Report

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The Role of Water Rates and Rate Structures in Promoting Municipal Water Conservation in Colorado

Prepared for
Colorado Water Conservation Board

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The mission of the Colorado Water Conservation Board (CWCB) is "to conserve, develop, protect and manage Colorado's water for present and future generations."[1] A key aspect of that mission is the development of the Colorado Water Plan (Water Plan). The most recent Water Plan, adopted in January 2023, included a number of agency actions for CWCB to address. Agency Action 1.7 from the Water Plan is to "Identify Turf Replacement Options that Support Transformative Landscape Change."[2] In pursuit of that objective, the Water Plan further states that "CWCB will use information and data it collects through its turf replacement program to create a handbook that explores study findings and compares the potential for municipal tools like water rate structures, water budgets, incentives, and land use codes to aid this transformation."

Over the past two years, CWCB has sponsored considerable research into the water savings potential, benefits and costs from turf replacement in Colorado to implement Action 1.7. In support of additional objectives under Action 1.7, this report examines the potential for municipal water rates and rate structures, including water budgets, to promote reductions in water use, including through voluntary turf replacement.

How Water Rates and Rate Structures Can Help Reduce Water Use

Most water utilities bill their customers on a monthly or bi-monthly basis. Billing is the most frequent, and most important, opportunity for water utilities to communicate with their customers. With the recent exception of customers using automated payment procedures, customers must at least briefly review their bills to determine and pay the amount due for the billing period. In addition, billing provides a tangible financial incentive for customers to pay attention to this information and to manage their water use. Additional information provided with the bill, such as year over year usage and cost comparisons like those often provided with electricity bills can further reinforce these messages.

The evolution of water rates and rate structures. Although metering and billing according to water use is now required in Colorado[3], it is easy to forget that nearly universal, volumetric water billing – where customers are billed based on their metered water use – is actually a relatively recent development. The state's largest municipal water provider, Denver

[1] Colorado Water Conservation Board website: https://cwcb.colorado.gov/about-us.

[2] Colorado Water Plan. Colorado Water Conservation Board, Colorado Department of Natural Resources, 2023. Https://https://dnrweblink.state.co.us/CWCB/0/edoc/219188/Colorado_WaterPlan_2023_Digital.pdf. Page 188.

[3] CRS 37-97-103 Mandatory Use of Metered Water Delivery and Billing Systems. Https://https://dnrweblink.state.co.us/cwcb/0/edoc/210468/37-97-103.pdf

Water, was formed over 100 years ago in 1918. Denver Water did not complete the universal metering of its customers until 1991.[4] This timeline is not unusual. Greeley Water, another of the larger municipal water providers in Colorado's Front Range, began metering in 1983 and completed metering of all of its customers in 1996.[5] Not surprisingly, previous studies have shown that metering (and charging customers for their water use on a volumetric basis) alone is one of the most effective ways to promote water conservation and typically reduces water use by 15 to 35 percent.[6]

Early volumetric water rate structures were generally relatively simple, with customers typically paying a fixed monthly charge to cover basic administrative costs and a consistent volumetric charge per thousand gallons of water use regardless of their total usage. This type of rate structure is sometimes termed a "flat rate structure." In some cases, early rate structures featured volumetric rates that declined (on a per gallon basis) as consumption increased, a practice more commonly found among electric utilities, which can be described as a "declining block rate structure." In other words, under declining block rate water structures, customers are charged less for water per gallon as their usage increases.

As water conservation has become an increasingly critical focus for water providers due to the scarcity of available water supplies and the continually increasing cost and complexity of adding new supplies[7], most water providers have adopted rates intended to help manage water demand. Most frequently, at least for single-family residential customers, water providers now use inclining block rates which charge a higher amount per thousand gallons of water use as customers' water use increases.

COMMON RATE STRUCTURES

"Flat Rates"—Cost per gallon remains the same as consumption increases

"Inclining Block Rates" – Cost per gallon increases as consumption increases

"Declining Block Rates" – Cost per gallon decreases as consumption rises

During the past decade or so, some water providers – including the City of Boulder, Greeley Water and Centennial Water and Sanitation in Colorado – have adopted "water budget" based billing. Water budget billing can be thought of as a more nuanced type of inclining block rates where the volume of water within the volume tiers is customized for each customer based on their landscape area. Both customer-tailored water budget rates and more general inclining block rates can be described as conservation-oriented water rate structures.

Another important development regarding water rates and billing is the increasing adoption of advanced metering infrastructure (AMI). AMI can provide customers with real time information regarding their water use – typically via messages sent to their cell phones – alerting customers

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[4] Denver Water website: https://www.denverwater.org/about-us/history/timeline

[5] Greeley Water website. https://greeleygov.com/services/ws/home.

