system cost reduction derives not from the absolute amount of the variable landfill cost "avoided" but from the difference in (1) the size of the variable cost component of land disposal and (2) net costs of landfill alternatives. This is true even if land disposal is fully variable in cost, as shown in the table below.

(a) Net Recycling Cost/Ton	(b) Net Land Disposal Cost/Ton	(c) Land Disposal Variable Cost/Ton	(d) Net Total Cost Saved/Ton [(c) minus (a)]
$100	$90	$90	($10)
$100	$90	$60	($40)
$100	$90	$30	($70)

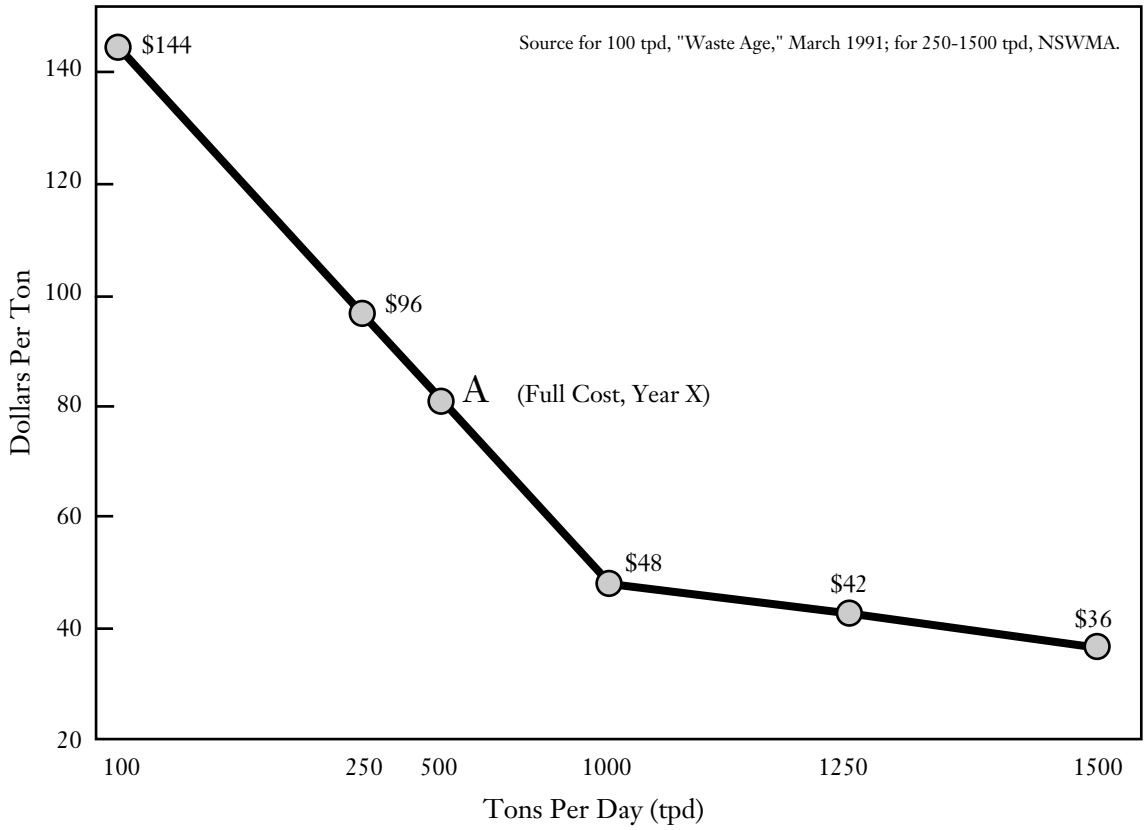
The table compares three scenarios. In each, the net cost of recycling [column (a)] is $100/ton, and the net cost of land disposal [column (b)] is $90/ton. The only difference is in the amount of variable costs [column (c)]. When land disposal costs are fully variable, the net cost saved [column (d)] is -$10/ton, the difference between the $90/ton variable cost of land disposal and the $100/ton cost of recycling. This means that total costs will increase by $10 for each additional ton of waste recycled. When only $60/ton of land disposal is variable, the net cost saved is -$40 per ton, the difference between the $60/ton variable cost of landfilling and the $100/ton cost of recycling. When variable costs constitute $30/ton for landfilling, the net cost saved by recycling is decreased to -$70/ton. In each case, the variable cost of landfilling is "avoided" in the short term but replaced by the greater (in this example) net cost of recycling.

Long-Term Major Changes. If the increase in MSW to be diverted from the land disposal path is significant (i.e., more than a marginal change), a projection of avoided cost based on the current costs of landfilling might overstate savings because landfill diversion and other factors can significantly increase

future unit costs of land disposal. The cost following a major program change will depend on economies or diseconomies of scale, which can be thought of as falling on a "cost curve."

