



# Declining Water Sales and Utility Revenues:

**A Framework for Understanding  
and Adapting**

National Water Rates Summit

Racine, Wisconsin  
August 2012

# SUMMIT SUMMARY

## Declining Water Sales and Utility Revenues

*A FRAMEWORK FOR UNDERSTANDING AND ADAPTING*

August 29 – 31, 2012

The Johnson Foundation at Wingspread

---

### Summary of the Identified Problem

In increasingly more regions across the United States, maintaining long-term water supply reliability has become an important concern. This concern has underscored the need for and the implementation of widespread water conservation efforts, and has spawned the creation of such organizations as the Alliance for Water Efficiency (AWE) to help water suppliers design appropriate responses.

Partly due to successful water conservation programs, improved water-saving fixtures and technology, and a number of other factors, both water sales and water-related revenues are falling on a national level. With sales and revenues declining, how can water utilities cover costs of water treatment and delivery? How can they cover the rising costs of infrastructure repair and replacement? Most importantly, how can they meet these costs while still encouraging much-needed conservation efforts?

This daunting question – dubbed the “conservation conundrum” – provided the backdrop and framing for the Declining Water Sales and Utility Revenues summit.

### Summary of the Process

The Alliance for Water Efficiency successfully convened this summit of water rates experts at the Johnson Foundation at Wingspread on August 29 – 31, 2012. Twenty-five industry experts participated, along with five observers. The experts included rate setters, economists, regulators, utility executives, and advocates. The conversation was wide-ranging and productive.

To prepare the attendees for the summit, Dr. Janice Beecher of Michigan State University’s Institute of Public Utilities and Dr. Thomas Chesnutt of A&N Technical Services prepared a framing paper and the Alliance for Water Efficiency hosted a webinar a week before the event. Subsequent to the summit, Drs. Beecher and Chesnutt incorporated elements of the discussion into a White Paper that was distributed to the participants, is available on AWE’s website, and will be the basis for subsequent working groups on the topic and presentations at professional meetings. This work was made possible by funding from the Walton Family Foundation.

The summit itself entailed seven elements. It began with opening presentations that framed the conversation as one that far transcended economics alone, introducing political, regulatory, social, and communication context as well. It then addressed five different discussion topics:

- 1) How and why are water sales declining?
- 2) Are water utility revenues falling short of revenue requirements?
- 3) Do water utilities and the conservation community have a messaging problem?
- 4) What methods are available to repair revenues and improve fiscal stability?
- 5) What role do industry standards, practices, and policy reforms play?

It concluded with a summary discussion of ways in which the thinking of the experts had shifted as a result of the summit conversation.

This document summarizes the compiled proceedings of the summit.

### **Framing Discussion: Politics and the “Conservation Conundrum”**

The economic and financial components of this conversation cannot take place without a profound discussion of political components as well. While the simultaneous needs for balanced budgets and water conservation are reasonably well accepted, political considerations alter the playing field. Despite politician’s good intentions, forces such as NIMTO – “not in my term of office” – and a desire for political advancement can inhibit approvals for rate increases. Most politicians’ primary motivation, after all, is to get reelected. Water boards tend to be a good starting point for young political aspirants. Raising rates is neither a road to reelection nor political advancement because of the unfortunate negative perception by the rate-paying public.

Furthermore, in many regions, water availability follows a pattern of boom and bust. In periods of shortage, water utilities encourage conservation, and consumers respond effectively. In periods of plenty, however, the pattern reverts. Utilities collect as much revenue as they can, and consumers feel confident that the supply will remain reliable well into the future.

The group as a whole embraced and expanded on these realities. Public dialogue in rate cases, while expensive, time consuming, and cumbersome, can help relieve the pressure on the rate case decision makers, especially when those decision makers are elected officials. However, they require planning, time, money, and hard work. Likewise, with education and a deeper understanding of the systemic consequences of unreliable water supplies, consumers could vote with their heads instead of their wallets; politicians and constituents alike need to be educated on issues related to water supply.

One proposed solution that was discussed entails shifting the onus of responsibility from elected to non-elected officials, appointed boards, or independent municipally owned corporations, thus putting distance between the electoral process and rate setting, sidestepping the re-election dilemma. Another entails engaging the “intense minority”: those individuals who care enough to make noise about an important issue.

Utilities are not free of responsibility in addressing this problem. Few utilities fully understand the reliability requirements or concerns of their customers. If the true costs of reliability could be effectively measured and communicated, consumers might be more willing to agree to the related costs.

### **Discussion #1:**

#### **How and why are water sales declining?**

The intent of the discussion was to lay a foundation for quantifying root causes of declining sales and declining revenues, thus potentially establishing a list of priorities for addressing the problem. What proportion is due to utility undercollection? To the relocation of industries? To the downturn in the economy? To stricter codes and standards? To active water conservation programs? The group, however, quickly shifted the direction because of the dynamic, constantly shifting nature of the playing field. No answer for one region could hold for others. This dynamic overtone of the conversation persisted throughout the summit.

The conversation began with a comparison of the Seattle and Denver areas. As the Seattle area experienced a drop in water usage, a suburban water agency did not interpret the available data quickly enough and did not adjust rates accordingly. As a result, it entered into unnecessary contractual agreements with water suppliers and is now buying unneeded water at a premium price. Part of the dilemma grew from unreliable demand forecasting. While utilities must make decisions based on forecasts, those forecasts often miss the mark. In practical terms, per capita water use in the region dropped by 20% to 50% because of a combination of code changes, more efficient use, active conservation programs, price, community education, and weather and rain patterns. The situation is not yet really changing: even as the population increases, water sales are declining, not for one reason, but for all of these reasons in shifting proportions.

Another challenge highlighted by this complexity is variability. Weather patterns shift continuously, economic conditions are cyclic, and neither is easily predictable.

Denver, on the other hand, saw its supplies dwindling as the population continued to grow. It responded by spending millions of dollars on a consumer education campaign that few smaller utilities could afford. The resulting conservation awareness and improved efficiencies stabilized the supply dilemma, and the city revised its rates to reflect a balance of declining sales despite increasing population. As a result, the city is tightly controlling the historical spikes in water sales that occur on very hot days. The city is now planning around the notion of a permanent decline in per capita usage.

Measuring demand presents a snapshot of the complexity of the dilemma: predicting water sales requires precise metering and more rigorous demand forecasts. Upgrading meters to measure lower flows, however, costs millions of dollars. Building that money into the budget is challenging and time consuming, especially in light of the fact that the outcome simply reflects more accurate billing and consumption records. Past methods of straight-line extrapolation of per-capita consumption are no longer valid. Accurately measuring and predicting the effects of climate change simply cannot be done. Despite the complexity of these challenges, the group

agreed that better methods for estimating future demand and converting to modern, more accurate metering are important and necessary steps nationwide.

The discussion revealed a logical red flag: while there has been a long-term trend of per capita water use declining, will the trend continue or will water use stabilize? How can demand forecasters know when reductions in usage are long-term or short-term?

Likewise, cultural shifts are taking place. While warm climate populations continue to grow, per capita water use continues to decline. The big drivers tend to be code changes, more efficient fixtures, landscape changeouts, and better data. Cultural changes, however, are also appearing to be significant as the historical desire for green lawns seems to be waning in upcoming generations. In Phoenix, for example, changeovers from turf lawns and high-water-demand plants to native desert landscaping are shifting water use patterns dramatically. As the summit panel noted upon hearing such information, while the revenue declines are of very serious concern, the long term successes in service to a more sustainable future must be celebrated.

## **Discussion #2:**

### **Why are revenues falling short of requirements?**

Current research from the Water Resource Foundation is revealing that while a sampling of utilities are seeing water use drops of 20% or more, revenues are declining by only about 5%. They are looking at rate structures and strategies that control utilities' financial risks and examining the effects of specific elements, such as economic cycles, various finance and rate models, and risk assessment tools. The results of this study will be published in mid-2013. Interim findings appear on the Water Resource Foundation blog.

While not all utilities everywhere are experiencing revenue shortfalls, the very notion of falling revenues raises serious concerns among officials. Effective rate setting is core concern, but setting rates is a challenging process because it is so complex and involves so many stakeholder groups. Regulatory lag, for example, is a well-known and understood problem – and, in fact, valuable in controlling monopolistic effects – but not one that is readily manageable. To put lag into operational terms, it is not uncommon for two years to pass from the completion of a cost design to actual revenue collection.

The group suggested a research effort aimed at identifying financially sound utilities and capturing their differentiating practices. The question of whether a utility is private or public did not seem to drive financial decision making or long term financial security. Solutions such as fixed revenue schemes ensure revenue but do not encourage efficient operation, which is a cornerstone concept among water providers.

The complex relationships among revenue, costs, and budgets girded a number of conversations. Their relationship is a systemic one, rather than linear. Miscalculations related to any of them can throw the full calculation out of balance.

Likewise, the effects of the declining economy and housing market have been complex and wide ranging. In addition to reduced water sales, for example, development charges and connection fees have plummeted in some service territories. Interestingly, similar sets of conditions have resulted in a range of impacts to the financial health of utilities, probably depending on the accuracy of the long-term forecasting, the effectiveness of the management team, and the speed with which the utility could respond to shifting conditions.

Effective forecasting drives many of these institutional concerns affected by the management and decision-making process, but effective forecasting presents unusual challenges. While engineers might tend to overestimate sales, financial analysts fear the budgetary implications of overestimation.

The depth of these complexities became more apparent during a conversation related to budgeting for maintenance and equipment replacement. From an economic perspective, the most cost-effective strategy in certain situations might be to budget for no system maintenance whatsoever, and instead run the equipment “to failure.” This approach flies in the face of demonstrated management theory, and could not be a viable strategy when reliability and the public health are parts of the equation. Thus, rate setters and accounting systems must balance any unusual factors.

Further, water bills often contain items in addition to drinking water itself, such as the cost of waste water treatment, storm water management, fire protection and other forms of resource management. Indeed, entire watersheds might be considered infrastructure in need of maintenance, and “forest to faucet” watershed governance might become increasingly common. Obviously, line item charges need to be real, but they are not always readily apparent. Since customers respond to the bill rather than the line items, this public education effort is challenging and difficult.

### **Discussion #3:**

#### **Do water utilities and the conservation community have a messaging problem?**

The City of Austin kicked off this conversation by identifying a strategic messaging error: the utility told customers they could save on their water bill by conserving water. Those savings rarely appear on the bill, and explaining how reduced water use does not always translate to a lower water bill is problematic. Worse, utilities have often responded to this enigma by slashing conservation budgets in times when supplies are not at risk.

