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White Paper

Revenue Effects of Conservation Programs: The Case of Lost Revenue

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Introduction

By helping customers reduce their water use, conservation programs can affect the amount of revenue collected by a water supplier. A utility's revenue requirements are divided by expected water usage to establish the rate charged for service for a specified period of time:

Revenue requirements / expected water usage = average rate

A reduction in water usage, therefore, can adversely affect the utility's ability to meet its revenue requirement over the term for which the rates are established. The potential impact of conservation is particularly noticeable if the utility practices full-cost ratemaking; that is, it recovers the entire cost of service through water rates and is therefore economically efficient. Rates that reflect the true cost of service induce efficient behavior on the part of both producers and consumers.

The impact is also more noticeable for systems that recover a significant portion of the revenue requirement through the fixed charge component of the rate design. In many cases, water systems cover a significant portion of *fixed costs* (for capacity) through the *variable charge* on the customer's bill.

The ability of a water utility to meet its revenue requirements is a legitimate concern. Failure to do so undermines the financial viability of the system and its ability to meet infrastructure and service needs. But the issue of "lost revenue" or "rate impacts" has sometimes been wrongly

used as a rationale to avoid water conservation. To understand the revenue and rate implications of conservation programs, one must examine how conservation programs affect water use in the short and long term *and* how water suppliers respond to reduced sales.

Lost Revenue in the Short Term: So long as any portion of a rate structure varies with the amount of water consumed, *short-term* water conservation will reduce revenues unless rate adjustments are made within the time frame for which revenue requirements and rates are established. Of course, adjustment mechanisms are available for this very purpose.

Thus, ensuring revenue neutrality requires inclusion of water conservation's effects in the ratemaking process. Attaining the same level of revenue entails imposition of a higher rate per unit of water on the anticipated sales volume, taking conservation into effect.

A further analytical complication is that rate increases associated with usage reductions (along with rate increases needed to meet rising costs) may exacerbate the dilemma of meeting revenue requirements. The demand response induced by the price elasticity of water demand may cause a further decline in usage, and further impair revenues. Because water usage is not considered highly price-elastic, this effect is not likely to be very significant. Nonetheless, it too must be taken into account when reconciling conservation and ratemaking.

Water systems and the public and private entities that manage them face a considerable public-relations challenge with regard to the conservation-rates linkage. The customer is asked to conserve water while being "rewarded" with a rate increase. Revenue neutrality would suggest that, on average, the customer's total bill to the utility will be unchanged. Nonetheless, the uneducated customer may believe that their sacrificed usage is unfair in light of no appreciable financial benefit in the form of a reduced bill. Ideally, customers will not equate water conservation with lifestyle impairment; if they do, convincing them that conservation is a good deal is harder still.

The general political unpopularity of rate increases adds to the conundrum, and may explain the frequent disconnect between water conservation programs and ratemaking. Though many

customers may not know the volumetric rate they pay for water, most customers do recoginized increases in their water *bill*. Though the distinction between rates and bills may at first seem subtil, it is key to understanding the long term role of conservation in minimizing customer bills. It is to this long term role of water conservation that we now turn.

Lost Revenue in the Long Term: A short-term perspective emphasizing revenue effects may disfavor the implementation of beneficial water conservation programs. Understanding the true impact of water conservation, however, requires a less myopic, long-term view. In the short term, the utility may have little control over its cost structure, particularly its fixed costs. Water conservation will help reduce the variable costs of operation, particularly in the areas of energy and chemicals. As noted, however, the coverage of fixed costs is problematic when water usage is reduced in the short term.

In the long term, however, "all costs are variable." Beneficial conservation means that total benefits, taking resource values into account, exceed total costs. Water conservation will help utilities avoid both fixed capital and variable operating costs by avoiding investments in unnecessary capacity to meet inflated demand for water services.

Indeed, the whole idea of implementing cost-effective conservation programs is to lower the *long term* cost structure and thereby reduce the revenue requirements of the water utility. By putting off the day that expensive capacity additions are required, long-term conservation can result in customer bills that are lower than they would be otherwise. The communications challenge to the utility is to educate customers about the long-term benefits of water conservation in terms of lower costs to both the utility and to the people it serves.