Exhibit 5-4

Economies of Scale at Landfills



A "cost curve" relates the per ton cost of an activity or path to the scale of that activity or path. In general, the greater the volume of units processed, the lower the per unit cost because fixed costs can be "spread" over more units and more efficient technology can be applied. This effect is referred to as "economies of scale." The per ton cost of MSW activities or paths in the long run will reflect their relative economies of scale. Exhibit 5-4 illustrates a cost curve for the current costs of land disposal. As shown, economies of scale begin to level out for land disposal facilities processing between 750 and 1,500 tons per day; in other words, the cost per ton decline is relatively small in this area. On the other hand, economies of scale are strong between 100 and 250 tons per day; the cost per ton is very sensitive to the volume of waste disposed. Point A on the curve represents the full cost calculation for a given year at a particular

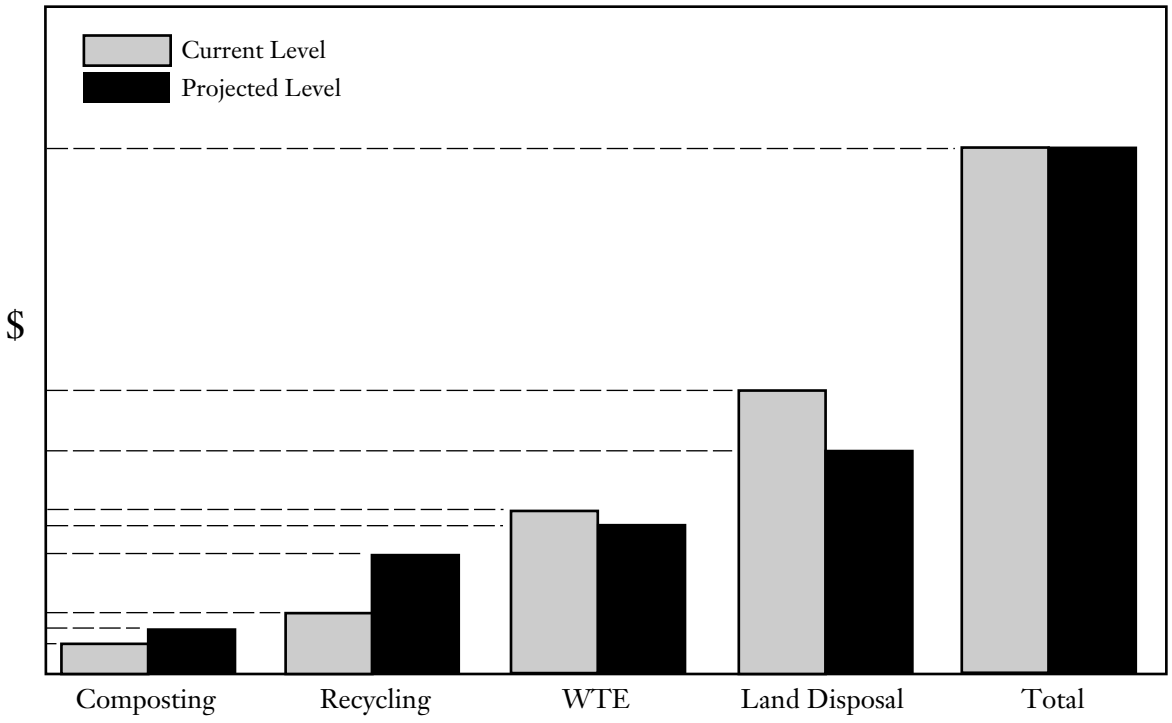
scale of operations. For planning and management purposes, a single point might be a poor basis for extrapolating and projecting future costs, particularly if major changes are contemplated in the volume of waste to be handled.

Projecting the long-term costs of activities or paths that communities might want to increase or decrease (e.g., long-term avoided costs of land disposal) is best done on the basis of a cost curve, which takes scale economies and diseconomies into account. Depending on the shape of the cost curve, unit costs per ton might decrease more or less steeply with increasing volume, due to economies of scale. Although FCA can identify a point on the curve (e.g, point "A") and help estimate variable and fixed costs for projections of the effects of marginal changes, FCA alone is an insufficient basis on which to draw the cost curve and project long-term costs and cost savings from major changes to the MSW system. Unfortunately, data to construct an appropriate cost curve for a community might not be readily available.

