NRRI 94-18

REVENUE EFFECTS OF WATER CONSERVATION AND CONSERVATION PRICING: ISSUES AND PRACTICES

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September 1994

This report was prepared by The National Regulatory Research Institute (NRRI) with funding provided by participating member commissions of the National Association of Regulatory Utility Commissioners (NARUC). The views and opinions of the authors do not necessarily state or reflect the views, opinions, or policies of the NRRI, the NARUC, or NARUC member commissions.

EXECUTIVE SUMMARY

Water conservation can be exceedingly beneficial to the environment, society, and consumers, but not necessarily to water supply utilities (especially in the short term). Philosophical support for water conservation invariably encounters the practical issues of water utility economics. Conservation behavior and conservation pricing affect the balance between the price of water and the quantity of water demanded. Depending on a utility's predetermined revenue requirement, changes in quantity or in price may or may not result in revenue deficits, surpluses, or consequential instability.

The disincentive for water utilities to promote conservation appears to be strong. Traditional economic regulation tends to reinforce the disincentive for utility-sponsored conservation. Regulated utilities generally are more motivated to invest in supply-side resources and increase sales than to engage in demand management. Reductions in utility sales through conservation can cause revenue erosion and uncertainty, which in turn can reduce profits to investors and increase perceived risks. However, reductions in revenues may be accompanied by reductions in costs. Moreover, revenue uncertainty for water utilities can be anticipated and quantified, and coping strategies can be developed through improved utility planning.

The cost profile and demand characteristics of the water industry are very relevant in the development of water conservation policies. Conservation generally will not allow water utilities to significantly downsize their *existing* operations or offset distribution system and infrastructure replacement costs. The primary savings anticipated from water conservation result from avoided capital and operational costs in the functional areas of source development and treatment. Conservation can be instrumental in forestalling capacity expansion and calibrating *future* operations to reflect demand patterns modified by permanent water-use efficiency improvements.

In areas with plentiful water supplies and ample system capacity that are experiencing no growth or economic decline, conservation should be managed with care so that it does not lead to inefficient or unnecessarily harmful results. In growth areas, demand management may prove to be a valuable resource. Investing in smaller increments of demand-side resources, compared with large-scale supply-side resources, can help utilities increase planning flexibility and lower some forms of risk. Numerous examples of cost-effective urban water demand management are available, particularly for the municipal sector. Although load management is not widely practiced by the water supply industry, alternative rate structures and service categories (such as interruptible service) could be used to improve system efficiency, as well as permit variations in water pricing.

Ratepayers benefit when conservation strategies lower costs without impairing the quality of service or consumer lifestyles. Cost savings for consumers can help build public support for conservation programs. Modern efficiency standards for water-using appliances and fixtures will affect future water demand. As much as half of the conservation potential for single-family residences may be for *indoor* water use. Many water efficiency technologies are relatively inexpensive to install and can yield a fairly quick payback. Utility managers sometimes are concerned that too much conservation leaves too little room for using temporary curtailments during droughts and other periods of water shortage. Conservation advocates respond that better planning will decrease the frequency of shortages. As methods of demand forecasting become more sophisticated, it may be easier to incorporate conservation effects into utility planning.

Pricing is a necessary but not always a sufficient way to motivate customers to reduce waste and use resources wisely. Efficient water pricing usually reflects marginal-cost pricing principles. However, it is unnecessary to estimate marginal costs with precision in order to design more efficient water rates. All water rates have some orientation toward conservation because charging for water use induces consumers to make sensible water-use choices. A variety of conservation-oriented rates structures are available, including uniform, increasing-block, and excess-use rates. Some rate structures have a stronger conservation orientation than others. For many utilities, a phased approach can help mitigate the adverse economic and political effects associated with changing the rate structure.

The demand for water is relatively price-inelastic, although changes in price can induce meaningful changes in water usage with respect to both managing demand and meeting revenue requirements. More than one hundred water demand studies were completed in the past three decades. Importantly, it is not uncommon for the results of one study to contradict the results of another in terms of statistical findings. Although the generalizability of the specific findings is limited, existing demand studies can be used to establish benchmarks for estimating the price elasticity of demand. The price elasticity of water demand varies according to a number of critical dimensions, including the level and design of rates. The price elasticity of water demand also varies by customer class, geographic region, and type of use (such as indoor or outdoor, and peak or off-peak). Public education and other programs can enhance the effect of price on water usage. Long-term responsiveness to changes in price is likely to be greater than short-term responsiveness.

Unfortunately, the impact of price changes on water usage is not always considered in the determination and allocation of utility revenue requirements. In effect, water demand may be treated as perfectly price-inelastic and price-induced usage changes may be ignored. However, as long as price-elasticity coefficients are not zero, water usage will be affected by changes in price. Importantly, a revenue shortfall can occur regardless of whether water usage is highly responsive to price as long as ratemakers do not account for the effect of rate increases on usage and revenue reductions are not matched by cost reductions. Reasonably accurate demand forecasts that account for price-elasticity effects are essential for developing reasonably accurate revenue forecasts. Although not every change in usage can be attributed to a change in price, the impact of price on the quantity of water demanded may become increasingly important.

Utilities can engage in conservation through demand management, although they may not be well-motivated to do so. The disincentives for utilities to invest in demand-side resource options center on three interrelated points: (1) traditional ratemaking processes can be incompatible with demand management; (2) demand-side options can reduce utility sales; and (3) demand-side options can increase utility risks and threaten profitability. Commission experience with providing electric utilities with regulatory incentives for conservation and demand management is considerable. Although the rationale for water conservation may be different than the rationale for energy conservation, the available ratemaking incentives for both types of utilities are somewhat generic. Ratemaking incentives can be considered in conjunction with either conservation programs or conservation pricing. Utility managers and regulators have preferences for certain types of incentive systems. Three general types of incentives are: cost-recovery mechanisms (deferral to rate case, flow through to rates, modified cost recovery, and special-purpose rates); lost-revenue mechanisms (cost-based pricing, revenue adjustments, decoupling sales, selling services, and alternative regulation); and performance-motivation mechanisms (expense or ratebase markup, rate-of-return adjustments, shared savings, bounty or unit bonuses, and management rewards). For the energy sector, no approach has emerged as the singular favorite of the commissions; similarly, no singular solution will apply to the water sector. The future of incentive systems for utility-sponsored demand management in the energy sector is uncertain. The appropriate use of regulatory incentives for energy or water utilities is *not* to make demand management preferable to supply-side investments, but to encourage *cost-effective* resource planning.

Commission policies and practices in the area of water conservation are evolving, as revealed through a detailed NRRI survey of commission staff members. Generally, commission policies and preferences in the area of energy conservation have not been transferred to the water sector. Although commission experience in the water conservation area remains somewhat limited, staff members are highly aware of conservation and planning issues and their potential relevance to water utility regulation. Commission interest in efficiency pricing and conservation-oriented rate structures appears to be growing. In several states, policies related to water conservation and planning were under development at the time of the NRRI survey. However, some state commissions clearly have not embraced the idea of water conservation. In general, utility conservation programs must be shown to be cost-effective before cost recovery is allowed by regulators. Like other utility activities, conservation activities involve a degree of regulatory risk.

Developing industry-specific policies on conservation and conservation pricing is a formidable challenge. In meeting this challenge, water utilities and regulators have begun to recognize efficiency as a viable resource option for the water sector. Many of the concerns about the effects of conservation on water utility revenues can be addressed by taking a long-term, efficiency-oriented perspective.

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FOREWORD

Public utility commissions that regulate water utilities will be faced with the issue of how to contend with the revenue effects of conservation and conservation pricing. The potential effects include revenue instability, surpluses, and deficits. This very focused report attempts to be "ahead of the learning curve" while building upon a foundation of previous NRRI research in the water field, including *Compendium on Water Supply, Drought, and Conservation* and *Integrated Resource Planning for Water Utilities.* Detailed coverage of the growing literature in this area, as well as current regulatory issues and practices, is provided.

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September 1994

ACKNOWLEDGEMENTS

The authors thank Douglas N. Jones, Raymond W. Lawton, Kenneth Rose, and John D. Borrows of the NRRI for review, Wendy Windle for computer graphics, Linda Schmidt for production assistance, and Francine Sevel for proofreading. The NRRI Research Advisory Committee reviewers were Mr. Bill Talbott (and staff) of the Florida Public Service Commission and Professor Otto Doering of Purdue University. Their insights and suggestions were invaluable in preparing the final draft of the report.

Many professional colleagues were helpful in the formulation and clarification of ideas embodied in the report. The authors acknowledge, in particular, George Raftelis, Thomas Chesnutt, Warren Liebold, and Amy Vickers for their thoughtful assistance on specific issues. The survey was conducted in conjunction with a companion study sponsored by the American Water Works Association Research Foundation (AWWARF). This project benefited greatly from the coordination with the AWWARF study, and especially from the collaboration with Edward Amatetti and Rick Albani of the Vista Consulting Group.

Of course, the authors accept responsibility for the research and the final content of the report.

CHAPTER 1

THE EFFECT OF CONSERVATION ON WATER UTILITIES

Water conservation can be exceedingly beneficial to the environment, society, and consumers, but not necessarily to water supply utilities (especially in the short term). Water providers are in the business of selling water. The idea of promoting water conservation intuitively runs contrary to their own self-interest. Reductions in sales may mean reductions in revenues and, in the case of regulated investor-owned utilities, reductions in profits as well. Most utility managers perceive conservation as a significant threat to revenue stability, as well as a threat to the level and stability of earnings, a problem that worsens during periods of rising costs.[1] As rational decisionmakers, utility managers are not likely to willingly embrace conservation unless substantial economic disincentives can be overcome. However, as Vickers and Markus point out, meaningful conservation in the water sector probably will require more than basic economic motivation: "Corporate commitment to [demand management] and environmental preservation is essential to realizing water conservation goals."[2]

Traditional economic regulation tends to reinforce the disincentive for utilities to promote conservation. As regulators of investor-owned and some public-sector water utilities, the state public utility commissions have a growing interest in and influence on water conservation policies and practices. State regulation can be particularly influential with respect to either reinforcing or removing utility disincentives for water conservation for

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[1] See Janice A. Beecher and Patrick C. Mann with John D. Stanford, *Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives* (Columbus, OH: The National Regulatory Research Institute, 1993). Water utility costs are rising because of the need to comply with federal drinking water standards, replace an aging water delivery infrastructure, and expand water systems to meet growth.

[2] Amy Vickers and Edward J. Markus, "Creating Economic Incentives for Conservation," *American Water Works Association Journal* 84, no. 10 (October 1992): 42-45.

jurisdictional utilities. This report examines the commission role in these increasingly important endeavors.

Previous research studies of conservation and integrated resource planning by the NRRI lead naturally to an investigation of the revenue effects of water conservation and conservation pricing. Many state public commissions today are faced with these issues and the interest in water conservation is growing. The revenue and pricing dimensions of conservation merit particular attention from regulators. The key research questions addressed in this study are: (1) How does water conservation affect utility sales, revenues, and profits? (2) What are the current trends and issues and practices in water conservation and conservation pricing? (3) What is the relationship between price and demand? (4) What is the role of price in water conservation? and (5) What regulatory and ratemaking incentives are used to mitigate the adverse effects of water conservation on utility sales, revenues, and profits? While this inquiry is somewhat focused on conservation effects for regulated investor-owned water utilities, most of the information, analysis, and findings is generic and relevant for all larger water utilities, regardless of ownership or regulatory structure.

Quantity, Price, and Revenues

This study is structured around the fundamental relationships among quantity, price, and utility revenues. In this context, the issue is not the determination of utility *revenue requirements,* but actual *revenues* that result from selling the utility product. In its simplest form, the level of revenues for a water utility can be regarded as a function of the quantity of water demanded and the price of water:

$$\text{Revenues} = f\,(\text{Quantity x Price})$$

Simplistically, increases in quantity or in price increase utility revenues; decreases in quantity or in price decrease utility revenues. Water conservation practices are aimed at deliberately reducing the quantity component of the equation. Unless accompanied by a rate increase, the utility's revenues will be reduced. Water conservation pricing, on the other hand, often is associated with a rate increase. The implications of these dynamics for revenues are summarized in table 1-1.

Evaluating the potential effects of conservation pricing on revenues is doubly difficult because of the responsiveness of quantity demanded to price. Water demand is considered relatively price-inelastic, but not perfectly so. Increasing the price of water can lead to a decrease in the quantity demanded. The fact that water demand is relatively price-inelastic (in the relevant price range) means price increases do not necessarily decrease utility revenues. In fact, under certain circumstances, price increases for conservation or other purposes can substantially increase utility revenues. Importantly, in a regulatory environment, it is necessary to evaluate the revenue consequences of price changes in the context of determining and allocating utility revenue requirements. Ignoring reductions in water usage caused by price increases (associated with rising costs or rate-design modifications) can lead to revenue shortfalls for regulated water utilities.

From the utility's standpoint, a reduction in total revenues associated with a reduction in quantity demanded appears to pose a predicament. However, the implications of reduced revenues cannot be evaluated independently of concurrent changes in costs. Utilities should be indifferent to changes in total revenues, provided that they are matched by changes in costs.[3] The relevant issue in the context of conservation is the effect on *net utility revenues,* measured by cash revenues less cash outlays. The concept of net revenues also helps account for normal fluctuations in revenues, which do not warrant extraordinary regulatory treatment. Depending on the utility's predetermined revenue requirement, therefore, changes in quantity or price may or may not result in revenue deficits, surpluses, or consequential instability. Despite the possibility that some forms of conservation can be revenue-neutral, the disincentive for utilities to promote conservation appears to be strong.

[3] John Boland, "Forecasting the Demand for Urban Water," in David Holtz and Scott Sebastian, eds., *Municipal Water Systems* (Bloomington, IN: Indiana University Press, 1978), 91-114.

TABLE 1-1
REVENUE EFFECTS OF CHANGES IN PRICE AND CHANGES IN QUANTITY DEMANDED

		Price		
		Decrease	No change	Increase
	Decrease	Decrease in revenues		Indeterminant
Quantity	No change		Revenue neutral	
	Increase	Indeterminant		Increase in revenues

Source: Authors' construct. Revenue effects are indeterminant under some scenarios without knowledge of the effect of price on quantity demanded.

The Disincentive to Conserve

Over the past decade, utility-sponsored conservation has become well-recognized as a possible means of meeting growing demand in both the energy and water sectors. Numerous studies have emphasized the potential for conservation and demand management to defer the need for costly new supplies and avoid the adverse environmental impacts associated with developing supply-side resources. For water conservation, in particular, the long-term goals of cost avoidance and environmental protection are generally compatible.[4] Despite agreement among policymakers, efficiency advocates, and utility executives about the potential

[4] A tension can exist between cost-reduction and environmental preservation goals, because cost reductions can lead to increased consumption (which environmentalists tend to discourage). However, these goals are not necessarily mutually exclusive in the long term.

advantages of demand management and conservation, many believe that the nation's public utilities have not taken full advantage of demand-side resource opportunities.

Regardless of the substantial environmental appeal of demand-side resource options, it is undeniable that they differ from supply-building possibilities. Demand-management options can reduce utility sales, while supply additions can provide opportunities to increase sales (for example, by expanding into new markets). Thus, the apparent bias against demand-side investments is inherent and understandable. No revenue or profit-seeking retail provider of any good or service would intentionally seek to undermine its own sales. An analogy sometimes used is the idea that gas stations would not encourage customers to buy more gasoline-efficient cars.[5] From the perspective of public utilities, conservation programs seem to run contrary to their own best interest. The sales-earnings linkage for regulated utility monopolies is illustrated in figure 1-1.

According to a study prepared for the Pennsylvania Energy Office, utilities investing in demand management have reason for concern about how they will fare under traditional ratemaking because of varying degrees of uncertainty associated with lost revenues. Traditional ratemaking may not help utility managers overcome their skepticism about engaging in demand-side activities that are unfamiliar, harder to control, and inconsistent with traditional utility objectives. Moreover, proponents of demand-side programs often are perceived as adversaries of utilities and even hostile to utility interests. While the legitimacy and severity of these concerns vary with circumstances of individual utilities and their regulatory environment, many electric utilities historically have had valid reasons to be wary of demand-side activities. According to the authors, "The inescapable conclusion is that under traditional ratemaking, most utilities will surely be worse off because of sales losses generated by significant new [demand management]."[6]

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[5] This analogy can be debated. A broader view recognizes that a conscientious service orientation toward customers might enhance long-term business opportunities.

[6] Paul Chernick and John Plunkett, *From Here to Efficiency: Securing Demand-Management Resources* (Volume 3: Cost Recovery) (Harrisburg, PA: Pennsylvania Energy Office, 1993), 129.

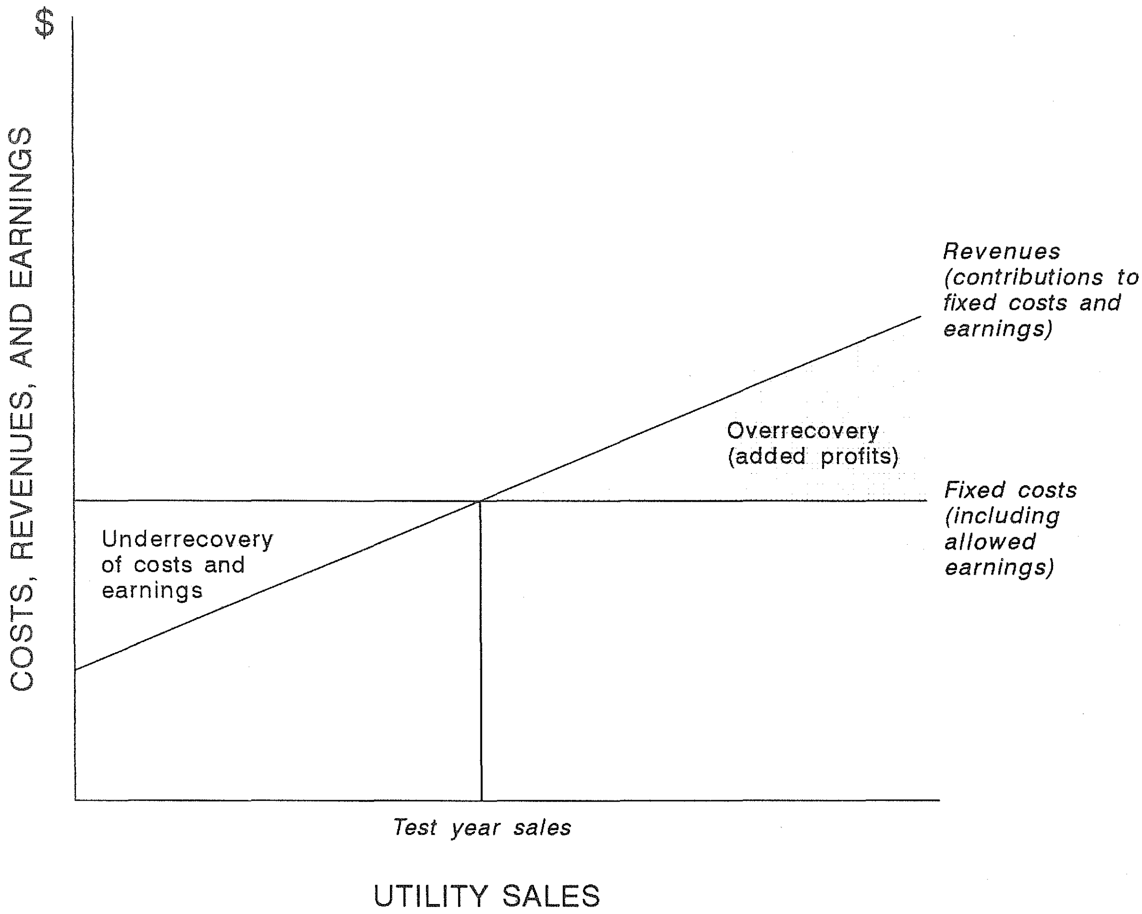

Fig 1-1. The sales-earnings link as depicted in Office of Technology Assessment, *Energy Efficiency: Challenges and Opportunities* (Washington, DC: Office of Technology Assessment, 1993), 135.

To a large degree, the disincentives for utility-sponsored conservation are simply economic. That is, pursuit of demand-side options seems to work at cross purposes with the utility's financial interest, and thus imposes costs for which the utility would expect to be compensated. Disincentives also arise from perceptions that demand management will increase a utility's exposure to risk. In sum, the disincentives to invest in demand-side resource options center on three interrelated arguments (described further in chapter 4): (1) traditional ratemaking processes can be incompatible with demand management, (2) demand-side options can reduce utility sales, and (3) demand-side options can increase utility risks and threaten profitability. Not everyone agrees about the relevance or magnitude of these disincentives. Nonetheless, conservation advocates have devoted considerable effort to finding ways to overcome the perceived barriers to demand-side utility investments.

A Competing Perspective

The issue of conservation impacts on utility revenues and earnings is not as new as it may appear. In the early 1970s, the nation's electric utilities sought rate increases to remedy the consequences of consumer conservation. Douglas N. Jones suggested that this issue can be considered both in terms of technical and procedural implications for ratemaking, as well as in terms of the more difficult public policy issues raised.[7] An important point is that the short-term cost consequences of conservation might not be appropriately passed along to consumers in every circumstance. Alternative interpretations of conservation effects can be used to guide regulatory treatment in relation to conservation.

First, according to Jones, certain conservation effects may be short-term in nature. In fact, establishing a causal link between conservation and reduced earnings can be extremely difficult. Thus, regulators should not be too quick to offer long-term rate relief for a short-term problem. Second, certain fluctuations in earnings should be considered "normal" for ratemaking purposes. Moreover, regulators set merely an *allowed* rate of return, not a

[7] Douglas N. Jones, "Conservation and Utility Earnings: A Policy Predicament," *Public Utilities Fortnightly* (April 25, 1974).

guaranteed rate of return. Third, it can be argued that utility ratepayers and shareholders should share the burden of risks of forces (such as resource scarcity) outside most everyone's control. As Jones points out, changes in circumstances may require consumers to bear some costs (in terms of higher rates), and shareholders to bear some costs (in terms of lower dividends). Regulators may want to consider providing utilities with revenue relief to counter the effects of conservation, but combine the relief with lowering the utility's return on equity to bring revenues and earnings into alignment. This response, in part, would discipline utilities for not anticipating and planning for demand reductions through conservation. It also recognizes that additional revenues have the effect of reducing utility's risks. Beyond these alternatives, it is reasonable to consider resources other than ratepayer resources (such as tax incentives, underwriting, or subsidies) to compensate utilities for earnings lost through conservation. Finally, the allocation of additional costs to customer classes also should be given careful consideration, particularly with respect to the burden placed on captive residential customers.

Another point is that conservation-oriented pricing, in particular, does not necessarily create revenue deficits for the utility. As noted above, conservation pricing can lead to surplus revenues. Some economists favoring marginal-cost pricing principles worry little about the problem of surplus utility revenues induced by conservation pricing, given the variety of alternatives to reallocate the excess through taxation or other means.[8] Surpluses can be used to fund conservation programs or build a reserve for future capacity needs. With efficient pricing and related demand adjustments, however, revenue surpluses can be reduced. As discussed later in this report, the potential for deficit or surplus revenues can be reduced through modified pricing schemes and various forms of incentive regulation.

Today, revenue uncertainty can be anticipated and quantified, and coping strategies can be developed through better planning. The premise that pricing, revenue, and earnings instability present an insurmountable barrier to implementation of efficient pricing by water

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[8] E. F. Renshaw, "Conserving Water Through Pricing," *American Water Works Association Journal* 74, no. 1 (January 1982).

utilities has not gone unchallenged.[9] Advanced computer models and simulation techniques are available to help utilities plan for uncertainty, as emphasized in a recent analysis sponsored by the American Water Works Association Research Foundation and the U.S. Bureau of Reclamation.[10] Thomas Chesnutt and colleagues, who conducted the investigation, make the profoundly simple point that ignoring uncertainty does not make it go away. They modeled the distribution of water demand and used Monte Carlo simulations to quantify revenue uncertainty under alternative scenarios. The key conclusions of the analysis are as follows.[11]

- The uncertainty surrounding future revenues can be quantified; the magnitude of uncertainty depends directly on where rate impacts fall (by customer class and time of year).

- For a one-year time horizon, variability in weather induces the most variability in revenue; over longer periods, other variables come into play (such as price changes, long-term demographic and economic trends, and changes in the utility's cost environment).

- Left alone over time, the revenue risk from a given rate structure will accumulate; acceptable short-run risks may be unacceptable in the long run.

- Revenue planning is simpler under uniform rate structures using average demand values; revenue planning under block rate structures requires more extensive knowledge of water demand patterns and their determinants.

- Empirical measures of uncertainty can be used to make probability statements about revenue surpluses or shortfalls.

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[9] Patrick C. Mann and Donald C. Schlenger, "Marginal Cost and Seasonal Pricing of Water Service," *American Water Works Association Journal* 74, no. 1 (1982): 6-11.

[10] Thomas W. Chesnutt, Anil Bamezai, Casey McSpadden, John Christianson, and W. Michael Hanemann, *Revenue Instability Induced by Conservation Rate Structures: An Empirical Investigation of Coping Strategies* (Denver, CO: American Water Works Association Research Foundation, 1994).

[11] Ibid.

- Once utility managers can attach a measure to the risk of revenue variations, they have a basis for hedging against these risks through the use of various coping mechanisms (contingency funds, the inclusion of a risk margin in the determination of revenue requirements, automatic or more frequent rate adjustments, and cost reductions or deferrals[12]).

- Quantifying revenue variability has the added benefit of providing the information needed to use rates effectively in managing water demand.

- Rapid changes in a utility's cost environment require responsive rate modifications for the dual purposes of aligning revenues with costs and sending customers an accurate message about the true value of water service.

- Incorporating uncertainty into revenue planning will affect the workload of both utility managers and rate regulators.

Utilities that historically emphasized supply expansion over efficient pricing and load management may have created a predicament for themselves. While overcommitting to expensive fixed capacity, the water industry often has priced its commodity inefficiently (that is, prices generally have not reflected the true economic value of water). A possible indicator of this phenomenon is that the real price of water has grown at a rate below the general inflation rate.[13] The combination of overbuilding and underpricing leaves utility monopolies in the worst possible position in the face of further demand reductions. Utilities that have correctly priced the commodity and practiced load management might be far better situated. The concept of managing demand, however, is relatively new to many water utilities.

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[12] Assuming that the utility already is operating efficiently, crisis-driven cost reductions or deferrals (a *defacto* coping mechanism) can disrupt utility operations and adversely affect service quality, to the detriment of the utility and ratepayers alike over time.

[13] Patrick C. Mann and Paul R. LeFrancois, "Trends in the Real Price of Water," *American Water Works Association Journal* 75, no. 9 (September 1983): 441-443.

Conservation and the Water Utility Cost Profile

The disincentives associated with conservation by energy utilities may be magnified for the water industry because of the cost profile of water supply. In general, like other public utilities, the water industry is capital intensive and has demonstrated a strong supply-side orientation. This orientation has been rationalized in quality-of-service terms (such as reliability), economic terms (such as economies of scale), and political terms (such as attracting water-using economic activities).

Water is a value-added commodity. The value of publicly supplied water derives almost entirely from the cost of withdrawal, treatment, and distribution of water by vertically integrated utility monopolies. Water utilities remain one of the more tried and true monopolies in terms of basic economic characteristics. The economies of the water supply industry also are intrinsically related to the economies of its brethren industry that provides wastewater treatment and disposal. Water itself is essential and without substitutes, although water *service* is substitutable (such as through self-supplied or bottled water). For the most part, conventional community water service is monopolistic and is not provided competitively.[14] Economies of scale mean that unit average costs decrease with the quantity of water provided. It would be inefficient and extremely costly to have a redundant transmission and distribution system for treated water. Even in comparison to other fixed utilities, water utilities require substantial investment in fixed assets relative to the variable costs of production (including the cost of raw water, energy, and treatment chemicals). The variable costs of electricity and natural gas service are generally larger because of substantial fuel costs.

Water pricing reflects these industry economies. Water rates generally take the form of a fixed charge that does not vary with usage plus a variable charge that does vary with usage. In water utility rate design, regulatory analysts sometimes become frustrated by the fact that traditional cost-of-service principles can lead to very high fixed charges and very low

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[14] A forthcoming NRRI report on water utility privatization will address emerging opportunities for competition in the water industry.

variables charges for water utilities. This problem undermines the price-signal purpose of the rate, and thus can appear to run contrary to conservation goals. When utility costs are shifted from fixed to variables charges, as may occur with conservation-oriented pricing, revenue stability and predictability are reduced.

For many water utilities, residential demand takes the lion's share of total water demand. The peaking characteristics of water demand strongly influence the design of water systems and can limit the potential for conservation savings in certain areas. Raw water storage facilities, such as reservoirs, generally are designed to meet average annual demand; transmission and treatment facilities, as well as major feeder mains, pumping stations, and local storage facilities, are designed to meet maximum-hour demand, or maximum-day demand plus fire protection flow requirements, whichever is greatest.[15] Conservation can be especially helpful in managing seasonal variations in demand and long-term growth in demand. Although conservation generally will not allow utilities to significantly downsize their *existing* operations, it can be instrumental in forestalling the expansion of source-of-supply and treatment capacity, and calibrating *future* operations to reflect demand patterns modified by permanent efficiency improvements.

The primary savings anticipated from water conservation result from avoided capital and operational costs in the functional areas of source development and treatment. These costs, which are on the rise, already are very substantial for most water utilities.[16] Conservation is a somewhat limited strategy in terms of offsetting distribution system and infrastructure replacement costs. For example, an existing water treatment plant may require modifications to meet new federal standards. In general, because of economies of scale in treatment, the entire plant will be modified to treat water at its rated capacity. Lowering water usage in this instance constrains the utility's ability to spread costs and can result in a

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[15] F. Pierce Linaweaver and John C. Geyer, "Use of Peak Demands in Determination of Residential Rates," *American Water Works Association Journal* 56, no. 4 (April 1965); and Charles W. Howe and F. Pierce Linaweaver, "The Impact of Price on Residential Water Demand and its Relationship to System Design and Price Structure," *Water Resources Research* 3 (First Quarter 1967): 13-32.

[16] Beecher, Mann, and Stanford, *Meeting Water Utility Revenue Requirements.*

rate increase. However, efficiency improvements may help some utilities extend the life of particular treatment and infrastructure facilities. In the long term, efficiency can make it possible to build fewer facilities or facilities with lower capacity requirements. All of these dynamics, and the prudence of alternative supply and demand management options, must be carefully considered by water utility planners and regulators.

Given these cost characteristics, conservation in areas experiencing population and economic growth has the greatest potential. In areas with plentiful water supplies and ample system capacity that are experiencing no growth or economic decline, conservation must be managed with care so that it does not lead to inefficient or unnecessarily harmful results. Uneconomic conservation can force customers to make choices they would otherwise not make. The implications are particularly adverse for low-income customers, for whom total water use is less discretionary and forced choices are especially difficult. In no-growth areas, a reasonable goal is to introduce long-term efficiency in a way that does not jeopardize the utility's financial viability, lead to gross excess utility capacity, or unnecessarily harm the economic welfare of utility customers. Long-term strategic planning and a gradual movement toward efficient pricing can help accomplish this goal. For some areas, regionalization also might help achieve long-term efficiency in the water supply industry.

One study of the impact of water conservation on the operation of a rural water utility found that in the short term, a 20 percent reduction in demand through conservation would reduce customer bills by 16 percent but would reduce utility operating costs by only 2 percent, creating obvious revenue problems.[17] A long-term perspective looking to the year 2020, however, tells a different story. The study's authors estimated that source and storage facilities could be postponed by three and four years respectively, resulting in a substantial savings to the community in terms of the water utility's total operating costs.

In sum, many of the arguments against conservation melt away when taking a long-term efficiency view. In the long term, economists recognize, all costs are variable. For the water industry, given the longevity of utility fixed plant, a comparatively longer planning

[17] N. R. Bhatt and C. A. Cole, "Impact of Conservation on Rates and Operating Costs," *Journal of Water Resources Planning and Management* 111, no. 2 (April 1985): 192-206.

horizon may be warranted. Regardless of their supply and demand situation, however, all water utilities should give careful consideration to implementing cost-based rates, long-term efficiency and waste-reduction strategies, and cost-effective conservation programs targeted to low-income populations in their service territories.[18] Some forms of water conservation may merit less qualified support.

The Commission Role in Water Conservation

Since the early 1980s, the state commissions have played a role in promoting planning and conservation by electric utilities. The impetus for this relatively recent role can be traced to rising energy costs, construction cost overruns, and a generally poor record of planning for future capacity. Conservation advocates from consumer and, more recently, environmental groups have pushed hard for the commissions to provide incentives for investing in demand management. Whether commission interest in promoting efficiency and planning for the energy sector will transfer to the water sector is a current question.

More than a decade ago, rate structure reform was identified as a major issue in water conservation, but not necessarily as a policy priority.[19] The limited jurisdiction of the state public utility commissions over rate structures and the lengthy process of rate reform were cited as the principal reasons for the limited attention to water conservation pricing by the states relative to other policy alternatives.

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[18] Janice A. Beecher, "Water Affordability and Alternatives to Service Disconnection," *American Water Works Association Journal* 86, no. 10 (October 1994), 61-72; and Robert E. Burns, et al., *Alternatives to Disconnecting Utility Service* (Columbus, OH: The National Regulatory Research Institute, forthcoming). The potential for savings from water conservation in low-income housing is great because of the prevalence of more leaky and less efficient fixtures and appliances. Also, conservation programs can improve bill-payment ability and behavior, which in turn can reduce utility disconnection and collection costs.

[19] Brent Blackwekder and Peter Carlson, *Survey of the Water Conservation Programs in the Fifty States* (Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, 1982).

To some degree, the water utility industry historically has resisted commission involvement in water conservation and, in particular, commission-mandated conservation pricing. In 1981, the California Water Association submitted a blistering critique of water conservation pricing to the state public utility commission, arguing that the commission and staff had simply transferred conservation ratemaking practices from electric and natural gas cases to water cases, without rigorous analysis.[20] Their comparative analysis is provided in table 1-2. According to the analysis, based on the differing cost characteristics of the industries, a 10 percent reduction in residential sales would result in no reduction in net income for a natural gas utility, a 10 percent reduction in net income for an electric utility, and a 28 percent reduction in net income for a water utility.

The association asserted that water utility problems of revenue adequacy and revenue stability had been unnoticed or ignored by the commission, that commission staff had not presented evidence on the price elasticity of water demand, and that price-elasticity studies in general might have limited value in regulatory proceedings. Because water is considered a relatively good value for consumers, increases of a "few pennies" were not considered influential. Staff also had not produced evidence in support of conservation benefits in comparison to adverse effects on utilities and customers. The utilities also believed that the staff responsible for rate design policy should participate in commission ratemaking proceedings.

Specifically with regard to conservation pricing, the association asserted that the rationale for low service charges and high increasing-block variable charges is derived more from intuition than actual facts. It was recommended that for the water industry, two-thirds of utility costs should be recovered through fixed charges. According to the association's analysis, the effects of conservation pricing are much more adverse for water utilities than for energy utilities, mainly because a change in unit sales volume does not affect water utility

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[20] Rate Design Committee of the California Water Association, *Water Utility Rate Design,* a report presented to the California Public Utilities Commission (Sacramento, CA: California Water Association, 1981).

TABLE 1-2
COMPARATIVE REVENUE LOSSES FROM CONSERVATION
FOR INDIVIDUAL PUBLIC UTILITIES (1981)

	Electricity	Natural Gas	Water
Results of Operation with Normal Sales (a)			
Revenue	$1,000	$1,000	$1,000
Variable expenses	530	750	390
Fixed expenses	292	191	417
Income tax	47	16	52
Interest expense	61	20	66
Net income	70	23	75
Results of Operation with a 10 percent Reduction in Residential Sales			
Revenue (b)	$970	$978	$930
Variable expenses	514	728	363
Fixed expenses	292	191	417
Income tax	40	16	30
Interest expense	61	20	66
Net income	63	23	54
Reduction in net income	$7	$0	$21
Percent reduction	10%	0%	28%

Source: Rate Design Committee of the California Water Association, *Water Utility Rate Design,* a report presented to the California Public Utilities Commission (Sacramento, CA: California Water Association, 1981), table 8.

(a) A full commodity rate structure is assumed.
(b) For the natural gas industry, a revenue adjustment is included.

costs to the same degree it affects energy utility costs. Water utilities are subject to greater fluctuation in sales than energy utilities (particularly in the residential sector which leads to greater volatility in water utility earnings. Water utilities also must provide fire protection services, and there is no comparable service obligation in the energy sector. The commission, according to the study, occasionally and arbitrarily would take corrective action when a large-volume customer complained about water utility rate design, "but unless the wheel squeaks loud enough, no grease is forthcoming."[21]

The validity of some of these arguments against the commission role in water conservation seems more questionable by today's economic and analytical standards. For example, assumptions in 1981 about the price elasticity of water demand may be invalid due to various socioeconomic and cultural changes, including the maturation of the conservation ethic. Older price elasticity estimates may have been a function of the relatively low real price of water; in the very low price range of the demand curve, a price increase may induce little conservation. Water consumers in the 1990s, faced with higher prices, might be more informed and more likely to adjust their consumption in response to changes in price or other factors. Some might also be more environmentally-aware and supportive of resource conservation policies. Finally, the need for conservation responses by consumer and water utilities may be greater today given increasingly constrained water supply resources.

For their part, regulators are experimenting with incentive mechanisms to promote conservation as appropriate. Three basic types of incentives have been explored in the energy sector: cost-recovery mechanisms, lost-revenue mechanisms, and performance-motivation mechanisms. Each has potential applications to regulated (and nonregulated) water utilities. Emotions run high on both sides of the debate over using regulatory and ratemaking incentives to promote utility-sponsored conservation. This tension mirrors the disagreement between advocates of planning and advocates of market-based approaches to utility supply decisions. Although well-established in the energy sector, the analysis of these issues is only beginning to take shape in the water sector. However, policymakers should not simply transfer approaches from the energy sector, many of which remain controversial and

[21] Ibid., 12.

unproven. Quite appropriately, industry-specific approaches and policies have begun to emerge for water.

Utilities and regulators have recognized that water conservation, price-induced or otherwise, will have revenue consequences. Maintaining revenue neutrality under conservation programs may necessitate rate increases. The troublesome result is that consumers may not be rewarded for their conservation through lower utility bills. Similarly, conservation pricing promotes efficiency but also does not necessarily lower bills. To balance conservation goals with the utility's financial needs, and mitigate adverse consequences, revenue planning must go along with demand planning. In general, conservation should not be a losing proposition to the utility; nor should stable or declining utility sales reflect poorly on utility managers. The need for clear and consistent regulatory treatment that reflects appropriate public policy and conservation goals presents a formidable challenge.

Organization of the Study

Conservation disrupts the traditional balance among utility sales, revenues, and profits. But this is not an acceptable rationale for condemning conservation or neglecting its potential merits. Rather, the effects of conservation should be anticipated, measured, and incorporated into decisionmaking. To that end, the revenue effects of water conservation generally are discussed in chapter 2. Conservation pricing, and in particular the price elasticity of water demand, is discussed in chapter 3. Chapter 4 is devoted to a review of incentive systems to overcome the impact of conservation of sales, revenues, and profits. Based largely on the considerable experience in contemplating and actually providing incentives for demand management in the electricity sector, various types of cost-recovery, lost-revenue, and performance-motivation incentives are reviewed. Finally, chapter 5 provides a summary of a detailed survey of the state public utility commissions with regard to issues and practices in the water conservation area. Detailed tables on specific state responses, and a copy of the survey instrument, are provided as the appendix of this report.

CHAPTER 2

WATER CONSERVATION

Why conserve water? All of the water that has ever been on earth is still on earth. Water moves across space and time but never leaves the biosphere. Water has all the appearance of being nature's most plentiful and renewable resource.[1]

However abundant, the earth's water resources are finite and constrained. Population growth, particularly in areas without naturally abundant water supplies, has begun to put a strain on nature's capacity to provide. Moreover, water is not a perfectly renewable resource. Local water sources can be overdrawn or polluted beyond their capacity to renew. Substantial amounts of nonrenewable energy, chemicals, and other resources are required to deliver water and dispose of wastewater at acceptable levels of quality. Stringent but largely necessary drinking-water and pollution-control standards, as well as more stringent regulation of water withdrawals, make it all the more difficult to fulfill the growing demand for water. The opportunity costs associated with ignoring efficiency as a resource seem to be on the rise.

Conscientious water utilities, regardless of ownership form, are planning now for the effects of conservation in their service territories. The emerging interest in "total water management" reflects these endeavors. Water utility planners today have little choice but to incorporate conservation effects into their demand and revenue forecasts. Importantly, utilities with apparently plentiful supplies and reasonably stable demand patterns must account for the potential of conservation practices to dampen demand, even if they are not engaged in conservation programs per se. All water utilities, regardless of their circumstances, should evaluate the potential for price-induced usage reductions (intentional or unintentional) or usage reductions induced by other forces. In the latter category, one important force is the gradual and inevitable replacement of high water-use fixtures with low water-use fixtures.

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[1] See Janice A. Beecher and Ann P. Laubach, *Compendium on Water Supply, Drought, and Conservation* (Columbus, OH: The National Regulatory Research Institute, 1989).

Utilities experiencing demand growth, and facing limitations on supply options, might choose to aggressively develop their demand-side resources. In some regions, regulators may begin requiring them to do so. For instance, it may become more difficult and expensive to acquire water-supply permits or certificates of need without demonstrating a commitment to demand management efforts. In the long term, utility-sponsored conservation could play an important role in improving the efficient use of water resources. According to water conservation planning experts, "A carefully planned and implemented long-term conservation program can reduce water consumption by 10 to 20 percent over a 10 to 20 year period."[2] As Peter Macy explains, a well-designed conservation program will yield a net decrease in costs because of improved efficiency in deployment of utility capital and operating resources.[3]

The implications of conservation for supply planning, illustrated in figure 2-1, can be dramatic. Conservation can lower capacity requirements and help avoid certain costs. It is increasingly important for supply planning to incorporate estimates of conservation-affected demand. Obviously, depending on the extent of the utility's reliance on usage-sensitive charges, the revenue and rate impacts of demand reductions can be significant as well. This chapter explores general conservation and demand forecasting issues that will be relevant for utilities and regulators as they prepare for potential effects on operations and revenues. Conservation pricing issues are reserved for the following chapter.

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[2] William O. Maddaus and Gwendolyn A. Gleason, "Planning Cost-Effective Conservation Programs for Public and Private Utilities," a paper presented at the Annual Meeting of the American Water Works Association in New York, 1994.

[3] Peter P. Macy, "Integrating Conservation and Water Master Planning," *American Water Works Association Journal*. 83, no. 10 (October 1991).

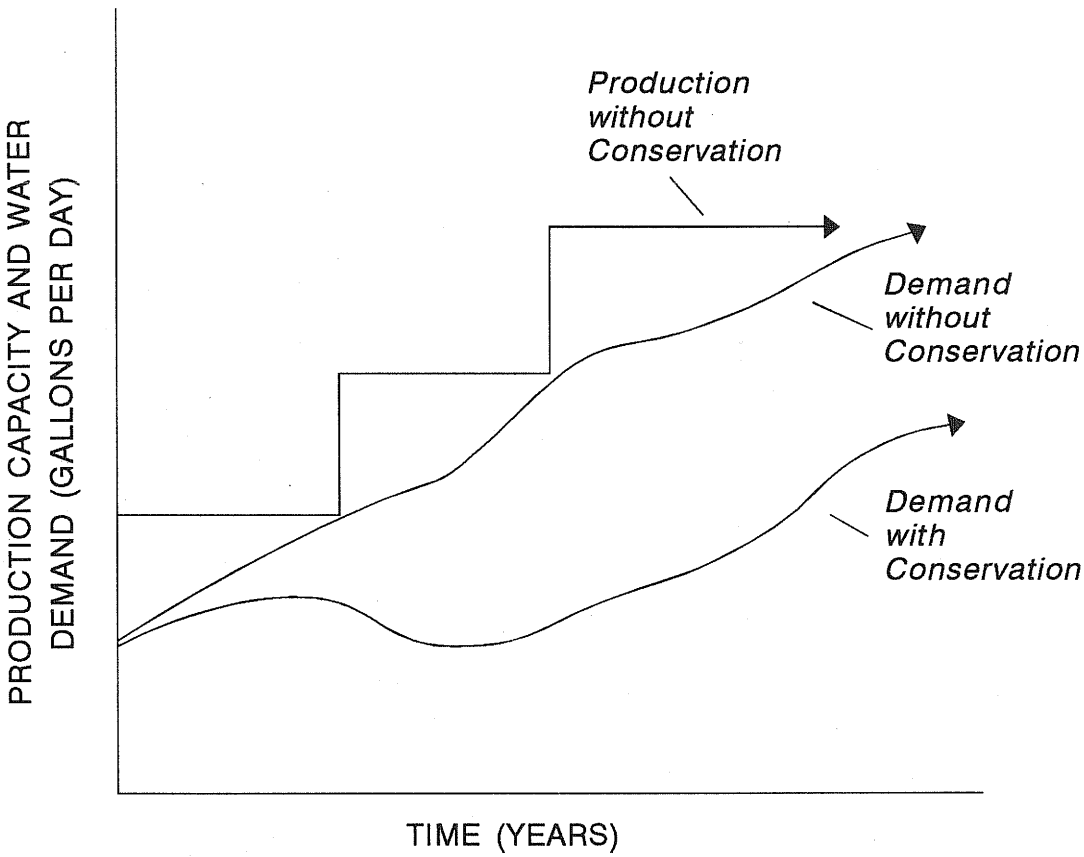

Fig. 2-1. Theoretical role of water conservation in lowering water demand (authors' construct).

Conservation Policy and Planning

The idea that utilities can meet future demand through a combination of supply-side resources (such as new source supplies, purchased supplies, and transfers) and demand-side resources (such as conservation and strategic load management) has arrived in the water sector. Leading global environmentalist Sandra Postel has emphasized the importance of overcoming the institutional barriers to conservation as not just a valuable resource in its own right, but one that compares favorably to supply-side resources.[4] These barriers, which include pricing policies and water laws, have contributed to the inefficient and wasteful use of water and undermined the potential for cost-effective demand management. According to Postel, "Only by managing water demand, rather than ceaselessly striving to meet it, is there hope for a truly secure and sustainable water future."[5]

An apparent shift in United States water resource policy can be detected at the national level, and in particular in the western region of the country, as noted recently in a document prepared by the U.S. Geological Survey:

> Water management in the United States has traditionally focused on manipulating the country's vast supplies of freshwater to meet the needs of users. The effects of this "supply management" approach have been felt in every sector of the economy, from municipal water supply to irrigation. Increasing development costs, capital shortages, government fiscal restraint, less favorable storage reservoir sites, and increasing concern for the environment have forced water managers to begin to rethink traditional approaches to water management and to experiment with new ones. Experts on the subject of western water agree that the West is in transition from the era of water development to an era of water management and conservation. Attention now and in the future will be centered on optimizing the use of existing surface-water projects . . . on

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[4] Sandra Postel, "Increasing Water Efficiency," in Lester R. Brown, et al., *State of the World 1986* (New York: W. W. Norton & Company, 1986), 41.

[5] Ibid.

developing more efficient water application techniques, and on developing other water conservation measures . . . [6]

Integrated resource planning (IRP), which has been advocated by a number of utility regulators and adopted by a number of utilities, is a form of planning that emphasizes joint consideration of supply-side and demand-side resource options and the development of well-balanced planning scenarios. Investing in smaller increments of demand-side resources, compared with large-scale supply-side resources, can help utilities increase planning flexibility and lower some forms of risk. Thus, for both the energy and the water sectors, incentives for conservation and demand management are intrinsically related to the goals of integrated resource planning.[7]

Least-cost and integrated planning both embrace the idea of conservation. One of the leading principles of integrated planning is the balanced consideration of demand management and supply management options in developing utility planning scenarios. Conservation continues to be a source of philosophical and public policy controversy and a sore subject for those who put great faith in water's natural abundance and equate conservation with the unjustified curtailment of water use and a decline in consumer lifestyles. However, the emergence of a conservation paradigm in the water sector is partially responsible for our reexamination of traditional water utility planning. This paradigm recognizes water as a finite and often constrained resource.