[6] Alliance for Water Efficiency website. https://www.allianceforwaterefficiency.org/resources/metering#:~:text=As%20measured%20recently%20by%20utilities,and%20commodity%20rates%20are%20implemented.

[7] Citizen's Guide to Colorado Water Conservation. Second Edition. Colorado Foundation for Water Education. 2016. Page 2.

to potential leaks or other issues and allowing them to manage their water use on a real time basis, rather than reacting to information about water use in the previous period provided with their monthly or bimonthly bill.

Interaction between water rate structures and water conservation programs. Put simply, conservation-based water rate structures – such as inclining block rates or water budget rates – can be thought of as providing the financial incentive for customers to reduce their water use. Municipal water conservation programs can provide the means for them to use water more efficiently. Municipal water conservation programs have historically focused mostly on indoor water use – through successful programs such as rebates and incentives for replacing toilets and other indoor fixtures and water using appliances – but are now increasingly targeting reductions in outdoor water use through measures such as irrigation audits and voluntary turf replacement programs.

Current Water Rates and Rate Structures in Colorado

To further examine municipal water rate structures and their influence on water use in Colorado, the study team gathered current single-family residential and commercial water rates from 49 water providers across Colorado.

The study sample, shown in Figure 1, consisted of a range of water providers from across Colorado. The sample includes many of the largest water providers in the state (such as Denver Water, Aurora Water, Colorado Springs Utilities, Greeley Water and Fort Collins Utilities) as well as numerous smaller water utilities. The sample is also geographically diverse. Twenty seven of the 49 water providers in the sample (55 percent) are located in either the South Platte Basin or the Metro Basin, which make up about 70 percent of the state's population. Eight of the 49 providers (16 percent of the total) are located in the Arkansas Basin, which includes about 19 percent of Colorado's population. Twelve of the 49 providers (24 percent) are located in Western Colorado – including water providers in the Colorado Basin, the Gunnison Basin, the Southwest Basin and the Yampa Basin. Those basins make up about nine percent of the state's total population. The final two providers (about four percent of the total sample) are located in the Rio Grande Basin which is home to about one percent of the state's population.

Figure 1. Colorado Municipal Water Providers Included in Sample for this Study

Arkansas Basin (8)
- Board of Water Works of Pueblo
- Canon City Water Department
- Colorado Springs Utilities
- City of Fountain
- Pueblo West Metropolitan District
- Security Water District
- Town of La Junta
- Town of Rocky Ford

Colorado Basin (5)
- City of Aspen
- City of Glenwood Springs
- City of Grand Junction
- Eagle River Water and Sanitation District
- Ute Water

Gunnison Basin (3)
- Town of Delta
- Town of Gunnison
- Town of Montrose

Rio Grand Basin (2)
- Alamosa
- Town of Del Norte

Southwest Basin (2)
- City of Cortez
- Town of Durango

Yampa Basin (2)
- Mount Werner Water & Sanitation District
- Town of Craig

South Platte Basin (11)
- City of Boulder
- City of Greeley
- City of Longmont
- Town of Erie
- Left Hand Water District
- Little Thompson Water District
- Town of Superior
- Fort Collins-Loveland Water District
- Fort Collins Utilities
- City of Evans
- City of Loveland

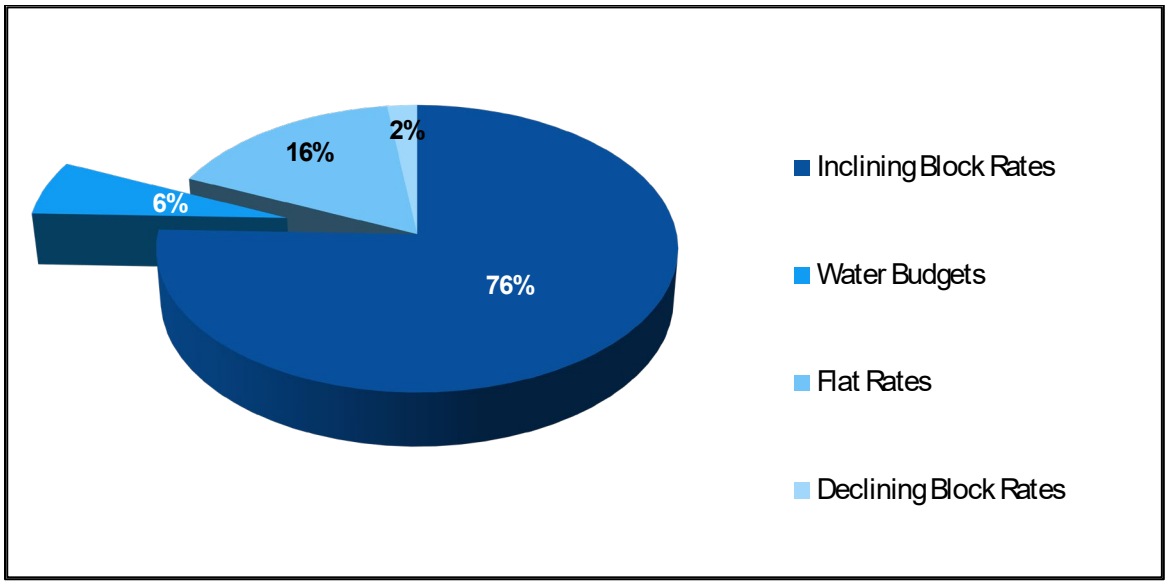
Metro Basin (16)
- Aurora Water
- Castle Rock Water
- Centennial Water and Sanitation District
- City and County of Broomfield
- City of Arvada
- City of Aurora
- City of Brighton
- City of Englewood
- City of Golden
- City of Thorton
- City of Westminster
- Denver Water
- East Cherry Creek Valley Water and Sanitation District
- Parker Water and Sanitation District
- Town of Frederick
- City of Northglenn

