Water Pricing Primer

for the Great Lakes Region

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The *Primer* also builds substantially on Dr. Beecher's research and teaching related to water industry structure, regulation, and pricing. The *Primer* draws from her various publications, as well as her participation in educational programs of the Institute of Public Utilities at Michigan State University. The shared insight and experience of many colleagues over many years is gratefully acknowledged.

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Introduction

The upper Midwestern region of North America is home to the nation's largest surface source of fresh-water. Covering more than 94,000 square miles and providing more than 10,000 miles of coastline, the magnificent Great Lakes—Erie, Huron, Michigan, Ontario, and Superior—account for more than 80 percent of the continent's surface water supplies. The Great Lakes watershed extends to nearly 300,000 square miles across eight states and two provinces: Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Ontario, Pennsylvania, Québec, and Wisconsin.[1]

The great waters of the Great Lakes distinguish the region from other areas of the country and the world where water resources are more obviously stretched and strained. Although in relative terms the region is considered "water rich," the watershed is not immune from forces of ecological stress or exempt from the dictates of prudent management. Many localized areas within the basin have experienced, or will likely experience, physical or economic water scarcity. Some may experience institutionally imposed scarcity in the form of statutory or regulatory mandates or restrictions. The *Great Lakes-St. Lawrence River Basin Water Resources Compact,* enacted in October 2008, reflects the federal, regional, and state commitment to active and collaborative stewardship of the region's most valuable common resource. Although the *Compact* does not explicitly address pricing by water utilities, its emphasis on sustainability, efficiency, and conservation points clearly to consideration of the integral role of price.[2]

The Great Lakes, of course, are more than just a remarkable natural feature. The lakes supply waters for recreational, agricultural, and public water system purposes. Water systems in the Great Lakes region, like the region itself, can be distinguished from systems located in other regions in terms of water availability, cost drivers, and service demo-graphics. For water systems everywhere, however, sound pricing is an essential tool for both resource management and financial sustainability. Although many resources on water pricing are available to water utility managers and oversight boards, few are developed with the nation's "middle" region specifically in mind. Although applicable to water pricing generally, this *Primer* also attempts to fill that gap.

In addition, the *Primer* highlights findings from the 2010 Great Lakes Water Rate Survey, which was also designed to bring attention to regional ratemaking practices. Based on data derived from system tariffs and websites as of mid-year 2010, the survey focuses on the top ten water systems (based on service population) in each of the eight states in the Great Lakes region. Key findings are summarized here and detailed in a separate report.

This *Primer* and the complementary survey report are available online at:

http://glc.org/wateruse/watervalue/

[1] See Great Lakes Information Network at **www.great-lakes.net.**

[2] "Within two years of the effective date of this Compact, the Parties commit to promote Environmentally Sound and Economically Feasible Water Conservation Measures such as:

a. Measures that promote efficient use of water;
b. Identification and sharing of best management practices and state of the art conservation and efficiency technologies;
c. Application of sound planning principles;
d. Demand-side and supply-side measures or incentives; and
e. Development, transfer and application of science and research."

Great Lakes-St. Lawrence River Basin Water Resources Compact, Article 4.

The Rationale for Efficiency

The rationale for water efficiency and conservation may seem much clearer in the dry desert of the Southwest than in the watershed of the Great Lakes. Indeed, water may be the region's greatest resource advantage. Water-intensive industries, including various means of energy generation, are more appropriately located in areas that have water. Those areas in turn benefit from the associated economic activity. The prospect of developing a "water economy" is all the more reason to manage resources wisely and sustainably for the long run. Whether water is considered abundant or scarce, wise resource management and sustainability are becoming universally shared values.

A distinction can be made between efficiency and conservation. Efficiency suggests achieving the same level of output with lesser inputs or resources (or more output with the same inputs). Efficiency gains contribute to a well-functioning economy, freeing resources for other productive uses. Conservation suggests reducing resource consumption, regardless of outputs. Conservation preserves inputs. Concerns about pressure on the environment in the short run and sustainability of resources in the long run argue for consideration of prudent efficiency as well as conservation. Mounting concerns about global climate change have brought considerable attention to both energy and water resource management.

As a commodity, unfinished water in the Great Lakes region generally does not present a significant cost to utilities or their customers.[3] Historically, water rights and extraction fees have not been attached to withdrawals, in accordance with riparian rights of Eastern water law.[4] The appearance of abundant supplies can make efficiency and conservation a tough sell to utilities, customers, and other stakeholders. Water is a renewable resource, but it is also vulnerable and transient. Resource management can ensure the ongoing quality and reliability of water resources.