The issue of language became increasingly apparent during this discussion. To some, conservation is synonymous with rationing. To many, it means efficiency. Rarely is conservation understood to be a long-term investment strategy in water supply that will offset future capitals costs to the ratepayers. Thus, conservation often gets a “bad rap” from customers and water commissioners.

Another example of the messaging challenges we face is that people have no idea of the real cost of water or its value to society. Tap water in the United States has a long history of being

readily available and inexpensive. It has been so cheap and plentiful as to devalue its actual worth. Nevertheless, its quality and importance cannot be overstated.

The overall customer message needs to be clearer. It needs to be properly segmented so customers understand such distinctions as those between “conservation” and “efficiency.” With the Internet revolution and the rise of social networking, new tools are available for addressing these messaging challenges.

The messaging challenge goes far beyond conservation and efficiency. Consumers need to be able to differentiate between rates and bills, especially in instances when bills rise even when water use does not. The concept of “cheap” water needs to become a thing of the past. Consumers also need to value a clean water supply’s contribution to public health and safety, as well as the economy.

A question of marketing arose in the discussion: why is it that water is generally marketed by engineers rather than by branding or marketing experts? The complexities related to capturing, treating, and delivering drinking water might require just such a shift. (If the concept of “clean coal” can get such traction, why does clean, reliable water present such a challenge?) Billing units present a strong case in point: depending on the water provider, customers may be billed in gallons, cubic feet (cf), or hundred cubic feet (ccf), and very few consumers know what a cf or ccf is.

The inevitable raising of rates will require trust, clarity, and understanding. Consumers need to understand the full implications of not raising rates. They need to understand the drivers of rates and rate increases. For many utilities, effectively communicating these messages will require professional help.

One aspect of water that affects the messaging challenge is that “all water is local,” so national messaging campaigns are not perceived by consumers to be relevant to them. Consumers tend to be more responsive to water issues when they understand the sources of their water. When water utilities import water from long distances, establishing a sense of stewardship proves challenging; thus, utilities have not been able to capitalize on the potential benefits of national messaging.

Overall, the group expressed widespread agreement that messaging is an essential practice that has not received the attention it needs.

#### **Discussion #4:**

#### **What methods are available to repair revenues and improve fiscal stability?**

Segueing from the last discussion, this conversation began with the premise that rates should be accurately calculable under virtually any circumstance. What is not readily calculable is the extent of political will needed to accomplish this goal.

Consumption also plays an important role in rate setting. While fixed costs are not directly related to consumption, consumption plays a role in driving fixed and variable costs. Different rate-setting methodologies prioritize consumption and costs in different ways.

In Southern California, Rancho California Water District has implemented a water budget-based rate structure. The structure has a 500% rise between the lowest “budget” tier (\$1 per hundred cubic feet) and the highest tier (\$5 per hundred cubic feet). Since the implementation of this structure, the top tier of users has reduced its usage by 50%. While the water district has seen total water demand decline by 30% over the last five years, it has still maintained full cost recovery due to the basic rate setting principal of recovering fixed cost with fixed revenues and structuring the budget-based tiered rates to reflect the marginal costs of water supply sources. Rancho California and others, such as the City of Austin, have framed their innovations as a strategy for providing a baseline of essential water at a very low rate within a rate structure that encourages water use efficiency and helps ensure appropriate cost recovery in changing demand cycles.

There are numerous case studies of a wide variety of rate structure types. The overriding lesson is that no single rate structure can work for all communities, and customization to the culture and the needs of the service area is essential. Some customers will always be displeased, regardless of rate structure. Rate stabilization funds can supplement rate structures by offsetting unexpected drops in water sales, but all-too-often, they get raided for general fund purposes, thus compromising their value for the intended purpose.

The direction of this discussion broached an innovative idea that generated some interest among the full group: creating a mechanism for demand insurance for water, perhaps similar to a derivative program. If the political will existed, a market could emerge for sharing the risks associated with supplying water.

The other conversation that generated some degree of interest – though not as positive as that for demand insurance – was of decoupling, similar to the efforts prevalent in the electricity market. In short, decoupling efforts in California have not worked to the satisfaction of consumers. According to one participant, “California’s experience with decoupling is troubling. It isn’t working.” Water and energy differ in a number of significant ways, which in turn shift the ways that strategies such as decoupling can work. While decoupling is successfully increasing efficiencies in electrical consumption, overall electrical consumption continues to increase. This equation cannot be sustained with fresh water. Likewise, there are very large gaps between large and small water users. Who picks up the costs when large users cut back on consumption?

This conversation led to a widely accepted truth, summarized by this thought: “We are looking for a magic pill. We have the basics and must recognize that there is a new normal in water usage. Since rate making spreads costs over water sales, the industry must accept that sales are down to a new lower level.”



This “back to basics” thought generated real interest, and the idea emerged that perhaps this entire conversation has become more complicated than it needs to be, once the concept of a “new normal” is taken into account. As one participant noted, rate designs do not improve revenues; they only improve stability, and different structures provide different levels of stability. Revenues must cover costs. And as another voice noted, getting the basics right is always necessary, but in this shifting environment, it may not be sufficient.

### **Discussion #5:**

#### **What role might industry standards, practices, and policy reforms play?**

A number of ideas kicked off this discussion: increased sophistication in capital planning, more detailed cost-of-service studies, clearer debt standards, continuing education on rates, professional certification, tiered rate structures. All are important, but the future must be approached with caution. Consumers need information, and if behavior is to change, financial incentives will be needed as well.

The issue of values and value judgments is a vexing one: behavior change efforts entail value suppositions, as does the allocation of water budgets. An appropriate amount of water for one customer in one community may be quite different for one customer in another community. Nationwide regulation might provide some value, but the risks might outweigh the benefits. In addition, much water infrastructure was built to support businesses and industries that no longer exist. That said, however, there are strong and important differences between mandates and incentives.

Likewise, the future needs to balance the costs of action and of inaction: what are the effects of not undertaking a project? How do you charge a ratepayer when the benefit of the action spreads beyond that sphere? To some, these thoughts approach the socializing of costs, which becomes tricky. The engineering and planning communities need better information.

According to a recent survey by the American Water Works Association 70% of water utilities are not fully recovering their costs. This is an unacceptable situation. We need to improve the ability for public water systems to get the revenue they need. At the very least, states could use third-party agencies that are disconnected from utilities and politicians that could determine whether or not revenues are sufficient. The State of Wisconsin Public Service Commission (PSC) regulates both public and private water systems, and assumes the responsibility for approving all changes to water rate-making in the state. Thus, the political “heat” is off at the local level and water systems can more easily approach the PSC for needed changes to their revenue structures.

At the very least it seems to make economic sense for utilities’ sustainability doctrines to mandate that efficiency be incentivized and not penalized, and doing so is possible in this era of social media with new tools for reaching out. The primary challenges, however, focus on staying responsive to citizens and respecting local needs.

## Summary Discussion

At the end of the Summit, each participant noted summary thoughts and areas where his or her thinking had shifted during the summit. This summary clusters those thoughts by topic area but keeps the tone and language of the thoughts relatively intact.

### *General Comments*

- The time has come for the whole industry to shift from a paradigm of growth to a paradigm of sustainability.
- We have done a great job up until now. Now we face a new set of challenges. We have to begin by stepping back to the basics.
- We must concentrate on building utilities that are sustainable, not only financially, but in other ways as well. Is today's utility structure unsustainable? Building sustainable utilities is more important than addressing revenue losses alone.
- Big utilities may not need regulation. Small ones do.
- Although there is not one single magic solution, water utilities need to embrace efficiency as a way to better serve customers by minimizing costs and maximizing benefits from smarter water services.

### *Forecasting and Rate Design*

- We need to realize the value of avoided costs.
- We need to improve our analytical tools, including measurement and verification. We need to implement standards on system reliability.
- We need to evaluate utilities based on their sustainable management practices.
- We have not yet seen the end of declining water sales.
- We must quantify and standardize. We don't have industry-wide methods for demand forecasting or assessing system conditions. We don't have metrics for affordability and equity. With those, we could make better cases to elected officials.
- We need to shift our approach to demand forecasting from thinking of it as a single point to simulation and risk modeling. We need to represent the future as a distribution of possibilities rather than a point, and we need to inform decision makers about probabilities and consequences of risk.
- We need to emphasize that well-designed outdoor efficiency efforts can contribute to revenue stability by lowering weather-related fluctuations.

- Utilities need to comprehensively reassign costs, revenues, risk management, and customer communications.
- All assessments need to include environmental and social benefits.

### *Political Observations*

- In the case of setting water rates, regulation appears to have some significant value because it removes rate setting from the political arena. Since rates get set by regulatory boards, the politicians have a cover and consumers can have some confidence that they are paying fair rates. On the one hand, removing the decision making from the immediate view of the consumer may be viewed as being anti-democratic. On the other hand, doing so removes the process from political wrangling, thus increasing effectiveness.
- The problems we face right now are more political than technological.
- As a group, we must resist being fatalistic, especially about politics.
- Although the challenge of matching revenue with sales is technical, at some level the solutions are all political.

### *Communicating and Messaging*

- We must work harder to communicate meaningfully with customers who need regular messaging on real costs.
- We need to improve public understanding. While we have been successful with efficiency improvements, we are behind on infrastructure, and the public still takes water for granted. We need to message “the value of water.”
- Communication and education are key. People need to understand the full range of reasons of why usage is declining. We need to educate regulatory bodies. We need to recognize full costs.
- Utilities must advocate for the stewardship of the resource. Consumers need to understand their water sources. Water use is not going to rise again; it will continue to decline.
- We need to work harder to prepare the next generation of voters. Kids need to understand the plumbing beneath their streets and their homes. They need to tour water and sewer plants. Focusing on the next generation will help us in our role as public servants.

### *New Ideas*

- The idea of spreading risk, such as by insurance, is intriguing. We can find ways to recover revenues without just raising rates.

- The idea of creating insurance instruments is worth pursuing.
- We should focus on the top 20% - 30% of the utilities to help move best practices forward. Then we can focus on the others to help them achieve the basics. As part of that effort, we can develop manuals of best practice. Perhaps we should even require attendance at a “rate school” that informs utilities of the basics. Perhaps we should consider certification. Perhaps we need to better define the broad set of management and leadership skills that need to be taught. Right now, there is a leadership void in the industry.
- We must find a mechanism that will force change. State regulators are not the answer. We need a conscious strategy to reach a wider audience.

#### *Needed Research*

- We need to understand the full span of causes for changing water usage, both in the short and long terms. Reductions come from much more than conservation and efficiency, but they are often framed as the cause. We need to stay creative in looking at solutions.
- These issues we are confronting – the conservation conundrum – are real. We need to understand them better and we need to help others understand them better.

