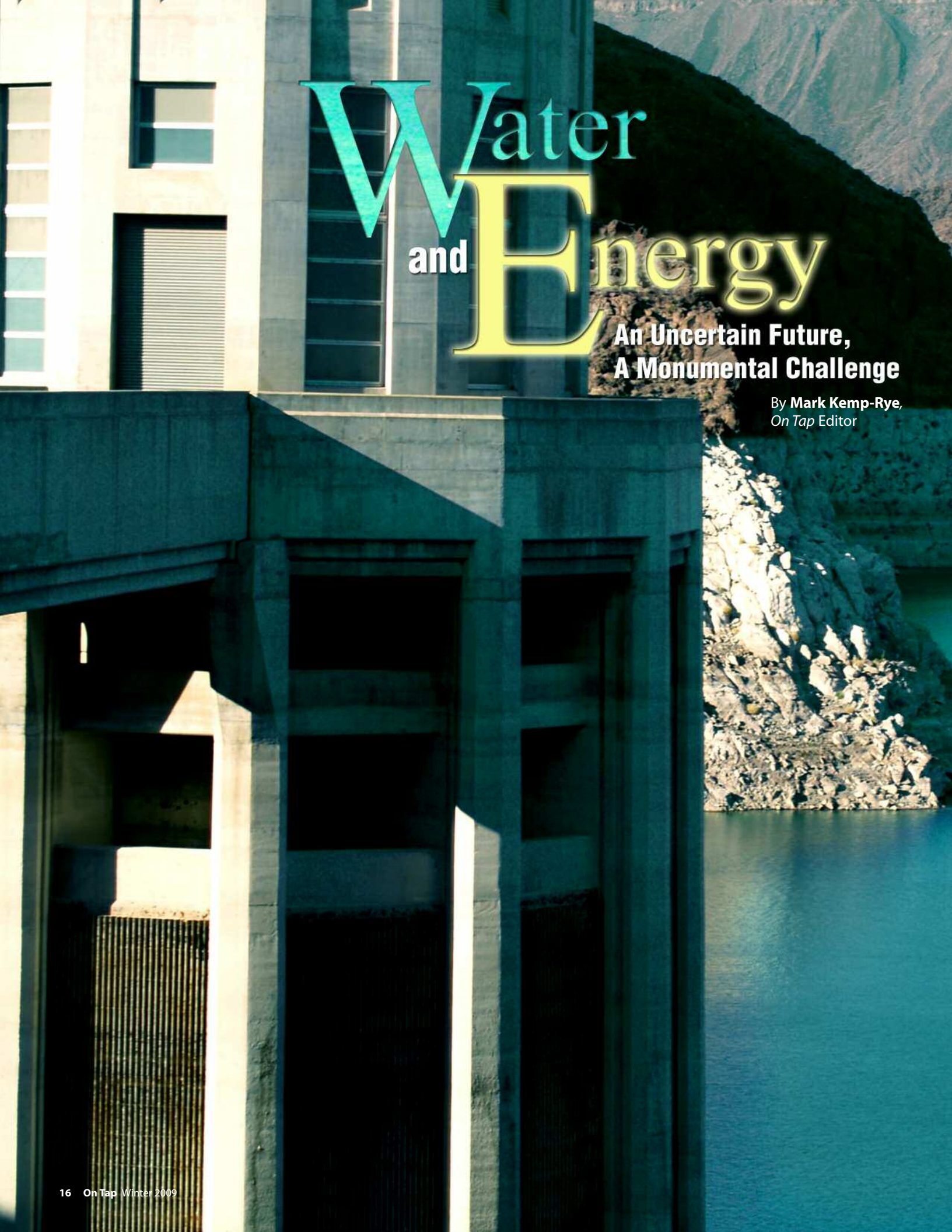
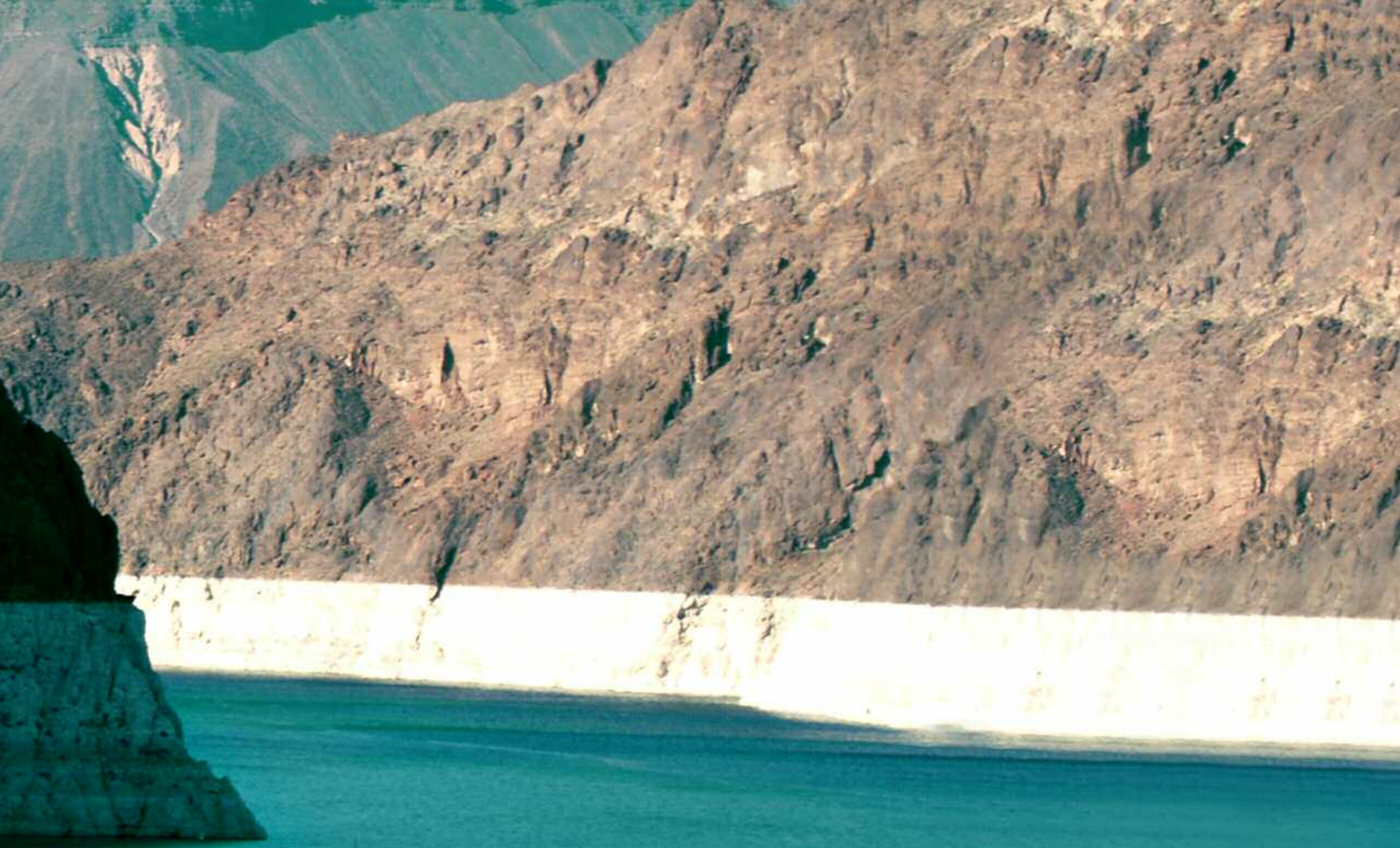


