Pricing Municipal Services: The Economics of User Fees

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ABSTRACT

User fees for municipal services may generate revenue for municipalities and their utility commissions, but they are equally important as prices for those services. Pricing services at marginal cost can lead to efficient production and consumption of the service, and efficient allocation of the service when capacity limits are reached; and it can help to guide investment on an efficient basis. Marginal costs should never be lower than operating costs and may be much higher in certain situations. It is important to include opportunity costs and environmental costs in the calculation of marginal costs. These principles are illustrated with respect to waste management and water supply services.

KEYWORDS: FEES ■ WASTE DISPOSAL ■ WATER ■ UTILITIES ■ PRICING ■ MUNICIPAL

INTRODUCTION

As governments have responded to public pressure to reduce taxes, public spending at all levels in Canada has been constrained, reducing the ability of municipal agencies to fund their services. These developments have led to increased interest in user fees as an alternative to taxation for funding municipal services. This paper looks at user fees from the perspective of the economics discipline, identifying principles that may offer some guidance for the design of such fees.

I argue that for some services, user fees are not only feasible but economically desirable, because they help to allocate resources to maximize the satisfaction that we receive from those resources. User fees can constrain demand at a time when it is very expensive to expand supply. User fees can help to mediate situations where users are clamouring for more service and the agency does not have the resources to meet that increased demand. User fees can even help to deal with demand that varies greatly over time, through their tempering effect on such variations.

While the main message of the paper is supportive of user fees, some caveats are in order. The two examples explored here, waste management and water supply, are services for which the principal beneficiary is the consumer. Both present some

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opportunity for consumers to save costs by reducing their consumption of the service. There are other public services, such as schooling, however, for which there are strong positive externalities, leading to arguments for substantial or even complete public subsidy. I do not argue that we should charge for all services, only that we should charge user fees for some.

Another caveat, not developed in the paper, is that if user fees are established, they should be consistent among users. When public bodies set prices, there is often pressure to give special prices to special interest groups. Politically influential individuals or groups may demand a discount or a special rate. In general, such demands should be resisted. If the rationale for user fees is sound, they should be implemented as uniformly as possible, for both efficiency and equity reasons. If one set of users is thought to be particularly needy, those consumers could be given independent subsidies rather than reduced rates, so that the subsidy is transparent and the price is not distorted.

ECONOMIC PRINCIPLES FOR PUBLIC SERVICE PRICING

Achieving Economic Efficiency

Economists have identified several conditions that must be met for public enterprises to maximize the welfare of the public whom they serve. The first is allocative efficiency. Allocative efficiency arises when the efficient level of output is produced, and that occurs when the cost of the last unit produced just equals the value of that unit.[1] The true cost of an added unit of output is the variable cost or "marginal cost." If we price a service at the marginal, or variable, cost of provision, users will face a price that represents the cost of the service. If the value of the service to a resident is equal to or greater than the cost of provision, the resident will consume it. If the value of the service is less than the cost of provision, she will not consume it. Each resident can adjust his or her consumption in response to the price, so that the last unit of the service consumed is valued at the price, which equals the marginal cost of supply.

Setting the price at any other level will lead to waste of one sort or another. If the service is priced below marginal cost, some users will consume it even though it costs more to supply them than the service is worth to them. It is wasteful to produce something for a consumer who values it at less than the cost of production. Alternatively, if the service is priced above marginal cost, some residents will be discouraged from consuming it even though the value of the service to them exceeds its marginal cost of production. Those residents are deprived of something for which they would willingly pay more than the cost of production. Again, society loses.

Of course, some services are not subject to this principle. Most of us believe that the benefits of schooling extend not only to the student but to society at large; therefore, our governments provide public schooling at no charge through high school. Indeed, we are so convinced of the value to society and to the individual of

this schooling that we compel our children to attend school for many years. In this case, the positive externality of the service renders the marginal cost pricing principle irrelevant. However, for services whose benefits accrue principally to the consumer, marginal cost pricing retains its attraction; it allocates resources efficiently, and it delivers goods and services to those who value them most highly.