## SUMMIT ATTENDEE LIST

#	Salutation	First Name	Last Name	Organization
1	Mr.	Jeff	Armstrong	Rancho California Water district
2	Mr.	Laurent	Auguste	Veolia North America
3	Mr.	Drew	Beckwith	Western Resource Advocates
4	Dr.	Janice	Beecher	Institute of Public Utilities, MSU
5	Mr.	Gary	Breaux	Metropolitan Water District of Southern California
6	Dr.	Thomas	Chesnutt	A&N Technical Services
7	Mr.	Chuck	Clarke	Cascade Water Alliance
8	Ms.	Heather	Cooley	Pacific Institute
9	Mr.	Todd	Cristiano	Denver Water
10	Mr.	Michael	Deane	National Association of Water Companies
11	Ms.	Mary Ann	Dickinson	Alliance for Water Efficiency
12	Ms.	Linda	Discepolo	Regional Water Authority of South Central CT
13	Mr.	Douglas	Frost	City of Phoenix
14	Mr.	Rick	Giardina	Red Oak Consulting/EFAB
15	Dr.	Ronald	Griffin	Texas A&M/MIT Press Book
16	Mr.	Ben	Grumbles	Clean Water America Alliance
17	Ms.	Sarah	Hayes	American Council for an Energy Efficient Economy
18	Mr.	John	Howard	South Carolina PSC / NARUC
19	Mr.	Jeff	Hughes	UNC Finance Center
20	Mr.	Dave	LaFrance	American Water Works Association
21	Mr.	Tracy	Mehan	The Cadmus Group
22	Dr.	Kenneth	Mirvis	The Writing Company
23	Mr.	David	Mitchell	M.Cubed
24	Mr.	Edward	Osann	Natural Resources Defense Council
25	Mr.	Jeffrey	Ripp	Wisconsin Public Service Commission
26	Mr.	Scott	Rubin	Attorney/Consultant
27	Mr.	Todd	Rydstrom	San Francisco Public Utilities Commission
28	Mr.	Darryl	Slusher	City of Austin
29	Dr.	Manny	Teodoro	Colgate University
30	Mr.	Christopher	Woodcock	Woodcock Associates

### Observers

1	Ms.	Carole	Baker	Texas Water Foundation
2	Dr.	Lynn	Broadus	The Johnson Foundation
3	Mr.	Claus	Dunkelberg	Milwaukee Water Council
4	Mr.	Andrew	Fahlund	Stanford University
5	Ms.	Jenny	Hoffner	American Rivers
6	Ms.	Sharlene	Leurig	CERES

# DECLINING WATER SALES AND UTILITY REVENUES

## *A FRAMEWORK FOR UNDERSTANDING AND ADAPTING*

A WHITE PAPER FOR THE  
NATIONAL WATER RATES SUMMIT  
AUGUST 29-30, 2012  
RACINE, WISCONSIN

PREPARED BY:

JANICE A. BEECHER, PH.D.  
INSTITUTE OF PUBLIC UTILITIES  
MICHIGAN STATE UNIVERSITY

THOMAS W. CHESNUTT, PH.D.  
A & N TECHNICAL SERVICES, INC.



300 W. ADAMS STREET, SUITE 601 | CHICAGO, IL 60606  
PH: 773-360-5100 | [WWW.A4WE.ORG](http://WWW.A4WE.ORG)

## Table of Contents

Introduction .....	1
Issue 1: How and why are water sales declining? .....	8
Issue 2: Are water utility revenues falling short of revenue requirements? .....	9
Issue 3: Do water utilities and the conservation community have a messaging problem? .....	10
Issue 4: What methods are available to repair revenues and improve fiscal stability? .....	11
Issue 5: What role do industry standards, practices, and policy reforms play? .....	14
Thinking About Solutions .....	15
Concluding Thoughts .....	16
Selected Readings .....	17
Exhibit 1. Trends in Residential Water Sales and Revenues for Wisconsin Utilities (Class AB) .....	3
Exhibit 2. Trends in Consumer Prices (CPI) for Water and Sewer Maintenance and Utilities .....	4
Exhibit 3. Water Pricing Goals.....	5
Exhibit 4. Water Pricing and Sustainability .....	5
Exhibit 5. Revenues, Rates, and Bills: Mapping the Message .....	7
Exhibit 6. Methods for Addressing Revenue Shortfalls .....	12

The views and opinions are those of the authors and do not necessarily reflect those of the Alliance for Water Efficiency or the Johnson Foundation.

---

The scenario is becoming all too familiar. Utility managers see falling water sales and falling revenues. Rates must be raised simply to maintain revenues, but rate increases are also needed to pay for the rising cost of infrastructure replacement and improvement. Higher rates might even induce a price response in the form of further declines in usage (shifts along the demand curve).<sup>1</sup> The effects of economic recession make matters worse, particularly for areas experiencing declines in service population and economic activity (shifts in the entire demand curve). As water price increases outstrip overall inflation, boards of directors and water customers alike are balking at successive and high rate increases. Promoting water conservation in this context seems illogical at best and self-destructive at worst. In a twist of distorted incentives, the water manager may even hope for drought. Infrastructure-intensive public utilities face a serious “conservation conundrum”<sup>2</sup> in that socially beneficial efficiency appears contrary to their financial self-interest, particularly in the short run. The combination of rising costs and falling sales is a potential recipe for revenue shortfalls and fiscal distress. *What is a water manager or rate regulator to do?*

A Summit on Declining Water Sales and Utility Revenues Summit in Racine, Wisconsin, convened by the Alliance for Water Efficiency, examined how this problem is manifested across the country. This white paper explores its root causes and offers potential utility and policy solutions.

---

## Introduction

This white paper was drafted initially to frame the central issues in advance of an August 30, 2012 national summit of prominent water industry leaders, economists, and financial experts to examine the root causes of the current problems with water utility rates and revenues, and to outline potential utility solutions as well as policy and regulatory reforms. Finalized following the summit, the paper presents a framework for defining the problem and exploring both root causes and potential utility and policy solutions, as organized around five issue areas:

- Issue 1. How and why are water sales declining?
- Issue 2. Are water utility revenues falling short of requirements?
- Issue 3. Do water utilities and the conservation community have a messaging problem?
- Issue 4. What methods are available to repair revenues and improve fiscal stability?
- Issue 5. What role might industry standards, practices, and policy reforms play?

Water utilities today face a serious challenge related to what is loosely understood as “declining demand.” Water “demand” connotes different meanings. Engineers think about demand in terms of water supply or production measures, also understood as “system load.” Planners think about demand in terms of water consumption or sales measures, also understood as “realized demand.” Economists think about demand in terms of a choice-based functional relationship between prices charged and *quantity*

---

<sup>1</sup> The association of rate increases with falling revenues is a phenomenon sometimes referred to as a “death spiral,” even though relative price inelasticity will forestall the actual demise of a utility enterprise and rates can be adjusted for “demand-repression” effects in the context of rising revenue requirements. The responsiveness of water usage to prices varies but water demand has been empirically estimated to be less price-elastic than energy demand, making the “death-spiral” metaphor less applicable.

<sup>2</sup> Janice A. Beecher, “The Conservation Conundrum: How Declining Demand Affects Water Utilities.” *Journal American Water Works Association* (February 2010).



*demanded* (a downward sloping curve reflecting both willingness and ability to pay).<sup>3</sup> For the purposes of this paper, we consider demand generally in terms of the aggregate quantity demanded from, and provided to, water customers.

For decades, efficiency and conservation have been advanced as part of an integrative approach to resource management that recognizes the joint consideration of supply and demand management in fulfilling community water needs. Like demand, “efficiency” also has different meanings. Technological efficiency is achieved when it is impossible to increase output without increasing inputs, whereas economic efficiency is achieved when the cost of producing a given output is as low as possible.<sup>4</sup> The latter depends in part on the former. Efficiency might also be defined in broader social terms (such as “service accessibility” or “highest and best use”) or environmental goals (such as “resource preservation” or “maximizing production of ecological services”). This paper considers water efficiency as maximizing net benefits—the difference between the benefits of water consumption and the costs of the resources required to supply that consumption, including disposal of any “waste” water. Conservation generally involves a reduction in usage; conservation measures may be imposed to reshape water usage patterns or as part of drought or emergency management (including temporary rationing). Evaluating the desirability of a change in water consumption through efficiency or conservation measures requires comparing benefits and costs.

The rationale for improving the efficiency of usage through full-cost pricing, efficiency standards, and other means has always rested on the idea that efficiency gains on the demand side will translate into more efficient utility operations, including reduced operating costs in the short run (including the cost of energy and chemicals) and avoided capacity costs in the long run (including the cost of supply development, pipeline transmission, and treatment plants). Improved efficiency also reduces risk and uncertainty, including risk and uncertainty associated with volatile sales. Reduced environmental costs or added environmental benefits are also achieved over both the short and long terms.

Aggregate water withdrawal trends clearly illustrate the stability of water withdrawals relative to population growth, reflecting both lower per-capita usage and efficiency gains.<sup>5</sup> To illustrate the reality of declining water usage and its effects, we examine trends over the last decade for residential sales, revenues, and average sales price for a large sample of utilities in Wisconsin – host state to the National Water Rates Summit (Exhibit 1). Though the total number of residential customers has risen over the last decade (top line) total residential sales has been flat (light blue line) while the sales per customer trend shows a decline. Revenues per residential customer or per volume of sales (a proxy for average prices) have gone up.

