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CLIMATE CHANGE

WATER RESOURCES

The author of this article, a former assistant EPA administrator for water, says the prevailing analysis of a truly sustainable water system or utility has both expanded and deepened within the industry and at EPA. He cites water resources as one of many areas that already manifest profound effects from climate change and says it is time to start planning and building for a very different future if we are to avoid disruptions to our economy and society. He says this will require a proactive and aggressive response from America's water sector. The author says prudence dictates that utility managers follow precautionary, adaptive strategies to foster utility systems and operations that are robust, resilient, and flexible in anticipating alternative climate scenarios.

Energy, Climate Change, and Sustainable Water Management

BY G. TRACY MEHAN, III

More than four years ago the Environmental Protection Agency unveiled its Four Pillars of Sustainable Infrastructure.[1] Its aim was a sustainable regime of investment and management which looked at water and wastewater facilities in a broader context: the demand side as well as the supply side, the watershed as well as the treatment works, and the responsibilities of ratepayers as opposed to federal taxpayers.

The Four Pillars consisted of Better Management, Full-Cost Pricing, Efficient Water Use, and the Watershed Approach to Protection.

Since that time 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 such diverse matters as energy management, climate adaptation, and other subjects which directly impact the ''triple bottom line'' for the economic, environmental, and social aspects of a successful operation.

[1] *See* http://www.epa.gov/waterinfrastructure.

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First, Get a Million Dollars

Theoretically, you could build the entire house of water infrastructure on just one pillar: full-cost pricing,[2] arguably the first among equals. While this is a fine idea, it recalls the old Steve Martin joke on ''How to make a million dollars without paying taxes. First, get a million dollars.''

Full-cost pricing is a hard goal to attain given that most of America's water and wastewater utilities are publicly owned; and any decision on water rates is, of necessity, a political decision—often a controversial one. An August 2002 General Accountability Office (GAO) report[3] on its survey of several thousand drinking water and wastewater utilities indicated that 29 percent and 41 percent, respectively, were not generating enough revenue from user rates and other local revenue sources to cover their full cost of service. Roughly one-third of the utilities, therefore, deferred maintenance because of insufficient funding, had 20 percent or more of their pipelines nearing the end of their useful life, and lacked the basic plans for managing their capital assets.

During my tenure as Assistant Administrator for Water at EPA, we calculated that American households spent an average of $707 annually on soft drinks (carbonated) and other non-carbonated beverages compared to an average of $474 on water and wastewater charges.[4]

So a portfolio approach, i.e., the Four Pillars, which reduces the cost of operations and capital investments, or provides least-cost options for providing clean, safe water is prudent in the circumstances. Moreover, many of these cost-effective activities, such as the watershed approach or source water protection, bring with them vital environmental benefits such as land protection, as well as restoration of habitat and natural flow regimes.

A Renewed Focus on Energy: A Fifth Pillar

While energy efficiency was implicit in the Four Pillars, specifically the ones for Better Management and Water Efficiency, we did not give it a great deal of attention back in 2003. At that time, climate change was not even discussed as being relevant to sustainable infrastructure or the infrastructure investment gap, which was and still is on the minds of water utility managers and EPA.

I have argued that it is well past time to incorporate energy management and efficiency into the vision of sustainable water infrastructure, a Fifth Pillar if you will.[5] Global pressures on energy prices and environmental concerns have moved the issue to the top of the heap for the water sector, which consumes 3 percent of the total electricity generated by the U.S. electric power industry. It 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.

For economic reasons alone energy management ought to be the Fifth Pillar of Sustainable Infrastructure. Climate change and the necessity of either mitigating or adapting to it solidifies the case beyond all doubt.

Emerging Consensus on Climate Change Science

For any citizen coming to grips with the rapid developments in the science of climate change, especially for the overwhelming majority of us who are not climatologists, the past few years have been very confusing. Endless debate over the climate record, ice core samples, the impact of cloud cover, and the dark arts of modeling, to name just a few, has presented very daunting obstacles to understanding, much less participating in, the public dialogue.