As noted earlier, water is abundant and renewable but not perfectly so. It is not always where people need it when they need it. The water and wastewater infrastructures both consume nonrenewable energy and chemicals. Water resource development has significant environmental impacts. Integrated planning can help recognize and help to

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[6] Wayne B. Solley, Robert R. Pierce, and Howard A. Perlman, *Estimated Use of Water in the United States in 1990* (Washington, DC: U.S. Geological Survey, 1993), 69 (footnote omitted from quote). See also, C. F. Wilkinson, *Western Water Law in Transition* (Boulder, CO: University of Colorado Law Review).

[7] On IRP for water utilities, see Janice A. Beecher, Patrick C. Mann, and James R. Landers, *Integrated Planning for Water Utilities* (Columbus, OH: The National Regulatory Research Institute, 1991).

reconcile the alternative perspectives on conservation. Generally, the term "efficiency" finds more acceptance than the term conservation. Reducing waste (for example, excessive leaks in the distribution system) can be cost-effective even for areas with abundant supplies because the water saved is an increasingly valuable (or value-added) commodity.

Some advocates contend that water conservation should, like recycling, become second nature to consumers. Government agencies have recognized the merits of conservation through policies that promote efficient water use and public education. Gradual improvements in water-use technology, the emergence of a conservation ethic, and the growing emphasis on water's value can affect all water service territories, regardless of whether utility-sponsored conservation programs are implemented.

Adapting some aspects of least-cost energy planning to the water sector can be problematic. Should demand management programs perform below expectations, for example, alternative water supply options may be limited. Furthermore, since water utilities are usually not physically interconnected (as in the case of electricity), it may be difficult for utilities to meet unanticipated demand on short notice. The relatively low price of water in many areas may prove to be a disincentive for consumers to invest in demand management measures. If consumers do conserve, water utilities may find it difficult under current rate structures to meet overall revenue requirements and cover fixed costs. This can be especially troublesome in the water sector because of the relative stability in aggregate per capita demand. Revenue shortfalls can lead to price increases which can stimulate further conservation.

For many water utilities the variable costs associated with water itself are small in comparison to the fixed, capital costs of the storage, treatment, and distribution systems. For these reasons, some analysts believe that conservation works best in the case of utilities that want to forestall the need for additional source capacity. Conservation and more efficient use, therefore, can be especially important for areas experiencing demand growth. But in the long term, all costs are variable. The implication of this point is that long-term efficiency is a legitimate goal for all utilities, regardless of their current supply situation.

The rationale for water conservation goes beyond the capacity constraints on water supply utilities. First, environmental externalities are a growing concern in the water sector.

Large water supply projects can have significant regional environmental impacts that can be costly to mitigate. Second, the water industry makes substantial use of energy and chemicals, not only for water supply but also for wastewater management. In some areas, wastewater treatment capacity is severely constrained, meaning that conservation programs for indoor water use could be advocated. Third, a special need exists to develop planning methods that recognize the different interests of water and wastewater systems when their capacity situations are divergent. This issue is complicated when the water and wastewater systems are separately owned, operated, regulated, or funded.

Although the debate is unresolved, efficiency advocates in the energy sector have argued that demand management benefits not only the environment but the larger economy as well.[8] When available water resources are limited, local economic growth can be limited.[9] The analytical merit of incorporating variables like economic development in utility planning decisions remains controversial.[10] Since water resources cut across so many uses and so many planning, management, and regulatory boundaries, these larger economic issues are sure to be relevant to the conservation debate. However, because water is an essential natural resource, the potential for agreement on certain conservation goals (such as waste reduction and wise use) may be higher for water than for other resources.

Water conservation has several dimensions. An important distinction can be made between conservation on the supply side and conservation on the demand side, as well as between short-term and long-term strategies. A summary of options can be found in table 2-1. For many utilities the first and foremost effort should be supply-side conservation. Ignoring the potential for improving supply-side efficiency makes little sense. Water supply audit and leak detection and control programs are expensive but increasingly cost-effective,

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[8] Edward Moscovitch, "DSM in the Broader Economy: The Economic Impacts of Utility Efficiency Programs," *The Electricity Journal* 7, no. 4 (May 1994): 14-28.

[9] Joe Schwartz, "The Real Price of Water," *American Demographics* (September 1988): 29-32.

[10] Skip Laitner, Ian Goodman, and Betty Krier, "DSM as an Economic Development Strategy," *The Electricity Journal* 7, no. 4 (May 1994): 62-69. See also "DSM: Not for Jobs, But on its Merits," *The Electricity Journal* 7, no. 4 (May 1994): 80-81.

TABLE 2-1
SUPPLY-MANAGEMENT AND DEMAND-MANAGEMENT PRACTICES

Managing	Time	Supply Management	Demand Management
Water Suppliers	Short-term strategies	. Supply audits and metering . Leak detection and repair . Resource management . Transfers, diversions, and auxiliary supplies . Pressure reduction . Relaxation of standards (extreme emergencies)	. Rates, penalties, and surcharges . Pleas for voluntary use reduction . Use bans and rationing
	Long-term strategies	. Phased source development . Additional storage and conveyance capacity . Loss reduction program . Resource management and conjunctive use . Transfer, diversions, reallocation . Imports (Canada/Mexico) . Reclamation and reuse	. Conservation programs for each water-use sector . Comprehensive metering for all water uses . Conservation rates . Water-use audits . Public information and education . Plumbing efficiency standards and retrofits
Water Consumers	Short-term strategies	. Participation in planning and management processes	. Reduction in water use . Use of substitutes
	Long-term strategies	. Participation in planning and management processes	. Wise indoor/outdoor use . Efficient appliances and fixtures, including retrofits . Efficient landscaping and irrigation practices . Reuse, recycling, and recirculation . Agricultural, industrial, and commercial efficiency applications

Source: Authors' construct.

while also providing a significant source of water.[11] An aggressive program to protect and preserve water sources also is essential. Supply-side conservation has no adverse effect on utility revenues and is more directly under the utility's control. Expenses for supply-side conservation generally can be recovered from ratepayers. Conservation on the demand side, on the other hand, raises revenue issues that require careful consideration.

Conservation, Efficiency, and Demand Management

Conservation, efficiency, and demand management are highly interrelated and largely interchangeable ideas. Semantic differences among them are not emphasized in this report. *Conservation* seems to be the more generic term, encompassing the other two. Various types of conservation can be identified: technical (basically, long-range improvements in technical efficiency that seem to occur "naturally"); voluntary (changes in consumer behavior); coercive (responses brought about by utility actions, including changes in the pricing structure); and mandatory (such as penalties, fines, and user restrictions).

A common sense definition of conservation is reduction in use, particularly wasteful use. Another connotation is that resources conserved also are preserved, that is, protected and maintained for other purposes or future needs. Conservationists are linked closely with the environmental movement and the guiding principles of reduce, reuse, and recycle. Some are guided in their efforts by a belief in impending scarcity. Some also accept certain sacrifices in lifestyle if necessary to achieve broader conservation goals. In general, however, conservation should not be equated with water user restrictions that impair consumer lifestyles, as sometimes are required during emergencies or droughts.

Efficiency, a cornerstone of economic theory, is a more value-neutral term referring to the appropriate balance of supply and demand for a resource. The guiding principle for efficiency is allocation through pricing that reflects true costs. The more evaluative terms of scarcity and abundance are replaced by the more neutral concepts of supply, demand, and

[11] S. Sowby, "Leak Detection Programs Recover Revenues," *American Water Works Association Journal* 73, no. 11 (November 1981): 562-564.

price. The concept of efficiency is useful in explaining human choices, as well as in explaining water-using technologies and behaviors (such as efficient appliances, plumbing fixtures, and landscaping practices). Efficiency does not necessarily require sacrifice, at least not by those who are willing and able to afford the price of using a resource. Indeed, some efficiency advocates argue for "doing more with less" through expanded use of efficiency methods, including both supply management and demand management.

Demand management (or demand-side management) also is a more value-neutral and pragmatic term. It refers generally to the use of conservation practices and/or pricing to influence demand patterns in a utility's service territory. The peaks and valleys in utility demand directly influence the configuration of a water system's physical plant and therefore its cost. For most practical purposes, demand management can be equated with *load management*, although certain load-management activities are applied over a shorter planning horizon than demand-management activities.[12] Strategic load management captures the idea that utilities do not have to passively accept demand as unalterable, but that they can influence demand patterns in ways significant enough to affect system efficiencies. Utilities can use load management to manipulate the shape of demand (daily, seasonally, and so on), as illustrated in figure 2-2. In relation to conservation, load management obviously suggests a reduction in utility load. In practice, load management also can mean increasing load during off-peak periods to help spread costs and improve load factors (that is, the efficient use of system capacity).

In the realm of water supply, all three perspectives--conservation, efficiency and demand management--are relevant. All have legitimacy in the design and implementation of public policies toward water resources. From the standpoint of public utilities, demand management or load management have special meaning in terms of recognizing conservation as a resource option. It does not appear that load management has been applied by water utilities to a significant degree. By contrast, load management is an essential part of electric utility planning and management:

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[12] Sarosh Talukdar and Clark W. Gellings, eds., *Load Management* (New York, Institute of Electrical and Electronics Engineers, Inc., 1987).

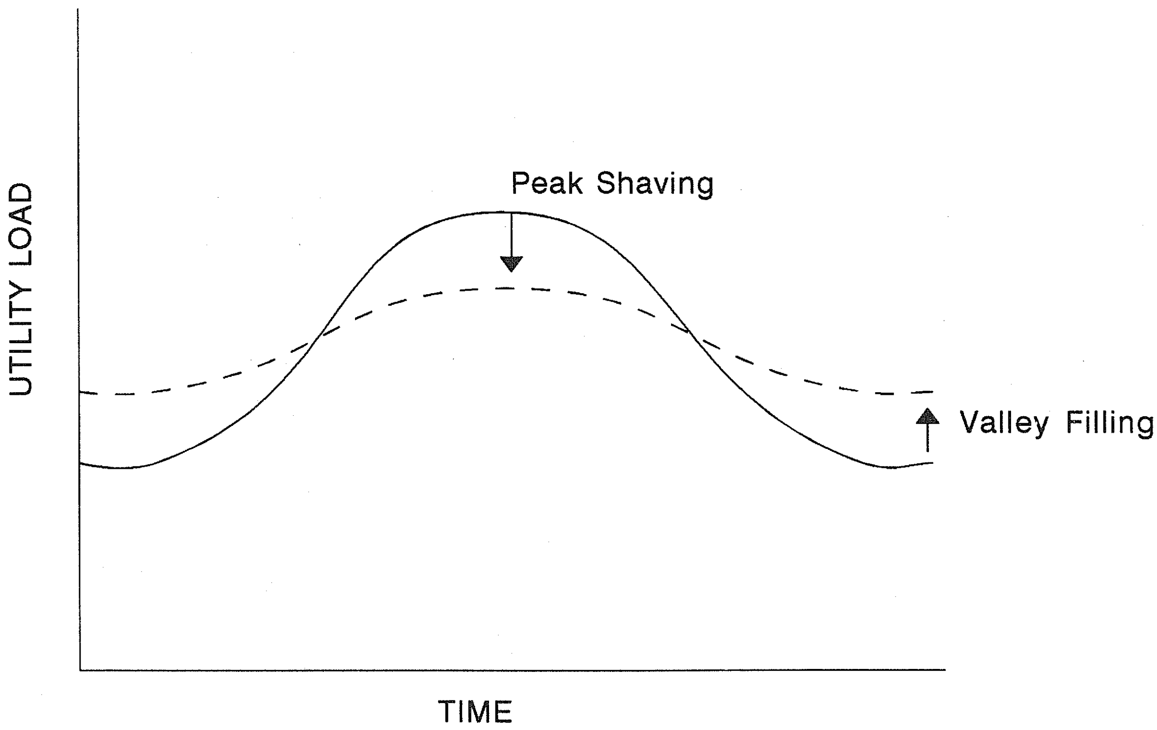

Fig. 2-2. Example of a utility load-management strategy (authors' construct).

> Load management actions are taken to control load growth, alter the shape of the load curve or increase the supply through nonutility or nontraditional sources. The actions may be initiated to reduce capital expenditures, improve capacity limitations, provide for economic dispatch, reduce the cost of service, improve load factors, improve system efficiency, or improve system reliability. The actions may be normal procedures or emergency procedures. . . . [13]

According to electricity experts Talukdar and Gellings, load management emerged in the electricity sector during the 1960s and 1970s, initially in Europe and New Zealand, and has become "a subject of active interest through the electric utility industry, in regulatory circles, and for the public at large."[14] The approach, they argue, applies to utilities of all sizes, regardless of ownership structures or the demography of the service territory. In addition to the basic types of load management identified in table 2-2, electric utilities also have classified a number of demand-side activities that can be used to help shape utility load curves: end-use equipment control, utility equipment control, energy storage, incentive rates, dispersed generation and alternative energy sources, energy cooperatives, customer demand-side promotions, and performance improvements both in equipment and systems.[15] Many specific activities can be identified within each of these general categories.

Based on experience in the electricity sector, successful implementation of load management depends on more than technical and operational expertise on the part of utilities. Customer acceptance is recognized as a key factor in the effective use of load management. Customer acceptance will be influenced generally by demographic and attitudinal factors, as well as by existing patterns of demand in the service territory. In addition, customer participation in load-management programs will be influenced by: price or other incentives, the degree of the program's impact, effects on lifestyles, aesthetic considerations,

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[13] Talukdar and Gellings, *Load Management,* 5.

[14] Ibid.

[15] Ibid., 8.

TABLE 2-2
BASIC LOAD-SHAPE CONCEPTS FOR PUBLIC UTILITIES

Load-Shape Concepts	Definition
Peak clipping	Reduction of load during peak demand periods. Generally achieved in the electricity sector by directly controlling customers' appliance. This direct control can be used to reduce capacity requirements, operating costs, and dependence on critical inputs.
Valley filling	Building load during off-peak periods. Particularly desirable to utilities when the long-run incremental cost is less than the average price. Adding properly priced off-peak load under those circumstances can decrease the average price.
Load shifting	Accomplishes many of the goals of both peak clipping and valley filling. It involves shifting load from on-peak to off-peak periods, allowing the most efficient use of capacity.
Strategic conservation	A reduction in sales, often including a change in the pattern of use. The utility planner must consider what conservation actions would occur naturally and then evaluate the cost-effectiveness of utility programs intended to accelerate or stimulate conservation actions.
Strategic load growth	A targeted increase in sales. It can involve increased market share of loads that are or can be served by competitors, as well as development of new markets.
Flexible load shape	Allowing customers to accept lower than normal reliability for some service. The customer's load-shape will be flexible, depending on real-time reliability conditions.

Source: Adapted from Sarosh Talukdar and Clark W. Gellings, eds., *Load Management* (New York, Institute of Electrical and Electronics Engineers, Inc., 1987), 6-7.

communications and customer service, liability implications, and misconceptions or unfounded fears on the part of customers.[16]

In any demand management strategy, the characteristics of water demand must be carefully considered. Like electricity, water demand varies seasonally. Both the electricity and water sectors experience warm-weather peaks. A unique feature of water is that both demand and supply are affected by weather patterns, with the unfortunate reality that drought can create water shortages at the same time customers demand more water, especially for lawn watering. For conservation purposes, seasonal variations in water demand (driven by more discretionary outdoor use) usually are more relevant than daily or hourly variations.

The potential for load management in the water sector is affected by the physical characteristics of water supply and distribution. Water is storable and storage facilities are used to meet daily and hourly peak demands, which typically include fire protection needs. For example, treatment and storage facilities are designed to meet maximum-day demand. As a practical matter, many utility load-management techniques require more sophisticated metering and billing than generally is practiced in the water sector. Time-of-use metering, for example, is generally not available. Remote metering for multiple utility services (that is, energy and water) can be cost-effective, but implementation barriers to this technology may be hard to overcome without regulatory inducements. Still, some load-management practices could be applied in the water sector to improve efficiency, including load management for water-intense industries, load shifting on a seasonal basis (rather than hourly or daily), and demand management programs that decrease overall demand by changing consumption habits.

Load management by water utilities requires somewhat unconventional thinking. For example, it is conceivable that hourly peaks in water demand could be managed by establishing interruptible service for large-volume customers to assure that incidental fire-flow requirements can be met.[17] In the electricity sector, some large-volume users accept a certain

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[16] Talukdar and Gellings, 141-42.

[17] It is assumed that the service interruption could be accomplished without impairing water quality.

certain probability of interrupted service in exchange for a lower price.[18] In the water sector, a form of interruptible service occurs when user restrictions are imposed during a water emergency or shortage. However, water pricing policies typically do not account for these occurrences as interruptible service. The water industry and its regulators generally have not recognized the potential use of any form of sanctioned degradation in service quality for the purpose of differentiating prices. In theory, however, interruptible and other service categories could be used to improve system efficiency and permit variations in water pricing. This assumes, of course, that the benefits of these rate design alternatives would outweigh implementation costs.

Modern Water Efficiency Standards

Contemporary interest in conservation and demand management is not due simply to changes in culture and attitudes toward the environment, but also to significant changes in public policy.[19] The most consequential of these may be the enactment of new plumbing fixture efficiency standards under the National Energy Policy Act of 1992 (EPAct), as summarized in table 2-3. As Amy Vickers points out, "the enactment of federal standards demonstrates that water conservation has gained a foothold on the nation's environmental agenda."[20] Indeed, both energy and water conservation can be linked to modern pollution prevention strategies at the national and state levels.

EPAct establishes maximum-water-use standards for plumbing fixtures, requires product labeling, and provides recommendations for state and local incentive programs to

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[18] In some cases, actual service interruption can be very infrequent, which can compromise the validity of the rate. Interruptible rates sometimes are provided for economic development purposes or to retain industries that might otherwise leave the utility system.

[19] Amy Vickers, "Emerging U.S. Water Conservation and IRP Policy Initiatives," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

[20] Amy Vickers, "The Energy Policy Act: Assessing its Impact on Utilities," *American Water Works Association Journal* 85, no. 8 (August 1993), 62.

TABLE 2-3
WATER EFFICIENCY STANDARDS ESTABLISHED BY
THE ENERGY POLICY ACT OF 1992

Faucets
The maximum water use allowed by any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

Faucet Type	Maximum Flow Rate (gallons per minute or per cycle)
Lavatory faucets	2.5 gpm
Lavatory replacement aerators	2.5 gpm
Kitchen faucets	2.5 gpm
Kitchen replacement aerators	2.5 gpm
Metering faucets	0.25 gpc

Showerheads. The maximum water use allowed for any showerhead manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing pressure of 80 pounds per square inch.

Water Closets. (1) The maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is as follows:

Water Closet Type	Maximum Flush Rate (gallons per flush)
Gravity tank-type toilets	1.6 gpf
Flushometer tank toilets	1.6 gpf
Electromechanical hydraulic toilets	1.6 gpf
Blowout toilets	3.5 gpf

(2) The maximum water use allowed for any gravity tank-type white two-piece toilet which bears an adhesive label conspicuous upon installation of the words "Commercial Use Only" manufactured after January 1, 1994 and before January 1, 1997, is 3.5 gallons per flush.

(3) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

Urinals. The maximum water use allowed for any urinals manufactured after January 1, 1994, is 1.0 gallons per flush.

Source: U.S. Department of Energy handout dated July 18, 1994.

accelerate voluntary replacement of water-using fixtures.[21] The Department of Energy, through its Office of Buildings Technologies, is responsible for implementing EPAct's water efficiency provisions. As Vickers points out, water utility engineers, planners, and managers must begin to take the effects of the new standards into account in forecasting water demand. Household water demand will continue to decline as high-volume toilets, faucets, and the like are replaced. These permanent effects can be considered on a per capita, per household, and systemwide basis. The savings from individual fixtures quickly add up, providing many systems with a new "source" of water and reducing the need for capacity expansion. In addition to water savings, the efficiency standards will yield savings in energy and chemicals associated with both water supply and wastewater treatment, which in turn yields measurable environmental benefits.

The estimated savings associated with efficient water-use fixtures is provided in table 2-4. On a per capita and per household basis, the water savings (and cost savings) can be substantial. The actual savings for any new fixture depends, of course, on the nature of the fixture being replaced. Replacement of older, more wasteful fixtures will be more beneficial and yield a quicker payback for the retrofit expenditure. Beyond the plumbing standards, the efficiency potential of water-using appliances also is relevant. With the newly required product labeling, consumers can evaluate both the energy and water-use efficiency of appliances. Table 2-5 provides estimates of water savings from more efficient clothes washers and dishwashers. According to the conservation literature, the clothes washer is sometimes the "forgotten" appliance, although it uses a significant amount of water. Modern horizontal-axis machines (sometimes known as "front loaders") can perform better than their predecessors and use only about one third of the water, not to mention energy savings.[22] Finally, table 2-6 provides estimates of potential water savings from miscellaneous measures, such as landscaping practices and public education.

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[21] Ibid.

[22] Allan J. Dietemann and Suzan J. Hill, "Water and Energy Efficient Clothes Washers," a paper presented at the Annual Meeting of the American Water Works Association in New York, 1994.

TABLE 2-4 POTENTIAL WATER SAVINGS FROM EFFICIENT FIXTURES					
Fixture (a)	Fixture capacity (b)	Water Use (GPD)		Water Savings (GPD)	
		Per capita	2.7-person household	Per capita	2.7-person household
Toilets (c)					
Efficient	1.5 gallons/flush	6.0	16.2	na	na
Low-flow	3.5 gallons/flush	14.0	37.8	8.0	21.6
Conventional	5.5 gallons/flush	22.0	59.4	16.0	43.2
Conventional	7.0 gallons/flush	28.0	75.6	22.0	59.4
Showerheads					
Efficient	2.5 (1.7) gallons/minute	8.2	22.1	na	na
Low-flow	3.0 to 5.0 (2.6) gal/min	12.5	33.8	4.3	11.7
Conventional	5.0 to 8.0 (3.4) gal/min	16.3	44.0	8.1	22.0
Faucets					
Efficient	2.5 (1.7) gallons/minute	6.8	18.4	na	na
Low-flow	3.0 (2.0) gallons/minute	8.0	21.6	1.2	3.2
Conventional	3.0 to 7.0 (3.3) gal/min	13.2	36.6	6.4	17.2
Toilets, Showerheads, and Faucets Combined					
Efficient	not applicable	21.0	56.7	na	na
Low-flow	not applicable	34.5	93.2	13.4	36.4
Conventional	not applicable	54.5	147.2	33.5	90.4

Source: Amy Vickers, "Water Use Efficiency Standards for Plumbing Fixtures: Benefits of National Legislation," *American Water Works Association Journal* 82 (May 1990), 53.

na = not applicable
(a) Efficient = post-1994
    Low-flow = post-1980
    Conventional = pre-1980
(b) For showerheads and faucets: maximum rated fixture capacity (measured fixture capacity). Measured fixture capacity equals about two-thirds the maximum.
(c) Assumes four flushes per person per day; does not include losses through leakage.
(d) Assumes 4.8 shower-use-minutes per person per day.
(e) Assumes 4.0 faucet-use-minutes per person per day.

TABLE 2-5
POTENTIAL WATER SAVINGS FROM EFFICIENT APPLIANCES

Fixture (a)	Fixture capacity	Water Use (GPD)		Water Savings (GPD)	
		Per capita	2.7-person household	Per capita	2.7-person household
Clothes Washers (b)					
Efficient	42 to 47.5 gallons/load	12.6	34.0	na	na
Conventional	55 gallons/load	16.5	44.6	3.9	10.6
Dishwashers (c)					
Efficient	9.5 to 12 gallons/load	1.6	4.4	na	na
Conventional	14 gallons/load	2.4	6.4	.8	2.0

Source: Authors' construct based on information contained in California Department of Water Resources, *WaterPlan: Water Conservation Assumptions* (Sacramento, CA: California Department of Water Resources, 1989). Estimates are affected by rounding.

na = not applicable
(a) Assumes one fixture. Savings are calculated based on most efficient washer assuming continued improvements in efficiency.
(b) Assumes .3 loads of laundry/person/day.
(c) Assumes .17 loads of dishes/person/day.

TABLE 2-6 POTENTIAL WATER SAVINGS FROM MISCELLANEOUS MEASURES	
Water Use	Percent Savings
High efficiency landscaping	50.0
Lawn watering guides	15-20.0
Low water-use plants	7.5
Pressure reduction	3.0
Public education and behavior changes	1.0
Industrial water conservation	10-20.0

Source: Authors' construct based on information contained in California Department of Water Resources, *WaterPlan: Water Conservation Assumptions* (Sacramento, CA: California Department of Water Resources, 1989).

Many water efficiency technologies are relatively inexpensive to install and can yield a fairly quick payback (from a few months to a few years). However, the benefits and costs (or cost-effectiveness) of alternative conservation techniques and programs are beyond the scope of this study. Super-efficient technologies (such as in-home water recycling systems) also are not considered. A variety of computer programs are emerging to help analysts evaluate these issues from the perspective of participants and utilities, and in terms of rate, community, and societal impacts.[23] In addition to water savings, potential energy and chemical savings can be estimated as well. Apparently, many of the performance problems with the earlier generation of water-efficient fixtures and appliances have been overcome. As a result, confidence in their performance and benefits is on the rise. In fact, pursuant to federal policy and growing interest in demand management, strategies for accelerating fixture and appliance replacements are under consideration. Some water systems already provide special incentives (such as customer rebates) for retrofits and replacements.[24]

Utility-Sponsored Conservation Programs

Water conservation programs can produce sustained benefits in lowering water demand and extending the useful life of existing supplies. In the global community, urban water conservation programs have been implemented in Beijing, China; Bogor, Indonesia; the Boston metropolitan area; Jerusalem, Israel; Melbourne, Australia; Mexico City, Mexico; Singapore; Southern California metropolitan areas; and Waterloo, Canada.[25]

Many city planners have embraced conservation not because of ideological persuasion or external pressure but because their analyses support demand management as an effective and least-cost resource option. This is new territory for many utilities and, in the case of public-sector utilities, for the municipalities that run them. Utilities that sponsor demand management programs (especially publicly owned utilities) can mitigate against revenue and

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[23] K. O'Grady, "Methods for Analyzing Benefits and Costs of Conservation Alternatives," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 1947-1957.

[24] See Gary S. Fiske and Ronnie Ann Weiner, *Customer Incentives for Water Conservation: A Guide* (Washington DC: U.S. Environmental Protection Agency, 1994).

[25] Sandra Postel, *Last Oasis: Facing Water Scarcity* (New York: W. W. Norton & Company, 1992), 148-49.

rate effects by diversifying program funding and spreading costs over time.[26] Strategies such as third-party financing also can help utilities reduce perceived risks associated with implementing conservation programs. Another goal associated with some utility conservation programs is the desire to improve the affordability of water service for consumers. Targeting conservation to low-income consumers can help control consumer costs, as well as utility uncollectible accounts.

So great is the potential for water savings through toilet replacement that some municipal water systems have initiated toilet rebate programs to accelerate the installation of low water-use fixtures. The City of San Diego began its program in 1991, with annual funding of $500,000 planned for five years.[27]

In the United States, the interest in toilet efficiency is a coast-to-coast phenomenon. Steven Ostrega, the Deputy Commissioner of the New York City Department of Environmental Protection, refers to conservation as the city's "new-found religion."[28] In recent years, water supply facilities for New York have at times exceeded safe yields. Water service rates for the city's customers rose by as much as 232 percent from 1985 to 1993, resulting from: (1) the loss of governmental subsidies; (2) federal legislation requiring the city to stop dumping sewage sludge in the ocean, which will increase costs by $1 billion; and (3) the need to refurbish the city's 6,000-mile water and wastewater infrastructure, in disrepair after a decade or more of neglect. New York City's comprehensive set of conservation initiatives appears in table 2-7.

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[26] R. W. Cuthbert and P. R. Lemoine, "Water Rates and Conservation: Short-term Realities Versus Long-term Goals," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 1405-10.

[27] Marsi A. Steirer, Dianne Parham, Leisa Lukes, and Mike Schlei, "San Diego's Toilet Rebate Program Experience: An Evolutionary Approach," a paper presented at the Annual Meeting of the American Water Works Association in New York, 1994.

[28] Steven F. Ostrega, "New York City: Where Conservation, Rate Relief and Environmental Policy Meet," a paper presented at the Annual Meeting of the American Water Works Association in New York, 1994.

TABLE 2-7
NEW YORK CITY CONSERVATION INITIATIVES

Program	Plan	Expectations
Universal metering	Meter entire city by 1988; employ automated meter reading equipment where appropriate	Incentive/disincentive based billing system producing 100 to 150 MGD savings in the previously unmetered residential sector
Toilet rebate program	Replace up to 1.5 million toilets through a rebate of up to $240 per fixture; also require that 2.5 gpm showerheads be in place to qualify for the rebate	33 percent of all toilets are replaced, resulting in a savings of approximately 90 MGD
Residential water survey program	Offer free audit services and free installation of low-cost items (showerheads, toilet devices, aerators)	6 to 20 MGD savings, with higher savings reflecting leak repairs by owner; provides city with information about the housing stock and elevates conservation consciousness
Sonar leak detection	Survey and repair below street pipe leaks. Stressed drainage zones (about 30 percent of the city) are surveyed every nine months; the entire city at least once every three years	Save approximately 30 MGD and increase crew productivity (increase leaks repaired per day), thereby decreasing leak correction time
Hydrant locking devices	Use effective magnetic caps to lock 30,000 hydrants (33 percent of total) in areas most prone to hydrant abuse	Approximate savings of 0.5 MGD in average weather but as much as 100 MGD on days above 90 degrees; reduces public criticism of utility's conservation efforts in an environment of open hydrants

Source: Steven F. Ostrega, "New York City: Where Conservation, Rate Relief and Environmental Policy Meet," a paper presented at the Annual Meeting of the American Water Works Association in New York, 1994.

MGD = millions of gallons daily
gpm = gallons per minute

The New York Toilet Rebate Program

Clearly the most impressive contemporary application of demand management in the water sector is the ambitious program underway in New York City to replace more than 1 million toilets within the next three years.[29] At the current level of program funding, 1.25 million toilets can be replaced.[30]The toilet-rebate program aims to accelerate the replacement of water guzzling toilets (typically 5 gallons-per-flush) with water efficient models using only 1.6 gallons-per-flush. Replacements were underway in 1994, beginning in the Bronx and extending in phases to Manhattan, Brooklyn, and throughout the city. Although New York already had implemented a variety of water conservation measures (such as education, metering, leak detection, and certain use restrictions), efforts were stepped up in response to increasing water demand, potentially inadequate wastewater treatment capacity, mounting pressure on rates for water service, and the interest in identifying least-cost solutions.

A comprehensive least-cost analysis of resource options, as summarized in table 2-8, led to the establishment of the toilet rebate program. The $240 rebate level was chosen because it would encourage the right amount of participation at the right cost. Although this option was the clear favorite in terms of cost, other considerations favored its selection as well. Conventional supply options would require wastewater treatment capacity for the additional sewage flows. The short lead time of the replacement program (three to four years) compared favorably to supply projects requiring ten years or more for planning, design, permit acquisition, potential litigation, and actual construction. Contentious water quality and environmental issues were significant factors in the analysis too. Positive customer impacts weighed in heavily as well. By replacing toilets, metered customers could see reductions in total water and wastewater bills of 20 to 40 percent; bill reductions would be greater if the replaced fixtures were leaking. Furthermore, rate increases would not be needed to cover additional capacity costs.

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[29] This summary is based on data and information handouts, and personal communications in 1994 with Warren Liebold, Director of Conservation, Bureau of Water and Energy Conservation, New York City Department of Environmental Protection.

[30] As of the summer of 1994, approximately 7,500 toilets had been replaced.

TABLE 2-8 LEAST-COST RESOURCE ANALYSIS FOR NEW YORK CITY (a)					
Resource Option (b)	Supply (MGD)	Supply cost ($mil) (c)	Cost of additional wastewater treatment capacity ($mil)	Cost/MGD capacity ($mil) (c)	Total cost per gallon (cents) (d)
Current supply and treatment sources	na	na	na	na	0.189
$150 toilet rebate (e)	40.2	$150	negative	$3.73	na
$240 toilet rebate (e)	90.6	$393	negative	$4.34	0.104
$360 toilet rebate (e)	150.9	$860	negative	$5.70	na
Chelsea pumping station expansion (f)	250.0	$1,200	$1,500	$10.80	0.318
Hudson skimming project	400-1,000	$4,000-8,000	$2,500-6,000	$14-16	na

Source: Data provided by New York City Department of Environmental Protection, Bureau of Water and Energy Conservation (1994).

na = not applicable

(a) Costs are in present value using an 8 percent discount rate. The consumer energy savings that will result from showerhead replacement are not included in the analysis but are estimated to be $8.4 million annually.
(b) The Chelsea supply expansion project time frame is six to eight years; the time frame for the toilet rebate program is three to four years.
(c) Only capital costs associated with supply and treatment are included in the comparison of capacity costs.
(d) Total capital and operating costs for water supply and wastewater treatment (pollution control) are included in the comparison of cost per gallon.
(e) Rebate program costs include all costs, including rebates, administration, and a private sector program coordinator.
(f) Operating costs, primarily due to filtering, are estimated at approximately $50 million annually.

Metered and unmetered water customers in New York City, including city residents served by the privately owned Jamaica Water Supply Company, can participate in the toilet rebate program.[31] Homeowners, apartment-building owners, and commercial-property owners can receive rebates amounting to: (1) up to $240 of the installed cost for the first bathroom in a dwelling unit (defined as a private home or apartment), (2) $150 for each additional bathroom in the same dwelling unit, and (3) $150 for toilets installed in nonresidential buildings. At least 70 percent of the toilets in multifamily or commercial buildings must be replaced for participants to earn a rebate. The city provides an ample list of qualifying fixtures to eligible participants, who must select a licensed master plumber to perform the installation. The program also requires the simultaneous installation of certified showerheads and faucet aerators at the premises. Water savings are assured through professional installation, as well as regulations guiding the disassembly and disposal of the replaced toilet fixtures (which assures that they will not enter secondary markets). Rebates are issued to participants (or to their plumbers at each homeowner's discretion) within thirty days of notification to the program office, subject to spot inspections conducted within that time period. The program is not designed to cover all replacement costs. The payback period, realized through reduced water bills, is expected to be under one year for many water customers.

An important element of the New York toilet rebate program is the partnership with a private contractor (VOLT Information, Energy and Water Technologies, or VIEWtech), and a carefully crafted system of program performance incentives. The contractor helps promote the program, processes applications, performs inspections, and distributes the rebate checks. The contractor is paid on a unit basis, contingent on whether it meets specific performance criteria:

- Requests for application packages must be fulfilled by 5:00 pm if the request arrives before noon, or by noon the next business day if the request arrives after noon.

- Completed applications must be processed within ten business days.

[31] Jamaica serves some customers in the eastern part of Queens. However, New York City provides wastewater service to these customers and supplies some water to Jamaica as well, which is why some Jamaica customers are included in the rebate program.

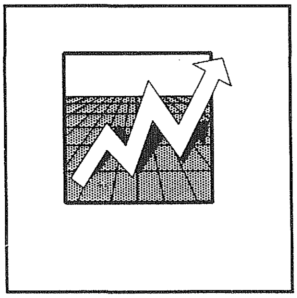
- Rebate checks must be issued within thirty days of receiving postinstallation paperwork, as long as property owners are cooperative about scheduling inspections within two weeks after the paperwork is received

- Office staffing for the program must be sufficient to ensure that no callers are left "on hold" for more than three minutes.

- Detailed biweekly reports are submitted by the contractor to the city.

By using a private firm, the city is taking advantage of and encouraging the emerging competitive market for conservation services. Private-public partnerships can help water utilities use market forces (such as profits) and market mechanisms (such as competitive bidding), and possibly avoid overbureaucratization of conservation programs. Private vendors also can assume a considerable amount of risk associated with the successful performance of programs, in part because of the opportunity costs associated with failure. Program integrity, monitoring, and evaluation are strongly emphasized by the architects of the New York program. Detailed evaluations will encompass program results in terms of consumer satisfaction, as well as water, wastewater, and energy savings.

Water Demand Forecasting



Revenue forecasting for a water utility is intrinsically related to demand forecasting. No doubt about it, water demand forecasting is an increasingly complex endeavor. The variety of models used in forecasting has expanded from simple univariate methods that simply extrapolate demand into the future; to single-variable regression analyses that correlate demand with population growth or another key indicator; to multiple-regression equations incorporating numerous explanatory variables and interactions among them; to probabilistic, sensitivity, simulation, and/or game theory (or Monte Carlo) models that can account for various contingencies and scenarios. Demand studies generally require reliable time series data on water usage, ideally on a monthly basis by usage sector, as well as data on potential explanatory variables (such as climatic, land-use, demographic, and economic factors). End-use or load studies by customer class can be helpful in understanding water demand, but are expensive to conduct. It may be especially difficult to assess the potential for industrial water conservation without end-use data and analysis. Demand monitoring by the water-use sector has become a more important endeavor for water utilities, especially in larger service territories.[32] As reported in table 2-9, the basic uses of water for the residential sector are fairly well-known.

Water demand for outdoor uses (and thus total demand) is known to vary significantly according to seasons and weather patterns within seasons. In demand forecasting, weather variations must be normalized to control for extreme weather conditions.[33] Analysts must compare demand for comparable seasons to assess permanent changes in seasonal demand patterns. Metering and pricing effects also play an increasingly significant role in demand forecasting (see chapter 3). Many analysts believe that the effects of both average and marginal prices should be considered in demand modeling.[34] Finally, it is critical for today's water demand forecasters to take into account the effect of conservation measures on future consumption.

Modern water demand forecasting can take full advantage of advances in computer hardware and software capabilities that have made it easier and less expensive to perform these studies. How much a utility or regulators should invest in demand forecasting depends on available resources and the relative risks associated with error. Errors in forecasting can be very costly. Still, modelers eventually must accept the quality of the available data, including some level of error. According to one expert, after a model has been properly specified, it is more efficient to accept the inherent level of error and concentrate efforts on identifying the upper and lower bounds in a projected range of water demand, rather than "to persist in fine-tuning a model to extract the last ounce of efficiency from a limited database."[35]

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[32] Eric Rothstein, "Water Demand Monitoring in Austin, Texas," *American Water Works Association Journal* 84, no. 10 (1992): 52-58.

[33] In capacity planning, utilities vary in their tolerance of periodic drought conditions.

[34] Jack A. Weber, "Statistical Analysis of Inverted Block Rates," in *Proceedings of the Annual Conference of the American Water Works Association* (Denver, CO: American Water Works Association, 1993).

[35] Jack A. Weber, "Integrating Conservation Targets into Water Demand Projections," *American Water Works Association Journal* 85, no. 8 (August 1993): 70.

TABLE 2-9
TYPICAL RESIDENTIAL WATER USE IN
GALLONS PER CAPITA PER DAY (a)

<table>
<tr><td rowspan="8">RESIDENTIAL
WATER USE (b)
123.3 gpcd (100%)</td><td rowspan="7">INDOOR
WATER USE
78.2 gpcd (63%)</td><td>Water Use</td><td>GPCD</td><td>Percent</td></tr>
<tr><td>Toilets</td><td>27.4</td><td>35</td></tr>
<tr><td>Laundry</td><td>17.2</td><td>22</td></tr>
<tr><td>Showers</td><td>14.1</td><td>18</td></tr>
<tr><td>Faucets</td><td>10.2</td><td>13</td></tr>
<tr><td>Baths</td><td>7.8</td><td>10</td></tr>
<tr><td>Dishwashing</td><td>1.6</td><td>2</td></tr>
<tr><td>OUTDOOR
WATER USE
45.1 gpcd (37%)
(c)</td><td colspan="3">Landscape watering
Swimming pools
Car washing</td></tr>
</table>

Source: Indoor water use estimates are from Brown and Caldwell, Inc. (1986) as reported in William O. Maddaus, *Water Conservation* (Denver, CO: American Water Works Association, 1987), 22.

(a) Gallons per capita per day (gpcd).
(b) No conservation is assumed. Variations in actual water use can be substantial.
(c) Potential savings associated with outdoor water use can be considerable.

Water Demand Elasticities

In econometric analyses of water demand, elasticity coefficients represent the responsiveness of demand to changes in multiple explanatory variables. Price elasticity of demand refers to the effect of a change in price on water usage. Other variables produce elasticity estimates as well. Both natural and socioeconomic factors, such as income, affect water demand patterns.[36] Hot and dry weather are correlated with increased outdoor water use, as homeowners try to prevent brown lawns. If those same homeowners enjoy high incomes, greater water use also is expected. This hypothesis is consistent with anecdotal complaints from some utility managers about how difficult it is to get results from demand management techniques, including price changes, when income levels are high. Income elasticities have been measured for specific utility service territories.[37] The income elasticity for water demand has been estimated to range from 0.10 to 0.90.[38] Finally, the possibility of different ethnic elasticities for water demand also has been suggested.[39]

Although a wide variety of variables have been used to model water demand, certain variables are consistently found to be statistically significant. In its simplest form, water demand is a function of customer characteristics, service territory characteristics, and pricing characteristics.[40] Regression analyses using relatively few variables can capture the compound effects of these variables and yield robust statistical estimates with fairly impressive explanatory power.

In a multiple regression analysis of pooled time-series data for Tucson, Arizona, researchers found that price, income, and socioeconomic variables significantly influenced

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[36] R. Pina, R. Vilchis, and M. Buenfil, "Water Demand Parameters for Supply System Planning," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

[37] R. Bruce Billings and W. Mark Day, "Elasticity of Demand for Residential Water: Policy Implications for Southern Arizona," *Arizona Review* 31, no. 2 (1983).

[38] Richard W. Cuthbert, "Effectiveness of Conservation-Oriented Water Rates in Tucson," *American Water Works Association Journal* 81, no. 3 (March 1989): 65-73.

[39] Mark Day, "A Discussion of Empirical Evidence of the Conservation Impact of Water Rates," *Water Pricing and Water Demand* (Phoenix, AZ: Arizona Corporation Commission Utilities Division, 1986). Day included a measure of Hispanic-American ethnicity in his elasticity study, finding a weak inverse relationship to water demand.

[40] On increasingly complex models of water demand, see Thomas W. Chesnutt, Anil Bamezai, Casey McSpadden, John Christianson, and W. Michael Hanemann, *Revenue Instability Induced by Conservation Rate Structures: An Empirical Investigation of Coping Strategies* (Denver, CO: American Water Works Association Research Foundation, 1994).

residential water demand.[41] A summary of the analysis is provided in table 2-10. The results are instructive, although clearly not generalizable for all water service territories. Elasticities are provided for the statistically significant variables for a marginal-price and an average-price model. The authors also averaged the elasticity estimates across the models for key variables, including income (+0.33), home ownership (-0.18), and publicity (-0.05). The percent of new households and growth in connections were negatively related to water use. In terms of age, the 55-64 group was negatively related to water use, while the over-65 group was positively related to water use (explained by retiree gardening). As expected, weather variables have a strong impact, but their explanatory power is greater when modeled as individual variables rather than as an integrated evapotranspiration variable. Price and rate design had significant effects in the models, as discussed in the next chapter. However, it is noteworthy that price is not always regarded as a highly significant variable in demand forecasting.[42]

In the Tucson analysis, publicity about the need for conservation was found to have a statistically significant but minor impact. Elasticity for the publicity variable ranged from -0.04 to -0.14 (for a combined average of -0.05). Although public education or publicity may appear to have a limited role, it is probably safe to assume that it remains a significant role, particularly in combination with price. Other studies have suggested that savings from utility conservation programs will diminish if public education efforts are not maintained.[43] A study of demand reductions in Fairfax County, Virginia, for example, emphasized the importance of a combined education and pricing approach.[44]

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[41] R. Bruce Billings and W. Mark Day, "Demand Management Factors in Residential Water Use: The Southern Arizona Experience," *American Water Works Association Journal* 81, no. 3 (March 1989): 64.

[42] Weber, "Integrating Conservation," 70.

[43] Mark Maimone and Michael Labiak, "A Linear Regression Analysis of Nassau County's Water Conservation Program," a paper presented at the Annual Meeting of the American Water Works Association in New York, 1994.

[44] F. P., Griffith, "Policing Demand Through Pricing," *American Water Works Association Journal* 74, no. 6 (June 1982).

TABLE 2-10
SAMPLE REGRESSION ANALYSIS AND ELASTICITY ESTIMATES
FOR WATER DEMAND IN TUCSON, ARIZONA (1974 to 1980)

Statistically Significant Variables (a)	Elasticities (b)	
	Marginal-Price Model (c)	Average-Price Model (d)
Price	-0.52	-0.70
Rate premium (c)	-0.21	
Income	0.36	0.31
Temperature	0.81	0.63
High temperature	0.10	0.10
Summer rain	-0.06	-0.06
Winter rain	-0.01	
Publicity	-0.05	-0.04
Persons per household	0.48	0.16
Homeownership	-0.18	
Age 55 to 64	-0.20	-0.08
Age 65 or older	0.28	-0.13
New households	-0.25	
Growth	-0.30	-0.22
Model Strength Indicators		
Adjusted R-squared	0.84	0.84
F statistic	309.11	451.95
Durbin-Watson	2.09	2.01
Sample size	984	984

Source: R. Bruce Billings and W. Mark Day, "Demand Management Factors in Residential Water Use: The Southern Arizona Experience," *American Water Works Association Journal* 81, no. 3 (March 1989): 58-64. Elasticities are based on combined data for all Tucson water department districts.

(a) All included variables are statistically significant at the 0.1 level or better.
(b) Elasticities indicate percentage changes in water use (+ or -) associated with a 1 percent increase in the variable indicated.
(c) Average price was measured by total revenue divided by total water sold to residential customers.
(d) The marginal-price model incorporates a "rate premium" variable to reflect the difference between the actual bill and what the customer would pay if all water were sold at the marginal price.

The need to "unbundle" elasticities according to the various types of water demand has been recommended.[45] For example, water demand can be categorized according to customer class, and further categorized according to nondiscretionary (such as indoor) and discretionary (such as outdoor) usage. Understanding the specific drivers behind specific types of demand, and their statistical interactions, can help utility planners incorporate the effects of conservation in the demand forecasts for a specific service territory.

Incorporating Conservation in Forecasting

As noted above, aggregate per capita residential water demand generally is very stable (controlling for the effects of weather). One reason is that not many new uses for water have been "discovered." Another is that markets for water-using fixtures and appliances are fairly well-saturated. One implication of this reality is that the effects of conservation may be offset by growth in the number of users, but not necessarily by growth in per capita use. Indeed, upgrading the efficiency of water-using devices should lead to declines in per capita use. By one estimate, current and potential water conservation efforts can range from 5 to 20 percent of monthly sales volume, an amount considered highly significant in the realm of demand forecasting.[46] It is an equally significant amount for the purpose of projecting revenues. The challenge for planners is to narrow the forecast range based on informed expectations about conservation potential in the service territory.

The seasonal variations in peak water demand are manifested in differences between indoor and outdoor use. Conventional wisdom and a host of empirical studies hold that outdoor water demand is more variable, discretionary, precipitation-elastic, temperature-elastic, and price-elastic than indoor demand.[47] Also, the potential for water conservation through

[45] Chesnutt, et al., *Revenue Instability*.

[46] Weber, "Integrating Conservation Targets," 70.

[47] For example, precipitation elasticity has been estimated to range from -0.1 to -0.2, and temperature elasticity has been estimated to range from 0.35 to 0.55. Weber, "Integrating Conservation Targets," 67. Price elasticities are considered in chapter 3 of this report.

improved landscaping and irrigation practices is known to be substantial. This could lead to an assumption that the potential for water conservation will be greater for outdoor demand. Yet, as much as half of the conservation potential for single-family residences may be for *indoor* water use, based on the implementation of modern efficiency standards for fixtures and appliances.[48] Thus, conservation effects are equally important in forecasting indoor and outdoor water demand and their seasonal variations.

