Water and Wastewater Pricing

An Informational Overview

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I. Introduction: The Role of Prices

This paper discusses the role of the price mechanism in water and wastewater conservation. It is designed to stimulate conversation about water pricing strategies among local water and wastewater utilities, government planners, industry professionals, and advocates of watershed protection. Pricing strategies can also raise revenue to meet clean water needs, but this purpose is addressed in other EPA publications.

Most of us learned in elementary school that water is indestructible and is recycled through the hydrologic cycle. However, recent experience has determined that water cannot be treated as a perfectly renewable resource. Withdrawals from our watersheds for drinking, sanitation, agriculture, and industrial use, and subsequent wastewater treatment, are processes that, at today's scale, have large "unpriced" external effects, including land use consequences, biological degradation, and water quantity depletion. In view of these encroaching resource limits, it is important to consider how to translate these causal relationships through the price mechanism to reflect the underlying costs to society. As local utilities propose expansions in water and wastewater capacity, significant environmental issues are raised in most major metropolitan areas. Clearly, the need for conservation and planning is greater than ever. Although there are many ways to promote conservation, the focus of this paper will be on pricing.

The most frequent response of economists to the imperatives of environmental protection and resource conservation is to use the price mechanism more strategically. For economists, "full costs" refers to the complete societal costs (environmental, social, and actual) that stem from the production and consumption of a good or service. Economics shows us that social welfare is maximized when all costs are reflected in prices. This is sometimes referred to as "full-cost pricing" or the "polluter-pays principle." Only when production and consumption decisions take into account all costs to society can they result in the most appropriate balance of supply and demand. When prices are artificially low, we tend to consume too much. When prices are artificially high, we consume too little.

From an environmental economics perspective, pricing can be an extremely valuable tool for signaling the value of water. Since water is basic to life, and certainly to the quality of life, the pricing of water can be a powerful means of signaling its scarcity to consumers, most of whom see very little connection between their water usage and their total bill. As water demands are increasing and water supplies are diminishing, economic tools are among the most powerful ways to communicate the true value of fresh water.

The polluter-pays principle is popular among economists, but it is important to emphasize that it usually suggests only a *theoretical* optimum. It is rare to see an "externality" fully priced and charged. This would mean identifying all the environmental effects of the product at each stage in the economic cycle from production to waste, assigning those effects a monetary value, and using the tax system or other authorities to add this total monetized value to the price.

American laws and social norms have not yet embraced the approach of price correction to achieve environmental goals. European countries are farther along inimplementing these kinds of price changes, alternately called "ecological tax reform" or "green fees." Approximately one-third of U.S. electric utilities, however, practice a form of demand management via peak-hour pricing of electricity. By pricing electricity high enough to encourage consumers to modify their electricity consumption, these participating electric utilities were able to take off 4 percent of the total peak load in the United States (Energy Information Administration, 1996).

Another example of price correction in the United States is in the area of municipal solid waste. More than 4,000 communities have established what the U.S. Environmental Protection Agency (EPA) terms "pay-as-you-throw" programs (also known as unit pricing or variable-rate pricing), in which residents are charged for trash collection based on the amount thrown away. This creates a direct economic incentive to recycle more and to generate less waste. More information can be found at the EPA Web page *"Pay As You Throw"* at http://www.epa.gov/payt/.

As with many other resources, it is unlikely that water and wastewater prices will ever fully reflect the "full cost" approach favored by environmental economics, but there are some "directionally correct" pricing structures designed to encourage conservation. Section III describes these rate structures in more detail.

While beyond the scope of this paper, an equally important reason to consider conservation-based rate structures is to raise revenue for utilities faced with economic and population growth, aging plants and pipes, and tighter environmental regulations. In a recent report issued by EPA's Office of Water, the capital needs for water and wastewater systems were estimated for the next two decades. In present value terms, funds needed for both water and wastewater systems over the next 20 years approach a half trillion dollars (EPA, *The Clean Water and Drinking Water Gap Analysis*, 2002).

To meet these needs, water and wastewater providers will need to increase their investments by at least 3 percent in real terms over this time period.

Rising capital needs are attributed to:

- Many sewage treatment plants and underground pipe systems needing replacement (with their useful lives expiring);
- More stringent drinking water and wastewater standards; and
- Increasing expense and controversy associated with developing new sources of water.

To summarize, strategic pricing of water and wastewater can play a greater role in meeting the investment needs of our nation's water and wastewater utilities. Pricing strategies can manage demand for water and wastewater services (or slow the growth rate of demand) and raise revenues to support critical capital investments. In the water sector, these imperatives are greater than ever.