The second condition for maximizing the welfare of users of public services is rationing efficiency. If there is a limit on the amount that can be produced, it is important to allocate those units of production to the users who value them most. To do otherwise is to lose value that could be achieved by reallocation. Rationing efficiency means that in times of shortages, the price should be above the marginal cost of production. If the water system or electrical system has reached its capacity, the product may have to be priced above marginal cost in order to allocate the limited supply efficiently to those who value it most.

The third condition is cost efficiency. This means that the output should be produced at the minimum social cost. Cost efficiency requires that there be no waste in the production process and that investment in plant and equipment be made judiciously to minimize the total cost of producing the efficient amount.

Complications for Marginal Cost Pricing

For goods and services produced under conditions of constant costs, marginal cost pricing may be applied with only the usual difficulties associated with trying to determine those costs accurately and fairly. However, some public services are natural monopolies for which there are economies of scale, so that marginal cost is below average cost. In other words, a price equal to marginal cost will not cover the fixed costs of providing the service. In older cities, the infrastructure that provides the service may require renovation or rebuilding at tremendous cost. How are those costs treated in an efficient pricing scheme?

There are at least three approaches to paying for fixed costs or capital costs. One is to use a two-part tariff that includes a subscription fee or customer fee for access to the service and a marginal cost price for each unit consumed. The two-part tariff is common for telephone, gas, and electric services, for example. The marginal cost price for each unit of consumption ensures that the right amount is consumed so that allocative efficiency is achieved, while the subscription fee collects revenue to pay for fixed costs, without distorting consumption decisions.

A second approach arises from the second condition mentioned above, which requires that at times when consumption presses on capacity, the price should be raised to allocate the limited supply efficiently. This approach justifies a price above short-run marginal costs whenever consumption is at or close to capacity. Peak-load pricing, time-of-use pricing, and seasonal pricing are all mechanisms to implement this approach and to provide additional revenue that will help to cover fixed costs.

A third approach is to set prices sufficiently above marginal costs to pay for capital costs. Since prices will now be too high, there will be inadequate consumption of the good. The lost satisfaction arising from this reduced consumption can

be minimized, if there are several classes of consumers, by raising the price most for those whose demand is most inelastic—meaning that they will not reduce their consumption much in response to the high price. This is referred to in the literature as "Ramsay pricing."[2]

Pricing that varies from year to year or more frequently in response to capacity utilization may be unpopular with consumers. An alternative is to use long-run marginal cost pricing, in which the price is set high enough to cover the incremental cost of capacity expansion to serve added demand. By definition, this price should be sufficient to cover capital costs. If the service is one for which demand is time-varying, such as the demand for municipal water, the price can be set at short-run marginal cost in the off-peak season and at long-run marginal cost in the peak season. This "peak-load pricing" will help to constrain demand at the peak time, thus postponing the need for investment in additional capacity, while allowing increased use of the service when its marginal cost is low.

Two further elements in marginal cost pricing are externalities and opportunity costs. Externalities are physical effects that do not involve a market transaction. Pollution discharge is a common form of externality; the polluter does not pay for the harm that its discharge causes. Economic theory dictates that marginal costs should really represent marginal social costs, including any external costs caused by production. Thus, if the deposit of waste in a landfill causes environmental harm (smell, nuisance birds, water pollution), the value of that harm should be included as part of the marginal cost of waste disposal. Opportunity cost is the value of a scarce resource in its alternative employment. The meaning of this concept will become apparent in the discussion below of pricing for landfills and for water resources.

While economists generally agree that marginal cost pricing is efficient, the above discussion reveals that more than one concept of marginal cost may be relevant and that, in some cases, something other than marginal cost may be relevant. Also, since marginal cost is an economic concept, not an accounting concept, considerable effort may be required to determine marginal costs from accounting data. Worse yet, some costs—such as joint costs or fixed costs—are not easily allocated to an activity and there is no easy way to resolve disputes over how these should be treated. Finally, political or practical imperatives may prevent marginal cost pricing even in cases where we can agree what that means. In these circumstances, a second-best pricing scheme must be designed which meets those imperatives without sacrificing more efficiency than is necessary. Thus, the pricing problem may be complex to resolve in practice and may require careful deliberation and study.