Clearly, the February report of the United Nation's Intergovernmental Panel on Climate Change offers the most compelling evidence, to date, that human beings have significantly, and negatively, impacted global temperatures, sea levels, and habitat among other things.[6]

As a lawyer who generally embraces the importance of science, risk assessment, and economics in the formation of environmental public policy, I was impressed by the conclusions reached by The Honorable Richard A. Posner, [7] a judge on the U. S. Court of Appeals for the Seventh Circuit, and, literally, a founding father of the very rigorous Law and Economics movement originating at the University of Chicago.[8]

Posner and his followers are strong proponents of both economic efficiency and political liberty. He has also written about catastrophes and the appropriate responses to low-probability, high-risk occurrences.

In 2004, Posner concluded that the evidence was altogether convincing that global warming was a serious problem for which human-caused emissions were the principal cause. Since then, he says that ''more evidence has accumulated and the voices of the dissenters are growing weaker.''

''The global-warming skeptics are beginning to sound like the people who for so many years, in the face of compelling evidence, denied that cigarette smoking was harmful to health,'' claims Posner.

Posner identified several arguments for incurring ''hefty current expenditures'' to reduce carbon dioxide emissions in the near term. Global warming already imposes steadily rising costs. Also, there is a small risk of abrupt, catastrophic global warming at any time. He believes ''a small risk of a huge catastrophe can add up to a very large expected cost.''

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[2] Full-cost pricing refers to prices and rate structures that recover the costs of building, operating, and maintaining a system. More information on this practice as it relates to water is available at http://www.epa.gov/waterinfrastructure/pricing/index.htm.

[3] U.S. General Accounting Office, *Water Infrastructure: Information on Financing, Capital Planning, and Privatization*, GAO-02-764 (August 2002), available at http://www.gao.gov/new.items/d02764.pdf.

[4] For the detailed calculations, *see* footnotes 3 and 4 in G. Tracy Mehan, III, Assistant Administrator for Water, U.S. Environmental Protection Agency, ''Investing in America's Water Infrastructure,'' Keynote Address to the Schwab Capital Markets' Global Water Conference, Washington, D.C., April 15, 2003, available at http://www.epa.gov/water/speeches/041503tm.html.

[5] G. Tracy Mehan, III, ''Energy Management: The Fifth Pillar of Sustainable Infrastructure?'' Water Environment & Technology, August 2007, p. 10.

[6] The report is available at http://www.ipcc.ch/ipccreports/assessments-reports.htm.

[7] *See* http://www.law.uchicago.edu/faculty/posner-r.

[8] Richard A. Posner, ''Disaster Insurance,'' Hoover Digest (2007, No. 2), p. 44

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Posner's third argument is ''that reducing our consumption of energy by imposing a heavy energy tax would confer national security benefits by reducing our dependence on imported oil.''

For this lawyer, Posner's testimony is potent stuff. But even if we view the scientific evidence as more contingent or uncertain than does Posner, there still are solid grounds for much greater effort on this front.

Some of us will recall the discussions of a ''No Regrets'' strategy for dealing with the specter of climate change back in the late 1980s and early 1990s. The idea was to pursue other policy objectives in ways that also reduce carbon emissions and, at least in part, address climate change. For instance, promoting energy efficiency and alternative energy sources saves money, reduces conventional pollution, and enhances national security resulting in less carbon going into the atmosphere. Planting trees provides habitat, controls polluted runoff into rivers and streams, and mitigates urban heat island effects while sequestering carbon in the process.

The Response to Emerging Consensus

The current state of the science would, at a minimum, indicate accelerating the ''No Regrets'' strategy as a good start at mitigation of the problem. Clearly, this strategy is not, in and of itself, sufficient; but it would carry us much farther than we are today.

In fact, there appears to be a broad, deep, organic response to the emerging scientific consensus on the part of business corporations, states, cities, and, if the success of EPA's voluntary programs is any indication, citizens throughout the country, many of whom are moving forward on their own with programs to mitigate greenhouse gas emissions, establish cap-and-trade regulatory regimes, and promote renewable sources of energy.