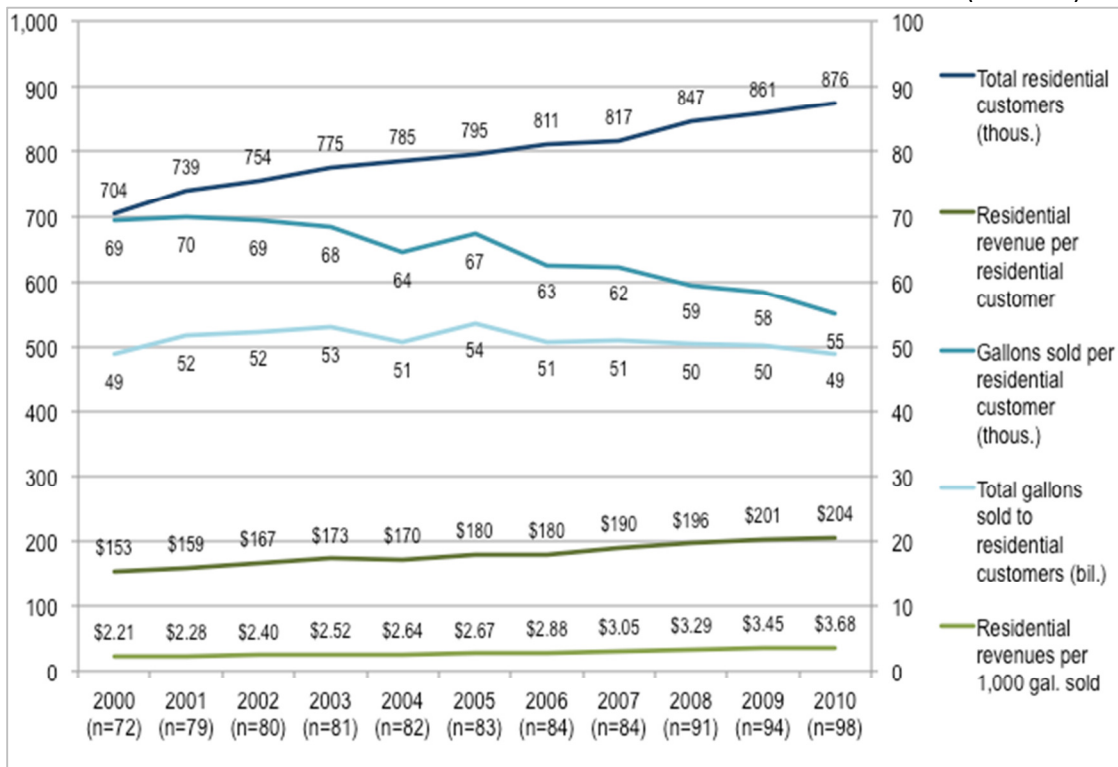
---

<sup>3</sup> For more on understanding water demand, see Stephen Merrett (2004), “The Demand for Water: Four Interpretations,” *Water International* 29 (1): 27-29.

<sup>4</sup> These definitions are from About.com: Economics.

<sup>5</sup> Kenny, J.F. et al. (2009) *Estimated use of water in the United States in 2005*. U.S. Geological Survey Circular 1344.

Exhibit 1. Trends in Residential Water Sales and Revenues for Wisconsin Utilities (Class AB)



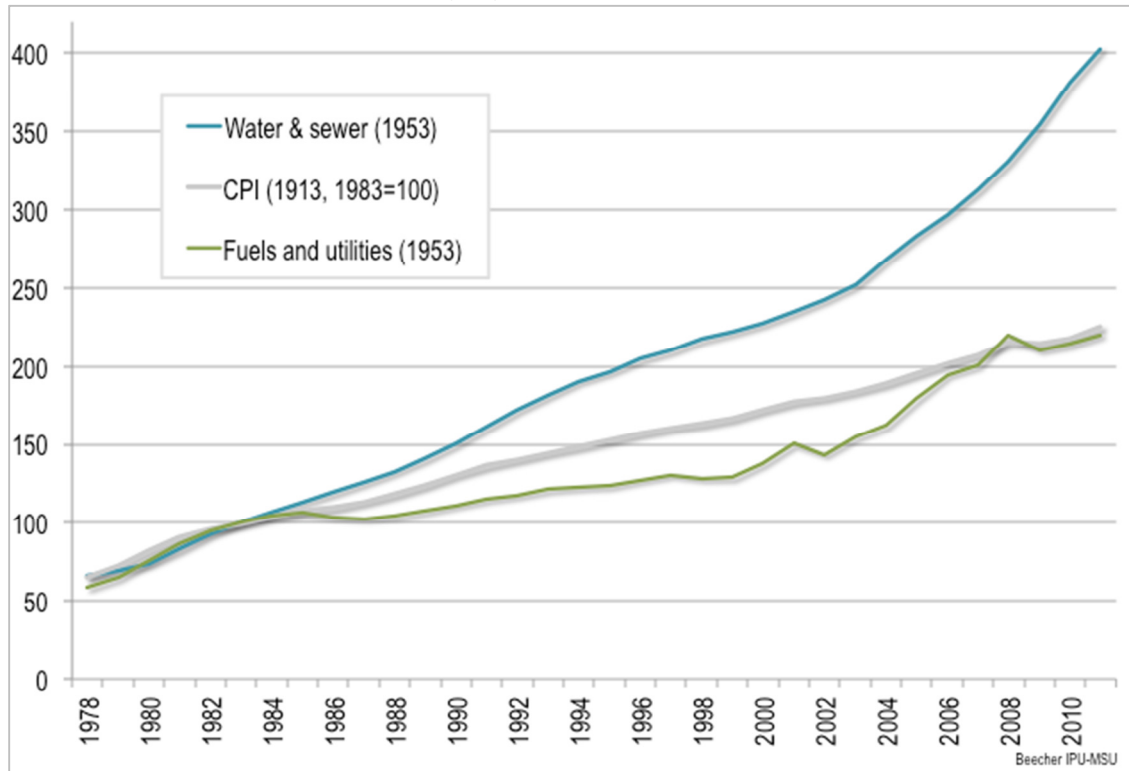
Source of data: Wisconsin Public Service Commission.

At least some of the trend in aggregate water usage appears to be durable, making for “new normals” in the water business. Flat or declining sales are affecting many water utilities, regardless of whether they have actively engaged in conservation programs. The loss of load caught many utility managers, industry analysts, and even efficiency advocates off guard. Improved standards and practices have helped to improve water efficiency and shift demand. In some cases, utility programs have accelerated market penetration and impact. Rising prices are also playing a role. Wisconsin is not the only state in the nation experiencing a rise in the real price of water. Exhibit 2 compares the national Consumer Price Index (CPI) to the indices for “water and sewer maintenance” and “fuels and utilities.” Trends clearly indicate that water prices are under pressure, suggesting the potential for prices to influence the quantity demanded, even when demand is relatively “price inelastic.”

Conservation may have value to the environment and society, but its economic value to utilities depends in part on whether costs can be avoided or revenues can be generated from an alternative end use for “conserved” water; if no economic value is perceived, the rationale for utility conservation programs is undermined. Otherwise, loss of water sales (or load) translates directly into loss of revenues, and loss of revenues translate into higher rates and charges simply to maintain revenue neutrality and cover the cost of operations, much of which is fixed in the short run. Given the prospects of new normals in water usage, utility revenues are in need of repair as much as water

infrastructure. Yet more efficient water supply systems are de facto more sustainable systems because they are better positioned to operate within their economic and ecological means. The parameters of sustainability may vary by location, but true efficiency gains are universally good from an economic perspective.

Exhibit 2. Trends in Consumer Prices (CPI) for Water and Sewer Maintenance and Utilities



Source of data: Bureau of Labor Statistics.

In the long term, water supply and demand will find an efficient equilibrium. In the short term, however, reductions in water sales are a cause of fiscal stress for utilities and a potential disincentive to further investment in efficiency. This problem is exacerbated by the fact that water supply in general is a rising-cost industry. The combination of declining sales and rising costs, along with the movement toward full-cost pricing, is placing considerable pressure on utility water rates. For water utilities, a price that reflects true costs is a more efficient price. Regardless of the reason, higher rates can be expected to cause additional reductions in price-sensitive customer end uses, which in turn may require additional rate increases. Raising rates can become a political issue with elected boards and city councils as well as state regulatory agencies when jurisdiction applies. Customers are generally unhappy with high utility bills, particularly unhappy about paying anything more for water, and especially unhappy when they pay more while using less.

Water pricing is complex because it tends to involve multiple and sometimes competing policy goals (Exhibit 3). Pricing is central to long-term sustainability (Exhibit 4). Sustainable systems spend to an optimal service level and price in a manner that recovers capital and operating expenditures. The logic of economic efficiency applies

both to spending and pricing. Underspending and overspending have deleterious effects, as do underpricing and overpricing. Cost studies can inform these determinations.

Revenue sufficiency and stability are core goals and a function of both rate levels and rate design. Ideally, rates are set to recover all revenue requirements, or the true cost of service. Water utilities are highly capital intensive but recover some fixed costs through variable charges, in part to amplify price signals and improve efficiency in usage over time. In some respects, the emphasis that conservation places on the *value of water* has detracted attention from the value – and the cost – of the substantial *infrastructure* required to provide safe, adequate, and reliable water service as well as fire protection and wastewater services.

Exhibit 3. Water Pricing Goals



Source: Janice A. Beecher, Institute of Public Utilities, Michigan State University.

Exhibit 4. Water Pricing and Sustainability

	Expenditures Relative to Optimal Service Level		
Prices relative to total expenditures	<1 expenditures are below optimum ("cost avoidance")	= 1 expenditures are optimal	>1 expenditures are above optimum ("gold plating")
<1 prices are below expenditures ("price avoidance")	Deficient system	Subsidized system	Budget-deficit system
= 1 prices are at expenditures	Underinvesting system	<b>SUSTAINABLE SYSTEM</b>	Overinvesting system
= >1 prices are above expenditures ("profit seeking")	Revenue-diverting system	Surplus system	Excessive system

Source: Janice A. Beecher, Institute of Public Utilities, Michigan State University.

For public utilities, it is not uncommon to see marginal costs (total costs/total units sold) below average costs, so pricing at marginal cost can result in insufficient revenues. In

the short run, marginal costs may be low for systems with excess capacity resulting from load loss. When marginal costs exceed average costs (as in persistent scarcity conditions), then pricing at marginal cost can result in excess revenues. Depending on average and marginal costs (considered in the short and long runs), selling available water may well be efficient and consistent with the goals of stewardship and the boundaries of sustainability. Some communities are actively trying to attract water-intensive industries to their service territories (Evanston, Illinois, provides an example). Although total system (full accounting) costs are used to define revenue requirements, marginal costs can provide guidance for rate design. Indeed, marginal-cost pricing lends theoretical support for conservation-oriented rate structures.

Cost allocation and rate design assign cost responsibility to customers but should be “revenue neutral.” Different rate structures, however, have different incentives and implications for utilities and their customers. High fixed charges (and decreasing-block rates) provide revenue stability and mitigate the utility’s incentive to sell, but can weaken usage-based price signals and raise affordability concerns. High variable (or volumetric) charges (and increasing-block rates) provide more affordability but less stability, and make utilities more dependent on sales (including dry weather cycles). Concerns about revenues are turning more attention to a variety of conventional and unconventional cost recovery, revenue assurance, and rate-design options.

These dynamics have already been a source of frustration for utility managers and their customers. The relationship between revenue requirements, rates, and bills is complex (Exhibit 5). Particularly vexing is the potential association of efficiency and conservation with higher rates, which can undermine support for efficiency goals as well as the public’s trust. Utility sponsored conservation programs can be especially hard to justify; in a context of excess capacity and revenue shortfall they appear rather self-defeating. Improving communications in this area is an urgent challenge for the water sector. The revenue issue is as much about messaging as about rates and rate structures.