Water and Energy

An Uncertain Future, A Monumental Challenge

By **Mark Kemp-Rye**, *On Tap* Editor



"Water and energy are the two most fundamental ingredients of modern civilization," writes Michael E. Webber in an October 2008 special edition of *Scientific American*. "Without water, people die. Without energy, we cannot grow food, run computers, or power homes, schools, or offices. As the world's population grows in number and affluence, the demands for both resources are increasing faster than ever."

Increased demand for finite resources always presents challenges. With water and energy, the two issues are closely related: energy production requires water, and water treatment and distribution require energy. Currently, drinking water and wastewater systems use an estimated 56 billion kilowatt hours or about three percent of the nation's energy consumption. Water and wastewater facilities are energy intensive, accounting for more than one-third of municipal energy use, according to the U.S. Environmental Protection Agency (EPA).

Exacerbating this situation is the reality that, for the most part, energy and water remain separate in everything from public awareness to policy to planning. In the years ahead, both EPA and the U.S. Department of Energy (DOE) expect water and energy use will continue to climb, stretching both resources even more.

"Competing demands for water supply are affecting the value and availability of the resource," a 2006 DOE report notes. "Operation of some energy facilities has been curtailed due to water concerns, and siting and operation of new energy facilities must take into account the value of water resources. U.S. efforts to replace imported energy supplies with non-conventional domestic energy sources have the potential to further increase demand for water." Many experts are calling for comprehensive planning efforts now to prevent future crises.