Disciplining Investment Through Pricing

As stated earlier, the third condition for efficiency is cost efficiency. In many cases, public utilities receive their capital funding from general public revenues. When funds are plentiful, utilities may overinvest in excess facilities or facilities that cost more than necessary to satisfy the anticipated demand. When funds are tight, utility capital budgets may be starved, causing high maintenance costs, inadequate service, or inadequate capacity. If capital costs are paid through user fees, capital investments

may be made when the utility can persuade the public that the investment is necessary for the public interest. The need to justify the expenditure to customers may provide some useful discipline on investment.

With respect to investment in capacity, if consumers are required to pay for new investment through a price equal to long-run marginal cost, at least during peak periods, they will restrain their demand to levels at which the value of additional consumption to them is as great as the cost of providing the necessary capacity. In addition to limiting peak-period demand, long-run marginal cost pricing will discipline investment in new capacity. If the agency must charge the full capacity cost to peak-period users, it will not invest beyond the capacity that is justified by consumer demand. By the time that demand is pressing on capacity, even at long-run marginal cost prices, the revenue from that demand will be sufficient to finance the needed capacity expansion.

APPLICATION: WASTE MANAGEMENT

Municipalities must generally make two pricing decisions with respect to waste management services. The first is the price paid by the user for waste pickup. The second is the price paid for putting waste into a landfill (the tipping fee).

Large industrial, commercial, and institutional firms often are required to arrange and pay for their own waste disposal services. The residential sector, however, is generally served by a monopoly operated either by the municipal government itself or by a private contractor hired by the municipality. Usually, municipal waste collection is paid for from tax revenues. However, this means that the price per kilogram of waste discarded by a household is zero, which is clearly not the marginal cost of the service. A zero price to the user means that the user will discard more waste than if the service were properly priced. The alternative is a user-pay program, which may approximate marginal cost pricing, thus achieving one of the conditions for efficient waste management.

User-pay programs require customers to pay for the pickup of general waste based on its volume or weight, rather than through general tax levies that are unrelated to quantities of household waste. User-pay programs provide a means of financing waste collection and disposal, and they give consumers a financial incentive to reduce waste disposal through source reduction, reuse, and recycling. User-pay programs have been adopted almost exclusively in jurisdictions where there is already a recycling program in place, giving residents an alternative to placing all items in the garbage. Some user-pay programs require customers to purchase special tags that must be attached to a garbage bag before it will be picked up. Alternatively, customers purchase specially marked garbage bags. In some programs, each tag or bag carries the same price; in others, customers receive an allowance of, for example, one free tag or bag per week per household and purchase additional tags or bags as needed. A second type of user-pay program requires the customer to place all waste in a special container and to pay a fee for each container set out. A third type of program requires customers to subscribe to one or more containers and to pay a monthly fee based on the volume of these containers,

which may be set out once a week. Finally, some jurisdictions weigh the waste as it is picked up and bill the customer for the actual weight collected. Charging by weight rather than by volume allows each customer to pay only for the exact amount of waste disposed of, rather than paying for integral bags or cans.[3]

There have been a number of studies of the effects of user-pay systems in Canada and the United States (see table 1). In most cases, free (tax-supported) garbage pickup was compared with a per-bag fee averaging about $1.00 per bag but ranging from $0.68 to $2.00. Most of the studies measured the reduction in tonnage of regular garbage collected, and many measured the increase in the collection of recyclables. Miranda et al. found average reductions in waste volumes of 34 to 43 percent arising from per-bag fees in 21 US cities with less than 50,000 population.[4] A subsequent study of five communities in the Midwest and four cities in California found that pay per bag was somewhat more effective in reducing waste than were monthly subscription fees for garbage carts.[5] Skumatz reports that Seattle diverted 24 percent of its waste as a result of imposing a subscription user-pay system and that total waste management costs were reduced as well.[6] Seattle has continued to reduce its waste disposal volume with the addition of curbside recycling and more sophisticated charging for waste collection. Word, Higginbotham, and Pluenneke report that the introduction of a subscription fee per can based on can size reduced waste disposal in Austin, Texas by 23 percent, increasing recycling in general and yard waste separation in particular.[7]

Many jurisdictions express concern about increases in littering and illegal disposal, but these problems have been controlled in most areas where user-pay has been adopted. However, it is recognized that there are areas or building types for which user-pay cannot be adopted because the likely cost of enforcement would be too great.