Single-family residential water rate structures among sample water providers. For single-family residential customers, the most common rate structure among the sample utilities features inclining "blocks" or "tiers" (increasing rates) as consumption increases. For example, a typical inclining block rate structure with four blocks (or tiers) might charge $3.80 per thousand gallons for the first three thousand gallons used per month, $5.30 per thousand gallons for the next seven thousand gallons used per month, $7.50 for next the next ten thousand gallons used per month and $11.00 per thousand gallons for any water use beyond twenty thousand gallons per month. So, a customer consuming 22,000 gallons during the month would be charged $3.80 x 3 + $5.30 x 7 + $7.50 x 10 + $11.00 x 2 = $144.50 for their monthly water use. In addition to these types of volumetric charges, most rate structures also include a monthly fixed or "base" charge for service that is unrelated to the volume of water used by the customer. The average

base charge across the sample providers is about $24 per month. Thirty-seven of the 49 water providers in the sample (76 percent) have inclining block rates, a higher proportion than the 57 percent of water utilities across the nation that use inclining block rate structures.[8]

Another three providers (the City of Boulder, Greeley Water and Centennial Water and Sanitation) have water budget-based rates for single-family customers. All but one of the remaining nine water providers in the sample have flat rates for single-family residential customers, while one provider has declining block rates – where the price of water declines as consumption increases. Overall, a total of 40 of the 49 providers in the sample (about 82 percent) have single-family water rates that, at least in theory, are intended to reduce water use and promote conservation as shown in Figure Y.

Figure Y. Types of Single-family Residential Water Rate Structures Among Sample Utilities



Most of the water providers with inclining block rates have either three tiers (blocks) (41 percent) or four tiers (38 percent) in their rate structure for single-family residential customers. Seven of the providers with inclining block rates (18 percent) have five tiers. Just one provider with inclining block rates in the sample has just two tiers for single-family residential customers.

In addition to the basic nature of the rate structure, the extent to which water rates promote conservation may also depend on the strength of the pricing signal provided to the customers. All else equal, a rate structure with steeper increases in price from tier to tier should provide a

[8] *Water and Sewer Price and Affordability Trends in the United States, 2017-2023.* Journal AWWA. September 2024.

stronger incentive to conserve water than a rate structure that has relatively flat prices across the consumption tiers.

Two metrics that provide an indication of the strength of the pricing signal from the rate structure are the **percentage increase in the price per thousand gallons as the customer moves from the second highest tier to the top tier** (often thought of as the excessive use tier) and the **overall increase in the price of water from the lowest tier to the top tier.**

Among the sample utilities, the average increase in the price of water as a customer's consumption moves from the second highest to the highest tier is 47 percent and the median increase is similar at 44 percent. Seven of the 37 providers with inclining block rates for residential customers (about 20 percent of that group) have an increase of more than 60 percent in the price of water between the second highest and the highest tiers. At the other end of the spectrum, five of the 37 providers with inclining block rates (about 15 percent of that group) have an increase of less than 20 percent between the second highest and highest tiers.