The Lake Mead Conundrum

When it was completed in 1935, Hoover Dam was both the largest hydroelectric dam in the world and the largest concrete structure. Hailed as one of the "seven wonders of the industrial world," Hoover Dam provides electricity to several western states and water from Lake Mead, the reservoir formed behind the dam, supplies water to growing communities in Southern California and Nevada.

The population boom in Arizona, Nevada, and California, spurred in part by the success of Hoover Dam, Lake Mead, and other similar projects, has now resulted in a vexing situation. Increased water use (and climate change) mean that Lake Mead is frequently 100 feet below its average historic level, as the dramatic photographs on this and the preceding page show. If the water drops another 50 feet, the water-powered turbines in Hoover Dam will not be able to function, potentially putting places like Las Vegas in the dark.

This conundrum isn't confined to the arid southwest. Lake Norman, near Charlotte, North Carolina, an area that averages

Energy Production and Water Use

Energy issues have been in the news lately. But another precious resource—water—is needed to produce the energy modern society needs.

Using available governmental reports, researchers at Virginia Tech's Water Resources Research Center calculated the water efficiency of 11 types of energy sources (biodiesel, coal, fuel ethanol, liquefied natural gas, synfuel-Fischer Tropsch, tar sands, oil shale hydrogen, synfuel-coal gasification, petroleum/oil and natural gas) and five power-generating methods (hydroelectric, fossil fuel thermoelectric, nuclear, solar thermoelectric, and geothermal).

According to the study, the most water-efficient energy sources are natural gas and synthetic fuels produced by coal gasification. The least water-efficient energy sources are fuel ethanol and biodiesel. In terms of power generation, the researchers found that geothermal and hydroelectric energy used the least amount of water, while nuclear plants use the most.

This study is part of a multi-college partnership at Virginia Tech that proposes a unique approach to managing water and energy resources called the Decentralized Energy and Water Systems. Read more at www.vwrrc.vt.edu/watercooler-nov07.html.

more than 44 inches of rain each year, dropped to 94 feet in 2008, only one foot above the minimum needed for a nearby nuclear power station.

As the Lake Mead and Lake Norman examples so dramatically illustrate, water and energy require each other. "Woefully underappreciated, however, is the reality that each of these precious commodities might soon cripple our use of the other," Webber writes. "We consume massive quantities of water to generate energy, and we consume massive quantities of energy to deliver clean water. Many people are concerned about the perils of peak oil—running out of cheap oil. A few are voicing concerns about peak water. But almost no one is addressing the tension between the two: water restrictions are hampering solutions for generating more energy, and energy problems, particularly rising prices, are curtailing efforts to supply more clean water."

Conservation Is Key

The simple solution, of course, is to use less water and less energy. "Water and energy conservation measures represent an opportunity to stretch both resources," states the DOE. "Reducing water consumption can save energy for water supply and treatment as well as for heating water and thus reduce the requirements for water and the energy sector." As with so many simple things, though, this is easier said than done.

New treatment technologies and water system tools tend to need more energy. Reverse osmosis, for example, requires a great deal more energy than rapid sand filtration. Other new developments such as geographic information systems and SCADA, while undoubtedly useful and often a key tool in better utility management, use more electricity than older methods. This isn't to say we should abandon technology but that the higher power needs should be considered.

Around the country, utility systems are examining their energy usage and turning to alternate methods to power their operations:

- In Bath, Maine, the water district saves more than $30,000 a year through new variable frequency drives on two pumps. The drives adjust the speed of the pumps according to the volume of water they need to pump to meet demand.
- The wastewater treatment plant in Charlemont, Massachusetts, has a 15-kilowatt photovoltaic solar array that has cut energy costs by more than half since the panels went online in 2005.
- In Lometa, Texas, newly installed solar panels generating 70,000 kilowatt-hours per year are expected to cut the wastewater treatment plant's electric bill in half.
- A 12-acre array of solar panels in Rifle, Colorado, will generate enough power to run a pump station that draws water from the Colorado River and a new wastewater treatment plant.

Continued on page 31.

Continued from page 18.

EPA Region 1 has been especially active in promoting energy efficiency. "Cities and towns across New England have found they can save money at the same time they respond to increased citizen interest in less polluting energy sources," they state in the brochure "New England: Cleaner Environment through Energy Efficiency and Clean Energy."

