ACHIEVING ENERGY AND WATER SECURITY:

SCALABLE SOLUTIONS FROM THE PRIVATE SECTOR

U.S. CHAMBER OF COMMERCE FOUNDATION
Corporate Citizenship Center

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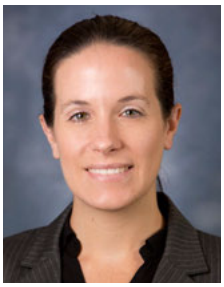


Each year, the U.S. Chamber of Commerce Foundation Corporate Citizenship Center (CCC) produces a series of reports highlighting the positive contributions of businesses tackling pressing environmental and social challenges. In the 2014 environment report, we are pleased to present nearly 30 success stories illustrating how the private sector is moving the needle on energy and water issues that benefit the environment and the bottom line.

Energy and water are essential for economic development, food production, and global security. However, rapid population growth, an increasingly prosperous middle class, urbanization, changes in climate, and demographic shifts from rural to urban centers are putting increasing pressures on our limited energy and water resources. According to the United Nations, by 2030 the world will need at least 30% more water, 45% more energy, and 50% more food. The private sector, as a significant user of energy and water, has a critical role to play in successfully addressing these challenges toward ensuring a more secure and prosperous energy and water future.

The good news is many forward-thinking companies are leading the way in solving energy and water challenges through greater efficiencies and conservation, new tools, technologies, and innovation, and strategic partnerships. Examples in this report include:

- **MillerCoors:** Developing and scaling water-efficient farming practices that save water, energy, and money
- **Veolia North America:** True Cost of Water tool helps companies navigate the financial implications of water-related risks
- **Office Depot:** Piloting new energy efficiency technologies that reduce carbon emissions and realize energy and cost savings
- **HP:** Moonshot, an innovative low-power server technology that tackles the heavy footprint of the Internet with less complexity, space, and power
- **DSM:** Partnership with the U.S. Department of Energy addresses pressing energy challenges while improving U.S. economic competitiveness and private sector profitability

As a result of efforts like these, businesses not only help achieve energy and water security, but also can reduce risk, improve productivity and realize cost savings, meet shareholder expectations, enhance brand and reputation, and become more resilient to changing environments.

We hope this report will provide you with a deeper understanding and appreciation of how businesses are solving complex energy and water challenges, and that you are inspired by their successes to take your sustainability initiatives to the next level. At the U.S. Chamber of Commerce Foundation, we believe replicating and scaling the approaches featured in this report will help meet and manage the growing global demand for energy and water that is safe, secure, affordable, accessible, and sustainable.

A New Era of Energy Security

Christopher Guith, Vice President, Policy, Institute for 21st Century Energy,
U.S. Chamber of Commerce

America's energy landscape has witnessed a cataclysmic shift over the past five years, on a scale greater than anything previously experienced. After decades of increasing risk to its energy security, the United States has turned a corner, and in a big way. Yet federal policies continue to reflect dated and inaccurate assumptions that hinder greater progress.

The recent focus on shale energy production has been truly transformative. The innovative adoption of hydraulic fracturing with horizontal drilling and advanced seismic imaging has enabled companies to economically produce previously unthinkable quantities of natural gas and oil.

Since 2008, domestic production of oil has increased more than 50%. Coupled with stagnant demand owing to increased fuel economy and a tepid economy, increasing output caused a significant decrease in imports. In 2012, the United States became a net exporter of petroleum products (i.e., gasoline, diesel, and jet fuel) for the first time in 50 years. Similarly, 2013 saw the United States producing more crude oil than it imported, for the first time in 17 years.

Also owing to shale development, U.S. natural gas production has increased by nearly 30% since 2006. After years of positioning itself to increase natural gas imports, seemingly overnight the United States is on the verge of becoming a net exporter. But this is just the beginning of a trend that, given the right policies, will continue to increase its energy security over decades to come.

In August 2013, the Institute for 21st Century Energy at the U.S. Chamber of Commerce published its annual Index of U.S. Energy Security Risk[1] which quantifies the risk to America's energy security across dozens of data points while also comparing current circumstances to the past. This 2013 volume demonstrated that the shale revolution is beginning to increase America's energy security significantly.

All four of the major areas of energy risk measured—geopolitical, economic, reliability, and environment—demonstrated improvement over the previous year. Of particular note is that risks related to carbon dioxide emissions fell to their lowest levels since 1994, reflecting gains in efficiency, increased use of natural gas, and sluggish economic growth.

In spite of its vastly improving energy disposition, America's energy policy continues to reflect a period of perceived energy scarcity marked by the 1973 Arab Oil Embargo. Forty years hence, federal policies continue to make 86% of coastal waters and more than 75% of federal onshore lands off-limits for energy production.

Although domestic production of oil and natural gas continues to climb at staggering rates, the Congressional Research Service determined in March 2013 that these increases were on private and state lands while production on federal lands had decreased. Additionally, America still imports nearly 50% of the crude oil it uses.