Expected per capita or per household water savings from efficiency improvements can be incorporated into demand forecasts on a system-specific basis. Weather normalization and comparison of appropriate seasons can provide a baseline against which conservation-affected demand can be compared. Including expectations about conservation in demand forecasting requires an evaluation of the potential for conservation practices to have a lasting effect on demand patterns. The age and condition of existing fixtures and appliances must be evaluated. Obviously, replacement of older fixtures will yield greater water savings (see table 2-4). Assuming that markets are not saturated with water-efficient fixtures and appliances, analysts must assess the potential market penetration for various water-using appliances and fixtures. Jack A. Weber provides the following assessment categories:[49]

- The *applicable market* is made up of those customers who possibly could be affected by the measure. It excludes customers who already employ the measure. This implies that the current conservation performance should be the sum of existing conservation measures already in place, with recognition of some undefined measures.

- The *target market* is the portion of the applicable market that the utility wants to penetrate. The marketing effort of each specific program measures aims at this market.

- The *acceptance rate* defines the portion of the target market that will fully participate in the conservation measure.

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48 Weber, "Integrating Conservation Targets," 63-70.

49 Ibid.

- The *total market* is defined as the market penetration that results from applying the acceptance rate to the target market. In equation form, the total market is the product of a number of participation ratios:

- Total market = [potential market] x [applicable market percentage] x [utility target percentage] x [acceptance rate]

The growing literature on water conservation is helpful in making these determinations, based on the experience of utilities with efficiency programs already in place. In one American Water Works Association study, the potential market penetration rates for various water conservation measures were approximated as follows:[50]

- Public education (90 percent)
- Retrofit devices (30 to 40 percent)
- Water audits, multifamily (10 to 30 percent)
- Showerhead promotion (20 to 25 percent)
- Toilet leak repair (10 to 25 percent)
- Efficient landscape watering, multifamily and single-family (25 percent)
- Efficient landscaping, multifamily and single-family (5 to 25 percent)
- Advanced plumbing code (15 percent)

Many water conservation measures have a lasting effect on demand. Toilet replacements, for example, are unlikely to be "undone" because removal would be cost-prohibitive. Showerheads and aerators, on the other hand, can be removed by consumers. As in the market penetration rates, removal rates also must be estimated. Conservation behaviors, however, can vary over time. A certain amount of upward pressure on demand can be

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[50] Adapted from a graphical presentation in Peter P. Macy and William O. Maddaus, "Cost-Benefit Analysis of Conservation Programs," *American Water Works Association Journal* 81, no. 3 (March 1989): 43-47.

expected after initial conservation savings are realized, based on consumers' resumption of certain water-use habits. However, this "rebound" or "takeback" effect may or may not be significant.[51] In sum, the analyst must try to segregate temporary and permanent effects on demand. Especially hard to measure is the long-term impact of cultural and attitudinal changes on water demand.

Similarly, demand hardening has emerged as a potential issue in water conservation and planning.[52] Demand hardening can occur in different water-use classes. As in the case of energy conservation, this refers to the diminished ability or willingness of customers to reduce their water demand during a shortage or emergency. Utility managers sometimes are concerned that too much conservation leaves too little room for using temporary curtailments during droughts and other periods of water shortage. Customers will have already conserved as much as they can or want to conserve. Conservation advocates, however, would argue that with effective conservation programs that bring supply and demand in better synchronization, the frequency of shortages should be less. Also, conservation-oriented customers may be more well-informed and cooperative during emergencies.

The importance of considering the effects of conservation in demand and revenue forecasting cannot be overstated. The consequences of overestimating or underestimating potential conservation effects can be costly. Great strides have been made in water demand forecasting. A need clearly exists to continue these efforts in improving the quality of data, research design, and analytical methods in this area. For example, the industry could benefit from further development of detailed end-use data, quasiexperimental approaches, and nonlinear estimation techniques. Demand analysts eventually must accept some amount of uncertainty in their forecasts, but a flexible strategic planning process can accommodate an acceptable margin of forecasting error.

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[51] With toilet fixtures, the rebound effect is not a problem; having more efficient toilets does not cause customers to use them more frequently. This makes modern toilets a particularly "pure" form of efficiency.

[52] John E. Flory, Thomas Pannella, *Long-Term Water Conservation and Shortage Management Practices: Planning that Includes Demand Hardening* (Sacramento, CA: California Urban Water Agencies, 1994).

CHAPTER 3

WATER CONSERVATION PRICING

Conservation-oriented rate structures increasingly are advocated as a necessary part of long-term water planning and management strategies. In fact, conservation pricing can be considered a necessary, but not always sufficient, part of promoting wise use of water resources. It is necessary because an appropriate pricing signal is critical for guiding water consumers in their consumption decisions and water suppliers in their supply decisions. Pricing can be insufficient, however, to the extent that water consumers and suppliers may lack adequate and reliable information for interpreting prices.

The prevailing economic view is that the price of utility services, including water service, should reflect true costs.[1] Though it may seem simple enough, the alignment of utility costs and prices still remains more art than science.[2] Conservation-oriented pricing makes these points especially clear. The use of prices to manage demand is not easily divorced from the utility's ability to meet revenue requirements. A poorly designed rate structure can jeopardize the financial health of the utility and cause ratepayers to suffer the consequences. A well-designed rate structure can help a utility manage its supplies more efficiently, encourage consumers to make wise choices, and have positive environmental and social effects as well.

The demand for water is not perfectly price-inelastic; that is, water usage by customers is inversely related to the real price charged for water service. Thus, rate increases can be a singularly effective method of conservation. However, it is important to recognize that if water rate increases lag behind inflation rates, there can be an implicit incentive for customers

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[1] See D. C. Gibbons, *The Economic Value of Water* (Washington, DC: Resources for the Future, 1986).

[2] Janice A. Beecher and Patrick C. Mann, *Cost Allocation and Rate Design for Water Utilities* (Columbus, OH: The National Regulatory Research Institute, 1990).

to increase water usage. In conservation pricing, the real price of water (which screens out inflationary effects) is more important than the nominal price of water.

This chapter considers conservation-oriented pricing for the water sector. Some basic conservation-oriented rate structures and their advantages and disadvantages are briefly reviewed. Because of the importance of price elasticity of demand in predicting the impact of a change in price on utility sales and revenues, considerable attention is paid to the ever-evolving literature in this area and its implications for water utility ratemaking.

Pricing for Efficiency

A planning perspective recognizes that pricing is more than simply the means of meeting revenue requirements. It sends a signal that in turn affects demand that in turn affects the design of the water system. A planning framework allows the consideration of nontraditional approaches, not only marginal-cost analysis but variable-rate structures (such as seasonal rates and increasing-block rates) that can be used to implement it. Planning could force a more thorough evaluation of the incremental costs associated with adding capacity.

Efficiency is an untapped resource in the water sector partly because of distorted prices. Water resource economists have long attributed many of the distributional problems in the water sector to the lack of cost-based price signals. Regulatory economists have pressed for efficiency-oriented pricing in the private sector.[3] The criteria for efficiency pricing in the regulated water sector have been well-documented.[4] For public-sector water utilities, many analysts have emphasized the need to move toward rates that recover the true cost of service

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[3] Patrick C. Mann, *Water Service: Regulation and Rate Reform* (Columbus, OH: The National Regulatory Research Institute, 1981). See also, Beecher and Mann, *Cost Allocation*.

[4] Steven H. Hanke and John T. Wenders, "Costing and Pricing for Old and New Customers," *Public Utilities Fortnightly* (April 29, 1982): 46.

without underpricing (requiring a transfer from the governing body), overpricing (providing a transfer to the governing body), or subsidizing some customers at the expense of others.[5]

Efficient pricing is based on marginal-cost pricing theory. Marginal cost is the additional cost of producing or selling the next additional unit. The marginal cost of water service is the cost incurred in providing the additional water service. In practical terms, the two essential components of marginal costs are, first, the change in operating costs caused by changing the utilization rate for existing capacity, and second, the cost of expanding capacity, including the operating costs associated with the increased capacity. If the water utility is operating below capacity, marginal cost involves the incremental operating cost of producing more product units within the existing system capacity. In contrast, if a capacity increment is required, marginal cost involves the new capacity costs and the new operating costs. Calculating marginal costs involves projecting capacity and operating costs for a specified time span given a particular demand forecast.

Avoided cost is a concept that emerged in part from federal policies designed to require electric utilities to purchase electricity from independent (that is, nonutility) power producers (or qualified cogenerators and small-power providers). The rate used is based on the incremental energy and possibly capacity costs the utility would have incurred if it would have generated the additional power itself or purchased it from another source. While the use of avoided cost in the water sector is not identical to its use in the energy sector, it still has relevance. The marginal or incremental cost of conservation, for example, can be compared to the avoided cost of providing one less unit of water to consumers. This comparison can be useful in identifying least-cost planning alternatives.

Economic theory recognizes that water demand is malleable and can be manipulated by price to some degree. Water supply, even though a monopoly, is not exempt from the economic forces governing supply and demand. Academic economists, in particular, have argued that policymakers (including state public utility commissioners) should aim toward "competitive pricing" for public and private water suppliers and that water prices should be

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[5] See J. Goldstein, "Full-Cost Water Pricing," *American Water Works Association Journal* 78, no. 2 (1986): 52-61.

used to "damp down demand to the available supply," as in the larger market-oriented economy.[6] Contemporary lessons from Europe, according to one academician, indicate how pricing is a far more "virtuous" system than bureaucracy for processing economic information.[7] Although somewhat rhetorical, the underlying argument for the importance of pricing to achieve conservation goals is essentially sound.

In applied regulatory economics, considerable effort is devoted to the intricate and circular relationship among water system capacity, costs, prices, and demand. For conservation purposes, the emphasis narrows to demand and its response to price. Demand for indoor water uses is less sensitive to changes in price than demand for other outdoor uses. Only for basic drinking water needs (for survival) is demand virtually unresponsive to price. A price increase when the price is very low to begin with will not necessarily affect demand to a large degree. At higher prices, however, it can be hypothesized that demand is more price responsive. Another issue is the potential for a cultural and generational effect on water-consumptions habits caused by the increase in environmental awareness by water customers. Today's consumers are exposed to more information and options regarding their resource consumption, in part due to conservation programs advanced by energy utilities but also through community recycling and other efforts that affect consumer consciousness. Economic pressures can induce some consumers (especially large-volume customers) to seek out ways to reduce their utility costs. These motivated consumers are more likely to respond to changes in price. Thus pricing is an essential but not necessarily a sufficient mechanism for manipulating consumption (as discussed in the previous chapter). As seen later in this chapter, a great deal of effort has been devoted to the study of the price variable in econometric studies of water demand.

Conceptually, price-induced water conservation involves a reduction in the quantity of water demanded (that is, a movement along a given demand curve). Other structural changes, such as changes in consumer preferences or income levels, can result in shifting the demand

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[6] Laurence S. Seidman, *Recommended Water Conservation Policies,* a paper prepared for the Water Resources Agency for New Castle County, Delaware (July 12, 1991), 1-2.

[7] Ibid.

curve for water. Economists stress important theoretical differences between these structural and behavioral phenomena and their effects on the equilibrium between supply and demand. From a practical standpoint, all types of usage reduction from conservation, if not anticipated in the determination and allocation of revenue requirements, can lead to a revenue shortfall for water utilities (that is, a disequilibrium). In rate regulation, with its focus on the generation of revenues to match revenue requirements, it is probably not of substantive importance whether the usage reduction involves a decrease in *quantity demanded* or instead involves a decrease in *demand.*

The Conservation-Pricing Debate

The well-established theory behind efficiency pricing is not debated here, in favor of turning attention toward more pragmatic issues of conservation pricing, that is, pricing designed explicitly for demand management and demand reduction purposes. Pricing has been recognized as a tool for managing demand during periods of drought.[8] However, it has not always been recognized as a method for accomplishing long-term demand management. Agreement at the theoretical level sometimes breaks down during actual implementation of a pricing structure. The general advantages and disadvantages of conservation pricing are summarized in table 3-1. Some of the more compelling arguments are discussed below.

The Argument in Favor of Conservation Pricing

Conservation and conservation pricing have been well-recognized as having positively operational effects on utilities in terms of postponing or deferring capital expansion for wastewater and water services, decreasing operating expenses for pumping and chemical treatment, and reducing water purchases from wholesale suppliers. Conservationist,

[8] S. F. Mack and B. Ferguson, "Water Rates and Revenue Impacts of Severe Drought Response, City of Santa Barbara, 1990-1993," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 673-680.

TABLE 3-1
ADVANTAGES AND DISADVANTAGES OF
CONSERVATION-ORIENTED RATE STRUCTURES

Advantages of Conservation-Oriented Rate Structures
. Metering and cost-based pricing send an appropriate economic signal to guide consumption decisions and generally are regarded as equitable.
. The cost of developing new supplies can be attached to existing use.
. Expansion of water systems into difficult-to-serve areas can be discouraged.
. The useful life of existing capacity can be extended and the need for new capacity can be postponed.
. Diseconomies in distribution can be offset by overall operational economies.
. Managing demand through price can be essential during water-supply emergencies, such as extreme cases of drought.
. Cost-based pricing enhances water-system financial viability.
Disadvantages of Conservation-Oriented Rate Structures
. Manipulating demand through prices is perceived to cause net revenue instability.
. Some forms (such as increasing-block rates and sliding-scale rates) can increase the threat of bypass by large-volume customers, which can lead in turn to the problems of underutilized capacity or stranded investment.
. A decrease in average demand can occur without a concurrent decrease in peak demand, which only exacerbates the utility's problem of covering fixed costs.
. Complex structures can require more advanced metering capability and/or more sophisticated cost-tracking methodologies, which can be costly.
. Apparent inconsistency with conventional cost-of-service and consumer-choice principles can be a problem.
. Some alternatives (such as penalties) can be perceived as punitive and may be appropriate only for extreme circumstances.
. Pricing structures can be incompatible with the economic development goals of the community served by the water system.

Source: Authors' construct.

environmentalist, and natural resource perspectives tend to regard all varieties of conservation (that is, any reduction in total or per capita water use) as highly beneficial.

The interest in rate structures that promote efficiency and conservation is related to several fundamental criticisms of conventional ratemaking for water utilities. Water pricing generally has ignored the circularity that exists in the relationship among capacity, cost, price, and demand. That is, changes in price lead to changes in quantity demanded and so on. The consequence was that demand was largely taken as a given and utility managers sought to continually add capacity to meet that demand, plus some excess capacity for meeting anticipated demand growth. In other words, the potential to manage utility loads through pricing (along with other tactics) was not often considered. Other utility sectors have long recognized load management as a short-term operational strategy and a long-term planning strategy.

Conventional pricing strategies also have tended to ignore variations in cost associated with variations in demand. The result is a potential subsidy of peak users by off-peak users. The variety of peak-load pricing models is substantial. In telecommunications, for example, time-of-day pricing is frequently used. For the water sector, seasonal pricing is more appropriate for meeting efficiency goals. Seasonal rates recognize that the peak user is the cause of much of required system capacity. For water utilities, seasonal rates can improve capacity utilization rates while constraining capacity requirements. Perhaps most importantly, seasonal rates convey efficient or conservation-oriented price signals to consumers. In brief, the anticipated effects of seasonal rates include load shifting, capacity savings, and possibly reduced consumer bills.

From a more pragmatic perspective, metering and conservation rate structures simply save water. Pricing policies and other conservation-oriented policies in Tucson, Arizona probably have been studied more than those for any other city.[9] Over the years, Tucson water managers have implemented and modified a variety of conservation-oriented rate

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[9] William E. Martin, Helen M. Ingram, Nancy K. Laney, and Adrian H. Griffin, *Saving Water in a Desert City* (Washington, DC: Resources for the Future, 1984).

structures, providing a wealth of information and data on water savings. Most recently, the rate structure has been simplified to improve equity and consumer acceptance.[10]

A study of increasing-block rates in Tucson estimated weather-normalized water savings of 55 million cubic feet in 1983, 100 million cubic feet in 1984, 150 million cubic feet in 1985, and 130 million cubic feet in 1986.[11] These water savings translate to annual water-use requirements for 3,500 to 9,400 single-family customers, which constitutes 5 to 8 percent of the total customer class requirement. Furthermore, the proportion of residential water use dropped from 60 percent of total system use in 1978 to less than 53 percent in 1986.[12] The author of this particular study concluded that single family residential customers are price sensitive and that increasing-block rates can be an effective demand management tool when used along with other conservation methods. Of course, care should be taken to not overgeneralize from the experiences of this desert city. However, the effect of pricing on water conservation in Tucson and elsewhere has been effectively demonstrated.

The Argument Against Conservation Pricing

Despite the known benefits of conservation pricing, its actual implementation can be problematic. An economic regulatory perspective recognizes that conservation pricing can have mixed effects that must be anticipated and managed for the benefit of both the utility and its customers.

Pricing is similar to other strategies associated with conservation in terms of having both advantages and disadvantages associated with its use.[13] In particular, there exists a

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[10] L. A. Peart and K. D. Warner, "Tucson's Rate Structure Changes Designed to Strengthen Conservation Pricing Incentives," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 655-671.

[11] Richard W. Cuthbert, "Effectiveness of Conservation-Oriented Water Rates in Tucson," *American Water Works Association Journal* 81, no. 3 (March 1989): 65-73.

[12] Industrial use also declined during the period, while commercial and multifamily use (to which increasing-block rates were not applied) increased substantially.

[13] William O. Maddaus, *Water Conservation* (Denver, CO: American Water Works Association), 1987.

tradeoff between revenue stability in the short-term and improved economic efficiency in the long-term. Revenue instability is the most frequently cited problem with various forms of conservation rates. Since most water rates are tied to the volume of water consumed and since conservation causes a reduction in use, conservation will cause utilities to experience reduced revenues and an unstable cash flow. Thus, the shift toward conservation rates increases the variability of future revenue flows. Another implication of revenue instability is the potential for increased cost of capital for the utility. In addition, delaying supply projects may inflate construction costs. These adverse financial effects could cause utilities to lose public support for future supply projects.

Conservation ratemaking can raise several efficiency issues, including: (1) the lag between rate implementation and actual conservation effects; (2) the accuracy of predicting the magnitude of short-term and long-term reductions in usage, revenue, operating cost, and capital costs; (3) the effectiveness of conservation rates over time; and (4) the administrative costs of the conservation rate program relative to benefits.[14] In addition, the actual effect of seasonal and other rates on load shifting (and therefore on capital and operating requirements) will be uncertain, because consumer responsiveness to prices in today's economic environment remains uncertain for many water utilities.

A key concern with regard to seasonal rates is the potential to reduce average but not peak or maximum demands. Remaining "needle peaks" leave considerable capacity unused and capital costs must be spread over a smaller amount of average usage. For utilities that have plentiful capacity, some forms of *short-term* conservation can be regarded as inefficient because of existing system-cost economies. It seems inappropriate to ask customers to conserve when supply capacity is readily available. Conservation in this instance can result in less usage at a higher cost to consumers, which clearly does not improve their welfare.

Despite their appeal to environmentalists, some conservation rates (such as increasing-block rates), may not accurately reflect the cost of water service. The true costs of water

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[14] Gary C. Woodard, "A Summary of Research on Municipal Water Demand and Conservation Methodologies," *Water Pricing and Water Demand* (Phoenix, AZ: Arizona Corporation Commission Utilities Division, August 1986), 19-47.

service, depend in part on the cost of providing additional units of water, the cost of providing additional units of water at system peak and off-peak times, and the cost associated with providing service to additional customers.[15] Large-volume users who are price sensitive (that is, their demand is more price sensitive) might expect a volume discount through decreasing-block rates. Conservation rates (whether or not cost-based) may induce bypass by large-volume users who can use self-supplied water. Even though this could result in long-term system and allocational efficiencies, the short-term revenue effect can be devastating for the utility and the remaining customers who must cover the revenue requirement.

Some water rate analysts have focused specifically on the prudence of eliminating decreasing-block rates, even in the face of pressure to conserve water resources. John Guastella, for example, raises several pertinent questions: (1) Is the demise of decreasing-block rates cost-justified? (2) Does the elimination of these rates really promote conservation? (3) Are better conservation-oriented rates structures available? (4) Do the alternatives simply provide a subsidy from high-volume to low-volume users? and (5) Are regulators adequately considering cost-of-service and revenue-requirement issues when eliminating decreasing block rates.[16] One particularly troublesome result of the transition from decreasing-block to uniform rates is that a *reduction* in rates for low-volume usage (accompanied by a rate increase for high-volume usage) appears to provide a discount for basic water service. This price signal can induce consumption by low-volume users, which runs contrary to conservation goals.[17]

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[15] Ibid.

[16] John F. Guastella, "Rate Design Issues: Single Tariff Pricing and Conservation Rates," *Biennial Regulatory Information Conference* (Columbus, OH: The National Regulatory Research Institute, 1994). Draft dated March 3, 1994. See also, Thomas R. Stack, "Potential Consequences of Abandoning Cost-Based Declining-Block Rates," in *Proceedings of the Biennial Regulatory Information Conference* (Columbus, OH: The National Regulatory Research Institute, 1992).

[17] Assuming that the tail blocks cover peak demand, however, overall efficiency may justify the appearance of a rate discount in the initial blocks. Also, reducing the rate for the initial blocks may not be cost-justified or necessary in a phased approach.

Finally, more efficient pricing of water service can lead to substantially higher water bills. Among other things, this presents an affordability problem for low-income customers who may have to make significant sacrifices to maintain essential utility services. Thus, conservation pricing can be met with resistance by high-use and low-use customers alike. Resistance to price increases or changes in the pricing structure often is manifested in political turmoil for members of ratemaking bodies (including both state commissions and local governing boards).

The Counterpoint

Concerns about conservation pricing are legitimate and cannot be dismissed lightly. Water utility managers are rightly concerned about the actual effectiveness of conservation rates and the financial effects of reduced water usage. Unless they are convinced that the projected long-term cost savings are realistic, the reluctance to implement conservation rates will persist.[18] The fact that implementing a conservation-oriented rate structure can be complicated, and even political in nature, is not really disputed.

However, a persuasive counterpoint argument is taking shape. Some economists have argued that the implementation issues associated with moving from average-cost to marginal-cost pricing (including price, revenue, and earnings volatility) can be addressed and that these perceived barriers are no excuse for disregarding marginal-cost and seasonal pricing for water utilities.[19] In particular, it is unnecessary to estimate marginal costs with precision in order to design more efficient water rates. Put one way, "approximately right" is better than "precisely wrong."[20] Water systems can move toward conservation-oriented rates (including

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[18] William O. Maddaus, "Integrating Water Conservation into Total Water Management," *Journal American Water Works Association* 82 (May 1990): 12-14.

[19] Patrick C. Mann and Donald C. Schlenger, "Marginal Cost and Seasonal Pricing of Water Service," *American Water Works Association Journal* 74, no. 1 (1982): 6-11.

[20] This phrase is borrowed from the growing literature on incentive regulation for public utilities. Kurt A. Strasser and Mark F. Kohler, *Regulating Utilities with Management Incentives: A Strategy for Improved Performances* (New York: Quorum Books, 1989), 171.

increasing-block rates), and reduce water usage without jeopardizing revenues.[21] According to some financial analysts, rate structures used to smooth load shapes can actually enhance revenue stability.[22] In other words, managing peak demand through appropriate tail-block pricing can be very useful. Water utility planners can use computer models to evaluate conservation rate structures and their effects on revenues and other areas, as depicted in figure 3-1.[23] Today, the revenue effects of conservation and conservation pricing can be anticipated and estimated, so that attention can be turned to strategies for managing these effects.[24]

With time, even some of the political complexities of conservation pricing can be overcome.[25] From a strictly economic standpoint, conservation rates do not require public approval since once these rates are implemented they will affect water usage regardless of the consequences that could befall politicians and policymakers. That is, irrespective of their popularity (or unpopularity) conservation rates will induce consumers to reduce water consumption by some amount. Cost savings should help build public support for conservation programs, but utilities might have to work hard to assure this outcome. Cost-based conservation rates that promote economic efficiency will be easier for many constituencies to accept than rate structures that appear to be designed for political reasons (such as when rates are kept artificially high or low for a particular class of customers). For many water utilities,

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[21] Jeffrey L. Jordan, "Rates: Consider Conservation Water Pricing," *Opflow* (American Water Works Association) 20, no. 4 (April 1994): 1, 4.

[22] Edward J. Amatetti, "Managing the Financial Condition of a Utility," *American Water Works Association Journal* 86, no. 4 (April 1994).

[23] C. J. Price-Emerson, et al., "Water Conservation Promoting Rate Structure Computer Model," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 1239-82.

[24] Thomas W. Chesnutt, Anil Bamezai, Casey McSpadden, John Christianson, and W. Michael Hanemann, *Revenue Instability Induced by Conservation Rate Structures: An Empirical Investigation of Coping Strategies* (Denver, CO: American Water Works Association Research Foundation, 1994).

[25] Martin, et al., *Saving Water in a Desert City.*

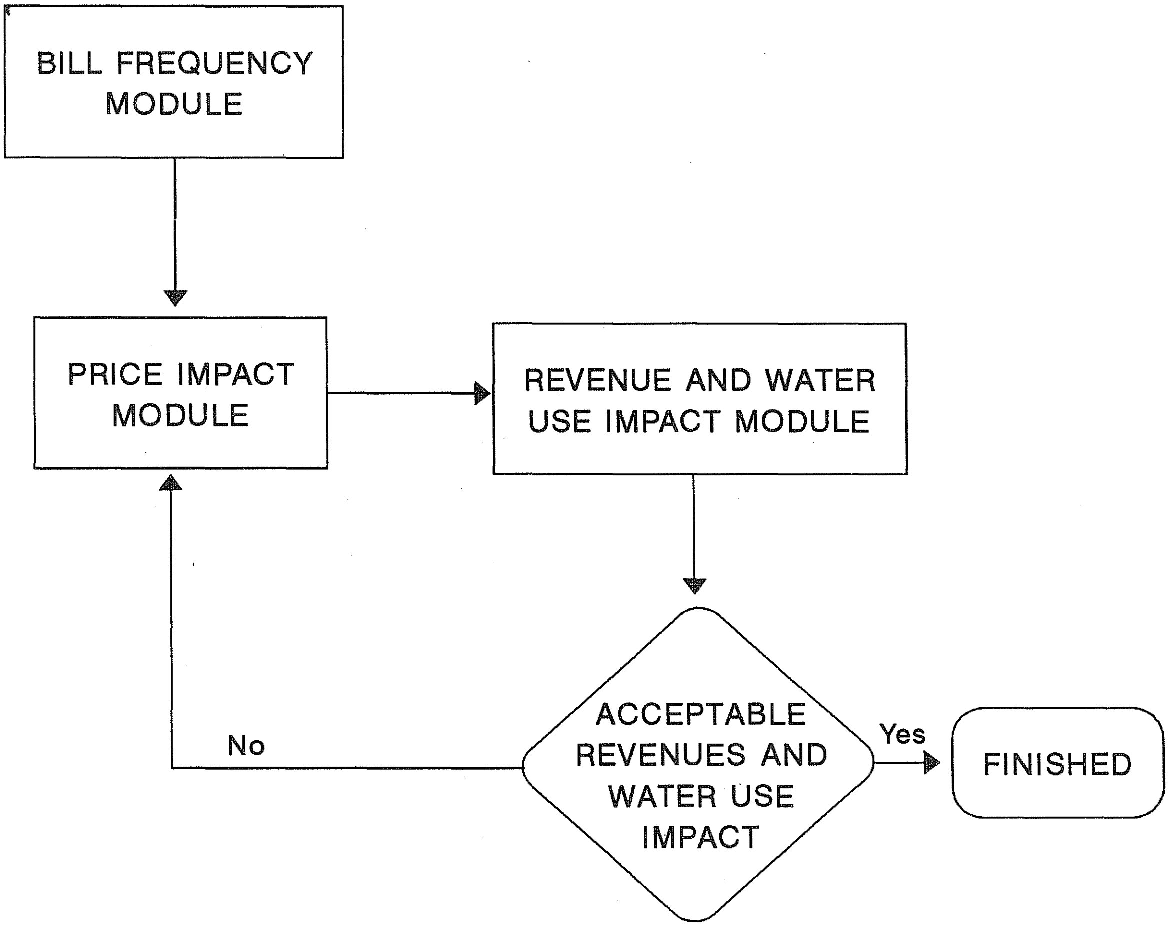

Fig. 3-1. Computer model design for conservation-promoting rate strucctures as depicted in C.J. Price-Emerson, et al., "Water Conservation Promoting Rate Structure Computer Model," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 1242.

a phased approach can help mitigate against the adverse economic and political effects associated with changing the rate structure.

Certainly, utility managers and regulators must consider potential tradeoffs before implementing dramatic changes in the rate structure to achieve conservation or demand management goals. It also is appropriate to consider regulatory and ratemaking mechanisms to offset adverse effects when conservation pricing is mandated.

Conservation-Oriented Rate Structures

Entire technical conferences have been devoted to the design of rate structures to promote conservation.[26] Most involve economists well-versed in the efficiency paradigm. Water pricing based on marginal costs, in comparison to alternative rate forms, has been advocated as the correct way to promote conservation.[27] The basic steps for designing a water conservation rate structure appear in table 3-2. By following the steps, the effects of a change in price on utility revenues can be estimated and evaluated.

Several criteria can be used to judge whether a rate structure is conservation oriented: (1) the structural form of the rate; (2) the proportion of costs recovered through fixed versus commodity charges; (3) the effective communication of the pricing signal through customer billing; and, (4) for public-sector utilities, the extent to which the cost of utility service is covered through user fees (that is, rates) or other sources of revenues (such as taxes or general fund transfers).[28] The importance of these factors can be weighted according to

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[26] M. Bloome, *Rate Structures to Promote Conservation: Proceedings of a Conference Organized by the Delaware River Basin Commission and the New York City Water Board.* West Trenton, NJ: Delaware River Basin Commission, 1990; and Arizona Corporation Commission, *Water Pricing and Water Demand* (Phoenix, AZ: Arizona Corporation Commission Utilities Division, 1986). See also, American Water Works Association, et al., in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

[27] B. C. Lippiatt and S. F. Weber, "Water Rates and Residential Water Conservation," *American Water Works Association Journal* 74, no. 6 (June 1982): 279-281.

[28] Marvin Winer, et al., "Definition of Water Conservation Promoting Rates," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

TABLE 3-2
STEPS IN DESIGNING A RATE STRUCTURE AND EVALUATING REVENUE EFFECTS

Basic Steps	Basic Considerations
Express a percentage demand reduction goal for the water system	$\frac{\text{Water demand goal}}{\text{Current water demand}}$
Estimate the expected reduction in demand based on the price elasticity of demand for the service territory, by customer class if appropriate	Factors to consider and their relationship to elasticity: prices (+), consumer income (-), persons per household (-), rainfall (-), temperate climates (-)
Determine the percentage change in price needed to achieve demand reduction goals, by customer class if appropriate	$\frac{\text{Percentage reduction goal}}{\text{Estimated demand elasticity}}$
Calculate the revised price level	$\frac{\text{(\% Change in price) x (Existing price)}}{\text{Existing price}}$
Calculate the revised demand level	(% Change in price) x (Elasticity value)
Estimate revised revenues under the revised price based on expected demand reductions	(Revised demand) x (Revised price)
Calculate revenue requirements based on reductions in variable costs resulting from reductions in demand	(Fixed costs) + (Variable costs at revised demand level)
Compare revised revenues with original revenues	(Revised revenues) - (Original demand x original price)
Select a rate structure that achieves the demand reduction goal while recovering allowable water system costs	In allocating costs, the impact of the rate structure on user demand and revenues for specific customer classes must be considered
Evaluate the need for special ratemaking provisions (such as cost-recovery or lost-revenue mechanisms)	Potential revenue instability can be addressed with additional rate structure modifications (e.g., revenue adjustment mechanisms)

Source: Adapted in part from American Water Works Association, *Before the Well Runs Dry: Volume 1--A Handbook for Designing and Local Water Conservation Plan* (Denver, CO: American Water Works Association, 1984).

policymaking concerns. Selecting a conservation rate structure is comparable to selecting any rate form in terms of the type of evaluation standards applied.[29]

Metering Water Service

Pricing water service depends on the practice of metering water-service customers. As mentioned in chapter 2, New York City features universal metering in its demand management strategy.[30] Since water consumption varies significantly with the presence of meters, metering policies are very relevant to water planners. By one estimate, the introduction of meters can produce a 20 percent savings in water use.[31] A study of submetering of water customers in apartment buildings, condominiums, and mobile home parks, suggested that although additional costs are incurred by utilities, water savings could range from 20 to 40 percent.[32] Metering and submetering also can assist in a water utility's leak-detection efforts. But perhaps most importantly, metering provides utilities with the opportunity to manage demand through pricing.

Basic Conservation Rate Structures

All water rates have some orientation toward conservation because charging for water use, in contrast to providing free water service or subsuming the price in rents or other

[29] D. S. Hasson, "Selecting a Conservation Rate Structure," in *Proceedings of Conserv93.* (Denver, CO: American Water Works Association, 1993).

[30] See Anthony J. Blackburn, *The Impact of Metered Billing for Water and Sewer on Multifamily Housing in New York* (New York: New York City Department of Environmental Protection and New York City Rent Guidelines Board, 1994).

[31] California Department of Water Resources, *WaterPlan: Water Conservation Assumptions* (Sacramento, CA: California Department of Water Resources, 1989).

[32] Theodore C. Schlette and Diane C. Kemp, "Setting Rates to Encourage Water Conservation," *Water/Engineering and Management* 138, no. 3 (May 1991): 25-29.

charges, induces consumers to make sensible water-use choices.[33] More specifically, metered (and submetered) water rates incorporating a commodity charge are conservation-oriented since users pay increasing bills with increasing usage. Anecdotal stories abound about how water can be wasted when customers are not required to pay for their usage. At higher prices, the inclination to waste water is further discouraged. Martin and Wilder, in a study of water pricing for Columbia, South Carolina, found that both water usage and service terminations decline with increasing water rates.[34] Despite the efficiency effects of metering and pricing in general, some rate structures (such as increasing-block rates) have a stronger conservation orientation than other rate structures (such as uniform or decreasing-block rates).

Each of the basic rate design alternatives used by water utilities, depicted in figure 3-2, have implications for managing revenues and cash flows in the context of achieving water conservation goals.[35] Decreasing-block (or declining-block) rates, in which the applicable unit price declines with higher usage blocks, generally has been viewed as discouraging conservation.[36] The uniform rate (or uniform-commodity rate), in which a single rate applies to all consumer usage, has been viewed as more conservation-oriented than the decreasing-block structure. The increasing-block (or inclining or inverted-block) rate form, in which the applicable unit price increases with higher usage blocks, has been viewed as one of the more conservation-oriented rate structures.

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[33] John Farnkopf, et al., "Characteristics of Conservation-Oriented Rates," a paper presented at the Annual Conference of the American Water Works Association in Vancouver, British Columbia (1992).

[34] Randolph C. Martin and Ronald P. Wilder, "Residential Demand for Water and the Pricing of Municipal Water Services," *Public Finance Quarterly* 20 (January 1992): 93-102.

[35] Beecher and Mann, *Cost Allocation.*

[36] On the other hand, with decreasing-block rates the utility may have less incentive to promote sales. See chapter 4.

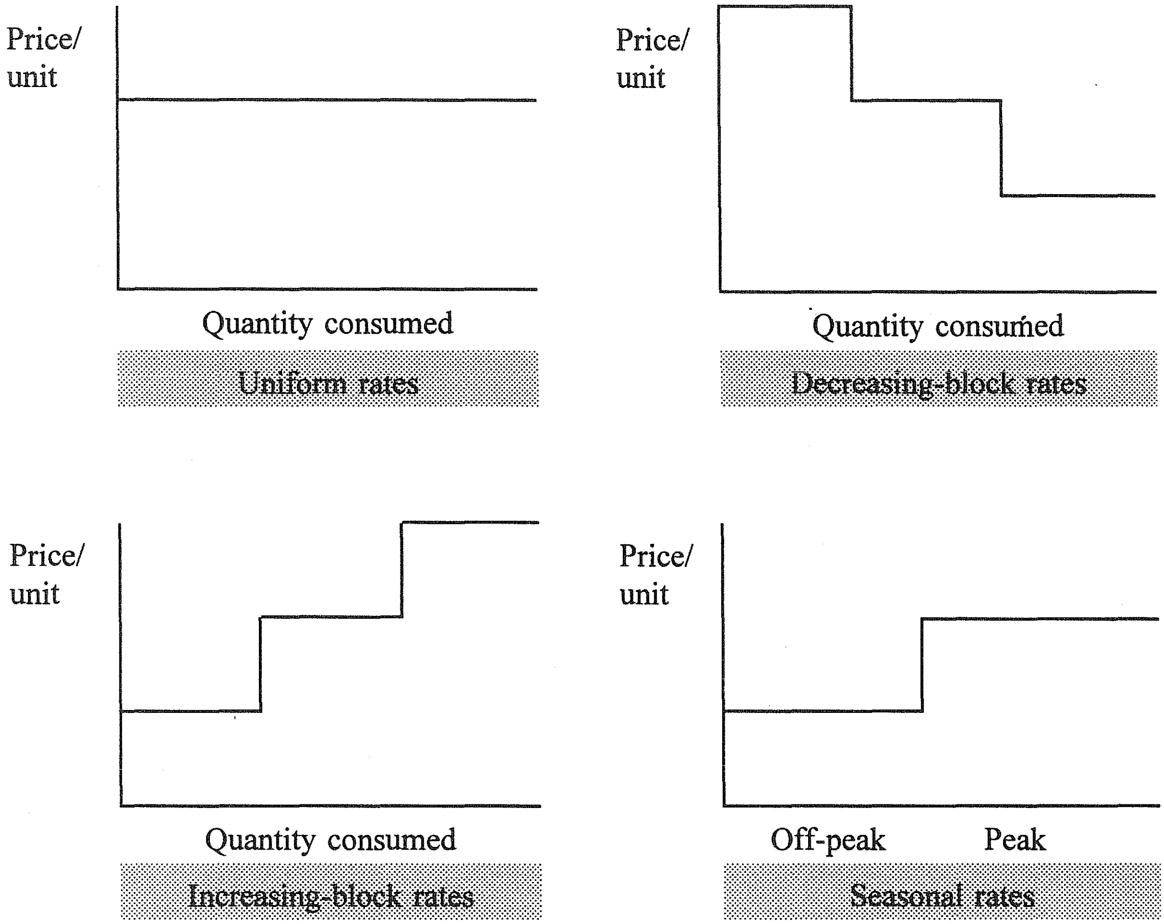

Figure 3-2. Basic water utility rate structures.

Additionally, any of the three basic rate forms can be combined with a seasonal rate structure to reflect variations in costs associated with peak demand patterns. Seasonal rates can be based on either incremental or embedded costs. Applied in the context of marginal-cost or incremental-cost considerations, seasonal rates can be used to promote economic efficiency. With seasonal pricing, customers pay higher rates during periods of peak demand (usually the summer) than they do during off-peak periods (usually the winter).[37] More complex and nonlinear rate structures reflecting these principles also can be considered. For example, decreasing blocks could be applied during off-peak seasons and increasing blocks could be applied to peak seasons of demand (figure 3-3). However, in practice, examples of this kind of ratemaking generally are not found in the water sector.

Water utility rate structures can be made more conservation-oriented through several approaches. As noted above, a recent trend has been to substitute decreasing-block rates with uniform or increasing-block rates. Some water utilities with substantial seasonal peaks have begun to implement seasonal rate structures. In some cases, more modest rate structure modifications have been made. For example, reducing the number of usage blocks in a decreasing-block rate structure (that is, rate flattening) can be considered a conservation-oriented rate strategy.

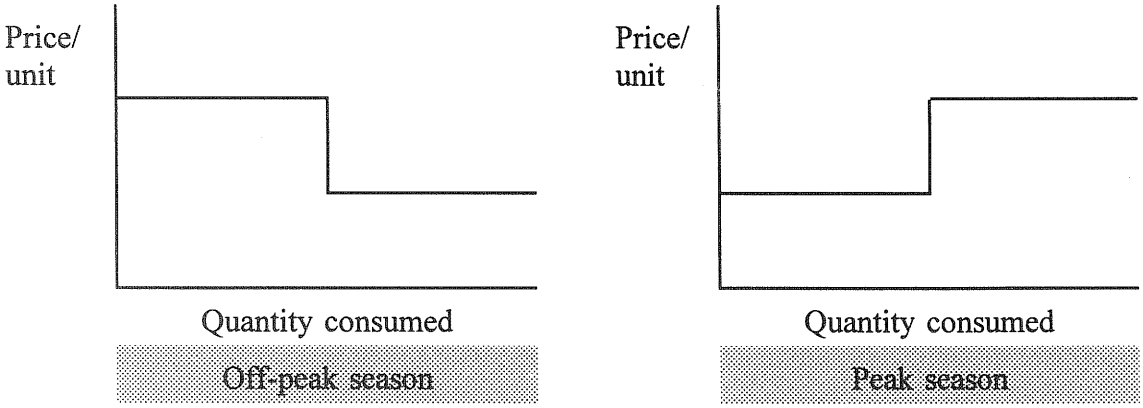

Figure 3-3. Example of a nonlinear rate structure.

[37] Three seasons, with no customer classes, have been used for ratemaking in Phoenix, Arizona. An evaluation found larger differences in peaking characteristics within classes than between classes. The city also has implemented a special environmental fee to pay for improvements associated with federal drinking water standards. See Jefferey S. DeWitt, "The Evolution of Water Rates in Phoenix, Arizona," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

Alternative Conservation Rate Structures

Although uniform, increasing-block, and seasonal rates are the basic rate forms that promote water conservation, additional variations in rate design can be identified for potential application. A summary of conservation-oriented rate structures appears in table 3-3. The table describes the basic features for the following structures: metered service, uniform rates, increasing-block rates, seasonal rates, excess-use rates, indoor-outdoor rates, sliding-scale rates, scarcity pricing, spatial pricing, and penalties. Each form can be appropriate under certain circumstances, but the use of these alternatives also depends on the metering and billing capability of the utility. Universal metering is probably an appropriate goal for all utilities. The use of penalties, on the other hand, probably should be limited to extreme emergency situations. The use of more sophisticated rate structures, such as the excess-use or sliding-scale forms, should be evaluated in terms of the marginal costs and benefits associated with implementation. Water utilities also can promote conservation through the use of a surcharge or capacity deferral benefit.[38] Calculating the conservation surcharge involves one of several methods for estimating marginal cost in water supply.[39] The conservation surcharge is derived from the cost savings associated with conservation--the costs avoided by eliminating excess or discretionary usage. The end result is a commodity charge reflecting the costs that would be avoided if consumers lowered their level of demand. Determining the appropriate value for the conservation surcharge involves two steps: (1) identifying discretionary water consumption and (2) estimating the cost consequences of having consumers continue their long-term usage patterns at levels that include this discretionary usage.

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[38] Patrick C. Mann and Don M. Clark, "Water Costing, Pricing and Conservation," in *Proceedings of the Eighth Biennial Regulatory Information Conference* (Columbus, OH: The National Regulatory Research Institute, 1992). See also, Beecher and Mann, *Meeting Water Utility Revenue Requirements,* chapter 6.

[39] Beecher and Mann, *Cost Allocation and Rate Design.*

TABLE 3-3
A COMPARISON OF CONSERVATION-ORIENTED RATE STRUCTURES

Rate	Definition	Objectives
Metered service	Customer bills vary with water usage	Send a price signal to customers, promoting efficiency and discouraging waste
Uniform rates	Price per unit is constant as consumption increases	Reduce average demand
Increasing-block rates	Price per block increases as consumption increases	Reduce average (and possibly peak) demand
Seasonal rates	Prices during season of peak use are higher than off-peak season	Reduce seasonal peak demand
Excess-use rates	Prices are significantly higher for above-average use	Reduce peak demand
Indoor/ outdoor rates	Prices for indoor use are lower than prices for outdoor use	Reduce seasonal peak demand associated with outdoor use, which is considered more price-elastic
Sliding-scale rates	Price per unit for all water-use increases based on average consumption	Reduce average (and possibly peak) demand
Scarcity pricing	Cost of developing new supplies is attached to existing use	Reduce average use
Spatial pricing	Users pay for the actual cost of supplying water to their establishments	Discourage new or difficult-to-serve connections
Penalties	Charges certain customers a prespecified amount for exceeding allowable limits of water use	Reduce peak demand and discourages wasteful water use

Source: Authors' construct.

A conservation surcharge unbundles water usage in excess of average or normal levels and identifies the incremental cost associated with that usage. The conservation surcharge signals the opportunity cost associated with the consumer's decision to continue discretionary usage. The conservation surcharge can stand alone and thus be appended to a variety of rate forms based on either embedded or marginal cost. Revenues from the conservation surcharge can be placed in a dedicated deferred credit account to offset future costs incurred by the water utility in implementing conservation programs. In essence, the conservation surcharge can be separate from the revenue requirements of the water utility. The conservation surcharge provides a forward-looking conservation signal and complements least-cost planning, particularly if the accumulated funds from the conservation surcharge are used to finance conservation programs. Because the conservation surcharge is external to basic revenue requirements, it provides an efficient price signal without creating revenue deficiency. In other words, basic utility revenue requirements are covered and only the revenues associated with the surcharge are potentially unstable.

A chief benefit of conservation surcharges is that they reconcile embedded-cost and marginal-cost ratemaking principles, while providing funds for utility conservation programs. Consumers who elect to conserve avoid paying for the capacity that is linked to excess usage; consumers who elect not to conserve directly fund the capacity that ultimately will be necessary to meet the excess demand. In either case, consumer choice is maintained.[40] On the downside, surcharges can be complicated to implement, administer, monitor, and evaluate. Surcharges can cause revenue instability and result in excess earnings. A major potential barrier to their use is that regulators usually find it difficult to permit a rate mechanism that is external to the traditional determination of revenue requirements.

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[40] By contrast, consumer choices are limited when mandatory water-use restrictions are imposed by the utility.

Robert A. Collinge has proposed a similar rate form, which he refers to as a revenue-neutral "feebate" system to help utilities achieve water conservation goals.[41] The system consists of three parts: (1) a simple rate structure designed to achieve revenue neutrality while recovering the utility's fixed and average variable costs; (2) an entitlement program providing a baseline amount of water to each customer at the standard rate based on variables independent of ongoing usage, summing to the utility's intended supply amount; and (3) feebates in the forms of offsetting penalties assessed to customers using water above their entitlement and rebates to customers using water below their entitlement. According to Collinge, the result is that "water guzzlers" pay for the privilege of overconsumption, while "water frugal" customers are rewarded for their conservation efforts. Like any other conservation program, the success of a feebate system will depend largely on consumer information and awareness. However, some economists will argue that the feebate is equivalent to a price reduction, which could lead to the unintended consequence of increased water use.

Trends in Water Pricing

The variety of water utility rate structures implemented or under consideration seems to be expanding, both for nonregulated systems and commission-regulated systems.[42] Informed observers expect this trend to continue through the present decade.[43] Concerns about both equity and efficiency in water utility ratemaking also seem to be growing.

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[41] Robert A. Collinge, "Optimal Conservation by Municipal Water Customers: A Revenue-Neutral 'Feebate' System," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 707-17. See also, Robert A. Collinge, "Revenue-Neutral Water Conservation: Marginal Cost Pricing with Discount Coupons," *Water Resources Research* 28, no. 3 (March 1992): 617-22.

[42] On the diversity of commission-approved rate structures, see chapter 5.

