Declining Residential Water Use Presents Challenges, Opportunities

Conservation efforts and use of more efficient appliances are causing residential customers to use less water. How does this affect the way utilities conduct their business and operations?

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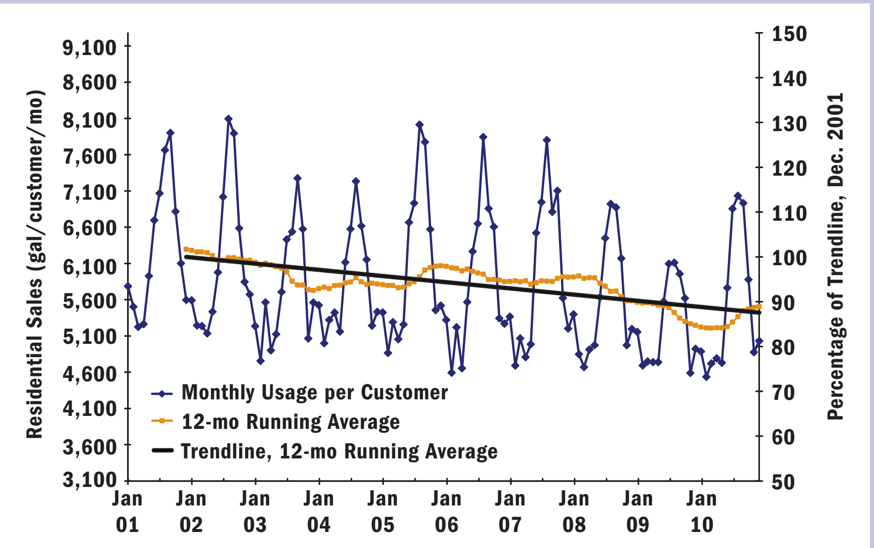
FOR MANY North American utilities, residential water use has declined steadily for the last 20 years. In many locations, the trend has accelerated in the last decade. The long-term trend could significantly affect utilities.

A utility services company studied historic water usage trends for its US operations during the last 10 years. Figure 1 shows monthly residential use per customer. Overall, residential water use across the company's largest state subsidiaries declined about 1.4 percent/yr/customer between 2001 and 2010. The trend of declining use was consistent across widely ranging geographic locations and demographic characteristics. Similar results were found in a study of winter-only consumption in northern US service areas where there's little or no outdoor water use during winters.

Figure 1. Monthly Residential Sales Per Customer

Residential water use declined between 2001 and 2010 among state subsidiaries of a large utility services company.



The consistency of the findings indicates strong underlying drivers are affecting indoor residential usage patterns. These findings closely match data published in a 2010 Water Research Foundation Report, North America Residential Water Usage Trends Since 1992.

CAUSES OF DECLINING USE

Several factors appear to contribute to declining household water use, including high-efficiency plumbing fixtures; a decline in persons per household in many locations; utility-led water efficiency programs, such as consumer education, fixture retrofit, and water audit programs; increased conservation practices and awareness; economic conditions; and price elasticity.

The Energy Policy and Conservation Act of 1992 mandated the manufacture of water-efficient toilets, showerheads, and

The US Environmental Protection Agency's WaterSense program is promoting water efficiency and enhancing the market for water-efficient products, programs, and practices. For example, a WaterSense home is independently inspected and certified to use 20 percent less water than a standard new home. The first model homes in the nation to receive the WaterSense label were recently completed in the Springwood community of Roseville, Calif.

PHOTOGRAPH: KB HOMES

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faucet fixtures. For example, a toilet manufactured after 1994 uses 1.6 gal/flush (gpf) or less compared with an older toilet's water use, which was 3.5–7 gpf.

The Energy Independence & Security Act of 2007 established high-efficiency standards for dishwashers and clothes washers. Dishwashers manufactured after 2009 and clothes washers manufactured after 2010 must meet water efficiency requirements that could reduce water used by such fixtures by 54 percent and 30 percent, respectively. Fixtures and appliances that surpass these requirements are increasingly available in the marketplace.

All other factors being equal, typical residents living in a home built in 2011 would use 35 percent less water for indoor purposes than a nonretrofitted home built before 1994. The accompanying table contains more details about regulatory requirements and the typical effect they have had on residential water use. Changing household demographics, such as a decrease in the number of persons per household, have also affected residential water use.

Although indoor water use for consumption and hygiene is considered relatively inelastic, i.e., not affected by economic conditions, it can be affected by water and sewer rate increases. For example, leaks that may be ignored when rates are low tend to be repaired when rates increase. Nonessential residential water use for lawn and garden irrigation, car washing, water features, and swimming pools tends to have more elasticity relative to water and sewer rate increases. In addition, conservation-inducing rate structures have prompted significant elasticity in indoor water use. Price elasticity estimates generally range from -0.05 to -0.50 (percentage change in consumption divided by the percentage change in price). Elasticity estimates the percent change in consumption expected to occur in response to a percent price increase; the negative sign implies that consumption decreases as the price of water increases.