The studies described above reported reductions in solid waste tonnage collected ranging from 14 to 47 percent. In most cases, there was a substantial increase in recycling tonnage, although this increase did not fully explain the reduction in garbage tonnage. It appears, generally, that consumers increased recycling, generated less waste, and increased the use of other options such as composting.

An Ontario Ministry of Environment and Energy study of recycling programs in the Greater Toronto Area (GTA) estimated that a $1.00 per-bag fee for residential waste collection would divert an additional 4 to 14 percent of materials from the waste stream.[8] It implied that adding a user-pay feature to the existing Ontario recycling program would impose net recycling costs not greatly different from the savings in waste collection and disposal, and would significantly increase recycling volumes.

User-pay programs involve additional costs for publicity, tag printing, distribution, administration, enforcement, and interacting with the public. Word, Higginbotham, and Pluenneke refer to information costs of $5 to $6 per household, but do not estimate ongoing annual costs.[9] These added costs would have to be considered in evaluating a user-pay program.

For economic efficiency, user fees should cover the marginal social costs of waste collection and disposal. Unfortunately, these costs are not well documented.

TABLE 1 Summary of User-Pay Studies

City/municipality	Year	Fee	Effect: weight (wt.), volume (vol.)
Craven Cty, N.C.	1991	$1.25/33 gal.	RCL wt. up 1 lb./setout
Charlottesville, Va.	1992	$0.80/32 gal.	SW wt. –14% SW vol. –37% RCL wt. +16%
Various US (9)	1980-1988	$0.67 to $1.73/32 gal.	SW wt. –15% from $1.00 fee
21 small US	1985?-1991	$0.68 to $2.00 avg $1	SW wt. –34% SW wt. –43% SW wt. –34%
5 Midwest, 4 Calif.	1988-1992 1992-1993	$0.85-1.56/bag $6-15/cart/mo.	SW 0 to –35% SW 0 to –20%
Tompkins County, N.Y. ...	1990	$0.70/bag	RCL rises with price
Gananoque, Ont.	1991	$1/bag; 2 for 1 RCL-vol. drop	SW wt. –40% RCL up despite vol. drop
Sidney Township, Ont.	1994	$1.50/bag	SW wt. –47%
Seattle, Wash.	1981-1987		SW wt. –24%
Austin, Tex.	1991	mthly subscription: $6.48/30 gal. $9.72/60 gal. $12.96/90 gal.	SW –23%
OMOE forecast	2000	$1.00/bag	SW –4% to –14%

RCL = recycling; SW = solid waste.

Sources: References for each study, in the order presented, are as follows: Robert Bracken, "Volume Based Collection: North Carolina County Institutes Sticker System" (1992) vol. 33, no. 2 *BioCycle* 35-37; Don Fullerton and Thomas C. Kinnaman, *Household Demand for Garbage and Recycling Collection with the Start of a Price Per Bag*, NBER Working Paper no. 4670 (Cambridge, MA: National Bureau of Economic Research, October 1993); Robin R. Jenkins, *The Economics of Solid Waste Reduction: The Impact of User Fees* (Brookfield, VT: Edward Elgar, 1993); Marie Lynn Miranda, Jess W. Everett, Daniel Blume, and Barbeau A. Roy Jr., "Market-Based Incentives and Residential Municipal Solid Waste" (1994) vol. 13, no. 4 *Journal of Policy Analysis and Management* 681-98; Marie Lynn Miranda and Joseph E. Aldy, *Unit Pricing of Residential Municipal Solid Waste: Lessons from Nine Case Study Communities*, report prepared for Office of Policy, Planning and Evaluation, US Environmental Protection Agency (Durham, NC: Duke University School of the Environment, 1996); James D. Reschovsky and Sarah E. Stone, "Market Incentives To Encourage Household Waste Recycling: Paying for What You Throw Away" (1994) vol. 13, no. 1 *Journal of Policy Analysis and Management* 120-39; Marc Thivierge and Claudia Kauffman, "Case Study of Gananoque's User Pay Experience," paper presented at the Recycling Council of Ontario's 14th annual conference, Toronto, October 27, 1993; Robert Argue, "Sidney's User Pay Experience," paper presented to the Recycling Council of Ontario's 15th annual conference, Hamilton, Ontario, October 6th, 1994; Lisa A. Skumatz and Cabell Breckinridge, *Variable Rates in Solid Waste: Handbook for Solid Waste Officials*, vol. 1, *Executive Summary* (Seattle: Seattle Solid Waste Utility, June 1990); Joe D. Word, Katherine Higgenbotham, and David Pluenneke, "Variable Rate System Works in Texas" (1992) vol. 33, no. 7 *BioCycle* 52-53; and Ontario, Ministry of Environment and Energy, *Greater Toronto Area 3R's Analysis: EA Input Document* (Toronto: Ministry of Environment and Energy, 1994).