Raw water may be an inexpensive input, but potable or "finished" water is a value-added commodity that is provided "on demand" for a variety of daily uses, from drinking water to fire protection (which dictates the utility's reserve margin). Water utilities add value to water through treatment, storage, and transportation—delivering as much as a *ton of product every day* directly to the consumer's home and ready to use. The capacity to provide water is maintained regardless of whether a drop is used on any given day. Water is also the only utility product that consumers physically ingest, making public-health considerations paramount.

At the individual level, a conservation ethic is a matter of personal choice. For utilities, the central rationale is not conservation for its own sake but *cost avoidance*. Avoided costs are system-specific and vary with conditions and over time. Alternative methods for avoiding costs may be available on both the supply side and the demand side. Avoided-cost analysis can inform the assessment of prudence with regard to conservation expenditures, which is especially important in the context of rising costs associated with infrastructure renovation and replacement.

Delivering water requires both capital and operating expenditures. Reductions in water losses and water use result in immediate savings in terms of reduced operating costs, namely energy and chemicals. Indeed, the "water-energy nexus" has focused attention to the joint benefits of water efficiency and conservation. Over the long term, load management can improve utilization and extend the life of existing capacity, and help some water systems resize, postpone, or avoid capacity additions. The benefits of efficiency in indoor water use can extend to wastewater systems as well. Not all water system costs can be avoided through conservation, of course, but efficiency and load management can help utilities optimize (or re-optimize) supply operations and capital investments over time.[5]

Efficiency and conservation can be accomplished through utility pricing and programs, as well as through changes in policies, codes, and standards in the utility's environment. More efficient prices (that is, prices that approximate economic value), will induce more efficient water usage. Programs that focus on the deployment of technologies in accordance with new standards can alter the price-usage relationship.[6] Over time, pricing and programs, along with consumer education, can work together to make durable changes in cultural attitudes toward water.

For many water systems in the Great Lakes region, water usage has been suppressed by the combination of recent recessionary effects and efficiency gains already achieved through contemporary practices and plumbing standards. For most, water demand is unlikely to return to historical levels in the aggregate or on a per-capita basis. For some, present conditions of excess capacity, relatively plentiful water supplies, and wholesale agreements may constrain the costs that can be avoided in the short run. Fortunately, other cost pressures may not be as significant for other areas of the country. In many respects, these conditions present a window of opportunity for utilities to take a long-term view and plan to phase-in price reforms and resource-management strategies. Today's efficiency improvements will help ensure tomorrow's water sustainability in the Great Lakes region.

3 Many water systems purchase water, where wholesale prices reflect capital and operating costs.

4 The *Compact* is bringing renewed attention to state fees on water withdrawals, as are presently imposed in both Minnesota and Wisconsin. These "regulatory" fees are designed to support the cost of implementing the *Compact*, rather than approximate the value of the water withdrawn.

5 As discussed later, efficiency gains may also translate into demand and revenue erosion, which may require adjustments to rates charged for water services.

6 In economic terms, price changes induce movement along the demand curve and programs move the entire curve.

Cost Knowledge

All ratemaking begins with cost knowledge. In other words, water managers need to understand and appreciate the value of water in both accounting and economic terms. The lack of cost knowledge presents a formidable obstacle to the development of more efficient and effective water pricing.

Accounting for public utilities differs from generally accepted accounting principles (GAAP). In the United States, there is no mandatory system of accounts for water utilities. However, the National Association of Regulatory Utility Commissioners (NARUC) has established an accounting system that is used or adapted by most states with economic regulatory jurisdiction for water utilities. Many non-regulated water systems use a variation of this system to establish costs and provide the building blocks for cost-based rates. In the Great Lakes region, water utilities are subject to economic regulation to varying degrees in Illinois, Indiana, New York, Ohio, Pennsylvania, and Wisconsin but not in Michigan or Minnesota. Wisconsin stands out in terms of comprehensive jurisdiction for publicly and privately owned systems; in Indiana, municipal utilities may submit to regulation voluntarily.[7]

The system of accounts consists of a balance sheet for assets and liabilities, including utility plant accounts; an income statement that itemizes revenues and expenses; and various supporting documents. Regulated systems file annual financial and operating reports, as well as rate review applications consistent with this reporting system. Privately owned water utilities are subject to policies of the Federal Accounting Standards Board (FASB), while publicly owned systems are subject to policies of the Governmental Accounting Standards Board (GASB). Both boards work to ensure that utilities are appropriately cost-conscious.[8]

Moving toward economic and environmental sustainability argues for improving water cost knowledge for water systems of all types, regardless of size, ownership, management, or resource conditions. Pressure on costs—and prices—brings greater urgency and importance to incorporating costs into the rates charged for water services.