Distributional Issues: The revenue effects of conservation can be evaluated in terms of distributional consequences. Who are the winners and losers? Absent a revenue-neutral rate adjustment, the customer participating in conservation is a "winner" with a reduced water bill; the water utility is a "loser" in terms of reduced revenues. Resources are distributed toward consumers and away from the utility. If the utility is not recovering costs, however, the result is economic inefficiency.

Solutions to the revenue issue also have distributional consequences. If the water agency increases the water rates to attain revenue neutrality, the winners and losers are altered. The participants in conservation programs would not gain as much because their water bills would not be reduced. Nonparticipants would be adversely affected because higher rates would be applied to higher usage (that is, higher than the usage of participant-customers), thereby causing higher bills.

The fairness of these distributional outcomes may be debated. In general, however, full-cost ratemaking that assigns costs to cost-causers is considered more "fair" than the alternatives because it accurately reflects the value of resources and helps customers to make more informed decisions about their water use.

Lost Revenue from Three Perspectives

Is "lost revenue" really lost? Is lost revenue a cost? What is the true nature of lost revenues? The issue of lost revenue is examined here using the logic of cost-benefit analysis from three perspectives: the perspective of society as a whole, the perspective of the water supplier, and the perspective of water customers.

(1) **Societal Perspective:** From the perspective of society as a whole, revenue lost to the water supplier due to conservation programs is revenue gained (because it is not paid) by the water customer. In a cost-benefit framework, this distributional effect is termed a transfer payment. Narrowly, transfer payments are not included as a cost or benefit in cost-benefit analyses from society's perspective. Each dollar "lost" to the water supplier is exactly matched by a dollar "gained" by the water customer. Broadly, however, the inefficiency associated with under-pricing and under-recovering of revenues relative to the value of water service will have adverse consequences in terms of the sustainability of the system and the efficiency of production and usage. Thus, there is a "cost" to society associated with lost revenues. The picture brightens in the long-term for society if

prices are aligned with costs, which in turn are aligned with efficient levels of conservation and usage.

(2) Supplier Perspective: For the water supplier, the short-term loss of revenue represents a genuine cost. In fact, the prospective of lost revenue can be a significant disincentive for implementing conservation programs, despite long-term benefits. Assuming a reasonably efficient operational utility, reduced revenues in the short term may force harmful cost cutting. Conservation programs themselves may fall victim to short-term cost controls made under duress. Absent a revenue-adjustment mechanism, revenue deficiencies may translate into service problems. Again, however, the long-term perspective changes the perception of benefits and costs. Most conservation programs save water over a multiple-year period. Sound planning and ratemaking to maintain revenue neutrality over the long term will help the system keep revenues and costs in alignment. Indeed, the assumption that long-term conservation would cause unrecoverable lost revenue constitutes an implausible planning assumption because water utilities that incur revenue shortfalls year after year would certainly not be financially viable in the long term.

Under the more reasonable planning assumption that utilities desire financial sustainability, rates will be adjusted to ensure full-cost recovery. Under these conditions, there is no lost revenue due to conservation. Full-cost recovery also includes any other costs associated with ratemaking, including demand analyses, cost-of-service studies, and financing costs associated with any lag between the incurrence of a cost and its recovery. From the supplier's perspective, then, the revenue effects of water conservation can be fully addressed through utility planning and ratemaking.

The cost effects of water conservation from the water supplier perspective also need to be addressed. For public projects there is well established precedence for establishing a correspondence between the incidence of project costs and the generation of project benefits. Most traditional water supply projects, for example, are paid for by issuing bonds that are repaid over the useful life of the project; this ensures that payment for the project corresponds to the benefits it generates. Long term conservation programs, under a similar logic, should be "financed" so that payment for programs correspond to the benefits they generate.

(3) **A Customer's Perspective:** From a customer's perspective, the cost or benefit of conservation programs can be measured in terms of total water bills. In the short term, as noted, revenue neutral rates will mean that customers may not see a reduction in their water bills. However, cost-effective conservation programs will lead to water bills that are relatively lower over the long run. Conservation programs also tend to have distributional effects. Participants will tend to see lower bills relative to nonparticipants even if rates are increased due to reduced water consumption. Nonparticipating customers can see slightly higher bills if rates are adjusted to ensure revenue neutrality and their water usage remains constant. Because water conservation will lower total system costs over the long term, all customers will benefit regardless of whether they participated directly in a water conservation program. In reality, of course, customer effects are complicated by additional factors. Different customer groups—residential customers v. large-volume customers, low-income v. high-income customers, and so on—may experience different outcomes depending on their water usage habits as well as characteristics of the utility's rate design.