II. The Water Sector

Public Ownership – Heavily Subsidized

Over the past 200 years, water management in the United States has been dominated by government decisions concerning agriculture, water rights, transportation, hydroelectric power, manufacturing, and drinking needs. The U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers focused on large-scale development of water resources during a time in history when water was believed to be abundant and easily renewed. Dams, canals, aqueducts, and reservoirs were built to move water from where it was abundant to where it was needed, or to store it for use during dry seasons. The federal government financed much of that work, with the Department of the Interior's Bureau of Reclamation playing a key role. As its name suggests, the goal of that agency was to "reclaim" arid lands.

States generally govern water within their boundaries. State laws and regulations define the allocation of the rights of private parties and government entities to use such water. State water laws usually allocate water according to a "grandfathered" system of "first in time, first in right" (appropriative rights) or according to proximity of land ownership (riparian rights). While water uses must be beneficial, allowable withdrawals are generally unpriced (free).

Today, the water allocation problem is more difficult than ever due to a number of forces: increased population, periodic drought, depletion of groundwater, degradation of water quality, land use concerns, and competition among water users (agriculture, recreation, urban drinking water, and industrial use). In the arid West where conflict over water rights has a long history, some institutional reform of water policy is under way to better manage the agricultural use of water. Fueling the situation is the historical underpricing of water. During the 1970s and 1980s, EPA's wastewater treatment Construction Grants Program was a major source of federal funds, providing more than $60 billion for the construction of public wastewater treatment projects. In the 1987 amendments to the Clean Water Act, Congress set 1990 as the last year that grants would be appropriated. As the grants program was phased out, it was replaced by the State Revolving Fund (SRF) program, in which federal funds are used as seed money to capitalize revolving loan funds that provide low-interest loans for wastewater treatment.

SRF loans offer municipalities a substantial discount compared to market rate financing; however, this discount does not approach the level of subsidy under the Construction Grants Program. The 20-year era of the Construction Grants Program (1972–1992) produced a significant decline in the pollutant loads discharged by sewage treatment plants. These and other government efforts to develop water supplies and improve water treatment produced many important environmental benefits. However, an unintended and unforeseen result was the weakening of a price mechanism that might have guided the supply and demand for water more prudently.

All told, the institutional character of the water sector and the influence of governments has imbued the water sector with deep political roots and economic norms—not unlike other parts of our public infrastructure such as roads, airports, and energy.

Laws, Regulations, and Local Politics

Rate setting can be constrained by the varying legal and regulatory codes of states and local jurisdictions. Most states have a water code or law that outlines the rights of public water and wastewater utilities as well as the state's authority over investor-owned utilities. Federal law, including the Clean Water Act and the Safe Drinking Water Act, does not mandate water pricing policy.

Publicly owned systems are subject to the oversight and competing interests of county, city, or regional governing boards, water authorities, or commissions. For publicly owned utilities, elected officials are often influenced by competing fiscal pressures. And because long-term capital planning and conservation measures are not required, local decisions might not include the need to create depreciation reserves or other financial mechanisms to finance inevitable system replacements. In addition, both citizens and elected officials might wish to keep water and wastewater prices low to attract economic development.

In recognition of the competing interests that affect rate structures, EPA's 1989 publication *Building Support for Increased User Fees* (EPA 1989) was introduced to provide guidance on how to conduct an effective public education program that emphasizes the connection between higher fees and the financial and operating integrity of a water or wastewater utility. In public education programs for new rate structures, acceptance is improved when the public understands:

- The need for capital improvement programs such as expansion and upgrades;
- The benefits associated with water conservation: pollution prevention through reduced water withdrawals and wastewater flows, habitat protection, and energy conservation; and
- The increased revenues that allow a utility to pay for conservation measures such as metering, improved water accounting, leak detection, water-use audits, retrofits, reuse and recycling, and landscape improvements.

Clearly, information plays a role in how water users respond to price. To the extent that the public can be assured of the appropriate use of revenues derived from higher prices, improved rate structures stand a far better chance of succeeding.

III. Rate Structures and Practices in the Water Sector

Current Pricing Practices in the Water Sector

The importance of water to our survival renders it, literally, priceless. But this intrinsic value of water is frequently left out of traditional pricing. Traditional pricing quantifies the costs of capture, treatment, and conveyance. Consequently, this method often obscures the larger, but less quantifiable, societal interests in preserving our water resources.

Supplementing traditional pricing with incentives for consumers to manage demand is a combination that serves both financial and environmental goals. This is also known as demand management pricing.

