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Meeting Future Water and Energy Demands in the Arkansas River Basin

EXECUTIVE SUMMARY

The Arkansas River originates in the Rocky Mountains near Leadville, Colorado. It descends over 10,000 feet as it flows east toward Kansas, providing water to two major metropolitan areas, numerous power plants, and thousands of acres of agricultural land. In addition, it supports varied ecosystems and sustains a robust fishing, boating, and recreational economy.

The Arkansas River is fully or over-allocated, and groundwater levels in the Ogallala/High Plains Aquifer have declined markedly over the last half-century. Demands in the basin, however, continue to grow. While cities and power plants have historically looked toward the agricultural sector to meet their burgeoning water needs, demand for ethanol and higher crop prices may limit the agricultural community's willingness to sell. Climate change may further reduce available supplies.

Fortunately, municipalities in the Arkansas River Basin have substantial room to improve their water use efficiency, and the basin has exceptional renewable energy resources. Meeting future water needs will require efforts in both the municipal and energy sectors. This report outlines strategies for cities and the energy sector to meet growing demands while conserving the Arkansas Basin's natural resources.

MUNICIPALITIES

Population has grown rapidly in communities all along Colorado's Front Range. This growth is projected to continue — counties in the Arkansas Basin expect to add almost half a million new residents by 2030. Along with this municipal growth, water demands also are projected to grow. By improving both indoor and outdoor water use efficiency in all sectors, however, municipalities can consume less water in 2030 than they do today — reducing the need to develop new, expensive water supplies. In this report, we compare future water needs under three scenarios developed by Western Resource Advocates (WRA):

1. Business as Usual (BAU), which reflects current levels of conservation.

2. SFR Efficiency, which incorporates additional water use efficiency measures in the single-family residential (SFR) sector.

3. System-wide Efficiency, which builds on the SFR Efficiency scenario by expanding water use efficiency measures in the commercial, industrial, and institutional sectors.

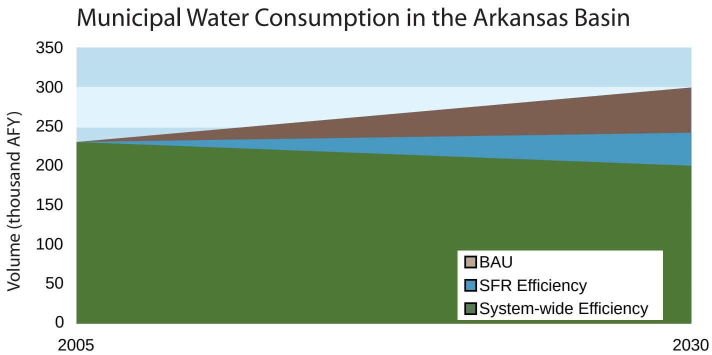


Figure 1. Municipal water consumption in the Arkansas River Basin under three future scenarios: Business as Usual, improved water use efficiency in the single-family residential sector (SFR Efficiency), and improved system-wide water use efficiency (System-wide Efficiency).

Both Efficiency scenarios demonstrate substantial savings available through conservation measures. Relative to BAU, the SFR Efficiency scenario avoids the consumptive use of over 32,000 acre-feet per year (AFY) in 2030; the System-wide Efficiency scenario saves over 44,000 AFY. (One acre-foot is enough water for two households for one year). Under both of these scenarios, municipalities use less water in 2030 than in 2005 (Figure 1).

ELECTRICITY GENERATION

Growing urban areas are also driving growth in electricity demand along Colorado's Front Range. To meet this growth, electricity suppliers plan to construct new coal, wind, and gas-fired capacity in the basin. Two proposed coal plants account for the bulk of new, proposed capacity: Tri State Generation and Transmission (G&T) proposes to develop a 1,400 megawatt power plant in southeastern Colorado and, in conjunction with several other utilities, has applied to add 1,400 MW of coal-fired capacity to the Holcomb coal plant near Garden City, Kansas. It is unlikely the utilities will develop both plants; therefore, under Business as Usual, we assume only one of these two plants moves forward.

The Business as Usual scenario relies on the utilities' resource plans to project future generation and water use in the basin. We then model an Alternate scenario, replacing all new coal-fired capacity with energy efficiency, renewable sources of energy, combined heat and power, and some generation at natural gas plants (Figure 2). Although not all of the renewable energy generation will happen in the Arkansas Basin — the San Luis Valley, for example, may provide the best solar power — for a fair comparison of scenarios, we include the total water demands of the Alternate scenario. In 2015, the Alternate scenario avoids the consumption of 14,000 AFY relative to the BAU scenario. In 2030, these savings are even greater: the Alternate scenario saves almost 20,000 AFY relative to the BAU trajectory (Figure 3).