Recently, students and staff of the Pace Law School Center for Environmental Legal Studies carried out a survey of all 50 states, yielding an impressive compilation of state legislation, rules, and executive orders relating to climate change, regulatory and voluntary programs, energy efficiency and renewable energy.[9]

For some years now, my firm, The Cadmus Group Inc., has been honored to support the EPA ENERGY STAR[10] and its Climate Protection Partnerships, [11] all voluntary programs embraced by individual citizens, governments, school, colleges, universities, and corporations, which have prevented 70 million metric tons of carbon equivalent greenhouse gas emissions in 2006, up from 63 million in 2005. The ENERGY STAR program alone removed the equivalent of greenhouse gas emissions from 25 million automobiles in 2006.

EPA's Climate Leaders Program,[12] another initiative which Cadmus is pleased to support, has grown to 150 companies representing more than 8 percent of the total U.S. greenhouse gas emissions, all of whom set ambitious goals for emissions reductions.

Stakeholder activism, especially on the part of stockholders, is elevating climate change to the top of the agenda, eclipsing all other environmental issues.

Multinational corporations face complex disclosure issues with the Securities and Exchange Commission due to fragmented greenhouse gas regulatory regimes in the United States, the divide between signatory and non-signatory countries to the Kyoto Protocol, and proliferating greenhouse gas emissions trading markets.[13]

Rebecca Smith, writing in The Wall Street Journal, reported that ''From coast to coast plans for a new generation of coal-fired power plants are falling by the wayside as states conclude that conventional coal plants are too dirty to build and the cost of cleaner plants too high.''[14] Citing reversals in Florida, North Carolina, Oregon, and other states, she reports that nearly two dozen coal projects have been cancelled since early 2006. In March, the new buyers of TXU Corp. agreed to drop to drop eight of 11 proposed power plants for Texas (38 ER 615, 3/16/07).

According to Smith, ''Citibank downgraded the stocks of coal mining companies on July 18, noting that 'prophecies of a new wave of coal-fired generation have vaporized.' ''

Whatever one thinks of these developments, and they are scary given the current absence of an alternative energy system adequate to our needs, it is clear that the world is changing. It is time to start planning and building for a very different future if we are to avoid disruptions to our economy and society.

It is my sense that consensus will continue to coalesce around the science in ratifying the view that climate change is real and, more significantly, that human beings are significant contributors to the long-term problem.

Cost-Effective Responses?

However, tremendous controversy will persist and intensify over the appropriate policy response to the science, stemming primarily from issues of cost and feasibility. The pace of cost-effective technological innovation or management responses will be key variables affecting America's political will to address, head-on, the causes of climate change.

Take the case of carbon capture and storage, basically geologic sequestration of carbon dioxide underground, which might, I repeat, might be a very cost-effective means of mitigating anthropogenic sources of the most significant greenhouse gas emissions from large-scale burning of coal. Again, this is an area where

[9] *See* http://www.law.pace.edu/environment/climate-change-book.html.

[10] ENERGY STAR is a voluntary program and joint effort of the Department of Energy and EPA, launched in 1992, to reduce greenhouse gas emissions through superior energy-efficient products and practices. The program has more than 8,000 partners working to deliver energy-efficient solutions for consumers, businesses, industrial facilities, and nonprofit organizations. *See* http://www.energystar.gov/.

[11] *See* http://www.epa.gov/cpd.html.

[12] EPA's Climate Leaders program challenges larger, individual companies to develop long-term, comprehensive climate change strategies including the completion of an inventory of GHG emissions, the setting of ambitious reduction goals, and annual reporting of progress. *See* http://www.epa.gov/climateleaders/.

[13] *See* the discussion by Jeffrey A. Smith and Matthew Morreale in chapter 13, ''Disclosure Issues,'' in *Global Climate Change and U.S. Law*, American Bar Association, ed. Michael B. Gerrard (2007): 453-455.