7 Nationally, only Georgia, Michigan, Minnesota, North Dakota, South Dakota, and Washington, DC do not have economic regulatory jurisdiction for water utilities, primarily due to the limited presence of investor-owned systems.

8 GASB Policy Statement 34, for example, requires utilities to show how they will maintain the value of their assets.

The Cost of Water

Cost knowledge involves not just knowing total costs, but understanding the drivers behind them. All utilities demonstrate distinctive cost characteristics, including scale economies, long-life assets, and capital intensity. Utility cost profiles include both fixed and variable components, as delineated through systems of accounts.

Water utilities (and wastewater utilities) are distinctly capital intensive, even compared with other utilities or other large industries. Water utilities invest significant financial capital in fixed assets relative to their annual operating revenues (a ratio of about 5 to 1). Fixed assets include all of the utility's supply, treatment, transmission, and distribution facilities, much of which is long-lived and serves generations of water customers.
Aging infrastructure and the relative high cost of replacement is a significant cost driver for the water industry today. The combined requirements of water, wastewater, and storm-water management are considerable.

The fixed costs of the water utility include the capital costs associated with fixed assets, namely debt costs and equity costs. Although economics dictate that "all costs are variable in the long run," certain operating costs will be fixed in the short run. Contractual obligations to vendors and employers are examples. The fixed costs of system operations must be covered regardless of short-run fluctuations in water sales. Wholesale water rates are also designed to recover fixed and variable costs. Depending on contractual agreements, the cost of water purchased on a wholesale basis may be regarded as fixed or variable to the purchasing distribution system.

The variable costs of providing water services are also under pressure. Water utility operating costs are dominated by labor, supplies and services, energy, chemicals, and purchased water (as applicable). The Great Lakes states are advantaged by water abundance and population stability when compared to other regions of the country, but the region is hardly unaffected by the inflationary effects of other key inputs. Personnel costs rise with appropriate compensation for a professionalized workforce. Treatment costs escalate with new contamination threats and increasing chemical

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costs. Water utilities are energy-intensive, as well as capital-intensive, and the rising costs associated with energy infrastructure and climate response will have significant impacts.

For many water systems, perhaps particularly in the Great Lakes region, the combination of rising costs and flat or declining demand is a potent recipe for rising prices. Economic recessions magnify the effect. The pressure on prices is made all the greater for systems that have historically underpriced water due to lack of cost knowledge, reliance on subsidies, or deferral of investment, as well as for systems that are expected to generate revenues for purposes other than water operations.[9] Water utilities may find themselves in the unenviable position of advancing economic efficiency by imposing *higher* rates that recover costs and send appropriate price signals to customers about the value of water services. Even though customers will benefit from long-run efficiency gains, they may need to pay higher rates along the way in order to cover fixed costs and maintain financially viable utilities.

Cost-based Rates

Operating water utilities as financially independent enterprises that base their rates on costs is essential to long-term water-resource and water-system sustainability.[10] Utilities must recover revenue requirements based on the actual "cost of service" in order to sustain operations over time.[11] Economic regulation of utilities in the U.S. emphasizes full-cost ratemaking in accordance with well-established principles, namely that burdens should follow benefits, that pricing should not be unduly discriminatory, and that rates charged and returns earned should be "just and reasonable." In economic regulation, ratemaking is understood as a "balancing act" that considers the interests and rights of both utilities and their customers within the context of the broader public interest.

For utilities, the accounting cost of service includes all prudently incurred costs associated with capital investment and operations, including financing costs (debt and equity), depreciation expenses, and reserves (as approved by oversight bodies). Investor-owned and many publicly owned utilities include a return on their investment in revenue requirements. Taxes or their equivalents are also included. Translating costs into rates requires a "willingness to charge" on the part of utilities, even when it becomes politically challenging. Full-cost pricing argues for eliminating inefficient subsidies and transfers involving water system financial resources. By enhancing financial capacity, full-cost pricing also plays a role in closing the perceived infrastructure funding gap between expenditure needs and actual levels.

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Of course, it is well recognized that *accounting costs* will usually fail to recognize the "true" *economic value* of service, which includes costs associated with environmental externalities, resource depletion, and infrastructure replacement. Externalities are difficult to quantify and generally are not well reflected in prices (market-based or regulated). Society can "charge" these costs (for example, through extraction fees, development fees, penalties, or taxes) but often does not.