[43] David F. Russell and Christopher P. N. Woodcock, "What Will Water Rates be Like in the 1990's," *Journal American Water Works Association* 84 (September 1992): 68-72; Richard D. Giardina, "Conservation Pricing Trends and Examples," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

As costs for the water supply industry rise, it is no wonder that cost-allocation and rate-design alternatives will get increasing attention. The magnitude of the recent rate increases (in some cases, more than twice that of the overall rate of inflation) have forced these issues to the forefront both for water utility managers and economic regulators. Traditional rate structures have drawn fire from critics who suggest that they do not send adequate pricing signals. A frequently noted trend in the water sector in recent years is the decline in the use of decreasing-block rates, matched by expanded use of uniform and increasing-block rate structures.[44] In addition, many water utilities have incorporated seasonal variations within their uniform, decreasing-block, or increasing-block rate structures. As discussed in chapter 5, some state (and interstate) regulatory commissions have begun to encourage conservation-oriented water rate structures. In sum, the rate design capability of the water supply industry appears to be evolving and maturing in some significant ways.

The Effectiveness of Conservation Rates

As discussed further below, researchers have analyzed the effectiveness of conservation-oriented rate structures for a number of specific water service territories. Nieswiadomy and Molina conducted a time-series analysis of water demand for consumers in Denton, Texas for 1976-1985.[45] Their demand models employed two price variables: marginal price and the ratio of average price to marginal price. Price sensitivity was estimated for decreasing-block rates (in effect for 1976-1980) and increasing-block rates (in effect for 1981-1985). The implication of this analysis was that consumers respond to average price when confronted with decreasing-block rates and respond to marginal price when confronted with increasing-block rates.

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[44] Ellen M. Duke and Angela C. Montoya, "Trends in Water Pricing: Results of Ernst & Young's National Rate Survey," *Journal American Water Works Association* 85 (May 1993): 55-61. See also, Jacob Boomhouwer and Karyn L. Johnson, "California Water Rate Structures are Changing From Uniform to Tiered," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

[45] Michael L. Nieswiadomy and David J. Molina, "A Note on Price Perception in Water Demand Models," *Land Economics* 67 (August 1991): 352-359.

In a recent study, Jordan evaluated the effects of a conservation-oriented rate change in Spaulding County, Georgia. In January 1991, the water authority introduced increasing-block rates that resulted in a 5 percent decline in per capita water use and a 21 percent increase in utility revenues. During the same time period, 6 percent growth in the number of customers resulted in merely a 1 percent increase in total water use.[46] According to Jordan, the fact that water usage is relatively insensitive to changes in price can actually work to the advantage of utilities in terms of meeting revenue requirements.

Cuthbert analyzed the effectiveness of conservation rates for Tucson, Arizona for 1977-1986.[47] Tucson initiated a seasonally-differentiated increasing-block rate structure for single-family residential customers in 1977. The results for the single-family residential class were impressive. Water use for the residential class declined from 60 percent of total use in 1978 to 53 percent in 1986. The implication of this specific study was that increasing-block rates can substantially reduce residential usage.

Mann and Clark examined the experience of Spring Valley Water Company (New York) with conservation rates.[48] Spring Valley initiated a seasonally-differentiated decreasing-block rate structure in 1980. The seasonal rate structure substantially affected per capita usage and on the timing of maximum-day and maximum-hour demand. Over a ten-year period, the ratio of peak-hour to average-day demand declined from 2.68 to 1.73 and the ratio of peak-day to average-day demand declined from 1.52 to 1.25. As noted earlier, water conservation rates can be effective in reducing water usage because the demand for water is not purely price-inelastic.

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[46] Jordan, "Rates: Consider Conservation Water Pricing."

[47] John Cuthbert, "Effectiveness of Conservation-Oriented Water Rates for Tucson, Arizona," *Journal American Water Works Association* 81 (March 1989): 65-73.

[48] Don M. Clark and Patrick C. Mann, *Testimony in PSC Case No. 89-W-1151 - Phase II* (Albany, New York: New York Public Service Commission), 1991.

Price Elasticity of Water Demand

Price elasticity measures the sensitivity of the quantity demanded of a good or service to changes in its price, controlling for variations in other significant factors. Mathematically, price elasticity is the ratio of the percentage change in quantity demanded to the percentage change in price. With an elasticity of -.30, for example, a 10 percent increase in price is associated with a 3 percent reduction in the quantity demanded.[49] In this example, all other things being equal, revenues would increase by 6.7 percent (110 percent of prices multiplied by 97 percent of quantity demanded).[50]

Since there is an inverse relationship between price and quantity demanded, price-elasticity coefficients will have negative values. If water usage is relatively responsive to rate changes, water demand is considered relatively price-elastic (the price-elasticity coefficients will have absolute values exceeding 1.0 (for example, -1.3). In contrast, if water usage is relatively unresponsive to rate changes, demand for water service is considered relatively price-inelastic (the price-elasticity coefficients will have absolute values less than 1.0 (for example, -0.3). However, a price-elasticity coefficient with a value less than 1.0 can be very meaningful with respect to both managing demand and meeting revenue requirements. A 10 percent increase in price leading to a 7 percent decrease in usage, for example, can be dramatic for a given water system.

Unfortunately, price elasticity is not always considered in the determination and allocation of utility revenue requirements. In effect, water demand may be treated as perfectly price-inelastic and price-induced usage changes may be ignored. However, as long as price-elasticity coefficients are not zero, water usage will be affected by changes in price. Importantly, a revenue shortfall can occur regardless of whether water usage is highly

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[49] Whether the reverse holds, that a price decrease corresponds to a usage increase, is a matter of ongoing debate for this and other forms of elasticity.

[50] Mathematically, in an unregulated market environment, when demand is price-elastic, a price increase produces a revenue decrease; when demand is price-inelastic, a price increase produces a revenue increase. These results do not apply for the regulated water sector, where revenue effects are evaluated in comparison to revenue requirements.

responsive to price as long as ratemakers do not account for the effect of rate increases on usage and revenue reductions are not matched by cost reductions. Reasonably accurate demand forecasts that account for price-elasticity effects are essential for developing reasonably accurate revenue forecasts.

The relevance of price elasticity of demand to water utility managers and regulators is straightforward. Price elasticity is an essential tool for estimating the effect of a rate change on water demand and revenues.[51] The omission of price elasticity from rate design analysis creates the potential for revenue instability, as well as revenue shortfalls. Revenue shortfalls can be especially problematic if the rate structure is substantially modified (for example, shifting from decreasing-block rates to increasing-block rates), or if a large rate increase is implemented. The exclusion of price elasticity from a rate design analysis is a lesser problem if changes in the rate structure are modest.

The necessary consideration of price elasticity in water costing and rate design analysis is driven by the iterative process in which traditional water rate regulation takes place. That is, the rate setting process is a dynamic process in which the step of setting rates equal to an observed embedded cost can generate a cyclical pattern in which rate changes produce use changes, which further change certain unit costs, eventually leading to further rate changes. In brief, water demand affects cost of provision, in turn cost of provision determines rates, and in turn water rates affect usage. Importantly, these dynamics are at work *regardless* of whether prices are changed for efficiency or conservation reasons. In other words, *any* change in price (such as cost-based increases) can affect the quantity of water demanded.

Numerous studies of water demand have been conducted in the past three decades. The majority of these studies have focused on either aggregate municipal demand or on residential demand. Few studies have examined commercial and industrial demand. In general, the empirical results indicate that municipal and residential demands are price-inelastic. The demand for water tends to be relatively price-inelastic due to the essential

[51] Beecher and Mann, *Cost Allocation and Rate Design.*

nature of water service and the lack of close substitutes.[52] An exception is when residential demand is disaggregated into seasonal (that is, outdoor use) and nonseasonal (that is, domestic or indoor use) components. Seasonal demands tend to be less price-inelastic than nonseasonal demands. Evidence also exists that price elasticity is positively correlated with water rate levels; that is, coefficients with higher absolute values are associated with higher rates, and vice versa.

In statistical studies, price may appear not to be a major determinant of water usage for a variety of reasons. The price effect on usage can be minimal if there is little change in real water prices over the long-term. Also, price impacts can seem to be overwhelmed by the effects of other demand parameters (such as temperature, rainfall, and household income). That is, the response of water usage to price can appear to be relatively small compared to the response of usage to other climatic or demographic factors. Measuring the responsiveness of water usage to changes in rates is further complicated by the timing or lags in consumer responses. Consumers might not immediately react to water rate increases. Finally, the conservation ethic among consumers in a given locality can enhance or impede water conservation responses. The existence of a strong conservation ethic among consumers can produce significant conservation effects even with modest rate increases.

Estimation Issues

Most water demand studies have employed cross-sectional data, thus yielding long-term price-elasticity estimates. Only a few studies have employed time-series data that focus on a specific geographical area experiencing substantial price changes over time. In addition, there are few reliable estimates of the price elasticities of peak and off-peak water demands, as well as the effect of conservation rates on water usage and peak demands. The econometric methods used in water demand studies are becoming increasingly sophisticated, which helps to assure that the statistical estimates are robust.

[52] Water has no substitutes. Water delivery systems are substitutable to a degree. One example is drinking bottled water instead tap water. Another is using self-supplied well water instead of water supplied by a community system. Also, some uses of water can be substituted (such as sweeping the driveway instead of hosing it clean).

More than one hundred water demand studies were completed in the past three decades. A previous review of more than fifty of these demand studies concluded that the most likely price elasticity range for residential demand is -.20 to -.40 with price-elasticity coefficients for commercial and industrial demand being in the range of -.50 to -.80.[53] This review indicated that commercial and industrial users will tend to reduce usage in response to a rate increase by a larger proportion than residential users. Presumably, a large increase in water rates will induce some commercial and industrial users to seek alternative supplies.

The literature review also indicated that the price elasticity of municipal demand can be difficult to interpret unless the weights of the individual sectors (for example, residential, commercial, industrial, and governmental) can be specified. Each user class responds differently to rate increases. In this context, price-elasticity coefficients are comparable only for well-defined user classes. For example, one cannot justifiably compare residential class data with aggregate municipal data.

A review of the literature can provide standards of reference or benchmarks for establishing reasonable price-elasticity estimates. Obviously, relying on a literature review to estimate the price elasticity of demand is an imperfect approach. Existing studies will not help analysts predict unique responses to price changes in specific service areas. However, given the general nature of municipal water demand, comparing demand studies for similar service areas can be appropriate for benchmarking purposes.

Despite the overall result of relatively price-inelastic water demands, substantial variations in empirical results can be demonstrated. Boland provides several explanations for these different findings.[54] First, average-price and marginal-price variables will tend to generate different price-elasticity coefficients, particularly in the context of decreasing-block rates. Second, given the practice of levying wastewater charges on the basis of water usage,

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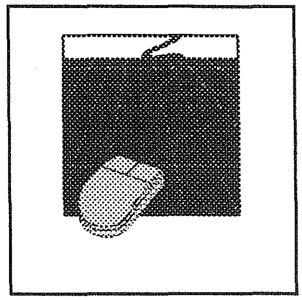
[53] Planning and Management Consultants, *Influence of Price and Rate Structures on Municipal and Industrial Water Use* (Fort Belvoir, VA: Institute for Water Resources, United States Army Corps of Engineers, 1984).

[54] John J. Boland, "Forecasting the Demand for Urban Water," in David Holtz and Scott Sebastian, eds., *Municipal Water Systems* (Bloomington, IN: Indiana University Press, 1978), 91-114.

estimation models incorporating sewage charges, in addition to water rates, produce more valid results than the estimation models that exclude wastewater charges.

Other problems with the calculation of price elasticity and the use of elasticity estimates are noteworthy.[55] Most water demand studies have used cross-sectional data that are presumed to yield long-run price-elasticity estimates. Only a few studies have used pooled time-series data that focus on a specific geographical area experiencing substantial rate changes over time. That is, data constraints have resulted in more estimates of long-run price elasticity than estimates of short-run price elasticity. In this context, specific cross-sectional studies can be flawed by incompatible accounting and operating data from different water utilities and by the lack of credible supporting demographic data. Specific time-series studies can be flawed by small sample sizes, infrequent price changes, and a lack of supporting demographic data.

Selected Water Demand Studies



One of the most important and lasting contributions to the literature on water demand was the compilation of empirical studies prepared for the U.S. Army Corps of Engineers.[56] An adaptation and update of this pathbreaking chronology (which included studies through 1978) appears in table 3-4. Of the many water demand studies that have been conducted in the past several decades, several are worthy of comment because of their substantial contribution to academic and practical knowledge about the price elasticity of water demand. Importantly, it is not uncommon for the results of one study to contradict the results of another in terms of statistical findings. Although the review can be used for benchmarking, the generalizability of specific findings is

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[55] Ibid.

[56] Planning and Management Consultants, *Influence of Price.* See also, William O. Maddaus, *Water Conservation* (Denver, CO: American Water Works Association, 1987), 66.

limited. Some of the more recent water demand studies are highlighted below according to key variables, findings, and conclusions.

Research Findings

Rate Design

Researchers have found that water rate design can affect water usage. Stevens, Miller, and Willis conducted a cross-sectional analysis of 1988 water demand for eighty-five communities in Massachusetts.[57] Employing an average price variable, price elasticities were calculated for three rate structures: uniform rates, decreasing-block rates, and increasing-block rates. For uniform rates, price elasticities ranged from -.10 to -.43. For decreasing-block rates, price elasticities ranged from -.40 to -.69. For increasing-block rates, price elasticities ranged from -.42 to -.54. The implications of this analysis were that price elasticities are not substantially affected by type of rate design and that the level of rates is more important than rate structure in affecting water usage. Similarly, Young, Kinsley, and Sharpe, in a study of residential consumers of the Washington Suburban Sanitary Commission for 1974-1979, found that an increasing step rate was a very powerful tool in reducing water usage.[58] In a step rate, the increasing rate applies to all water usage and not simply to the last usage increment, thus producing much higher average rates for high-volume users than for low-volume users. The implication of this particular study was that increases in rate levels substantially reduce water usage, particularly among high-volume consumers.

Another study confirmed the importance of rate levels. That is, changes in higher rates produce greater usage responses than changes in lower rates. Martin and Thomas conducted a cross-sectional analysis of residential water demand, using 1978-1979 data for

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[57] Thomas H. Stevens, Jonathan Miller and Cleve Willis, "Effect of Price Structure on Residential Water Demand," *Water Resources Bulletin* 28 (August 1992): 681-685.

[58] C. E. Young, K. R. Kinsley and W. E. Sharpe, "Impact on Residential Water Consumption of an Increasing Rate Structure," *Water Resources Bulletin* 19 (February 1983): 81-86.

four cities including Tucson and Phoenix, Arizona.[59] A comparison of demand data from the four cities indicates a long-run price elasticity for residential water demand of approximately -.50, over a wide range of prices and also indicates that residential water demand tends to become more price-elastic with higher water prices.

Fixed Charges

Increases in fixed water charges (for example, an increase in service charges or minimum charges) can induce consumer usage responses. Billings and Agthe examined residential water demand in a time-series study of Tucson, Arizona for 1974-1977.[60] Their models incorporated marginal price as well as a rate variable reflecting fixed charges. The latter variable was measured by the total water bill minus the hypothetical bill if all usage were sold at the marginal price. The overall price elasticities ranged from -.39 to -.63. The marginal price elasticities ranged from -.27 to -.49. The conclusion of this study was that the addition of a variable measuring fixed charges increases overall price-elasticity coefficients. A supplemental analysis by the same research team (and colleagues) again incorporated marginal price as well as the fixed charges variable.[61] The conclusion of this analysis was that the addition of a variable reflecting fixed charges in the demand model leads to higher short-run and long-run price-elasticity coefficients.

Average v. Marginal Prices

Analysts have hypothesized that the selection of the price variable can affect price-elasticity results. Jones and Morris conducted a cross-sectional study of residential water

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[59] William E. Martin and John F. Thomas, "Policy Relevance in Studies of Urban Residential Water Demand," *Water Resources Research* 22 (December 1986): 1735-1741.

[60] Bruce R. Billings and Donald E. Agthe, "Price Elasticities for Water: A Case of Increasing Block Rates," *Land Economics* 56 (February 1980): 73-84.

[61] Donald E., Agthe, R. Bruce Billings, John L. Dobra and Kambizz Raffiee, "A Simultaneous Equation Demand Model for Block Rates," *Water Resources Research* 22 (January 1986): 1-4.

demand for Denver, Colorado.[62] Their analysis, based on 1976 data for 326 water consumers, employed models using average price as well as marginal price. Price elasticities ranged from -.18 to -.34 in the average price models and ranged from -.14 to -.44 in the marginal price models. This study indicated that the use of average price rather than marginal price may not yield substantially dissimilar price-elasticity coefficients.

Williams and Suh conducted a cross-sectional analysis, based on 1976 data for eighty-six water systems.[63] They used three rate variables to calculate price elasticities: marginal price, average price, and monthly water bill. For residential demand, price elasticity was -.25 for marginal price and -.48 for average price with bill elasticities ranging from -.18 to -.32. For commercial demand, price elasticity was -.14 for marginal price and -.36 for average price with bill elasticities ranging from -.23 to -.34. For industrial demand, price elasticity was -.44 for marginal price and -.74 for average price with bill elasticities ranging from -.72 to -.98. The conclusion of this analysis was that the use of average water rates shows higher usage responses than when marginal water rates are incorporated in the model, particularly in the context of decreasing-block rates.

In the multiple regression analysis described in the previous chapter, Billings and Day used a pooled time-series/cross-sectional analysis for data on three utilities in the Tucson area.[64] Two residential demand models incorporating increasing-block rate structures were estimated. The analysis focused on the period 1974 through 1980, a period in which Tucson experienced substantial reductions in water usage, due both to conservation pricing and programs. The estimates of long-run price elasticity averaged -.72. For the marginal-price model, elasticity averaged -.52; for the average-price model, elasticity averaged -.70. The investigators found that the average-price model had superior explanatory power when

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[62] C. Vaughn Jones and John R. Morris, "Instrumental Price Estimates and Residential Water Demand," *Water Resources Research* 20 (February 1984): 197-202.

[63] Martin Williams and Byung Suh, "The Demand for Urban Water by Customer Class," *Applied Economics* 18 (December 1986): 1275-1289.

[64] R. Bruce Billings and W. Mark Day, "Demand Management Factors in Residential Water Use: The Southern Arizona Experience," *American Water Works Association Journal* 81, no. 3 (March 1989): 64.

incomes are high and water prices are low; the model incorporating marginal prices and a rate premium (reflecting the difference between the actual bill and what the customer would pay if all water were sold at the marginal price) had superior explanatory power when prices were higher or incomes were lower, and as water bills approached 2 percent or more of household income.

Wastewater Charges

The incorporation of wastewater treatment rates in the demand estimation model can affect price-elasticity estimates. This is a relatively recent discovery. Griffin and Chang conducted a time-series analysis of water demand for thirty Texas communities for 1983-1985.[65] The price variables in the model included water dependent sewer charges. Price elasticity was -.19 for winter and -.37 for summer. Excluding sewer charges, price elasticity was -.10 for winter and -.30 for summer. The implication of this analysis was that the omission of water dependent sewer rates from the model can bias the price-elasticity results by reducing the absolute values of the price-elasticity coefficients. Future demand studies might also include an estimate of stormwater treatment charges, which are now affecting many regions of the country. This type of analysis would help in the assessment of consumer responses to total water sector costs.

Customer Class

Each user class responds differently to water rate changes. Thus, price elasticities are comparable only for well-defined users classes, such as single-family residential, multi-family residential, commercial, industrial, and governmental. For example, the previously noted analysis of Williams and Suh clearly indicated that industrial water demand is substantially more price-responsive than residential water demand.[66] Schneider and Whitlatch conducted a

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[65] Ronald E. Griffin and Chan Chang, "Pretest Analysis of Water Demand in Thirty Communities," *Water Resources Research* 26 (October 1990): 2251-55.

[66] Williams and Suh, *Applied Economics,* 1275-89.

pooled time-series/cross-sectional analysis of water demand for metropolitan Columbus, Ohio.[67] The analysis, employing data for 1959-1976, covered sixteen communities served by the Columbus water system. Price elasticities were calculated for five customer classes (residential, commercial, industrial, government, and schools) as well as for total demand. For residential customers, price elasticity was -.11 for the short-run and -.26 for the long-run. For commercial users, price elasticity was -.24 for the short-run and -.92 for the long-run. For industrial users, price elasticity was -.11 in the short-run and -.44 for the long-run. For government units, price elasticity was -.44 for the short-run and -.78 for the long-run. For schools, price elasticity was -.38 for the short-run and -.96 for the long-run. And for total demand, price elasticity was estimated to be -.12 for the short-run and -.50 for the long-run. The conclusion of this analysis was that both short-run and long-run price elasticities vary substantially over customer classes.

Indoor v. Outdoor Use

Residential demand can be disaggregated into two components, indoor usage or outdoor usage. These two components of residential demand have different sensitivities to rate changes. Howe and Linaweaver performed a cross-sectional analysis of residential water demand incorporating thirty-nine urban areas.[68] The price elasticity of total residential demand was estimated to be -.41 using a weighted average of the domestic and irrigation elasticities. The price elasticity for residential domestic demand was estimated to be -.23. The price elasticity for domestic irrigation demand was estimated to be -.70 in the western United States and -1.57 in the eastern United States. This analysis suggests that domestic demand is highly price-inelastic and that irrigation demand is price-inelastic in the west but is price-elastic in the east.

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[67] Michael L. Schneider and E. Earl Whitlatch, "User-Specific Water Demand Elasticities," *Journal of Water Resources Planning and Management* 117 (January-February 1991): 52-73.

[68] Charles W. Howe and F. Pierce Linaweaver, "The Impact of Price on Residential Water Demand and its Relationship to System Design and Price Structure," *Water Resources Research* 3 (First Quarter 1967): 13-32.

Howe, in a cross-sectional analysis, dissagregated residential water demand into winter and summer (rather than into domestic and irrigation) components.[69] The price elasticity for winter demand was calculated as -.06. Summer price elasticity was estimated to be -.43 for Western U.S. and -.57 for Eastern U.S. The implications of this study is that again seasonal usage is less responsive to rate changes in the West than in the East.

Carver and Boland examined seasonal variations in municipal water demand using pooled time-series/cross-sectional data.[70] Their sample was thirteen water systems primarily serving residential consumers in the Washington D.C. area; the period of analysis was 1969-1974. The pooled analysis generated short-run price elasticities ranging from -.02 for winter demand to -.11 for summer demand, and long-run price elasticities ranging from -.11 for summer demand to -.70 for winter demand. The implication of this analysis was that summer usage is more responsive to rate changes than winter usage, both in the short-run and in the long-run.

A study of the water systems within the South Florida Water Management District found residential price elasticities to vary according to price levels and property values.[71] Elasticities for single-family homes were estimated to range from -0.01 to -0.90. However, no discernible relationship between price and water use could be found for residential apartments (the elasticity coefficient was -0.00). The study confirmed the general belief that indoor water use is less price-elastic. The virtually price-inelastic demand found for apartment dwellers could be attributed to master metering. Although one might expect that apartment owners who are responsible for bill payment would be motivated to reduce water costs by installing more efficient fixtures and appliances, the results of the analysis did not detect this type of response.

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[69] Charles W. Howe, "The Impact of Price on Residential Water Demand; Some New Insights," *Water Resources Research* 18 (August 1982): 713-716.

[70] Philip H. Carver and John J. Boland, "Short-Run and Long-Run Effects of Price on Municipal Water Use," *Water Resources Research* 16 (August 1980): 609-616.

[71] John B. Whitcomb, Jay W. Yingling, and Marvin Winer, "Residential Water Price Elasticities in Southwest Florida," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993), 695-701.

Peak v. Off-Peak

Based on variations in indoor and outdoor use, it is no wonder that water demand can vary between peak and off-peak water periods. Lyman conducted a time-series analysis of water demand for thirty households in Moscow, Idaho for 1983-1987.[72] Price elasticity was estimated for both short-run and long-run, as well as for peak demand and off-peak demand. For short-run peak demand, price elasticities ranged from -1.38 to -2.02. For long-run peak demand, price elasticities ranged from -2.60 to -3.33. For short-run off-peak demand, price elasticities ranged from -.40 to -.43. For long-run off-peak demand, price elasticities ranged from -.63 to -.71. The implications of this analysis were that both short-run and long-run peak water demand is more price-elastic than off-peak demand. Further, the study found that the price sensitivity of peak demand affects off-peak demand when consumers purchase and use more water-efficient appliances.

Price elasticity during periods of drought also is a significant issue because of implications of peak usage. Moncur analyzed single-family residential demand in Honolulu using a pooled time-series/cross-sectional analysis.[73] Price, income, household size, and rainfall variables were included in the regression as well as a dummy variable representing a water restriction program. Even during periods of serious drought, it was found that a 40 percent increase in the marginal price of water would result only in a 10 percent reduction in water use (an elasticity coefficient of -.25).

Short-Term v. Long-Term

Long-term responsiveness to changes in price is likely to be greater than short-term responsiveness. This finding, which is particularly true for residential consumers, can be attributed partly to the assumption that consumers in the long term have more opportunity to use water efficiently. Agthe, Billings, Dorba, and Raffiee conducted a time-series analysis of

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[72] R. Ashley Lyman, "Peak and Off-Peak Residential Water Demand," *Water Resources Research* 28 (September 1992): 2159-2167.

[73] J. E. Moncur, "Urban Water Pricing and Drought Management," *Water Resources Research* 23, no. 3 (1987): 393-98.

residential water demand for Tucson, Arizona for 1974-1980.[74] Employing marginal price, their estimating models calculated both short-run and long-run price elasticity. Short-run price elasticity was estimated to be -.50; long-run price elasticity was estimated to be -.87. The implication of this study was clearly that long-term residential water demand is more sensitive to price than short-term residential water demand.

Regional and Zonal Variations

As previously indicated, usage responses to rate changes vary across geographical areas. Foster and Beattie conducted a cross-sectional study of 218 water utilities in the United States.[75] The analysis, employing 1960 data, categorized water systems into six regions and calculated the price elasticity of residential demand for each region. The price elasticities ranged from -.30 in the Midwest to -.43 in New England. Other price elasticities were -.36 for the Southwest and -.38 for the South. The price-elasticity estimates for the Rocky Mountain region (-.58) and for the Pacific Northwest (-.69) were adversely affected by very small samples. The implications of this analysis include that it is difficult to formulate a residential water demand model for the entire United States and that usage responses to rate changes are greater in New England than in the more arid Southwest.

Some elasticity studies have segmented demand into areas of water usage within a utility's territory. Weber, in a pooled time-series/cross-sectional analysis of the East Bay Municipal Utility District (EBMUD), in California, generated estimates of long-run price elasticity for summer water demand.[76] His demand model employed marginal water price and focused on the period 1981 through 1987. The analysis used data for twelve pressure zones in the EBMUD service areas; price-elasticity estimates ranged from -.10 to -.25.

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[74] Donald E. Agthe, et al., "A Simultaneous Equation Demand Model for Block Rates," *Water Resources Research* 22 (January 1986): 1-4.

[75] Henry S. Foster and Bruce R. Beattie, "On the Specification of Price in Studies of Consumer Demand under Block Price Scheduling Urban Residential Water Demand for Water in the United States," *Land Economics* 55 (February 1979): 43-58.

[76] Jack A. Weber, "Forecasting Demand and Measuring Price Elasticity," *American Water Works Association Journal* 81, no. 5 (May 1989): 57-65.

The Role of Public Education

Conservation education programs can be as important in reducing water usage as rate increases. Nieswiadomy conducted a cross-sectional analysis of water demand for 430 water utilities in the United States.[77] Using 1984 data, the demand models used several price variables, as well as variables reflecting utility-sponsored conservation and public education programs. For the marginal-price model, price elasticities ranged from -.29 to -.45; for the average-price model, price elasticities ranged from -.22 to -.60. One finding of this study was that conservation programs, by themselves, may not affect water usage. However, in the West, public education has influenced water usage more than changes in rates. Agthe, Billings, and Dworkin, in a study of 644 households in Tucson, Arizona, found that whether or not consumers are knowledgeable about the water rate structure is an important factor in water conservation.[78] For example, consumers who were aware of the increasing-block rate structure believed that it reduced water usage. It should be noted that the majority of the consumers surveyed were not aware of either the existence of an increasing-block rate structure or seasonal rate differentials (both of which had been in place for seven years prior to the survey). The important implications of this analysis were that informed consumers take initiatives to reduce water usage while uninformed consumers are unlikely to engage in conservation, given any restructuring of rates. Another potentially important factor is the long-run effect of education on the very shape and level of the demand curve, not just the movement between points on the existing curve.

If water rates lag behind rates of inflation, this can induce consumers to increase usage. For example, if the actual price of water remains constant for several years after a rate increase, the real price of water can revert to (or possibly decline below) its original level. Martin and Kulakowski examined water policy for Tucson, Arizona over the extended period

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[77] Michael L. Nieswiadomy, "Estimating Urban Residential Demand: Effect of Price Structure, Conservation, and Education," *Water Resources Research* 28 (March 1992): 609-615.

[78] Donald E. Agthe, R. Bruce Billings and Judith M. Dworkin, "Effects of Rate Structure on Household Water Use," *Water Resources Research* 24 (June 1988): 627-630.

of 1965 to 1988.[79] They found that conservation information and education programs were not as effective in reducing water usage as increases in the real price of water. That is, water usage is more affected by increases in real water prices than by increases in actual or nominal water rates. Water rate increases in excess of inflation rates could have more significant conservation effects.

Implications

In a regulatory framework, the key price-elasticity issues center on the validity, relative importance, and proper interpretation of elasticity estimates and implications for both demand and revenues. Price elasticities for different customer classes also must be considered. For example, the water demand patterns for large-volume customers generally are more price-elastic than those for residential and commercial customers. The repeal of volume discounts, combined with a rate increase, will most likely trigger a response by large-volume customers. These users might try to reduce their water consumption through efficiency improvements or consider bypassing the water supplier in favor of self-supply. In extreme cases, they might seek to relocate, although this reaction is rarely justified on purely economic grounds. Regardless of which option is chosen, the result for the utility is revenue instability and shortfalls. These problems are made worse when elasticity estimates are excluded from the rate design analysis prior to setting prices. In other words, assumptions about the interaction between demand elasticities and alternative rates structures must be given careful consideration.[80]

A hypothetical example can illustrate the importance of price elasticity in rate design. The water system in this example has a sizable residential customer base and one very large industrial customer, in this case a brewery. The key assumptions are that the water utility has

[79] William E. Martin and Susan Kulakowski, "Water Price as a Policy Variable in Managing Urban Water Use," *Water Resources Research* 27 (February 1991): 157-166.

[80] D. Comer and Richard Beilock, "How Rate Structures and Elasticities Affect Water Consumption," *American Water Works Association Journal* 74, no. 6 (June 1982): 285-287.

increased its tail-block rate by 50 percent and that the tail block incorporates 98 percent of the water usage of the brewery. Properly specified water demand analyses for the brewery industry have indicated that the long-run price-elasticity coefficients range from -.40 to -.60. In other words, a 10 percent increase in rates reduces brewery water usage by 4 to 6 percent.[81]

The result of the tail-block increase is a usage reduction in the range of 20 to 30 percent. Given that the brewery formerly paid $300,000 annually for water, the water utility cannot presume that water revenues from the brewery will increase to $450,000 (a 50 percent increase); most likely, brewery revenues will fall short of $400,000. If the price-elasticity effect on usage was not incorporated in the rate design analysis, the long-run result is a revenue shortfall for the utility. A corresponding result is that lost revenues needed to cover fixed costs could be made up through further rate increases.

The implications of omitting price elasticity from the rate design process are becoming more critical. Some emerging evidence suggests that the price sensitivity of water demand may be increasing over time (with increasing real water prices) and that conservation programs can influence the shape or nature of water demand curves. Thus, the price elasticities for all user classes. In this context, it is difficult to provide practical benchmarks for gauging how much effort should be spent on developing elasticity estimates for a given water service territory. However, common wisdom would suggest that for many water systems, the price of ignorance on this issue can be high. While it may not be cost-effective for all systems to conduct their own detailed demand studies, it seems sensible to use the existing research to develop benchmarks for assessing the potential impact of price changes on the quantity of water demanded.

[81] The price elasticity for beer demand is not included in this analysis, but certainly should be a consideration to the brewery if it plans to pass along the water rate increase to beer consumers. Price-inelastic beer demand would be an advantage to the water utility (and other providers of beer ingredients). However, the demand for beer is not price-inelastic and the beer industry is highly competitive, so that breweries have strong incentives to hold down the cost of production.

In future demand studies, a number of complex issues will become increasingly challenging, such as: the changing magnitude of rate increases and total customer bills (for water, wastewater, and stormwater); the combination effects of the ability and willingness to pay for water service; the presence of realistic opportunities to conserve water and promote efficiency; the sense of urgency associated with water resource conservation; and the compound effect of prices and other variables in shaping the overall demand for water. Analysts must bear in mind that not every change in usage can be attributed to a change in price. However, the impact of price on the quantity of water demanded may become increasingly important, making the price-elasticity estimation more vital than ever.

TABLE 3-4
RESEARCH ON ESTIMATED PRICE ELASTICITY
FOR WATER DEMAND

Investigator	Year	Data (a)	Type of Demand	Elasticity
Gottlieb	1952	68 Kansas cities		-1.02
	1952	19 Kansas cities		-1.24
	1957	84 Kansas cities		-0.69
	1957	24 Kansas cities		-0.68
	1958	24 Kansas cities		-0.66
	1963	Kansas (CS)		-0.95 (mean)
Seidel & Baumann	1957	U.S. cities (CS)	$.45/1,000 gal	-0.12
Renshaw	1958	36 systems (CS)		-0.45
Fourt	1958	34 U.S. cities (CS)		-0.39
Heaver & Winter	1963	Ontario cities		-0.254
Wong, et al.	1963	N.E. Illinois (CS)		-0.31 (mean)
Hedges & Moore	1963	Northern California	Irrigation	-0.19
Howe & Linaweaver	1963-1965	21 cities	Domestic sewers	-0.23
			Seasonal use	-1.16
	1967	39 urban areas (CS)	Total residential	-0.41
			Residential domestic	-0.23
			Sprinkling, west	-0.70
			Sprinkling, east	-1.57
Gardner & Schick	1964	42 Northern Utah systems (CS)		-0.77
Flack	1965	54 western cities (CS)	$.45/1,000 gal	-0.12
		All cities (CS)	$.45/1,000 gal	-0.65
Ware & North	1965	634 Georgia households	Residential	-0.67

TABLE 3-4 (continued)				
Investigator	Year	Data (a)	Type of Demand (b)	Elasticity
Bain, Caves, & Margolis	1966	41 Northern California cities (na)		-1.10
			Irrigation	-0.64
	1966	41 California cities (CS)		-1.099
Conley	1967	24 Southern California cities (CS)		-0.625 (mean)
Bruner	1969	Phoenix, AZ		-0.33
Turnovsky	1969	19 Massachusetts towns (CS)		-0.225 (mean)
		Massachusetts (CS)	Industrial	-0.47 to -0.84
Burns, et al.	1970s	Stratified two-price comparison	Indoor use	-0.20 to -0.38
			Sprinkling	-0.27 to -0.53
Grima	1970	91 observations (CS)		-0.93
	1972	Ontario cities	Winter	-0.75
Wong	1970	Chicago, IL (TS, 1951-1961)		-0.15 (mean)
		Four large groups (CS)		-0.54 (mean)
Ridge, R.	1972	(CS)	Industrial, malt liquor	-0.30
			Industrial, fluid milk	-0.60
Young, R.A.	1973	Tucson, AZ (TS, 1946-1971)	Reanalysis	-0.20
DeRooy	1974	New Jersey (CS)	Chemical, cooling	-0.89
			Chemical, processing	-0.74
			Chemical, steam gen.	-0.74
Grunewald, et al.	1975	150 rural Kentucky cities (CS)		-0.92
Hogarty & McCay	1975	Blacksburg, VA (TS, 2 years)		-0.50 to -1.40
Pepe, et al.	1975	4 S. Carolina cities (TS, 2 and 3 years)		-0.00 to -0.51

TABLE 3-4 (continued)				
Investigator	Year	Data (a)	Type of Demand (b)	Elasticity
Camp. R.C.	1978	228 Mississippi households (CS)		-0.24 to -0.31
Carver, P.H.	1978	13 Washington, D.C., systems (TS/CS, 6 years)	Short-run	-0.00 to -0.10
	1978	Fairfax County, VA (TS, 4 years)	Innovative price structure	-0.02 to -0.17
Lynne, et al.	1978	Miami, FL (CS)	Department stores	-0.33
			Grocery stores	-0.89
			Hotels	-0.14 to -0.30
			Eating and drinking	-0.00 (c)
Foster & Beattie	1979	218 U.S. systems, 6 regions (CS, 1960)	Midwest	-0.30
			New England	-0.43
			Southwest	-0.36
			South	-0.38
			Rocky Mountain	-0.58
			Pacific Northwest	-0.69
Billings & Agthe	1980	Tucson, AZ (TS, 1974-1977)	Residential overall	-0.39 to -0.63
			Residential marginal	-0.27 to -0.49
Carver & Boland	1980	13 Washington, D.C. systems (TS/CS, 1969-1974)	Resid. short-run winter	-0.02
			Resid. short-run summer	-0.11
Carver & Boland (continued)	1980	13 Washington, D.C. systems (TS/CS, 1969-1974)	Resid. long-run winter	-0.70
			Resid. long-run summer	-0.11
Howe	1982	Regional U.S. (CS)	Residential winter	-0.06
			Residential summer, west	-0.43
			Residential summer, east	-0.57

TABLE 3-4 (continued)				
Investigator	Year	Data (a)	Type of Demand (b)	Elasticity
Jones & Morris	1984	326 Denver, CO households (CS, 1976)	Average price models	-0.18 to -0.34
			Marginal price models	-0.14 to -0.44
Agthe, Billings, & Dorba, & Raffice	1986	Tucson, AZ (TS, 1974-1980)	Residential short-run	-0.50
			Residential long-run	-0.87
Martin & Thomas	1986	4 cities (CS, 1978-79)	Residential	-0.50
Williams & Suh	1986	86 systems (CS, 1976)	Residential marginal	-0.25
			Residential average	-0.48
			Resid. bill elasticity	-0.18 to -0.32
			Commercial marginal	-0.14
			Commercial average	-0.36
			Commercial bill elasticity	-0.23 to -0.34
			Industrial marginal	-0.44
			Industrial average	-0.74
			Industrial bill elasticity	-0.72 to -0.98
Moncur	1987	Honolulu, HI, including drought period (TS/CS 1980s)	Resid., marginal price	-0.25
Billings & Day	1989	Tucson, AZ, water department districts (TS/CS 1974-1980)	Res., combined long-run	-0.72
			Resid., marginal price	-0.52
			Resid., average price	-0.70
Weber	1989	East Bay Municipal District (TS/CS, 1981-1987)	Summer, long-run	-0.10 to -0.25
Griffin & Chang	1990	30 Texas communities (TS, 1983-1985)	Winter with sewer	-0.19
			Summer with sewer	-0.37
			Winter, no sewer	-0.10
			Summer, no sewer	-0.30

TABLE 3-4 (continued)				
Investigator	Year	Data (a)	Type of Demand (b)	Elasticity
Schneider & Whitlatch	1991	16 Columbus, OH communities (TS/CS, 1959-1976)	Residential short-run	-0.11
			Residential long-run	-0.26
			Commercial short-run	-0.24
			Commercial long-run	-0.92
			Industrial short-run	-0.11
			Industrial long-run	-0.44
			Government short-run	-0.44
			Government long-run	-0.78
			Schools short-run	-0.38
			Schools long-run	-0.96
			Total short-run	-0.12
			Total long-run	-0.50
Lyman	1992	30 households, Moscow, ID (TS, 1983-1987)	Short-run peak	-1.38 to -2.02
			Long-run peak	-2.60 to -3.33
			Short-run off-peak	-0.40 to -0.43
			Long-run off-peak	-0.63 to -0.71
Nieswiadomy	1992	430 U.S. water utilities (CS, 1984)	Marginal price	-0.29 to -0.45
			Average price	-0.22 to -0.60
Stevens, Miller, & Willis	1992	85 Massachusetts communities (CS, 1988)	Uniform rates	-0.10 to -0.43
			Decreasing-block	-0.40 to -0.69
			Increasing-block	-0.42 to -0.54
Whitcomb, Yingling, & Winer	1993	Southwest Florida Management District (TS/CS 1988-1992)	Single-family homes	-0.01 to -0.90
			Apartments	-0.00 (b)

Source: Authors construct based on Planning and Management Consultants, *Influence of Price and Rate Structures on Municipal and Industrial Water Use* (Fort Belvoir, VA: Institute for Water Resources, United States Army Corps of Engineers, 1984), updated for post-1978 studies.

(a) Type of data used for the statistical analysis: cross-sectional (CS), time-series (TS), or pooled time-series/cross-sectional (TS/CS).
(b) Not significantly different from zero.

CHAPTER 4

RATEMAKING INCENTIVES FOR PROMOTING UTILITY-SPONSORED CONSERVATION

A recurring issue associated with conservation and demand management is whether public utilities should be provided with specific incentives to steer investments away from the supply side and toward the demand side. This issue may be especially critical for investor-owned water utilities, who are concerned not only about revenue stability but also about profitability. Ratemaking incentives can be considered in conjunction with either conservation programs or conservation pricing.

Incentive regulation generally refers to methods used by regulators to correct for the cost-plus nature of traditional ratebase/rate-of-return regulation and, in the context of demand management, to correct for the bias favoring supply-side investments. For conservation purposes, incentives go beyond traditional financial inducements or appeals to a utility's sense of public duty. Rather, a system of rules is established whereby demand-side investments are made at least as profitable--if not more profitable--as conventional supply-side investments (when successfully executed).[1] Most incentives work positively to make demand-side investments more attractive; incentives also can work negatively to make supply-side investments less attractive.[2] The idea behind some demand-side incentive systems is to attenuate or even sever the ties between utility sales and earnings. Certain ratemaking incentives can result in aggregate short-term cost reductions that merely enhance utility

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[1] The idea of making demand management *more* profitable than supply management is very controversial from an economic efficiency standpoint.

[2] In the electricity sector, some environmentalists favor the use of adders to inflate the cost of new supply options and make them less attractive in comparison to demand management. For a critique of this approach, see Kenneth Rose, Paul A. Centolella, and Benjamin F. Hobbs, *Public Utility Commission Treatment of Environmental Externalities* (Columbus, OH: The National Regulatory Research Institute, 1994).

profits. Ideally, however, incentives should promote long-term cost reductions, efficiency improvements, and technology investments.

This chapter considers the evolution of ratemaking incentives for conservation and demand management by public utilities. The chapter covers the rationale for incentives, the emergence of incentives in the electricity sector, utility and regulatory perspectives on incentives, and the effectiveness of incentives. Also included is an assessment of several specific cost-recovery, lost-revenue, and performance-motivation mechanisms that have been implemented or merely proposed for implementation. Following the descriptive information is a brief discussion of evaluation issues.

By necessity, this review draws heavily from the energy literature. State commission experience in providing incentives to electric utilities is impressive, although the experience with some of the particular methods and techniques is very limited. The rationale for conservation and the effects of conservation vary by sector, as discussed in chapter 1. However, the available ratemaking incentives for both energy and water utilities are somewhat generic in character because incentive mechanisms address problems associated with traditional economic regulation of public utilities.

Not everyone agrees with the merits of providing utilities with incentives to conserve. If utility-sponsored conservation is desired, regulatory incentives designed for electric utilities can be adapted to water utilities. A few state commissions have introduced regulatory incentives for conservation and demand management to the water sector, as discussed further in chapter 5. Given mounting resource and environmental constraints on water supplies, an expanded role for conservation and demand management incentives could be in store for the water industry. As the interest in water conservation grows, the need for industry-specific methods based on the cost characteristics of water supply may become apparent.

The Rationale for Incentives

As already noted, the rationale for incentives is based on the idea that regulated utility monopolies face substantial disincentives for conservation and demand management. The disincentives to invest in demand-side resource options center on three interrelated points:

(1) traditional ratemaking processes can be incompatible with demand management; (2) demand-side options can reduce utility sales; and (3) demand-side options can increase utility risks and threaten profitability. Each of these basic arguments is summarized below.

Three Interrelated Arguments

Traditional Ratemaking Processes Can Be Incompatible With Demand Management

Utilities, as regulated monopolies, are allowed to set their prices at a level that makes it possible to recover all prudently incurred operating expenses and fixed costs, plus earn a reasonable rate of return on their ratebase. Importantly, utility profit levels are not guaranteed by regulators. The rate setting process is based on the assumption that the relationship between future costs and sales levels will remain the same as that calculated by the commission for a given test year. Naturally, assumptions about future costs, sales, and revenues are rarely, if ever, exactly borne out. Between rate cases (a period characterized by the term "regulatory lag") a utility is motivated to sell more product whenever the marginal revenue from sales exceeds the marginal cost of production.

For many electric utilities, various regulatory instruments--particularly fuel adjustment clauses, purchased power clauses, and regulatory accounting practices--combine to assure that the net additional cost to the utility of producing more product is essentially zero. This net zero cost to the utility, as distinguished from the actual cost of the new power, is the result of the pass through of fuel costs and possibly other variable costs directly to the consumer. When the marginal cost of production to a utility is zero, every sale is profitable. Water utility investors who can pass variable costs through to customers can find themselves in the same situation. In fact, higher fixed costs and relatively low variable costs in the water sector could enhance the profit motive to increase sales.

If regulators determine that utility profits are too high, regulators can intervene and lower the utility's price. But even when rates are lowered, the utility is not necessarily required to give refunds or credits to customers to make up for previous excess earnings. Unless regulators intervene, a utility can retain all the profit it earns between formal rate cases. More frequent rate cases resolve the problem of excess profits somewhat, but not without adding substantially to the cost of regulation to utilities and the states. In sum, the utility has a significant incentive to maximize sales between rate cases.

Demand-Side Options Can Reduce Utility Sales

As mentioned, demand-management programs that reduce utility sales work at cross purposes with the utilities' financial interests because reducing sales means reducing revenues. The result may be that the utility under-recovers the allowed fixed costs that were authorized for collection by the regulatory commission in the prior rate case.[3] This problem can be mitigated by the use of a forward-looking test year (which adjusts test year sales for anticipated conservation and demand management impacts) and more frequent rate cases (which bring actual and test year sales into closer alignment). Even with such policies, however, utilities may be motivated to increase (rather than decrease) sales because every sale anticipated but not realized reduces the contribution to fixed costs and earnings. Even if unanticipated sales growth puts the utility above its projected test year sales, every conserved unit of power or water cuts into potential earnings. Although these arguments seem logical, not all regulatory analysts agree with the proposition that utilities are strongly motivated by the desire to increase sales because sales growth is not necessarily a prerequisite for profitability.[4]

Demand-Side Options Can Increase Utility Risks and Threaten Profitability

Since large ("lumpy") units of capacity take several years to build and place in service, utility shareholders bear the risk over a long period of time that plants might not be completed and the investment may not be recovered. This form of risk can motivate utility managers to acquire smaller resource increments that can be brought on line in shorter periods. These smaller increments can help utilities keep supply and demand in closer correspondence. For the electric industry, purchased power, small generating units, and

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[3] Under-recovery of fixed costs can occur with supply-side investments too.

[4] Steven Kihm, "Why Utility Stockholders Don't Need Financial Incentives to Support Demand-Side Management," *The Electricity Journal* 4 (June 1991): 28-35.

demand management (under some circumstances) meet these criteria. On the other hand, demand-side investments could be perceived by utilities as riskier for several reasons. In fact, utilities may expect to be compensated for higher risks through higher rates of return. These arguments about risk hold both for electricity and water utilities.

In general, most utilities currently are less experienced in acquiring demand-side resources than supply-side resources. Customer response to even the most prevalent types of conservation and demand-management programs (such as high-efficiency appliances or fixture rebates) cannot be predicted with complete confidence. Low market acceptance could lead to greater exposure to regulatory risk. Knowledge about potential market penetration rates and consumer acceptance is especially limited in the water sector, where experience with full fledged programs and reliable evaluation data are scarce.