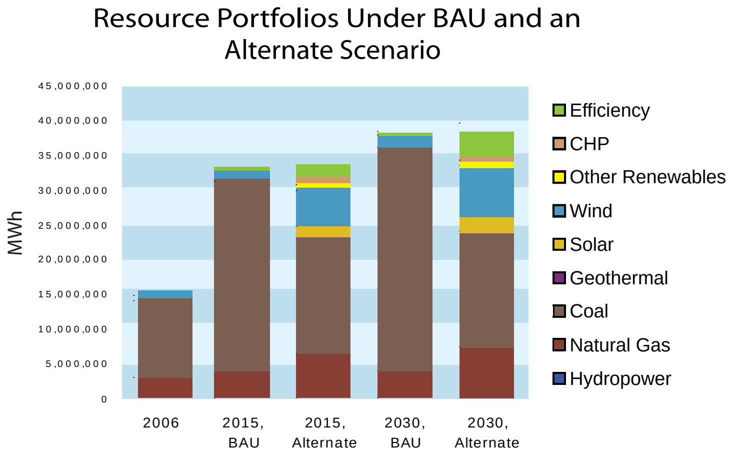


Figure 2. Resource portfolios in 2006, 2015, and 2030 under a Business as Usual trajectory and an Alternate approach that relies on renewable energy, energy efficiency, combined heat and power, and natural gas.

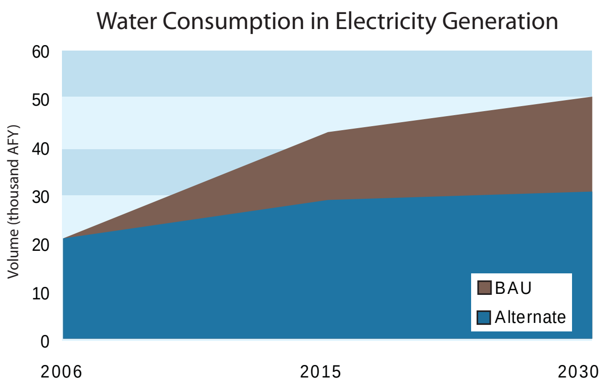


Figure 3. Water consumed for electricity generation under two resource portfolios: BAU and the Alternate scenario.

AGRICULTURE

Growing municipalities and power plants historically have looked toward agriculture for additional water rights, but with high crop prices and ethanol development, the agricultural community's willingness to sell may change.

Indeed, Tri State G&T has purchased water rights throughout Prowers County in southeastern Colorado. Similarly, municipalities — Aurora, Colorado Springs, and others — have purchased and transferred water rights. In the Business as Usual scenario, we estimate future water use for the agricultural sector based on a continued trend of agricultural-to-urban and agricultural-to-industrial conversions. This trend has important economic and social impacts on rural communities, but addressing these impacts is beyond the scope of this report. However, we note that more aggressive municipal water conservation, energy efficiency, and water-efficient renewable sources of energy will all be essential if Colorado hopes to preserve its agricultural sector. Additionally, new institutional arrangements like the "Super Ditch," a rotational fallowing program, may slow the conversion of agricultural water rights to urban areas.

In western Kansas, other factors influence the agricultural sector's future water demands. Ethanol development and the high price of wheat has lead some farmers to put marginal croplands — previously enrolled in the Conservation Reserve Program — back into production. This trend could have important consequences on groundwater resources, particularly in the Ogallala Aquifer.

In southeastern Colorado, the Arkansas Basin is fully or over-allocated, and development of new cropland is unlikely, regardless of the price of corn or wheat. Climate change, however, may have extensive impacts on water resources. We focus on just one impact — increased rates of evapotranspiration — on agricultural lands in the Arkansas River Basin. A recent report projects higher average temperatures throughout the southwestern U.S., with the droughts of the past becoming the norm, and dust bowl or La Niña events occurring on top of drier baseline conditions. In the Climate Change scenario, we overlay the impact of increased rates of evapotranspiration on the Business as Usual scenario described above (Figure 4).