In the absence of an authoritative mandate, however well intentioned, utilities should not arbitrarily charge prices in excess of costs.[12] Prices at economic and environmental value can exceed accounting costs and lead to excess revenues and earnings for the utility monopoly. However, economic cost can be factored into rate design by applying marginal-cost pricing principles. Marginal-cost or incremental-cost pricing methods focus particular attention to tail-block usage, where efficiency gains are achieved.[13] Pricing can also distinguish between discretionary and non-discretionary use for both equity and efficiency purposes. That is, more discretionary, and less essential, uses of water should be more costly to consumers. Although the delineation among uses can be guided by health and other standards, it can also be value-laden and controversial.

[9] Some government-owned systems may receive transfers, tax equivalents, or returns on investment.

[10] Aspen Institute (2010). *Sustainable Water Systems*, Report of the Dialogue on Sustainable Water Systems. Aspen, CO.

[11] Revenue requirements may be defined on a "cash needs" or "utility" basis; the latter is more demanding in terms of cost accounting but may enhance understanding of the cost of service. See American Water Works Association (2000), *Manual Principles of Water Rates, Fees, and Charges* (AWWA Manual M1), Denver, CO.

[12] Excessive prices are a potential abuse of monopoly power for public or private utilities, and expressly prohibited for regulated utilities.

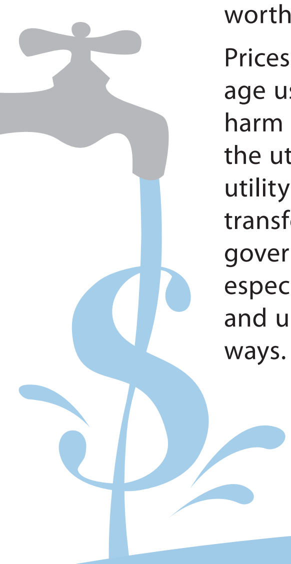
[13] Marginal cost is the cost associated with producing the next increment of a good or service.

Pricing & Efficiency

Price is a necessary, though not always sufficient, means of inducing economic behavior. Information and persuasion can complement pricing in terms of encouraging efficiency and conservation, but they are not substitutes for the powerful signals sent by prices. Rising prices will induce conservation regardless of whether utilities actively promote conservation.

Utilities are monopolies and monopolies are not subject to the forces of the competitive market place. A cost-based rate approximates a competitive market rate for efficiency purposes, while compensating the utility fairly. The technical cost characteristics of utilities (declining average and marginal costs) also make pricing challenging. The "fair return" price for monopolies is in between the high price that a monopolist might set (excessive) and the low price that the market might set (socially optimal), in order to recover the actual cost of providing service. Efficient prices support efficient resource allocation and sustainability over time. The perfectly efficient rate, of course, is elusive. The goal for utilities, like other enterprises, is to pursue *improvement* in economic efficiency and to maintain efficiency through periodic rate adjustments.

Prices that do not reflect costs are considered economically inefficient and potentially harmful. Prices that are "too low" relative to costs encourage excess (wasteful) usage, which in turn can lead to excess capacity investment. Underpricing also suggests that a water utility may have inadequate financial reserves or that it relies on subsidies, both of which undermine sustainability. Persistent underpricing tends to reinforce a false sense of the worth of services and even a sense of entitlement.



Prices that are "too high" relative to costs discourage use and can cause undue deprivation and harm to consumers and to the economy in which the utility operates. Overpricing suggests that the utility is building excessive reserves or providing transfer payments to another entity, including local governments. Overpricing of essential services is especially deleterious because it leads to unsafe and unhealthy behaviors that are costly in other ways. Protecting captive consumers from the abuse of market power in the form of excessive pricing and profits is the basis for economic regulation of private utility monopolies. In some states, economic regulation is also extended to publicly owned systems to promote cost and price accountability.

Efficient pricing relates to how water utilities and water resources are managed. Better pricing can help utilities shift "load" and improve capacity utilization by smoothing out the peaks and valleys of usage over time. Better price signals may also induce overall load reductions that improve operational and investment efficiency.

> The goal for utilities, like other enterprises, is to pursue improvement in economic efficiency and to maintain improvements through periodic rate adjustments.

How Price Matters

Prices matter to the allocation of all goods and services, and utilities are no exception. Modern pricing theory recognizes that prices are not just a means of recovering costs. A price is an essential incentive mechanism. A change in price can "move" usage along the demand curve and can thus be used deliberatively in demand and load management to achieve efficiency goals.