Thanks to the skill and entrepreneurial spirit of American business, the country's energy security is increasing but there remains significant room for improvement. Federal energy policies must recognize this new energy reality and be brought up to date to reflect the energy revolution taking place throughout America to secure our energy future.

[1] U.S. Chamber of Commerce Institute for 21st Century Energy. http://www.energyxxi.org/energy-security-risk-index

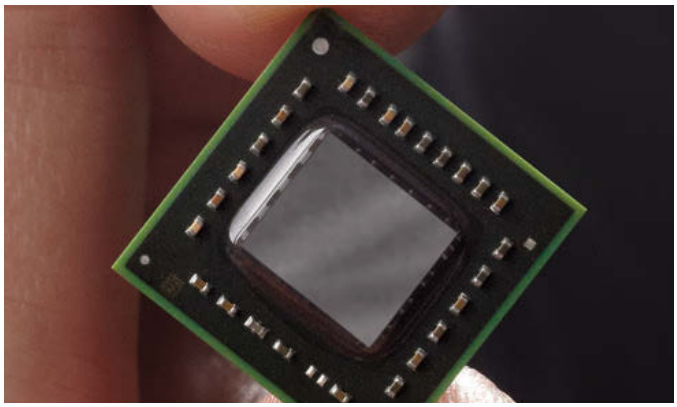
Breakthroughs in "Doing More with Less"

Justin Murrill, Global Sustainability Manager, AMD

Finding innovative ways for businesses to provide more products and/or services—while using fewer natural resources—is an increasingly important opportunity and challenge facing society. With the global population projected to approach 9 billion people by 2050[1], and energy use projected to increase 56% in the next three decades[2], it's clear that businesses need to achieve exponential gains in resource efficiency.

Delivering greater IT performance with less power is a tenet of AMD computing technology. We recognize that our processors influence the energy consumption and accompanying greenhouse gas emissions (GHG) of the products they power, which range from high-performance computers and commercial servers to consumer laptops and game consoles. That's why we are excited about several breakthroughs in AMD's product energy efficiency and the associated results. For example, AMD's latest ultra-dense server solutions use as little as one-fourth the power and one-sixth the space of traditional servers, slashing energy consumption and the associated costs and environmental impact[3]. AMD's innovative "Accelerated Processing Unit" (APU) family of processors—which integrates a Central Processing Unit (CPU) with a discrete-level graphics processor onto a single chip—was designed to significantly reduce energy use and GHG emissions over the life of the product, compared to our previous-generation products.

Another important conservation opportunity is moving IT resources to the cloud. AMD established one of the largest private cloud networks in the world in order to better support our internal Research & Development (R&D) design projects and increase productivity. As part of this, our IT department consolidated our data centers while doubling computing capacity and leveraging existing infrastructure, resulting in more than $6 million in savings.[4]



Now AMD's cloud technology innovations are helping other organizations increase IT productivity while conserving energy.[5]

Consolidating data centers, moving more resources to the cloud, and utilizing more efficient office space design have generated significant water and energy savings at AMD (yet to be quantified). Other recent conservation efforts have reduced AMD's absolute global energy use by 13% and normalized water use at non-manufacturing sites by 26% (2009–2012), with conservation projects last year alone yielding more than $2.7 million dollars in savings.[6]

Achieving breakthroughs in doing more with less positions AMD for greater success in a resource-constrained world, and supports the twin goals of a growing economy and healthy planet.

[1] United Nations – World Population to 2300. http://www.un.org/esa/population/publications/longrange2/WorldPop2300final.pdf
[2] U.S. Energy Information Administration. http://www.eia.gov/
[3] AMD/Sea Micro Technology Overview. http://www.seamicro.com/sites/default/files/SM_T001_64_v2.7.pdf
[4] AMD Private Cloud Case Study. http://www.em.avnet.com/en-us/design/featuredpromotions/Documents/Featured%20Products/AMD/Develop%20a%20private%20cloud%20for%20AMD_Case%20Study.pdf
[5] AMD Cloud Case Study with Intergenia. http://web.amd.com/assets/CustomerReferenceProgramPackage2012/52604A_IntergeniaCustomerCaseStudy_FINAL.pdf
[6] AMD's 2012/13 Corporate Responsibility Summary Magazine. http://www.amd.com/us/Documents/AMD_Regional_Insert_Report_English.pdf

Environmental Sustainability and the Anheuser-Busch Fairfield Brewery

Anthony Sanfillipo, General Manager, Anheuser-Busch Fairfield Brewery

The Anheuser-Busch brewery in Fairfield, California, is an excellent example of the company's continuing commitment to help protect the environment and its local communities. Fairfield is the leader in renewable energy technology for Anheuser-Busch InBev breweries around the world. The brewery is currently using "green" energy provided by an onsite solar array and wind turbine to provide on average 15% of its electricity needs. In 2014, the brewery is planning to install a second wind turbine to expand use of green energy.