Second, the lack of familiarity with demand management increases the likelihood of incorrectly estimating program benefits and costs, which makes outcomes less certain. As program savings are uncertain, so too is the distribution of savings. For example, it may be difficult to allocate savings according to demand patterns. If average demand is reduced but peak demand remains constant, the utility's load factor (the ratio of average use to peak use) is decreased and unit costs are increased. Thus, utility managers may be disinclined to pursue resource options with which they are less familiar and less comfortable, all other things being equal, even when the resource may prove to be as reliable as the alternatives in the long run.

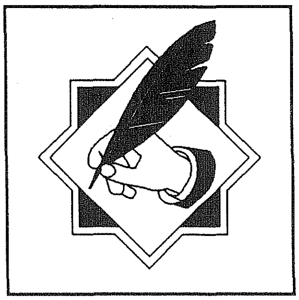
Third, a chief concern among utility managers seems to be that end-use conservation technologies resides at the customer's property. Consequently, utilities have much less control over conservation resources than they have over supply-side resources, and may reasonably perceive demand-side resources as less reliable. For example, certain installed demand management measures might be removed or destroyed well before the end of their expected life, a situation over which the utility has little or no control.

Fourth, in a retrospective review of today's demand-management programs, regulators might conclude that they were implemented imprudently or were not "used and useful," and should therefore not be accorded full cost recovery. This risk is heightened by the knowledge that turnover among regulators is high, and that decisions by today's regulators will not be binding on their successors. Of course, the risk of disallowance or differential regulatory treatment over time is ever present for all utility expenditures, whether on the supply side or the demand side.

Finally, utilities always are concerned that conservation and demand management will lower load factors and therefore require rate increases to cover fixed costs. Rate increases can lead to further reductions in demand and revenue erosion. The magnitude of this form of risk depends on the price elasticity of demand, as emphasized in chapter 3. Risks associated with rate hikes will be more acute in competitive markets or service territories in which the potential for bypass by large customers is significant.

Some empirical support can be found for the idea that demand management can be risky. In a recent attempt, Hirst and Blank found that electric utilities running even modest efficiency programs could experience reductions in equity returns by almost 100 basis points.[5] Such findings can lead to the conclusion that utilities need rate-of-return incentives to motivate them to invest on the demand side.

The Emergence of Incentives



In the past five years, the subject of conservation and demand management incentives has moved from the fringes of electric utility regulation to the mainstream. A majority of the state public utility commissions provide one or more demand-side incentives to electric utilities, as summarized in table 4-1. The state commissions and the utilities they regulate continue to watch for precedents established by others in the use of incentives. Precedents established in the energy sector have relevance for the use of ratemaking incentives in the water sector.

Early experience with incentives dates back to at least 1980. Legislation in Washington State made it possible to grant utilities a 2 percent bonus rate of return on the equity portion of investments that are "reasonably expected to save, produce, or

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[5] Eric Hirst and Eric Blank, "Quantifying Regulatory Disincentives to Utility DSM Programs," *Electricity* 18, no. 11 (1993): 1091.

TABLE 4-1
REGULATORY INCENTIVES FOR UTILITY DEMAND MANAGEMENT IN THE ENERGY SECTOR BY STATE

State	Ratebase recovery	Lost revenue	Shared savings	High rate of return	Decoupling	Bounty	Number of Measures
Alabama	No	No	No	No	No	No	0
Alaska	No	No	No	No	No	No	0
Arizona	No	Yes	Yes	No	No	No	2
Arkansas	No	No	No	No	No	No	0
California	Yes	Yes	Yes	Yes	Yes	No	5
Colorado	Yes	No	Yes	No	No	No	2
Connecticut	Yes	Yes	No	Yes	Yes	No	4
Delaware	No	No	No	No	No	No	0
District of Columbia	Yes	Yes	Yes	No	No	No	3
Florida	Yes	No	No	No	No	No	1
Georgia	No	Yes	No	No	No	No	1
Hawaii	No	Yes	Yes	Yes	No	No	3
Idaho	Yes	No	No	Yes	No	No	2
Illinois	No	Yes	No	No	No	No	1
Indiana	No	Yes	Yes	No	No	No	2
Iowa	Yes	Yes	Yes	No	No	No	3
Kansas	Yes	No	No	Yes	No	No	2
Kentucky	No	No	No	No	No	No	0
Louisiana	No	No	No	No	No	No	0
Maine	Yes	Yes	Yes	No	Yes	No	4
Maryland	Yes	Yes	Yes	No	No	No	3
Massachusetts	Yes	Yes	No	No	No	Yes	3
Michigan	Yes	No	No	Yes	No	Yes	3
Minnesota	Yes	Yes	Yes	No	No	Yes	4
Mississippi	No	No	No	No	No	No	0
Missouri	No	No	No	No	No	No	0

TABLE 4-1 (continued)							
State	Ratebase recovery	Lost revenue	Shared savings	High rate of return	Decoupling	Bounty	Number of Measures
Montana	Yes	No	No	Yes	No	No	2
Nebraska	No	No	No	No	No	No	0
New Hampshire	No	Yes	Yes	No	No	No	2
New Jersey	Yes	Yes	Yes	No	No	Yes	4
New Mexico	No	No	No	No	No	No	0
New York	Yes	Yes	Yes	Yes	Yes	No	5
Nevada	Yes	Yes	No	Yes	No	No	3
North Carolina	No	No	No	No	No	No	0
North Dakota	Yes	No	No	No	No	No	1
Ohio	No	Yes	Yes	No	No	No	2
Oklahoma	Yes	No	No	No	No	No	1
Oregon	Yes	Yes	Yes	No	No	No	3
Pennsylvania	Yes	No	No	No	No	No	1
Rhode Island	No	No	No	No	No	No	0
South Carolina	No	No	No	No	No	No	0
South Dakota	No	No	No	No	No	No	0
Tennessee	No	No	No	No	No	No	0
Texas	Yes	No	No	Yes	No	No	2
Utah	No	No	No	No	No	No	0
Vermont	Yes	Yes	Yes	No	No	No	3
Virginia	No	No	No	No	No	No	0
Washington	Yes	Yes	No	Yes	Yes	Yes	5
West Virginia	No	No	No	No	No	No	0
Wisconsin	Yes	No	No	No	No	No	1
Wyoming	No	No	No	No	No	No	0
Totals	25	21	17	11	5	5	---

Source: Office of Technology Assessment, U.S. Congress, *Energy Efficiency: Challenges and Opportunities for Electric Utilities* (Washington, DC: Office of Technology Assessment, 1993), 133-34.

generate energy at a total incremental system cost...[that was] less than or equal to [the cost of energy from] conventional energy resources which utilize nuclear energy or fossil fuels."[6] The Washington commission interpreted the statute to authorize two types of regulatory treatments. First, utilities could be allowed to treat conservation program expenditures as investments (rather than periodic expenses), meaning that demand-side investments could be ratebased (comparable to supply-side investments). Second, preferential financial treatment could be given to demand-side investments in terms of the 2 percent higher rate of return.

In effect, however, the 2 percent bonus apparently did not stimulate significant demand-side activity in Washington State. Since the bonus was insufficient to offset conservation-induced revenue losses between rate cases, incremental conservation efforts still penalized utilities by cutting into profits. Also, the statute lacked a provision for utilities to accrue carrying charges on demand management investments made between rate cases. The net result was that utilities continued to favor supply-side investments for financial reasons.[7]

The next major development was a proposal in 1981 by the Pacific Gas & Electric Company (PG&E) to establish an electric revenue-adjustment mechanism (ERAM). To improve its financial stability, the company proposed reconciling actual base (nonfuel) revenues to the revenue level authorized by the commission. The ERAM took effect in 1982 and was implemented for California's other major utilities over the three consecutive years. Under ERAM, a utility does not lose authorized base revenues when it increases its demand management efforts between rate cases because the shortfall is collected from ratepayers in the next period, with an appropriate adjustment for interest. Symmetrically, any gains from expected sales are returned to ratepayers. This feature is known as decoupling because it severs the link between base revenue and the level of sales. ERAM does not make demand-side resources more profitable for utilities than other resource options. However, in

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[6] Washington Revised Code, 80. 28. 025 (1980). This is an example of legislative ratemaking policy, which can be controversial with respect to the discretionary authority of the state commissions.

[7] Glenn Blackman, "Conservation Incentives: Evaluating the Washington State Experience," *Public Utilities Fortnightly* 127 (January 15, 1991).

comparison to traditional regulation, ERAM removes the short-term revenue penalty from lost sales and reduces the incentive to promote sales.

In 1986, the Wisconsin commission directed the Wisconsin Electric Power Company (WEPCO) to begin a large-scale "conservation construction program," emphasizing rebates and low-interest loans to customers investing in energy efficiency measures. The commission authorized ratebasing most of the utility's outlay in order to spread the program costs over several years.[8] The commission allowed for increasing the rate of return on demand-side investments only if the company reached a target level for reducing peak load. According to this scheme, one percentage point additional return on the equity portion of demand management would be received for each 125 megawatts of demand reductions. This was the first major commission decision to tie a financial bonus to quantified performance in demand management.

By the middle-1980s, a new planning paradigm was firmly established for the electric industry. The emergence of least-cost planning (LCP) or integrated resource planning (IRP) is closely related to the emergence of incentives for conservation and demand management. The new mode of planning promised to minimize the costs of energy services by expanding the menu of possible resources to include demand-side and nontraditional supply-side options. By 1988, more than a dozen states were practicing some form of least-cost or integrated planning, and a majority of states were moving in that direction.[9] Using integrated planning principles, regulators and industry analysts began to focus on whether demand-side and supply-side resources were competing on an equal footing. In the first national conference on least-cost planning sponsored by the National Association of Regulatory Utility

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[8] Wisconsin Public Service Commission, *Order in Docket No. 6630-UR-100* (December 30, 1986).

[9] Barakat, Howard & Chamberlin, Inc., *Status of Least Cost Planning in the United States* (Palo Alto, CA: Electric Power Research Institute, 1988).

Commissioners (NARUC), it was argued that the goals of least-cost planning could not be achieved without substantial reform of traditional ratemaking methods.[10]

Following the least-cost planning conference, NARUC's Energy Conservation Committee sponsored a workshop on the relationship between least-cost planning and utility profitability. The committee issued a resolution urging state commissions to adopt appropriate mechanisms to compensate a utility for earnings lost through successful implementation of demand-side programs related to least-cost planning.[11] The resolution prompted several state commissions to begin studying the incentives issue, while some utilities also began to formulate financial incentive proposals. By early 1989, the demand-side incentives movement was in full swing, with an emphasis on identifying and correcting the disincentives affecting the pursuit of demand management by electric utilities.

Regulatory proceedings in 1989 and 1990 established several incentive plans that have become the basis for most of the subsequent action in this area. Among the most important developments were: the passage of an order in New York establishing incentives for Niagra Mohawk Power Company (NIMO) and Orange and Rockland Utilities (O&R); the approval in three states of parallel demand management incentive proposals put forth by the New England Electric System (NEES); the development of incentive proposals for California's major utilities in a collaborative process; and the revision of Orange and Rockland's original incentive system less than a year after its initial implementation.

The NIMO/O&R decision by the New York commission authorized the utilities to estimate and collect from ratepayers conservation-related lost revenues, that is, the portion of authorized revenue base that is foregone when demand management succeeds. Like ERAM, this adjustment was seen as a means to eliminate the financial penalty of expanding demand-side programs between general rate cases. The utilities were further granted demand

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[10] David Moskovitz, "Will Least Cost Planning Work Without Significant Regulatory Reform?" a presentation at the NARUC Least Cost Planning Conference in Aspen, Colorado (April 12, 1988).

[11] Energy Conservation Committee of the National Association of Regulatory Utility Commissioners, "Statement of Position of the NARUC Energy Conservation Committee on Least Cost Planning and Profitability" (July 26, 1988).

management bonuses, expressed as shares of the net savings from selecting demand-side options in lieu of supply-side options. The shared-savings approach linked the bonus to the utility's performance and was expected to motivate utilities to both expand their programs and maximize cost-effectiveness. Many of the incentive mechanisms adopted by the states after 1989 emulated the shared-savings (or shared-benefits) approach pioneered by the New York commission.[12]

The New England Electric System (NEES) proposed to receive as a bonus a portion of the savings resulting from its demand-management programs. The Massachusetts commission thoroughly revised NEES's proposal for calculating the incentive, offering a fixed dollar amount per kilowatt and kilowatt-hour saved, in lieu of a share of the savings.

The California collaborative process, which included fifteen different parties (including the state's four major electric utilities), resulted in incentive proposals that were approved by the commission in August 1990. Two of the three utility mechanisms followed the shared-savings approach; the third was based on ratebasing the utility's demand-side investments. Each utility also would be subject to a financial penalty if it failed to meet program-specific performance objectives. Subsequent to the California collaboration, provisions for penalties have appeared in the design of many other incentive systems.

The most recent major event in this area was the revision of the Orange and Rockland incentive mechanism by the New York commission. The original formulation was thought not to have the hoped-for effect. In August 1990, the commission approved a revenue decoupling mechanism (RDM) for the utility. Modeled after California's ERAM, it was the first full decoupling arrangement adopted in another state. A revision of O&R's demand management bonus was teamed with the RDM. The commission replaced the shared-savings approach with an annual adjustment, which can be positive or negative. The adjustment is a function of the utility's performance in two areas: cumulative energy savings (in kilowatthours) and net resource savings (in dollars). Also in the early 1990s, commission orders in the states of Maine and Washington expressed concerns about the potential for

[12] See New York Public Service Commission, *Case 29409, Opinion No. 80-20* (July 26, 1988).

excessive earnings under decoupling and the possible need for a statistical recoupling mechanism to reduce price volatility.[13] Decoupling can be particularly unstable during recessionary periods, which is why some states may be rethinking this form of incentive.

This brief history of how demand-side incentive regulation unfolded for the electric industry is instructive. However, the past does not always point clearly to the future. Increasing competition, restructuring, and deregulation within various corners of the energy sector seem to clash with utility-sponsored conservation programs and regulatory incentives for these demand-side activities. Many of these changes focus attention on prices rather than costs. Some integrated resource planning advocates fear that the current trends will erode the concept of the regulated utility franchise and diminish the ability of regulators to impose demand-side requirements considered by advocates to be socially beneficial.[14] In short, a clear tension exists between the reliance on market forces and the use of commission intervention to guide utility planning choices.[15] Whether these competing paradigms can be reconciled remains to be seen.

Utility and Regulatory Perspectives

The literature on demand management incentives is rife with diverse views, opinions, and experiences. Much can be learned about the workings of incentive systems from knowledgeable informants in the electricity sector. In a relatively recent account, twenty-six electric utility and thirteen regulatory representatives were provided the opportunity to express their perspectives on actual experiences with conservation and demand management

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[13] Hirst and Blank, "Quantifying Regulatory Disincentives," 1103.

[14] Eric Hirst, *Cost and Effects of Electric-Utility DSM Programs: 1989 Through 1997* (Oak Ridge, TN: Oak Ridge National Laboratory, 1994), 32.

[15] Kenneth Rose, "Planning Versus Competition and Incentives: Conflicts, Complements, or Evolution?" in Clinton J. Andrews, ed., *Reforming Electricity Regulation: Fitting Regional Networks into a Federal System* (Westport, CT: Quorum Books, 1994).

incentives.[16] Although too limited for statistical sampling and generalization purposes, the survey revealed several important points. Again, perspectives on incentives for the electricity sector may have relevance for adapting these approaches to the water sector.

The survey respondents indicated their belief that both utilities and regulators are interested in receiving or providing demand management incentives. However, regulatory representatives may have underestimated utility interest to some degree. Commission representatives were more likely to express reservations about establishing incentive systems. Some of the regulators surveyed believed that incentives should be tied to utility performance in demand management rather than to spending levels. Utility representatives emphasized the need for incentives to: (1) compensate for lost profit opportunities, (2) provide a bonus to stimulate demand management, (3) get utility managers to focus on demand management, and (4) overcome the lost-revenues problem. These concerns also were cited by a majority of regulatory representatives. However, according to regulators, the top reason for incentives is the need to create a level regulatory "playing field" for demand-side and supply-side resources.

Utility representatives identified the following chief concerns about demand-side incentives: (1) that bonuses will be undercut by offsetting reductions in recoverable costs; (2) that rate increases will be required to pay for incentives; and (3) that ratepayer backlash against providing incentives to utilities might arise. The responses of the regulators differed sharply. Regulators indicated that their chief concerns were about: (1) the appropriate size of bonuses and the difficulty of choosing the optimal incentive level, (2) the possibility that incentives will encourage "goldplating" of demand-side programs, and (3) the potential for windfalls to utilities. Regulators also were concerned that paying utilities to act in the public interest could set a bad precedent, and that the actual results of demand-side programs are difficult to monitor and measure.

As already noted, most incentive systems implemented or proposed have three basic components: a cost recovery mechanism, a mechanism to adjust for lost revenues, and a

[16] Michael W. Reid, *Demand-Side Management Incentive Regulation* (Palo Alto, CA: Edison Electric Institute and Electric Power Research Institute, 1991).

mechanism to motivate utilities (through bonuses and other rewards) and correct for perceived risks. Utility managers and regulators both tended to rank the bonus component as the least important. However, regulators assigned greater importance to the lost-revenue component over the cost-recovery component. Utility representatives reversed that ranking.

Of the variety of methods and mechanisms used to provide a bonus, the sharing of net savings seemed to have the greatest acceptance among survey respondents. Other methods acceptable to a majority of respondents were ratebasing with a bonus rate of return and per-unit bonuses paid for each kilowatt or kilowatthour saved. The least acceptable method for regulators appeared to be a bonus based on a percentage markup on demand-side expenditures, while the least preferred method for utility representatives was a formula adjustment to overall rate of return based on an index of customers' average bills. Respondents also were asked to evaluate California's ERAM, which reconciles a utility's actual base revenues to an authorized amount. Respondents seemed to agree that ERAM decouples utility profits from sales. Regulators also indicated that ERAM is a good way to adjust for lost revenues. Some utility representatives were concerned that ERAM reduces incentives for utilities to operate efficiently.

Finally, utility and regulatory commission representatives expressed similar views on the expected impacts of demand-side incentives. The majority believed that incentives would result in moderate expansion of demand-side programs over the next five years. A minority of respondents envisioned a more substantial impact from incentives on demand-side investments. When asked whether any other resource options should receive incentives, utility managers favored incentives for investing in nontraditional, renewable resources.[17] Most regulators, however, did not seem to endorse the use of incentives for options other than demand-side resources.

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[17] For example, in the energy sector, incentives could be used to promote environmentally cleaner supply-side options, such as clean-coal technologies and combined-cycle gas turbines. However, the appropriate role of economic regulation in furthering environmental goals is an ongoing matter of debate.

The Effectiveness of Incentives

Proponents of ratemaking incentives believe strongly in the effectiveness of these methods and advocate their continued use. Utility investments on the demand side seem to be expanding in both the energy and water sectors. Electric utilities are spending about $2 billion per year (1 percent of their revenues) on demand-management programs.[18] The most aggressive utilities are investing two to 6 percent of their gross revenue in this area. This growing commitment is largely attributed to regulatory and ratemaking incentives provided to investor-owned electricity providers by the state public utility commissions. Although data and analysis on the effectiveness of conservation and demand management are abundant, conclusive empirical evidence about the causal connection between regulatory incentives and utility involvement in demand-side activities is thin at best.[19]

In a recent study, data were examined for seventeen electric utilities that received positive financial incentives for demand management, and fourteen utilities that have received no such incentives.[20] The impact of incentives was analyzed in three respects. First, annual demand-side expenditures and savings were compared for the year before and after the incentives were approved. Second, long-range demand management plans for the 1991-2000 period were examined, with an eye to comparing plans prepared before and after incentives were implemented. Third, utility managers, regulatory staff, and representatives of active intervenor groups were interviewed.

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[18] Steven M. Nadel, Michael W. Reid, and David R. Wolcott, eds., *Regulatory Incentives for Demand-Side Management* (Washington, DC: American Council for and Energy-Efficient Economy, 1992).

[19] See Eric Hirst, *Cost and Effects of Electric-Utility DSM Programs: 1989 Through 1997* (Oak Ridge, TN: Oak Ridge National Laboratory, 1994), 32.

[20] Steven M. Nadel and Jennifer A. Jordan, "Regulatory Incentives for DSM" in Steven M. Nadel, Michael W. Reid, and David R. Wolcott, eds., *Regulatory Incentives for Demand-Side Management* (Washington, DC: American Council for and Energy-Efficient Economy, 1992), 229-255.

The analysts concluded that, on average, providing utilities with financial incentives has a positive and statistically significant impact on levels of utility demand-side activity. A more specific finding was that shared-savings incentives tended to promote commercial and industrial demand-side programs more than residential programs. It was concluded that incentives can attract management attention and help quiet skeptics within the utility. However, the authors also concluded that the experience with incentives is too limited to generate conclusions about the relative merit of alternative approaches, the optimal levels of incentives, and whether incentives should be continuous or intermittent.

Some analysts are especially concerned about whether regulatory incentives have any unintended or adverse effects on utility costs. Leland Johnson argued that a rational firm subject to traditional economic regulation is apt to shift resources to any area that regulators have targeted for improvement.[21] As a result, it is possible total utility operating costs may not be lower after the introduction of performance-based incentives. A recent empirical study supports this conjecture. Analyzing electric utilities, Berg and Jeong found that targeted incentives do not have a statistically significant effect on a utility's actual operating costs relative to predicted operating costs.[22] However, in a replication of this study using a modified statistical technique and data structure, Graniere, Hegazy, and Cooley concluded that performance-based incentives can result in reduced utility operating costs.[23]

In sum, far more empirical research is needed on the role of incentives and their actual impact on utility performance. Although numerous types of incentives are available for implementation, none is an entirely proven method in terms of accomplishing its task in a cost-effective manner.

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[21] Leland Johnson, *Incentives to Improve Electricity Performance: Opportunities and Problems* (Santa Monica, CA: Rand Corporation, 1985).

[22] Sanford V. Berg and Jinook Jeong, "An Evaluation of Incentive Regulation for Electric Utilities," *Journal of Regulatory Economics* 3, no. 1 (1991): 45-55. See also their "Corrections" in *Journal of Regulatory Economics* 3, no. 6 (1994): 321-28.

[23] Robert J. Graniere, Youssef Hegazy, and Anthony Cooley, "Demand-Side Management Policies: The Removal of a Disincentive and the Adoption of Incentives," *NRRI Quarterly Bulletin* 15, no. 1 (March 1994): 39-52.

Specific Types of Incentives

A wide variety of regulatory and ratemaking policies can be used to provide incentives, and correct for disincentives, associated with demand-side resource options.[24] Each approach has relevance for both the energy and water sectors. Each also has advantages and disadvantages. Many of the incentive systems under consideration follow a three-part formula consisting of:

- *Cost-recovery mechanisms* to improve revenue stability, reduce regulatory lag, and ensure that the utility would be able to promptly recover in rates all prudently incurred costs of demand-side programs.

- *Lost-revenue mechanisms* that would adjust rates to compensate for the short-term loss in base sales, revenues, and profits that result from successful demand-side programs.

- *Performance-motivation mechanisms* that provide bonuses (or penalties) for meeting (or not meeting) program goals to help offset the risks perceived by utility managers, and motivate utility shareholders to expand cost-effective demand-side programs.

Some ratemaking incentives achieve more than one goal simultaneously. For example, lost-revenue mechanisms tend to motivate utility performance as well. Also, it seems customary to combine mechanisms in the course of implementing an incentive system. The essential characteristics of each type of incentive are provided in table 4-2 and discussed individually below, followed by a summary evaluation.

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[24] For comprehensive and detailed reviews, See Nadel, Reid, and Wolcott, eds., *Regulatory Incentives*; Office of Technology Assessment, U.S. Congress, *Energy Efficiency: Challenges and Opportunities for Electric Utilities* (Washington, DC: Office of Technology Assessment, 1993); and Michael W. Reid, Julia B. Brown, and Jack C. Deen, *Incentives for Demand-Side Management, Second Edition* (Washington, DC: The National Association of Regulatory Utility Commissioners, 1993).

Cost-Recovery Mechanisms

Deferral to Rate Case

Adjustments to the conventional cost-deferral and amortization processes can be used to compensate utilities for net revenue losses from acquiring demand-side resource options. Several states allowed different approaches for deferral and recovery of demand-side costs. Deferral mechanisms can be used to mitigate revenue disincentives, as well as to account for incentive payments or penalties to a utility.

The mechanism can make utilities indifferent as to what type of resource is acquired. It can encourage utilities to acquire resources at the lowest possible cost because the mechanism does not include recovery of direct program costs. It is also relatively simple to administer and implement. Three key disadvantages are associated with this mechanism. First, the risk of nonrecovery remains. Regulators might deny cost recovery when it is requested in the rate case. Second, the utility incurs the out-of-pocket expenses during the deferral period, possibly adding to cash-flow problems. Third, deferral may not provide utilities with adequate incentives to participate in cost-effective demand management efforts.

Flow Through Costs to Rates

In contrast to deferring costs, another approach is to use an annual automatic adjustment mechanism to expedite recovery of lost revenues attributable to acquiring demand-side resources. This alternative is different from a deferral mechanism in that rate recovery occurs through an automatic adjustment to the utility tariffs. No separate ratemaking proceeding is necessary to begin cost recovery from ratepayers. Massachusetts, New York, and Vermont have explicitly allowed for recovery of lost revenues. The decoupling mechanisms in California, Maine, and Washington implicitly allow for recovery. This incentive encourages least-cost planning and cost minimizing decisions and provides timely recovery of demand-side expenditures. It also is fairly simple to administer and implement and reduces the risk of nonrecovery. The problem with this mechanism is that regulators may feel they do not have adequate opportunity to examine and control expenditures. Also,

TABLE 4-2
REGULATORY INCENTIVES FOR UTILITY DEMAND MANAGEMENT

General type of incentive	Specific type of incentive	Explanation
Cost-recovery mechanisms	Deferral to rate case	Deferral of accounting for variations in expenses until a subsequent rate case
	Flow through costs to rates	Accounting for variations in expenses through the use of an adjustment clause, surcharge, rider, or other ratemaking mechanism
	Modified cost accounting	Recovery streams other than immediate, straight-line amortization used to mitigate the short-term effects of costs on rates and improve revenue stability
	Ratebase recovery	The inclusion of demand-side expenditures, including general and administrative costs associated with planning and management, in the utility's ratebase
	Special-purpose rates	Rate-design alternatives that enhance the utility's ability to invest in demand-side resources and recover associated costs
Lost-revenue mechanisms	Cost-based pricing	Pricing schemes, such as incremental-cost pricing, that account for short-run and long-run costs so that lost revenues are matched by reduced costs
	Revenue adjustments	Demand-side specific revenue requirement adjustments to compensate for lost sales and revenues
	Decoupling sales	Methods that separate sales from sales, revenues, and profits in the regulatory determination of revenue requirements so that reductions in sales do not cause reductions in earnings
	Selling services	A decoupling strategy emphasizing sales of utility services, as compared to sales of conventional utility outputs
	Alternative regulation	Alternatives to traditional ratebase/rate-of-return regulation used to eliminate incentives that favor supply-side over demand-side activities

TABLE 4-2 (continued)		
General type of incentive	Specific type of incentive	Explanation
Performance-motivation mechanisms	Expense or ratebase markup	A percentage markup in the value of certain demand-side expenses or ratebased demand-side investments
	Rate-of-return adjustments	Adjustments to return on equity (or overall rate of return) used to reward or penalize utilities for progress in demand-side programs
	Shared savings	A sharing formula to compensate a utility for some or all of the costs, both direct and indirect, that result from a demand-side program
	Bounty or unit bonuses	A predetermined payment provided to utility shareholders for participating in demand-side programs or exceeding unit conservation goals
	Management rewards	A predetermined payment provided to utility managers for building successful demand-side programs or exceeding unit conservation goals

Source: Authors' construct.

automatic adjustments for conservation expenses can prove controversial, as has been the case with automatic fuel-adjustment clauses.[25]

Modified Cost Accounting

In order to mitigate the short-term effects of costs on rates, and improve revenue stability, utilities could be allowed to use cost recovery streams other than immediate, straight-line amortization. In the electricity sector, several utilities are adopting different modified

[25] On automatic adjustment clauses, see Robert E. Burns, Mark Eifert, and Peter A. Nagler, *Current FAC and PGA Practices: Implications for Ratemaking* (Columbus, OH: The National Regulatory Research Institute, 1991).

cost-recovery accounting streams. Any of these streams would result in less recovery of the resource cost in the near term, yet allow full recovery by the end of the asset's useful life. The impact of such methods on cost-minimization and least-cost planning by the utility is neutral. Although the nominal rate will be lower in the near term, rates would have to be higher in the later years of the resources' life. The result can be an intergenerational transfer, with future customers paying at the expense of current customers. Also, because the utility may need to file for more frequent rate increases, some risk might be transferred to shareholders.

Ratebase Recovery

A major contrast between supply-side and demand-side expenditures is that the former is more likely to be entered into the ratebase, while the latter is more likely to be recovered as an annual expense. To encourage more equitable consideration among resource options, some advocates have proposed the inclusion of demand-side investments in the utility's ratebase. A wide variety of expenses, including general and administrative costs associated with planning and managing demand-management programs, can be considered for ratebase treatment. This would allow the utility both to spread costs over time and earn a return on demand-side expenditures. As discussed below, additional incentives also have been proposed in conjunction with ratebase recovery. One option is to markup the value of demand-side investments to make them even more profitable. Another is to provide the utility with a premium rate of return for the amount of the demand-side investment in the ratebase.

Special-Purpose Rates

Demand management, and related cost-recovery, can be accomplished in part through tariff revisions reflecting special-purpose rates. These rates, which go above and beyond conservation-oriented pricing (chapter 3), can help utilities both in terms of effecting demand management-programs and recovering program costs. An example of a special-purpose rate is a residential split rate, whereby residential customers electing to meet predetermined efficiency standards are classified separately from nonparticipants. The rate spread between the two groups would reflect the reduced long-run incremental cost of serving the more efficient customer group.

Another example of a special-purpose rate is a hookup fee assessed for connecting new homes to the utility system. As part of a demand-side program, the fee could be positive (a payment to the utility) for homes not built to efficiency standards and negative (a payment to builders) for efficient homes. Revenues collected from the hookup fees could be amortized in rates, and the payment mechanism could be designed to compensate the utility for program costs. Only Idaho has adopted this alternative (the negative fee version) for a jurisdictional electric utility.

Finally, a related pricing matter concerns the desire by some utilities to explicitly identify the rate impact of demand-side costs in the form of a separate line item on customer bills. Although it would have a neutral impact on least-cost and cost-minimization behavior, this alternative could alleviate some of utility concerns about upward pressure on rates caused by acquiring conservation resources. The reasoning behind its use is that customers may be more tolerant of rate increases associated with activities that they support.

Lost-Revenue Mechanisms

Cost-Based Pricing

Varieties of cost-based pricing, based on the principles of marginal-cost or incremental-cost pricing, can help utilities accomplish demand management goals. As previously discussed, rate structures, such as seasonal rates and increasing-block rates, affect demand by assigning higher prices to customers responsible for peak usage. From a revenue stability standpoint, increasing-block rates are especially controversial.

Conceptually, increasing-block rates can be designed with tail block rates equal to the long-term incremental cost of supplying the utility service. Their purpose is to provide consumers with the correct long-run pricing signal to guide their consumption. Since long-run incremental costs are usually above short-run incremental costs, customers will be motivated to lower their demand but utilities will not be inclined to promote conservation (due to the apparent prospect of lost revenues and profits). Thus, some forms of incremental-cost pricing can appear to require the companion use of a lost-revenue mechanism. This point is debatable.

In theory, and in the long term, incremental-cost pricing can help resolve the revenue issue because, even though sales might be stabilized or reduced, foregone revenues are offset by avoided costs. That is, the effects of incremental-cost pricing should be revenue neutral. This may be especially obvious for utilities facing scarcity situations, where the next increment of capacity will be very costly. Indeed, one of the most persuasive arguments in favor of demand management is the potential to forestall capacity expansion or postpone it indefinitely. Potential disallowances and other risks associated with capacity expansion also are reduced, which further enhances revenue stability. Furthermore, the key revenue issue associated with marginal-cost pricing approaches is not revenue *deficits* but revenue *surpluses.* Thus, the companion use of a lost-revenue feature along with incremental-cost pricing may not be necessary, especially if rate reviews occur with frequency. However, regulators may want to stimulate further demand-side activity through some other form of performance motivation (such as a markup, bonus, or higher return).

A very provocative twist on the use of cost-based pricing in the context of demand management is the potential use of *decreasing-block* rate structures. Decreasing-block rates generally are regarded as the chief nemesis of conservation because they appear to discount high-volume usage. However, the incentives literature provides another potential interpretation. In this conception, the utility frontloads its fixed costs into customer service charges and the initial blocks of usage, and the tail block rate is set at the utility's *short-run* marginal cost of service. These lower unit prices reduce the utility's incentive to sell more of its product.

Some economists and rate analysts have suggested that decreasing-block rate structures can be efficient under certain circumstances.[26] Of course, this rate form tends to appeal to utilities because it enhances revenue stability, perhaps especially in the context of

[26] Steve H. Hanke, "Pricing as a Conservation Tool: An Economist's Dream Come True," in David Holtz and Scott Sebastian, eds., *Municipal Water Systems* (Bloomington, IN: Indiana University Press, 1978), 221-246.

conservation. However, this particular approach has several significant drawbacks. First, it seems to run contrary to conventional marginal-cost pricing principles, which emphasize consideration of long-run costs. Second, the appearance of volume discounts might offend conservationists, who believe they encourage excessive or wasteful use of water. Third, although the rate sends a strong pricing signal to all customers, high prices for basic usage can cause substantial affordability problems for certain customers.

The permutations of cost-based pricing in conjunction with conservation pricing and programs are virtually endless. As discussed previously, nonlinear rate structures could be designed. For example, decreasing-block rates could be used during off-peak months and increasing-block rates could be used during peak months of usage. This would help utilities manage demand while avoiding some of the negative financial incentives for doing so. When implementing more complicated rate-design methods, however, the potential for greater uncertainty, higher administrative costs, and customer confusion must be considered.

Revenue Adjustments

A basic revenue-adjustment mechanism can be used to compensate utilities for revenues lost in conjunction with conservation and demand management. This mechanism may or may not include a cost-adjustment clause.

In the first instance, the utility can create a normalized account to reconcile forecast revenues with actual revenues while also implementing a cost-adjustment clause. In the case of energy, the cost-adjustment clauses give balancing-account treatment to fuel and purchased power costs. California and New York have revenue-adjustment mechanisms in place, while Maine and Washington adopted variations of this mechanism. For the water sector, comparable methods (perhaps a "WRAM") also have been proposed.[27] The advantages of this approach are that it: (1) removes disincentives associated with lost revenues; (2) explicitly

[27] Thomas W. Chesnutt, Anil Bamezai, Casey McSpadden, John Christianson, and W. Michael Hanemann, *Revenue Instability Induced by Conservation Rate Structures: An Empirical Investigation of Coping Strategies* (Denver, CO: American Water Works Association Research Foundation, 1994).

provides decoupling of revenues from sales; and (3) can include a complementary performance-based bonus.

Revenue-adjustment mechanisms can have varied effects with respect to the profitability of adding least-cost resources. When a utility is between rate cases, substituting a lower cost-resource for a higher-cost resource will increase profits. However, two factors work against this incentive. The first is the deterministic nature of the rate cycle. When the utility makes profitable substitutions, the gain from these substitutions will last only until the next general rate case. When such substitutions are contemplated late in the cycle, the earnings impact will be small. Second, a fuel-adjustment clause for electric utilities can lessen the incentive to reduce costs and bias the utility toward resource substitutions that are more fuel-intensive. Demand-management incentives, therefore, may be partially offset by other ratemaking practices.

Revenue adjustments have specific implications for utilities and ratepayers. First, they can be difficult for ratepayers to understand. Second, they can make utilities indifferent to conditions that could raise rates or degrade customer service. Third, they reduce "gaming" or "strategic manipulation," since decoupling removes the opportunities to exploit the difference between forecasted and actual costs between rate cases.

An alternative approach is to create a normalized account for reconciling forecast utility revenues with actual revenues without using a cost-adjustment clause. For electric utilities, variable power costs could be recovered at a fixed rate per killowatthour between rate cases. A comparable method could be used for water utilities. This alternative may be preferable because it gives the utility an incentive to acquire profitable least cost resources. The utility would increase earnings by substituting conservation resources for supply-side resources whenever the former were less costly.

Since the recovery of lost revenues would be implicit, verification of savings would not be a major issue. Therefore, the utility should not have incentives to manipulate the program strategically. This alternative, however, is relatively costly to implement because it requires a regular review of base sales. This cannot be done without a formal regulatory review, which can be contentious if prudence issues are raised.

Decoupling Sales

Proponents of demand-side activity have long argued that, from their perspective, a major problem with traditional ratebase/rate-of-return regulation is that utilities are motivated to increase sales of the traditional utility product in order to boost revenues and profits. With decoupling, revenue requirements and profits are determined independently of forecast sales. In other words, decoupling provides regulatory assurance that a utility will receive a predetermined level of revenues between rate cases, thereby removing the disincentive to promote conservation.[28] Decoupling is a more explicit and comprehensive method than basic revenue-adjustment mechanisms for accomplishing this task. Proponents of utility demand management often advocate decoupling.[29]

Some analysts favor decoupling over net-lost-revenue adjustments because: (1) decoupling removes all demand management incentives; (2) decoupling does not require evaluation; (3) utilities do not profit from demand-management programs that produce less-than-expected savings; and (4) utilities no longer have a disincentive to promote conservation-oriented policies, including rate structures, efficiency standards, and educational programs.[30]

One approach to decoupling is to provide utilities with revenues on a per-customer basis rather than a per-unit-sold basis. This approach links fluctuations in revenues to fluctuations in customers rather than fluctuation in how much utility product is purchased. It can be especially useful in states using historical test years to determine utility revenue requirements.[31] Under some circumstances, however, decoupling could compensate utilities for sales losses unrelated to conservation. Another variation of decoupling is the use of bill

[28] Robert J. Graniere and Anthony Cooley, *Decoupling and Public Utility Regulation* (Columbus, OH: The National Regulatory Research Institute, 1994), 1.

[29] Moskovitz, "Will Least-Cost Planning Work Without Significant Regulatory Reform?"

[30] Eric Hirst and Eric Blank, *Regulating as if Customers Matter: Utility Incentives to Affect Load Growth* (Boulder, CO: Land and Water Fund of the Rockies, 1993).

[31] See Nadel, Reid, and Wolcott, *Regulatory Incentives,* chapter 4.

indexing, which can be combined with other decoupling or lost-revenue mechanisms.[32] Bill indexing can be used to promote least-cost resource management and provide utilities with the added incentive of mitigating adverse cost impacts on average customer bills. However, indexing can introduce new forms of revenue uncertainty to utilities and price unpredictability to ratepayers.

In a recent NRRI report on decoupling, Graniere and Cooley explain how decoupling ensures that utilities earn--on average and over time--no more or less than approved revenue requirements.[33] It is possible to justify decoupling on the basis of preserving the environment and protecting the financial integrity of the utility. Decoupling also can benefit ratepayers under certain economic circumstances.[34] However, the authors conclude that decoupling can increase the cost of capital, operations, and capacity expansion, as well as increase costs to ratepayers who must compensate the utility for revenue losses associated with conservation. According to the report, another effect of decoupling is a tradeoff between revenue volatility for the utility and price volatility for customers. A possible remedy is statistical recoupling, which would sever the link between sales and earnings while still assigning to the utility risks associated with weather fluctuations, economic conditions, and customer growth (as happens under traditional regulation).[35]

Selling Services

A somewhat dramatic way to decouple sales from revenues and profits is to shift the focus from providing traditional utility outputs (kilowatthours or gallons, for example) to services. In the telecommunications sector, following divestiture and the progressive unbundling of telephone services, the service orientation of increasingly competitive

[32] Ibid., chapter 8.

[33] Graniere and Cooley, *Decoupling and Public Utility Regulation.*

[34] Specifically, decoupling benefits ratepayers in the short term when marginal costs exceed price and in the long term when the present value of price decreases are greater than the present value of price increases. The reverse also holds.

[35] Hirst and Blank, "Quantifying Regulatory Disincentives," 1103.

companies is perhaps the most mature of the utility industries. For example, in the electricity sector, the concept of energy-service charges reflects the idea that the demand for power (kilowatthours) is derived from the services that they produce for consumers, such as light and heat. Conservation produces energy services in the same way that power sales do. If a utility installs a conservation measure which leaves the consumer as comfortable as before, but at an annual savings of 100 kilowatthours, the measure can be thought of as producing energy services equivalent to the 100 kilowatthours saved. In theory, consumers would be willing to pay any amount up to the retail value of the saved energy for the conservation measure. Billing for conservation and generation resources on the basis of the energy services provided allows equal treatment of the two resource types from the utility's perspective.[36] Idaho regulators have made use of the energy service-charge concept. In theory, the concept is equally applicable to water utilities. The key advantages of the concept are that it: (1) inherently allows for demand-side cost recovery, (2) can be performance-based if the utility is allowed to keep its share of the savings achieved, (3) is measurable, and (4) minimizes costs to nonparticipants. However, this form of pricing can be difficult and costly to administer.

A related incentive mechanism would allow utilities to retain for shareholders all earnings from services provided in other utilities' service areas. Wisconsin has experimented with this type of approach for the electric industry. This alternative would provide each utility a double incentive to install cost-effective conservation measures. First, it would be able to increase shareholders returns directly by its work in other utilities' service areas. Second, it would face competition in its own service area from other utilities' service subsidiaries.

Alternative Regulation

Some demand-side incentive plans are part of the larger contemporary interest in regulatory reform, which eventually will affect energy and water utilities alike. Eliminating

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[36] Myron B. Katz, "Utility Conservation Incentives: Everyone Wins," *The Electricity Journal* 2 (October 1989): 26-35.

traditional ratebase/rate-of-return regulation altogether, replacing it with other types of ratepayer protection, would take away some of the incentives favoring supply-side over demand-side activities. Price caps and other regulatory alternatives under consideration might have this effect. With price-cap and related mechanisms, utilities are motivated to provide services in the most efficient way because keeping costs down enhances profitability. When profits are not dependent on sales or constrained by regulators, demand-side and supply-side activities can compete on equal footing.

A variation of the price-cap approach under consideration is the use of long-term contracts. Under a long-term fixed price contract, the utility enters into a long-term agreement with the commission by which it agrees to supply all of the energy needed in a service territory at specified terms, conditions, and rates. This alternative was proposed in Oregon for use in the electricity sector.

Deregulating certain kinds of profits through price caps, contracts, or other systems can make demand-side strategies more attractive. For example, deregulating profits from wholesale sales can be used to motivate some utilities to invest on the demand side in order to free up supply-side resources for the wholesale market. Shareholders could be allocated a prespecified percentage of the levelized margin from long-term (firm or nonfirm) wholesale sales made possible through demand-side investments. Since margins from sales are defined as revenues less the cost of supply, the utility should be motivated to acquire resources at minimum cost.

Performance-Motivation Mechanisms

Expense or Ratebase Markup

This incentive would motivate utilities to invest on the demand side by marking-up the value of expenses or investments. By marking up the expenditure or investment by a percentage factor (for example, 110 percent of the actual amount), utility revenues and profits are enhanced. In the case of ratebased expenditures, this incentive is somewhat comparable to an acquisition adjustment used to motivate larger, financially viable water utilities to assume ownership and operation of smaller, nonviable systems. By entering into the ratebase a value exceeding the book value of an asset, both cash flow and profitability are enhanced. Mark-ups provide clear incentives to utilities and are relatively easy for regulators to administer. Determining the appropriate level of the demand management markup can be very problematic. The key problem with the approach, of course, is that it runs directly contrary to traditional cost-of-service ratemaking principles. It also can give the appearance that utilities are somehow "getting away with something." Critics of incentives often are especially critical of the markup approach.

Rate-of-Return Adjustments

Perhaps the most powerful tool available to regulators under traditional economic regulation is the ability to adjust the rate of return, which defines the earnings capability of the regulated utility. Rate-of-return adjustments can be used, and are used, in a variety of contexts to reward utilities for desirable performance and punish them for poor performance. Adjustments can be made using qualitative or quantitative evaluation criteria. With regard to demand-side incentive, rate-of-return adjustments take three general forms: (1) adjustments based on the investment in demand-side resources, (2) adjustments based on achieved savings, and (3) adjustments based on customer bills.

Under the first type, the utility's authorized rate of return on demand-side investment is adjusted according to amounts spent on cost-effective demand-side measures. In effect, a premium rate of return is allowed for that portion of the ratebase devoted to the demand side. California and Washington, for example, have allowed an additional return on equity for demand-side investments in the electricity sector. According to this approach, acquiring least-cost demand-side options would be the utility's most profitable course of action. However, with cost recovery assured, a return adjustment based on amounts spent on demand-side activities would make all conservation investments profitable. Because higher cost measures will yield more profits, this incentive may not be consistent with least-cost planning principles. Implementing this mechanism requires numerous decisions about the appropriate level of the adjustment, base values to which adjustments are made, and so on.

An alternative approach is to adjust a utility's authorized rate of return on conservation investments, based on the level of cost-effective demand management savings achieved. New York and Massachusetts implemented this method for electric utilities. The incentive can be structured in a number of ways, based on several considerations. First, the adjustment can be based on a predetermined savings level or a sliding scale with both rewards and penalties possible. Second, the adjustment could be made to the utility's return on equity or to its overall rate of return. Third, the adjustment can be applied to the utility's entire ratebase or simply to the net investment in conservation. Obviously, applying the adjustment to the total ratebase would have a larger impact, and place both the ratepayers and the utility at greater risk should a scaling mechanism be implemented.

Finally, rates of return can be adjusted based on customer bills. In this approach, the utility's return on equity is adjusted in accordance with the difference between its average customer bills and their forecast value. In this mechanism, an index would be constructed based on average bills within each customer class. A forecast of average bills would be made in conjunction with the utility's rate filing, and the utility would earn an additional rate of return on equity based on the amount by which the actual value of that index falls short of its forecast value. Overshooting the predicted value, for all customer classes or individual classes, would result in a reduction in the allowed return on equity. In this approach, the utility would have an incentive to acquire *cost-effective* resources, but not necessarily to add *least-cost* resources. A resource addition that puts upward pressure on total bills in the short term, but lowers bills in the long term, would be perceived as unprofitable.

The advantages of the return-on-equity adjustment are that it: (1) inherently provides a familiar and positive incentive to which utilities can respond; (2) can be performance-based by tying the incentive to savings; and (3) tends to minimize program costs if the incentive is tied to net resource savings.

However, some practical difficulties with return adjustments are worth noting. In practice, determining the adjusted return amount could be difficult, and perceived as arbitrary, since rates cannot be calculated with certainty. Setting a return on equity in a rate case, for example, usually involves each party developing its own estimate of the cost of capital followed by a round of litigation or negotiation before a rate is stipulated for the purpose of establishing revenue requirements. These elements would likely arise in proceedings concerning incentives-oriented return adjustments. Furthermore, because a utility does not file for a rate case every year, a return adjustment would suffer from the lack of precision associated with regulatory lag.

Shared Savings

This incentive allocates to utility shareholders a predefined portion of any savings in overall system costs attributable to demand-side activities. The use of shared savings is one of the more common types of incentives among states that offer shareholder incentives for demand-side activity. Many states favor a shared-savings approach for electric utilities; it is too early to gauge the level of interest in applying the approach to water utilities. This probably reflects the fact incentives funded out of savings are more likely to win ratepayer support than incentives funded out of incremental charges to ratepayers. It also is among the mechanisms widely accepted by utility managers. In order to carry out a shared-savings alternative, the following information is needed: an incremental resource cost standard; the percentage of savings to allocate to shareholders; and a lost-revenue recovery mechanism. The incremental cost standard could be a revised avoided cost. The standard, administratively-determined, avoided-cost estimate would be adjusted to reflect a cost stream based on alternatives other than demand-side resource . Because the lost revenues associated with acquisition of conservation resources can be significantly larger than the potential difference between avoided cost and the cost of the incremental resource, a lost revenue recovery mechanism is still needed.