Water utilities that are content with their financial situations have probably done many things correctly; there are a correspondingly large number of ways for water utilities might end up in a less satisfactory place. Thinking about solutions requires reexamining “the problem” and its root causes. Only by better understanding the nature of the problem and how it came to manifest can decision makers, water managers, and rate analysts begin to sculpt solutions.

Although much has been written about the revenue effects of conservation, there remains a need for a systematic framework for mapping potential relationships among revenues, rates, and bills. Such a framework can provide the basis for a new narrative about water conservation, in part to dispel the perceived connection between water conservation and all rate increases. The intended audience is water utility managers and their oversight boards, public utility regulators, consumer groups, conservation advocates, and other stakeholders. The following sections examine each of the five issue areas that framed the discussion at the National Water Rates Summit.

Exhibit 5. Revenues, Rates, and Bills: Mapping the Message

Condition	Revenue Requirements	Rate (\$/unit)	Bill (\$/customer)
<b>Usage</b>			
Usage decline (other things equal near term)	neutral	↑	neutral
Economic demand management	↓	↑	↓
Uneconomic demand management	↑	↑	↑
<b>Costs</b>			
Rising infrastructure costs	↑	↑	↑
Rising operating costs	↑	↑	↑
Supply-side efficiency	↓	↓	↓
<b>Market</b>			
Customer additions (gain scale)	↑	↓	↓
Customer losses (lose scale)	↓	↑	↑
<b>Rate design</b>			
Price-elastic usage	neutral	↑	↓
Price-inelastic usage	neutral	↑	↑
Cost reallocation	neutral	↓↑	↓↑
<b>Full-cost pricing</b>			
Subsidy	↓	↓	↓
Loss of subsidy	↑	↑	↑
Transfers	↑	↑	↑

Source: Janice A. Beecher, Institute of Public Utilities, Michigan State University.

## *Issue 1: How and why are water sales declining?*

- ❖ Water usage and sales relate directly to water utility design, investment, and operation.
- ❖ Declining water sales of 1 to 3% annually is not an uncommon observation today.
- ❖ Water usage patterns differ between developed and developing political economies.
- ❖ Given water's essential nature, the trend in water sales will not reach zero.
- ❖ Water sales should eventually stabilize at a relatively efficient, predictable, and sustainable level.
- ❖ Declining sales are particularly problematic for “declining cities” experiencing population loss and weak economic activity.
- ❖ Declining sales have operational effects on water and wastewater systems.
  - Reduced water flows can affect water quality.
  - Reduced water and wastewater flows can affect infrastructure integrity (e.g., corrosion).
- ❖ Implications of declining water usage on operations.
  - Water and wastewater systems are likely suboptimal relative to utilization.
  - Long-life water infrastructure should be built to meet today's increasingly efficient use and tomorrow's prevailing usage patterns.
  - Changes in load create opportunities to avoid costs and redirect investment.
- ❖ Many systems have experienced declines in sales even under conditions of dry weather.
- ❖ A universally valid and reliable empirical model for estimating contemporary water sales has yet to be specified.
- ❖ Aggregate water usage is partly a function of socioeconomic conditions and characteristics.
  - Total water usage can grow with growing population and economic activity.
    - Growth masks per-connection and per-capita trends.
    - Loss of population will suppress sales.
  - Economic recessions will tend to suppress sales.
  - Recessionary influences on water sales vary in their duration and durability.
  - Water usage varies seasonally according to weather, namely, precipitation and evapotranspiration.
  - Climate change will influence weather and the quantity of water supplied and used in a given time period.
- ❖ Aggregate water usage can be understood as a function of per-connection and per-capita usage because different drivers are at work.
  - Evidence suggests that both are falling in many areas.
- ❖ Per-connection or household usage (weather adjusted) is a function of:
  - Household size (fewer people per household) and demographic composition.
  - Property (lot) size.
  - Composition of single- and multi-family housing.
  - Growth policies affecting housing.
  - Nature of commercial activities and industrial processes.
  - Efficiency in irrigation practices on customer premises.
  - Local codes and restrictions on irrigation.
  - Price-induced effects on discretionary use.
    - Metering elasticity of demand.
    - Price elasticity of demand (effect of marginal prices and the total bill for both water and wastewater).

- ❖ Per-capita water usage (weather-adjusted) is a function of:
  - National standards and codes for water-using fixtures and appliances.
  - Commercial and industrial process efficiencies and technologies.
  - Incentives that accelerate efficiency deployment (programs, rebates).
  - Changing culture, attitudes, and environmental ethic (for example, reduced urban irrigation) based in part on perceptions of scarcity in water supplies.
- ❖ Price appears to be playing an increasingly important role.
  - Full-cost pricing is necessary but not always sufficient for inducing efficient water use.
  - The current decline in water sales embeds a customer response to price that is often imperfectly recognized in utility planning and ratemaking.
  - Water is subject to the laws of supply and demand, just like other goods and services – water is essential but technically not “priceless” (that is, water services are excludable and “priceable”).
  - Price is how we “self-ration”; that is, prices guide our consumption decisions.
  - Utility services are generally less price-elastic, but not perfectly inelastic (that is, usage is not completely unresponsive to changes in price).
  - The “real” (inflation-adjusted) price of water in the U.S. has been rising.
  - Usage may have entered a more price-elastic portion of the demand curve for water.
  - Different water uses within and across customer classes present different elasticities (essential use is less elastic).
  - Consistent with the law of demand, rising prices will affect the quantity of water demanded whether or not they are part of a conservation strategy.
- ❖ Falling sales and revenues are industry-wide problems directly related to the adoption of efficiency standards and practices.
  - Much of the efficiency gains are related to the effects of standards, prices, and economic conditions.
  - Some are due to the impact of utility efficiency programs.
  - The revenue impact may be the same but the policy implications differ.

## ***Issue 2: Are water utility revenues falling short of revenue requirements?***

- ❖ For the water industry, aging infrastructure needs and costs are blamed for a widening “gap” between expenditures and revenues for many, though not all, public utilities.
- ❖ The gap is essentially a “construct” for focusing policy attention.
- ❖ Strategies for closing the water utility funding gap from the top include:
  - Efficiency practices (least-cost).
  - Technological innovation (capital and operating).
  - Market-based approaches as appropriate (bidding).
  - Industry restructuring (consolidation and convergence).
  - Integrated resource management (supply and demand).
- ❖ Strategies for closing the water utility funding gap from the bottom include cost-based rates for water services.
- ❖ Economic regulation by state public utility commissions can help ensure both cost prudence and cost-based pricing.
  - State regulation can help “depoliticize” local ratemaking to some degree.
  - Given rising costs and falling revenues, operational efficiency and “cost control” are important but many utility costs cannot be avoided through supply-side and demand-side efficiency.



- ❖ Assuming that the utility's revenue requirements reflect the prudent cost of service, adjusted for any costs reduced or avoided through efficiency gains, the revenue shortfall problem can normally be explained by rates that are too low.
- ❖ Reasons for revenue shortfalls:
  - Lagging rate increases, so that revenues from rates will never be sufficient to cover actual revenue requirements or the budgeted cost of service.
    - Rate lag can reflect bureaucratic processes or "political will" (also known as "willingness to charge").
  - Under-collection of revenues or receivables owed to the utility.
  - Inadequate cost forecasting in the ratemaking process, including reliance only on historical cost data.
  - Inadequate sales forecasting in the ratemaking process, including "demand-repression" effects associated with rate increases.
    - Simplistic and non-robust linear forecasts and moving averages are inadequate.
    - End-use modeling is needed (market adoption rates).
    - General trends in water sales can be effectively forecast.
    - Scenarios can be used for modeling weather effects and the effects of weather on water usage can be estimated.
  - Inattention to rate design in terms of the allocation of costs to fixed and variable charges, and elasticity effects on revenue stability and sufficiency.
- ❖ For most water utilities, infrastructure replacement costs are outweighing the costs avoided through efficiency (particularly in the short term).
  - Water bills continue rise but not as much as they would without improved efficiency.

### ***Issue 3: Do water utilities and the conservation community have a messaging problem?***

- ❖ The water utility investment and cost profile may not be widely understood or appreciated.
- ❖ Piped community water service is capital intensive with high fixed costs.
- ❖ Fire protection needs present an engineering design and operational constraint.
- ❖ The conservation ethic has focused considerable attention on the "value of water" as compared to the "value of water service."
- ❖ In the long term, all costs are variable, but in the short term most costs are fixed.
- ❖ Water efficiency helps water systems avoid operating costs in the short run and capital costs in the long run.
- ❖ Declining sales may leave systems with excess capacity and stranded investment, which undermines the case for conservation in the short run.
  - Promoting water use and attracting water-using industries is controversial.
- ❖ The impact of efficiency and conservation on water rates and bills is controversial, but not necessarily well understood or well-articulated.
  - Revenue neutrality in ratemaking suggests that water rates increase due to falling sales, but water bills increase due to rising costs.
  - Lower sales volume, given a relatively fixed revenue requirement, implies the need for a higher average rate per unit of water (net of efficiency savings actually reflected in authorized requirements).
  - In the face of rising rates, customers who can conserve will pay less than customers who cannot conserve (a distributional effect).

- ❖ Conservation investments (like other investments) should be prudent.
  - Water use has both negative and positive impacts and externalities.
  - While efficiency is almost always desirable, not all forms of conservation are desirable, cost effective, or economically efficient.
  - Cost-effective conservation, by definition, reduces utility revenue requirements.
  - Prudent and planned conservation should not result in revenue shortfalls.
  - Although prices are rising, water bills over time will be lower than they otherwise would be (that is, lower highs).
- ❖ Water utilities and the conservation community have not been very successful in crafting a message to the public about:
  - The role of water utilities in resource stewardship and sustainability (the “blue industry” is a “green” industry).
  - The realized and anticipated benefits of efficiency in terms of water, energy, environmental protection, and infrastructure costs.