In addition, the brewery is using an anaerobic digester system to generate biogas from pre-treatment of brewery wastewater. This biogas supplies 15% of the brewery's natural gas fuel requirements. The brewery has also used innovation to drastically reduce water use by more than 45% since 2006, and has a recycling rate of more than 99%.

Anheuser-Busch wishes to improve its business by saving money on electricity expenses, and to decrease the greenhouse gas emissions associated with the Fairfield facility. The brewery's solar and distributed wind energy projects help it achieve both of these goals. Energy is a large proportion of Anheuser-Busch's total operating costs. The use of solar and wind power improves the energy efficiency of Anheuser-Busch's operations, reduces cost, and decreases greenhouse gas emissions from the facility. As a result, the brewery has improved its economic competitiveness, which will help sustain the facility and tax base for the city.

The environmental benefits of these projects are significant. These combined renewable energy sources produce 5,400 megawatt hours of electricity in an average year, enough to power 609 average American homes.

Its ongoing efforts have earned numerous recognitions for the brewery, including being named *Food Processing Magazine's* 2013 "Green Plant of the Year."

By working to make its operations both more efficient and sustainable, Anheuser-Busch returns value to not only its business, but to the communities in which it operates. The key to the success of the Fairfield brewery's conservation efforts is its employees. Their day-to-day efforts and ongoing suggestions have truly made an impact in reducing the brewery's water, electricity, and fuel use, as well as in increasing recycling efforts. However, these efforts do not simply stop inside the brewery, but continue outside as well. Fairfield's employees have participated in numerous community events to help clean up and protect local watersheds that include the Suisun waterfront and its primary water source, Lake Berryessa.

Caesars Lightens Its Load on the Planet

Eric Dominguez, Corporate Director Engineering, Utilities & Environmental Affairs, Caesars Entertainment

Caesars Entertainment (Caesars), the world's most geographically diversified casino-entertainment company, is committed to environmental sustainability and energy conservation and recognizes the importance of being a responsible steward of the environment.

Responsible stewardship of the environment is a clear business imperative: It saves money, it reduces risk, it offers opportunity to meet guest preferences, and it engages our organization in a shared objective to protect and support vibrant communities. As part of an integrated sustainability strategy called CodeGreen, Caesars is focused on minimizing core environmental impacts, including an aggressive plan to reduce carbon emissions that contribute to climate change.

Buildings consume more than 30% of the total energy used in the United States and are a significant contributor to greenhouse gas (GHG) emissions. Through a comprehensive energy management program at its properties, Caesars is driving significant financial, social, and environmental benefits. The company has set a goal to reduce energy use by 20% on a per-square-foot basis by 2015 against a 2007 baseline, which equates to more than $25 million in annualized savings. Furthermore, Caesars committed to an absolute carbon reduction goal of 10% from 2007 to 2013.

Caesars achieved a significant environmental milestone by exceeding its absolute GHG emissions reduction goal of 10% one year ahead of schedule. The reduction was verified independently by a third party and resulted in more than 143,500 metric tons of avoided emissions per year, equivalent in weight to 11 miles of coal-filled freight cars.

Caesars was able to decrease GHG emissions by 11.4% from 2007 to 2012 despite property expansions. Paramount to the strategy was a focus on priorities that would have the highest level of impact while remaining seamless to the guest experience, including:

- Promoting smarter operations such as formalized shutdown procedures in food and beverage outlets;
- Improving efficiencies through technological innovation such as LED lighting and digital thermostats with integrated occupancy sensors; and
- Scaling high-value opportunities to reduce energy and carbon such as replacing more than 70,000 halogen bulbs with more energy efficient alternatives.

Caesars attained its short-term carbon reduction goal and nearly achieved its short-term energy reduction goal by decreasing energy use nearly 20% on a per-square-foot basis from 2007 to 2012. These efforts also put the company on a trajectory to reach its long-term energy and carbon reduction goals of 40% per square foot of conditioned space by 2025. The results yielded absolute annual electric savings of more than 145,000,000 kilowatt hours in 2012 relative to a 2007 base year, enough electricity to power more than 13,600 average homes or to meet the electricity needs of more than 35,000 people each year.

On December 13, 2013, Caesars published "Vibrant Communities," its fourth report covering Corporate Social Responsibility CSR and sustainability performance. Caesars is the first U.S. organization to receive the Global Reporting Initiative "Materiality Matters" check for sustainability and the first U.S. corporation to complete the report in accordance with G4 CORE level sustainability reporting guidelines. The full report can be found at **www.caesars.com/corporate/sustainability-reports.html** and provides more information regarding sustainability successes at Caesars.