Planning for Conservations Effect on Utility Revenue and Costs

The revenue effects of water conservation are manageable when viewed from a planning perspective and when planning and ratemaking are integrated. With adequate planning, uncertainty and adverse consequences are greatly reduced. Planning along with an integrated ratemaking strategy will help utilities actively manage revenue effects, rather than simply react to them.

How can utilities actively manage revenue effects? Some basic tools are available:

(1) Use forward-looking data when establishing revenue requirements (a "future test year"), taking planned usage changes and all program implementation expenses into account (including ratemaking expenses).
(2) Conduct a demand analysis based on alternative plausible scenarios to more accurately predict usage with the introduction of water conservation programs.
(3) Integrate findings from the demand analysis in a cost-of-service study to establish cost-based rates.

(4) Implement a demand response/revenue-adjustment surcharge in order to make periodic (quarterly or otherwise) adjustments to base rates between major rate adjustments used to re-establish revenue requirements.
(5) Consider the joint effects of program-induced and price-induced conservation on usage and revenues.
(6) Conduct regular audit and reconciliation procedures to ensure against over-collection of revenues from customers, particularly when adjustment mechanisms are used.
(7) Communicate the long-term benefits of conservation to water system customers and explain the role of cost-based rates in achieving efficiency goals.
(8) Avoid postponing necessary rate increases and practice gradualism in ratemaking to reduce "rate shock."
(9) Evaluate revenue requirements on an annual basis to ensure that costs and rates are properly aligned.
(10) Explicitly incorporate a degree revenue uncertainty into the integrated planning and ratemaking processes, and the overall operation of the utility, in order to better understand and manage its effects.
(11) Consider funding of long term conservation programs through long term financing. Just as no one would consider funding a dam through current operating expenses, there is also a solid case for financing water conservation programs.

It should be noted that different types of water systems may have more or less discretion in these areas depending on their ownership and management structure. Investor-owned water utilities are subject to the jurisdiction of the Public Utilities Commission in California. Particular ratemaking strategies are therefore subject to commission review and approval. Although a constraint for some potential solutions (including the use of adjustment mechanisms) regulation also supports full-cost ratemaking and provides a degree of accountability. In the absence of an approved rate-adjustment mechanism, a regulated utility may need to seek more frequent rate adjustments and bear the burden of proof of their necessity.

For water systems, the short-run challenge is to manage the effect of lost revenue on cash flows needed to cover all fixed and variable costs and system financial viability. Because conservation will reduce variable costs in the short run, the problem is best understood as a net-revenue problem.

The long-term challenge for water systems is to incorporate revised usage patterns, following the implementation of conservation strategies, into capital investment and operating decisions. Utilities can estimate the "yield" of conservation programs, which will in turn help them

explicitly avoid unnecessary costs. The avoided cost of conservation, or its benefit, is the difference between costs incurred with conservation and costs incurred without conservation.

For both the short and long term, a reasonably accurate understanding of the relationship between water usage and revenue requirements is essential for implementing ratemaking strategies to minimize the lost-revenue effect and maximize the long-term benefits of conservation. By addressing the lost-revenue issue, several goals are achieved:

- The utility is not harmed by beneficial conservation behavior in the short or long term and therefore not discouraged from implementing programs.
- Costs and prices are kept in alignment, promoting efficiency production and consumption.
- Cash flow is maintained for the financial health of the utility and the support of vital programs, including conservation programs.

What to say. How should water conservation planners respond to the concern that reductions in usage cause the system to lose revenues?

- The issue of lost revenues may not be a concern to customers, who might actually view it as a benefit, but it is a real problem for utilities.
- In the long-term, utilities and customers benefit from an efficient alignment of costs and revenues.
- Lost revenues are a short-term problem; in the long-term, the benefits of conservation for everyone far outweigh the costs.
- Revenue losses are only a problem if appropriate mitigative measures are not taken.
- Water utilities can ameliorate lost revenues through integrative planning and ratemaking.