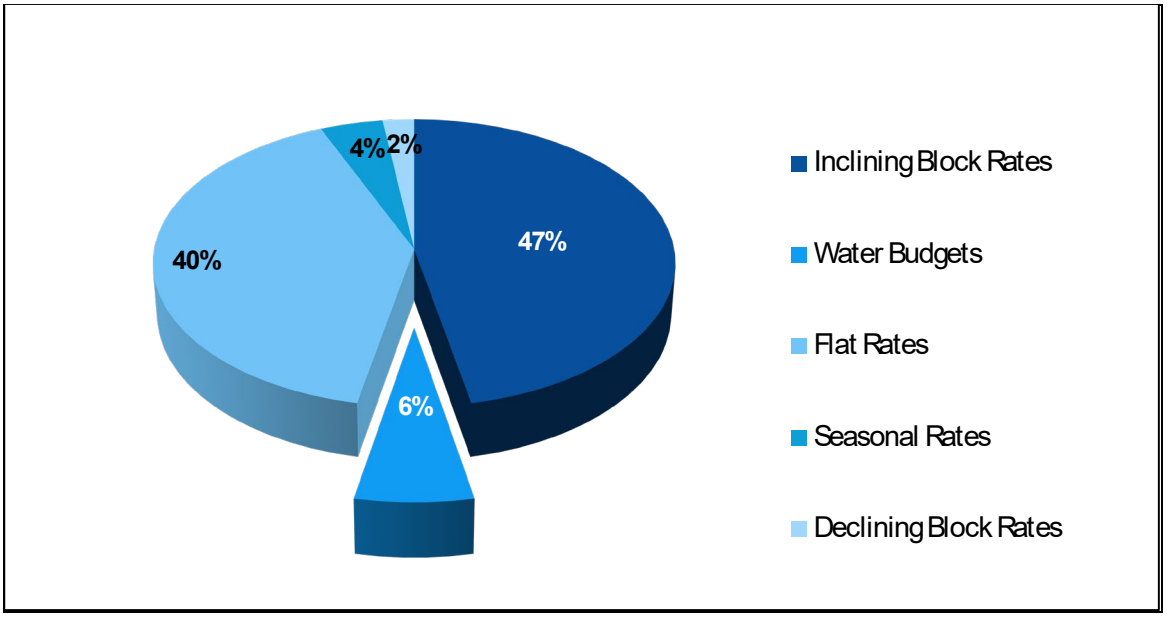
On average, the price of water in the top rate tier among sample providers with inclining block rates is nearly triple the price of water in the lowest tier (173 percent greater). The median increase from the bottom tier to the tier is 151 percent. Eleven of the 37 providers with inclining block rates (about 30 percent of those providers) have top tier rates that are more than triple the rates in the bottom tier.

Rate structures for other customer classes. The study team also collected data from the sample utilities regarding their rates for commercial customers. The sample for commercial rates was slightly smaller than for single-family residential rates, consisting of 47 utilities rather than 49.[9]

As shown in Figure Z, inclining block rates were also the most common type of rate structure for commercial customers (22 of 47, or 47 percent), but flat rate structures were much more common for commercial customers than for single-family residential customers (19 of 47, or 40 percent). Three providers have water budget rates for commercial customers (six percent of the sample), including Aurora Water which is currently in the process of developing those rates. Unlike the rates for single-family customers where none of providers in the sample use seasonal rates (where the price of the same amount of water consumption differs during the irrigation season from the rest of the year), two providers have seasonal water rates for commercial customers (Colorado Springs Utilities and Mount Werner Water and Sanitation District). As with the single-family rate sample, one provider has declining block rates for commercial customers.

[9] Due to the lack of readily available data, Longmont and the Fort Collins-Loveland Water District were not included in the commercial rate structure sample.

Figure Z. Types of Commercial Water Rate Structures Among Sample Utilities



Among the 22 water providers that have inclining block rate structures for commercial customers, the rate structures tended to be somewhat less complex than inclining block rate structures for single-family residential customers. Fourteen of the 22 utilities with inclining block rates for commercial customers had just two or three tiers (64 percent).

The steepness of the price increases from tier to tier also tends to be less than for single-family residential customers. The average increase in price from the second highest tier to the highest tier for commercial customers was 36 percent and the median increase was 31 percent (compared to 47 percent and 41 percent for single-family residential customers.)

On average, the price of water in the top rate tier for commercial customers among sample providers with inclining block rates was 130 percent greater than the bottom tier – compared to over 170 percent greater for residential customers. The median increase from the bottom tier to the top tier for commercial customers was much lower at 72 percent, compared to 151 percent for single-family residential customers.

It is not surprising that fewer water providers have inclining block rates for commercial customers, and those that do tend to have fewer tiers and smaller increases from tier to tier than for residential customers. Commercial customers are much more varied than single-family residential customers in terms of their water use, making it more challenging to establish rate tiers that accurately reflect efficient, and inefficient, levels of water use. For example, indoor water use for office buildings is generally limited to sanitary purposes and drinking water and is generally quite low on a per square foot basis. Water use in the hospitality sector (i.e., hotels, motels, bars and restaurants) can be about three times as high per square foot.