OPERATIONAL IMPLICATIONS

Because the current water use trend is likely to continue, water utility managers and operators must consider the effects of reduced consumption on their systems and rates. In some service areas,

Flow Rates for Typical Household Fixtures and Appliances

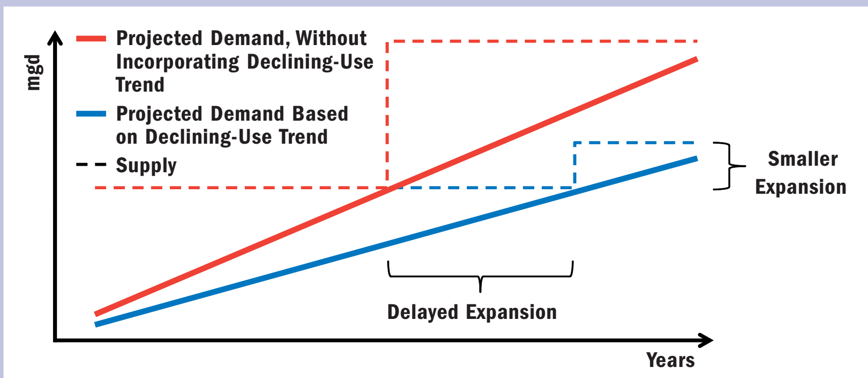
Flow rates vary significantly before and after implementation of various federal standards.

Type of Use	Pre-Regulatory Flow*	Regulatory Standards and Flows			WaterSense/ ENERGY STAR Current Specification+
		Regulatory Standard (maximum)	Federal Law	Year Effective	
Toilets	3.5 gpf	1.6 gpf	US Energy Policy Act	1994	1.28 gpf
Clothes washers**	41 gpl (14.6 WF)	Estimated 26.6 gpl (9.5 WF)	Energy Independence and Security Act of 2007	2011	Estimated 22.4 gpl (8.0 WF)
Showers	2.75 gpm	2.5 gpm at 80 psi	US Energy Policy Act	1994	No specification
Faucets***	2.75 gpm	2.5 gpm at 80 psi (1.5 gpm)	US Energy Policy Act	1994	1.5 gpm at 60 psi
Dishwashers	14 gpc	6.5 gpc for standard; 4.5 gpc for compact	Energy Independence and Security Act of 2007	2010	5.8 gpc for standard; 4.0 gpc for compact

* Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001
** Average estimated gallons per load and water factor
*** Regulation maximum of 2.5 gpm at 80 psi, but lavatory faucets available at 1.5 gpm maximum
+ Source: www.epa.gov/watersense and www.energystar.gov websites

Figure 2. Declining Use and Delayed Smaller Expansion

Declining water use may affect long-term capital planning.



population growth has been sufficient to provide an overall increase in total residential use (gal/mo). However, in areas where customer growth is slow or nonexistent, declines in customer use have resulted in lower overall water use. Utilities must address the financial implications of reduced consumption.

Several environmental and operational advantages result from lower water use. Necessary diversions from supply sources are lessened, leaving more water for passing flows or drought reserve. Reductions in power consumption, chemical use, and waste disposal reduce utility operating costs and provide environmental benefits, such as reduced carbon footprints and waste streams.

Declining water use also affects long-term capital planning. Utility planners should ensure that capital projects are based on the most current information. As shown in Figure 2, when anticipated customer demand indicates declining use, a project to develop a supply to meet future demands could be downsized or postponed. However, it's important to note that, although a utility's average daily consumption may decline, its peak day demands may not. Peak day demands typically drive capital infrastructure needs, such as treatment and pumping capacity. Peak day demands are driven by short-term events, such as hot, dry weather or seasonal community events that temporarily increase population or use. Utility managers and operators should understand customer demand patterns to determine peak demand trends and to understand whether those trends are the same as average usage.

Declining usage can also present opportunities to optimize management of water supplies, treatment facilities, and pump stations. Systems that rely on multiple supply sources with significant cost differences for securing, pumping, and treating may be able to save money by minimizing use of higher-cost supplies. Purchase water agreements should be reviewed regularly and given consideration for reducing annual purchases and minimizing take-or-pay limits where continued declining usage is anticipated. This can be particularly advantageous for systems that must purchase water to supplement more economical but limited or stressed supplies.

Reduced demands can present opportunities for more efficient and effective pumping and treatment. For example, lower demands can result in increased system storage capacity that allows more off-peak pumping and reduced electricity demand charges. Scheduled maintenance of certain process equipment, such as granular activated carbon media and membrane replacement, might be extended.

SUSTAINABILITY

Efficient residential water use has environmental, economic, and energy-efficiency benefits and should be encouraged. It may help utilities optimize asset allocation and reduce costs. However, many water utility capital needs (infrastructure renewal, reliability, regulatory projects, etc.) and operating costs (salaries, plant maintenance, customer services needs, IT support, security, etc.) are unaffected by reduced consumption. Water utilities must, therefore, mitigate the impact of lost revenue. However, reduced demand presents utilities with a significant but surmountable financial challenge: Rising infrastructure costs must be recovered from a declining sales base. Tariff design mechanisms, such as revenue-balancing accounts and increased fixed charges, help to decouple revenue from sales.

In its June 2008 publication—*Effective Utility Management, a Primer for Water and Wastewater Utilities*—the US Environmental Protection Agency described the attributes of an effective utility, which included water resource adequacy, financial viability, and operational optimization. By taking proactive steps to address revenue stability, efficient operations, and customer education, utility operators and managers can ensure that customers, the utility, and the environment benefit.

RESOURCES

- Beecher, Janice A., 2010. The conservation conundrum: How declining demand affects water utilities. *Journal AWWA*, 102:278.
- USEPA, 2006. Expert Workshop on Full Cost Pricing of Water and Wastewater Service.
- Vickers, Amy, 2001. *Handbook of Water Use and Conservation*, WaterPlow Press, Amherst, Mass.
- Water Research Foundation, 2010. North America Residential Water Usage Trends Since 1992.