Public-Private Partnerships Improve American Competiveness and Profitability

Hugh Welsh, President, DSM North America

In 2010 DSM, the global leader in life sciences and material sciences, announced its new strategy with a focus on mergers and acquisitions, innovation, partnerships, and sustainability. DSM began executing against this strategy almost immediately. On December 20, 2010, DSM announced that it had signed a deal to acquire NASDAQ--listed Martek Biosciences Corporation for $1.2 billion. This was an important first step in meeting the company's new strategic goals. On December 21, 2010, DSM made another announcement about taking an equally important step in meeting its strategic goals: It inked a partnership in Washington, DC, with the U.S. Department of Energy's (DOE's) Save Energy Now program.

While at first blush the private sector partnering with the government to improve sustainability and profitability seems improbable, the increasing challenges in energy and sustainability require innovative thinking and different kinds of partnerships. Pursuant to the Save Energy Now partnership, DSM North America pledged to reduce its industrial intensity by 25% over 10 years. This pledge is consistent with DSM's global commitment to reduce its energy consumption 20%–25% by 2025.

DSM's partnership with the DOE represents a mutual commitment by the partners to energy efficiency, not only to generate energy and carbon savings, but as an example to the country on how the private and public sector can work collaboratively to tackle some of the country's most challenging energy issues while increasing the competitiveness of the U.S. economy and the bottom line of participating companies.

This partnership, however, is not just about aspiration and inspiration; it is about doing the hard work necessary to keep our commitments to all stakeholders. DSM committed to include its large energy consuming manufacturing sites in Augusta, Georgia; Greenville, North Carolina; Kingstree, South Carolina; and Belvidere, New Jersey in the process. The DOE made available its Industrial Technical Assistance Program experts. Project management teams with participants from both DSM and DOE were created to do the technical evaluation and analysis of DSM processes at each facility. Once this initial analysis was complete, DOE experts benchmarked the results, concluded where energy savings opportunities where available in the DSM plants, and made specific actionable recommendations to DSM engineers on changes that could be made in manufacturing and operations to achieve the energy saving goals of the partners.

The technical expertise provided by the DOE has been invaluable. Energy savings were realized almost immediately, and additional projects and opportunities continue to be identified. These savings go right to DSM's bottom line, much to the delight of our shareholders. Lower energy usage reduces DSM's carbon footprint supporting both our sustainability goals and the goals of the U.S. government. DSM's ability to run large manufacturing operations at lower energy costs materially improves our ability to compete on the global stage. This increased competiveness allows us to continue large-scale industrial manufacturing at our U.S. facilities, and boosts U.S. competiveness generally. It creates job security for the thousands of DSM employees that work at these facilities, and improves the prospect that DSM will continue to grow in the United States and create the new jobs our economy desperately needs. It also ensures that we can continue to support the many communities in which we have the privilege to operate and who rely on DSM as a job creator and a meaningful contributor to the local economy.

Public-private partnerships to create a clean, sustainable energy future and profitability, growth, and economic competiveness is now a reality. The DSM and DOE partnership represents a new and innovative approach as to how the public and private sectors can work collaboratively to meet and align both business and society's goals in a truly sustainable way.

Fuel Sense: Every Drop Counts

Bobbi Wells, Managing Director, Air Operations Planning & Analysis, FedEx

FedEx moves more than 3.6 billion packages each year, across 220 countries and territories. It goes without saying commerce on this scale requires a lot of fuel. Aircraft are the biggest users at FedEx, but these planes are also flying farther, using less energy, and carrying more. It's part of FedEx's EarthSmart platform to create solutions for a more sustainable world.

For the aviation fuel management team, step one is to save as much fuel now without impacting quality or safety. Their Fuel Sense program is made up of 40 different initiatives—all designed to improve efficiency across operations, from pre-flight planning to in-flight routing and post-flight operation.

Examples range from the simple and logical, such as shutting down one engine while taxiing an aircraft between the ramp and the runway, to the highly complex, such as creating new computer technology to optimize the speed of an aircraft during travel.

Fuel Sense relies on the insight and expertise of flight crews, dispatchers, aircraft mechanics, engineers, and analysts to identify opportunities on the ground and in the air. These are then evaluated by the team, planned, and deployed across the network. Ideas like a standard climb procedure come directly from pilots. Standard climb reduces power earlier in the climb. This not only saves about 660,000 gallons of jet fuel or 6,300 metric tons of CO_2 a month, but also reduces noise impacting local communities.

Others come from cross-industry collaborations. Together, FedEx and the Federal Aviation Administration (FAA) improved the efficiency of the Memphis Airport by using advanced wake-turbulence research to reduce spacing between aircraft. Capacity increased by more than 15%, delays were reduced, and FedEx has saved approximately 350,000 gallons of jet fuel a month. This effort, called RECAT, is now rolling out nationwide.

Since 2005, FedEx Express aviation emission intensity is down by more than 18% while revenues are up by 36%. Fuel Sense contributions include:

- Cumulative fuel savings of 247 million gallons since 2007;
- Annual fuel burn reduction by 5%; and
- Year-over-year program expansion starting with five initiatives in 2007 to 40 this year.