The characteristics of the shared-savings mechanism are: it is performance-based because it inherently rewards utility performance in accomplishing demand-side objectives; it is understandable; it can be difficult to administer because of the complex measurements and calculations that are required; it is somewhat predictable especially when engineering estimates are used; it minimizes utility or societal costs (depending on the formula which is used); and it can present a cream-skimming problem in the short-term.

A variation of shared savings is the concept of conservation transfer sales, by which utility customers are allowed to sell, or participate in a joint sale with the utility, power made available by installing demand-side measures. A conservation transfer sale has been arranged between three public utility districts and Puget Sound Power & Light in Washington, with the

Bonneville Power Administration as an intermediary.[37] Since the margin from sales is defined as revenues minus cost of supply, the customer and the utility have the incentive under this policy alternative to acquire resources at minimum cost; the utility also has the potential to increase profits through least-cost options, depending on how the margin is split between the utility and its customers.

Bounty or Unit Bonuses

Under this frequently proposed incentive system, the utility could receive a payment for each unit (a kilowatthour of electricity or a gallon of water) of verified conservation achieved through a specified increase in allowed revenues. The payment would include program cost recovery. The mechanism provides a positive incentive that is performance-based and defined as a function of the amount of demand-side savings. It is easy to implement, oversee, and understand. However, it does not encourage cost effectiveness, and can present a cream-skimming problem in the short-term. That is, utilities may be more motivated to implement measures that can yield a quick bonus rather than engage in long-term conservation or demand-management programs.

Management Rewards

A provocative variation on the theme of bonuses is to provide rewards to successful utility managers instead of all utility shareholders.[38] The premise of the mechanism is that reductions in sales are not necessarily a threat to the earnings potential of a utility, so rewarding shareholders for a utility's demand management efforts may be unnecessary. Another implication is that utility managers should not have to demonstrate a record of sales growth to be "successful." Bonuses paid to key officers and managers for achieving specified levels of cost-effective demand-side acquisition would be included in utility rates. According to this perspective, key management should have a personal stake in meeting least-cost

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[37] Ibid.

[38] Kihm, "Why Utility Stockholders Don't Need Financial Incentives," 28-35. See also, Nadel, Reid, and Wolcott, eds., "Regulatory Incentives," chapter 11.

planning goals and management bonuses could be an effective method of encouraging demand-side activity at a minimum cost consistent with the utility's least-cost plan. Arguably, rewarding managers for helping to achieve conservation and demand management goals would be less expensive than rewarding all utility shareholders through return-on-equity adjustments and other methods that affect overall profitability.

Evaluating Incentive Alternatives

Evaluating and comparing alternative incentive systems can be tricky, especially given the limited experience in their actual implementation.[39] An attempt to summarize the ups and downs of the various approaches appears in table 4-3. Since each mechanism reflects or addresses a specific regulatory issue, direct comparisons among techniques are not made. A general set of evaluation criteria for evaluating the alternatives can be summarized as follows: (1) whether and how the incentive affects the level of demand-side investments, (2) whether the incentive enhances the quality of service provided to customers, (3) whether the incentive addresses the financial disincentives associated with acquiring demand-side resources, (4) the ability of the incentive to promote cost-minimizing behavior by the utility in the short and long terms, and (5) perceptions of utility managers and regulators about the incentive and the practicality of its implementation. In considering implementing any approach, all of these matters are appropriately investigated.

In a recent study by the NRRI, the authors concluded that revenue-adjustment and decoupling mechanisms alone do not provide utilities with strong incentives to engage in demand-side activities.[40] Shared-savings systems, which are favored by a number of state commissions, seem to provide the extra motivation needed by utilities, while also providing assurances that utilities will not be rewarded unless measurable benefits from demand-side

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[39] Oregon Public Utility Commission, *Investigation Into Electric Utility Incentives For Acquisition of Conservation Resources* (July 1991).

[40] Graniere, Hegazy, and Cooley, "Demand-Side Management Policies," 39-52.

TABLE 4-3
EVALUATING ALTERNATIVE REGULATORY INCENTIVES

General type of incentive	Specific type of incentive	Key Advantages	Key Disadvantages
Cost-recovery mechanisms	Deferral to rate case	Conventional standards of evaluation can be applied.	Regulatory lag persists. May not provide an adequate incentive.
	Flow through costs to rates	Reduces regulatory lag and improves utility cash flow.	Sufficient regulatory review may be difficult.
	Modified cost accounting	Uses known accounting techniques. Regulators can review costs and methods.	Can conflict with cost recovery for nonconservation investments.
	Ratebase recovery	Reduces supply-side bias. Does require substantial change in the regulatory process.	Conservation and demand-side investments may not always be significantly large. Can provide incentive to gold-plate demand-side investments.
	Special-purpose rates	Can be effective in allocating costs based on cost-of-service principles.	Can be met with resistance or difficult to implement.
Lost-revenue mechanisms	Cost-based pricing	Emphasizes economic efficiency and can reduce the incentive to sell more product.	Prices can never reflect true marginal costs and proxy methods must be developed.
	Revenue adjustments	Reduces or removes the incentive to sell more product. Can be used with other decoupling or performance incentives.	Difficult and costly to administer. May aggravate utility customers. Can introduce perverse incentives.
	Decoupling sales	Can remove incentive to sell more product. Can be consistent with some versions of regulatory reform.	Can increase rates, total customer bills, and price instability. Does not necessarily lead to least-cost solutions. Difficult to administer.

TABLE 4-3 (continued)			
General type of incentive	Specific type of incentive	Key Advantages	Key Disadvantages
Lost-revenue mechanisms (continued)	Selling services	Substantially alters supply-side bias. Promotes a targeted service orientation for the industry.	Difficult to administer. Can expand utility activities beyond traditional and familiar boundaries.
	Alternative regulation	Places incentives in the larger context of regulatory reform and the need to improve performance signals for all utility operations. Easier to administer in the long term.	Difficult to administer in the short term. Requires the establishment of legitimate and accepted performance indicators.
Performance-motivation mechanisms	Expense or ratebase markup	Provides clear cost recovery. Relatively simple and effective in making demand-side investments more attractive.	May not encourage cost-minimizing behavior. Can be perceived as arbitrary.
	Rate-of-return adjustments	Relatively simple and effective in making demand-side investments more attractive. Can be performance-based.	Can be perceived as arbitrary. Rewarding all investors can be costly.
	Shared savings	Provides room for agreement between utilities and regulators. Promotes cost minimization. Prevents excessive utility earnings.	More complex and difficult to implement, particularly specification of the sharing methodology and monitoring.
	Bounty or unit bonuses	Explicitly links rewards to performance goals. More predictable than other forms.	Appears to reward utilities. May not encourage cost-minimizing behavior.
	Management rewards	Relatively easy to implement and possibly more cost-effective than rewarding or penalizing all shareholders	Unconventional and may offend ratepayers.

Source: Authors' construct.

programs can be demonstrated. Thus, despite the clamor for recovering lost revenues, the role of performance-motivation mechanisms should not be ignored by policymakers seeking to promote conservation and demand management. Linking incentives to actual performance in achieving goals also seems inherently sensible.

Another recent analysis provides a useful summary of evaluation issues associated with incentives for conservation and demand management, as reported in table 4-4. In this evaluation, a comparison of the key areas--cost recovery, lost revenues, and performance motivation--is considered for different types of efficiency programs (including supply-side efficiency).[41] Incentives may be necessary to "jump start" utility activity on the demand side, particularly with respect to actually investing in efficiency. However, incentives may not be justifiable in the long term. When it becomes easier to distinguish good demand-side performance from bad, special incentives outside of other utility performance evaluation systems may not be needed. The appropriate objective for regulators, according to Chernick and Plunkett, "is not to make [demand management] preferable to supply, but to ensure that utilities have incentives to pursue the most cost-effective resource plan."[42]

The challenge for research analysts in the field of regulation is to identify incentives that are both appropriate and effective in meeting resource planning objectives. Establishing the causal connection between incentives and utility behavior and performance is extremely difficult. Even if the linkage is established, how can policymakers know they are providing the right level of motivation--not too much and not too little? Too little incentive can undermine conservation efficiency goals; too much can translate into excessive profits. Either way, ratepayers pay the price. Miscalculated incentives, no matter how well-intentioned, can produce perverse effects familiar to regulators (such as cream skimming, free-ridership, and other forms of inefficiency). Some incentive systems also have the appearance of providing preapproval for specific technologies or the regulatory treatment of certain utility costs. From a regulatory perspective, prepproval may not be desirable in the context of prudence considerations. Other types of incentives appear simply to reward utilities for what they should be doing anyhow--operating in the public's interest.

Several general implications can be derived from these discussions. A variety of incentives are available to stimulate utility investment in demand-side resources. For the

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[41] Paul Chernick and John Plunkett, *From Here to Efficiency: Securing Demand-Management Resources* (Volume 3: Cost Recovery) (Harrisburg, PA: Pennsylvania Energy Office, 1993), 129.

[42] Ibid, 131.

TABLE 4-4
SUMMARY EVALUATION OF INCENTIVE ISSUES BY PROGRAM TYPE FOR ELECTRIC UTILITIES

Evaluation Issues	Program Type					
	Efficiency programs		Load management	Promotional	Rate design	Supply-side efficiency
	Investment	Information				
General						
Extensive utility experience?	No	Yes	Yes	Yes	Yes	Yes
Results readily measurable?	Yes	No	Yes	Sometimes	Sometimes	Yes
Cost-Recovery Issues						
Significant costs?	Yes	No	Yes	Sometimes	No	Sometimes
Special treatment necessary? (a)	Yes	No	Not usually	No	Not usually	No (capitalized)
Lost-Revenue Issues						
Revenues lost?	Yes	Maybe	Small	Negative	Sometimes	No
Special recovery justified? (b)	Yes	No	No	No	Rarely (set in rate case)	No
Performance-Motivation Issues						
Generally good for ratepayers?	Yes	Yes	Sometimes	Sometimes	Yes	Yes
Short-term benefits for shareholders?	No	No	Often	Yes	Sometimes	No
Incentives required? (c)	Yes	No	No	No	No	No

Source: Adapted from Paul Chernick and John Plunkett, *From Here to Efficiency: Securing Demand-Management Resources* (Volume 3: Cost Recovery) (Harrisburg, PA: Pennsylvania Energy Office, 1993), 130.

(a) Special treatment is necessary if the utility lacks extensive experience and will bear significant costs.
(b) Special recovery is justified if the utility lacks extensive experience, results are readily measurable, and revenues are lost.
(c) Incentives are necessary if the utility lacks extensive experience, results are readily measurable, ratepayers will generally benefit from the programs, and the shareholders will receive no short-term benefits from the programs.

energy sector, no approach has emerged as the singular favorite of the commissions. No singular solution will apply to the water sector as well. Also significant is the finding that perceptions of utility managers and regulators about incentives are generally consistent. Naturally, utilities may be more concerned about compensation and regulators may be more concerned about protecting ratepayers from being overly or unnecessarily rewarded.

This review was based mainly on the literature and experience with incentives in the electricity sector. Yet the debate over the merits of demand management, particularly in the context of increasing competition, rages on. Noted regulatory economist Paul Joskow provides a formidable critique of commission-mandated demand management by electric utilities and, by implication, the regulatory incentives for programs he considers uneconomic.[43] Joskow believes that demand-management programs cost considerably more dollars and save considerably less energy than proponents of these efforts suggest. Proponents of conservation should be prepared to defend the merits of conservation and the merits of conservation-oriented incentives as well. This is a time consuming but necessary investment of analytical resources in order to assure that the best possible results are achieved for utilities, ratepayers, society, and the environment.

Finally, it is appropriate to contemplate the role of incentives in the larger context of regulatory reform and potentially dramatic changes in the regulatory environment. Incentives could play an extremely important role in regulatory models that reward utilities based on performance measures rather than according to the traditional metric of ratebase/rate-of-return regulation.

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[43] Paul L. Joskow and Donald B. Marron, "What Does a Negawatt Really Cost? Further Thoughts and Evidence," *The Electricity Journal* 6., no. 6 (July 1993): 14-26. *The Electricity Journal* is a good source on the running debate about the merits of utility-sponsored demand management. See also, Paul Joskow and Donald B. Marron, "What Does Utility-Subsidized Energy Efficiency Really Cost," *Science* 260 (April 16, 1993): 281.

CHAPTER 5

SURVEY OF COMMISSION PRACTICES IN WATER CONSERVATION AND CONSERVATION PRICING

Currently, forty-six state public utility commissions regulate prices and other economic activities of water utilities (and wastewater utilities) that meet the criteria for economic regulation, although the scope of jurisdiction varies from state to state.[1] Conservation and conservation pricing for water utilities are making their way onto the regulatory policy agenda for the state commissions, much in the same way these issues became important for the energy sector.

Economic regulation is premised on the belief that utilities provide service vested with the public interest and that state oversight of utility monopolies is necessary to balance the utility and consumer interests. Economic regulation substitutes for public ownership, on the one hand, and potentially ruinous competition, on the other. Commission regulation plays a considerable role in decisionmaking by jurisdictional utilities. Regulatory treatment of utility expenses determines whether utility shareholders or ratepayers will cover certain expenses or capital costs. The regulatory environment, meaning perceptions of regulators by financial interests, can affect the utility's cost of capital. Finally, the economic regulation of public utilities can provide positive or negative performance incentives that mold utility performance to fit a specific regulatory or public policy concern. Commissions can adjust returns on equity and other elements of the revenue requirement determination to reward or penalize utilities.

[1] Water utilities are not regulated by the regulatory commissions in Georgia, Minnesota, North Dakota, South Dakota, and Washington, D.C. Nebraska will begin regulating investor-owned water utilities in 1994. The reason for no economic regulation in some states appears mainly to be the absence of substantial investor ownership of water systems. Also, easily accessible water supplies and the threat of bypass through self-supply provides a check on the potential abuses of monopoly power.

These regulatory powers certainly are relevant in the context of both energy and water conservation. As seen throughout this report, proponents of utility-sponsored conservation and public utilities themselves view traditional economic regulation as a barrier because it reinforces the linkage between sales, revenues, and earnings. The retrospective and reactive nature of traditional regulation adds to the utility's uncertainty about future cost recovery. As in the case of electricity, water conservation advocates and some regulated water utilities have begun to ask rate regulators to consider alternative incentive mechanisms for cost recovery, lost revenues, and performance motivation. Investor-owned water utilities, in particular, are not expected to embrace the idea of conservation as a corporate goal without a profit incentive.[2] Nonprofit or government-owned utilities also may need specific inducements to engage in extensive water conservation efforts. Some of the potential inducements for water utility involvement in water conservation, such as relaxed permitting requirements for future source development based on conservation practices, are outside the purview of the state commissions.

Yet, this is still relatively new territory for many state public utility commissions. Commission experience in the area of energy conservation provides no assurance that the same policies and procedures will be applied to the water sector. Also, regulators correctly want to be assured that conservation is cost-effective and beneficial to ratepayers before they provide incentives designed to change utility planning and operating behaviors. Like other utility activities, conservation activities involve a degree of regulatory risk. This chapter reports a detailed survey of commission staff on regulatory practices in the areas of water conservation and conservation pricing, followed by a general discussion of the application of regulatory incentives for conservation to the water industry. The detailed state-by-state results of the survey appear in the appendix of this report.

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[2] Amy Vickers and Edward J. Markus, "Creating Economic Incentives for Conservation," *American Water Works Association Journal* 84, no. 10 (October 1992): 42-45.

Survey of the State Commissions on Water Conservation

As part of this study, staff members at forty-five state public utility commissions with jurisdiction over water utilities were surveyed. Nebraska is the only state excluded from the survey, because its jurisdiction for water utilities was established very recently (in the middle of 1994). The survey, which was conducted in conjunction with a study of the American Water Works Association Research Foundation (AWWARF), is a highly detailed accounting of commission activity in the area of water conservation. Investor-owned water utilities, in particular, need to be aware of commission policies affecting them in the area of conservation. However, many of the issues central to economic regulation are generic to all utilities, regardless of ownership structure.

The survey is comprehensive with respect to current commission regulation of water utilities. However, no attempt is made to explain variations in the data with exogenous variables. Attitudinal questions are not emphasized because staff member attitudes, however insightful, are not necessarily translated into commission policy. In other words, even if staff members favor a particular approach, actual policy is not established until more formal commission action is taken. Thus, the survey deals primarily with actual commission experience in water conservation. Although comprehensive, the results should not be overgeneralized. Some commissions regulate hundreds of water utilities and the survey data do not fully capture the many variations in policies and procedures within jurisdictions.

The key findings of the NRRI survey on water conservation issues and practices can be summarized as follows:

- The state public utility commissions have somewhat limited experience in water conservation policymaking and in special regulatory treatment of conservation-related expenditures.

- Experience in implementing energy conservation policies does not predispose a commission to implement water conservation policies; conservation activities by water utilities must be independently justified.

- Commissions appear to be approving a variety of water rate structures, including conservation-oriented rates, but they do not as yet tend to approve marginal-cost pricing for water utilities.

- Regulatory treatment of conservation related expenditures does not appear to vary according to whether the program was initiated by statute, regulation, or by the utility itself.

- Most water conservation program costs are expensed (rather than capitalized) and recovered through the normal course of ratemaking.

- Commissions that require water utilities to implement conservation strategies will provide appropriate regulatory treatment of related expenses and have a variety of tools at their disposal for doing so.

- Commission staff members appear to have well-formed views about water conservation and, as expected, are particularly aware of utility revenue stability and related economic impacts that occur with implementation.

Survey Results

Table 5-1 summarizes the results of the NRRI survey to the commissions. The data are tabulated according to the number of commissions responding, out of a possible forty-five commissions (excluding Nebraska). For some of the questions, commission staff members could indicate more than one response, meaning that totals within question areas can exceed forty-five. The specific findings of the survey, drawn from table 5-1 and the detailed state-by-state data, are summarized below.

Commission Jurisdiction and Policies

Forty-six states regulate investor-owned water utilities (including Nebraska). Eleven state commissions have some jurisdiction for municipal water systems; seven regulate water districts; five regulate cooperatives; five regulate homeowners' associations; and six have jurisdiction over systems otherwise organized or defined (such as private, not-for-profit, or association nonprofit systems). These classifications must be used with caution to the extent

TABLE 5-1
GENERAL SUMMARY OF NRRI SURVEY OF COMMISSIONS ON WATER CONSERVATION PRICING AND REVENUE RECOVERY ISSUES

Survey Question	N
Commission Jurisdiction for Water Utilities	
Investor-owned utilities [4,119 utilities]	45
Municipalities [1,713 utilities]	11
Water districts [1,442 utilities]	9
Cooperatives [1,057 utilities]	5
Homeowners' associations [64 utilities]	5
Other [610 utilities]	6
Commission Policies on Water Conservation and Planning	
Does the commission have a general water conservation policy?	18
Does the commission have a conservation pricing policy?	11
Has the commission required a least-cost or integrated resource plan?	5
Have utilities voluntarily prepared a least-cost or integrated resource plan?	2
Commission Policies on Marginal-Cost Pricing	
Commissions that encourage marginal-cost pricing for water utilities	2
Commissions that discourage marginal-cost pricing for water utilities	9
Commissions that have approved marginal-cost pricing for nonwater utilities	25
Water Utility Rate Structures in Use	
Flat charges	39
Uniform rates	36
Decreasing-block rates	29
Increasing-block rates	18
Seasonal rates	15
Excess-use rates	6
Other	8

TABLE 5-1 (continued)	
Survey Question	N
Water Utility Rates Structures Approved for Conservation Purposes	
Increasing-block rates	11
Uniform rates	8
Seasonal rates	3
Excess-use rates	2
Other	2
Special Rate Design Features Approved for Jurisdictional Water Utilities	
Penalty charges	16
Off-peak discounts	2
Lifeline rates	2
Daily-peak pricing	1
Billing Cycles in Use	
Monthly	43
Bimonthly	23
Quarterly	30
Semiannually	14
Annually	20
Mixed or Other	11
Commission Approval of Changes in Water Utility Billing Cycles	
Has a billing cycle change been approved for conservation or other purposes?	9
Has a billing cycle change been rejected for conservation or other purposes?	3
Potential Benefits Associated with Conservation Rates Cited by Commission Staff	
Promoting efficient use of water resources	21
Discouraging discretionary or excessive use	19
Preserving water resources	15
Avoiding, reducing, or forestalling capacity expansion and expenditures	14
Rewarding efficient water users	8
Avoiding or reducing social or environmental costs	6
Shifting water demand to desired periods of the day, month, or year	3
Other	6

TABLE 5-1 (continued)

Survey Question	N
Potential Problems Associated with Conservation Rates Cited by Commission Staff	
Potential instability of revenues	16
Potential inconsistency with "cost-of-service" principles	15
Difficulties in predicting customer demand and utility revenues	14
Difficulties in applying conservation rates across all user classes	10
Possible adverse rate impacts on various classes of customers	10
Practical difficulties associated with marginal-cost pricing	6
Legal difficulties in some states with conservation rate methodologies	2
Other	3
Policies to Address Potential Revenue Instability Associated with Conservation Pricing	
Service or other special charges	6
Rate structure modifications	6
Adjustments in later rate cases	4
Phase-in plans	3
Revenue stabilization reserves	1
Automatic annual surcharges	1
Other automatic adjustment clauses	2
Other	2
Policies Implemented to Address Surplus or Deficit Revenues Associated with Conservation Pricing	
Rate structure modifications	4
Balancing accounts	1
Automatic surcharge the following year	1
Automatic adjustment to ratebase	1
Surcharge or other adjustments	1
Customer refunds	0
Other automatic adjustment clauses	2
Other	2

TABLE 5-1 (continued)	
Survey Question	N
Conservation Measures Implemented by Jurisdictional Water Utilities	
Leak detection and repairs	28
Meter testing and repairs	27
Public education (labor and materials)	18
Water audits performed by the utility	14
Residential retrofit kits (purchase cost)	12
Followup surveys and pilot studies	11
Developing a conservation rate structure	11
Retrofit program (labor and administration)	8
Developing a demand management program	3
Timing of Regulatory Treatment for Conservation Expenses	
Rate case following program implementation	16
Rate case prior to program implementation	6
Rate case following review of program results	4
Special rate case proceeding	4
Annual pass through adjustments	1
Not specified	7
Regulatory Incentives and Disincentives for Water Conservation	
Are demand management incentives provided to water utilities?	4
Has the commission ever disallowed a water conservation expenditure?	2
Have specific costs been approved for one water utility and not another?	1
Justification for utility conservation programs specified by staff	17
Is further justification required if the conservation program is not mandated?	6

Source: *1993/1994 NRRI Survey on Commission Regulation of Water Utilities.* For each individual question, the maximum number of responses is forty-five, because forty-five state commissions were surveyed. Nebraska is the only state excluded from the survey, because its jurisdiction for water utilities was established very recently. See the appendix for the detailed state-by-state results.

that some states may classify a regulated system as an investor-owned utility, even though it has characteristics of a nonprofit organization (such as a homeowners' association).

As noted above, the state public utility commissions have authority over a variety of community water systems. Most of the regulated utilities are investor-owned (4,119 utilities). However, jurisdiction in some states also extends to a variety of other water utilities with public or quasi-public (nonprofit) ownership structures. Although jurisdiction for investor-owned systems tends to be comprehensive, the degree of economic regulatory influence over the other kinds of systems varies substantially from state to state. Regardless of ownership structure, many of the water utilities regulated by the state commissions are small (or very small) in size.

Of the forty-five commissions surveyed, eighteen reported that they have a general water conservation policy. These policies can be manifested as general statements of policy, statutes, rules and regulations, case-by-case findings by the commissions, or a combination of approaches. A comprehensive conservation policy statement developed by the Pennsylvania commission is provided in table 5-2. New York's policy targets larger systems with a demonstrated need for conservation. Some states (including Kentucky, Michigan, and Washington) have conservation policies explicitly addressing water waste. Only eleven commissions reported that they specifically have conservation pricing policies, which were predominantly of the case-by-case variety. Some states, such as Utah, address conservation ratemaking on a case-by-case basis; others are more explicit in their policies are becoming more explicit. The commissions in Massachusetts and Pennsylvania, for example, are working to eliminate the minimum water-use allowance provided in some conventional water rate structures. New Jersey staff noted that, in addition to substantial state involvement in water conservation, the interstate Delaware River Basin Commission has enacted rules and regulations related to conservation pricing for water purveyors located in the basin area.[3]

As noted, the basis for some commission policies regarding water conservation is statutory. A substantial amount of state law deals with drought and emergency situations. The Ohio administrative code, for example, contains provisions for the use of water

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[3] The directives of the Delaware River Basin Commission can have the effect of preempting some of the states in certain areas of water pricing.

TABLE 5-2
PENNSYLVANIA PUBLIC UTILITY COMMISSION
POLICY STATEMENT ON WATER CONSERVATION

§ 65.20. Water conservation measures—statement of policy.

In rate proceedings of water utilities, the Pennsylvania Public Utility Commission (Commission) intends to examine specific factors regarding the action of failure to act to encourage cost-effective conservation by their customers. Specifically, the Commission will review utilities' efforts to meet the criteria in this section when determining just and reasonable rates and may consider those efforts in other proceedings instituted by the Commission.

(1) *Education.* At least once a year a utility should provide each customer with a brochure or similar type of material which discusses efficient water-use practices, the expensive waste caused by leaking plumbing fixtures, the availability of retrofitting plumbing devices to curtail unnecessary water use, and the possible savings on water and fuel bills that could ensue when these conservation methods are implemented.

(2) *Water audit for large users.* On an annual basis each large, nonresidential customer, such as a college, motel or health club, should receive, or be directed to the availability of the large water user audit procedure developed by the Department of Environmental Resources, or other, similar format, via a printed message on or with their bill.

(3) *Efficient plumbing fixtures.* Customers should be notified annually that water-saving plumbing fixtures should be installed in new construction or when remodelling. If construction or renovations are not scheduled, customers should be encouraged to retrofit existing plumbing fixtures.

(4) *Unaccounted-for water.* Levels of unaccounted-for water should be kept within reasonable amounts. Levels above 20% have been considered by the Commission to be excessive.

(5) *Leak detection.* A system of leak detection should be utilized on a regular basis, with leaks being repaired as expeditiously and economically as possible.

(6) *Metering.* A comprehensive metering program should be in place which includes metering sources of supply, metering service to customers—aside from formally granted interim exemptions, and the regular testing and maintenance of meters in service.

(7) *Conservation plan.* The mandatory conservation contingency plan should be properly filed within each utility's tariff.

Source: Annex A: Title 52. Public Utilities Part I. Public Utility Commission Subpart C. Fixed Utility Service. Chapter 65. Water Service, *Pennsylvania Bulletin* 18 no. 28 (July 9, 1988).

restrictions to assure adequate supplies for public fire protection and basic human needs when necessitated by conditions beyond the control of the water utility.[4] A report on the use of restrictions must be filed with the public utility commission, which can suspend their use if the restrictions are found to be unreasonable or discriminatory. The statute also provides for disconnecting customers who do not comply with the restrictions.

Five commissions (Arizona, California, Kentucky, Nevada, and Ohio) reported that they had required at least one jurisdictional water utility to prepare a least-cost or integrated resource plan. Nationally, only a handful of regulated water utilities have actually been asked to prepare least-cost plans for the commissions, even though some (such as Kansas) reported having such policies for energy utilities. New Hampshire, New Mexico, and Ohio were among the states reportedly evaluating least-cost or integrated resource planning for water utilities at the time of the survey. Others, including Texas and Washington, were considering water conservation policies. Staff in two states (Connecticut and Kentucky) reported that jurisdictional water utilities have voluntarily prepared least-cost plans. In Washington State, comprehensive utility plans filed with the Department of Health include conservation goals. In Wisconsin, despite abundant water supplies, staff are considering the potential role of water conservation as part of the agency's strategic planning process.

Only two states (Massachusetts and New York) reported that marginal-cost pricing for water utilities was encouraged. Nine state commissions reportedly discouraged marginal-cost pricing for the water sector and the rest were neutral on the subject. By comparison, according to staff, twenty-five commissions have approved marginal-cost pricing for nonwater utilities.

Water Conservation and Rate Design

As noted in chapter 1, commission adaptation of conservation ratemaking from energy utilities to water utilities has been met with some degree of skepticism. The California Water Association expressed strong concerns in the early 1980s about the apparent trend of simply

[4] Ohio Administrative Code Section 4901:1-15-36.

transferring conservation-oriented rate structures from the energy to the water sector.[5] Commission staff, particularly in the midwestern region of the country, also have expressed very legitimate concerns about the potential effects of changing conventional utility rate structures.[6] Studies of trends in water pricing frequently note the persistent use of decreasing-block rate structures in the midwest region of the country, despite national trends toward rate structures that appear to be more conservation-oriented.[7]

Commission staff were surveyed in detail about water utility rate structures in use, with particular attention to rate structures approved for conservation purposes. A variety of rate structures can be found in any given state, so the state-by-state results cannot be overgeneralized. The majority of the states have some utilities using flat charges (where the water bill does not vary with usage) or uniform rates (where the water bill varies with usage but the unit charge does not). Flat charges often are used by very small systems without meters. For systems that meter, the prevailing rate structure seems to be a two-part method combining a basic facilities charge and a usage charge.

Utilities in twenty-nine states are using decreasing-block rates. However, based on staff comments, the commissions seem to be encouraging both metering and usage-sensitive pricing. Pennsylvania, for example, has a universal metering policy. Florida recognizes a uniform rate as a conservation rate. New Jersey has explicitly encouraged the use of uniform rates and the elimination of discounts for large-volume customers. In terms of conservation-oriented rates, increasing-block rates are used in fifteen states, seasonal rates in six states, and excess-use rates in six states. Many variations in ratemaking techniques can be found. In

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[5] Rate Design Committee of the California Water Association, *Water Utility Rate Design,* a report presented to the California Public Utilities Commission (Sacramento, CA: California Water Association, 1981).

[6] Thomas R. Stack, "Potential Consequences of Abandoning Cost-Based Declining-Block Rates," in *Proceedings of the Biennial Regulatory Information Conference* (Columbus, OH: The National Regulatory Research Institute, 1992).

[7] Ellen M. Duke and Angela C. Montoya, "Trends in Water Pricing: Results of Ernst & Young's National Rate Survey," *Journal American Water Works Association* 85 (May 1993): 55-61.

Wisconsin, for example, flat charges vary seasonally. The state of Arizona has statutorily designated conservation areas, in which excess-use rates are used for larger systems. Also in the category of excess-use rates, the Vermont commission has approved swimming-pool rates.

When specifically asked about their approval of rate structures for conservation purposes, eight commissions reportedly approved uniform rates and eleven approved increasing-block rates. Pennsylvania, according to staff, is among the commissions that do not believe that increasing-block rates produce conservation results. Three state commissions (Idaho, New Mexico, and New York) have approved seasonal rates and two (Arizona and California) have approved excess-use rates.

An approach similar to "feebates" (discussed briefly in chapter 3) was approved by the Arizona Corporation Commission and implemented by the Sun City Water Company in 1992.[8] Customers using water above their baseline receive a 25 percent surcharge, while customers using water below their baseline receive a 25 percent discount. The proponent of surcharge/discount or feebate pricing, however, considered the approved methodology to be flawed because baseline entitlements were determined according to customers' ongoing use (as compared to independent factors), which introduces potential bias and inefficiency to the scheme.[9]

In addition, some staff emphasized the importance of metering for conservation purposes, because it is essential for all forms of usage-sensitive pricing. Finally, staff reported the use of a variety of other special rate-design features relevant to conservation and other policy considerations: penalty charges (sixteen commissions), daily-peak pricing (Wisconsin), off-peak discounts (New Jersey and New Mexico), and lifeline rates (California and Massachusetts). In California, penalty charges can be used as part of authorized rationing. In Massachusetts, a utility was directed by the commission to consider the establishment of a lifeline rate for low-income customers.

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[8] Vickers and Markus, "Creating Economic Incentives," 42-45.

[9] Robert A. Collinge, "Optimal Conservation by Municipal Water Customers: A Revenue-Neutral 'Feebate' System," in *Proceedings of Conserv93* (Denver, CO: American Water Works Association, 1993).

The statutory basis for conservation-oriented ratemaking for water utilities may prove increasingly important. Rhode Island's general laws are very specific about the role of water pricing in water supply management.[10] The law explicitly provides for consideration of the following factors in setting fees, rates, and charges: (1) recovery of all capital and operating costs (fixed and variable), of production, conservation, use, management, protection, obtaining, development, procuring, and/or transporting water, and its sale at wholesale or retail; (2) marginal-cost pricing; (3) emergency and drought period surcharges; (4) seasonal price structures; (5) difference in costs based upon different points of delivery; (6) the effect of fees, rates, and charges on use of water and, where applicable, on wastewater costs and charges; (7) the effect of reducing nonaccount water to levels consistent with stated goals; and (8) preparing, maintaining, and implementing water supply management programs. The Rhode Island commission also is authorized to reduce rates "consistent with the amount by which a supplier exceeds the stated goals for nonaccount water," which is "defined as the difference between the metered supply and the metered consumption for a specific period including an allowance for firefighting."[11]

Clearly, not all of the state commissions have embraced the idea of conservation-oriented rate structures. In some cases, increasing-block rates or surcharges are used on a temporary basis to manage loads and relieve service difficulties associated with inadequate capacity until water supplies can be permanently increased. Thus, for some jurisdictions and some water utilities, long-term benefits of conservation-oriented pricing are not perceived at this time. In general, however, it appears that the commissions, and the utilities they regulate, are expanding their use of alternative rate-design methodologies.

Water Utility Billing Cycles

As mentioned above, metering is a basic first-step in providing customers with essential information about their consumption behavior. This information is communicated

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[10] Rhode Island General Laws, Section 46-15.4-6.

[11] Ibid.

through the water bill, with varying degrees of frequency. Almost all of the commissions reported that they have utilities using monthly billing. Bimonthly billing was reported in twenty-three states; quarterly billing in thirty states; semiannual billing in fourteen states; and annual billing in twenty states. Eleven state commissions reported that mixed billing cycles were used by utilities (for example, quarterly for residential customers and monthly for nonresidential customers, and other combinations). State statutes may place limits on allowable billing cycles. In Washington State, the law specifies that utility bills shall not exceed three months.

For conservation-oriented pricing structures to be effective, an appropriate billing cycle must be implemented. Seasonal pricing with quarterly billing, for example, might not provide customers the opportunity to use billing information to change their consumption behavior. According to the survey, commissions in nine states approved a change in the billing cycle for conservation or other policy purposes. These states were Connecticut, Kentucky, Massachusetts, Missouri, New York, Ohio, Pennsylvania, Rhode Island, and Vermont. In three of these states (Connecticut, Kentucky, and Ohio), however, proposed changes in utility billing cycles were rejected. In Connecticut, for example, the commission found that the additional administrative costs of meter reading and billing were not justified by the utility proposing the change. Aside from conservation, several staff members mentioned that billing cycles were changed to improve utility cash flow and mitigate against rate shock, particularly rate shock associated with implementing federal drinking water standards.

Potential Benefits and Problems Associated with Conservation Rates

Commission staff were asked to identify the potential benefits and problems associated with implementing conservation-oriented rate structures for water utilities. Staff were allowed to identify more than one advantage or drawback. While staff viewpoints may not be a predictor of actual commission decisionmaking, they are both insightful and reflective of commission policy directions.

In decreasing order of times mentioned by staff, the benefits associated with conservation rates were: promoting efficient use of water resources (twenty-one mentions); discouraging discretionary or excessive use (nineteen mentions); preserving water resources (fifteen mentions); avoiding, reducing, or forestalling capacity expansion and expenditures (fourteen mentions); rewarding efficient water users (eight mentions); avoiding or reducing social or environmental costs (six mentions); and shifting water demand to desired periods of the day, month, or year (three mentions). In addition, staff also mentioned the potential importance of drought management, integrated resource and water management planning, fixture replacement, and low water-use landscaping. Some states, like California, appear to support the principles reflected in the identified benefits even though no specific conservation rate design has been implemented.

In decreasing order of times mentioned by staff, the problems associated with conservation rates were: potential instability of revenues (sixteen mentions); potential inconsistency with "cost-of-service" principles (fifteen mentions); difficulties in predicting customer demand and utility revenues (fourteen mentions); difficulties in applying conservation rates across all user classes (ten mentions); possible adverse rate impacts on various classes of customers (ten mentions); practical difficulties associated with marginal-cost pricing (six mentions); and legal difficulties in some states with conservation rate methodologies (two mentions). Staff in Idaho indicated that seasonal rates were found to be consistent with cost-of-service principles, so that this issue is not really a problem. Importantly, some commission staff members pointed out that not all water systems have the supply-adequacy or capacity problems that sometimes are used to justify conservation-oriented rate structures.

Policies to Address the Revenue Impacts of Conservation Pricing

The effect of conservation on utility revenues is of major concern to both utilities and regulators. Reductions in sales due to conservation can erode utility revenues and profits and make them less predictable, particularly for utilities with limited experience and reliable data on water demand. Under these conditions, utilities might have difficulty meeting revenue requirements. Retroactive ratemaking and regulatory lag can exacerbate these issues, which is why methods to address revenue stability are appropriately considered in conjunction with mandated conservation pricing or other programs. More frequent rate cases can remedy the problem of revenue stability (and the occurrence of deficits or surpluses), but this also adds to the cost of regulation to utilities and regulators.

The survey revealed that commission experience with specific conservation pricing and other conservation programs is limited. Few state commissions have implemented methods to address the impact of conservation on revenue stability, even though the states may have implemented such measures for energy utilities with conservation programs.

In decreasing order of use, the commissions have used: service or other special charges (six states); rate structure modifications (six states); adjustments in later rate cases (four states); phase-in plans (three states); revenue-stabilization reserves (one state); and automatic annual surcharges (one state). Six state commissions (Arizona, Connecticut, Kentucky, New Mexico, New York, and Vermont) reportedly have implemented more than one of these methods. The Arizona staff reported they have used an automatic adjustment method for quantifying and recovering net lost revenues attributed to conservation (in conjunction with other price-elasticity-of-demand adjustments). Some states, including California, have basically rejected the use of conservation pricing for the time being. Others, such as Ohio, report that they have not yet had a test case for this issue. Similarly, Florida staff members have discussed all of the available stabilizing methods without implementing any particular approach as yet.

A closely related problem associated with conservation pricing concerns the treatment of surplus or deficit revenues. In other words, along with revenue instability comes the potential for the investor-owned utility to accrue amounts substantially above or below its predetermined revenue requirements and allowed rates of return. Surpluses can lead to excessive profits; deficits can create cash flow and related financial viability problems. Revenue instability does not necessarily result in underearning or overearning, but the potential for these additional consequences can be a concern. Of course, utility investors may be more concerned about inadequate revenues and profits, and utility regulators may be more concerned about excessive revenues and profits. Longer periods between rate adjustments (that is, infrequent rate cases) exacerbate these problems.

Commission experience in methods for dealing with surpluses and deficits is very limited for the water sector. Four state commissions have used rate structure modifications

(Colorado, Connecticut, New York, and Washington). A sampling of other methods also are reported: balancing accounts (Vermont); automatic surcharge the following year (Arizona); automatic adjustments to the ratebase (Washington); and a surcharge mechanism (New York). Arizona and Washington also have used other automatic adjustment methods. Massachusetts reports that it addresses revenue issues through retroactive ratemaking. California, which does not implement conservation pricing as a matter of policy, has used memoranda accounts in conjunction with authorized rationing. California also has provided for customer refunds of surplus utility revenues received from penalties imposed during drought periods.

Staff at the Washington commission are refining a number of their water utility regulatory policies, including the use of reserve-fund accounts in conjunction with surcharges and conservation rate structures that have the potential to generate excessive revenues. Reserve-fund accounts must be separate accounts, with no mingling with other funds or revenues. Quarterly reporting to commission staff is required. Distribution of funds, excepted for preapproved loan payments for securities, requires prior review and approval by staff. Staff determinations are clarified to utilities through letters specifying any conditions imposed on the use of special conservation-oriented rates and related accounts.

Regulatory Treatment of Conservation Expenditures

A number of the state public utility commissions have addressed conservation expenditures in the course of water rate cases and other proceedings. Conservation investments could have been initiated by statute, regulation, and/or the water utility itself. In Texas, the commission's water rights program requires utilities to have a conservation plan before additional water rights can be granted.

In decreasing order, the commissions have considered conservation expenditures by jurisdictional utilities for: leak detection and repairs (twenty-eight states); meter testing and repairs (twenty-seven states); labor and materials for public education (eighteen states); water audits performed by the utility (fourteen states); the purchase cost of residential retrofit kits (twelve states); followup surveys and pilot studies (eleven states); developing a conservation rate structure (eleven states); labor and administration for a retrofit program (eight states); and developing a demand management program (three states).

Commission staff were asked to indicate the type of regulatory treatment provided for each of the conservation expenditures. Almost all of the items specified were treated as an annual expense in the determination of utility revenue requirements. In three states (Kentucky, Montana, and West Virginia), commission staff reported that the cost of leak detection and repairs could be expensed or added to the ratebase and depreciated over time. In Texas, amortization has been used for meter testing and repairs. The type of regulatory treatment did not vary depending on how the expenditure was initiated (by statute, regulation, or the utility).

The timing of regulatory treatment is important to utilities in terms of reducing regulatory lag between when an expense was incurred and when corresponding revenues are received through rates. From the utility's perspective, settling regulatory treatment issues prior to program implementation would be beneficial. From the regulator's perspective, a proceeding following the review of program results might be preferred. Some of the states with experience in treating conservation expenditures did not indicate the timing of the treatment; in these states (and probably many of the others), the relevant expenditures may have been dealt with in the course of a normal rate case. Staff in Kentucky noted that the timing of regulatory treatment depends on whether program costs are known and measurable.

The following modes of regulatory timing were specified by the commissions: a rate case following program implementation (sixteen states); a rate case prior to program implementation (six states); a rate case following review of program results (four states); and a special rate case proceeding (four states). The Washington commission was the only one to report the use of an annual pass-through adjustment. As in the type of regulatory treatment, the timing of regulatory treatment did not vary with how the expenditure was initiated (by statute, regulation, or the utility).

Regulatory Incentives for Conservation

The final section of the state survey concerned potential regulatory incentives or disincentives associated with utility implementation of demand management or conservation measures.

The survey instrument provided staff with a list of potential incentives used across the commissions for motivating energy utilities to invest in conservation (such as shared savings, bounty, and other methods discussed in chapter 4). Only four states reported experience with providing incentives for water conservation. Arizona has provided for deferred recovery. Connecticut has provided for deferred recovery, ratebasing, and return on equity adjustments. New York has used decoupling, deferred recovery, and shared savings. Washington has implemented a lost-revenue adjustment, as mentioned earlier.

State laws may begin to address the incentives issue in the water sector as conservation advocates well-versed in these methods become involved in the legislative process. Of course, this raises the possibility of legislative ratemaking policy which, as noted earlier, can be complicated and controversial. The Rhode Island statute cited above for conservation-oriented ratemaking, also provides explicitly for the possibility of decoupling water utility sales and revenues and making adjustments to revenues based on conservation:

> Notwithstanding the provisions of Sections 39-2-2 and 39-2-5, all rates and charges made by water suppliers which decline as quantity used increases are hereby declared to be no longer conducive to sound water supply management designed to properly conserve, develop, utilize, and protect this finite natural resource. The public utilities commission may order rates for suppliers of water which either do not vary with quantities used or when there is evidence of increasing costs to either the utility or to society, rates which increase as the quantity used increases. If the commission finds that changing the rates to comply with this section will cause a hardship to a class of customers, the commission may order that rates for that class of customers be changed to comply with this section over a period of time not to exceed five (5) years.[12]

Only recently have the state commissions begun to hear testimony about the potential need for incentives for water utilities to engage in conservation. The Boise Water Corporation, for example, proposed revenue adjustment methods to the Idaho Public Utilities Commission to help it contend with the effects of conservation in its service territory.

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[12] Rhode Island General Laws, Section 46-15.4-6.

Consumer advocates in the case suggested that the utility should reform its rate structure and prepare a comprehensive integrated resource plan that incorporates consideration of demand management with long-term supply management.[13] However, the utility and consumer advocates at times have disagreed strongly about appropriate revenue adjustment and decoupling methodologies. Consumer advocates have argued that a poorly designed incentive system will result in excessive earnings to the water utility.[14] In some instances, advocates argued that "fatal flaws" in the utility's chosen methodology justify an entire disallowance of the requested adjustment.[15]

Commission staff in two states (California and Connecticut), reported that their commissions disallowed a water conservation expenditure. Staff in California, which does not mandate conservation, noted that the expenditure must be shown to be cost-effective prior to implementation. Connecticut also reportedly disallowed specific conservation-related costs for one water utility but not another. Although not counted as a "disallowance" per se, Wisconsin staff members indicated that some utilities have conducted studies in favor of conservation rates, but the proposed rate structure changes were not approved.

Staff in seventeen state commissions identified the kind of justification required of utilities for their conservation programs. Most mentioned that the expenditures must be shown to be cost-effective; many noted that the expenditures must be well-documented; and some basically reiterated traditional ratemaking principles (such as whether expenses are "just and reasonable"). Arizona staff, for example, emphasize that the conservation must compare favorably to other alternatives; compliance with state statutes and regulations also must be shown. Other forms of justification include state or county sponsorship (Delaware), program goals and cost-benefit analysis (Florida), excessive cost of supply-side alternatives (Michigan),

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[13] Testimony before the Idaho Public Utilities Commission by Thomas Michael Power on behalf of the Idaho Citizens Coalition in rate cases involving the Boise Water Corporation (1990 and BOI-W-93-1, 1993).

[14] Ibid. (1993), 14.

[15] Testimony before the Idaho Public Utilities Commission by Dr. Don C. Reading on behalf of the Coalition of Boise Water Customers in a rate case involving the Boise Water Corporation (BOI-W-93-1, 1993).

proof of need in comparison to alternatives (Ohio), benefits to ratepayers (Oklahoma), and insufficient service capacity (Virginia). For six states (Connecticut, Florida, New York, Ohio, Texas, and Virginia), staff indicated that further justification may be required when a conservation program is utility-sponsored but not commission-mandated. As indicated by the Florida staff, the "prudence" of the costs would be more carefully reviewed under these circumstances. Benefits to ratepayers and demonstration of need were mentioned by other states.

Summary and Discussion

The results of the survey are confined to some extent by the limited experience of the state public utility commissions in water conservation policy. Commission policy always will be constrained somewhat by the boundaries of regulatory jurisdiction. Some of the commissions, such as Wyoming, regulate only a small number of very small water utilities for which the issues of conservation and planning are elusive, especially in comparison to issues of basic survival and financial viability. Yet some states, such as Arizona, already have fairly mature water conservation policies in place at their commissions.

Commission staff uniformly demonstrate a high level of awareness of and knowledge about water conservation issues. Several staff members acknowledged that water conservation and conservation pricing are relatively new areas for commission policy development. Given the growing interest in water conservation nationally, state regulators can be expected to pay increasing attention to revenue stability and other economic issues associated with utility conservation strategies.

For commission-regulated water utilities, "regulatory climate" is always an important consideration. An important aspect of the regulatory climate is whether the commissions are open to the use of alternative regulatory and ratemaking approaches in areas such as conservation and demand management. Water utilities and even commission staff involved in water regulation will want to be aware of commission precedents in the energy sector. Although much of the commission experience in the energy sector has not been transferred to the water sector, this may not always be the case. As in the energy experience, inevitable cost and price increases probably will draw attention to the potential for efficiency improvements in the water sector.