Most studies of waste collection purport to estimate average costs per tonne, not marginal costs. Even these studies are few, and they produce widely varying results. The Ontario GTA study estimated average garbage collection costs of $60 per tonne in Metro Toronto and from $38 to $54 per tonne in four surrounding regions.[10] First Consulting Group estimated that marginal waste collection costs in the GTA were about $35 per tonne, although it is not clear that the marginal/average distinction was fully explored in this study.[11] Because much of the cost of waste collection arises from truck and operator time related to stopping at a number of lifts, marginal costs arising from more or less waste at each lift must be substantially below average costs. Dewees and Hare conclude that the long-run marginal social cost per tonne of waste collection may average Cdn $25. They also conclude that marginal collection costs vary considerably from one city to another, and that many waste managers probably do not know their true marginal costs per tonne.[12]

The marginal cost of waste disposal should be reflected in a tipping fee that covers the operating cost of the site, all amortized capital costs including closure and post-closure costs,[13] the opportunity cost of the space if future sites will be more expensive, and the value of any environmental harm that will be caused by the disposal. A survey of disposal costs performed for Environment Canada considered capital costs, operating costs, and perpetual care costs, but did not consider opportunity costs of space or the value of environmental harm. The survey found an average cost of Cdn $28 per tonne across Canada.[14] Because the study ignored opportunity costs and dealt only with the larger sites, this figure probably underestimates the true value. Data from Metro Toronto suggest a cost of at least $50 per tonne, and the bids for handling Toronto's waste as the Keele landfill closes were just over $50. Annual surveys of landfill tipping fees in the United States have found fees that are higher in the northeast and lower in the southwest, averaging about US $24 per ton. Adding transportation costs from the transfer station to the landfill of about US $6 per ton yields a total of about US $30,[15] which converts to over Cdn $50 per tonne. These fees do not include opportunity costs. Dewees and Hare conclude that the marginal social cost of disposal for the GTA may exceed $50 per tonne, not counting environmental costs, while elsewhere in Canada it may be as low as $30 per tonne.[16]

If a municipality pays for waste disposal by a third party, the cost of waste disposal is clear; it is the cost per tonne of the contract. But what if the municipality operates its own landfill? How should it set the tipping fee and the waste disposal component of the price to be included in a user-pay system?

As suggested above, the cost of placing a cubic metre of waste in a landfill is not just the current operating cost of the landfill, but must include all amortized capital costs plus closure and post-closure costs, the opportunity cost of that space, and the value of environmental harm. Conceptually, the most difficult part of this calculation is the opportunity cost of space. It can be understood as follows. Suppose that the operating cost of Dismal Dump is $10 per cubic metre and that Next Landfill will cost $50 per cubic metre of waste disposed (about $100 per

tonne at a density of 0.5 tonnes per cubic metre). The *opportunity* cost of placing a cubic metre of waste in Dismal Dump is not $10, but $10 plus an amount that reflects the fact that each cubic metre so disposed of hastens the time when the city will have to pay $50 per cubic metre. The socially efficient tipping fee at Dismal Dump is not $10, but $50 discounted for the number of years until Next Landfill will be required. The private operator of a landfill who is not subject to rate regulation should anticipate the future cost increase and charge a price slightly lower than the cost of commissioning Next Landfill now. The public operator should do the same.