Several lessons learned have been gleaned from this initiative, including:

Set a cross-divisional common goal. This mindset helped the Fuel Sense team engage a broad number of team members, leading to far broader fuel-saving efforts than if a few managers tried to solve the problem on their own.

Incremental wins open minds. There was some initial resistance simply because the program challenged time-honored practices like always carrying de-icing fuel even in good weather. With a little more collaboration, a process was put in place to carry fuel only when ice was forecasted. These early wins helped more team members want to be a part of the solution.

Measure, monitor, and promote savings. The team developed a simple report to monitor all initiatives. Key performance indicators helped the team stay focused, set goals, and gain support from upper management. Fuel Sense now has champions at every level of the company.

Bag-2-Bag® Recycling: The Energy and Environmental Advantage of Closed Loop Recycling

Philip Roth Rozenski, MBA, Director of Sustainability, Hilex Poly Co. LLC

The growth of consumer awareness around sustainability issues creates not only new product demands but also opportunities for companies to engineer new production and business processes that conserve energy. Hilex Poly Co. LLC, the largest manufacturer of plastic carryout bags in North America, embraced this strategic opportunity with the creation of its Bag-2-Bag closed loop recycling program, which recycles used plastic retail bags and other consumer films to make new plastic retail bags with high levels of recycled content.

In 2005, Hilex invested more than $25 million to build a national recycling facility in North Vernon, Indiana. To support the facility, Hilex established a post-consumer feedstock for the facility through a national post-consumer film collection network. To date, Hilex has worked with retailers to distribute more than 34,000 retail collection bins throughout 38 states and 2 Canadian provinces. A 2012 study by Moore Recycling found that these efforts have created access to plastic bag recycling within three miles of home for between 91% and 93% of all Americans.

Hilex's North Vernon facility and its Bag-2-Bag program now enable consumers to return plastic retail bags that are not reused at home to local retailers so that they can be recycled into new bags. This process saves energy and resources compared to traditional plastic retail bag manufacturing, while at the same time contributing less to landfills.

The Bag-2-Bag process produces bags that require 20% less energy and generate 11% lower carbon emissions compared to standard plastic retail bags. Additionally, the North Vernon recycling process diverts more than 20 million pounds of bags and film from landfills each year.

A 2009 audit by Sustainable Green Products Inc. found that Hilex Poly's North Vernon facility saved 207.8 kilowatt hours of energy per pound of recycled content used in the production of plastic bags. With a more than 20-million-pound capacity, Hilex has recovered and used post-consumer plastics that have produced a direct energy savings of more than 21.3 million kilowatt hours since 2009.

Year	2009	2010	2011	2012	2013 YTD	Total
KWH Saved	2,688,089,626	4,615,686,481	4,688,871,638	4,879,769,656	4,453,130,135	21,325,547,536

Hilex's five-year energy savings equates to powering 1.89 million households for a year. The magnitude of this energy savings is even greater when compared to the impact of other more energy intensive alternatives, such as paper retail bags or reusable bags. Hilex is also making use of the millions of pounds of recycled content it acquires from vendors who also embrace bag and film recycling.

The growth of consumer demand for more sustainable or "green" product offerings can often be seen as business disruption. Hilex has proven that the growing trend of corporate sustainability is not a disruption to business models but rather a complement. Green products are manufactured through reduced consumption of energy, water, and other input resources. And, much like six sigma programs, which manufacturers have used for years to reduce waste and costs, sustainability strategies have the ability to reduce waste and costs while also meeting growing consumer demand for green product options. The success of Hilex's Bag-2-Bag recycling program shows how a business can invest in sustainability to produce results that benefit both industry and consumers alike.

HP.com Puts HP Moonshot to the Test

Nate Hurst, Global Director of Environmental Progress, HP Corporate Affairs

When data centers running one of busiest websites on the planet can achieve power savings of 89%, IT managers take notice. Including those at HP.

HP.com is one of the world's most highly trafficked sites, receiving more than 300 million hits per day. HP relies on six U.S.-based data centers to handle this traffic. As computing demands grow, HP's IT managers are constantly looking for ways to maximize compute power and flexibility within the existing space and power constraints of our six data centers. They found a game-changing solution with HP Moonshot.

HP Moonshot is a new kind of server architecture designed and tailored for specific workloads to deliver optimum performance. It's the world's first software-defined server to run Internet-scale applications.

High-density HP Moonshot servers are built from chips more commonly found in smartphones and tablets. That allows the servers to deliver reduced energy use in a smaller footprint, and at a significantly lower cost. The servers also gain efficiency from shared management, power, cooling, networking, and storage.

How small is HP Moonshot? Small enough to carry in one hand. A chassis that once fit a single server can fit 45 Moonshot servers. A rack that once fit 64 servers can accommodate 1,800 Moonshots.

