The Next Generation of Data-Driven Demand Management: Long-Range Planning for Revenue Stability

Gregory M. Baird and Jeff Lipton

The U.S. Water Industry

The water industry in the United States is complex and diverse. Each organization and management structure is relatively unique, ranging from municipalities of single cities or counties, to private utilities, to water districts encompassing entire interstate regions. Nationwide there are nearly 54,000 community water systems[1].

The industry doesn't employ any standard communication approaches with end users, as each program is directed by varying officials and managers. As one of the most capital intensive[2] ($6.84 of investment to earn one dollar of revenue)[3] sectors of cities (with water-related services twice as capital intensive as electricity and three times as gas),[4] and with historically low water prices and associated revenues, venture capital and private equity have been reluctant to deploy capital to the water industry.[5]

The industry is also facing a near-term future of growing demand. From 2015 to 2019, the U.S. is projected to have a population growth rate of 2.4 percent, with just under half of the states with higher growth rates reaching up to 7.5 percent.[6] Much of this growth is occurring in arid urban regions where the cost for new water supplies is rapidly climbing, as traditional supply sources have already been tapped. For water utilities, that means more customers, more water demand, and more infrastructure development needs.

In addition to new infrastructure, the country is facing a different crisis: replacing existing infrastructure. In 2002, the U.S. Environmental Protection Agency (EPA) projected a daunting $335 billion gap to replace and update America's entire aging water infrastructure in the next 15 years—and that's just for drinking water[7]; the estimate for underground water pipe replacement over the next 20 years (including sewer and storm systems) is much, much larger. A recent U.S. Conference of Mayor's estimate placed a combined need for all assets, including growth, at up to $4.8 trillion[8]. With over 240,000 water main breaks in 2013 and an engineering grade of D from the American Society of Civil Engineers (ASCE)[9] the U.S. wet infrastructure is at a critical crossroads, requiring this hidden issue to become a public discussion at all levels.

Water Executives Facing New Realities

Amidst this backdrop of decreasing supplies, growing demand, and the need for massive infrastructure investment, the U.S. water industry also finds itself at the dawn of a new revolution of data-driven water management practices, definitions, and applications. This transformation builds on the evolution of water resource supply and protection planning, while facing the current realities of asset failure due to deferred investments, population shifts, unfunded environmental mandates, utility knowledge loss and skill shortages, water supply variability, increased public scrutiny on utility spending, changing financial markets, and continued cost increases.

Gregory M. Baird is president of Water Finance Research Foundation in Salt Lake City, and Jeff Lipton is director of marketing at WaterSmart Software in San Francisco.

Misalignment of water supply and demand is one of the greatest environmental concerns from coast to coast, from the informed citizen to the finance managers to the elected officials with delegated oversight. The drivers of this distress include climate change; population growth; regulations; demand variability complicated by changing weather patterns and water-saving efforts; wastewater reuse; and exchanges, ownership, and transfers.

Water utility managers are expected to know not only the per-capita demand of a growing and changing population, but also how to protect existing customers from water shortages due to natural or manmade emergencies, like contamination, drought, earthquakes, infrastructure loss, fires, algae blooms, infestations, and toxic spills.

Engineers are tasked with the evaluation of infrastructure needs, including replacement and repair schedules. They must assess asset and capacity needs, and, through master planning efforts, strive to achieve sustainability goals and build more resilient water systems.

Finance professionals are expected to understand the costs of these complex water issues and how they will impact rates and revenues, while simultaneously addressing the affordability concerns of the customer base. Even wastewater utilities, which have historically been unconcerned with water supply issues, are now forced to deal with the costly effects of lower flows from water demand management efforts, the complexities of reuse planning, and regulatory water quality requirements, particularly in the wake of the lead-in-water disaster in Flint, Mich.

It's therefore unsurprising that utility finance professionals do not like the notion of conservation because the term has become synonymous with revenue loss, potential decreases in credit ratings, and higher capital costs. Revenue erosion often leads to budget cuts that impair the ability to invest in preventive maintenance programs to extend asset life. Reduction in maintenance budgets leads to premature asset failure that drives up capital costs against an ever-increasing list of deferred capital projects, upgrades, infrastructure repairs, and replacements. This downward fiscal cycle results in the inability to control or forecast revenue, and greater uncertainty concerning water usage. In this context, conservation distorts the price elasticity of demand and creates pressure to rebalance the fixed and volumetric components of water rates to help reduce revenue variability.