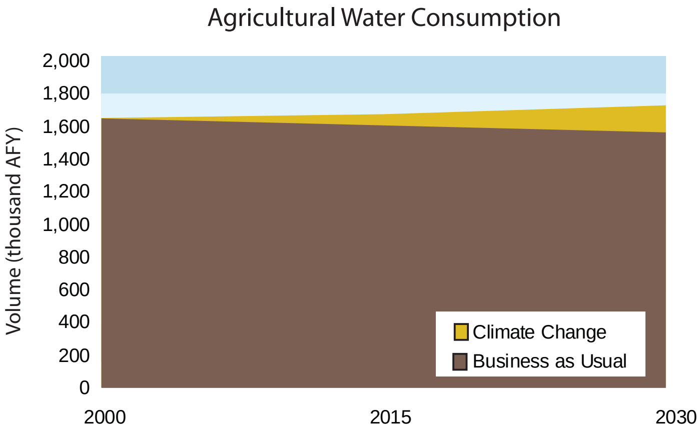


Figure 4. Water consumed for agriculture in the Arkansas Basin under Business as Usual declines, but increased temperatures, driven by climate change, could increase total water consumption.

Our analysis of climate change represents a conservative approach; it does not include changes in precipitation, snowmelt, or streamflow. These changes could have additional impacts on the basin's water resources.

CONCLUSIONS AND RECOMMENDATIONS

Meeting municipal, energy, and agricultural water demands — while providing sufficient instream flows for environmental needs — will require action by each sector. Under BAU, WRA projects basin-wide demands will be 62,000 AF greater in 2030 than in 2005. This reflects continued conversions of agricultural lands. Between 2005 and 2030, water use in the municipal and energy sectors and due to climate change grows by 142,000 AF (Figure 5). Fortunately, municipalities can garner substantial water savings by focusing on conservation and efficiency measures. And, by investing in water-efficient renewable sources of energy and energy efficiency, electric utilities can significantly reduce their water demands (Figure 6). Given the potential impacts of climate change, these measures will be essential to meeting future basin-wide water demands.

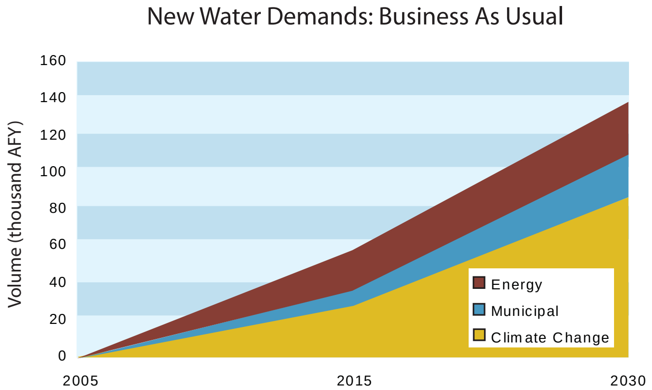


Figure 5. Under BAU, water use in the municipal and energy sectors grows substantially. Most new demands will be met by agricultural transfers. Additional water losses, driven by climate change, will further stress the Arkansas Basin's water resources.

Recent developments in the Arkansas River Basin underscore the importance of integrated planning between the water, energy, and agricultural sectors. In order to meet a growing population's water demand, Colorado Springs Utilities hopes to develop the Southern Delivery System, a pipeline to pump water from the Arkansas River to Colorado Springs. The pipeline will be one of the most energy-intensive water supply systems in the western U.S. If these new energy demands are met with water-intensive forms of electricity generation, like coal power, they will further increase water use in the basin. At the same time, Tri State G&T continues to press forward on its plans to construct a water-intensive, coal-fired power plant in Prowers County.

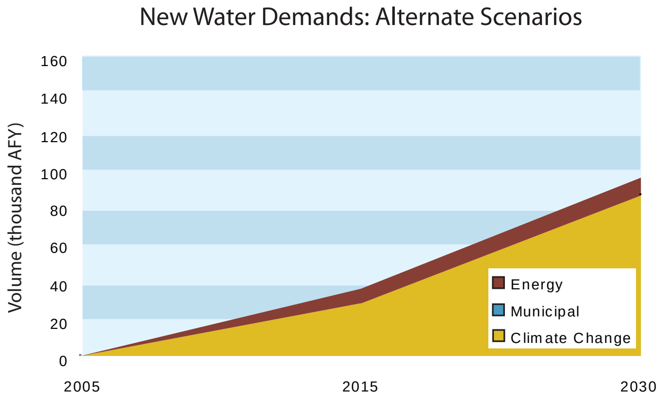


Figure 6. Under WRA's Alternate Scenarios, future water demands in the basin grow, but by much less than under BAU. Municipal water use (not shown) is lower in 2030 than in 2005.

In fully allocated river basins like the Arkansas, integrated strategies for meeting future water and energy demands are critical. We propose several measures to address the policy gaps, connect energy and water decisions, and promote integrated planning. While this report focuses on the Arkansas River Basin, many of these measures are applicable in other states and river basins.

1. Accelerate water conservation to provide energy savings, and accelerate energy conservation and use of renewable energy sources to provide water savings.