DAILY COMMERCIAL WATER USE VARIABILITY (Gallons per thousand square feet of built space)

Hospitality Sector	278
Medical Sector	109
Office	94
Retail	122
Other	158

BBC study for Phoenix Water Services Department, 2012

Given the greater variability in the way that water is used, it is more difficult to determine the level of water use that is "efficient" for commercial customers – particularly as an overall group. Water budget-based billing (also termed water allocation-based billing) such as the new rates that Aurora is currently developing can overcome this challenge and produce more equitable conservation promoting rates for commercial customers by establishing different indoor water use budgets for different types of uses and different outdoor water use budgets for different amounts of outdoor landscaping. It is important to note that the effort and cost required to develop the necessary information is substantial.

Interviews with water providers. To gain additional insights regarding the factors involved in designing rate structures and setting water rates to meet multiple objectives, the study team conducted interviews with seven of the water providers in the sample including Aurora Water, Colorado Springs Utilities, Denver Water, the City of Durango, Eagle River Water and Sanitation, the City of Englewood and the Greeley Water and Sewer Department. To facilitate candid discussions, we agreed to keep individual responses confidential and focus on broader themes.

While each water provider is unique, insights from these discussions included:

- The first priority for water rates and rate structures is to generate sufficient revenues to operate the utility and provide funding for essential infrastructure upgrades and replacements. Revenue stability, in the face of variable weather and water demands, is also an important consideration.

- Promoting conservation is a key priority for most, but not all water providers. It is particularly important for utilities faced with growing water demands. In those cases, the rate and finance staff typically work closely with the conservation staff.

- The goal of conservation-oriented rates is to promote efficient use. Individually tailored water budgets, which take the size of customers' landscapes into account in setting the size of the tiers at the individual customer level, can be particularly effective. But encouraging efficient water use is not necessarily the same as minimizing use, and setting rates that allow customers to afford to maintain healthy landscaping is also important.

- Major changes in rate structure, such as changing the number of blocks in the billing structure, adding more detailed customer classes or converting to a water-budget based structure are rare and many of the utilities that we spoke with have been operating under the same basic rate structure for a decade or more. Specific volumetric rates within the structure are typically reviewed annually based on projected financial needs.

- Most providers with inclining block rates or water budgets felt their rates were effective at promoting conservation among single family households. Very few providers felt their rates and rate structures were having an impact on water use among other customer classes. Several providers, however, are either moving towards more conservation-oriented rates for other customer classes or at least contemplating such a move in the future.

- For providers with inclining block rates or water budgets, only a small proportion of their customers reach the uppermost rate tier based on their water use – typically less than ten percent.

The Price Elasticity of Water Demand

The relationship between the cost of water and the amount of water that customers use is referred to as the "price elasticity of demand" (price elasticity).[10] Price elasticity is calculated by dividing the percentage change in water use by the percentage change in the price of water. For example, if the price of water increases by 25 percent and the amount of water use then falls by ten percent, the price elasticity is -0.4 (-10% divided by 25%).

Economists have long been interested in the price elasticity of demand for water and have published price elasticity studies for more than forty years. While the elasticity calculation may sound simple, it usually is not because there are a number of complicating factors. In particular, in the case of an inclining block rate structure, the price of water is actually determined by the amount of water consumed. Further, economists continue to debate whether customers respond to the "marginal" price of water (in the case of an inclining block rate structure, this means the cost per thousand gallons in the highest block of the rate structure in which the customer's consumption falls), or the "average" price of water (which would be lower than the marginal price in the case of an inclining block rate structure). If customers focus primarily on the total amount of their bill rather than the details of the rate structure, they are essentially responding more to the average cost of water than the marginal cost under an inclining block rate structure.

While price elasticity demand studies use a variety of approaches to estimate the elasticity, there are some areas of general agreement:

- Water is an "inelastic" good – meaning that the absolute value of the price elasticity is usually less than one. This means that the percentage reduction in water use is typically less than the percentage increase in price.

- Outdoor water use is generally believed to be more elastic than indoor water use, likely because it tends to be more discretionary for the consumer. It is easier and can be more impactful to irrigate less frequently or for shorter periods than to make major changes in indoor water use habits.

[10] Technically the official term is the "own price elasticity of water demand", since price elasticity can also refer to cross-price elasticities – such as the effects on municipal water use from changes in the cost of substitutes such as bottled water.