[14] Rebecca Smith, ''New Power Plants Fueled by Coal Are Put on Hold,'' The Wall Street Journal, July 25, 2007: A1

Cadmus has been pleased to support EPA's Underground Injection Control Program, in collaboration with the Climate Change Division, in exploring the potential of CCS to mitigate climate change through the injection of carbon dioxide deep underground.[15]

EPA Administrator Stephen L. Johnson's announcement Oct. 11, that the agency now will develop regulations to establish ''a clear path to geologic sequestration'' is very welcome news. EPA anticipates proposing regulatory changes to the Underground Injection Control Program in the summer of 2008 and invites public input throughout the process.

Geologic sequestration involves capturing the carbon dioxide from a power plant or other source and transporting and injecting it into deep subsurface rock formations with the aim of keeping it out of the atmosphere for hundreds of years, perhaps longer. The carbon dioxide could be injected into deep saline aquifers, depleted hydrocarbon reservoirs, or coal seams that cannot be mined. The wells would all be subject to regulation by the Underground Injection Control Program, a long-standing regulatory regime.

While carbon dioxide injection is used routinely to increase production of some oil and gas wells, injecting large volumes captured from, say, fossil-fuel-burning plants raises several additional technical issues. Can the injected carbon dioxide make its way through fractures and faults in rock formations, and thereby leak back to underground drinking water sources and impact water treatment processes, or the land surface where it can be trapped in low-lying and enclosed areas causing asphyxiation? What about the corrosive nature of the carbonic acid that is created when carbon dioxide dissolves in water and its effect on well integrity and the environment? Other issues relate to impurities that may be injected along with the carbon dioxide and long-term liability or responsibility for sequestrations lasting centuries.[16]

The costs of carbon capture and storage, particularly capture technologies, remain high, but may decline with broader application. Carbon capture and storage may well turn out to be a godsend for the coal industry in a carbon constrained era, giving it a new lease on life for literally hundreds of years.

Actions at a scale necessary to substantially impact greenhouse gas emissions, resulting in real-word mitigation of climate patterns, will require massive deployment of every conceivable tool—nuclear power, carbon capture and storage, land use management, energy efficiency, renewable energy, and, someday maybe, geoengineering and Solar Radiation Management, undreamed of by science fiction writers.

Resilience is the Essence of Adaptation

The case for immediate and sustained action is most compelling when we consider adaptation to climate change regardless of its causes. Adaptation offers immediate, tangible, cost-effective, and, therefore, politically viable methods of coping with climate change. This is not the same thing as saying it will be easy. The focus must be on change to fit the new situation, including ''behavioral change of an individual or group in adjustment to new or modified cultural surroundings.''[17]

An era of shifting climate will compel us to change the ways we manage ourselves, our natural resources, and our economy. It will surely require systemic economic and societal transformation amounting to cultural change, hopefully more evolutionary than revolutionary, avoiding severe impacts to our communities, our pocketbooks, and the ecosystems upon which we depend.

Adaptation requires resilience. And resilience is predicated upon ''staunch acceptance of reality; a deep belief, often buttressed by strongly held values, that life is meaningful; and an uncanny ability to improvise.'' That was the view of Diane L. Coutu, senior editor at the *Harvard Business Review* who specialized in psychology and business.[18]

Resilience is not the same thing as optimism. Coutu quotes James Collins, the celebrated author of the best selling business book, *Good to Great,* on the case of Admiral Jim Stockdale a prisoner of war who was tortured by the Vietcong for eight years. In response to Collins's enquiry as to who did not make it out of the camps, Stockdale replied, ''Oh, that's easy. It was the optimists. They were the ones who said we were going to be home by Christmas. . . You know, I think they all died of broken hearts.''

This is not to disparage optimism, one tethered to reality. ''But for bigger challenges, a cool, almost pessimistic, sense of reality is far more important,'' says Coutu.