The demand curve represents the consumer's marginal willingness to pay, which also incorporates their *ability* to pay (income effects). Elasticity measures the responsiveness or sensitivity of usage to price, represented mathematically by the percentage change in quantity demanded divided by the percentage change in price. Demand for necessities, including utilities, tends to be relatively price inelastic. This is not to say the price is ineffective, only that the effects are relatively less than for other items. Importantly, system-level price elasticities vary by customer class, type of usage, time frame, rate structure, and rate level. Demand for water is also influenced by factors other than price, such as income, weather, and other discrete influences that alter demand curves. Water usage is negatively correlated with price, positively correlated with income, negatively correlated with precipitation, and so on. Elasticity estimation is complicated and has been the subject of numerous studies and reports. Care must be taken to develop system-appropriate estimates.

Understanding elasticities is instrumental to designing rates and estimating the impact of rate changes on water usage and sales revenues. Conservation-oriented rates that differentiate rates for discretionary and price-elastic usage may be more effective (for example, rates that target seasonal outdoor usage). For price-inelastic usage and users, price changes may have little effect except to increase bills and exacerbate concerns about the affordability and regressivity of utility costs. Large rate increases can induce short-term "rate shock," with both economic and political consequences. Unfortunately, price signals may also "fall on deaf ears" for high-income households that are less price sensitive.

Price responsiveness has a direct bearing on utility sales revenues, making elasticity estimation a central part of planning and ratemaking. Water utilities need to be aware of potential price effects on various types of usage, whether or not by deliberate design. For *price-inelastic* demand, price increases will increase revenues and result in excess earnings if revenues exceed costs. For *price-elastic* demand, price increases may result in under-earning absent a "demand repression" adjustment in rate setting.

When utility services are a major production input, large-volume water users (commercial and industrial customers) will look to conserve as a matter of sound business practice, regardless of price. Highly price-sensitive customers may bypass the utility altogether through self-supply or even relocation. Bypassing may harm remaining customers by loss of scale and stranded costs associated with excess capacity. Permanent loss of load may jeopardize the utility's operational economies and financial health. These problems are all too familiar in the Great Lakes region, where utilities need to strike an appropriate balance among competing goals that include economic development, as well as environmental stewardship.

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Rate Design

Cost allocation and rate design present some of the biggest challenges to water utilities. Once a utility's total annual cost of service or "revenue requirement" is established, costs must be allocated to customers as informed by a cost-of-service study. Many U.S. water systems use the "base-extra capacity" method for allocating costs, which differentiates the cost of meeting average demand and providing the additional capacity for meeting peak demand.

Simplistically, revenue requirements divided by usage determines the rate charged for service (and rates multiplied by usage equal revenues). Of course, the process is much more complicated and water utilities have numerous rate-design options, ranging from very simple to highly complex. Water rate design is not purely an economic exercise, as each rate is reflective of the water utility's values and goals, including efficiency. Rate structure choices may also be affected by regulatory and other public policies or mandates.

Water "tariffs" typically reflect a combination of fixed and variable charges. The fixed component of the bill will not vary with water usage, as compared with the variable component. Fixed charges, sometimes called customer costs, usually include administrative and metering costs. Increasingly, water utilities include a fire-protection charge as part of their fixed costs. For many water utilities, a substantial share of *fixed costs* associated with water system capacity are recovered through *variable charges*.

For water utilities, recovering more costs through fixed charges enhances revenue stability because revenues are less dependent on sales. However, high fixed charges also weaken price signals. Fixed charges are also more regressive and less affordable, meaning that they will take a larger share of income for low-income households. Conversely, recovering more costs through variable charges reduces revenue stability because revenues are more dependent on sales. Variable charges send better price signals to customers, and are more affordable and less regressive. Consumer and environmental advocates both prefer higher variable charges relative to fixed charges, although consumer advocates worry about the impact of the total bill. [14]

[14] Regulators in Wisconsin encourage water utilities to keep fixed charges between 25 percent and 50 percent of the total bill for residential customers.

No manner of rate design will compensate for revenue requirements that understate full costs.

Metering and billing practices also matter. The utilities examined in the 2010 Great Lakes Water Rate Survey billed mostly monthly or quarterly in about equal numbers for residential customers, with monthly billing more common for non-residential customers. Although it adds to administrative costs, more frequent billing sends more timely signals and may ease affordability; less frequent billing, however, may magnify price signals. Budget billing (equalizing payments over time) and bills that combine municipal services may mute price signals. Billing practices, as well as rate structures and rates, tend to vary by customer class (residential, commercial, and industrial). Municipal utilities often differentiate rates for inside-city and outside-city customers.

An economically efficient rate recovers the utility's full cost of service to ensure financial sustainability. No manner of rate design will compensate for revenue requirements that understate full costs. Resource efficiency can be enhanced through improved rate design, that is, how the revenue requirement is allocated to water customers and uses.

