Energy, Climate Change, and Sustainable Water Management

New technologies, management systems, economic instruments, and sustainable land-use practices are needed to cope with changing climate patterns and their effects on the water cycle.

by G. Tracy Mehan III

More than five years ago, the Environmental Protection Agency (EPA) unveiled its Four Pillars of Sustainable Infrastructure. The program’s aim was a sustainable regime of investment and management that looked at water and wastewater facilities in a broader context: the demand side and the supply side, the watershed and the treatment works, and the responsibilities of ratepayers as opposed to those of federal taxpayers.

The Four Pillars consisted of Better Management, Full-Cost Pricing, Efficient Water Use, and the Watershed Approach to Protection. Since then, the prevailing view of a truly sustainable water system or utility has both expanded and deepened within the industry and at EPA. It has evolved into a much broader, dynamic concept. Sustainability now encompasses diverse matters such as energy management, climate adaptation, and other subjects that directly affect the economic, environmental, and social aspects of a successful operation.

A Renewed Focus on Energy: A Fifth Pillar

Although energy efficiency was implicit in the Four Pillars—specifically in Better Management and Efficient Water Use—it was not given a great deal of attention in 2003. At that time, climate change was not even considered relevant to sustainable infrastructure or the infrastructure investment gap, which was, and still is, on the minds of water utility managers and EPA.

It is well past time to incorporate energy management and efficiency into the vision of sustainable water infrastructure—a Fifth Pillar so to speak. Global pressures on energy prices and environmental concerns have moved the issue to the top of the list for the water sector, which consumes 3 percent of the total electricity generated by the U.S. electric power industry. Electricity accounts for roughly one-third of utilities’ operating costs. Some experts estimate that energy consumption at water and wastewater utilities will grow by more than 20 percent in the next 15 years.

continued on page 2
For economic reasons alone, energy management ought to be a Fifth Pillar: Sustainable Infrastructure. Climate change and the necessity of either mitigating or adapting to it solidify the case beyond all doubt.

In 2003, the General Accounting Office surveyed state water managers and determined that even under normal or non-drought conditions, 36 states anticipated water shortages in localities or regions or on a statewide level in the next 10 years. Under drought conditions, 46 states expected shortages in the same time frame. In addition, increasing population and declining groundwater levels indicate that the freshwater supply is reaching its limits in some locations while freshwater demand is increasing. Furthermore, the building of new, large reservoir projects has tapered off, and existing storage is threatened by age and sedimentation.

Impacts of Climate Change on Water

A recent report by the American Water Works Association Research Foundation and the University Corporation for Atmospheric Research points out that climate change and variability portend significant consequences for water utilities, especially in the western United States. Although scientists generally agree on the broad features of likely hydrological changes, such as an increase in global average precipitation and evaporation because of warmer temperatures, significant uncertainty remains about the amount of precipitation and runoff at the regional and watershed levels.

Scientists suggest, however, that the global climate cycle will become more intense, resulting in heavier but less frequent periods of precipitation. They point to the possibility of longer periods of drought alternating with spells of heavy rainfall and runoff. The consequences are many and include the following:

- Greater variability in runoff would make maintaining optimal reservoir levels more difficult and would reduce the reliability of water storage.
- Increased reliance on groundwater during extended dry spells would reduce aquifer levels and discharges to surface-water bodies, with unintended consequences for aquatic ecosystems.
- Shorter periods of snow accumulation in mountainous regions, especially at lower altitudes, would result in reduced snow pack, which, together with earlier melting in the spring, would lead to reduced flows in late summer, when water is scarce and demand is greater.
- Treatment costs would increase because of heavier runoff.
- Floods, droughts, hurricanes, and wildfires—as well as the soil erosion they cause—would increase, threatening water quality and utility infrastructure.
- Rising sea levels would lead to saltwater intrusion and flooded infrastructure.

Colorado River Basin

The pressure on water availability is building in the Colorado River basin. This watershed covers 240,000 square miles and seven states, including California, as well as a portion of Mexico. This past February, a blue-ribbon scientific committee of the National Research Council, part of the National Academies, issued a stunning report.

The committee reviewed data from tree-ring studies. Those studies provide a much longer-term view of weather and climate—going back 300, 500, and even 800 years—than do stream gauges, which extend back only 100 years. The committee found that average annual flows vary more than previously assumed and that extended droughts are not uncommon. Moreover, future droughts may be longer and more severe because of a regional warming trend. Evidence suggests that rising temperatures will reduce the river’s flow and water supplies.