- The long-run price elasticity (the change in consumption over an extended period of time following a price increase) is likely to be larger than the short-run price elasticity. Customers can make larger changes over the course of a few years than a few months. For example, over a longer period they can change their landscaping, replace inefficient older fixtures and appliances and make other structural changes in the way they use water in addition to modifying their behavior.

Given the many variations among published studies concerning the price elasticity of demand for water (different utilities, geographic areas, types of rate structures, time periods, micro versus macro data, etc.), some of the most useful information from a big picture standpoint for our purposes comes from meta studies. Meta studies analyze and report on results from numerous other price elasticity studies conducted using primary data such as individual billing records.

One of the more recent and comprehensive meta studies examining the price elasticity of water demand was published in 2018 by Riccardo Marzano, et.al. (Marzano study).[11] The Marzano study was not only the largest meta study of the price elasticity of demand to date (in terms of the number of previous studies and analyses included in the meta study), but also used innovative approaches to further examine the reasons behind the differing price elasticity estimates in previous published studies.

Some of the key findings from the Marzano study that are useful in understanding and estimating the amount of water that has been saved by conservation-based water rates were that:

- The average price elasticity of demand among the 615 previous estimates included in the Marzano study is about -0.40;

- Price elasticity of demand in summer is considerably more elastic than in winter (0.33 larger in absolute value); and

- The rate structure itself matters. Inclining block rates alone – regardless of the change in the price of water itself – reduce water use. This finding suggests that water users do respond to the marginal price of water, not just the total bill or average price.

How Much Water is Being Saved by Conservation-oriented Rates in Colorado?

Based on the sample of water provider rates collected for this study, we can infer that most municipal water providers in Colorado have inclining block rate structures or water budgets for single-family residential customers. Based on prior price elasticity studies, as summarized in the 2018 Marzano study just described, those rate structures are reducing water use. The importance of conservation-based rate structures such as inclining block rates or individualized water budgets is also reinforced by an Eastern Municipal Water District study in California in

[11] Marzano, et.al. "Price Determinants of the Price Response to Residential Water Tariffs: Meta Analysis and Beyond." *Environmental Modeling & Software.* Volume 101, March 2018.

2015 that found that their switch to water budget-based rates alone had reduced water use by 15 percent, even though the average price of water had not changed.[12]

As detailed in this section, we estimate that conservation-oriented water rates are currently saving about 105,000 acre-feet per year in municipal water use across the State of Colorado. The basis for that general estimate is discussed in the following section.

Conservation-oriented rates for single-family residential customers. Estimating the savings from water conservation-based rate structures is not possible without far more information, including the number of customers using water in each block of each rate structure for each utility and what those customers' costs would be under an alternative, flat rate structure. However, a rough approximation can be made by assuming that the middle of the rate structure (e.g. the third tier for a five-tier structure or the average of the second and third tiers for a four-tier structure) represents the approximate volumetric price of water if the utility had a flat rate structure instead. The calculation of the estimated water savings from single-family residential water users is:

$P_R \times R_R \times E_R = S_R$

Where:
P_R = Estimated municipal water providers with conservation-oriented rates for single-family residential customers: 82 percent
R_R = Average rate change between top tier and middle of the rate structure: 62 percent
E_R = Estimated price elasticity of water demand for residential customers: -0.40, and
S_R = Estimated annual savings in water use: 20 percent

Based on analysis developed for the most recent update to the Colorado Water Plan, statewide municipal water use in 2015 was approximately one million acre-feet per year. Fifty-two percent of that water use was for residential purposes, so total statewide residential water use was estimated to be about 520,000 acre-feet per year.[13]

The municipal water use estimates developed for the Water Plan did not distinguish between single-family residential use and multi-family residential use. Based on BBC's prior experience in analyzing municipal water demands and developing future demand projections for Colorado water providers, we estimate that single-family residential water use likely accounts for about 70 percent of total residential use.[14] Based on that assumption, 2015 statewide single-family residential water use was likely about 365,000 acre-feet per year.

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[12] *Water Use Efficiency and Drought Response with Allocation-based Tiered Rate Structures.* Paul D. Jones PE. General Manager. Eastern Municipal Water District. June 19, 2015.

[13] Current and Projected Planning Scenario Municipal and Industrial Water Demands. ELEMENT Water Consulting, Inc. July 15, 2019.

[14] In particular, BBC's estimate of the approximate proportion of residential water use accounted for by single-family residential homes is based on detailed analyses of customers and water use served by the Aurora Water (2014-2015) and Greeley Water (2016-2022). These proportions can vary considerably depending on municipal development patterns.