Water in all its aspects—chemical, physical, and biological—is one of many areas that already manifest profound impacts of climate change. This, in turn, will necessitate a proactive and aggressive response from America's water sector.

Water Management in a Changing Climate

In 2003, the General Accountability Office surveyed state water managers and determined that even under normal or non-drought conditions, 36 states anticipated water shortages in localities, regions, or statewide 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.[19]

Colorado River Basin. The mounting pressure on water availability is building to a kind of perfect storm in the Colorado River basin. This watershed covers 240,000 square miles and seven states including California, and a portion of Mexico. This past February, a blue-ribbon scientific committee of the National Research

[15] *See* http://www.epa.gov/safewater/uic/wells_sequestration.html.

[16] *See* ''The Commercial Deployment of Carbon Capture and Storage Technology,'' by Kipp A. Coddington, David M. Meezan, and Kristin Holloway Jones (38 ER 2045, 9/21/07).

[17] *Webster's II New College Dictionary,* Houghton Mifflin Company (1995): 12

[18] Diane L. Coutu, ''How Resilience Works,'' *Harvard Business Review* (May 2002): 3

[19] U.S. General Accountability Office, *Freshwater Supply: States' Views of How Federal Agencies Could Help Them Meet Challenges of Expected Shortages*, GAO-03-514 (July 2003), available at http://www.gao.gov/new.items/d03514.pdf.

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Council, part of the National Academies, issued a stunning report.[20] To summarize the findings in the most succinct way, let me quote the headline from *The New York Times* reporting its release: ''That 'Drought' in Southwest May Be Normal, Report Says.''[21]

The National Research Council committee reviewed data from tree-ring studies which provide a much longer-term view of weather and climate than do stream gauges which extend back only a hundred years. Tree-ring data go back 300, 500, even 800 years. In any event, 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. The preponderance of the 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. Unfortunately, the tree-ring reconstructions show that the years 1905-1920 were exceptionally wet ones!

Add to this the rapid increases in population in states such as Arizona (a 40 percent rise since 1990) and Colorado (30 percent growth in the same period), and you can see how water is becoming as precious as oil in that part of the world.

Las Vegas. In Clark County, Nev., which includes Las Vegas, water consumption doubled between 1985 and 2000, notwithstanding improved water conservation and efficiency.

We should take a moment to reflect on the Las Vegas (formerly, Las Vegas Springs!) experience and what it teaches us about the magnitude of the task before us and the potential of successfully, resiliently adapting to water shortages caused, in this case, by a five-year drought, the worst in perhaps 100 or even 500 years.[22]

Las Vegas's water comes from Lake Mead which is down almost 60 percent of capacity and, upstream from Mead, Lake Powell which is down approximately 34 percent of capacity, the lowest level since it was filled up three decades ago. The city shares Colorado River water with 30 million people, roughly 10 percent of all Americans, from Denver to Salt Lake City, Phoenix, Tucson, Los Angeles, and San Diego.

Agriculture consumes 90 percent of Nevada's water; but 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 Nevada's economic output. The average hotel room uses 300 gallons of water a day, but most of it is recycled.

Pat Mulroy, the general manager of the Southern Nevada Water Authority, has noted the ''mind-boggling'' phenomenon of retirees and others moving to the desert to plant Kentucky bluegrass, ''a particularly thirsty kind.'' According to Mulroy the City was planting grass on *medians* which was ''like moving to Alaska and walking down the street in a bathing suit in January.''

I think we can safely say that Mulroy is a person with the ability to face reality as it is, rather than how she might wish it to be.

Not only did it stop planting grass on medians, but Las Vegas started paying $1 per square foot to remove grass or turf. As of 2005 it removed 50.9 million square feet, for an annual savings of 2.8 billion gallons of water. It is pushing desert plants for landscaping. Despite a population growing at 5,000 per month, water consumption declined from 318,000 acre-feet to less than 272,000 from 2002 to 2003, and even lower in 2004.