When the Colorado River Compact, which allocates water between the upper and lower basin
states, was signed in 1922, it was assumed that the annual average river flow was closer to 16.4 million acre-feet. However, tree-ring reconstructions show that the years between 1905 and 1920 were exceptionally wet. Compounding the problem is the rapid increase in population in states such as Arizona (a 40 percent rise since 1990) and Colorado (a 30 percent rise). As a result, water is becoming as precious as oil in that part of the world.

**Las Vegas: A Case Study**

In Clark County, Nevada, which includes Las Vegas, water consumption doubled between 1985 and 2000, notwithstanding improved water conservation and efficiency. Las Vegas’s water comes from Lake Mead, which has fallen to almost 40 percent of capacity, and upstream from Lake Mead at Lake Powell, which has fallen to approximately 66 percent of capacity, the lowest level since Lake Powell was filled three decades ago. The people of Las Vegas share Colorado River water with 30 million other people, roughly 10 percent of all U.S. inhabitants, from Denver, Colorado, to Salt Lake City, Utah; Phoenix and Tucson, Arizona; and Los Angeles and San Diego, California.

Agriculture consumes 90 percent of Nevada’s water. In contrast, the Strip in Las Vegas—with 15 of the world’s 20 largest hotels, complete with fountains, sea battles between pirate ships, and an 8.5-acre lake—accounts for less than 1 percent of the state’s water use while producing 60 percent of its economic output. The average hotel room uses 300 gallons of water a day, but most of that water is recycled.

Nevertheless, encouraged by the Southern Nevada Water Authority, the city decided to cut its waste. Retirees moving to Las Vegas often planted grass rather than using desert landscaping natural to the region. The city itself was planting grass on median strips.

Not only did it stop planting grass on medians, but Las Vegas began paying residents $1 per square foot to remove grass or turf. As of 2005, it had removed 50.9 million square feet of grass or turf for

“Some experts estimate that energy consumption at water and wastewater utilities will grow by more than 20 percent in the next 15 years.”
an annual savings of 2.8 billion gallons of water. The city is currently promoting desert plants for landscaping. Despite a population growing at 5,000 per month, the city’s water consumption declined from 318,000 acre-feet to less than 272,000 acre-feet from 2002 to 2003, and it dropped even lower in 2004.

**A Move Forward on Adaptive Strategies**

The U.S. water sector is responding to the emerging scientific consensus on the realities of global climate change and the stark reality of rising energy costs in a global market. On the West Coast and in the Northeast, for example, states are planning to launch regulatory cap-and-trade programs that will create the necessary incentives.

Energy Star is EPA’s flagship voluntary program. The program has established a new industry focus for the water and wastewater sector. According to EPA, drinking water and wastewater systems spend about $4 billion a year on energy to pump, treat, deliver, collect, and clean water. Energy costs to run drinking water and wastewater systems can represent as much as one-third of a municipality’s budget. Energy Star can contribute to the overall financial resiliency of water and wastewater utilities.

EPA is progressing well with its new WaterSense initiative—an offspring of the Four Pillars. Launched in 2006, WaterSense seeks to enhance the market for water-efficient products and services by building a national brand for water efficiency. On October 1, 2007, the agency announced its new product specifications for high-performance, water-efficient sink faucets for bathrooms. These sinks use about 30 percent less water than conventional models.

WaterSense has also labeled more than 60 high-efficiency toilets, which use 20 percent less water than standard models. This exciting new program will only expand with time, saving energy while saving water. WaterSense and Energy Star reinforce each other in terms of environmental and financial benefits.

The United States will need a diverse portfolio of technologies, management systems, economic instruments, and sustainable land-use practices to adapt to the reality of uncertain climate patterns and their effects on the water cycle.

G. Tracy Mehan III is principal with The Cadmus Group, Inc., and is the former assistant administrator for water for the Environmental Protection Agency. He can be reached by e-mail at gmehan@cadmusgroup.com. The views expressed herein are his own and not those of The Cadmus Group, Inc., or any of its clients.

---

**For More Information**

An expanded version of this article originally appeared in the Daily Environment Report, December 24, 2007, published by the Bureau of National Affairs. For more information about The Cadmus Group, visit www.cadmusgroup.com. For more information on the market for water treatment technologies, contact Ellen Bohon of the Office of Energy and Environmental Industries, tel.: (202) 482-0359; e-mail: ellen.bohon@mail.doc.gov. For more information on the market for climate change–related technologies, contact Marc Lemmond of the Office of Energy and Environmental Industries, tel.: at (202) 482-3889; e-mail: marc.lemmond@mail.doc.gov.