Water and wastewater demand can be manipulated by price to some degree. Water for necessities (sanitation, cleaning, and cooking) is far less responsive to price than water for more discretionary uses (lawn watering, car washing, and swimming pools). Water policy analyst Janice Beecher reviewed over 100 studies of the price elasticity of demand with the following conclusions (Beecher 1994):

- The most likely range for elasticity of residential water demand is -0.20 to -0.40, meaning a 10 percent increase in price lowers demand by 2 to 4 percent; and
- The most likely range for elasticity of industrial demand is -0.50 to -0.80, meaning a 10 percent increase in price lowers demand by 5 to 8 percent.

Clearly, water is "inelastic," meaning that when the price increases, consumption decreases but at a lower rate than the increase in price. To foster conservation, utility managers will need to consider how consumers will react and may need to adopt other conservation strategies as well.

Three rate surveys give us some insight into existing industry practices regarding conservation pricing. The Raftelis Environmental Consulting Group's *2000 Water and Wastewater Rate Survey* depicts 29 percent of surveyed communities using increasing block rates (where cost per thousand gallons increases at various increments of usage). The American Water Works Association's 1998 survey of the residential rate structures of 827 utilities shows approximately 22 percent employing increasing block rates and 2 percent employing seasonal rates. The largest sample set (over 1,200 systems) comes from EPA's *Community Water System Survey 2000* found at http://www.epa.gov/safewater/cwssvr.html. This survey shows only 9.2 percent of systems employing increasing block rates. To be precise, all these surveys pertain to water rates and not wastewater rates. However, most residential wastewater is not metered but is instead billed in proportion to water coming into residences (drinking water) or by some other formula.

Conservation Rate Structures

Prices can be used to help modify customer behavior to use less water at the tap and to prevent leakage and waste, consequently generating less wastewater for treatment. To achieve significant conservation gains that might enable water system managers to postpone the need for new capital outlays, utilities will need to expand their toolkit to include the widest array of conservation-oriented initiatives, including measures like universal metering, water accounting and use audits, retrofitting, and public education. The Office of Water's *Water Conservation Plan Guidelines*, issued in 1998, provides guidelines for utilities on conservation planning and the conservation measures listed above, including conservation pricing. See http://www.epa.gov/owm/water-efficiency/webguid.html.

The general types of conservation pricing options are:

- Repeal of volume discounts;
- Increasing block rates; and
- Seasonal rates.

Eliminating volume discounts removes any existing disincentive for conservation. Charging a higher unit price as consumption rises is the most popular form of conservation pricing. Seasonal rates, where prices rise and fall according to water supplies and weather conditions (with higher prices usually occurring between April and October), are used less often. With all these options, consumers have an incentive to conserve.

IV. Key Issues for Utilities, Communities, and Water Planners

To effectively manage demand, a utility must be able to determine future water needs. New water-demand forecasting models take into account the socioeconomic characteristics of a service area and project water use patterns accordingly. Utilities can see how seasonal changes, weather changes, and socioeconomic changes will affect water demand. Most important, for the purposes of conservation pricing, estimates of customer response to changes in user charges can be derived.

For effective pricing, utilities, communities, and water planners will need to consider at least three issues: the service population's ability to afford higher rates, the effects of conservation rates on a utility's revenues, and their actual effectiveness in reducing water demand. These are discussed below.

Affordability

The Congressional Budget Office (CBO) estimates that combined water and sewer bills currently average one-half (0.5) of 1 percent of household income in this country (Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure*, 2002). When compared to other developed countries, consumers in the United States are paying the lowest percentage of income for water and wastewater services.

In this same report, CBO provided an estimate of the percentage of household income that would be needed in the year 2019 to pay for future infrastructure investments. Under a low future costs scenario, water and wastewater bills can be expected to consume 0.6 percent of household income. Under a high future costs scenario, CBO estimates that water and wastewater bills will consume 0.9 percent of household income. Under either scenario, combined average water and wastewater bills for Americans are expected to remain under 1 percent of household income, extremely low compared to other countries.

Because these statistics are national averages and do not reflect regional differences or effects on low-income groups, the issue of affordability must be addressed. The best rate design involves taking into account the characteristics of particular customer classes. When considering conservation pricing, a utility, water-planning body, or local government might consider the service area population's ability to pay higher rates. Appropriately designed programs can mitigate the hardship of rate increases on low-income families. Not only does this have humanitarian benefits, but well-designed affordability programs can also benefit the utilities by avoiding costs associated with late payments, disconnection notices, and service terminations.