In the absence of metering, utilities impose flat fees for water services. Obviously, metering and variable rates send more accurate price signals to customers. The most basic metered rate is a uniform (or uniform-by-class) rate, where the price per unit consumed does not change with usage. Many water utilities implement decreasing-block (declining-block) rates, where the unit price falls, which they justify on the basis of favorable load profiles that lower the cost of service. These rates may not resonate well with those who favor conservation signals through increasing-block (inclining-block), seasonal, and excess-use rates where the unit price rises with use. Although time-of-day pricing is gaining in popularity for electricity load shifting, pressure requirements, storage capacity, and gravity-based distribution generally contraindicate applications in water. Moreover, load shifting by retail water customers would reduce energy costs but not energy or water usage.

Efficiency-oriented Rates

No clear consensus exists about what makes a rate "conservation-oriented." Any metered rate for which more water usage results in a higher bill sends a price signal to customers about the value of usage. Technically, this holds even for decreasing-block and uniform rates. The rate survey revealed that these rate structures continue to dominate for the systems examined; for residential use, 44 percent of the systems impose decreasing-block rates and 38 percent impose uniform rates. Relatively few systems in the group implement increasing-block rates (18 percent).

More and more water systems across the U.S. are examining their rate structures with an eye toward efficiency. Water resource economics argue for setting tail blocks equal to the "marginal cost" of water, taking a long-run view toward efficiency and sustainability. Some utilities set rate tiers on the basis of incremental costs associated with supply and capacity options. Nationally, experiments with rate design are expanding the range of approaches.

Rate design should be "revenue neutral." In other words, rates should be structured to allocate and recover the full cost of service established for the utility, but not to generate excess revenues (that is, revenues that are not cost justified). While different rate forms can be used to generate required revenues, some will communicate value better than others. Transitioning from decreasing-block to uniform rates or from uniform rates to increasing-block rates (including seasonal rates) can enhance rate signals and improve efficiency, particularly when considering long-run cost trends. Fortunately, efficiency oriented rate structures can also be responsive to equity and affordability concerns, because lower usage is usually priced at lower rates. The choice of rate structure, rate tiers, and tier breakpoints should not be arbitrary but informed by a cost-of-service study and an understanding of both cost drivers and price elasticities.

Generally, in the Great Lakes region and Midwest, water use varies seasonally. Warmer summer weather, particularly dry weather, is associated with an increase in outdoor water use for irrigation and other purposes. Seasonal peaks can be significant cost drivers for the water industry, causing systems to provide capacity that is unneeded and unutilized in the off season. Outdoor use is more discretionary and price sensitive. Many systems may find that a basic two-tier or seasonal rate will improve efficiency and load management. The first tier can be designed around average indoor use that is reasonably efficient; the second tier is priced at a higher unit (dollars per gallon) rate. Systems can implement this form of two-tier rate all year or seasonally, with similar results. However, monthly billing and customer education may be needed to ensure responsiveness. Despite their potential, the rate survey revealed only six systems that incorporate seasonality in their rates (one actually provides a summer discount).

Importantly, water rate structures do not have to be overly complex to achieve significant efficiency gains

Many refinements in rate design are theoretically possible, but not all iterations are justifiable in economic and other terms. The cost of implementation should be taken into account. Importantly, water rate structures do not have to be overly complex to achieve significant efficiency gains. In fact, complexity can add to administrative expense, confound interpretability and thwart public acceptance, which in turn undermines the efficacy of the rate.

Conservation & Revenues

Demand erosion associated with conservation-oriented pricing or programs presents water utilities with a conundrum because rising infrastructure costs must be recovered over a shrinking sales base.[15] Sales revenues provide cash flows that cover the variable cost of production, as well as the substantial fixed cost of utility infrastructure. Operational improvements, especially energy efficiency and loss control, will reduce costs but not enhance revenue flows. Even over the long run, supply-side and demand-side efficiencies cannot reduce core infrastructure and capacity needs, some of which are defined by public health and safety considerations, including fire protection.

Conservation-oriented rates can be especially perplexing. Loading more costs into variable charges encourages customer conservation but increases the utility's dependence on sales and sales revenue volatility because of weather and other influences. Loading more costs into fixed charges stabilizes cash flows but mutes customer incentives and burdens low-income households.

Acknowledging the revenue effects of conservation is important. Fortunately, for the utility with declining sales revenues, strategic coping methods are available. Forecasting and scenario building are more important than ever for improving predictive planning. Utility plans should incorporate long-term goals and performance metrics, as well as prudent investment strategies based on changing demand levels and patterns.

