IPU PRIMER

MICHIGAN STATE UNIVERSITY ▪ INSTITUTE OF PUBLIC UTILITIES REGULATORY RESEARCH AND EDUCATION

PRIMER ON WATER PRICING

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NOVEMBER 1, 2011 ▪ ipu.msu.edu

INTRODUCTION

Sound pricing is essential to the sustainability of public utility services. Although many ratemaking guides are available, this *Primer* is intended to outline basic principles related specifically to water utilities. It is hoped that the principles outlined here will spark further inquiry and investigation by regulators, their staff and other professionals involved in providing water service and regulating this vital public utility.

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 can be a resource challenge or a 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 concept of a "water economy" is all the more reason to manage resources wisely for the long run. Whether water is considered abundant or scarce, sustainability is becoming a universally shared value and full-cost pricing is becoming an acknowledged prerequisite.

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 resource sustainability in the long run argue for consideration of efficiency as well as prudent conservation. Mounting concerns about global climate change have elevated interest in both energy and water resource management, and their intersection.

As a commodity, unfinished water does not always present a significant cost to utilities or their customers. Even "purchased water" tends to reflect the capital and operating costs of the wholesaler. Regulatory fees, when they apply, are usually designed to support administrative costs rather than to approximate the value of water withdrawals. Where Eastern water law pertains, water rights and extraction fees have not been attached to withdrawals, in accordance with riparian rights. 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 its ongoing quality and reliability.

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 often dictates the capacity reserve margins). 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.

For utilities, the central rationale for demand-side efficiency is 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 on 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. As will be discussed later, efficiency gains may also translate into demand and revenue erosion, which may require adjustments to rates charged for water services.

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. In economic terms, price changes induce movement along the demand curve and programs move the entire curve. 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 U.S., stable or declining water usage reflects efficiency gains already achieved through contemporary practices and plumbing standards. Price and economic conditions also play a role. 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 term. 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.

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.

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 for use by most states with economic regulatory jurisdiction for water utilities. Water utilities are not subject to economic regulation in Georgia, Michigan, Minnesota, North Dakota, South Dakota, or Washington, D.C. Wisconsin is one of the few states with comprehensive jurisdiction that includes municipal 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.

Accounting for public utilities differs somewhat from generally accepted accounting principles (GAAP). 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 that detail operations. Regulated systems file annual financial reports, as well as rate review applications consistent with this reporting system. Publicly traded water companies are subject to financial regulation by the Securities and Exchange Commission (SEC). Privately owned water utilities are also 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 and transparent. GASB Policy Statement 34, for example, requires utilities to show how they will maintain the value of their assets.

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.

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 are long-lived and serve generations of water customers. Aging infrastructure and the relative high cost of replacement are significant cost drivers 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. Even regions with abundant water supplies and stable service populations are affected by inflationary effects on other key inputs. Water utility operating costs are dominated by labor, supplies and services, energy, chemicals, and purchased water (as applicable). Personnel costs rise with appropriate compensation for a professionalized workforce. Treatment costs escalate with new contamination threats and climbing chemical costs. Water utilities are energy-intensive, as well as capital-intensive, and costs associated with energy infrastructure modernization and climate response will have significant impacts.

For many water systems, particularly those serving "declining cities," the combination of rising costs and flat or declining demand is a potent recipe for rising prices. Economic recessions intensify the effect. The pressure on prices is made all the greater for systems that have historically underpriced water due to lack of cost knowledge, deferral of investment, or reliance on subsidies in the form of transfers or tax equivalents, as well as for systems that are expected to generate revenues for purposes other than water operations. 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.

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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 (see Aspen Institute, 2010). Utilities must recover revenue requirements based on the actual "cost of service" in order to sustain operations over time. 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)].

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 rights and interests 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 owner equity), depreciation expenses, and reserves (as approved by oversight bodies). Investor-owned and many publicly owned utilities include a return on 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 financing capacity, full-cost pricing also plays a role in closing the perceived infrastructure funding gap between expenditure needs and actual levels.

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. The emphasis of utility pricing on historical accounting costs can be a source of frustration to some environmental advocates. 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.

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In the absence of an authoritative mandate, however well intentioned, utilities should not arbitrarily charge prices in excess of costs. Excessive prices and profits are a potential abuse of monopoly power for public or private utilities, and expressly disallowed for regulated utilities. Prices that capture economic or environmental value can exceed accounting costs and lead to excess revenues and earnings for the utility monopoly. However, value can be factored into revenue-neutral rate design by applying marginal-cost pricing principles. Marginal cost is the cost associated with producing the next increment of a good or service. Marginal-cost or incremental-cost pricing methods focus particular attention to tail-block usage, where efficiency gains are achieved.

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 that drive infrastructure costs should generally 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.

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 motivate usage reduction regardless of whether utilities actively promote conservation.

Utilities are monopolies and monopolies are not subject to the forces of the competitive marketplace. 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 and fairly compensate utility investors. Efficient prices support efficient resource allocation and sustainability over time. Efficient prices also serve intergenerational equity by ensuring that today's customers do not shift costs or risks to tomorrow's customers (or vice versa). The perfectly efficient rate, of course, is elusive. The goal for utilities, like other enterprises, should be 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 (that is, a loss of positive externalities). 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 transparency and accountability.