This view of improved water use efficiency, however, is inherently flawed. In actuality, better control over water demand improves forecasting capabilities and moderates variability. This creates greater financial control and improves both short- and long-term prospects for more efficient operations, greater customer engagement, and reduced future capital requirements.

Controlled water demand reduction creates growth capacity in assets by extending operating lifetimes. Controlled water demand management also translates into trenchless rehabilitation of underground infrastructure when there is decreased throughput. This enables the utility to replace assets at lower cost, which is then passed on to customers in the form of more gradual rate increases. This holistic approach also accounts for the full life cycle of assets and infrastructure funding.

Focusing on Water Demand

Where do utilities turn for more water when wells and rivers have dried up due to dangerously low aquifer levels and record low precipitation? Historically, when utilities needed more water, dams and reservoirs were constructed and new wells were dug deeper. These approaches are no longer viable in many parts of the country where water providers are facing historically low water levels in rivers and aquifers, as well as decreased surface runoff.[10] Recycled and desalinated water are increasingly being pursued, but these projects take years or decades to develop, are incredibly expensive, and only address a modest portion of supply needs.

New forecasting models incorporate controlled demand management and capture the data of all water chain inputs, outputs, and stakeholders' water use actions. The long-term result is envisioned to include a dynamic and holistic data-driven picture that supports improved asset allocation and decision making. Such capabilities are expected "to help save energy, improve dynamic pricing ability, monitor water quality, extend infrastructure longevity, and reduce capital expenditures by managing peak demand."[11]

The Benefits of Water Demand Management

When considering updating or replacing current water treatment plant infrastructure, demand reduction is a high-value alternative to procuring new water supply resources. In addition to helping balance mismatches in supply and demand, short-term benefits of demand reduction include:

- Lower operations and maintenance costs
- Lower energy expenses
- Lower treatment costs
- Deferred or downsized capital projects
- Less rate shock
- Higher credit scores
- Reduced-rate loans for infrastructure projects
- Greater system reliability

Short-term demand reduction is usually associated with drought, natural disasters, and economic crises, where real results are needed as quickly as possible; however, improved water use efficiency as a supply resource moves beyond these conditions to offer substantial long-term benefits as well.

Water use reductions over a 20-year time horizon can help optimize demand management policies, while creating new virtual water supplies. These approaches have been shown to have significantly slowed down rate hikes in some utilities[12] and have yielded substantial avoided operational and capital costs. Additionally, investments in water use efficiency have improved demand forecasting and increased revenue control.[13]

Because of these and many other benefits, utilities across the nation (and the world) are investing in demand management, with a general trend toward assigning these responsibilities to water conservation managers and teams. Simultaneously, there is an increase in the number of organizations calling for improved water efficiency as a cost-effective source of supply, such as the Alliance for Water Efficiency, Waterwise, and the California Urban Water Conservation Council. Even when demand reduction is not a specific agency need, utility managers are increasingly honing in on demand management best practices as an integral component of their resource management plans.

Infrastructure Cost Savings: A Colorado Case Study

Improved demand management helps reduce operational and capital costs and allows utilities to more easily fund current and future projects without an exaggerated rate shock, while concurrently mitigating affordability issues. According to a recent study in Colorado[14], utilities were able to significantly downsize rate increases through demand reduction practices. The study analyzed water use behavior and utility policies since 1980, projecting out utility costs to the present day had demand reductions never been introduced. The results were startling.

According to the City of Westminster's findings, an additional 7,295 acre-ft would have been needed to meet rising demand. As new

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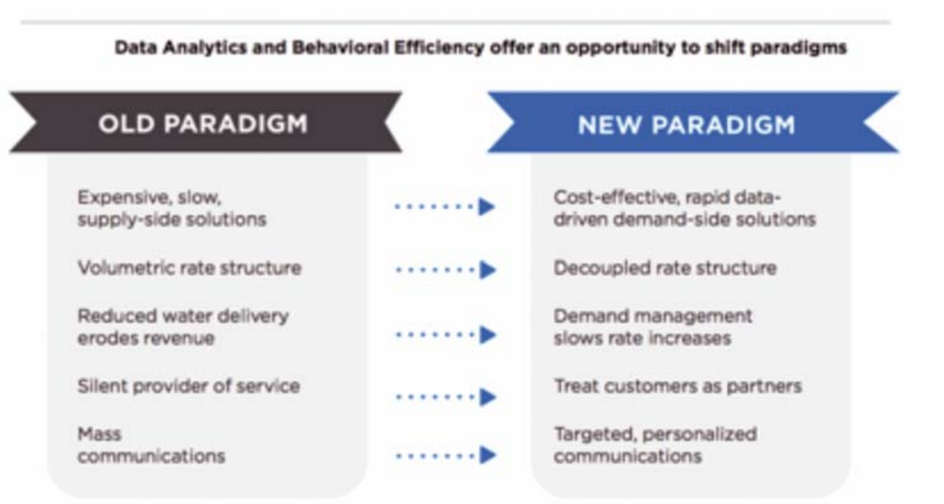