If, as suggested by the analysis above, conservation-oriented water rates are reducing single-family residential water use by about 20 percent, those rates have likely helped reduce statewide single-family residential water use by approximately 90,000 acre-feet per year.[15]

Conservation-oriented rates for commercial customers. The water savings from conservation-oriented rates for commercial customers are likely smaller than the savings from conservation-oriented rates for single-family residential customers. Overall commercial water use across the state is substantially less than overall single-family residential use and the degree to which commercial customers respond to the price of water has not been studied to the same degree as the price responsiveness of residential customers.

The pricing signal to commercial customers can be much more muted than for residential customers. For example, indoor water use in an office building is determined by the employees who work there (who do not see or directly pay the bill), water use in a hotel is largely determined by the guests (who also do not see or directly pay the bill), etc. In other words, without a clear price signal, there may be little motivation to conserve. With the notable exception of customers using water as part of their production process (which are more often industrial customers than commercial ones), the cost of water is also typically less significant for commercial users than for residential users.

However, a 2018 study of water use in Las Vegas, found that commercial users were more price responsive (with an estimated price elasticity of -0.61) than residential customers (with a price elasticity of -0.34). The same study cited prior literature indicating a range of price elasticities for commercial customers of between -0.23 and -0.63.[16]

Recognizing the results from the Nevada study, but also the reasons why price elasticity may be lower for commercial customers than for residential customers, we will simply assume the price elasticity of demand is about the same as the estimated elasticity for residential customers (or -0.4).

Similar to the preceding estimates of the water savings from conservation-oriented single family residential water rates, a rough estimate can be made regarding the current water savings from conservation-based rates for commercial customers. This estimate is based on the same approach shown for residential customers on page 11. In the commercial water use context, the calculation includes:

$P_c \times R_c \times E_c = S_c$

Where:
P_c = Estimated municipal water providers with conservation-oriented rates for commercial customers: 53 percent
R_c = Average rate change between top tier and middle of the rate structure: 38 percent

[15] 365,000 AF/yr with conservation rates divided by 0.80 equals about 456,000 AF/yr without conservation rates.

[16] Elasticity of Price Demand for Water for Residential and Commercial Sectors in Nevada. University of Nevada Cooperative Extension. 2018. https://naes.agnt.unr.edu/PMS/Pubs/2018-3559.pdf

E_c = Estimated price elasticity of water demand for commercial customers: -0.40, and
S_c = Estimated annual savings in commercial water use: 8 percent

Based on the statewide 2015 water use estimates developed for the Water Plan cited previously and prior BBC water demand studies for Aurora and Greeley which suggest that about 18 percent of municipal and industrial water use is for commercial purposes, statewide commercial water use may be around 180,000 acre-feet per year.

An eight percent reduction in commercial water use due to conservation-oriented rates would correspond to water savings of about 15,000 acre-feet per year.[17]

Combining the estimated reduction in single-family water use due to conservation-based rates of about 90,000 acre-feet per year with the estimated reduction in commercial water use of about 15,000 acre-feet per year, we estimate total annual water savings of about 105,000 acre-feet per year from conservation-oriented rates.

It is important to recognize that these estimated savings from conservation-oriented rates cannot be added to estimates of the water savings from more specific water conservation programs such as toilet rebate programs or incentivized turf replacement efforts. The price elasticity of demand, which is the critical factor in estimating the water savings from conservation-based rates, is calculated based on overall changes in water use relative to the change in the price of water due to conservation-based rates. The overall change in water use reflects the many factors that affect water use, including specific conservation programs like toilet rebates or turf replacement incentives. Put more simply, and as noted earlier, conservation-oriented rates are synergistic with more specific water conservation programs and can provide the incentive for homeowners to participate in those programs.

Further Considerations

Apart from incentivizing customers to reduce excess water use, there can be other benefits from conservation-oriented water rates. However, there are barriers to universal adoption of conservation-oriented rate structures in Colorado and adoption of conservation-oriented rates for other customer classes.

Other benefits from conservation-oriented rates. Inclining block rates and water-budget based rates can also promote equity among utility customers. In general, single-family residential water use has historically been correlated with income, with wealthy customers (and neighborhoods) generally using more water than low-income customers (and neighborhoods). Under inclining block rate structures, the higher rates for customers that consume more water under inclining block rate structures produce more revenue for utilities which can allow them to reduce the rates for customers who use less water while still producing the amount of revenue needed to run the utility. It is also noteworthy that the average monthly fixed or base charge (an

[17] 180,000 AF/yr of commercial water use with conservation rates divided by 0.96 equals about 187,500 AF/yr without conservation rates.

amount charged to every customer regardless of consumption) among the sample utilities with inclining block rates was also lower than the average base charge among utilities with flat rates (about $23 per month for providers within inclining block rates compared to about $30 per month for providers with flat rates).