HP recently transitioned its top two most trafficked sites to Moonshot—**www.hp.com** domain and download domain **ftp.hp.com**, which together account for about 95% of HP site user traffic. In the process, we freed up 18 racks across our six data centers, gaining more flexibility and space for future growth.

The energy savings are even more impressive. HP Moonshot achieves an 89% power savings while using about 80% less space and costs 77% less than a traditional server environment.[1]

Volker Otto, who directs HP's platform services and automation of IT infrastructure, calls Moonshot a "web hoster's dream."

"Data center space is precious," said Otto. "And our limitation is really about energy consumption in our data centers, which is constrained, as well as the constant need for more computer power for the application teams.

"When we switched to Moonshot servers, we were blown away. The results we saw were amazing with regard to handling thousands and thousands of (concurrent) end user connections."

At 89% less energy, 80% less space, and 77% less cost, imagine the possibilities for powering our digital world. It's estimated that mankind creates more data every two days than in all of human history up until 2003. In fact, if cloud computing were a country, it would rank fifth in terms of energy consumption. And demand continues to grow.

But consider this: If just 10 large web services providers switched their traditional servers to Moonshot, they could save a combined $120 million in energy operating expense and more than 900,000 tons of CO_2e emissions. For a server so small, that's huge.

Moonshot is truly innovative technology that can help people, businesses, and economies thrive while helping reduce impact on the environment—it's just one example of HP Living Progress. Learn more at **www.hp.com/livingprogress.com**

[1] According to internal HP engineering that compares HP Moonshot servers with traditional x86 server technology.

How IBM Helps Wind Power Pick up Momentum

Rolf Gibbels, Energy & Utilities Power Generation Solution Leader, IBM

Over the past decade, the use of wind power has exploded—driven initially by demand in North America and Western Europe. But a variety of factors, including the economic slowdown in Europe and low-cost natural gas in the United States, have slowed wind adoption in developed economies. Now, aided in part by sophisticated weather science, those developing countries could play a huge role in blunting the effects of climate change.

In fact, a test project in China's windy northern Hebei province could help clear the way for accelerated wind power adoption worldwide. IBM is partnering with the Jibei Electricity Power Company to use new technology to analyze weather and wind farm operations data to increase the reliability and economies of using wind energy on utility grids.

Today, coal provides about 80% of China's electricity. Smog chokes the major Chinese cities and huge clouds of soot from the country's coal-burning power plants have spread as far as the West Coast of the United States. The government is determined to do something about the situation through a combination of subsidies and directives. As a result, last year China overtook the United States as the world's largest user of wind power.

Still, advocates of wind energy face tough challenges. Wind and solar energy are intermittent, so utilities have to integrate them with other energy sources in their grids. Also, in most situations, fossil fuels remain less expensive than wind and solar. For wind energy to be price competitive, it has to be harvested as efficiently and effectively as possible.

This is where science and IBM's resources and capabilities can help. IBM research scientists began applying some of their most sophisticated weather forecasting techniques to wind energy and are now helping create the world's largest renewable energy test bed in China's Hebei province.

Sponsored by the State Grid Corporation of China, the Zhangbei 700MW demonstration project combines wind, solar, traditional sources, energy storage, and electricity transmission infrastructure. The goal for IBM scientists there is to help local planners integrate wind and solar energy sources into the grid in the most efficient way. The technology solution they have developed is called Hybrid Renewable Energy Forecasting (HyRef).

For both wind and solar, HyRef uses weather modeling and statistical analysis of power data to improve power forecasting. On the wind side, sensors on the wind turbines monitor wind speed, temperature, and direction, which are used as input to the weather model. On the solar side, analysis of images of clouds from cameras are used to track their movements in near-real time. The combination enables precise forecasts for wind and solar power from a few hours to a couple of days ahead in 15-minute intervals. Improvements in the accuracy of the forecasts along with an understanding of the errors enables a wind or solar farm operator to potentially increase the amount of renewable power generation that can be integrated into a power grid. In particular, the errors in these forecasts are now less than half of what the clients in China require.

A lot of elements have to fall into place for wind energy to fulfill its tremendous potential. The sluggish global economy and volatile energy markets are both wild cards. But worldwide, governments, university researchers, and businesses have gotten behind the power of wind energy. The emerging economies have the opportunity to leapfrog the more developed ones in their use of the newest technologies.