As long as costs and demand continue to shift, more frequent rate adjustments will help reduce lag in cost recovery and ensure that rates are properly aligned with costs. The 2010 Great Lakes Water Rate Survey found that the rates for the vast majority of utilities reported recent effective dates (2009 or 2010), a possible indication of rate-review timeliness. Forward-looking rates can be established by using a "future test year" for revenues. Cost-adjustment mechanisms can be used to flow certain costs through rates as they are incurred.[16] A demand-repression adjustment may be needed to recognize the effects of programs and prices on forecast use. Some revenue-assurance mechanisms may be appropriate for publicly owned systems, although "decoupling" sales and revenues may undermine price signals. Innovative regulatory and ratemaking tools can be responsive to the problem of revenue uncertainty, as well as help water utilities meet social objectives. Their use, particularly in combination, requires careful assessment and monitoring in terms of effects on utility accountability, incentives, risks, as well as customers.

[15] See Janice A. Beecher, "The Conservation Conundrum: How Declining Demand Affects Water Utilities," *Journal American Water Works Association* (February 2010).

[16] Regulators normally require these costs to be substantial, uncontrollable, and unpredictable.

Implementing a Change in Rates

Key steps in ratemaking:

1. Appreciate the cost of water services and commit to full-cost water pricing
2. Identify revenue requirements or a budget for a test year
3. Functionalize costs (supply, treatment, distribution, etc.)
4. Classify costs by purpose (customer, capacity, or commodity)
5. Allocate costs to usage according to an established methodology (e.g., base-extra capacity)
6. Assign costs based on a billing analysis to customer classes based on usage characteristics (residential, commercial, industrial, and others)
7. Design rates (fixed and variable charges) to cover revenue requirements and achieve policy goals

Water rates are best understood as part of a broader planning and management strategy that includes analytical steps, as well as engagement with key stakeholders and oversight bodies.

Changing rates involves a relatively straightforward but often uneasy process. Utility managers must begin with a full accounting of all costs, including all "known and measurable" costs anticipated for the period or "test year" for which rates will be established. As both are key inputs to rate-setting, accounting for both costs and usage is critical. Both financial and water audits may be needed.

A cost-of-service study is used to correlate water system costs with water usage. Costs are functionalized, classified, and allocated according to patterns of water usage. A billing analysis is used to assign costs to customer groupings or classes (typically, residential, commercial, and industrial customers based on meter size and other usage characteristics).[17] Rate design involves setting both fixed and variable charges, including rate tiers as appropriate. Efficiency and equity argue for differentiating rates on the basis of differences in the cost of service. Fortunately, many resources are available to systems for conducting cost-of-service studies and designing rates.[18]

Accountability is critical to ratemaking, as is engaging stakeholders and decision-makers by appropriate means throughout the process. All water systems are accountable to local or state oversight bodies, including local executives, boards of directors, and state economic regulatory agencies when jurisdiction is applicable (36 percent of the systems surveyed). State-regulated systems follow well-established and relatively rigorous procedures for accounting, reporting, and ratemaking. Today, more often than not, rate increases are required and utilities bear a burden of proof to justify costs, regardless of regulation. Cost allocation and rate design become more contentious as rates rise. Utilities must be prepared to fully justify the rates they seek to impose.

Adjusting rates can be arduous, particularly if a steep increase is needed. Ratemaking can be political and even a well-justified increase in rates can be controversial. Water utilities face a special challenge in raising prices while simultaneously asking customers to use water more efficiently or conservatively. Customers may be especially frustrated at the prospect of a water bill that does not decrease with decreased water usage. Convincing customers about the benefits of cost avoidance and sustainability over the long run may be difficult.

Over time, many water utilities have found that certain strategies can help the process go more smoothly. The following ideas may be useful to water utility managers:

- Follow sound principles and practices for cost-based ratemaking
- Communicate policy goals clearly
- Provide opportunities for stakeholder input
- Explore a full range of rate-design options
- Avoid excessive complexity
- Recognize impacts and trade-offs explicitly
- Phase-in big changes (gradualism)
- Amplify price signals with information and education
- Approach empirically and experimentally
- Monitor and evaluate marginal and net benefits and costs
- Modify based on impacts, outcomes, and evolving conditions

[17] Refinement of customer classes based on usage and cost patterns is an emerging area of interest.

[18] A list is included at the end of the *Primer*.