If the focus is on projecting the total cost of the entire system for handling MSW in the long run, avoided cost can refer to the total reduction in full costs of landfilling associated with the smaller volume of MSW sent directly to land disposal. Depending on the shape of the cost curve, the total cost of land disposal might decrease with lower volumes even as the unit cost per ton rises. Whether your community as a whole experiences reduced total costs depends on how the total avoided cost compares to the total increase in the costs of the alternatives to direct land disposal. Again, while the per ton cost might decrease with greater volumes processed, the total cost of the landfill alternatives likely will rise as their volumes of MSW handled increase. Exhibit 5-5 illustrates how a projected shift in the handling of waste can result in avoided costs of land disposal and WTE that together offset increased costs for greater levels of composting and recycling. The net result, in that example, is that total costs remain the same. Other scenarios are possible, however. Although FCA can provide a point on the cost curve and facilitate estimates of fixed and variable costs, planners and managers will want to estimate the shape of the cost curve, or other points on it, if more than marginal changes in waste management practices are being evaluated.

Exhibit 5-5

Current Full Costs and Cost Projections



Avoided Replacement Cost

The *avoided replacement cost* is the net cost that you expect to pay for land disposal when a new landfill or landfill contract is necessary. Although avoided cost can be calculated from FCA reports for current operations, estimating future avoided replacement cost requires some additional research beyond a review of your own accounting records. Full exploration of the concept of "avoided replacement cost" is beyond the scope of this *Handbook*. The following discussion is intended as an overview.

Many local governments have relatively low current land disposal costs associated with existing landfills that might close. Avoided replacement cost recognizes that (fixed) costs might increase when older facilities are replaced with newer ones. For example, depreciation and interest costs for older equipment and facilities are based on capital outlays made years ago, without any adjustment for inflation. Any inflation since the time of those outlays will mean that new facilities and equipment will require larger capital outlays, which will result in higher depreciation and interest charges. Also, older equipment and facilities might incur no interest costs if they have been paid off in full and might record no depreciation costs in their last years if their useful life turned out to be longer than the estimate used to fully depreciate the original outlay. Finally, facilities such as landfills and WTE facilities might be especially likely to incur higher replacement costs due to the cost of new environmental requirements. In this situation, local governments might want to research and estimate the replacement cost for land disposal at a new landfill or another existing landfill, including any additional costs for transfer and transport if the new landfill would be further away. This estimated future cost for land disposal can be used as a rough measure of the avoided replacement cost due to recycling and other waste management paths, to the extent that such efforts extend the life of the low-cost landfill and delay the higher replacement cost for land disposal.

- For example, if the net cost of recycling is $100 per ton, and the net cost of land disposal is $90 per ton, then the avoided cost due to recycling can be no more than $90 per ton, and there is an incremental cost of at least $10 per ton for every ton of waste that is recycled.
- When the capacity of the local landfill will be exhausted, and the net cost of land disposal at another landfill will be $120 per ton, then the avoided replacement cost due to recycling is $120 per ton. Every ton of waste recycled extends the life of the existing low-cost landfill and delays the $120 per ton replacement cost for land disposal. Therefore, recycling might impose an incremental cost of at least $10 per ton in the short run, but it might provide an incremental benefit of up to $20 per ton in the long run.

You can compare the replacement cost per ton for land disposal to your current net cost per ton for other MSW paths in Exhibit 5-5. If the replacement cost per ton for land disposal is higher than the net cost per ton for other waste management paths, then these paths are providing a long run incremental benefit to local residents, even if these paths create an incremental cost in the short run.

Management and Planning Applications for Full Cost Information

This *Handbook* does not explore the many potential applications of FCA data to management and planning issues, such as design of cost-based user rates (e.g., unit-based pricing), identification of potential cost-savings from process redesign, privatization/outsourcing decisions, and so on. The previous sections have addressed some of the issues that can arise in making comparisons and cost projections based on FCA numbers. Exhibit 5-6 illustrates, for a set of hypothetical cost information, the types of comparisons that can be made and lists the key concepts relevant to each type of conclusion. However, these concepts might be defined and used differently by other organizations and experts; there is no standardized terminology.

Exhibit 5-6

Comparing MSW Costs: Key Concepts for Managers and Planners

Cost Information		Key Concepts	Conclusions
		Full Costs	• Recycling x tons costs $10/ton more than land disposal of x tons
Recycling		Variable and Fixed Costs	• In the near term, increased recycling might add $50/ton to total costs, recognizing fixed costs of land disposal
Net Full Costs	$100/ton		
Land Disposal		Full Costs	• The net cost of recycling x tons should be only $10/ton greater than the net cost of land disposal of x tons in the long run, when all costs are variable
Net Full Costs	$90/ton		
Net Variable Costs	$50/ton		
Net Replacement Costs	$110/ton	Avoided Replacement Cost	• In the next few years, or when it is necessary to replace exhausted landfill capacity, recycling x tons will cost $10/ton less than landfilling