Retro-commissioning Saves Money; Helps Win LEED® Platinum

Dan Probst, Chairman, Energy and Sustainability, Jones Lang LaSalle

Although Chicago's Hyatt Center was built in 2005 to modern standards, building owners wanted to raise sustainability to the next level at the 48-story, 1.5-million-square-foot multi-tenant office tower. Owners of Hyatt Center set a goal of LEED® certification and engaged Jones Lang LaSalle, already general manager of the facility, to direct the initiative. A key component of the LEED® pursuit was a thorough retro-commissioning of Hyatt Center by experts from Jones Lang LaSalle's Engineering and Operations group. Besides providing six valuable points toward LEED® certification, the retro-commissioning produced major energy savings with little or no upfront expense through efforts including:

- Reengineering the building's automation system control sequence of operations, resulting in $200,000 annual savings.
- Evaluating lighting in parking garage and elevators (LED upgrade), resulting in $40,000 annual savings with a 1.6-year simple payback.
- Reengineering supply/relief fan operation, reducing the building's stack effect and energy usage.
- Implementing standard temperature settings throughout the building, which maintained steady summer and winter cooling and heat, and improved tenant comfort.
- Reducing operation hours of garage and lobby fans from 24/7 to running "as necessary."
- Reducing weekend HVAC service to "on request," saving $34,000 annually and resulting in 25% less energy use
- Reducing overall building static set-point from 1" to 0.8", saving approximately $33,000 annually.
- Balancing outside air intake with the relief fans and fan-powered boxes, saving $45,000 annually.
- Replacing elevator incandescent lamps with LED strips, reducing energy usage by 89% and increasing tenant comfort, while paying back the investment in 3.1 years, including an 18% utility rebate.

- Converting 1,130 lamps and 96 garage fixtures to energy-efficient products, receiving a 50% utility rebate that reduced payback to less than five months.

In the end, the submission resulted in a 2010 LEED® Platinum for Existing Buildings certification, a first for a multi-tenant Chicago office building, and one of the earliest for a comparable building in the United States. In addition, Hyatt Center raised its ENERGY STAR® score to 86, and won TOBY Office Building of the Year honors at local and regional levels.

Equally significant were Hyatt Center's solid sustainability gains. Energy consumption has been reduced by approximately 15%, producing a yearly savings of about $200,000 and adding an estimated $2.5 million to the value of the property.

Retro-commissioning is one of the most effective and economical ways to make a building run more efficiently, including reducing energy consumption. Essentially, a team of outside engineers carefully examine the building and "re-tune" the equipment to optimize building performance.

Success Is Simple: Go LEAN on Energy

Stewart VanHorn, Director of Global Energy Solutions, Kimberly-Clark Corporation

At Kimberly-Clark, our Sustainability 2015 goals are an integral component of our Global Business Plan. It integrates social, environmental, and economic elements into our company's agenda and weaves a sustainable-business mindset into our operations. By using LEAN principles and actively engaging our employees to instill a conservation approach in their daily operations, we are driving meaningful environmental impact reduction, earning a cost advantage through reductions in water and energy use and in waste sent to landfill, and securing a customer advantage with customers who want to do business with companies that operate in a transparent, responsible, and ethical manner.

LEAN Principles in Action

Since mid-2010, Kimberly-Clark's El Salvador mill, Sitio del Nino (SDN), has been on a LEAN Energy journey that has inspired, motivated, and energized its nearly 1,000 employees to eliminate wasted energy. The team created a conservation mindset through capability training and integrating energy used per ton of produced product into their management system, and they have since saved more than $1.8 million a year in energy costs. That savings represents a 6% reduction in energy use with less than $500,000 invested in capital improvements.

If all of our manufacturing facilities within our 110 global sites could reduce energy usage to target through conservation from LEAN Energy deployment at a similar magnitude, it would deliver almost 10% reduction in greenhouse gas emissions and reduce our worldwide energy spending by more than $65 million annually. LEAN Energy and the step-change value in energy cost reduction it delivers to a site's management system make it a leading, sustainable strategy for conservation and cost transformation in the future.

LEAN Energy provides the real-time tools to visually indicate an energy waste, creates standards to trigger action to eliminate the energy overconsumption, and establishes the methods to reinforce the value of energy at all facility levels. LEAN Energy intends to integrate energy into the existing facility Lean manufacturing system, elevating energy up into the management process dashboard with metrics of safety, quality, delivery, and cost.

Reducing Waste in Energy Consumption

In late 2012, the SDN facility hosted a LEAN Energy workshop attended by representatives from across Kimberly-Clark International including Latin America, the Middle East, Africa, and Asia Pacific. From the pilot deployment, the company's Global Energy Solutions Team (GEST) developed the LEAN Energy Standard that describes and provides supporting information to perform the necessary activities within each phase of the process. As a result of best-practice sharing, 12 facilities across Kimberly-Clark International deployed LEAN Energy on three continents with similar cost and carbon footprint reduction results amounting to savings of more than $3 million this year. The success has led to a plan for more than a dozen additional site deployments of LEAN Energy in 2014. Growing beyond K-C International, plants from the company's Family Care and K-C Professional business units in North America and Europe will join in the global rollout.

Beyond LEAN Energy—Next Generation

LEAN Energy is a strong driver to help to achieve the objectives set for the "Next Generation" of K-Cs sustainability strategy around climate change and energy security. The deployment of LEAN Energy globally and associated energy projects to engage K-C employees in a conservation mindset will deliver $65 million per year savings and a 10% carbon footprint reduction by K-C's 150th birthday in 2022.