#### ***Issue 4: What methods are available to repair revenues and improve fiscal stability?***

- ❖ A number of methods that utilities are considering for addressing revenue shortfalls are summarized here (Exhibit 6).
- ❖ When considering potential solutions, water utility managers are concerned about:
  - Rate lag between cost incurrence and cost recovery.
  - Reliance on volumetric charges and sales for utility revenues.
  - Revenue sufficiency and revenue stability over time.
- ❖ In many respects, traditional ratemaking principles and practices can effectively address material changes in costs, cost volatility, and changes in usage.
  - Under changing conditions of costs and sales, utilities need to be vigilant about rates.
  - All costs should be included in revenue requirements (full-cost pricing).
  - Revenue requirements should include costs for prudent conservation expenditures.
- ❖ Four key culprits in the revenue shortfall appear to be:
  - Lack of timely rate adjustments, including cost-adjustment rate mechanisms.
    - Ratemaking and regulatory politics may play a role.
    - Rate adjustments should be easier and more expedient for unregulated and/or publicly owned systems.
  - Inadequate cost and sales forecasting for the revenue requirements test year.
    - Lack of acceptance from state economic regulators.
  - Cost-allocation and rate-design practices.
    - Suboptimal allocation of costs to fixed and variable charges.
    - Possible over-reliance on variable charges.
  - Current loss of other revenue sources.
    - Subsidies from grants, loans, and intergovernmental transfers.
    - Recessionary effects on growth and system-development fees.
- ❖ The solution set varies based on utility organizational structure.
  - Larger systems have greater capacities and more options.

- Publicly owned systems may be subject to local political forces, but may have more flexibility to change practices.
- Regulated systems, including all private systems, must comport with regulatory standards and reviews.
- ❖ No recommendations are made here, as each method has potential advantages and disadvantages and involves tradeoffs.
  - Policy choices depend on perspective and goals (including equity and efficiency).
  - Some methods achieve similar goals by different means.
  - Consistency with generally accepted principles and practices and legal defensibility are concerns when departing from traditional forms of cost-based ratemaking.

**Exhibit 6. Methods for Addressing Revenue Shortfalls**

	<b>Description</b>	<b>Key Advantages</b>	<b>Key Disadvantages</b>
Rate adjustments	Rate reviews and adjustments that keep pace with changing conditions	<ul style="list-style-type: none"> <li>▪ Reduces rate-adjustment lag</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increases ratemaking expense</li> <li>▪ May be politically unwelcome</li> </ul>
Full-cost pricing	Water prices based on system budgeting cost of service studies	<ul style="list-style-type: none"> <li>▪ Supports fiscal autonomy of system</li> <li>▪ Enhances price efficiency</li> </ul>	<ul style="list-style-type: none"> <li>▪ May cause significant rate increases for subsidized systems</li> </ul>
Depreciation expense	Include in rates an expense for the depreciating the value of utility assets	<ul style="list-style-type: none"> <li>▪ Provides cash flow to system</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires utility basis of accounting and ratemaking</li> <li>▪ May cause significant rate increases</li> </ul>
Replacement value ratemaking	Base rates on anticipated cost of asset replacement	<ul style="list-style-type: none"> <li>▪ Account for inflationary effects</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires utility basis of accounting</li> <li>▪ May be arbitrary and inflate rates unnecessarily</li> </ul>
Reserve-account funding	Use a special charge or equity return mechanism to build a reserve account	<ul style="list-style-type: none"> <li>▪ Builds a reserve account for infrastructure replacement needs</li> </ul>	<ul style="list-style-type: none"> <li>▪ May be arbitrary and inflate rates unnecessarily</li> <li>▪ May cause intergenerational equity concerns</li> <li>▪ Funds may be diverted</li> </ul>
Improved cost forecasting	Pro forma adjustments for known and measurable cost changes or use of future test year	<ul style="list-style-type: none"> <li>▪ Reduces rate lag</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires analytical skill</li> </ul>
Improved sales forecasting	Enhanced econometric modeling v. simple moving averages (e.g., statistically adjusted end-use modeling)	<ul style="list-style-type: none"> <li>▪ Reduces rate lag</li> <li>▪ Weather-adjusted water usage is relatively predictable</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires analytical skill</li> </ul>
Weather normalization	Adjustment to forecast sales based on expectation of normal weather and precipitation	<ul style="list-style-type: none"> <li>▪ Reduces weather impact on revenues</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires analytical skill</li> </ul>

*Exhibit 6. Continued*

Cost-adjustment mechanisms	Pass through to customers of certain substantial and volatile costs (e.g., purchased water or power)	<ul style="list-style-type: none"> <li>▪ Simplifies and expedites rate adjustments</li> <li>▪ Keeps rates in line with actual costs</li> </ul>	<ul style="list-style-type: none"> <li>▪ May provide a disincentive for cost control</li> </ul>
Cost indexed rates	Rate adjustments based on a predetermined inflation index	<ul style="list-style-type: none"> <li>▪ Simplifies and expedites rate adjustments</li> </ul>	<ul style="list-style-type: none"> <li>▪ May mis-estimate real costs</li> </ul>
Demand-repression adjustment	Adjusts sales forecast to account for price elasticity on usage	<ul style="list-style-type: none"> <li>▪ Reduces rate lag by incorporating elasticity effects</li> </ul>	<ul style="list-style-type: none"> <li>▪ Requires analytical skill</li> </ul>
Revenue-stable rate design	Use of uniform rates, uniform by class, or large first blocks that stabilize revenues	<ul style="list-style-type: none"> <li>▪ Simplification and customer understanding</li> </ul>	<ul style="list-style-type: none"> <li>▪ May not be perceived as sufficiently conservation-oriented</li> </ul>
Fire-protection charges	Design of fixed charge based on the value and cost of fire protection	<ul style="list-style-type: none"> <li>▪ Stabilizes revenues by establishing a fixed charge</li> </ul>	<ul style="list-style-type: none"> <li>▪ Weakens variable price signals</li> <li>▪ More affordable if based on property values</li> </ul>
Three-part tariff	Design rates with three components: customer, capacity, and commodity charges	<ul style="list-style-type: none"> <li>▪ Stabilizes revenues by establishing a charge related to capacity costs</li> </ul>	<ul style="list-style-type: none"> <li>▪ High fixed charges</li> <li>▪ Raises affordability concerns</li> <li>▪ May weaken variable price signals, particularly with regard to future capacity costs</li> </ul>
Straight fixed-variable pricing	Alignment of fixed and variable charges with fixed and variable prices	<ul style="list-style-type: none"> <li>▪ Stabilizes revenues by effectively decoupling revenues from sales</li> <li>▪ Neutralizes the incentive to sell</li> </ul>	<ul style="list-style-type: none"> <li>▪ High fixed charges</li> <li>▪ Raises affordability concerns</li> <li>▪ Weakens variable price signals, particularly with regard to future capacity costs</li> </ul>
Water-budget rates	Rate design that considers property size, household size, and other variables in designing rate blocks based on a determination of “need”	<ul style="list-style-type: none"> <li>▪ Enhances revenue stability</li> <li>▪ Promotes conservation awareness</li> <li>▪ Politically acceptable to large-volume customers</li> </ul>	<ul style="list-style-type: none"> <li>▪ Difficult to reconcile with cost-of-service and related equity and efficient principles</li> <li>▪ Administratively complex</li> <li>▪ May reinforces legacy choices</li> <li>▪ Regressive in customer impact</li> </ul>
Rate stabilization fund	A designated fund for managing revenue deficits and surpluses	<ul style="list-style-type: none"> <li>▪ Provides fiscal protection for utility</li> </ul>	<ul style="list-style-type: none"> <li>▪ May cause intergenerational inequity</li> </ul>

<i>Exhibit 6. Continued</i>			
Public-benefit surcharge	A customer surcharge used to fund efficiency or other programs considered beneficial to the public	<ul style="list-style-type: none"> <li>▪ Educates customers about programs and costs</li> </ul>	<ul style="list-style-type: none"> <li>▪ May invite political resistance</li> </ul>
Lost-revenue adjustment	A rate mechanism or revenue recoupling method used to recover revenues lost due specifically to mandates designed to reduce usage	<ul style="list-style-type: none"> <li>▪ Neutralizes the incentive to sell</li> </ul>	<ul style="list-style-type: none"> <li>▪ Difficult to segregate sales lost due to mandates</li> <li>▪ Overstates incentive to sell</li> </ul>
Revenue assurance or decoupling	A rate mechanism or revenue cap designed to decouple sales from revenues and profits	<ul style="list-style-type: none"> <li>▪ Neutralizes the incentive to sell</li> <li>▪ Case is easier for publicly owned utilities (risk and profit issues)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Overstates incentives to sell</li> <li>▪ Discourages economic sales</li> <li>▪ Undermines price efficiency and variable pricing incentives</li> <li>▪ Perpetuates legacy investment</li> <li>▪ Shields utilities from elasticity effects</li> </ul>
Earnings adjustment mechanism	A rate mechanism to compensate private utilities for profit erosion due to efficiency	<ul style="list-style-type: none"> <li>▪ Neutralizes the incentive to sell</li> <li>▪ Can be used with various performance metrics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Undermines performance incentives</li> <li>▪ Shifts risks to customers</li> </ul>

Source: Janice A. Beecher, Institute of Public Utilities, Michigan State University.

### ***Issue 5: What role do industry standards, practices, and policy reforms play?***

- ❖ The impressive success of improved efficiency and the reality of declining water sales presents a challenge to water utilities in terms of:
  - The appropriateness of ratemaking methodologies.
  - The ongoing role of efficiency programs.
  - A discordant conservation message.
- ❖ Many policies and practices for water and other resources reflect an underlying assumption of economic and sales growth.
  - Water sales will not be a source of revenue growth for the water industry.
  - Expansion of the water industry will be limited.
  - Estimates of infrastructure needs may be distorted.
  - Infrastructure investment should emphasize re-optimization.
- ❖ Utility efficiency programs should be scrutinized to ensure they are prudent and cost effective.
  - Program subsidies must be cost-justified and ideally transitional with the purpose of hastening the adoption of self-sustaining efficiency technologies and practices).
  - Efficient prices, along with efficiency standards and consumer information, should be sufficient in the long run for most utilities and normal (nonemergency) circumstances.

- Analysts have considered the relative impact of prices and programs, with some asserting the predominant role of price (see Olmstead and Stavins, 2007).
- ❖ Sustainability is emerging as a better paradigm for water.
  - The industry must adjust to new normals in water usage in terms of infrastructure investment and efficient operations.
- ❖ Water utilities must have sufficient revenues to cover fixed costs and maintain safe and reliable service, including fire protection.
- ❖ Some solutions to the revenue shortfall issue raise institutional or public policy issues beyond the direct control of the individual utility.
- ❖ Policy responses that might be considered include:
  - Expanding economic regulation to ensure prudent investment and full-cost pricing, and depoliticize the ratemaking process (e.g., Wisconsin regulates all water systems).
  - Encouraging fiscal autonomy for water systems, supported by accounting and reporting standards as well as public and private lending requirements and other incentives.
  - Imposing regulatory, zoning, permitting or other restrictions on bypass of water utility service within an enfranchised service territory.
  - Promoting short-term and long-term supply and forecasting methodologies for both costs and sales, and requiring their use in capital planning and ratemaking.