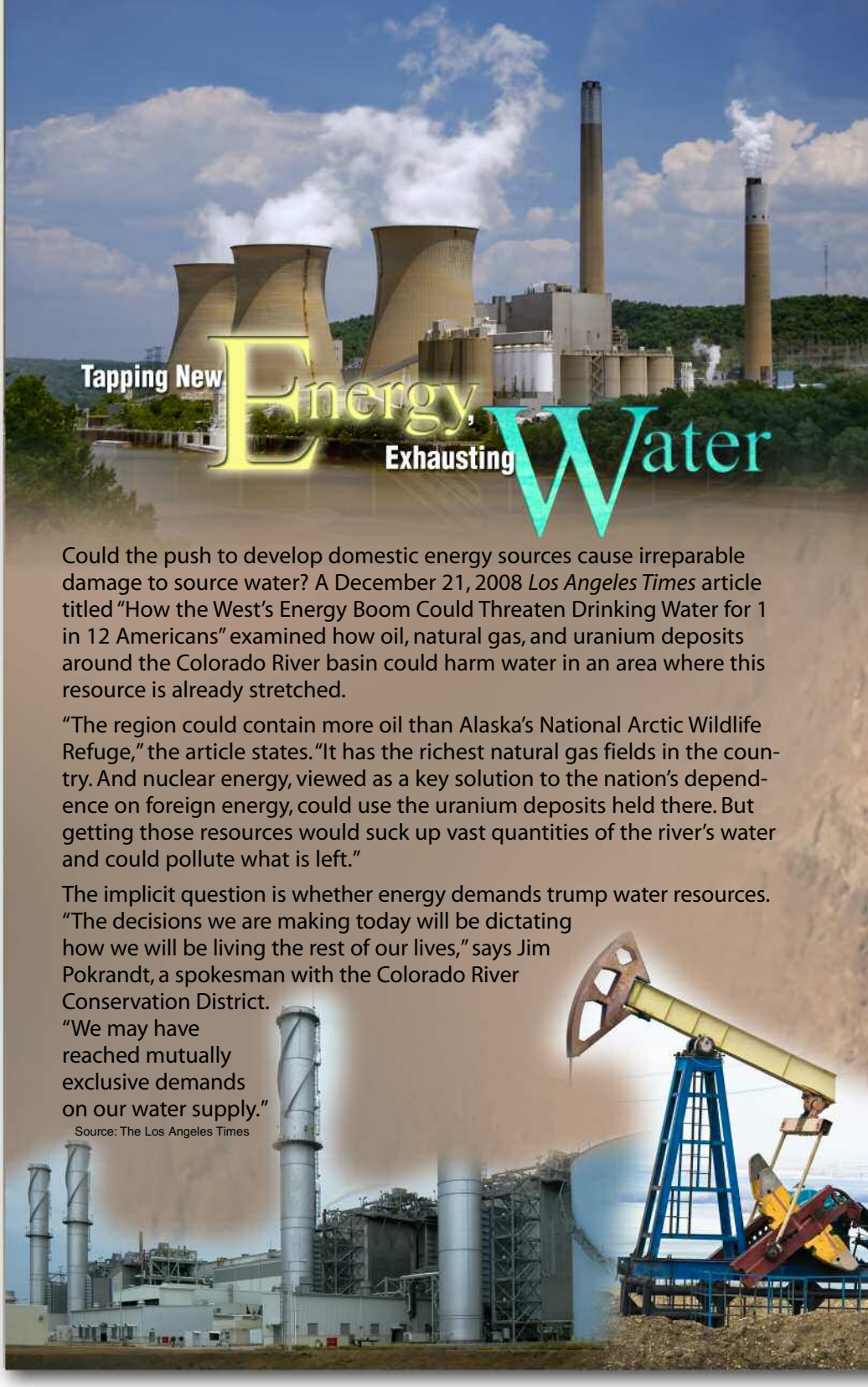
Cutting power costs is an important step. Not only will it save individual utilities money, but widespread adoption of energy savings would also benefit the entire country. "[EPA's] Energy Star program estimates that about $4 billion is spent annually to run drinking water and wastewater utilities," says Benjamin H. Grumbles, EPA assistant administrator for water (2004-2009). "If the sector could reduce energy use by just 10 percent through cost-effective investments in energy efficiency, collectively it would save about $400 million annually.

"Wasting energy is sending good resources down the drain," Grumbles continues. "Energy efficiency is good for the planet as well as the plant managers who make water clean and healthy."

Why would a small system drinking water or wastewater operator be interested in saving energy? "The bottom line is that energy efficiency equals cost savings, which mean small budgets, lower rates (or at least rates that won't climb as fast), and happier customers," says Jennifer Hause, technical services manager at the National Environmental Services Center. "Being more efficient means saving money for the community, that's the bottom line."