Climate Change Impacts 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.[23]

While scientists generally agree on the broad features of likely hydrological changes, such as an increase in global average precipitation and evaporation due to warmer temperatures, significant uncertainty remains about the amount of precipitation and runoff at the regional or watershed levels. Reliable predictions are presently impossible.

That said, the science suggests that the global climate cycle will become more intense, resulting in heavier but less frequent periods of precipitation. In other words, the science points to the possibility of longer periods of drought alternating with spells of heavy rainfall and runoff. The consequences are many. Let me describe just a few.

- 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, along 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 due to heavier runoff.
- Floods, droughts, hurricanes, and wildfires—as well the soil erosion they cause—would increase, threatening water quality and utility infrastructure.

[20] National Research Council, *Colorado River Basin Water Management: Evaluating and Adjusting to Hydroclimatic Variability*, Washington, D.C. (The National Academies Press 2007).

[21] Cornelia Dean, ''That 'Drought' in Southwest May Be Normal, Report Says,'' *The New York Times*, Feb. 22, 2007: A1

[22] George F. Will, ''A City That Bets on Water,'' *The Washington Post*, Feb. 27, 2005, available at http://www.washingtonpost.com/wp-dyn/articles/A54745-2005Feb25.html. My discussion of the Las Vegas case draws largely from Will's excellent article, admittedly outside his normal zone of interest.

[23] American Water Works Association Research Foundation and University Corporation for Atmospheric Research, *Climate Change and Water Resources: A Primer for Municipal Water Providers*, Denver (AWWA 2006).

- Rising sea levels would lead to saltwater intrusion and flooded infrastructure.

The American Water Works Association Research Foundation and the University Corporation for Atmospheric Research observe, quite correctly in my view, that despite regional and local uncertainties, prudence dictates that utility managers undertake ''planning for uncertainty'' which entails implementing precautionary, adaptive strategies designed to foster utility systems and operations that are robust, resilient, and flexible in anticipating alternative climate scenarios. Consistent with the views of most policy analysts in the realm of water resources, the ones I agree with anyway, they contend that Integrated Water Resources Management is the most effective method for assessing adaptation options and their implications.

Integrated Water Resources Management is a systematic approach to planning and management which involves stakeholders and customers in the process. Through continuous monitoring and review of the resources, it facilitates adaptive management. It also provides an opportunity to articulate supply- and demand-side options with the aim of addressing factors relating to biological systems and socio-economic management realities.

No single climate model will yield reliable projections of future climatic conditions. Climate change models will also have to be ''downscaled'' to the relevant watershed level.

The American Water Works Association Research Foundation and the University Corporation for Atmospheric Research recommend that any analysis use projections from several models to generate a range of plausible scenarios of the impacts of climate change on a utility's water resources.

Bob Hirsch, Associate Director for Water at the United States Geological Survey, points out that there is no substitute for real data and information which is always necessary to inform and improve the models themselves. Therefore, these are additional needs for sustainable water and wastewater utility management in the face of a changing climate.

Moving Forward on Adaptive Strategies

America'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.

Recently, I addressed a conference of the Oregon Association of Clean Water Agencies, an organization of 90 wastewater treatment utilities. A fair amount of the program was devoted to exploring how wastewater utility operators could manage or reduce greenhouse gases emanating from their operations, thereby saving money and generating additional revenues through the creation and sale of offsets or credits under Oregon's climate change laws and programs.[24] I suspect we will be seeing more of this kind of activity on the West Coast and Northeast where states are planning to launch regulatory cap-and-trade programs which will create the necessary incentives.

ENERGY STAR, EPA's flagship voluntary program, has established a new industry focus for the water and wastewater sector.[25] Cadmus is supporting EPA on this exciting initiative which allows us to bring to bear our core strengths in water and social marketing and voluntary programs. This is a win-win for sustainable infrastructure, climate mitigation, and adaptation to the extent it contributes to the overall financial resiliency of water and wastewater utilities.

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 a drinking water and wastewater systems can represent as much as one-third of a municipality's budget.