## Thinking About Solutions

- ❖ No single universally applicable solution can be offered: there is no magic bullet.
- ❖ Thinking about solutions requires reexamining “the problem” and its root causes.
- ❖ In thinking about potential solutions, some key questions should be addressed:
  - Does defining the problem define the solution?
  - Is the revenue sufficiency issue primarily a technical or political challenge?
  - Do structural characteristics of water systems matter to potential solutions?
  - What core ratemaking and other principles apply?
  - What tradeoffs are involved when choosing solutions?
- ❖ Does defining the problem define the solution?
  - Conducting a thorough assessment of existing rates is a necessary first step.
  - The assessment should consider whether the existing rate structure has proved adequate in the absence of severe recession, drought restrictions, or wet and cool weather.
  - More broadly, current water rates need to be assessed relative to expenditures, and expenditures need to be assessed relative to optimal service levels, preferable in a broader context of sustainability
- ❖ Is the revenue sufficiency issue primarily a technical or political challenge?
  - The water industry is not lacking in knowledge and tools for forecasting both sales and costs, as well as for asset and watershed planning and management.
  - Many nominal technical problems have underlying root problems: adherence to outdated financial practices, institutional inertia, regulatory guidance, and real or perceived political constraints.
  - Ratemaking to achieve goals requires leadership and political will, as much as technical knowledge (e.g., overcoming “NIMTO or not in my term of office”).
- ❖ Do structural characteristics of water systems matter to potential solutions?
  - The form and nature of solutions will be shaped and sometimes constrained by the institutional context.

- Small water utilities will not have the same resources and options that are available to larger ones.
- Municipal water utilities face a different set of political constraints and oversight than do investor-owned water utilities.
- Different utilities can also face different regulation and different regulators.
- ❖ What core ratemaking and other principles apply?
  - Ratemaking is guided by a long tradition of well-established and well-tested principles, particularly in the regulatory context.
  - Generally accepted ratemaking principles relate primarily to efficiency and equity considerations, while recognizing the importance of compensating utilities for the cost of service.
  - Departures from cost-based rates and revenue neutrality in rate design are cause for concern and may invite legal challenges.
- ❖ What tradeoffs are involved when choosing solutions?
  - Water rates are designed to accomplish multiple objectives (Exhibit 3).
  - Revenue sufficiency is a necessary but not sufficient condition for water utilities to fulfill their mission.
  - Regulatory and political acceptance of rates is essential.

## Concluding Thoughts

New normals in water usage are forming and the industry must find ways to navigate a path toward more efficient usage patterns. The water industry needs to own the issues of declining sales and revenues and update its message of conservation and efficiency to one of service and sustainability. Despite current trajectories, the declining usage problem is a transitory one; sales and revenues will eventually stabilize.

In many respects, the water sector has arrived at an inflection point where water managers must make tough decisions and where the industry as a whole needs to embrace a paradigm of sustainability, as opposed to one of perpetual growth. This is not to say that efficiency is no longer essential; in fact, efficiency is core to long-term sustainability. Efficiency efforts must be adjusted to new and hopefully improved conditions. Ironically, the industry and the conservation community must concede that efforts to improve efficiency are not failing but working. Efficiency gains should be celebrated for their impact on both water and energy, and also incorporated into capital planning and investment decisions. No longer just theoretical, the opportunity to avoid costs has arrived. The biggest risk for the industry may be building tomorrow's water supply infrastructure to meet yesterday's water demand.

## Selected Readings

Aubuchon, Craig P. and J. Alan Roberson (2012) "Price perception and nonprice controls under conservation rate structures," *Journal American Water Works Association*.

Abstract: This research evaluates the effect of price and nonprice conservation controls on monthly water system demand and explores differences in rate design, education and outreach programs, population growth, and regional climate variables among a national cross section of utilities. Using the Shin price perception parameter, this study found that under conservation rate structures, aggregate demand was related to something other than marginal or average price. The price-demand response increases with higher levels of consumption for both the marginal price and the total bill, which may provide preliminary evidence that the price signal of the total bill matters for demand. Nonprice controls were not found to be statistically significant in the study sample. Income elasticities were positive and slightly larger in magnitude than price elasticities, suggesting that over the long term, utility managers may need to increase rates faster than regional income growth for effective demand management.

Beecher, Janice A. (2010). "The conservation conundrum: How declining demand affects water utilities." *Journal American Water Works Association* 102 (2):78-80.

[\[http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW\\_0071587\]](http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0071587)

Abstract: This article discusses the significant financial challenge that utilities face in the rising infrastructure costs that must be recovered from a shrinking sales base. Fortunately, strategic coping methods are available such as forecasting, scenario-building, and planning. Utility plans should incorporate long-term goals and performance metrics as well as prudent investment strategies based on changing demand patterns. Cost recovery should recognize expenditures for cost-effective investments in efficiency, and regulators can provide additional incentives as appropriate. As long as costs and demand continue to shift, more frequent rate adjustments will help reduce lag and ensure that rates are properly aligned with costs. Forward-looking rates can be established by using a "future test year" for revenues. A demand-repression adjustment may be needed to recognize the effects of programs and prices on forecast use. Utilities will also need to examine rate-design options and assess whether they exacerbate or mitigate revenue volatility, uncertainty, and distributional consequences.

Beecher, Janice A. (2012). The ironic economics and equity of water budget rates. *Journal American Water Works Association* 104 (2).

[\[http://www.awwa.org/publications/AWWAJournalArticle.cfm?itemnumber=58445\]](http://www.awwa.org/publications/AWWAJournalArticle.cfm?itemnumber=58445)

Abstract: Water budget rates are gaining attention in the water sector. Although clearly well-intended, the water budget approach to rates raises serious theoretical and practical issues familiar to applied regulatory economics. In essence, water budget rates exemplify "social rate-making," that is, a system of pricing that departs from traditional economic standards in the interest of serving social goals—in this case water conservation. The inherent problem with this particular rate structure, however, is not its good intentions but its disconcerting implications. The troubling irony of water budget rates appears to be lost in the deliberation.

Chesnutt, T.W., G. Fiske, J.A. Beecher, D.M. Pekelney (2007) *Water Efficiency Programs for Integrated Water Management*, Water Research Foundation.

Executive Summary: Water utilities have increasingly come to appreciate the value of water use efficiency (WUE) for accomplishing their long-term mission of providing a safe and reliable potable water supply. The importance of water efficiency goes well beyond the short-term measures invoked to respond to drought emergencies, and is much broader in scope. Improved water-use efficiency is



seen as a viable complement to – and in some instances, a substitute for – investments in long-term water supplies and infrastructure. This understanding of water efficiency includes outdoor as well as indoor WUE, nonresidential water customers as well as residential customers, and utility delivery efficiency as well as end use efficiency. At the heart of the new understanding of water efficiency is an economic standard: a good WUE program produces a level of benefits that exceed the costs required to undertake the program.

Coomes, Paul, Tom Rockaway, Josh Rivard, and Barry Kornstein (2009). *North America Residential Water Usage Trends Since 1992*, Water Research Foundation.

[[http://www.waterrf.org/ExecutiveSummaryLibrary/4031\\_ExecutiveSummary.pdf](http://www.waterrf.org/ExecutiveSummaryLibrary/4031_ExecutiveSummary.pdf)]

Conclusion: “This research documents a pervasive trend toward lower water usage per household. The magnitude of the decline is consistent across North American utilities and is confirmed by more detailed data provided by the study’s 11 partner utilities, although there were annual variations due to regional factors. The results of the study’s statistical models identify the magnitude of both positive and negative forces affecting water usage. The decline in number of residents per household is clearly an important factor in falling water consumption per residential customer. However, the negative consequences of smaller households appears to be more than offset by the positive consequences of higher household incomes. Higher incomes have led to larger homes, with more water-using appliances, and more landscape irrigation. Thus, the net decline in water usage per household appears to be due to the steady penetration of low-flow appliances over the past 20 years. The end-use study found that low-flow appliances and changing household demographics accounted for a 16 percent reduction in average household water use in 2007, as compared to 1990... The steady decline in usage per household has important financial-planning consequences for water utility companies, as infrastructure is spread over more housing units using less water than before. The data compiled in this research are intended to assist utilities in developing realistic management plans that take into account the primary causes of declining residential water usage. The data provide a tool for projecting residential water usage in light of utility-specific trends. Utilities serving communities with growth in single-occupant households are likely to see erosion in revenues per household. Additionally, new federal regulations governing water-conserving appliances and fixtures further indicate that residential water usage will continue to decline as newer homes make up a larger component of the housing stock. Utilities may find it useful to track persons per household in addition to number of households as they plan infrastructure and set rates... Although the rate of decline may slow, there is no indication that national household-size trends will reverse. Also, new and existing federal regulations will prompt further penetration of water-conserving appliances.

Dalhuisen, Jasper M., Raymond J.G.M. Florax, Henri L. F. de Groot, and Peter Nijkamp (2003). "Price and Income Elasticities of Residential Water Demand: A Meta-Analysis," *Land Economics* 79 (2):292-308. [<http://le.uwpress.org/content/79/2/292.abstract>]

Abstract: This article presents a meta-analysis of variations in price and income elasticities of residential water demand. Meta-analysis constitutes an adequate tool to synthesize research results by means of an analysis of the variation in empirical estimates reported in the literature. We link the variation in estimated elasticities to differences in theoretical microeconomic choice approaches, differences in spatial and temporal dynamics, as well as differences in research design of the underlying studies. The occurrence of increasing or decreasing block rate systems turns out to be important. With respect to price elasticities, the use of the discrete-continuous choice approach is relevant in explaining observed differences.

Danielson, Leon E. (1979). "An Analysis of Residential Demand for Water Using Micro Time-Series Data," *Water Resources Research* 15 (4):763-767.

[<http://www.agu.org/pubs/crossref/1979/WR015i004p00763.shtml>]

Abstract: Residential water demand is estimated as a function of temperature, rainfall, house value, water price, and household size using monthly cross-section and time-series meter readings from 261 residential households in Raleigh, North Carolina, between May 1969 and December 1974. Tests for validity of assumptions are made, and a methodological approach is used that provides unbiased estimates of parameters and standard errors with data that exhibit serially correlated residuals. Demand relations are estimated for total residential, winter, and sprinkling demands. Sprinkling use per period per customer for each year is estimated by subtracting winter (November–April) from summer (May–October) use. Household size explained the largest proportion of the variation in the data. Estimated sprinkling demand was found to be highly responsive to changes in water price and the level of the climatic variables, while total residential demand and winter demand were less responsive to price changes.