Communication is Key

The hallmarks of sound ratemaking include basic principles of transparency and communication. A good rate should be unambiguous in meaning and easily understood by customers in terms of intent and purpose. The basis for the rate should be well-articulated. The rate tariff should be widely available and written in plain language. Fixed and variable charges should be apparent and special fees should be explained. Average customers should be able to replicate the calculation of their bills. A sample bill should be provided, with key elements highlighted, defined, and plain spoken. Actual bills should also be understandable, as well as informative.

For modern utilities, the website is an essential communications portal—enhanced today by online payment options, news and information, contact and resource links, and even social networking capabilities. Customers have come to expect these enhancements from their various service providers. Modern utilities should also endeavor to reach out to customers in native languages.

As noted, despite its importance, price is not always a sufficient means of communicating value. Information can help customers respond more effectively to prices. Utilities can lower the cost of information to customers by providing data on historical usage, along with ideas for using water services more efficiently. Although challenging, utilities also need to communicate the complex and dynamic relationship of water usage, costs, and rates.

A good rate should be unambiguous in meaning and easily understood by customers in terms of intent and purpose.

Although it was not the primary purpose of the rate survey, the process of collecting tariffs revealed considerable variation in the accessibility and quality of information. Although the majority of water utilities make their tariffs available online, nine systems in the survey group do not. In some cases, finding the tariff was more difficult than necessary because it was embedded in a municipality's administrative or finance site. In a few rare cases, public officials were reluctant to disclose the tariff.

Even when tariffs are readily found, however, interpretation can take a considerable amount of effort. Lack of standardization in accounting and ratemaking is partly to blame and both policymakers and utilities are well-advised to invest some effort in this area. Public utilities, regardless of ownership, are monopolies that must be highly transparent and accountable to the public they serve. As utilities recognize the role of pricing in sustainability, they will also recognize that communications will help achieve that goal. All of these efforts require resources and should be subject to an assessment of both benefits and costs, but effective outreach is both a worthy investment and an obligation of utilities. Ratemaking aside, communication is key to helping customers understand and appreciate the value of essential water services to their lives and their communities.

Appendix

Highlights of the 2010 Great Lakes Water Rate Survey

States included	Illinois, Indiana, Michigan*, Minnesota*, New York, Ohio, Pennsylvania, Wisconsin ** no economic regulatory authority*	
Number of systems	80 (ten largest systems by population per state)	
Smallest system	Janesville, WI	62,720 service population
Largest system	New York, NY	6,552,718 service population

		PERCENT:
Systems by ownership	Municipal/county	71
	Private	16
	Authority	11
	Not-for-profit	1
Systems by regulation	Not regulated	64
	Regulated	36
Systems by source	Surface water	76
	Ground water	24
Systems by supply	Purchase water	14
	Self-supply	86
Systems by operations	Wholesale sales	54
	Retail sales only	46
Systems by service area	Inside-city only	36
	Outside-city service	34
	Regional	14
	Private	16
Systems by spatial pricing	Spatial differentiation	36
	No spatial differentiation	64
Effective date of rates	2010	54
	2009	30
	2006-2008	11
	1985-2005	4
Residential billing cycle	Monthly	43
	Bimonthly	11
	Quarterly	41
	Other	5

		PERCENT:
Nonresidential billing cycle	Monthly	60
	Bimonthly	6
	Quarterly	28
	Other	6
Billing combinations	Water only	25
	Water and wastewater	31
	Water, wastewater, and stormwater	10
	Water and more	34
Residential rate structure	Uniform	38
	Decreasing	44
	Increasing	18
	Combined	1
Nonresidential rate structure	Uniform	31
	Decreasing	60
	Increasing	6
	Combined	3
Seasonality in rate	Yes	8
	No	92
Account setup fees	Specified	40
	Not specified	60
Connection charges	Specified	36
	Not specified	64
Special charges	Fire protection charges separated	29
Water included in minimum	Yes	24
	No	76

Estimated average monthly water bills for 1,000 cubic feet (7,480 gal.)

Bills by state	Illinois	$36
	Indiana	32
	Michigan	27
	Minnesota	21
	New York	29
	Ohio	28
	Pennsylvania	50
	Wisconsin	26
Bills by ownership	Municipal	$25
	Private	55
	Authority	34
	Not-for-profit	42
	County	31
Bills by regulation	Not regulated	$27
	Regulated	38
Bills by source	Surface water	$33
	Ground water	27
Bills by supply	Purchase water	$23
	Self-supply	32
Bills by operations	Wholesale sales	$33
	Retail sales only	29
Bills by service area	Inside-city only	$24
	Outside-city service	26
	Regional	34
	Private	55
Bills by spatial pricing	Spatial differentiation	$26
	No spatial differentiation	34

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