Back in March Benjamin H. Grumbles, assistant administrator for water at EPA, rallied his management team in a memo on ''Climate Change and the National Water Program'' which established a Climate Change Workgroup. He anticipated that adaptation would be the main focus of the workgroup, but he also noted the Office of Water's ongoing efforts regarding geologic sequestration and energy efficiency. As this article goes to press, the report is expected very soon and promises to energize adaptation in the water sector.

Moreover, EPA is progressing nicely with its new WaterSense initiative[26], an offspring of the Four Pillars, launched in 2006, which seeks to enhance the market for water-efficient products and services by building a national brand for water efficiency.[27] On Oct. 1, the agency announced its new product specifications for high-performance, water-efficient sink faucets for bathrooms that use about 30 percent less water than conventional models.

WaterSense has labeled more than 60 high-efficiency toilets which use 20 percent less water than standard models. This is an exciting new program which will only expand with time, saving energy while saving water.

WaterSense and ENERGY STAR are two sides of the same coin, again, the nexus between water and energy efficiency, which reinforce each other in terms of environmental and financial benefits.

America 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 impacts on the water cycle.

Here are a few ideas—some old, some new, some borrowed, and all blue—which might be relevant to pursuing sustainable water infrastructure and management in the context of rising energy costs and climate change:

- **Get the prices right as to the infrastructure, the water itself, and the incentives necessary to conserve and wisely use this most precious of resources**. Doing so also will encourage technological innovation. Volumetric pricing combined with metering is a great driver of water efficiency and conservation. Nor should we subsidize water provision itself, although we should design programs to aid the poorest of our citizens who need our support.

[24] Oregon Association of Clean Water Agencies, Newsletter (Summer 2007), pp 7-9.

[25] *See* http://www.energystar.gov/index.cfm?c=.government.water_wastewater_focus.

[26] *See* http://www.epa.gov/watersense/.

[27] *See*http://www.epa.gov/watersense/specs/faucet_final.htm.

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- **Corporations must recognize the business case for sustainable water use**, from the source to the facility, to the product, while taking advantage of the economic opportunities inherent in water efficiency, conservation, and product innovation.
- **Consider the landscape, the watershed, as well as the water itself. Protecting forests and grasslands will minimize unnecessary impervious surfaces, protect water quality, and maintain, even restore the natural flow regime**. Green infrastructure or low-impact development—green roofs, rain gardens, urban trees, curb extensions, and other amenities—can accomplish the same thing in the urban context while also mitigating urban heat island effect and, possibly, sequestering some carbon in the process. Managing development for higher densities which allow for more green space will also help.
- **Invest in more robust monitoring, data collection, and modeling to make it accessible and usable at the local watershed scale**. Knowledge and information are powerful tools and essential to any successful, iterative, adaptive strategies which must evolve over time.
- **Develop efficient water markets subject to necessary environmental regulation to protect aquatic ecosystems**. In most western states, agriculture consumes 80-90 percent of the water due to the long-standing legal doctrine of ''Prior Appropriation'' (''first in time, first in right''). Cities, water trusts, and environment groups are willing to pay the freight to protect their values and meet their water needs. They need to access efficient water markets to do so.
- **Look to the East, not just to the West**. Water efficiency and conservation now is recognized as an important goal even in water-rich areas such as the Great Lakes and the Southeast where Georgia, Alabama, and Florida are in a tense dispute over water allocations. Due to growth and climate, all regions of the country are challenged to adapt to the new, evolving water regime. The Great Lakes governors and a coalition of cities in the basin have all made new commitments to water conservation.

These suggestions are directed to all parties and sectors—public, private, and nonprofit—in addition to the water and wastewater communities. They recognize that there are essential public-private partnerships which are important to successfully addressing the challenges of sustainable water infrastructure in the evolving, dynamic world in which we find ourselves.

Conclusion

Implementing the vision of sustainable water infrastructure in this country will require imagination, creativity, and resilience. It will necessitate managing resources and people in collaborative partnerships to accomplish difficult ends in the face of changing energy markets, variable climate, and water shortages.

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