The American Water Works Association Research Foundation (AWWARF) issued the most comprehensive report available on rate structures designed to meet the needs of low-income customers. (This Web site is given in the references section; see AWWARF 1998). Entitled *Water Affordability Programs*, this report describes five rate structures that can be considered as model affordability programs. "Lifeline" rate structures can mitigate undue hardships for qualifying low-income customers by charging a lower rate for the portion of their monthly water supply that is considered nondiscretionary (the basic amount needed for sanitation, cooking, and cleaning). Beyond this lifeline amount, higher rates are charged. Alternatively, a discount can be applied to the fixed portion of the bill, (e.g., the meter charge, service charge, or other fixed amount). This method also maintains incentives to conserve.

Utilities can also offer budget billing programs, elderly discounts, and conservation assistance to low-income families. Section V covers a number of assessment tools and information sources that might be helpful in considering conservation-oriented rate structures.

Revenue Stability

In the small body of literature on water pricing, revenue instability is the most frequently cited problem with various forms of conservation rates (Beecher 1994). This is because conservation rates can shift cost recovery from fixed charges to variable charges (rates based on use). Utilities also worry that price increases might reduce their sales in an unpredictable manner, leading to less certain revenue streams. If consumers respond with a higher-than-expected reduction in water use, conservation can cause utilities to experience reduced revenues and an unstable cash flow.

One way to mitigate this concern is to gather reliable data on the local service area's "elasticity of demand." Computer models are available to estimate price elasticities for different customer classes, and hence, the revenue effects of conservation rate structures. Forecasting demand will help design rates that maintain financial stability for the utility. Existing demand studies can be used to approximate usage responses in a general benchmarking approach, or computer models can be used (in conjunction with detailed customer records) to specify consumer responses to price with greater accuracy. Section V describes some of the tools available for making these estimates.

A second way to mitigate concern about revenue instability is to create a revenue stabilization fund that can be used to even out the collection of revenue, particularly during droughts. In this case, the utility must be able to collect revenues in excess of annual expenditures in some years so that it can draw on the fund during revenue shortfalls that result from lower-than-expected consumption. In addition, legal safeguards are needed to protect these reserves for their intended use. Surpluses can be used to fund conservation programs or build a reserve for future capacity expansions or upgrades.

Effectiveness

The literature on conservation pricing for water is small but growing. University of Georgia Professor Jeffrey L. Jordan provides some insight in a 1994 article in the *Water Resources Bulletin.* In 1991 Spalding County, Georgia (part of the Atlanta metro area), transitioned from a decreasing rate structure to an increasing rate structure. Without implementing any other conservation measures, average yearly water use per customer fell by 5 percent (Jordan 1994). More recently, Jordan has written in the *Journal of the American Water Works Association* to report on results of a survey sent to those utilities identified as using some type of conservation rate structure (Jordan and Albani, 1999). For those 12 systems where the authors had adequate data, Jordan and Albani demonstrated that yearly average consumption dipped 8 percent and peak-demand-month usage declined 7 percent as a result of conservation pricing.

V. Assessment Tools and Information Sources

Show-Me Ratemaker

The state of Missouri's Department of Natural Resources offers free software that can be downloaded from its Web site at http://www.dnr.state.mo.us/oac/lgov.htm#rate%20studies%20for%20water%20and%20sewer. *Show-Me Ratemaker* can be run on Microsoft Excel, providing users with 5-year financial projections and analyses of different rates.

IWR-MAIN Water Demand Analysis Software

Developed under sponsorship of the U.S. Army Corps of Engineers, the Institute for Water Resources, Municipal and Industrial Needs for Water Resources (IWR-MAIN) software has been updated and continually modified since its inception in 1982. The most recent versions can be used on a personal computer. More about this software can be found at http://www.iwrmain.com/.

EPA Reports

EPA's Office of Water has issued two reports aimed specifically at the water and wastewater pricing issue. The first report, *Building Support for Increasing User Fees*, is a helpful guide on the public education needed to price clean water at rates commensurate with its value (EPA 1989). This report stresses that rate adjustments are most effective when used in conjunction with a public education program. This report can be viewed and downloaded electronically from EPA's Web site at http://www.epa.gov/clariton/clhtml/pubtitle.html.

A follow-up to this report came in 1993 with *Evaluating Municipal Wastewater User Charge Systems*, which provides the information needed to comply with EPA's construction grant user charge system regulations (EPA 1993). This report can be ordered free of charge from the National Service Center for Environmental Publications at http://www.epa.gov/ncepihom/.

AWWA Manuals

The American Water Works Association (AWWA) and the AWWA Research Foundation have multiple publications of interest. AWWA has periodically published a definitive manual on pricing; the most recent is *Principles of Water Rates, Fees, and Charges* (AWWA 2000). Additional documents relevant to rate design can be found at http://www.awwa.org/ and http://www.awwarf.com/.

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