Where to go for Help: Additional Resources

The CUWCC Handbook, *Designing, Evaluating, and Implementing Conservation Rate Structures,* contains many technical resources for conservation rate design including an annotated bibliography in Appendix A. Other resources that directly address the revenue effects of conservation include:

Revenue Effects of Water Conservation and Conservation Pricing (1994)
Beecher, J.A., P.C. Mann, Y. Hegazy, J.D.Stanford

National Regulatory Research Institute, NRRI Report No. 94-18
This report represents an early attempt to define the revenue effects of water conservation programs and the role of pricing in inducing conserving behavior. As an NRRI report, it pays special attention to the institutional constraints of regulated water utilities. The report clearly lays out the institutional disincentives for private and public utility support of water conservation. It also lays out the case for the potential benefits provided by conservation programs in concrete terms of the avoided supply development and treatment costs. Chapter 2 provides an overlook of the requirements of integrating conservation into water utility planning. Incorporation of conservation into demand forecasts is stressed. Chapter 3 discusses the instrumental use of water rates as a means of informing customer water use decisions. Chapter 4 analyzes the ratemaking incentives for promoting utility-sponsored conservation. It specifically mentions "lost revenue" in pointing to the need for regulatory solutions in removing the disincentive for regulated water utility sponsorship of conservation. Chapter 5 provides a survey of Commission practices in water conservation and conservation pricing.

Managing the Revenue and Cash Flow Effects of Conservation (1996)
Vista Consulting Group
AwwaRF Report ISBN0-89867-845-5
www.awwarf.com/exsums/90686.htm

This report discusses the financial impacts of conservation in the short and long run. Chapter 2 provides a conceptual model for the effect of conservation on utility revenue and cash flow. Chapter 3 stresses the need to better analyze and understand customer demand in order to better predict the revenue effects of conservation. Using an example, Chapter 4 illustrates how utility managers can assess the financial impacts of conservation programs. Chapter 5 looks at cost analysis for determining the effect of conservation on system cost, providing a cursory overview of marginal costing methods. Chapter 6 discusses price elasticity and its relevance for utility financial planning.

Long-Term Effects of Conservation Rates (1997)
Vista Consulting Group, Integrated Utilities Group, Inc., John Russell Associates, Inc.
AwwaRF Report, ISBN0-89867-904-4
www.awwarf.com/exsums/9723.htm

This report contains a spreadsheet rate model to help depict a before and after picture of utility demand, revenue, and costs. It is the companion report to the one mentioned above. The rates

model is constructed using Lotus version 5. A user manual, tables from the rate model, and a diskette containing the rate model are included with the report.

Revenue Instability and Conservation Rate Structures
Chesnutt, T., J. Christianson, A. Bamezai, C. McSpadden, and M. Hanemann
AwwaRF Report, ISBN0-89867-818-8
www.awwarf.com/exsums/90681.htm

This report measured revenue instability in two large water utilities to quantify the extent to which conservation pricing made revenue more variable. The report finds that any rate structure containing a volumetrically based water rate will vary when sales volume varies—The question is one of degree. The report provides a discussion of mechanisms to cope with revenue uncertainty, including contingency funds, rate adjustment mechanisms, more frequent rate adjustments, and management approaches to cost efficiency. The report concludes with the finding that water rates need to be an integral part of Demand Side Management (DSM) programs.

Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs, EPA 832-B-02-003 (Call 513.489.8190 to order by publication number)
This handy study contains case studies that document the monetary savings produced by water efficiency programs.

"Conservation Rates in the Real World", Journal AWWA, (February 1998)
Summary of CUWCC's award winning handbook for designing, evaluating, and implementing conservation rate structures.

Designing, Evaluating, and Implementing Conservation Rate Structures (1997)
CUWCC's technical handbook for water managers to aide in the design, evaluation, and implementation of conservation rate structures. A detailed summary appears on the following page.

A Guide to the CUWCC handbook
Designing, Evaluating, and Implementing Conservation Rate Structures

Overview — Conservation and Rates

Chapter 1 gives a brief overview of conservation and water rates. If water is over- or under- priced, inefficient water use will likely result.

Chapter 2 provides a view of the process of water rate-setting. Before you can determine how to get to where you want to go, it is helpful to know your current location.

