

Linking Water and Energy Along the Arizona-Sonora Border

Christopher A. Scott, Robert G. Varady, Anne Browning-Aiken, and Terry W. Sprouse – University of Arizona

The Southwest, including the U.S.-Mexico border region, is experiencing dramatic population and economic growth, which in turn is driving steep increases in the demand for both water and energy. Population is increasing twice as fast on the border as at the national level in either country, and is projected to grow by 50 percent from 2005 to 2030. Much of this growth is occurring in 14 border sister cities.

Pumping Water Requires Consuming Energy

In the perpetually water-short Southwest, with its rugged terrain and high evapotranspiration rate, most options for increasing water availability require increased energy consumption. Depending on the type of contract and customer served, energy costs of pumping currently comprise a quarter to a half of the total rate charged for Central Arizona Project water (CAP, 2007/2008). Utilizing Arizona's full Colorado River water allocation through CAP deliveries will cost tens of millions of dollars annually in energy. On a smaller scale, Sonora has its own interbasin water transfers, such as the Los Alisos/Rio Magdalena-Nogales aqueduct, that entail significant energy for pumping.

On both sides of the border, agricultural pumping represents a major energy demand. In the Mexican border states of Sonora and Chihuahua, groundwater pumping for irrigation accounts for 10 and 16 percent respectively of total state energy demand (Scott, 2007; CFE, 2006), although total agricultural power consumption began declining in 2000 in response to increasing power rates. The Comisión Federal de Electricidad (CFE) introduced reduced power rates for nighttime irrigation in 2003-04,

which initially led to an increase in total energy and groundwater consumption, likely due to lower costs and reduced controls on irrigation at night when labor costs are higher. However, one year after the nighttime irrigation rate

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was introduced, total energy consumed and groundwater pumped for Mexican agriculture continued their decline.

Similarly on the Arizona side, irrigation represents 10 percent of electrical power sales revenue for the Sulphur Springs Valley Electric Cooperative, but electricity use by irrigation increased 45 percent from 2002 to 2005, largely due to customers switching to electricity as natural gas prices increased.

Energy for Water Treatment

Wastewater treatment requires significant supplies of energy. On the U.S. side of the border, the Nogales International Wastewater Treatment Plant (NIWTP) treats about 15 million gallons per day (mgd) of wastewater originating from both Nogales, Arizona and Nogales, Sonora. Mexico has an allocation of 9.9 mgd per day at the plant, yet has regularly exceeded that amount over the last several years due to increased water supply and wastewater collection infrastructure in Nogales, Sonora. In 2004, the Maestros Group outlined a plan to build a 411-megawatt electrical generation plant in Nogales, Arizona, utilizing Mexican effluent for cooling. Despite its innovative

approach—the plant would have supplied electricity to both Arizona and Mexico—the plan has not moved forward.

Also in the works is Mexico's plan to build a wastewater treatment plant in Los Alisos, about 10 miles south of Nogales, Sonora. The plant would treat wastewater in excess of the 9.9 mgd allocation at the NIWTP. Under the existing treaty with the United States, Mexico could retain and reuse scarce water on its side of the border; however, this would likely prove to be a costly choice in energy terms, as the wastewater would have to be pumped upgradient and over a watershed divide to reach the proposed new plant. Additionally, Mexico would lose the cost advantage of allowing wastewater to flow downgradient to the NIWTP and the economy-of-scale benefits the larger NIWTP offers.

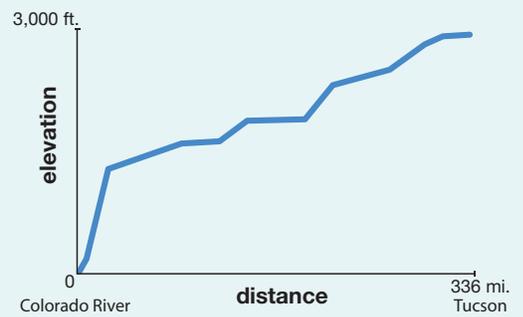
As the foregoing discussion has shown, the demand for a range of water services in the border region has been accompanied by increased energy use. With energy costs rising, its sources politically unstable, and its supplies uncertain, this trend places water management at odds with the palpable need to limit energy consumption.

Add Climate Change to the Mix

At the same time, the impacts of climate variability and change are becoming more widely accepted as important contributors to the water-energy link. In Mexico, the government and scientific establishment, sensitized by recent impacts of El Niño and La Niña, recognize the importance of climate on the agricultural and urban sectors. Mexico has taken a strong position on limiting global warming and is among those nations calling for such mitigative strategies as adoption of carbon caps and reduction of greenhouse gas emissions.



CAP Canal



3200 kWh to pump one acre-foot of CAP water from the Colorado River to Tucson.

Interbasin water transfers in Arizona and Nogales, Sonora require large amounts of energy. The profile of the Central Arizona Project through Arizona (right) shows an increase in elevation of 2900 feet from the Colorado River to its end near Tucson. The Los Alisos/Rio Magdalena-Nogales aqueduct in northern Sonora must cross over a watershed divide to reach Nogales.

The United States, as is well-known, has criticized and refused to sign the Kyoto Accords, while the Bush administration has until very recently questioned scientific research on global warming and denied human causation. However,

over the past several months, the U.S. public and its politicians are beginning to accept the need to address climate change. And in the border region, with its serious water and energy constraints, the issue has gained strong momentum.

In 2005, the states of Arizona and Sonora signed a "Declaration of Cooperation" to establish a joint binational climate change initiative (Arizona-Sonora Declaration, 2005), with follow-up activities planned by the Arizona-Mexico Commission.

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Planning Together for the Future

In the border region, U.S. and Mexican scientists and social scientists are meeting regularly and developing instruments to use jointly. One such effort would yield an ongoing, binational, U.S.-Mexico border climate diagnostic summary (Ray and others, 2007). This summary, to be prepared collaboratively and at regular intervals, would provide forecasts and value-added information on temperature, precipitation, and drought within the region. Once in place, the tool would help managers and policymakers in the water and energy sectors make more realistic and accurate decisions. And in a region of chronic multiyear drought, the importance of addressing societal and economic impacts of climate is essential to effective use of scarce water and energy resources.

Water and energy are closely coupled resources in the rapidly growing Arizona-Sonora border region. While there is increasing recognition of the water

resource implications of power generation, there is a concomitant need to more fully consider the energy implications of growing demands for water services.

Contact Christopher Scott at cascott@email.arizona.edu.

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