A New Approach Is Needed

Energy efficiency and water conservation are two key parts of this resource puzzle. In many ways, though, efficiency and conservation can be thought of as tools within the broader context of sustainability. Implicit in the notion of sustainability is that we must examine the interrelatedness of previously separate realities and that we carefully scrutinize how we intend to solve problems. And sometimes the ways we are used to aren't the best ways to move forward.



Tapping New Energy, Exhausting Water

Could the push to develop domestic energy sources cause irreparable damage to source water? A December 21, 2008 *Los Angeles Times* article titled "How the West's Energy Boom Could Threaten Drinking Water for 1 in 12 Americans" examined how oil, natural gas, and uranium deposits around the Colorado River basin could harm water in an area where this resource is already stretched.

"The region could contain more oil than Alaska's National Arctic Wildlife Refuge," the article states. "It has the richest natural gas fields in the country. And nuclear energy, viewed as a key solution to the nation's dependence on foreign energy, could use the uranium deposits held there. But getting those resources would suck up vast quantities of the river's water and could pollute what is left."

The implicit question is whether energy demands trump water resources. "The decisions we are making today will be dictating how we will be living the rest of our lives," says Jim Pokrandt, a spokesman with the Colorado River Conservation District. "We may have reached mutually exclusive demands on our water supply."

Source: The Los Angeles Times

"When it comes to water and wastewater projects, the default thinking seems to be 'put in the big pipe,'" Hause observes "I know of at least one project where a rural area is planning to install a county-wide sewer system. I'm not sure this makes sense, not only in terms of the initial cost but of the long-term energy needs to sustain it.

"Sometimes large-scale water infrastructure projects make sense," Hause continues. "But in many, many cases, a localized system represents a more viable solution, especially when energy costs are factored in. I believe we need to expand our thinking and consider new approaches."

Planning and cooperation are important considerations in a new approach to water and energy. According to the DOE, "collaboration on energy and water resource planning is needed among federal, regional, and state agencies, as well as with industry and other stakeholders. In most regions, energy planning and water planning are done separately. The lack of integrated energy and water planning and management has already impacted energy production in many basins and regions across the country."

"Mechanisms, such as regional natural resources planning groups, are needed to foster collaboration between stakeholders and regional and state water and energy planning, management, and regulatory groups and agencies," the DOE continues. "These types of collaborative efforts are needed to ensure proper evaluation and valuation of water resources for all needs, including energy development and generation."

The impending crisis can be averted but it will require a new sense of purpose and a commitment to finding long-range solutions. No longer can we take water and energy—two vital hallmarks of society—for granted.

"The nation's mandate for greater energy efficiency and independence reminds us that water is also not unlimited and there is much that we must do to preserve it, despite its free-flowing nature and seeming abundance," says Amy Vickers, president of Amy Vickers and Associates, a Massachusetts water conservation consultant. "Whenever we save water, we also save energy and help restore nature's balance. For every gallon of water we conserve, we not only act to restore our declining rivers and lakes, we also reduce our carbon footprint by lessening the amount of energy used to treat and pump water and wastewater."

More Information

The U.S. Environmental Protection Agency's Energy Star program has tools and information specifically tailored for drinking water and wastewater facilities. Go to *www.energystar.gov/waterwastewater* for more information. EPA has sections of their Web site devoted to water conservation (*www.epa.gov/watersense*) and sustainable infrastructure (*www.epa.gov/waterinfrastructure*).

The U.S. Department of Energy's *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water* is available online at *www.sandia.gov/energy-water/congress_report.htm.*

References

Cart, Julie. 2008. "Energy Dispute Over Rockies Riches." *Los Angeles Times* (December 28).

Hargreaves, Steve. 2008. "Natural Gas Boom vs. Groundwater Risks." Accessed July 28 at *money.cnn.com.*

Hoffman, Allan R. 2008. "The Connection: Water and Energy Security." *eBulletin.* Washington DC: The Safe Drinking Water Trust.

Lustgarten, Abrahm. 2008. "How the West's Energy Boom Could Threaten Drinking Water for 1 in 12 Americans." *San Diego Union-Tribune* (December 21).

U.S. Department of Energy. 2006. *Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water.* Washington DC.

U.S. Environmental Protection Agency. 2008. "New England: Cleaner Environment through Energy Efficiency and Clean Energy." U.S. EPA New England.

Webber, Michael E. 2008. "Energy versus Water: Solving Both Crises Together." *Scientific American* (October 22).

Over the last couple years, *On Tap* Editor **Mark Kemp-Rye** has looked for ways to cut down on home energy consumption. During this time, he has managed to cut his electric bill by more than one-third.