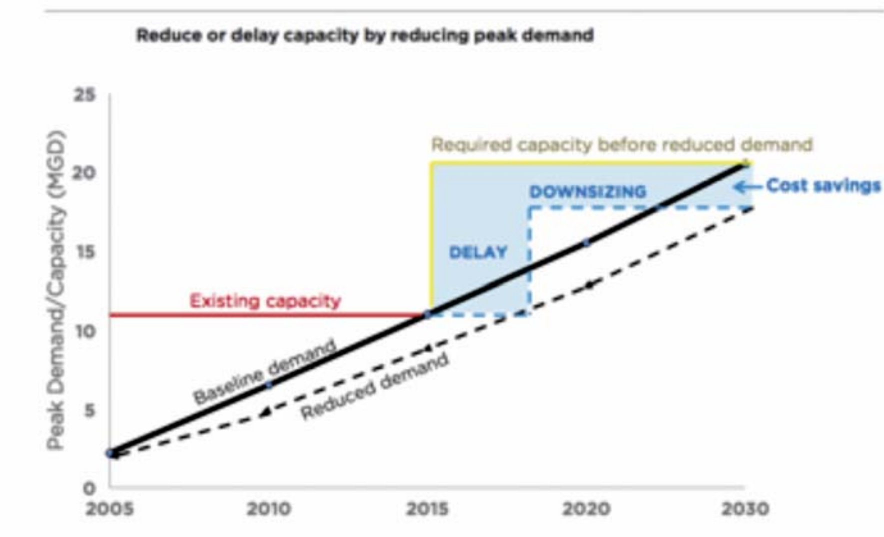

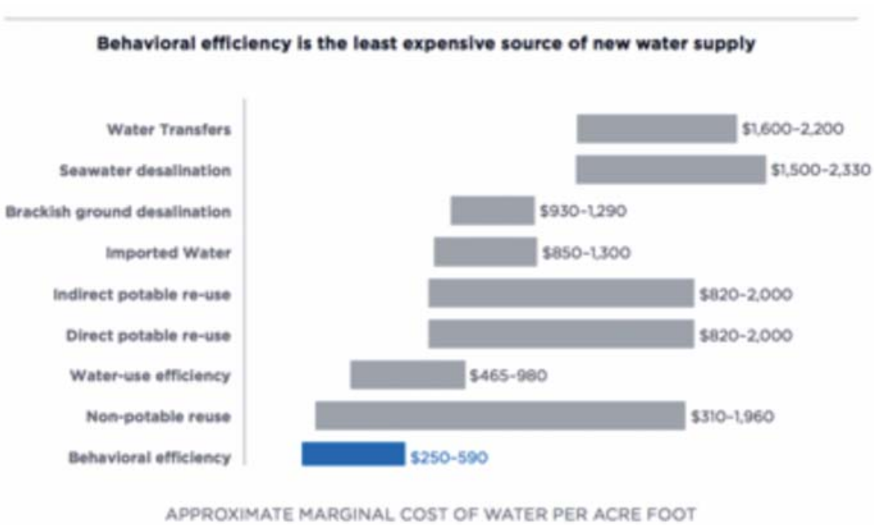

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water sources in the Colorado Front Range are priced at an astonishing $30,000 per acre-ft, the city calculated savings in capital investments to be nearly $219 million. Demand reductions particularly affected peak-season water production, saving the city approximately $130 million in additional treatment costs. Wastewater treatment savings of roughly $20 million were also realized.

Overall, through consistent demand management programs, the City of Westminster was able to avoid more than $591 million in costs for new capital investments in water source supply and infrastructure. The study also found that the utility saved, on average, $1.2 million in yearly operating costs.

The study also analyzed these costs and their repercussions on water and wastewater rates, as well as tap fees. Combined water and sewer bills would be 91 percent higher than they are currently, jumping from $655 to $1251 annually, had 1980 water usage levels continued without demand management. Similar results were found for tap fees, where rates would have increased by 99 percent had conservation never been introduced.