By reducing demand and the need to pump, convey, and treat water supplies, water conservation can offer significant energy savings. Water conservation devices that reduce use of hot water can provide additional, significant energy savings. We encourage electric utilities, in partnership with water utilities, to invest in water conservation measures.

Energy conservation often also provides water savings. Where energy efficiency measures reduce electricity generation at water-intensive power plants, they also reduce water consumption. We encourage states to expand or enhance their energy efficiency goals and standards. Just as importantly, some renewable energy resources (e.g., wind and solar photovoltaics) use negligible amounts of water. Meeting new electricity demands with these renewables instead of fossil fuel plants will yield valuable water savings.

2. Accurately reflect the value of energy and water in utility planning processes.

In many places, both electricity and water are artificially cheap. Accurately reflecting the value of water may make some forms of renewable energy more cost-competitive. For example, renewable energy generation often does not consume water — if these water savings are made available to meet municipal or environmental needs, they may avoid the need for municipalities to develop new water supplies. We recommend that utilities, plus state and local regulatory agencies, perform cost/benefit analyses on proposed energy portfolios that accurately include the opportunity cost of water used in electricity generation.

3. Be creative.

Integrating the power and wastewater sectors can be mutually beneficial. Thermoelectric power plants can and should utilize secondary water supplies, such as treated wastewater, reducing their impacts on pristine freshwater supplies, and receive a reliable, drought-proof water supply. State and regional water authorities should require new thermoelectric power plants to utilize recycled water supplies, where available. To this end, we encourage co-location of power plants and wastewater treatment plants.

Other opportunities also may arise. Water utilities may be able to design their systems to store water and make use of intermittent renewable resources for water pumping, and wastewater treatment plants can generate electricity from methane gas.

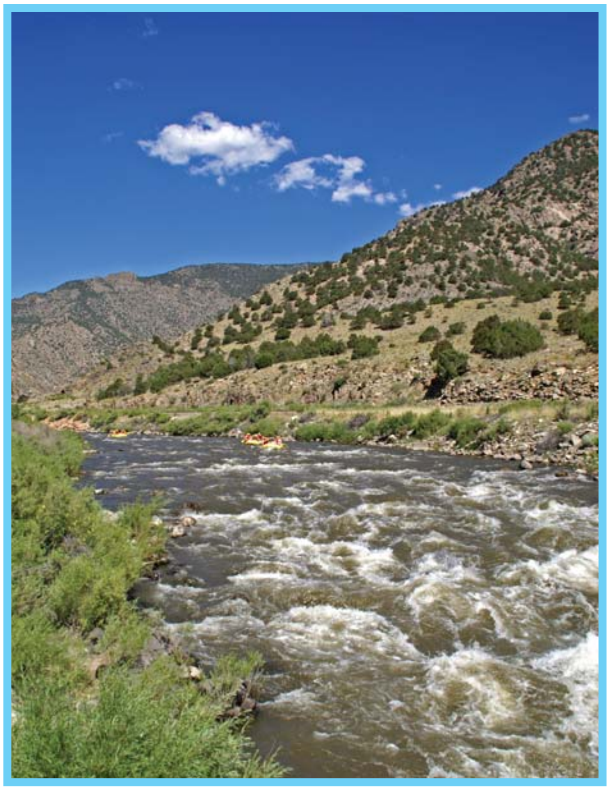
4. Insist that states' renewable portfolio standards and fuel standards be "water smart."

As states adopt or expand their renewable portfolio standards and renewable fuel standards, they should explicitly consider water resources. More importantly, a sustainable, national transportation fuels strategy should not include water-intensive fuels, like corn-based ethanol.

5. Recognize the benefits of decentralized solutions.

Decentralized approaches to meeting new water and energy demand have multiple benefits. In the water sector, rainwater harvesting — by decreasing demand — can avoid pumping, conveying, and treating water to potable standards before it is applied to a landscape. Similarly, low-impact development (e.g., bioswales and permeable pavement) enhance infiltration and reduce stormwater runoff — reducing irrigation needs and energy used to treat stormwater runoff. We encourage local planning commissions, plus state and local governments, to require low-impact development in new residential or commercial developments. Where it does not impact water rights, we encourage integration of rainwater harvesting in both new and existing developments.

Many forms of decentralized electricity generation, including solar panels and combined heat and power facilities, use less water than conventional, centralized thermoelectric power plants. As with energy conservation, utilities, as well as state and local decision-makers, should recognize these water savings and encourage the development of decentralized electricity generation.



This report is one of a series prepared by Western Resource Advocates on the competing water demands of growing cities, agriculture, electricity generation, and the environment. It was funded by a grant from the National Renewable Energy Lab.

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