Each of the various regulatory alternatives for dealing with water conservation has potential advantages and disadvantages based on the characteristics of water supply. Fixed costs in the water sector are substantial, which increases the potential for revenue instability when cost recovery is shifted to variable demand. Water utilities also remain vertically integrated (with supply, transmission, and distribution provided by the same utility), and characterized by pervasive monopoly economies. Some forms of alternative regulation may not easily apply to water because of lacking technological innovation, operational capability, or competition. Another consideration is utility experience in using certain kinds of methods. For example, the use of adjustment clauses and modified cost-recovery streams is more familiar to electricity utilities. Because of the size and operational characteristics of water utilities, the need to develop sector-specific policies is clear.

On the other hand, some energy conservation concepts apply very well to water. For example, the water sector has much to learn from the electricity sector in terms of load management through conservation programs and pricing. The range of rate design options for the water sector clearly can be expanded based on the experience in energy pricing. For example, marginal-cost pricing and pricing policies that consider long-term costs (including environmental externalities) may be informative for water utility ratemaking. Other concepts, such providing utility *services* instead of units of power or water, may have relevance as well. This concept in particular captures the "wise-use" notion that water-efficient technologies and practices can yield savings in both water and costs without degrading service quality or consumer lifestyles.

Finally, unregulated water utilities also can gain from experience in the regulated sector. Increasingly, unregulated public-sector water utilities are concerned with cost-of-service and other ratemaking principles that are the mainstay of state public utility regulation. Public-sector utilities are striving for financial viability and share many concerns with their investor-owned counterparts. However, some issues (such as the impact of revenue instability on earnings) are less germane for the public sector. In general, unregulated water utilities may have more freedom to implement revenue-adjustment mechanisms and other stabilizing techniques. More options also may be available to mitigate against the effects of short-term revenue losses. In theory, it should be easier to persuade publicly owned systems to invest in efficiency. As government agencies, publicly owned utilities should not need bonuses or other rewards to promote cost-effective conservation that is in the best interest of their constituencies. In other words, removing the profit incentive goes a long way toward removing the lost-revenue disincentive associated with conservation.

This is not to say that unregulated water systems are unconstrained in what they can implement. The political constraints on publicly owned systems can be substantial, as can be the economic constraints. Many water utilities are expected to help their local government authorities achieve economic development goals, which might contradict the utility's ideas about least-cost planning. In a few cases, the water department may be regarded as a revenue-producing enterprise (that is, one that provides a positive cash flow to the local governing body). Thus, even without a profit motive, the drive to increase sales and revenues can provide strong motivation to utility managers. Until these powerful political incentive systems are altered, it may be hard to convince public-sector utilities of the potential benefits of investing in conservation.

In conclusion, while considerable empirical research is available on the costs and benefits of energy and water conservation, very little is available on the actual effectiveness of providing regulatory and ratemaking incentives in this area. Furthermore, the use of government-sanctioned incentives should be compared to market-based solutions that allow demand-side resources to compete with supply-side resources on their own merits. More empirical research is needed to identify which approaches work and which also are cost-effective. This kind of analysis is essential prior to implementing incentive mechanisms on a large scale. The various policy alternatives can appropriately be considered in the larger context of planning, pricing, and regulatory reform for the water utility sector.

Developing industry-specific policies on conservation and conservation pricing is a formidable challenge. In meeting this challenge, water utilities and regulators have begun to recognize efficiency as a viable resource option for the water sector. Many of the concerns about the effects of conservation on water utility revenues can be addressed by taking a long-term, efficiency-oriented perspective.

APPENDIX

1993/1994 NRRI SURVEY ON STATE COMMISSION REGULATION OF WATER UTILITIES

TABLE A-1
COMMISSION REGULATED WATER UTILITIES

State Commission	Number of Regulated Water Utilities [Number of Regulated Water Utilities Serving >3,300 Population]					
	Investor-Owned	Municipal	Water Districts	Cooperatives	Homeowners' Associations	Other
Alabama	13 [0]	na	na	na	na	na
Alaska	21 [0]	1 [1]	na	1 [0]	na	na
Arizona	298 [25]	na	na	34 [4]	9 [0]	10 [1] (a)
Arkansas	3 [1]	na	na	na	na	na
California	210 [30]	na	na	na	na	na
Colorado	3 [1]	na	na	na	na	na
Connecticut	50 [19]	na	na	na	na	na
Delaware	16 [3]	na	na	na	na	na
Florida	201 [15]	na	na	na	na	na
Hawaii	11 [11]	na (b)	na	na	na	na
Idaho	24 [6]	na	na	na	na	na
Illinois	63 [10]	na	na	na	na	na
Indiana	22 [6]	187 [32]	10 [0]	86 [0]	na	na
Iowa	1 [1]	na	na	na	na	na
Kansas	3 [1]	na	1 [0]	na	na	3 [0] (c)
Kentucky	34 [4]	na	143 [21]	na	na	31 [0] (d)
Louisiana	111 [4]	na	na	na	na	na
Maine	36 [2]	28 [1]	89 [13]	na	na	na
Maryland	25 [3]	na	na	na	na	na
Massachusetts	31 [5]	na	78 [20]	na	na	1 [1] (e)
Michigan	1 [1]	na	na	na	3 [0]	15 [0] (f)
Mississippi	69 [9]	76 [57]	30 [4]	(g)	(g)	550 [117] (g)
Missouri	72 [8]	na	na	na	na	na
Montana	36 [3]	116 [55]	na	na	na	na
Nevada	21 [3]	na	na	36 [0]	na	na
New Hampshire	41 [ ]	na	na	na	na	na
New Jersey	57 [29]	11 [11]	na	na	4 [0]	na

TABLE A-1 (continued)

State Commission	Number of Regulated Water Utilities [Number of Regulated Water Utilities Serving >3,300 Population]					
	Investor-Owned	Municipal	Water Districts	Cooperatives	Homeowners' Associations	Other
New Mexico	40 [4]	na	16 [0]	na	0 [0]	na
New York	334 [7]	na	na	na	20 [0]	na
North Carolina	315 [10]	na	na	na	na	na
Ohio	29 [4]	na	na	na	na	na
Oklahoma	24 [0] (h)	na	na	na	na	na
Oregon	108 [3]	na	na	na	na	na
Pennsylvania	208 [16]	80 [10]	na	na	na	na
Rhode Island	2 [1]	5 [5]	na	na	na	na
South Carolina	66 [2]	na	na	na	na	na
Tennessee	9 [1]	na	na	na	na	na
Texas	1,200 [50]	500 (i)	900 (i)	900 [78]	na	na
Utah	25 [1]	na	na	na	na	na
Vermont	51	na	na	na	na	na
Virginia	71 [11]	na	na	na	na	na
Washington	81 [8]	na	na	na	na	na
West Virginia	52 [2]	160 [12]	175 [1]	na	28 [0]	na
Wisconsin	11 [2]	549 [200]	na	na	na	na
Wyoming	20 [0]	na	na	na	na	na
Total Utilities	4,119	1,713	1,442	1,057	64	610
Total Commissions	45	11	9	5	5	6

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 1. The number of water systems is approximated for many states.

na = not applicable

Notes to table A-1:
(a) Arizona. Systems in receivorship.
(b) Hawaii. Each county has its own municipal water system. These systems serve a majority of the population.
(c) Kansas. Proprietary systems.
(d) Kentucky. Water associations.
(e) Massachusetts. Correctional Institute at Bridgeport.
(f) Michigan. Private systems.
(g) Mississippi. Association nonprofit water systems. Cooperatives and homeowners' associations are not categorized.
(h) Oklahoma. Most systems have fewer than one hundred customers.
(i) Texas. A total of 542 municipal systems and water districts exceed 3,300 in population served.

TABLE A-2
SCOPE OF COMMISSION JURISDICTION FOR WATER UTILITIES

State Commission	Scope of Commission Jurisdiction					
	Investor-Owned	Municipal	Water Districts	Cooperatives	Homeowners' Associations	Other
Alabama	Comprehensive	none	none	none	none	none
Alaska	Jurisdictional rates	Jurisdictional rates	none	Jurisdictional rates	none	none
Arizona	Comprehensive	none	none	Comprehensive	Comprehensive	Comprehensive
Arkansas	Rates & tariffs	none	none	none	none	none
California	Rates & standards of construction	none	none	none	none	none
Colorado	Comprehensive	none	none	none	none	none
Connecticut	Comprehensive	none	none	none	none	none
Delaware	Comprehensive	none	none	none	none	none
Florida	Rates & territory	none	none	none	none	none
Hawaii	Conventional rate & service regulation	none	none	none	none	none
Idaho	Comprehensive	none	none	none	none	none
Illinois	Comprehensive	none	none	none	none	none
Indiana	Rates & more	Rates	Rates	Rates & more	none	none
Iowa	Rates & service	none	none	none	none	none
Kansas	Rates	none	Rates	none	none	Rates
Kentucky	Comprehensive	none	Comprehensive	None	None	Comprehensive
Louisiana	Comprehensive	none	none	none	none	none
Maine	Comprehensive	Comprehensive	Comprehensive	none	none	none
Maryland	Comprehensive	none	none	none	none	none
Massachusetts	Comprehensive	none	Rates filed and appellate review (for a few)	none	none	Rates
Michigan	Rates, rules & regulations, & stock	none	none	none	Rates, rules, & regulations	Rates, rules, & regulations
Mississippi	Rates, service, & area	Rates, service, & area (a)	Limited (service area only)	none	none	Limited (service area only)
Missouri	Comprehensive	none	none	none	none	none
Montana	Comprehensive	Partial	none	none	none	none

TABLE A-2 (continued)

State Commission	Scope of Commission Jurisdiction					
	Investor-Owned	Municipal	Water Districts	Cooperatives	Homeowners' Associations	Other
Nevada	Comprehensive	none	none	Limited	none	none
New Hampshire	Comprehensive	none	none	none	none	none
New Jersey	Comprehensive	Limited (b)	none	none	Comprehensive	none
New Mexico	Comprehensive	none	Limited	none	None	none
New York	Comprehensive	none	none	none	Limited	none
North Carolina	Comprehensive	none	none	none	none	none
Ohio	Comprehensive	none	none	none	none	none
Oklahoma	Rates & more	none	none	none	none	none
Oregon	Rates & service	none	none	none	none	none
Pennsylvania	Comprehensive	Rates & service (c)	none	none	none	none
Rhode Island	Rate & more	Rates & more	none	none	none	none
South Carolina	Rates & service	none	none	none	none	none
Tennessee	Comprehensive	none	none	none	none	none
Texas	Comprehensive	Appellate	Appellate	Appellate	none	none
Utah	Rates & service	none	none	none	none	none
Vermont	Comprehensive	none	none	none	none	none
Virginia	Comprehensive	none	none	none	none	none
Washington	Comprehensive	none	none	none	none	none
West Virginia	Comprehensive	Comprehensive	Comprehensive	none	Rates & service	none
Wisconsin	Comprehensive	Comprehensive	none	none	none	none
Wyoming	Comprehensive	none	none	none	none	none
Total Commissions	45	11	9	5	5	6

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 1.

none = no jurisdiction

<u>Notes to table A-2:</u>

(a) Mississippi. Rates, service, and service territory for areas beyond one mile of corporate limits.
(b) New Jersey. Limited to customers (1,000 or more) outside governmental boundaries.
(c) Pennsylvania. Jurisdiction is limited to regular municipalities that serve outside municipal limits (outside customers only). However, municipal Authorities are not regulated.

TABLE A-3
COMMISSION POLICIES ON WATER CONSERVATION AND PLANNING

State Commission	Does the commission have a general water conservation policy?	How was the conservation policy established?	Does the commission have a conservation pricing policy?	How was the pricing policy established?	Has the commission required a least-cost plan or IRP? [N utilities]	Have utilities voluntarily prepared a least-cost plan or IRP? [N utilities]
Alabama	No	na	No	na	No	No
Alaska	No	na	No	na	No	No
Arizona (a)	Yes	Policy statement	Yes	Case-by-case	Yes [1]	No
Arkansas	No	na	No	na	No	No
California (b)	Yes	Policy statement	No	na	Yes [na]	No
Colorado	No	na	No	na	No	No
Connecticut (c)	Yes	Statute & Rule/regulation	Yes	Rule/regulation & Policy statement	No	Yes [29]
Delaware	No	na	No	na	No	No
Florida (d)	Yes	Case-by-case	Yes	Policy statement	No	No
Hawaii	No	na	No	na	No	No
Idaho	Yes	Case-by-case	Yes	Case-by-case	No	No
Illinois	No	na	No	na	No	No
Indiana	No	na	No	na	No	No
Iowa	No	na	No	na	No	No
Kansas	No	na	No	na	No	No
Kentucky (e)	Yes	Rule/regulation & Case-by-case	No	Case-by-case	Yes [1]	Yes [na]
Louisiana	No	na	No	na	No	No
Maine	Yes	Policy statement	No	Case-by-case	No	No
Maryland	No	na	No	na	No	No
Massachusetts (f)	No	na	Yes	Case-by-case	No	No
Michigan (g)	No	na	No	na	No	No
Mississippi	No	na	No	na	No	No
Missouri (h)	Yes	Case-by-case	No	na	No	No
Montana	No	na	No	na	No	No
Nevada (i)	Yes	Statute & Rule/regulation	No	na	Yes [1]	No
New Hampshire (j)	No	na	No	na	No	No

TABLE A-3 (continued)

State Commission	Does the commission have a general water conservation policy?	How was the conservation policy established?	Does the commission have a conservation pricing policy?	How was the pricing policy established?	Has the commission required a least-cost plan or IRP? [N utilities]	Have utilities voluntarily prepared a least-cost or IRP? [N utilities]
New Jersey (k)	Yes	Policy statement	Yes	Policy statement & Case-by-case	No	No
New Mexico (l)	Yes	Case-by-case	Yes	Case-by-case	No	No
New York (m)	Yes	Generic order	Yes	Case-by-case	No	No
North Carolina (n)	No	na	No	na	No	No
Ohio (o)	Yes	Rule/regulation	Yes	Case-by-case	Yes [na]	No
Oklahoma	No	na	No	na	No	No
Oregon (p)	Yes	Other	No	na	No	No
Pennsylvania (q)	Yes	Rule/regulation & Policy statement	No	na	No	No
Rhode Island (r)	Yes	Statute & Policy statement	Yes	Statute	No	No
South Carolina	No	na	No	na	No	No
Tennessee	No	na	No	na	No	No
Texas (s)	Yes	Rule/regulation	Yes	Rule/regulation	No	No
Utah (t)	No	na	No	Case-by-case	No	No
Vermont	No	na	No	na	No	No
Virginia	No	na	No	na	No	No
Washington (u)	Yes	Statute & Policy statement	No	na	No	No
West Virginia	No	na	No	na	No	No
Wisconsin	No	na	No	na	No	No
Wyoming	No	na	No	na	No	No
Total Commissions	18	-----	11	-----	5	2

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, questions 2, 3, and 18.

na = not applicable

Notes to table A-3:

(a) Arizona. Increasing-block rate design is used; seasonal-rate structures are used when applicable.

(b) California. All Class A utilities (over 10,000 connections) are required to prepare least-cost or integrated resource plans.

(c) Connecticut.

(d) Florida. The commission actively promotes conservation. At the time of the survey, the staff had an informal position on water conservation pricing that was expected to be considered by the commission and become policy by the end of 1993.

(e) Kentucky. Most systems are metered with testing and replacement schedules stated within commission regulations. The commission requires a check of customer usage in its regulations. The commission has approved tariffs allowing disconnection for willful water waste. The commission has not addressed whether ratepayers should pay for resources not rendered. Pricing should be based on fully allocated and fairly distributed embedded costs over marginal or incremental cost bases.

(f) Massachusetts. In several cases, the commission directed utilities to eliminate the minimum water allowance used in the rate structure.

(g) Michigan. Michigan Administrative Code allows a utility to charge extra for water waste.

(h) Missouri.

(i) Nevada. Legislation was passed in 1991.

(j) New Hampshire. Metering is required whenever feasible.

(k) New Jersey. Jurisdiction is coordinated with Department of Environmental Protection and Energy, which regulates over 500 water supply systems (public and private), and the Delaware River Basin Commission. The importance of water conservation pricing was recognized through Board decisions and orders in the early 1980s.

(l) New Mexico. An IRP rule was being developed at the time of the survey. With respect to pricing, the increasing-block rate structure is favored as a means of reducing excessive consumption.

(m) New York. Water conservation policy is applicable to eight companies with operating revenues over $700,000 (Class A and B companies). Conservation pricing is used in those cases where a definite need to conserve exists.

(n) North Carolina. The commission by order on a case-by-case basis imposes restriction regulations on water usage.

(o) Ohio. Rule 4901:1-15-36 of the Ohio Administrative Code provides for water conservation restriction regulations (curtailment). Pricing examples include the use of a customer charge versus a minimum charge and the use of a single usage block.

(p) Oregon. Commission encourages companies to promote conservation.

(q) Pennsylvania. See policy attached for a copy of the rule and policy statement. The Commission supports decreasing-block rate structures for water utilities but allows the elimination of usage allowances in the minimums. Although the Commission did not require utilities to prepare least cost or integrated resource plans, the Commission is working on a program for water utilities.

(r) Rhode Island. General Law Title 46-15.4-6. At the time of the survey, water utilities were slowly phasing out the three-tiered decreasing-block rate schedules. Water utilities are using two blocks and narrowing the difference between the two blocks to achieve uniform rates.

(s) Texas. Decreasing-block rates cannot be used for residential customers.

(t) Utah. On a case-by-case basis, without a policy, the commission approved increasing-block rates for approximately one third of its regulated water utilities. The commission has implicitly encouraged conservation by approval of these rates.

(u) Washington. According to Engrossed Substitute House Bill 2026, Chapter 347 Laws of 1991 RCW 80.28.010, "In establishing rates or charges for water service, water companies as defined in RCW 80.04.010 may consider the achievement of water conservation goals and the discouragement of wasteful water use practices." The commission's basic charge allowance policy, with regard to water conservation, sets 400/500 cf as an allowance standard. Customers using less than the 800 or 1,000 cf allowances have no incentive to conserve.

TABLE A-4
COMMISSION POLICIES ON MARGINAL-COST PRICING

State Commission	Does the commission encourage or discourage marginal-cost pricing?	Number of water utilities for which marginal-cost pricing has been approved	Has the commission approved marginal-cost pricing for nonwater utilities?
Alabama	Neither	na	Yes
Alaska	Neither	na	No
Arizona	Discouraged	0	Yes
Arkansas	Neither	0	Yes
California	Neither	0	No
Colorado	Neither	na	No
Connecticut	Discouraged	0	Yes
Delaware	Neither	na	na
Florida	Neither	0	Yes
Hawaii	Neither	0	No
Idaho	Neither	na	Yes
Illinois	Neither	0	Yes
Indiana	Neither	na	Yes
Iowa	Discouraged	na	No
Kansas	Neither	na	No
Kentucky	Discouraged	0	Yes
Louisiana	Neither	na	na
Maine	Neither	0	Yes
Maryland	Neither	na	Yes
Massachusetts	Encouraged	3	Yes
Michigan	Neither	0	Yes
Mississippi	Neither	0	No
Missouri	Discouraged	0	No
Montana	Neither	na	Yes
Nevada	Discouraged	0	Yes
New Hampshire	Neither	0	Yes
New Jersey	Neither	na	Yes
New Mexico	Neither	0	Yes
New York	Encouraged	2	Yes

TABLE A-4 (continued)

State Commission	Does the commission encourage or discourage marginal-cost pricing?	Number of water utilities for which marginal-cost pricing has been approved	Has the commission approved marginal-cost pricing for nonwater utilities?
North Carolina	Neither	0	No
Ohio	Discouraged	0	No
Oklahoma	Neither	0	Yes
Oregon	Neither	na	Yes
Pennsylvania	Neither	0	Yes
Rhode Island	Neither	0	No
South Carolina	Neither	na	No
Tennessee	Neither	na	na
Texas	Neither	na	No
Utah	Neither	na	No
Vermont	Neither	na	Yes
Virginia	Neither	na	na
Washington	Discouraged	0	Yes
West Virginia	Neither	na	na
Wisconsin	Discouraged	na	Yes
Wyoming	Neither	na	na
Total Commissions	2 (Encouraged) 9 (Discouraged) 34 (Neither)	2 (Approved) 43 (0 or na)	25 (Yes) 20 (No or na)

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 4.

na = not available or not applicable

TABLE A-4
COMMISSION POLICIES ON MARGINAL-COST PRICING

State Commission	Does the commission encourage or discourage marginal-cost pricing?	Number of water utilities for which marginal-cost pricing has been approved	Has the commission approved marginal-cost pricing for nonwater utilities?
Alabama	Neither	na	Yes
Alaska	Neither	na	No
Arizona	Discouraged	0	Yes
Arkansas	Neither	0	Yes
California	Neither	0	No
Colorado	Neither	na	No
Connecticut	Discouraged	0	Yes
Delaware	Neither	na	na
Florida	Neither	0	Yes
Hawaii	Neither	0	No
Idaho	Neither	na	Yes
Illinois	Neither	0	Yes
Indiana	Neither	na	Yes
Iowa	Discouraged	na	No
Kansas	Neither	na	No
Kentucky	Discouraged	0	Yes
Louisiana	Neither	na	na
Maine	Neither	0	Yes
Maryland	Neither	na	Yes
Massachusetts	Encouraged	3	Yes
Michigan	Neither	0	Yes
Mississippi	Neither	0	No
Missouri	Discouraged	0	No
Montana	Neither	na	Yes
Nevada	Discouraged	0	Yes
New Hampshire	Neither	0	Yes
New Jersey	Neither	na	Yes
New Mexico	Neither	0	Yes
New York	Encouraged	2	Yes

TABLE A-5 (continued)

State Commission	Rate Structures in Use [Approximate Number of Water Utilities]						
	Flat Charges	Decreasing-Block	Uniform Rates	Increasing-Block	Seasonal Rates	Excess-Use Rates	Other
New York	Yes [200]	Yes	Yes	Yes	Yes	No	Step-up/ step-down [1]
North Carolina (o)	Yes [na]	No	Yes [na]	Yes [na]	No	No	No
Ohio (p)	Yes [13]	Yes [10]	Yes [4]	No	No	No	Yes [2]
Oklahoma	Yes [na]	Yes [na]	No	Yes [na]	No	No	No
Oregon (q)	Yes [na]	No	Yes [na]	No	No	No	No
Pennsylvania (r)	Yes [99]	Yes [189]	Yes [na]	No	Yes [a few]	Yes	No
Rhode Island (s)	Yes [1]	Yes [6]	No	No	No	No	No
South Carolina	Yes [19]	No	Yes [47]	No	No	No	No
Tennessee	Yes [5]	Yes [4]	No	No	No	No	No
Texas	Yes [<50]	Yes [<50]	Yes [800]	Yes [350]	Yes [25]	No	No
Utah (t)	Yes [2]	Yes [1]	Yes [13]	Yes [8]	Yes [1]	No	No
Vermont (u)	Yes [50]	No	Yes [20]	No	No	Yes [6]	No
Virginia (v)	Yes [19]	Yes [25]	Yes [19]	Yes [7]	No	No	No
Washington (w)	Yes [19]	Yes [1]	Yes [22]	Yes [8]	Yes [1]	No	Yes [30]
West Virginia (x)	Yes [30]	Yes [385]	No	No	No	No	No
Wisconsin (y)	No	Yes [500]	Yes [60]	No	Yes [560]	No	No
Wyoming (z)	Yes [most]	No	Yes [a few]	No	No	No	No
Total Commissions	39	29	36	18	15	6	8

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 5.

Notes to table A-5:

(a) Arizona. Meters always are required. Uniform rates are used for smaller systems; increasing-block rates are used in larger systems, desert areas and legislated conservation areas; seasonal rates are used where population varies dramatically by season; excess-use rates are used where water must be transported by vehicle and legislated conservation areas.

(b) Arkansas. Flat charges are used for having water available (with no usage).

(c) Colorado. Uniform rates include a customer charge than flat rate for metered water. One utility uses both increasing block and seasonal rates.

(d) Florida. Flat charges are used by eleven small utilities; decreasing block rates are used by small systems; uniform rates are used by small and large systems; increasing-block rates are used by large systems. Generally, the residential and nonresidential rates are the same.

(e) Hawaii. One company uses flat rates only. Ten utilities using uniform rates use a combination of flat charges and usage rates.

Notes to table A-5 (continued):

(f) Illinois. Flat charges are used for small systems (serving fewer than 1,000 residential customers); decreasing-block rates are used by systems of all sizes, but mostly those serving more than 1,000 customers; uniform rates are used by most systems (many of which serve less than 1,000 residential customers).

(g) Indiana. Approximately three hundred water utilities are regulated and the vast majority use decreasing-block or uniform rates.

(h) Kentucky. Flat charges are used by most smaller residential systems; decreasing-block rate are used by various system sizes for all customer classes; uniform rates are used in sales for resale; increasing-block rates are used by a small privately owned rural system that is mostly residential; small and large commercial bottling rates also are used.

(i) Massachusetts. Two companies using flat charges are converting to meters; one will use decreasing-block rates and one will use uniform rates. Decreasing-block rates include one fixture-rate system that is 37 percent metered; uniform rates includes one fixture-rate system that is 78 percent metered.

(j) Missouri. Uniform rates are used by all small systems serving fewer than 1,000 customers; special rates are used for large users and wholesale customers.

(k) Montana. Uniform rates by customer class are used.

(l) New Hampshire. Smaller utilities use flat charges.

(m) New Jersey. Flat charges are used by a few remaining small systems. A single-block tariff (uniform rate structure) is encouraged and has been the commission's policy since the 1980s for all water systems.

(n) New Mexico. Uniform rates and increasing block rates are used by small and large utilities.

(o) North Carolina. The predominant rate structure utilized for water utilities consists of a base facilities change (zero usage) and a usage charge on a per 1,000 gallon basis. There are, however, certain utilities and/or subdivisions which utilize flat rates but these are typically limited to smaller systems. Uniform rates are currently being utilized for a utility which serves many subdivisions over a wide geographic area. However, the issue of system specific rates is being studied by the Commission.

(p) Ohio. Smaller companies with a residential base use flat charges; decreasing-block rates usually are used by larger systems but any sized system can use them; where used, uniform rates apply to all customer classes.

(q) Oregon. Flat charges are used by approximately half of the smaller residential systems; uniform rates are used by approximately half of the medium-sized systems.

(r) Pennsylvania. The Commission has a universal-metering policy. Ninety-nine utilities implement flat charges despite the Commission's discouragement of the rate. Most utilities that have metered service use decreasing-block rate; some have a customer charge and a single block. When used, uniform rates are applied for all customer classifications. Excess-use rates are used only in drought emergency situations. Utilities have been allowed to eliminate the water-use allowance in the minimum rate to establish a basic customer charge.

(s) Rhode Island. Flat charges are used for smaller systems (360 customers); decreasing-block rates are used for systems serving over 3,000 population.

(t) Utah. Uniform rates are used by the largest systems.

(u) Vermont. Customers on flat charges are allowed an option to meter; uniform metered rates are provided; excess-use rates take the form of swimming-pool rates.

(v) Virginia. The smallest systems tend to use unmetered charges.

(w) Washington. Flat rates are used by 19 utilities; one utility uses decreasing block rates; uniform rates are used when utilities have only metered in block rates; one utility has both summer/winter flat rates; twenty-five utilities have flat and uniform rates; five utilities have flat and increasing block rates.

(x) West Virginia. Approximately thirty small utilities use flat charges.

(y) Wisconsin. Approximately five hundred systems (all classes) use flat charges; about 60 systems use uniform rates (all classes). Most tariffs have a seasonal flat feature (560 systems).

(z) Wyoming. Most use flat charges; a few also have a usage charge, but with no blocks specified.

TABLE A-6
WATER UTILITY RATE STRUCTURES APPROVED FOR CONSERVATION PURPOSES

State Commission	Rate Structures Approved for Conservation Purposes [Approximate Number of Water Utilities]				
	Uniform Rates	Increasing-Block	Seasonal Rates	Excess-Use Rates	Other
Alabama	No	No	No	No	No
Alaska	No	No	No	No	No
Arizona (a)	No	Yes [150]	No	Yes [1]	No
Arkansas	No	No	No	No	No
California (b)	No	Yes [a few]	No	Yes [10-15]	No
Colorado	No	No	No	No	No
Connecticut	Yes [20]	Yes [1]	No	No	No
Delaware	No	No	No	No	No
Florida (c)	Yes [na]	Yes [na]	No	No	No
Hawaii	No	No	No	No	No
Idaho	No	No	Yes [1]	No	Metered rates
Illinois	No	No	No	No	No
Indiana	No	No	No	No	No
Iowa	No	No	No	No	No
Kansas	No	No	No	No	No
Kentucky (d)	No	Yes [1]	No	No	Yes (1]
Louisiana	Yes	No	No	No	No
Maine	No	No	No	No	No
Maryland	No	No	No	No	No
Massachusetts (e)	Yes [2]	No	No	No	No
Michigan	No	No	No	No	No
Mississippi	No	No	No	No	No
Missouri	No	No	No	No	No
Montana	No	Yes [na]	No	No	No
Nevada	Yes [na]	Yes [na]	No	No	No
New Hampshire	No	No	No	No	No
New Jersey (f)	Yes [na]	No	No	No	No
New Mexico (g)	No	Yes [na]	Yes [na]	No	No

TABLE A-6 (continued)

State Commission	Rate Structures Approved for Conservation Purposes [Approximate Number of Water Utilities]				
	Uniform Rates	Increasing-Block	Seasonal Rates	Excess-Use Rates	Other
New York	Yes [na]	Yes [na]	Yes [na]	No	No
North Carolina	No	No	No	No	No
Ohio	Yes [4]	No	No	No	No
Oklahoma	No	Yes [1]	No	No	No
Oregon	No	No	No	No	No
Pennsylvania	No	No	No	No	No
Rhode Island	No	No	No	No	No
South Carolina	No	No	No	No	No
Tennessee	No	No	No	No	No
Texas	No	No	No	No	No
Utah	No	No	No	No	No
Vermont	No	No	No	No	No
Virginia (h)	No	No	No	No	No
Washington	No	Yes [13]	No	No	No
West Virginia	No	No	No	No	No
Wisconsin	No	No	No	No	No
Wyoming	No	No	No	No	No
Total Commissions	8	11	3	2	2

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 5.

No = no, none, none reported, or not applicable

Notes to table A-6:
(a) Arizona. The state has water conservation areas established by statute. Excess-use rates are used for a large system in a legislated conservation area.
(b) California. Increasing-block rates are used in a few circumstances. Excess-use rates are used as a penalty in authorized ratemaking.
(c) Florida. A cost-based uniform rate is considered a conservation rate. Two increasing-block rate structures are used to combat excessive usage.
(d) Kentucky. Small and large commercial bottling rates are used.
(e) Massachusetts. Two utilities are converting from unmetered rates. The commission discussed conservation but was more concerned with marginal-cost pricing principles.
(f) New Jersey. Conservation has been encouraged by the elimination of discounts for large users. The need to send correct pricing signals to all customers is recognized.
(g) New Mexico. Variations of increasing-block and seasonal rates are used.
(h) Virginia. Alternative rate structures have not been expressly used for conservation purposes. Increasing-block rates have been used to relieve service issues associated with inadequate capacity until supplies can be permanently increased.

TABLE A-7
SPECIAL RATE DESIGN FEATURES APPROVED FOR WATER UTILITIES

State Commission	Special Rate Design Features in Use [Approximate Number of Water Utilities]				
	Penalty Charges	Daily-Peak Pricing	Off-Peak Discounts	Lifeline Rates	Other
Alabama	No	No	No	No	No
Alaska	No	No	No	No	No
Arizona (a)	Yes [1]	No	No	No	No
Arkansas	No	No	No	No	No
California (b)	Yes [na]	No	No	Yes [na]	No
Colorado	No	No	No	No	No
Connecticut	No	No	No	No	No
Delaware	No	No	No	No	No
Florida	No	No	No	No	No
Hawaii	No	No	No	No	No
Idaho	No	No	No	No	No
Illinois (c)	Yes [1]	No	No	No	No
Indiana	No	No	No	No	No
Iowa	No	No	No	No	No
Kansas (d)	Yes [7]	No	No	No	No
Kentucky (e)	Yes [na]	No	No	No	No
Louisiana (f)	Yes	No	No	No	No
Maine	No	No	No	No	No
Maryland	Yes	No	No	No	No
Massachusetts (g)	No	No	No	Yes [na]	No
Michigan	No	No	No	No	No
Mississippi	No	No	No	No	No
Missouri	Yes [2]	No	No	No	No
Montana	No	No	No	No	No
Nevada	Yes [1]	No	No	No	No
New Hampshire	No	No	No	No	No
New Jersey (h)	Yes [na]	No	Yes [na]	No	No
New Mexico (i)	No	No	Yes [na]	No	No
New York	No	No	No	No	No

TABLE A-7 (continued)

State Commission	Special Rate Design Features in Use [Approximate Number of Water Utilities]				
	Penalty Charges	Daily-Peak Pricing	Off-Peak Discounts	Lifeline Rates	Other
North Carolina	No	No	No	No	No
Ohio (j)	No	No	No	No	No
Oklahoma	Yes [na]	No	No	No	No
Oregon	No	No	No	No	No
Pennsylvania	Yes	No	No	No	No
Rhode Island	No	No	No	No	No
South Carolina (k)	Yes	No	No	No	No
Tennessee (l)	Yes [na]	No	No	No	No
Texas	No	No	No	No	No
Utah	No	No	No	No	No
Vermont	No	No	No	No	No
Virginia	No	No	No	No	No
Washington	No	No	No	No	No
West Virginia (m)	Yes [na]	No	No	No	No
Wisconsin (n)	Yes [560]	Yes [6]	No	No	No
Wyoming	No	No	No	No	No
Total Commissions	16	1	2	2	0

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 5.

No = no, none, none reported, or not applicable

Notes to table A-7:

(a) Arizona. Excess-use rates are used as a penalty charge in a legislated conservation or transported-water area.
(b) California. Penalty charges are used as a part of authorized rationing. About eight years ago, the commission discontinued a lifeline rate policy that had been in effect for approximately twelve years.
(c) Illinois. Penalty charges were once used for a limited period during severe drought.
(d) Kansas. Penalty charges involve a delayed payment percentage.
(e) Kentucky. Penalty charges are included in 60 percent of the filed curtailment and water shortage response plans.
(f) Louisiana. A 5 percent charge for late payments is used, but it is in no way related to conservation pricing.
(g) Massachusetts. Milford Water was directed to prepare a low-income assistance rate as a basis for further consideration.
(h) New Jersey. Penalty charges are imposed for excess use during declared drought situations. Bulk-sale customers may include provisions in contract related to off-peak pricing.
(i) New Mexico. An off-peak discount was used at least once for an industrial rate.
(j) Ohio. Customers are not penalized per se; late fees and related devices are used.
(k) South Carolina. A late payment penalty of 1.5 percent after twenty-five days applies to all utilities.
(l) Tennessee. Late payment charges are used.
(m) West Virginia. Practically all utilities have penalty changes for late payments.
(n) Wisconsin. All utilities have late payment charge provisions. Six Milwaukee suburbs have daily peak-load pricing.

TABLE A-8
WATER UTILITY BILLING CYCLES

State Commission	Billing Cycles in Use [Approximate Number of Water Utilities]					
	Monthly	Bimonthly	Quarterly	Semiannually	Annually	Mixed or Other
Alabama	Yes [13]	No	No	No	No	No
Alaska	Yes [23]	No	No	No	No	No
Arizona (a)	Yes [415]	No	No	No	No	No
Arkansas (b)	Yes [all]	No	No	No	No	No
California (c)	Yes [na]	Yes [na]	Yes [na]	Yes [na]	Yes [na]	No
Colorado (d)	Yes [3]	No	No	No	No	Yes [1]
Connecticut (e)	Yes [11]	No	Yes [45]	No	Yes [4]	Yes [6]
Delaware	Yes [2]	No	Yes [9]	Yes [2]	Yes [3]	No
Florida	Yes [165]	Yes [20]	Yes [15]	No	No	No
Hawaii	Yes [10]	No	Yes [1]	No	No	No
Idaho	Yes [22]	Yes [1]	No	No	Yes [1]	No
Illinois (f)	Yes [na]	Yes [na]	Yes [na]	Yes [na]	No	No
Indiana (g)	Yes [na]	Yes [na]	Yes [na]	No	No	No
Iowa	Yes [1]	No	Yes [1]	No	No	No
Kansas	Yes [7]	No	No	No	No	Yes [9]
Kentucky (h)	Yes [199]	Yes [2]	Yes [3]	No	Yes [4]	No
Louisiana	Yes [na]	No	No	No	No	No
Maine	Yes [1]	No	Yes [146]	Yes [6]	No	No
Maryland (i)	Yes [4]	Yes [1]	Yes [17]	No	Yes [3]	No
Massachusetts (j)	Yes [1]	No	Yes [13]	Yes [4]	Yes [11]	Yes [3]
Michigan	Yes [3]	Yes [1]	Yes [13]	No	Yes [2]	Yes [19]
Mississippi	Yes [all]	No	No	No	No	No
Missouri	No	Yes [1]	Yes [7]	No	No	Yes [2]
Montana	Yes [130]	Yes [12]	Yes [10]	No	No	No
Nevada	Yes [most]	Yes [a few]	Yes [a few]	No	No	No
New Hampshire	Yes [3]	No	Yes [25]	Yes [5]	Yes [8]	Yes [na]
New Jersey (k)	Yes [a]	No	Yes	No	Yes [2]	No
New Mexico	Yes [all]	No	No	No	No	No
New York	Yes [na]	Yes [na]	Yes [na]	Yes [na]	Yes [na]	No

TABLE A-8 (continued)

State Commission	Billing Cycles in Use [Approximate Number of Water Utilities]					
	Monthly	Bimonthly	Quarterly	Semiannually	Annually	Mixed or Other
North Carolina	Yes [250]	Yes [15]	Yes [40]	Yes [5]	Yes [5]	No
Ohio (l)	Yes [11]	Yes [2]	Yes [9]	Yes [3]	Yes [2]	Yes [2]
Oklahoma	Yes [na]	Yes [na]	No	No	No	No
Oregon	Yes [most]	Yes [some]	No	No	No	No
Pennsylvania	Yes [most]	Yes [a few]	Yes [most]	Yes [a few]	Yes [a few]	Yes
Rhode Island (m)	No	No	Yes [4]	Yes [1]	Yes [1]	Yes [1]
South Carolina	Yes [63]	Yes [2]	No	No	Yes [1]	No
Tennessee	Yes [na]	No	No	No	No	No
Texas	Yes [most]	No	No	No	Yes [a few]	No
Utah	Yes [20]	Yes [3]	Yes [1]	No	Yes [1]	No
Vermont	Yes [3]	No	Yes [40]	Yes [3]	Yes [10]	No
Virginia (n)	Yes [32]	Yes [32]	Yes [5]	Yes [2]	No	No
Washington (o)	Yes [60]	Yes [19]	Yes [1]	No	Yes [1]	No
West Virginia (p)	Yes [most]	Yes [a few]	Yes [a few]	No	No	No
Wisconsin (q)	Yes [100]	Yes [2]	Yes [455]	Yes [3]	No	Yes [na]
Wyoming	Yes [most]	No	Yes [a few]	No	No	No
Total Commissions	43	23	30	14	20	11

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 6.

No = no, none, none reported, or not applicable

Notes to table A-8:

(a) Arizona. Monthly billing is required by rules. Of course, customers may pay in advance.

(b) Arkansas. All ASPC water utilities use monthly billing or all customer classes.

(c) California. All billing cycles are used. No way of knowing how many utilities use each cycle.

(d) Colorado. Seasonal customers are billed accordingly.

(e) Connecticut. The ten utilities billing monthly are large with mostly industrial and commercial customers. Quarterly billing utilities are small. The annually billing utilities operate only six months each year.

(f) Illinois. Many large utilities bill quarterly, although some bill monthly. When quarterly billing is used, large customers may be billed monthly. Small utilities have a mixture of quarterly, bimonthly, and monthly.

(g) Indiana. The vast majority of the approximate 300 water utilities use monthly billing cycle. Only a few use bimonthly or quarterly based upon historic use.

(h) Kentucky. Monthly billing is used for residential and nonresidential, medium-sized utilities, and all customer classes. Annual billing is for small privately owned systems (all classes); two of the systems are connected to resort areas or marinas.

(i) Maryland. For all utilities, the majority are residential customers.

Notes for table A-8 (continued):

(j) Massachusetts. Several large utilities bill larger customers on a monthly basis; these companies are included in the total for quarterly billing (residential customers). Mixed systems bill quarterly for residential customers and monthly for nonresidential customers.

(k) New Jersey. A few of the larger utilities using monthly billing for non-residential customers; most systems use quarterly billing for all classes; two systems use annual billing.

(l) Ohio. Large companies use monthly cycles, while the smaller use longer time frames. Basically, the customer classes are independent of the billing cycle. One small company bills residential quarterly and commercial monthly (listed as quarterly billing cycle); one large company bills residential monthly and large users bi-monthly (listed as monthly billing cycle).

(m) Rhode Island. Four utilities serving more than 3,300 customers use quarterly billing. Pawtucket (large system) bills semiannually; Providence (small system) bills annually; Newport (large system) bills every four months. Billing cycles are more frequent for commercial and industrial customers.

(n) Virginia. Companies with seasonal customers tend to utilize the quarterly and semiannual billing cycles.

(o) Washington. According to Washington Administrative Code 48-110-01 "Bills for Utility Service shall not exceed three months." The one company billing annually requested a waiver and received approval by Order.

(p) West Virginia. There are no differences in billing periods for customer classes (residential/non-residential).

(q) Wisconsin. There are no special differences in billing cycles based on system size. For about twenty-five utilities, residential and small nonresidential customers are billed quarterly and large industrial customers are billed monthly. These systems are included in the quarterly count of 455.

TABLE A-9
COMMISSION APPROVAL OF CHANGES IN WATER UTILITY BILLING CYCLES

State Commission	Has the commission ever approved a change in the billing cycle for conservation or other purposes?	Has the commission ever rejected a change in the billing cycle for conservation or other purposes?	Additional Comments
Alabama	No	No	None
Alaska	No	No	None
Arizona	No	No	None
Arkansas	No	No	None
California	No	No	None
Colorado	No	No	None
Connecticut	Yes [10]	Yes [3]	The meter reading and billing costs of switching from quarterly to monthly billing were not justified by utility.
Delaware	No	No	None
Florida	No	No	None
Hawaii	No	No	None
Idaho	No	No	None
Illinois	No	No	None
Indiana	No	No	None
Iowa	No	No	None
Kansas	No	No	None
Kentucky	Yes [1]	Yes [1]	The cost of conversion from quarterly to monthly billing was rejected.
Louisiana	No	No	None
Maine	No	No	None
Maryland	No	No	
Massachusetts	Yes	No	Billing changes generally are implemented to minimize bill impacts and to improve the utility's cash flow.
Michigan	No	No	No utility has requested a change in the billing cycle.
Mississippi	No	No	None
Missouri	Yes	No	None
Montana	No	No	None

TABLE A-9 (continued)

State Commission	Has the commission ever approved a change in the billing cycle for conservation or other purposes?	Has the commission ever rejected a changed in the billing cycle for conservation or other purposes?	Additional Comments
Nevada	No	No	None
New Hampshire	No	No	None
New Jersey	No	No	None
New Mexico	No	No	None
New York	Yes	No	Change in the billing cycle to reduce rate shock has been approved.
North Carolina	No	No	None
Ohio	Yes	Yes	Billing cycles have been changed to permit a change in the number of days a customer has to pay a bill. Also, changes in billing frequency have been made.
Oklahoma	No	No	None
Oregon	No	No	None
Pennsylvania	Yes	No	Changes have been approved for better cash flow.
Rhode Island	Yes	No	See Title 46-15. 4-6.
South Carolina	No	No	None
Tennessee	No	No	None
Texas	No	No	None
Utah	No	No	None
Vermont	Yes [2]	No	Billing cycles have been changed to quarterly or monthly in response to rate shock associated with compliance with federal drinking water standards.
Virginia	No	No	None
Washington	No	No	None
West Virginia	No	No	None
Wisconsin	No	No	None
Wyoming	No	No	None
Total Commissions	9	3	-----

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 6.

No = no, none, none reported, or not applicable

TABLE A-10
POTENTIAL BENEFITS ASSOCIATED WITH CONSERVATION RATES CITED BY COMMISSION STAFF

State Commission	Potential Benefits Associated with Conservation Rates							
	Preserve water resources	Promote efficient use	Shift water demand	Reward efficient users	Discour-age excess use	Avoid capacity expan-sion	Avoid social/ environ. costs	Other
Alabama	No	Yes	No	No	No	No	No	No
Alaska	No	No	No	No	No	No	No	No
Arizona	Yes	Yes	No	Yes	Yes	Yes	No	Encourage low water usage landscaping
Arkansas	No	No	No	No	No	No	No	No
California	No	No	No	No	No	No	No	All are endorsed but no conserva-tion rate design
Colorado	No	No	No	No	No	No	No	No
Connecticut	Yes	Yes	No	No	Yes	Yes	Yes	No
Delaware	No	No	No	No	No	No	No	No
Florida	Yes	Yes	No	No	Yes	Yes	Yes	No
Hawaii	No	No	No	No	No	No	No	No
Idaho	No	Yes	No	No	No	Yes	No	No
Illinois	No	No	No	No	Yes	No	No	No
Indiana	No	No	No	No	No	No	No	No
Iowa	No	No	No	No	No	No	No	No
Kansas	No	No	No	No	No	No	No	No
Kentucky	Yes	Yes	Yes	Yes	Yes	No	No	No
Louisiana	No	No	No	No	No	No	No	No
Maine	No	No	No	No	No	No	No	No
Maryland	No	No	No	No	No	No	No	No
Massachusetts	No	Yes	No	No	Yes	Yes	No	No
Michigan	No	Yes	No	No	Yes	Yes	No	No
Mississippi	No	No	No	No	No	No	No	No
Missouri	No	Yes	No	No	Yes	No	No	No
Montana	Yes	Yes	No	No	No	No	No	No

TABLE A-10 (continued)

State Commission	Potential Benefits Associated with Conservation Rates							
	Preserve water resources	Promote efficient use	Shift water demand	Reward efficient users	Discour-age excess use	Avoid capacity expan-sion	Avoid social/ environ. costs	Other
Nevada	Yes	Yes	No	No	Yes	Yes	Yes	Drought concerns
New Hampshire	No	No	No	No	No	No	No	No
New Jersey	Yes	Yes	No	No	Yes	No	No	No
New Mexico	No	No	No	No	No	No	No	IRP policy is forthcoming
New York	Yes	Yes	Yes	Yes	Yes	Yes	No	No
North Carolina	No	No	No	No	No	No	No	No
Ohio	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Oklahoma	No	No	No	No	No	No	No	No
Oregon	Yes	Yes	No	No	Yes	No	No	No
Pennsylvania	No	No	No	No	No	No	No	Fixture adaptations encouraged
Rhode Island	Yes	Yes	Yes	Yes	No	Yes	No	Rhode Island Water Supply Management Plan
South Carolina	Yes	Yes	No	No	Yes	Yes	Yes	No
Tennessee	No	No	No	No	No	No	No	No
Texas	Yes	Yes	No	Yes	Yes	No	No	No
Utah	Yes	Yes	No	Yes	Yes	No	No	No
Vermont	No	Yes	No	No	Yes	Yes	No	No
Virginia	No	No	No	No	Yes	Yes	No	No
Washington	Yes	Yes	No	Yes	Yes	Yes	Yes	No
West Virginia	No	No	No	No	No	No	No	No
Wisconsin	No	No	No	No	No	No	No	No
Wyoming	No	No	No	No	No	No	No	No
Total Commissions	15	21	3	8	19	14	6	6

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 7.