The report states that, "Each water system is unique, so the results from Westminster may not be applicable to everyone. Utilities could perform a similar analysis to see the real value of conservation; however, the $590 million cost associated with the additional 7,295 acre-ft of demand reveals the significant hardship associated with expanding water resources supply and wastewater treatment infrastructure in today's environment."

Not only is it a hardship for the utility, but also for the customer to keep up with rates that are increasing at an alarming rate. As a recent article states, "Water and wastewater rates have increased faster than the Consumer Price Index (CPI) over the past 15 years.[15] Managing the public response to rate increases has taken on growing significance in recent years as utilities grapple with the double-edged sword of rising infrastructure costs and decreasing demands[16] ."

Although rates will still increase, they will do so significantly more slowly when demand management programs are in place. Utilities are increasingly adopting rate structures that place more weight on fixed costs, rather than variable operating costs. Building demand-reduction programs into the monthly fixed costs of utility water and wastewater rate structures allows utilities to fully capitalize on all avoided water costs, as well stabilize revenues by emphasizing predictable fixed costs.

The Cost of Reducing Water Demand Versus New Water Sources

The best practices section of California's updated 2014 water plan discusses a way to maximize investments in data collection through utility- and customer-side analytics technologies:

> "In addition to using conservation rate structures to incentivize water conservation, some water suppliers are using a new behavioral approach to affect demand management. Based on insights from psychological research, behavioral water efficiency programs inform consumers of prevailing social norms, such as the average water use of neighbors, to drive conformity to a more efficient standard. This comparison creates a social framework in which water conservation is seen as highly valued by residents of a community."

The effectiveness of behavioral water efficiency programs has been tested in several communities, including in an East Bay Municipal Utility District pilot project run by WaterSmart Software, a technology startup. In this pilot, residents received water reports with information about their water consumption, the consumption of similar households, and personalized recommendations on ways to save. The yearlong pilot project involved 10,000 homes and a randomized control group.

Households that received water reports reduced their water use from 4.6 to 6.6 percent, were more likely to participate in utility audit and rebate programs, and reported higher levels of customer satisfaction.

The unit cost of saved water was between $250 and $590 per acre-ft, with a midpoint cost of $380 per acre-ft.[17]

As outlined by the American Water Works Association (AWWA) in its water resource manual, industry best practices for water use efficiency have included water surveys, residential plumbing retrofits, system water audits, leak detection and repair, metering with commodity rates, native plant landscaping, high-efficiency washing machines, low-flush toilets, and school education programs. The costs for these conservation or water efficiency programs range from $465 to $980 per acre-ft and are only utilized by a small percentage of customers.

Because demand reduction has a cost and a yield, like any potential water resource, a thorough cost–benefit analysis must be performed before implementing programs and AWWA offers a 10-step development process to do so. Integrating a demand management program as part of a larger water management plan can provide the best big-picture outlook on potential savings, avoided costs, and appropriate measures to benefit all stakeholders.

Improving Revenue Control

Water supply planners will not be able to make prudent and cost-effective estimates and plans unless the customer water demand factors become more accurate and consistent. Price elasticity of demand is now distorted by conservation messaging, which leads to more revenue uncertainty.

Revenue projections and rate studies use billing information that is essentially meter consumption data combined with established rates. Improved data reliability and sophisticated interpretation is critical to improving forecasts and capturing significant cost savings. This can be done in part by avoiding higher-than-necessary peaking factors and pipe sizes embedded in engineering assumptions. Infrastructure replacement planning activities that incorporate an integrated investment planning process with more accurate demand projections inevitably leads to lower long-term system costs. An integrated approach grounded in data analytics and customer engagement connects the short-term revenue gap from demand management programs to longer-term, cost saving investment strategies.

This interconnected financial planning process establishes how rate increases required to cover revenue loss from conservation activities are offset by the long-term cost savings for infrastructure repair and replacement programs.

A New Future

The application of data analytics in demand management, integrated with financial and infrastructure planning, embodies an emerging vision for water utility executives. From this new perspective, utility managers can engage all stakeholders by unifying various positions and providing for a more data-rich communications environment. This data translates into insight and increasingly transparent board and council meetings, more informed rate approval processes, and empowered customers.

A more robust data environment means increasingly credible consumption and financial forecasts, greater stability of financial resources, and less costly access to capital. Utilities will be able to realize direct avoided costs, while creating data-driven justifications for new projects that align with actual consumption needs, informed through controlled demand management. Data-rich tools for demand reduction and control offer an economically viable and effective way to reach out to individual households. This approach ultimately helps the utility of the future build a partnership with customers that yields greater consumption management through information technologies, data insights, and behavioral science that communicates the true value of water.

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