In November 2001, a Toronto city councillor was quoted as saying that "with the closure of Keele Valley, the cost of disposal will go up from $12 a tonne to $52."[17] While this may be true in an accounting sense, it is not true in an economic sense. The economic cost of a tonne of landfill at Keele Valley today, including the opportunity cost of the space, is $52 because that is what Toronto pays to dispose of some of its waste at the next best site, the Michigan landfills.

It does not appear that government-operated landfills charge a tipping fee that properly reflects future scarcity. The history of tipping fees at Keele Valley suggests that until the late 1980s, the tipping fee did not reflect the higher cost of future alternative sites. Worse yet, the per-tonne fee is charged only to private haulers. The residential waste collected by Metro municipalities and deposited at Keele Valley is paid for by a formula relating to the tax base, not on a straight tonnage basis. The GTA municipalities will face a reasonable set of incentives for waste reduction only if they must pay the same fee as commercial haulers for waste disposal at any Metro facility. Thus, an important waste management reform in the GTA and other municipalitites with similar policies would be to introduce at each landfill a uniform per-tonne tipping fee regardless of the source of the waste.

Most landfills also do not include in their tipping fees the expected value of environmental harm, except where financial liability for that harm is anticipated and built into the cost of operation. Environmental harm may include annoyance to the neighbours of the landfill from smells, birds, blowing refuse, and truck traffic. It may also include contamination of the groundwater if leachate escapes from the landfill during its operation or even decades after it is closed. While good environmental design should prevent groundwater contamination, in fact many landfills have allowed leachate to escape. It may be possible to estimate the likelihood of such escape for a particular landfill and then to estimate the likely cost of the resulting damage. That cost should be included in the tipping fee.

In summary, municipalities have two opportunities for adopting user fees for waste management. First, they can charge user fees for waste pickup, even including residential customers in many cases. These fees should reflect the marginal cost of pickup, handling, and disposal. Second, they can and should charge an appropriate tipping fee for any landfill that they operate. That tipping fee should cover operating costs, amortized capital costs, amortized closure and post-closure costs, and the opportunity cost of space in the landfill, as well as the value of any environmental harm caused by disposal.

EXAMPLE: WATER SUPPLY

Water supply differs from waste management in that it is easier to monitor customer usage. Many customers have water meters, and there is no technological or economic reason why all customers of a municipal water utility cannot be metered. Some of the problems that may arise with user pricing of waste disposal (illegal disposal, littering) do not arise with water pricing. Thus, water pricing should be even easier than waste pricing.

How does the economic prescription for marginal cost pricing fit the water utility? In theory, when water consumption is not limited by the capacity of the drinking water system or waste management system, the price of an additional cubic metre (m^3) of water should equal the sum of the incremental operating cost of serving a customer that additional amount plus the opportunity cost of the water source. Since the cost of treating wastewater depends on the volume of water, the water supply price might include the marginal cost of waste treatment as well. In the case of a city on a major lake, the opportunity cost of the water source may be essentially zero. However, if the water source is an underground aquifer or a small lake or river that is not being replenished at the rate of withdrawal, the raw water itself will have a value. If the demand for water is such that the supply pipes or pumps are at capacity, or the wastewater pipes or pumps are at capacity, the price should include the opportunity cost of this capacity.[18] In most cities in Canada, peak water demand is in the summer when supplies are at their lowest. Capacity constraints in the system and supply limitations are most likely in the summer, implying that prices should be higher in summer than during the rest of the year. Peak demand may arise at specific times of day, so that marginal costs, and thus prices, should be higher at certain times on weekdays than the rest of the time. Thus, the theoretical ideal would be a price schedule that varied by season and perhaps by time of day during the season of highest use; it also might include a special surcharge that could be applied in case of serious drought or shortages.[19]