Chapter 3 discusses desirable criteria for a water rate structure. These criteria constitute a standard to judge rate alternatives. These criteria for selecting a rate structure will be later referenced after the effects of alternative rate structures have been evaluated.

Part I—Designing Conservation Rates

Chapter 4 briefly address some of the arcana in a rate designer's toolbag - revenue requirements, cash needs, and "test" year. This handbook makes the conceptual distinction between the level of rates (how much revenue they will generate) and the rate structure (the "shape" of rates that additionally determine the incentive effects).

Chapter 5 examines the time-tested standard of reasonableness of a rate structure: the extent to which water rates reflect the cost of providing water service. The concept of conservation-oriented rates is best understood through the relationship of rates to costs.

Chapter 6 provides a decision structure for conservation rate design and specific guidance on the design of alternative rate forms. How can rates be designed to meet revenue requirements and reflect full costs?

Chapter 7 develops strategies to manage the revenue effects of conservation rates.

Part II—Evaluating Conservation Rates

Designing better water rates requires information of the effects of alternative rate structures—on water demand, on water utility finances, and on paying customers. **Chapter 8** first provides a structure for rate evaluation. Because any evaluation results depend on available data, the data requirements are first addressed. Next, the analytic methods that can measure the effect of alternative rate structures on demand, revenue, and customer bills are laid out. Examples are provided in accompanying spreadsheets (*demand.xls*, *revenue.xls*, and *bills.xls*). Last, methods to connect the quantification of these effects with the desired criteria for a rate structure are discussed.

Part III—Implementing Conservation Rates

Chapter 9 provides recommendations for ensuring the smooth implementation of a conservation rate structure. Separate sections are provided to give guidance for different audiences—management within the agency, the general public, and any approval process. The next section gives suggestions for designing customer bills to transmit a clear price signal. The final section provides suggestions for the evolving process of fine-tuning rates.

Chapter 10 presents four rate scenarios to illustrate the principals of conservation rate design. These rates appear in an accompanying spreadsheet, *rates.xlw*.

References

Amatteti, Edward. *Managing the Revenue and Cash Flow Effects of Conservation.* Prepared by Vista Consulting Group, Inc.; jointly sponsored by AWWA Research Foundation and U.S. Dept. of the Interior, Bureau of Reclamation, Technical Service Center, and Water Resources Research Laboratory. Denver, CO: AWWA Research Foundation and American Water Works Association, May 1996.

_____. *Long-Term Effects of Conservation Rates.* Prepared by Vista Consulting Group, Inc., Integrated Utilities Group, Inc., John Russell Associates, Inc.; sponsored by AWWA Research Foundation. Denver: AWWA Research Foundation: American Water Works Association, June 1997.

Beecher, Janice A., et al. *Revenue Effects of Water Conservation and Conservation Pricing: Issues and Practices.* NRRI 94-18. Columbus, OH: The National Regulatory Research Institute, September 1994.

Chesnutt, Thomas W., et al. *Revenue Instability and Conservation Rate Structures.* AWWA Research Foundation Order Number 60681. Denver: AWWA Research Foundation: American Water Works Association, September 1995.

Corral, Loeonardo Rafael, et al. *Price and Non-price Influences on Water Conservation: An Econometric Model of Aggregate Demand Under Nonlinear Budget Constraint.* CUDARE Working paper Series No. 881. Berkeley, CA: University of California Department of Agricultural and Resource Economics and Policy, 1999.

Hanemann, William Michael, et al. *Revenue Instability Induced by Conservation Rate Structures: An Empirical Investigation of Coping Strategies.* CUDARE Working paper Series No. 695. Berkeley, CA: University of California Department of Agricultural and Resource Economics and Policy, 1993.

Jordan, Jeffrey L. "The Effectiveness of Pricing as a Stand-Alone Water Conservation Program." American Water Resources Association Paper Number 93156. *Water Resources Bulletin,* Volume 30, Number 5 (October 1994), pages 871-877.

Moran, Alan. "Pricing Water for Conservation," Address to Earthwatch's Shearwater Conference, June 30, 2000, www.ipa.org.au/Speechesandsubmssns/amwater.html

Stallworth, Holly. "Conservation Pricing of Water and Wastewater." U.S. Environmental Protection Agency, Water Use Efficiency Program. www.epa.gov/owm/water-efficiency/index.htm, April 2000.