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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.

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 (that is, 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 can vary by customer class, type of usage, time frame, rate structure, rate level, and price information. 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 for households. 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 ratemaking and planning. 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 (namely, 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. Many utilities struggle in this context to strike a balance between competing goals of economic development and environmental stewardship.

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Cost Allocation and 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. Cost allocation considers ratepayer equity as well as price efficiency. Accordingly, customers that present similar costs should pay comparable rates (horizontal equity) and customers that present different costs should pay different rates (vertical equity).

Understanding the connection between customer usage and system costs is critical to cost allocation. Many U.S. water systems use the "base-extra capacity" method for allocating costs, which differentiates the cost of meeting average demand and the cost of providing the additional capacity needed for meeting peak demand.

Simply stated, revenue requirement 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 cost-allocation and 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 but not limited to 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 that together recover total costs. The fixed component of the bill does not vary with water usage; the variable component of the bill does vary. Fixed charges, sometimes called customer costs, usually include certain 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 actually recovered through variable charges. Regulators in Wisconsin encourage water utilities to keep fixed charges between 25 percent and 50 percent of the total bill for residential customers.

Recovering more costs through fixed charges enhances revenue stability for utilities because revenues are less dependent on sales. However, high fixed charges also weaken price signals to customers. Fixed charges are also more regressive and less afford-able, 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 under all rate structures.

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

Metering and billing practices also matter. Monthly and quarterly billing cycles are common for residential customers, but nonresidential customers are typically billed monthly. Although it adds to administrative costs, more frequent billing sends more timely signals and may ease affordability; less frequent billing, however, may amplify price signals. Budget billing (that is, 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, but the difference may or may not be cost based.

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 among 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 (such as dollars per gallon) does not change with usage. Block rates within service classes can be designed consistent with cost-based pricing principles to reflect average contributions to peak loads or the marginal cost of production for the system.

Many water utilities implement decreasing-block (declining-block) rates, where the unit price falls with usage, which they justify on the basis of favorable load profiles that lower the cost of service. These rates do 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 usage. 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, both of which remain popular in some regions (see Beecher and Kalmbach, 2011).

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.

As noted, 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 beyond accounting costs that are not cost justified). While different rate forms can be used to generate required revenues, some will communicate cost and 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.

Water use can vary seasonally because of weather or fluctuating service populations (as happens in tourist destinations). For much of the country, 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 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 potential effectiveness, seasonality is often not reflected in rate design (see Beecher and Kalmbach, 2011).

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, raise concerns about equity, 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 a conundrum to water utilities because rising infrastructure costs must be recovered over a shrinking sales base (Beecher, 2010). Sales revenues provide cash flows that cover the variable cost of production, as well as the substantial fixed cost of 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. Utilities that are dependent on tail-block revenues may be less inclined to promote conservation.

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 capability. Utility plans should incorporate long-term goals and performance metrics, as well as prudent investment strategies based on changing demand levels and patterns.

Timeliness in rate setting is also important. 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. 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. State rate regulators normally require these costs to be substantial, uncontrollable, and unpredictable. A demand-repression adjustment may be needed to recognize the effects of programs and prices on forecast use. 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 and impacts on utility customers.

IMPLEMENTING A CHANGE IN RATES

Water rates are best understood as part of a broader planning and management strategy that includes established 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.

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 based on usage patterns according to an established methodology (e.g., base-extra capacity).
6 Assign costs across and within customer classes (residential, commercial, industrial, and others) based on a billing analysis.
7 Design rates (fixed and variable charges) to cover revenue requirements and achieve policy goals.

Cost-of-service and billing studies are used to correlate water system costs with water usage. Costs are functionalized, classified, and allocated within and across customer groupings or classes (typically, residential, commercial, and industrial customers based on meter size and other usage characteristics). Refinement of customer classes based on usage and cost patterns is an emerging area of interest. 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 (see resources at the end of this *Primer*).

Accountability is critical to ratemaking, as is involving 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. 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 and rates to their oversight bodies (regulators or local officials). Cost allocation and rate design become more contentious as rates rise.

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.

Ratemaking strategies:

- 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.

COMMUNICATION IS KEY

Sound ratemaking respects basic principles of transparency and communication. Water rate schedules or tariffs can reflect considerable variation in the accessibility and quality of information (Beecher and Kalmbach, 2011). Locating tariffs can more difficult than necessary, especially when they are embedded municipality's administrative or finance site. Sometimes public officials seem reluctant to disclose their water rates. Even when the rates are readily found, interpretation can take a considerable amount of effort. Lack of standardization in accounting and ratemaking is partly to blame.

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 first 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.

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Public utilities, regardless of ownership or regulation, are monopolies that must be highly accessible by and accountable to the public they serve. As utilities 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.

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Recommended citation:
Beecher, Janice A. *Primer on Water Pricing.* Institute of Public Utilities, Michigan State University (November 1, 2011).

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