Fenrick, Steven Andrew, and Lullit Getachew (2012). "Estimation of the Effects of Price and Billing Frequency on Household Water Demand Using a Panel of Wisconsin Municipalities," *Applied Economics Letters* 19 (14): 1373-1380.

[\[http://www.tandfonline.com/doi/abs/10.1080/13504851.2011.629977\]](http://www.tandfonline.com/doi/abs/10.1080/13504851.2011.629977)

Abstract: A demand function of residential water consumption is developed from a 1997 to 2006 panel of 200 Wisconsin water utilities. A double-log functional form is assumed and parameters are estimated using a random effects model. The results suggest that the price is inelastic yet negative and statistically significant and this elasticity response grows stronger as the marginal price level is increased. Additionally, the model reveals water savings due to monthly billing and also the annual water savings from technology adoption.

Grafton, R. Quentin, Michael B. Ward, Hang To, and Tom Kompas (2011). "Determinants Of Residential Water Consumption: Evidence and Analysis from a 10-Country Household Survey," *Water Resources Research* 47. [\[http://www.agu.org/pubs/crossref/2011/2010WR009685.shtml\]](http://www.agu.org/pubs/crossref/2011/2010WR009685.shtml)

Abstract: Household survey data for 10 countries are used to quantify and test the importance of price and nonprice factors on residential water demand and investigate complementarities between household water-saving behaviors and the average volumetric price of water. Results show (1) the average volumetric price of water is an important predictor of differences in residential consumption in models that include household characteristics, water-saving devices, attitudinal characteristics and environmental concerns as explanatory variables; (2) of all water-saving devices, only a low volume/dual-flush toilet has a statistically significant and negative effect on water consumption; and (3) environmental concerns have a statistically significant effect on some self-reported water-saving behaviors. While price-based approaches are espoused to promote economic efficiency, our findings stress that volumetric water pricing is also one of the most effective policy levers available to regulate household water consumption.

House-Peters, Lily A., and Heejun Chang (2011). "Urban Water Demand Modeling: Review of Concepts, Methods, And Organizing Principles," *Water Resources Research* 47 (5).

[\[http://www.agu.org/pubs/crossref/2011/2010WR009624.shtml\]](http://www.agu.org/pubs/crossref/2011/2010WR009624.shtml)

Abstract: "In this paper, we use a theoretical framework of coupled human and natural systems to review the methodological advances in urban water demand modeling over the past 3 decades. The goal of this review is to quantify the capacity of increasingly complex modeling techniques to account for complex human and natural processes, uncertainty, and resilience across spatial and temporal scales. This review begins with coupled human and natural systems theory and situates urban water demand within this framework. The second section reviews urban water demand literature and summarizes methodological advances in relation to four central themes: (1) interactions within and across multiple spatial and temporal scales, (2) acknowledgment and quantification of uncertainty, (3) identification of thresholds, nonlinear system response, and the consequences for resilience, and

(4) the transition from simple statistical modeling to fully integrated dynamic modeling. This review will show that increasingly effective models have resulted from technological advances in spatial science and innovations in statistical methods. These models provide unbiased, accurate estimates of the determinants of urban water demand at increasingly fine spatial and temporal resolution. Dynamic models capable of incorporating alternative future scenarios and local stochastic analysis are leading a trend away from deterministic prediction.

Hunter, Margaret, Kelly Donmoyer, Jim Chelius, and Gary Naumick (2011). "Declining Water Use Presents Challenges, Opportunities," *American Water Works Association Opflow*.

[<http://www.awwa.org/publications/OpFlowArticle.cfm?itemnumber=56556>]

Abstract: For many North American utilities, residential water use has declined steadily for the last 20 years. In many locations, the trend has accelerated in the last decade. Several factors appear to contribute to declining household water use. The long-term trend could significantly affect the way utilities conduct their business and operations.

Krause, Kate, Janie M. Chermak, and David S. Brookshire (2003). "The Demand for Water: Consumer Response to Scarcity," *Journal of Regulatory Economics* 23 (2): 167-91.

[<http://ideas.repec.org/a/kap/regeco/v23y2003i2p167-91.html>]

Abstract: Provision of water raises several issues for municipal utility companies and other suppliers, including reliability of supply in and regions or during droughts, equity issues that arise because water is literally a necessity, and heterogeneity in consumer response to regulatory policy. We combine experimental and survey responses to investigate demand for water. The experiments simulate water consumption from a potentially exhaustible source, revealing heterogeneous demand for water. We estimate econometrically water demand for different consumer groups. A regulator could use estimates of disaggregated demand to attain conservation goals by designing an incentive compatible pricing system. The example given achieves a conservation goal while minimizing enforcement costs and welfare loss.

Mayer, P., W. DeOreo, T. Chesnutt, D. Pekelney, and L. Summers (2008). "Water Budgets and Rate Structures: Innovative Management Tools," *Journal American Water Works Association* 100 (5).

Abstract: Water budgets, volumetric allotments of water to customers based on customer-specific characteristics and conservative resource standards, are an innovative means of improving water-use efficiency. Once thought to be impractical because of technological constraints, water budgets linked with an increasing-block rate structure have been implemented successfully by more than 20 utilities. Key issues identified in this examination of water budgets and their potential value to North American water utilities include: different practical approaches to water budget rate structures; the benefits and challenges of these approaches; the potential uses of water budgets during drought; and, important steps in the water budget implementation process.

Mehan, G. Tracy, III and Ian Kline (2012). "Pricing as a Demand-Side Management Tool: Implications for Water Policy and Governance," *Journal American Water Works Association* 104 (2).

[<http://www.awwa.org/publications/AWWAJournalArticle.cfm?itemnumber=58441>]

Abstract: Full-value or -cost pricing and conservation pricing as demand-side management tools are examined along with the benefits of maintaining responsive and transparent government and the benefits realized as a result of such practices.

Merrett, Stephen (2004), "The Demand for Water: Four Interpretations," *Water International* 29 (1): 27-29.

Abstract: The management of water resources draws on a wide range of disciplines and one of the most frequent terms used among these disciplines is the “demand” for water. In fact, this single word can have at least four quite distinct meanings: the use of water, the consumption of water, the need for water, or the economic demand for water. Each of these four separate terms is carefully defined in the paper in the context of the hydrosocial balance of a region. The paper recommends precisely defining these four terms (use, consumption, need, economic demand) is necessary to avoid the ambiguities and confusion in water resources management that can arise from the catch-all term “demand.” It is also indicated that to regard supply-side activities to reduce leakage and evaporation as a form of demand management is mistaken.

Mieno, Taro, and John B. Braden (2011). "Residential Demand for Water in the Chicago Metropolitan Area," *Journal of the American Water Resources Association* 47 (4):713-23.

[\[http://onlinelibrary.wiley.com/doi/10.1111/j.1752-1688.2011.00536.x/abstract\]](http://onlinelibrary.wiley.com/doi/10.1111/j.1752-1688.2011.00536.x/abstract)

Abstract: “This paper provides the first contemporary analysis of residential water demand in humid Northeastern Illinois, in the vicinity of Chicago, and explores seasonal and income-based differentials in the responsiveness of water use to water prices. Using a panel of system-level data for eight water systems and controlling for seasons, weather, incomes, and community characteristics, the analysis yields low estimates of price elasticity of demand for water in line with other studies. Furthermore, price response is greater in summer and less in higher income communities. We suggest that use of seasonal pricing can help mitigate equity issues arising from differential income elasticities while taking advantage of the greater price responsiveness of summertime water use.”

Olmstead, Sheila M., and Robert N. Stavins. 2007. "Managing Water Demand: Price vs. Non-Price Conservation Programs," Pioneer Institute.

[\[http://www.hks.harvard.edu/fs/rstavins/Monographs & Reports/Pioneer Olmstead Stavins Water.pdf\]](http://www.hks.harvard.edu/fs/rstavins/Monographs%20&%20Reports/Pioneer%20Olmstead%20Stavins%20Water.pdf)

Excerpt from conclusion: “Water management in the United States has typically been approached as an engineering problem, not an economic one. Water supply managers are often reluctant to use price increases as water conservation tools, instead relying on non-price demand management techniques. These include requirements for the adoption of specific technologies (such as lowflow fixtures) and restrictions on particular uses (such as lawn watering)... This paper has offered an analysis of the relative merits of price and non-price approaches to water conservation. On average, in the United States, a ten percent increase in the marginal price of water can be expected to diminish demand in the urban residential sector by about 3 to 4 percent. For the purpose of comparison, this average of hundreds of published water demand studies since 1960 is similar to averages reported for residential electricity and gasoline demand... Estimates of the water savings attributable to non-price demand management policies such as watering restrictions and low-flow fixture subsidies vary from zero to significant savings. These programs vary tremendously in nature and scope. More stringent mandatory policies (when well-enforced) tend to have stronger effects than voluntary policies and education programs.”

Rockaway, Thomas D., Paul A. Coomes, Joshua. Rivard, and Barry. Kornstein (2011). "Residential Water Use Trends in North America," *Journal American Water Works Association* 103 (2): 76-89.

[\[http://www.awwa.org/files/Resources/Waterwiser/JAW0211rockaway.pdf\]](http://www.awwa.org/files/Resources/Waterwiser/JAW0211rockaway.pdf)

Conclusion: “This research investigated trends in household water use in North America. When controlling for weather and other variables, the evident decline in residential use was pervasive among the national and regional components of the study. A household in the 2008 billing year used 11,678 gallons less water annually than an identical household did in 1978... To investigate the causes of this decline, a local study of statistically representative households of the LWC was conducted in

Louisville. Adjusting for weather, water use per LWC customer fell from 208 to 187 gpd between 1990 and 2007, a decline of 21 gallons. Data-logging devices were installed at participating homes, and the data were incorporated into statistical models to examine possible causes and the relationships among socioeconomic factors, demographic factors, water-using appliances, behavior patterns, significant water features and types of irrigation, and residential water consumption. Demographic factors can account for a decline of 5 gallons, whereas income-related factors suggest an increase of about 5.4 gallons. This study attributes the remaining estimated net decline, about 19 gpd, to the increased installation of low-flow appliances in the Louisville market.”

*Standard & Poor’s (2012) From Droughts to Conservation: Water Can Have Big Effects on U.S. Municipal Utility Credit Quality.*

Overview: Intense competition for potable water means that while water in most of the U.S. is not yet priced like a commodity, it could be, and sooner than many might think. Although conservation efforts affect utility financial risk profiles, they can be beneficial. Making the most of increasingly scarce federal funds for infrastructure renewal and prudent risk management, including raising rates as needed, will be vital for utilities to maintain credit quality.