In theory, it should be relatively straightforward to implement marginal cost pricing, if the marginal costs can be determined. In practice, however, water utilities rarely use marginal cost pricing. In Canada, many water users are not even metered; instead, they pay for water and sewer service through their property taxes, rather than through user fees.[20] When utilities do charge a per-unit price for water, it often falls short of covering marginal costs.[21] What accounts for this mispricing by so many water utilities? First, utilities are often constrained to break even with respect to operating costs and amortized capital costs. Second, few water utilities, at least in Canada, employ seasonal pricing or time-of-use (TOU) pricing, and many might find the prospect radical. Third, studies have shown that the elasticity of demand for water is relatively low, so that substantial price increases are needed to significantly reduce demand.[22] Fourth, consumers would likely resist prices that varied from one year to the next depending on variations in supply and demand. Given these contraints, rather than insist on the ideal, let us consider the important elements and how they might influence utility pricing.

First, marginal cost pricing does not mean just recovering the variable operating costs of the system. When the system is at capacity, marginal cost principles require charging the opportunity cost of system capacity, which may be equal to the cost of capacity expansion. Even before a utility builds new capacity, it is justified in raising prices to allocate available demand among consumers and to constrain demand until that capacity is built. If politics will not allow the utility to vary prices from year to year, it may at least set prices above short-run marginal cost—that is, above variable costs. Maintenance costs must be included to ensure a reliable supply, as well as renovation or rebuilding costs in older systems. While one could argue about the exact way in which these costs should be included in the price, I believe that a utility is justified in including them. To put it another way, I do not believe that it makes sense to pay for capital costs from the tax base, whether these costs are for new construction or for rebuilding. An efficiency argument can be made that all capital and operating costs should be borne by water users, and that most of these costs should be determined on the basis of usage.

Thus, if economic growth will require expensive additions to the capacity of the system, the price of water should rise to reflect that capacity; and if the price increase is significant, it should rise before the capacity is increased, to restrict demand and delay the time of construction.[23] Moreover, if there are works that are dedicated to specific users, those works should be paid for by those users. Thus, the developer should pay for the pipes in the development, or the buyers should pay a special assessment to cover those costs.

What would be the benefits of marginal cost pricing for water? Charging a price that reflected all incremental costs, including capacity costs, would encourage water conservation up to the point where the value of the last cubic metre consumed was just equal to the real cost of supplying it. This pricing method would discourage consumption of water in low-value uses, and it would postpone the day when investment in new capacity would be needed.[24]

Second, while TOU pricing seems pretty remote for most water utilities, seasonal pricing is not difficult and not radical. Jurisdictions in the United States charge seasonal prices. When I lived in a Washington suburb in Maryland, we paid one rate during the winter and a much higher rate during the summer, when everyone was watering lawns and filling swimming pools and the flow of the Potomac River was low. The utility needs only to read the meters at the beginning and the end of the high-price season. Seasonal pricing would specifically restrain demand at times of maximum usage, thereby again postponing the need for new capacity investment. It would reduce the frequency of water shortages and the need for pleas for reduced water use.

Third, even in water-rich Ontario, many municipalities have limited access to good-quality drinking water supplies. Consequently, water itself has a value or opportunity cost that should be included in the price. Suppose that the municipality of New Liverpool in Ontario draws its water from wells that tap into an underground aquifer. Suppose that municipal, industrial, and private withdrawals from the aquifer exceed its recharge rate, and the level is dropping along with the quality; water is therefore scarce and becoming scarcer. What is its value? In the long

run, someone is going to have to get water from another source, often a pipe from a lake. The cost of that alternative, adjusted by some discounting for the delay until the community has to tap it, represents the opportunity cost of the water in the aquifer. Suppose that the cost of water piped from the lake, including pumping and amortization of the cost of the works, will be $\$1/m^3$. If we forget about discounting for simplicity, every cubic metre of water extracted today should be charged to the user at $1.

The logic of this calculation is that water in New Liverpool has the same value no matter where it comes from—the customer cannot tell the difference. Once the municipality begins pumping from the lake, the value of the raw water is $\$1/m^3$ because that is what it costs to bring it from the lake. Since every cubic metre extracted from the aquifer accelerates the need for the pipe to the lake, every cubic metre from the aquifer has the same value of $1.