The additional revenues from excess consumption under inclining block rate or water budget-based rate structures can also be used to help fund water conservation programs.

Barriers to further adoption of conservation-oriented rates. Based on the sample of utilities considered in this study, a large majority of single-family water rate structures in Colorado charge customers that consume water efficiently a lower price per gallon than customers who consume an excessive amount of water. In most cases, utilities have inclining block rate structures for single-family customers, while some utilities have gone further and adopted customer-specific water budgets. Both types of rate structures are conservation-oriented. However, the extent of the water savings from conservation-oriented rates varies from utility to utility depending on the specifics of their rates and rate structures.

In general, most of the water providers that do not have conservation-oriented rates for single-family residential customers (18 percent of the sample analyzed for this study) tend to be smaller utilities located outside of Colorado's Front Range that are not experiencing rapid growth in population and water demand. For such utilities that are not facing the prospect of needing to add new water supplies, the benefits from switching to conservation-oriented rates may need to appear to warrant to the costs of changing their rate structures, including the potential costs for rate studies and possible changes to billing software.

As discussed earlier, many water providers (47% of those we sampled) also have inclining block rate structures (and in some cases water budgets) for commercial customers. Using a similar rate structure for non-residential customers may increase the overall equity of a water utility's rate structure by encouraging other customer classes to also contribute to saving water. Given the greater variability among commercial customers and the way they use water, a water budget-based approach may be more effective and more equitable than more generic inclining block rates.

The potential to save water through conservation-oriented rates for multifamily residential customers is also more limited than for single-family residential customers. Most apartment dwellers do not pay directly for their water based on their usage because they are not individually metered. While condominium owners do pay for their water, they are also often not individually metered and instead pay through dues to a homeowners association for which water is a small portion of the overall cost. In cases where multifamily dwellings are individually metered, however, the savings potential from conservation-based rates can be similar to the savings from conservation-based rates for single-family residences.

Summary

This study for the CWCB has examined the role of conservation-oriented water rates in reducing water use in Colorado. Conservation-oriented rates are synergistic with more specific water conservation programs and can provide the incentive for homeowners, and to a lesser extent other water customers, to participate in those programs. Study findings, based on a sample of large and medium-sized water providers throughout Colorado, include:

- The majority of large and medium sized Colorado water providers have adopted conservation-oriented rates intended to help manage water use, particularly for single-family customers and to a lesser extent for commercial customers. However, these rate structures are not all the same, and some are more aggressive and likely more effective in trying to drive water use down to a "minimum" or efficient level of use.

- While conservation-oriented rates (inclining block rate structures and/or water budget-based rates) are prevalent, this does not mean that all utilities have hit a benchmark of efficiency, or that no additional work needs to be done. Lumping utilities together because they already have "water conservation-oriented tiered rate structures" should not be taken to minimize the hard work that some utilities are doing to aggressively drive down water use and may not adequately promote the drive for efficiency. For these reasons, CWCB staff have suggested a new term such as "conservation-forward" rates, which may be needed to distinguish the rate structures that are truly driven by aggressive water conservation targets.

- Most frequently, conservation-oriented rates feature an inclining block rate structure, though a handful of Colorado water providers have gone further by establishing customer-specific water budget-based billing. Water budget-based rates are more specifically targeted to the circumstances of each individual customer and may be both more effective at reducing water use and more equitable. These types of rates may be considered "conservation-forward" rather than just "conservation-oriented." Most water providers with conservation-oriented water rates feel that their rates are effective at promoting water conservation among single-family residential customers. None of the providers we spoke with feel that their current rates are promoting substantial conservation among other customer classes.

- BBC estimates that conservation-oriented rate structures in Colorado are reducing single-family residential water use by about 90,000 acre-feet per year (20 percent) and commercial water use by about 15,000 acre-feet per year (eight percent).

- These estimated savings from conservation-oriented rates cannot be added to estimates of the water savings from more specific water conservation programs. Conservation-oriented rates are synergistic with more specific water conservation programs and can provide an incentive for ratepayers to participate in those programs.

- It appears likely that more providers will move towards conservation-oriented rates for customer classes outside of single-family residential water users. Given the wide variety of customer characteristics in these other classes, customer-specific water budgets may be more effective and more equitable than basic inclining block rates. The effort and cost to develop these new rates will be substantial.

- Moving forward, standardizing the practice of individually metering multi-family and commercial water users (rather than metering at the building level) will provide greater opportunities to save water through conservation-forward water rates and rate structures.

- Separate metering for indoor and outdoor water uses in new developments (such as has been implemented in Greeley) can also facilitate opportunities for conservation-forward water rates, including water budgets, particularly for larger multi-family and commercial and industrial water users.