No = no, none, none reported, or not applicable

TABLE A-11
POTENTIAL PROBLEMS ASSOCIATED WITH CONSERVATION RATES CITED BY COMMISSION STAFF

State Commission	Potential Problems Associated with Conservation Rates							
	Inconsist. with cost-of-service	Hard to apply to all users	Legal difficul-ties	Potential revenue insta-bility	Adverse impacts on cust. classes	Demand/ revenue prediction	Marginal-cost pricing	Other
Alabama	No	No	No	No	No	No	No	No
Alaska	No	No	No	No	No	No	No	No
Arizona	Yes	Yes	No	Yes	Yes	Yes	No	No
Arkansas	No	No	No	No	No	No	No	No
California	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Indirectly reflected, but not specifically
Colorado	No	No	No	No	No	No	No	No
Connecticut	Yes	Yes	No	Yes	Yes	Yes	No	No
Delaware	No	No	No	No	No	No	No	No
Florida	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Hawaii	No	No	No	No	No	No	No	No
Idaho (a)	Yes	Yes	No	No	Yes	No	No	No
Illinois	Yes	No	No	No	No	No	No	No
Indiana	No	No	No	No	No	No	No	No
Iowa	No	No	No	No	No	No	No	No
Kansas	No	No	No	No	No	No	Yes	No
Kentucky	No	No	Yes	Yes	Yes	Yes	Yes	No
Louisiana	No	No	No	No	No	No	No	No
Maine	No	No	No	No	No	No	No	No
Maryland	No	No	No	No	No	No	No	No
Massachusetts	No	Yes	No	Yes	No	Yes	No	Some sys-tems have no supply problems
Michigan	Yes	No	No	Yes	No	Yes	No	No
Mississippi	No	No	No	No	No	No	No	No
Missouri (b)	No	No	No	Yes	No	No	No	No
Montana	No	No	No	No	No	No	No	No

TABLE A-11 (continued)

State Commission	Potential Problems Associated with Conservation Rates							
	Inconsist. with cost-of-service	Hard to apply to all users	Legal difficul-ties	Potential revenue insta-bility	Adverse impacts on cust. classes	Demand/ revenue prediction	Marginal-cost pricing	Other
Nevada	No	No	No	Yes	No	Yes	No	No
New Hampshire	No	No	No	No	No	No	No	No
New Jersey	Yes	Yes	No	Yes	Yes	Yes	No	No
New Mexico	No	No	No	No	No	No	No	No policy; may address case-by-case
New York	Yes	No	No	Yes	Yes	Yes	Yes	No
North Carolina	No	No	No	No	No	No	No	No
Ohio	Yes	Yes	No	Yes	Yes	Yes	No	No
Oklahoma	No	No	No	No	No	No	No	No
Oregon	No	No	No	No	No	No	No	No
Pennsylvania	Yes	No	No	Yes	No	Yes	No	No
Rhode Island	No	No	No	No	No	No	No	No
South Carolina	No	No	No	No	No	No	No	No
Tennessee	No	No	No	No	No	No	No	No
Texas	Yes	Yes	No	Yes	No	Yes	No	No
Utah	Yes	No	No	No	No	No	No	No
Vermont	Yes	No	No	Yes	No	No	No	No
Virginia	No	No	No	No	No	No	No	No
Washington	Yes	Yes	No	Yes	Yes	Yes	Yes	No
West Virginia	No	No	No	No	No	No	No	No
Wisconsin	No	No	No	No	No	No	No	No
Wyoming	No	No	No	No	No	No	No	No
Total Commissions	15	10	2	16	10	14	6	3

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 8.

No = no, none, none reported, or not applicable

Notes to table A-11:
(a) Idaho. The commission believes that seasonal rates are consistent with cost-of-service principles.
(b) Missouri. Potential revenue instability is addressed if the utility is metering for the first time.

TABLE A-12
POLICIES TO ADDRESS POTENTIAL REVENUE INSTABILITY ASSOCIATED WITH CONSERVATION PRICING

State Commission	Policies Implemented to Address Revenue Instability Associated with Conservation Pricing							
	Phase-In Plans	Revenue Stabilization Reserves	Service or Other Special Charges	Adjustments in Later Rate Cases	Rate Structure Modifications	Automatic Annual Surcharges	Other Automatic Adjustments	Other
Alabama	No	No	No	No	No	No	No	No
Alaska	No	No	No	No	No	No	No	No
Arizona (a)	No	No	No	No	No	No	Yes	Yes
Arkansas	No	No	No	No	No	No	No	No
California (b)	No	No	No	No	No	No	No	No
Colorado	No	No	No	No	No	No	No	No
Connecticut	Yes	No	Yes	No	Yes	No	No	No
Delaware	No	No	No	No	No	No	No	No
Florida	No	No(c)	No	No (c)	No (c)	No	No (c)	No
Hawaii	No	No	No	No	No	No	No	No
Idaho (d)	No	No	No	No	No	No	No	Yes
Illinois	No	No	No	No	No	No	No	No
Indiana	No	No	No	No	No	No	No	No
Iowa	No	No	No	No	No	No	No	No
Kansas	No	No	No	No	No	No	No	No
Kentucky	Yes	No	Yes	Yes	Yes	No	No	No
Louisiana	No	No	No	No	No	No	No	No
Maine	No	No	No	No	No	No	No	No
Maryland	No	No	No	No	No	No	No	No
Massachusetts	No	No	Yes	No	No	No	No	No
Michigan	No	Yes	No	No	No	No	No	No
Mississippi	No	No	No	No	No	No	No	No
Missouri	No	No	Yes	No	No	No	No	No
Montana	No	No	No	No	No	No	No	No
Nevada	No	No	No	Yes	No	No	No	No
New Hampshire	No	No	No	No	No	No	No	No
New Jersey	No	No	No	No	No	No	No	No

TABLE A-12 (continued)

State Commission	Policies Implemented to Address Revenue Instability Associated with Conservation Pricing							
	Phase-In Plans	Revenue Stabilization Reserves	Service or Other Special Charges	Adjustments in Later Rate Cases	Rate Structure Modifications	Automatic Annual Surcharges	Other Automatic Adjustments	Other
New Mexico (e)	No	No	Yes	No	No	No	Yes	No
New York	No	No	No	Yes	Yes	Yes	No	No
North Carolina	No	No	No	No	No	No	No	No
Ohio (f)	No	No	No	No	No	No	No	No
Oklahoma	No	No	No	No	No	No	No	No
Oregon	No	No	No	No	No	No	No	No
Pennsylvania (g)	No	No	No	No	Yes	No	No	No
Rhode Island	No	No	No	No	No	No	No	No
South Carolina	No	No	No	No	No	No	No	No
Tennessee	No	No	No	No	No	No	No	No
Texas	No	No	No	No	No	No	No	No
Utah	No	No	No	No	No	No	No	No
Vermont	Yes	No	Yes	No	Yes	No	No	No
Virginia	No	No	No	No	No	No	No	No
Washington	No	No	No	Yes	Yes	No	No	No
West Virginia	No	No	No	No	No	No	No	No
Wisconsin	No	No	No	No	No	No	No	No
Wyoming	No	No	No	No	No	No	No	No
Total Commissions	3	1	6	4	6	1	2	2

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 9.

No = no, none, none reported, or not applicable

Notes to table A-12:

(a) Arizona. Other automatic adjustments include quantification and recovery of net lost revenues attributed to conservation; this is what they have for other price-elasticity-of-demand adjustments have been considered but not implemented.
(b) California. The commission does not have a conservation pricing policy.
(c) Florida. To date, the commission has not used any methodology to address revenue instability, but all of the indicated measures have been discussed.
(d) Idaho. The commission is gradually moving away from flat rates.
(e) New Mexico. Other special charges, such as fire protection charges for vacant or undeveloped lots, have been used to address revenue instability; other automatic adjustments, such as pass throughs, are used (for example, testing fees associated with federally imposed drinking water standards).

Notes to table A-12 (continued):

(f) Ohio. The commission has not had an actual case concerning conservation or capital expenditures that would test the above applications.

(g) Pennsylvania. Utilities are allowed to eliminate use allowances in minimum rate, therefore, establishing a pure customer charge. Some companies are also using single block rates, each 1,000 gallons billed at the same rate.

TABLE A-13
POLICIES TO ADDRESS SURPLUS OR DEFICIT REVENUES ASSOCIATED WITH CONSERVATION PRICING

State Commission	Policies Implemented to Address Surplus or Deficit Revenues Associated with Conservation Pricing							
	Balancing Accounts	Customer Refunds	Rate Structure Modifications	Automatic Surcharge the Next Year	Automatic Adjustment to Rate Base	Surcharge or Other Adjustments	Other Automatic Adjustments	Other
Alabama	No	No	No	No	No	No	No	No
Alaska	No	No	No	No	No	No	No	No
Arizona	No	No	No	Yes	No	No	Yes (a)	No
Arkansas	No	No	No	No	No	No	No	No
California	No	No	No	No	No	No	No	Yes (b)
Colorado	No	No	Yes	No	No	No	No	No
Connecticut	No	No	Yes	No	No	No	No	No
Delaware	No	No	No	No	No	No	No	No
Florida	No (c)	No	No (c)	No	No	No	No	No
Hawaii	No	No	No	No	No	No	No	No
Idaho	No	No	No	No	No	No	No	No
Illinois	No	No	No	No	No	No	No	No
Indiana	No	No	No	No	No	No	No	No
Iowa	No	No	No	No	No	No	No	No
Kansas	No	No	No	No	No	No	No	No
Kentucky	No	No	No	No	No	No	No	No
Louisiana	No	No	No	No	No	No	No	No
Maine	No	No	No	No	No	No	No	No
Maryland	No	No	No	No	No	No	No	No
Massachusetts	No	No	No	No	No	No	No	Yes (d)
Michigan	No	No	No	No	No	No	No	No
Mississippi	No	No	No	No	No	No	No	No
Missouri	No	No	No	No	No	No	No	No
Montana	No	No	No	No	No	No	No	No
Nevada	No	No	No	No	No	No	No	No
New Hampshire	No	No	No	No	No	No	No	No
New Jersey	No	No	No	No	No	No	No	No

TABLE A-13 (continued)

State Commission	Policies Implemented to Address Surplus or Deficit Revenues Associated with Conservation Pricing							
	Balancing Accounts	Customer Refunds	Rate Structure Modifications	Automatic Surcharge the Next Year	Automatic Adjustment to Rate Base	Surcharge or Other Adjustments	Other Automatic Adjustments	Other
New Mexico	No	No	No	No	No	No	No	No
New York	No	No	Yes	No	No	Yes	No	No
North Carolina	No	No	No	No	No	No	No	No
Ohio (e)	No	No	No	No	No	No	No	No
Oklahoma	No	No	No	No	No	No	No	No
Oregon	No	No	No	No	No	No	No	No
Pennsylvania	No	No	No	No	No	No	No	No
Rhode Island	No	No	No	No	No	No	No	No
South Carolina	No	No	No	No	No	No	No	No
Tennessee	No	No	No	No	No	No	No	No
Texas	No	No	No	No	No	No	No	No
Utah	No	No	No	No	No	No	No	No
Vermont	Yes	No	No	No	No	No	No	No
Virginia	No	No	No	No	No	No	No	No
Washington	No	No	Yes	No	Yes	No	Yes	No
West Virginia	No	No	No	No	No	No	No	No
Wisconsin	No	No	No	No	No	No	No	No
Wyoming	No	No	No	No	No	No	No	No
Total Commissions	1	0	4	1	1	1	2	2

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 10.

No = no, none, none reported, or not applicable

Notes to table A-13:

(a) Arizona. Other automatic adjustments include quantification of net lost revenues attributed to conservation and recovery in a later period.
(b) California. Memoranda accounts are used in conjunction with authorized rationing.
(c) Florida. To date, the commission has not used any methodology to address surpluses or deficits, but all of the indicated measures have been discussed.
(d) Massachusetts. The issue of surplus or deficit revenues associated with conservation pricing would be addressed by retroactive ratemaking.
(e) Ohio. The commission has not had an actual case to test the above applications.

TABLE A-14
CONSERVATION MEASURES IMPLEMENTED BY WATER UTILITIES

State Commission	Type of Conservation Expense Initiated by Statute, Regulation, or Utility								
	Retrofit kits (purchase cost)	Retrofit programs (labor & admin.)	Water audits by the utility	Public education (labor & materials)	Follow-up surveys and pilot studies	Leak detection and repairs	Meter testing and repairs	Develop-ing con-servation rates	Develop-ing a DSM program
Alabama	No	No	No	No	No	No	No	No	No
Alaska	No	No	No	No	No	No	No	No	No
Arizona	Reg & Utility	Reg & Utility	Utility	Reg & Utility	Reg & Utility	Reg	Reg	Reg	Reg
Arkansas	No	No	No	No	No	No	No	No	No
California (a)	Reg & Utility	Reg & Utility	Utility	Utility	Utility	Utility	No	No	No
Colorado	No	No	No	No	No	No	No	No	No
Connecticut	Statute & Reg	Statute, Reg, & Utility	Statute, Reg, & Utility	Utility	Utility	Statute & Reg	Statute & Reg	Statute & Reg	Statute, Reg, & Utility
Delaware	No	No	Utility	Utility	No	Utility	Statute, Reg, & Utility	No	No
Florida	Utility	Utility	No	Utility	No	Utility	Reg	Utility	No
Hawaii	No	No	No	No	No	No	No	No	No
Idaho	No	No	No	Utility	Reg	Utility	Utility	No	No
Illinois	No	No	No	Utility	No	Utility	Reg	No	No
Indiana	No	No	No	No	No	No	No	No	No
Iowa	No	No	No	No	No	No	No	No	No
Kansas	No	No	No	No	No	No	No	No	No
Kentucky	Utility	Utility	No	Utility	Utility	Utility	Reg	No	No
Louisiana	No	No	No	No	No	No	No	No	No
Maine	No	No	No	No	No	No	No	No	No
Maryland	No	No	No	No	No	No	No	No	No
Massachusetts (b)	Utility	No	Utility	Utility	No	Utility	No	No	No
Michigan	No	No	No	No	No	Utility	Statute & Reg	No	No
Mississippi	No	No	No	No	No	No	No	No	No

TABLE A-14 (continued)

State Commission	Type of Conservation Expense Initiated by Statute, Regulation, or Utility								
	Retrofit kits (purchase cost)	Retrofit programs (labor & admin.)	Water audits by the utility	Public education (labor & materials)	Follow-up surveys and pilot studies	Leak detection and repairs	Meter testing and repairs	Develop-ing con-servation rates	Develop-ing a DSM program
Missouri	No	No	No	No	No	Statute, Reg, & Utility	Statute, Reg, & Utility	No	No
Montana	Utility	No	Utility	Utility	No	Utility	Reg	No	No
Nevada	No	No	Utility	Utility	Utility	Utility	Statute, Reg, & Utility	No	No
New Hampshire	No	No	No	No	No	No	No	No	No
New Jersey (c)	Utility	Utility	Utility	Utility	Utility	Utility	Statute & Reg	Statute & Reg	No
New Mexico (d)	No	No	Utility	No	No	Utility	Utility	No	No
New York	Utility	Utility	Utility	Utility	Utility	Utility	Reg	Utility	No
North Carolina	No	No	No	Utility	No	Utility	Utility	No	No
Ohio (d)	Utility	No	No	Utility	No	Statute, Reg, & Utility	Statute, Reg, & Utility	No	No
Oklahoma	No	No	No	No	No	No	Statute & Reg	Utility	No
Oregon	No	No	No	No	No	Statute & Reg	Statute & Reg	No	No
Pennsylvania	Utility	No	Utility	Utility	No	Utility	Utility	No	No
Rhode Island (e)	Statute, Reg, & Utility	Utility	Reg & Utility	Utility	Utility	Utility	Reg & Utility	Reg & Utility	Utility
South Carolina	No	No	Utility	Utility	Utility	Utility	Reg	No	No
Tennessee	No	No	No	No	No	No	No	No	No
Texas	No	No	No	No	No	Utility	Utility	No	No
Utah	No	No	No	No	No	No	No	Utility	No
Vermont	No	No	No	No	No	Utility	Statute & Reg	Statute & Reg	No
Virginia	No	No	No	No	No	Utility	Utility	Utility	No
Washington	No	No	No	No	No	Utility	Statute, Reg, & Utility	Utility	No

TABLE A-14 (continued)

State Commission	Type of Conservation Expense Initiated by Statute, Regulation, or Utility								
	Retrofit kits (purchase cost)	Retrofit programs (labor & admin.)	Water audits by the utility	Public education (labor & materials)	Follow-up surveys and pilot studies	Leak detection and repairs	Mmeter testing and repairs	Develop-ing con-servation rates	Develop-ing a DSM program
West Virginia	No	No	Statute & Reg	No	No	Utility	Statute, Reg, & Utility	No	No
Wisconsin	No	No	No	No	Utility	Utility	Statute & Reg	No	No
Wyoming	No	No	No	No	No	No	No	No	No
Total Commissions	12	8	14	18	11	28	27	11	3

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 11.

No = no, none, none reported, or not applicable

Notes to table A-14:

(a) California. Although initiated by the utility, existing state policy promotes these activities.

(b) Massachusetts. Meter testing is not considered a conservation measure.

(c) New Jersey. At the time of the survey, the Delaware River Basin Commission recently had enacted rules and regulations providing for conservation pricing by purveyors located in the basin area.

(d) New Mexico. This information is available only a case-by-case basis.

(e) Rhode Island. The reported data reflect a summary of activities by six utilities surveyed.

TABLE A-15
REGULATORY TREATMENT OF
CONSERVATION MEASURES IMPLEMENTED BY WATER UTILITIES

State Commission	Regulatory Treatment of Conservation Expenses								
	Retrofit kits (purchase cost)	Retrofit programs (labor & admin.)	Water audits by the utility	Public education (labor & matierlas)	Follow-up surveys and pilot studies	Leak detection and repairs	Meter testing and repairs	Develop-ing con-servation rates	Develop-ing a DSM program
Alabama	na	na	na	na	na	na	na	na	na
Alaska	na	na	na	na	na	na	na	na	na
Arizona	Deferred expense	Deferred expense	Voluntary (Not exp.)	Deferred expense	Deferred expense	Expense	Expense	Expense	Deferred expense
Arkansas	na	na	na	na	na	na	na	na	na
California	Expense	Expense	Expense	Expense	Expense	Expense	na	na	na
Colorado	na	na	na	na	na	na	na	na	na
Connecticut	Expense	Expense	Expense	Expense	Expense	Expense	Expense	Expense	Expense
Delaware	na	na	Unknown	Unknown	na	Unknown	Unknown	na	na
Florida	Expense	Expense	na	Expense	na	Expense	Expense	Expense	na
Hawaii	na	na	na	na	na	na	na	na	na
Idaho	na	na	na	Unknown	Unknown	Unknown	Unknown	na	na
Illinois	na	na	na	Expense	na	Expense	Expense	na	na
Indiana	na	na	na	na	na	na	na	na	na
Iowa	na	na	na	na	na	na	na	na	na
Kansas	na	na	na	na	na	na	na	na	na
Kentucky	Expense	Expense	na	Expense	Expense	Expense & Ratebase	Expense	na	na
Louisiana	na	na	na	na	na	na	na	na	na
Maine	na	na	na	na	na	na	na	na	na
Maryland	na	na	na	na	na	na	na	na	na
Massachusetts	Expense	na	Expense	Expense	na	Expense	na	na	na
Michigan	na	na	na	na	na	Unknown	Unknown	na	na
Mississippi	na	na	na	na	na	na	na	na	na
Missouri	na	na	na	na	na	Expense	Expense	na	na
Montana	Expense	na	Expense	Expense	na	Expense & Ratebase	Expense	na	na

TABLE A-15 (continued)

State Commission	Regulatory Treatment of Conservation Expenses								
	Retrofit kits (purchase cost)	Retrofit programs (labor & admin.)	Water audits by the utility	Public education (labor & materials)	Follow-up surveys and pilot studies	Leak detection and repairs	Meter testing and repairs	Dvelop-ing con-servation rates	Develop-ing a DSM program
Nevada	na	na	Expense	Expense	Expense	Expense	Expense	na	na
New Hampshire	na	na	na	na	na	na	na	na	na
New Jersey	Expense	Expense	Expense	Expense	Expense	Expense	Expense	Expense	na
New Mexico	na	na	Expense	na	na	Expense	Expense	na	na
New York	Expense	Expense	Expense	Expense	Expense	Expense	Expense	Expense	na
North Carolina	na	na	na	Expense	na	Expense	Expense	na	na
Ohio	Unknown	na	na	Expense	na	Expense	Expense	na	na
Oklahoma	na	na	na	na	na	na	Expense	Unknown	na
Oregon	na	na	na	na	na	Unknown	Unknown	na	na
Pennsylvania	Unknown	na	Unknown	Unknown	na	Unknown	Unknown	na	na
Rhode Island	Expense	Expense	Expense	Expense	Expense	Expense	Expense	Expense	Expense
South Carolina	na	na	Expense	Expense	Expense	Expense	Expense	na	na
Tennessee	na	na	na	na	na	na	na	na	na
Texas (a)	na	na	na	na	na	Expense	Amortized	na	na
Utah	na	na	na	na	na	na	na	Unknown	na
Vermont	na	na	na	na	na	Unknown	Unknown	Unknown	na
Virginia	na	na	na	na	na	Expense	Expense	Unknown	na
Washington	na	na	na	na	na	Expense	Unknown	Unknown	na
West Virginia	na	na	Expense	na	na	Expense & Ratebase	Expense	na	na
Wisconsin	na	na	na	na	Expense	Expense	Expense	na	na
Wyoming	na	na	na	na	na	na	na	na	na
Total Commissions	12	8	14	18	11	28	27	11	3

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 11.

na = not applicable

Notes to table A-15:
(a) Texas. The Commission's water rights program requires a conservation plan before granting additional water rights.

TABLE A-16
TIMING OF REGULATORY TREATMENT FOR CONSERVATION IMPLEMENTATION EXPENSES

State Commission	Timing of Regulatory Treatment for Conservation Expenses Initiated by Regulation, Utility, or Both					
	Rate Case Prior to Program Implementation	Annual Pass-Through Adjustments	Special Rate Case Proceeding	Rate Case Following Program Implementation	Rate Case Following Review of Program Results	Other (a)
Alabama	na	na	na	na	na	na
Alaska	na	na	na	na	na	na
Arizona	No	No	No	Both	No	No
Arkansas	na	na	na	na	na	na
California	Utility	No	No	No	No	No
Colorado	na	na	na	na	na	na
Connecticut	No	No	No	Regulation	Regulation	No
Delaware	na	na	na	na	na	Not specified
Florida	Both	No	Both	Both	Both	No
Hawaii	na	na	na	na	na	na
Idaho	No	No	No	Both	No	No
Illinois	No	No	No	Utility	No	No
Indiana	na	na	na	na	na	na
Iowa	na	na	na	na	na	na
Kansas	na	na	na	na	na	na
Kentucky (b)	Utility	No	No	Utility	No	No
Louisiana	na	na	na	na	na	na
Maine	na	na	na	na	na	na
Maryland	na	na	na	na	na	na
Massachusetts	No	No	No	Utility	No	No
Michigan	No	No	No	Both	No	No
Mississippi	na	na	na	na	na	na
Missouri	No	No	No	Utility	No	No
Montana	na	na	na	na	na	Not specified
Nevada	No	No	No	Both	No	No
New Hampshire	na	na	na	na	na	na

TABLE A-16 (continued)

State Commission	Timing of Regulatory Treatment for Conservation Expenses Initiated by Regulation, Utility, or Both					
	Rate Case Prior to Program Implementation	Annual Pass-Through Adjustments	Special Rate Case Proceeding	Rate Case Following Program Implementation	Rate Case Following Review of Program Results	Other (a)
New Jersey (c)	Both	No	No	No	No	No
New Mexico	na	na	na	na	na	Not specified
New York	Both	No	No	Both	No	No
North Carolina	na	na	na	na	na	Not specified
Ohio	No	No	B	Both	Both	No
Oklahoma	No	No	No	Both	No	No
Oregon	na	na	na	na	na	Not specified
Pennsylvania	No	No	No	Utility	No	No
Rhode Island	Utility	No	No	No	No	No
South Carolina	No	No	No	Regulation	No	No
Tennessee	na	na	na	na	na	na
Texas	na	na	na	na	na	na
Utah	na	na	na	na	na	na
Vermont	No	No	Utility	No	Utility	No
Virginia	No	No	No	Utility	No	No
Washington	No	Utility	Utility	No	No	No
West Virginia	na	na	na	na	na	Not specified
Wisconsin	na	na	na	na	na	Not specified (d)
Wyoming	na	na	na	na	na	na
Total Commissions	6	1	4	16	4	7

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 12.

na = not applicable or not available

Notes to table A-16:

(a) For all jurisdictions, conservation expenses could be addressed in a regular rate case proceeding.

(b) Kentucky. The timing depends on whether the program cost is known and measurable.

(c) New Jersey. Conservation reports and programs are required by the Department of Environmental Protection and Energy; the board does not mandate conservation programs. All major investor-owned purveyors have conservation programs in place.

(d) Wisconsin. These expenses (tables A-14 and A-15) generally are not applicable except for meter testing and leak detection programs that would be considered in the general rate case process.

TABLE A-17
REGULATORY INCENTIVES AND DISINCENTIVES FOR CONSERVATION

State Commission	Does the commission provide incentives for utilities to implement demand-side management?	Has the commission ever disallowed a water conservation expenditure?	Has the commission ever approved specific costs for one water utility and not another?	What justification must utilities provide for their conservation program?	Is further justification required if the program is utility sponsored but not commission-mandated?
Alabama	No	No	No	na	na
Alaska	No	No	No	na	na
Arizona	Deferred recovery	No	No	Cost-effectiveness (a)	No
Arkansas	No	No	No	na	na
California	No	Yes (b)	No	Cost-effectiveness	No
Colorado	No	No	No	na	na
Connecticut	Deferred recovery, ratebasing & return on equity adjustments	Yes	Yes	Cost and method of distributing conservation kits	Yes
Delaware	No	No	No	State or county sponsor	No
Florida	No	No	No	Goal of program & cost-benefit analysis	Prudence of costs would be more carefully reviewed
Hawaii	No	No	No	na	na
Idaho	No	No	No	na	na
Illinois	No	No	No	na	na
Indiana	No	No	No	Same as other rate-base expense	No
Iowa	No	No	No	na	na
Kansas	No	No	No	na	na
Kentucky	No	No	No	Expenses must be documented	No
Louisiana	No	No	No	na	na
Maine	No	No	No	na	na
Maryland	No	No	No	na	na
Massachusetts	No	No	No	na	na

TABLE A-17 (continued)

State Commission	Does the commission provide incentives for utilities to implement demand-side management?	Has the commission ever disallowed a water conservation expenditure?	Has the commission ever approved specific costs for one water utility and not another?	What justification must utilities provide for their conservation program?	Is further justification required if the program is utility sponsored but not commission-mandated?
Michigan	No	No	No	Excessive cost of alternatives (c)	No
Mississippi	No	No	No	na	na
Missouri	No	No	No	Proof of just and reasonable expense	No
Montana	No	No	No	na	na
Nevada	No	No	No	Cost-effectiveness	No
New Hampshire	No	No	No	na	na
New Jersey	No	No	No	na	na
New Mexico	No	No	No	No	na
New York	Decoupling, deferred recovery, & shared savings	No	No	Verify actual expenses	Cost justified by benefits
North Carolina	No	No	No	na	na
Ohio	No	No	No	Proof of need & comparison to alternatives	Maybe
Oklahoma	No	No	No	Benefits to ratepayers	No
Oregon	No	No	No	na	na
Pennsylvania	No	No	No	Basic support	No
Rhode Island	No	No	No	Costs shown on financial statements	No
South Carolina	No	No	No	Regulation requirements	No
Tennessee	No	No	No	na	na
Texas	No	No	No	na	Benefits to customers
Utah	No	No	No	na	na
Vermont	No	No	No	na	na

TABLE A-17 (continued)

State Commission	Does the commission provide incentives for utilities to implement demand-side management?	Has the commission ever disallowed a water conservation expenditure?	Has the commission ever approved specific costs for one water utility and not another?	What justification must utilities provide for their conservation program?	Is further justification required if the program is utility sponsored but not commission-mandated?
Virginia	No	No	No	Insufficient service capacity	Possibly demonstrated need
Washington	Lost-revenue adjustment (e)	No	No	na	na
West Virginia	No	No	No	na	na
Wisconsin	No	No (f)	No	na	na
Wyoming	No	No	No	na	na
Total Commissions	4	2	1	17	6

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 13-17.

na = not applicable

Notes to table A-17:
(a) Arizona. Evidence that conservation is a good method of achieving sufficient water to meet demand versus other alternatives; compliance with state statutes or regulations.
(b) California. Must be shown to be cost effective before the fact; those requests for cost approval that do not contain this are rejected. There is no mandated conservation program.
(c) Michigan. Maintenance, repair, replacement, and production and treatment costs must be considered excessive.
(d) Virginia. The utility would or may be required to demonstrate the need for increasing-block rates.
(e) Washington. Calculation of lost sales due to converting from flat rates to metered rates.
(f) Wisconsin. Some utilities have conducted studies but the commission has not authorized conservation rates as a result of these studies.

TABLE A-18
COMMENTS ON CURRENT WATER CONSERVATION POLICIES AND PRACTICES

Commission	Comments
Alabama	None.
Alaska	None.
Arizona	Arizona has statutes that require management of water resources. These statutes require land developers in designated conservation areas to obtain certification of a hundred year water supply before subdividing land. The Commission requires that these certifications be obtained before granting line extensions. Conservation is encouraged with increasing block rate designs, and cooperation with other agencies with conservation missions. Company may be fined or required to implement conservation programs to met ground water withdrawal targets that use a prior years per capita usage as a base. The Commission supports these efforts.
Arkansas	Water conservation and least-cost or integrated resource planning has not been issues at the Commission
California	The Commission has endorsed the State's policy of conservation, however, it has not undertaken overt action other than requiring class A utilities to prepare "Water Management Plans."
Colorado	The Commission has not addressed water conservation or least-cost planning with water utilities. The Commission only regulates three water utilities, two of which have less than 350 customers. Due to the limited financial viability of small water companies, they are being merged into adjacent water districts in order to be able to provide service.
Connecticut	Integrated resource planning is required based on Memoranda of Understanding between DEP, DPUC, and DHS
Delaware	None.
Florida	The Commission promotes water conservation and believes that pricing is one factor in achieving that goal.
Hawaii	The Commission has not adopted policies or practices on water conservation and least-cost planning.
Idaho	This is a relatively new area for the Commission. The Commission has expressed support for water conservation from both cost-of-service and environmental points of view.
Illinois	Water rates are established on cost-of-service principles. Blocks are designed for classes, so that water used outdoors is not charged at a lower rate. Water supply is generally adequate throughout the state. The Commission discourages wasteful use.
Indiana	None.
Iowa	None.
Kansas	The Commission's draft Integrated Resource Plan does not include jurisdictional water utilities.
Kentucky	None.

TABLE A-18 (continued)

Commission	Comments
Louisiana	None.
Maine	None.
Maryland	The Commission has recently formed an Integrated Resource Planning Division that, to date, deals primarily with the electric/gas utilities. To date, water conservation has not been a major issue with the water utilities.
Massachusetts	The Commission does not have a policy on conservation or least-cost planning for water utilities.
Michigan	Answers to the survey reflect very general policies that are flexible according to the utility involved. Michigan has very little problems with meeting the demands of water customers' use.
Mississippi	None.
Missouri	All water systems must be metered. All reason measures must be taken to account for water produced.
Montana	None.
Nevada	None.
New Hampshire	The Commission exercises an open generic water least-cost planning docket. DE 93-029 is currently pending.
New Jersey	The Commission has three agencies involved in conservation of water resources; Board of Regulatory Commissions, Department of Environmental Protection and Energy, and Delaware River Basin Commission. Through interaction with the National Association of Water Company's all major investor owned purveyors have some type of conservation program, which focuses on customers' "wise use" of water. New Jersey does not have a supply problem. But, distribution is a problem in certain areas during periods of heavy demand and hot weather.
New Mexico	A Integrated Resource Plan rule is pending. The proposed rule would require plans from all state public water systems of more than 15 connections or serving 25 or more customers. More than 90% of these are currently outside the Commission's jurisdiction.
New York	None.
North Carolina	The Commission has not addressed least-cost or integrated resource planning for water utilities.
Ohio	The Commission staff is reviewing integrated resource and least-cost planning. The Commission enforces a water restriction regulation.
Oklahoma	None.
Oregon	Most of Oregon's regulated water utilities are very small. Consequently, they do not undertake formal water conservation programs.
Pennsylvania	The Commission does not believe that conservation rates such as inverted rate structures produce conservation results. Customers traditionally do not do interim meter readings.

TABLE A-18 (continued)

Commission	Comments
Rhode Island	Some utilities have revenue set aside in a restricted conservation account.
South Carolina	None.
Tennessee	None.
Texas	The Commission utilizes inclining block rates frequently to assure that high use customers pay for excess facilities required. Utilities are required to devise a rationing plan for use during emergency periods. The Commission will encourage the largest purveyors to develop conservation plans in the near future.
Utah	None.
Vermont	No policies are currently implemented or practiced. However, the Commission foresees future filings for the adoption of least-cost, conservation, and integrated resource plans in the case of electric utilities.
Virginia	Currently, the Commission does not have any formal policies regarding water conservation and least-cost or integrated resource planning. For the most part, the state's privately owned systems are not affected by water shortages. However, in situations where a utility is experiencing rapid growth in demand, water outages, low-pressure problems, or other supply related service problems, increasing-block rate structures are recommended.
Washington	The Department of Health has primacy in Washington. The Department of Health requires that Comprehensive Plans be filed, which includes conservation planning goals.
West Virginia	None.
Wisconsin	To date, the Commission has not issued orders or done studies related specifically to water conservation issues. However, despite Wisconsin's abundant fresh water supplies staff is beginning to develop commission policy relating to conservation issues. This subject is part of the Water Division's strategic plan to develop in the next year.
Wyoming	Wyoming has only 20 water utilities subject to commission jurisdiction. Most of them are very small (serving fewer than 20 customers). Given the size of these utilities, when a rate application is submitted (averaging perhaps one per year), the key element involved is financial survival with the avoidance of rate shock; rate design is not an issue. There are no Class A water utilities in Wyoming. With this explanation, the commission has not felt the need to concern itself with integrated resource plans or conservation issues for water utilities.

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities, question 18.

TABLE A-19
SURVEY RESPONDENTS

State Commission	Staff Member Contact	Telephone Numbers
Alabama Public Service Commission	Stephen Bartelt	205-242-5211 Office 205-240-3161 Fax
Alaska Public Utilities Commission	Bill Marshall Joe Franco	907-276-6222 Office 907-276 0160 Fax
Arizona Corporation Commission	Calvin Nowack	602-542-3990 Office 602-542-3071 Fax
Arkansas Public Service Commission	Jeff Stalnaker	501-682-2051 Office 501-682-5864
California Public Utilities Commission	Robert E. Penny	415-703-1778 Office 415-703-1965 Fax
Colorado Public Utilities Commission	Frank Shafer	303-894-2000 Office 303-894-2065 Fax
Connecticut Department of Public Utility Control	Arthur Gamache	203-827-2600 Office 203-827-2613 Fax
Delaware Public Service Commission	Malak Michael/Kevin Neilson	302-739-3227 Office 302-729-4849 Fax
Florida Public Service Commission	Bill Lowe	904-488-7181 Office 904-487-0509 Fax
Hawaii Public Utilities Commission	Paul Shigenaga Henry Tsayemura	808-586-2020 Office 808-586-2066 Fax
Idaho Public Utilities Commission	Stephanie Miller	208-334-0300 Office 208-334-3762 Fax
Illinois Commerce Commission	Thomas Stack	217-782-7295 Office 217-782-1042 Fax
Indiana Utility Regulatory Commission	Michael Gallagher Adam King	317-232-2701 Office 317-232-6758 Fax
Iowa Utilities Board	William Adams	515-281-5979 Office 515-281-5329 Fax
Kansas Corporation Commission	Edward G. Kurtz David Daltimore	913-271-3215 Office 913-271-3354 Fax
Kentucky Public Service Commission	Jack Kaninberg	502-564-3940 Office 502-564-7279 Fax

TABLE A-19 (continued)

State Commission	Staff Member Contact	Telephone Numbers
Louisiana Public Service Commission	Robert Crowe Harold Lasserre, Jr.	504-342-4427 Office 504-342-7279 Fax
Maine Public Utilities Commission	Jim Buckley	207-287-3831 Office 207-287-1039 Fax
Maryland Public Service Commission	Joseph Walter	410-767-8000 Office 301-333-6495 Fax
Massachusetts Department of Public Utilities	Paul E. Osborne	617-727-3597 Office 617-723-8812 Fax
Michigan Public Service Commission	W. English	517-334-7266 Office 517-882-5170 Fax
Mississippi Public Service Commission	C. Keith Howle	601-961-5476 Office 601-961-5804 Fax
Missouri Public Service Commission	Mark Oligschlaeger	314-751-7131 Office 314-526-3484 Fax
Montana Public Service Commission	Ron Woods	406-444-6199 Office 406-444-7618 Fax
Nevada Public Service Commission	Mike Chapman	702-687-6001 Office 702-687-6110 Fax
New Hampshire Public Utilities Commission	Eugene Sullivan	603-271-2431 Office 603-271-3878 Fax
New Jersey Board of Regulatory Commissioners	Paul Slevin	201-648-2026 Office 201-648-4298 Fax
New Mexico Public Service Commission	Angela Romero Stuart Hamilton	505-827-6918 Office 505-827-6973 Fax
New York Public Service Commission	Richard Crimmins	212-219-4395 Office 212-219-4362 Fax
North Carolina Utilities Commission	Danny Stallings	910-733-4249 Office 910-733-7300 Fax
Ohio Public Utilities Commission	Susan Daly	614-466-5634 Office 614-752-8353 Fax
Oklahoma Corporation Commission	Glen Gregory Kristin Schultz	405-521-2211 Office 405-521-6045 Fax

TABLE A-19 (continued)

State Commission	Staff Member Contact	Telephone Numbers
Oregon Public Utility Commission	Mike Myers	503-373-7394 Office 503-373-7752 Fax
Pennsylvania Public Utility Commission	Judith Koch Carlson	717-783-5392 Office 717-787-4193 Fax
Rhode Island Public Utilities Commission	John Milano	401-277-3500 Office 401-277-6805 Fax
South Carolina Public Service Commission	Charles Creech	803-737-5100 Office 803-737-5199 Fax
Tennessee Public Service Commission	Roger Knight	615-661-9335 Office 615-741-5015 Fax
Texas Water Commission	Steve Blackhurst Debi Carlson	512-239-6938 Office 512-239-6972 Fax
Utah Public Service Commission	Dan Bagnes	801-530-6680 Office 801-530-6512 Fax
Vermont Public Service Board	Susan Martin	802-828-2358 Office 802-828-2342 Fax
Virginia State Corporation Commission	Gail Frasetta John Stevens	804-371-9733 Office 804-371-7376 Fax
Washington Utilities and Transportation Commission	Fred Ottavelli	206-586-6436 Office 206-586-1150 Fax
West Virginia Public Service Commission	Cleo McGraw	304-340-0300 Office 304-340-0325 Fax
Wisconsin Public Service Commission	David Sheard	608-266-3547 Office 608-266-3957 Fax
Wyoming Public Service Commission	Steve Oxley	307-777-7427 Office 307-777-5700 Fax

Source: 1993/1994 NRRI Survey on State Commission Regulation of Water Utilities.

NRRI Survey Instrument

To: ______________________________
Commission: ______________________________
From: Janice A. Beecher, NRRI (614) 292-1834 FAX: (614) 292-7196

Please help us in our current research on water conservation by completing the following questionnaire, which can be returned by mail or fax. The results will appear in an upcoming NRRI research report. Your participation, as always, is greatly appreciated.

1. **Number of water utilities under your jurisdiction**	**Number**	**Number serving >3,300 pop.**	**Nature of jurisdiction (Please indicate whether jurisdiction is comprehensive (rates & more), limited, etc.:**
Investor-owned	______	______	______________________
Municipal ______	______		______________________
County	______	______	______________________
Water Districts	______	______	______________________
Cooperatives	______	______	______________________
Homeowners' assoc.	______	______	______________________
Other:			
____________	______	______	______________________
____________	______	______	______________________

2. **Does your commission have a policy concerning water conservation in general?**
Yes _____ No _____
If so, how was it established?
Statute _____ Rule or regulation _____ Policy statement _____ Generic Order(s) _____
Case by case _____ Other ______________________________
Please comment: ______________________________

3. **Does your commission have a policy concerning water conservation pricing?**
Yes _____ No _____
If so, how was it established?
Statute _____ Rule or regulation _____ Policy statement _____ Generic Order(s) _____
Case by case _____ Other ______________________________
Please comment: ______________________________

4. **Regarding marginal-cost (or incremental) pricing for water utilities, has your commission:**
   Encouraged marginal-cost pricing _____
   Discouraged marginal-cost pricing _____
   Neither encouraged or discouraged marginal-cost pricing or never considered it ______
   Please indicate the number of water utilities under your commission's jurisdiction for which marginal-cost pricing has been approved: Number of utilities ________

   Has your commission approved marginal-cost pricing for <u>other</u> (<u>non-water</u>) utilities under its jurisdiction? Yes _____ No _____

5. **For water utilities, please indicate which of the following rate structures are used and the approximate number of utilities using them. Also, <u>please note</u> whether the use of the rate structure is generally limited to <u>smaller or larger</u> systems or to certain customer classes (<u>residential or nonresidential</u>):**

	Number of utilities (<u>Notes</u>)
Flat (unmetered) charges _____	______________________
Decreasing block rates _____	______________________
Uniform rates _____	______________________
Increasing block rates _____	______________________
Seasonal rates _____ _______	______________________
Excess use rates _____	______________________
Other _______________	______________________
______________________	______________________

For water utilities, has your commission ever approved any of the following rate structures <u>expressly for conservation purposes</u>:

	Number of utilities (<u>Notes</u>)
Uniform rates _____	
Increasing block _____	______________________
Seasonal rates _____	______________________
Excess use _____	______________________
Other _______________	______________________
______________________	______________________

For water utilities, has your commission ever approved any of the following rate structure features:

	Number of utilities (<u>Notes</u>)
Penalty charges _____	______________________
Daily peak load pricing _____	______________________
Off-peak discounts _____	______________________
Lifeline rates _____	______________________
Other _______________	______________________
______________________	______________________

6. For water utilities, please indicate which of the following billing cycles are used and the approximate number of utilities using them. Also, please note whether the use of the billing cycle is generally limited to smaller or larger systems or to certain customer classes (residential or nonresidential):

	Number of utilities (Notes)
All customers	
Monthly _____	____________________
Bimonthly _____	____________________
Quarterly _____	____________________
Semiannually _____	____________________
Annually _____	____________________
Other _____	____________________
Residential/nonresidential	
Monthly residential and quarterly nonresidential	____________________
_________ residential and _________ nonresidential	____________________
Other	
____________________	____________________
____________________	____________________
____________________	____________________

Has your commission ever approved a change in a utility's billing cycle for the purpose of promoting conservation or other policy goals?
Yes _____ (Number of utilities _____) No _____

Has your commission ever rejected a change in a utility's billing cycle for the purpose of promoting conservation or other policy goals?
Yes _____ (Number of utilities _____) No _____

If so, why:

____

____

Comment:

____

____

____

7. **Which of the following potential benefits associated with water conservation rates are reflected in your commission's policies? (Check as many items as you like.)**
Preserving water resources _____
Promoting efficient use of water resources _____
Shifting water demand to desired periods of the day, month, or year _____
Rewarding efficient water users _____
Discouraging discretionary or excessive use _____
Avoiding, reducing, or forestalling capacity expansion and expenditures _____
Avoiding or reducing social or environmental costs _____
Other ____

8. **Which of the following potential problems associated with water conservation rates are reflected in your commission's policies? (Check as many items as you like.)**
Potential inconsistency with "cost of service" principles _____
Difficulties in applying conservation rates across all user classes _____
Legal difficulties in some states with conservation rate methodologies _____
Potential instability of revenues _____
Possible adverse rate impacts on various classes of customers _____
Difficulties in predicting customer demand and revenues _____
Practical difficulties associated with marginal-cost pricing _____
Other ____

9. **What policies has your commission used to address the issue of potential revenue instability associated with conservation pricing:**
Phase-in plans _____
Revenue stabilization reserves _____
Service or other special charges _____
Adjustments in later rate cases _____
Rate structure modifications _____
Automatic annual surcharges _____
Other automatic adjustment clauses _____
Specify ______________________
Other ____

10. **What policies has your commission used to address the issue of surplus or deficit revenues associated with conservation pricing:**
Balancing accounts _____
Customer refunds _____
Rate structure modifications _____
Automatic surcharge the following year _____
Automatic adjustment to rate base _____
Surcharge or other adjustments _____
in subsequent rate case _____
Other automatic adjustment clauses _____
Specify ______________________
Other ____

11. **For each the following conservation measures that have been implemented by jurisdictional water utilities in your state, please indicate whether the measure was required by statute or regulation and how costs associated with the measure were treated in ratemaking (<u>for each item please indicate whether costs were allowed to be expensed, capitalized, or treated in other ways</u>)? Also indicate whether expenses related to these measures were ever disallowed by the commission (last column).**

Conservation Measure	Have any of the following measures ever been: Required by statute or regulation?	Ratemaking treatment	Initiated by the utility on its own?	Ratemaking treatment	Disallowed by the commission?
Purchase cost of residential retrofit kits	________	________	________	________	________
Labor/administration costs of retrofit programs	________	________	________	________	________
Water audits performed for customers by the utility	________	________	________	________	________
Labor and materials for public education initiatives	________	________	________	________	________
Follow-up surveys and pilot studies	________	________	________	________	________
Leak detection and repairs	________	________	________	________	________
Meter testing and repairs	________	________	________	________	________
Developing a conservation rate structure	________	________	________	________	________
Developing a demand-side management program	________	________	________	________	________
Other (specify): ______________	________	________	________	________	________

12. **Regarding recovery of conservation implementation costs, when is rate treatment generally resolved?**

Ratemaking Procedure	**Treatment of Conservation Related Costs:** If conservation measure is required by statute or regulation	If conservation measure is initiated by the utility on its own
Rate case prior to program implementation	______________	______________
Annual pass through adjustments	______________	______________
In a special rate case proceeding	______________	______________
Rate case immediately following program implementation	______________	______________
Rate case following review of program results (a few years later)	______________	______________
Other (specify):		
______________	______________	______________
______________	______________	______________

13. **Has your commission used any of the following incentive mechanisms for <u>water utility</u> demand-side management (DSM) programs (some of which are used in the electricity sector):**
    Decoupling of revenues from sales _____
    Balancing account treatment for DSM program costs _____
    Deferred recovery of DSM program costs _____
    Percentage markup of DSM expenditures _____
    Rate basing for DSM program costs _____
    Return on equity premium or bonus for rate based DSM investments _____
    Percentage share of DSM program savings _____
    Performance bonus per unit of DSM savings _____
    Overall return on equity adjustment _____
    Other incentives:
    ____
    ____
    ____

14. Has your commission ever disallowed an expenditure related to water conservation? Please explain:

____

____

____

15. Has your commission ever approved specific costs for conservation programs of one water utility and denied the same type of costs to another water utility? Please explain.

____

____

16. What justification must a water utility provide for its conservation program and related expenses, including specific documentation requirements? ______________________

____

____

17. Is further justification needed if the program is utility sponsored as compared with commission mandated programs? Please explain. ____________________________

____

____

18. Has your commission <u>required</u> a jurisdictional water utility to prepare a least-cost or integrated resource plan?
Yes _____ (Number of utilities ________) No _____

Have any jurisdictional water utilities prepared a least-cost or integrated resource plan <u>without</u> being required to do so by the commission?
Yes _____ (Number of utilities ________) No _____

19. Please use the following area to comment on the commission's current policies and practices in the areas of water conservation and least-cost or integrated planning.

____

____

____

____

____

____

Also, please send us copies of any commission policies, orders, or other materials related to the topics of water conservation and conservation pricing that you think might be useful for our study. Thank you again!

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