While the customer price for scarce water should include its scarcity value, it is not equally clear that the municipality should keep the money. If water is a provincial resource, in principle the provincial government should charge all who extract water from limited resources on the basis of their scarcity value. The municipality of New Liverpool, along with any industries and private landowners, should all pay the same price for raw water extracted to the province, and the municipality should include this payment in the price to its consumers.

We are not likely to see the price of water varying hourly in Ontario. Our endowment of water is too great, and the benefits of such a system would not likely justify the cost and upheaval. However, we should see prices that cover the full cost of the water system, including the renovation of existing systems, the construction of new systems, and opportunity costs. We should pay for the water system predominantly through the price of water, not through property taxes. Since even an abundant resource like water in Ontario can be exhausted by extravagant usage if it is free, we should see prices imposed for water extraction in many places in the province, and those prices should be passed on to consumers.[25] In systems where there are strong variations in demand by season, we should see prices varying by season, so that those who use water in the peak period and thus force us to expand capacity will pay for that expansion or constrain their demand.

We have heard concerns about shortages of fresh water in various parts of the world, and clearly there are shortages in some areas. However, many places that have shortages have failed to put in place a price system that could allocate the available water to its highest-value uses. With abundant water in Ontario, shortages tend to be localized and time-specific, but increasing population growth will put continued pressure on the available supply. Efficient pricing of water can both ensure that the supply is adequate for the demand and ensure the fiscal soundness of water utilities.

CONCLUSIONS

Economics provides three principles for assessing user fees for municipal services: allocative efficiency, rationing efficiency, and cost efficiency. These principles should be used for pricing services that do not involve substantial externalities.

They may not be applicable for services such as public education, which we believe has benefits for the entire community. Which principles should dominate in determining fees depends on facts relating to the service in the municipality, including its current costs and the degree of capacity utilization. All three principles can be served by forms of marginal cost pricing.

Marginal cost pricing means paying for use of the service through user fees based on the extent of usage and the costs that are associated with that usage. Therefore, a first principle for efficiency in municipal services is to apply user fees that represent a price for incremental use of the service.

Marginal cost pricing is not limited to current operating costs. It can include the opportunity cost of capacity when usage is high; the marginal cost of expansion when rising demand calls for additional capacity; the cost of maintenance and renovation needed to maintain performance of the system; the opportunity cost of inputs such as landfill space or raw water where this is in scarce supply; and the value of environmental harm caused by the service, such as the environmental disamenities associated with landfill operation.

Municipalities may see user fees simply as a means of generating additional revenue. This they do, but much more as well. User fees set carefully in consideration of economic principles can also help to constrain demand for services, allocate scarce services, and signal when the value of a service is such that new investment is warranted. Economically based user fees can match revenues to expenditures through varying phases of the life cycle of municipal infrastructure.

NOTES

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4 Marie Lynn Miranda, Jess W. Everett, Daniel Blume, and Barbeau A. Roy Jr., "Market-Based Incentives and Residential Municipal Solid Waste" (1994) vol. 13, no. 4 *Journal of Policy Analysis and Management* 681-98.

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8 Ontario, Ministry of Environment and Energy, *Greater Toronto Area 3R's Analysis: EA Input Document* (Toronto: Ministry of Environment and Energy, 1994).

9 Word, Higginbotham, and Pluenneke, supra note 7.

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11 First Consulting Group, *Activity-Based Costing: Implications for Curbside Recycling Systems*, final report to the Paper and Paperboard Packaging Environmental Council (Toronto: PPEC, 1995), 9 and 14.

12 Donald N. Dewees and Michael J. Hare, *Reducing, Reusing, and Recycling: Packaging Waste Policy in Canada*, Monograph Series on Public Policy no. 8, Centre for Public Management (Toronto: University of Toronto, 1999), 43.

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16 Dewees and Hare, supra note 12, at 44.

17 Connie Vitello, "The Inside Scoop on Toronto's New Diversion Plans" [October/November 2001] *Solid Waste & Recycling* 16 and 18, at 16 (available on the Web at http://www.solidwastemag.com).

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