MGM Resorts International and Regulatory Agencies Work Together toward Greener Solutions in Las Vegas

Chris Brophy, Vice President, Corporate Sustainability, MGM Resorts International

Background

Variable frequency drive (VFD) technology is a proven method for reducing the electricity consumption and extending the operational life of a wide range of electric motors. This is achieved by its ability to control the rotational speed of an alternating current motor, allowing it to conserve energy when the device is not in high demand.

Recognizing the conservation benefits of VFDs, MGM Resorts International initiated plans in 2011 to retrofit the company's pool, spa, and water feature pumps with this device. The pumps were operating at a consistent speed in most applications 24 hours a day, 7 days a week. With more than 300 pool pumps at MGM Resorts, the Corporate Sustainability Division and property operations recognized that the installation of VFDs could dramatically reduce the company's energy use.

The Challenge

VFD technology has been commonly used in the residential pool market as the environmental benefits of VFDs have been widely known. However, by 2011, little had been done with the technology in the area of commercial pools due to local regulations, federal agency oversight, and national guidance standards. From the beginning, MGM Resorts partnered directly with local regulatory agencies responsible for swimming pool operations to implement appropriate approvals and amend impeding regulations so the project could move forward.

The Project

In conjunction with the Southern Nevada Health District, the preliminary scope of the project was determined and included 268 pump motors ranging in size from 1 horsepower (HP) to 200 HP. MGM Resorts and the local regulatory agencies conducted numerous joint reviews and installed test units at MGM Grand that were carefully inspected to ensure compliance with all codes and requirements. By the end of 2012, 294 total retrofits were completed and now the technology is adopted as a standard for all pool, spa, and water feature new builds and renovations.

Because of an unwavering commitment to environmental responsibility, and through the power of partnership, MGM Resorts was able to influence commercial swimming pool practices not just at the company's properties, but in Las Vegas and elsewhere in the country. Additionally, the local regulatory agencies have provided guidance and feedback to counterparts on the U.S. federal level.

Results

MGM Resorts has saved more than 13.7 million annual kilowatt hours and $1.2 million in annual costs from the retrofit of 294 pumps.

Local contractors were able to sustain business workload during a difficult economy. More than 20 local technicians contributed to the project's success with MGM Resorts committing nearly $1.5 million to the local economy.

Lessons Learned

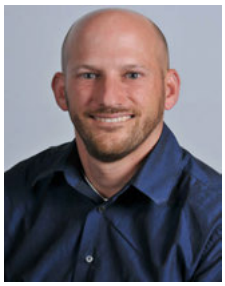
The primary key learning from the retrofit of nearly 300 pumps is the importance of collaboration and clear communications. From the beginning, it was imperative to present a complete case with participation from all parties involved as well as immediately engage governing bodies and regulatory agencies. Clear communication to the appropriate staff proved to be key. If our engineering staff was not engaged, the project would not be successful, as they have a primary health and safety requirement. Ongoing reporting and keeping the governing body involved during changes and updates from the agreed-upon scope is integral to the success of the project.

Another crucial learning is the importance of selecting a pilot property or location. By creating a test environment, necessary adaptations and joint reviews can be performed with a direct connection to the management team and real-time monitoring and reporting. Once the beta installation was completed and feedback obtained from all involved, it was critical to create an RFP (Request for Proposal) that was well defined. Since the project involved a multitude of applications and aggressive environments, we needed to include detail down to the hardware used to install the equipment, conduit, and plumbing.

Lastly, in terms of potential incentives or rebates, ensure that the local utility company is aware and included in the project prior to installation. The utility company can assist in the development of the plan for measurement and verification prior to deployment, therefore ensuring all parties are on the same page.

Internal Carbon Fee: A Powerful Model for Achieving Carbon Neutrality

Steve Lippman, Director, Corporate Citizenship, Microsoft



At Microsoft, we are committed to doing our part to create a more sustainable future. Environmental sustainability is core to our business, and key to that is our commitment to reduce our carbon impact. In 2013, we achieved our goal of carbon neutrality and net-zero emissions for our data centers, offices, software development labs, and employee air travel. The cornerstone of that commitment was instituting a company-wide carbon fee, a financial framework for integrating carbon neutrality commitments into our core business decisions.

Fourteen business groups in more than 100 countries are charged based on their actual output of carbon, mainly from business travel and electricity. The price is determined based on the market pricing for renewable energy credits (RECs) and carbon offsets, and an additional amount that provides Microsoft with funding to support other investments. These two fee components create the appropriate incentives to encourage the right behavior to drive energy efficiency across the company to reduce carbon emissions (e.g., since 2007, we have reduced our carbon footprint from air travel by 30,000 metric tons), and to accelerate investments in renewable energy and carbon offset projects.

We recently signed a 20-year power purchasing agreement (PPA) for wind energy in Texas that will be funded in part by proceeds from the carbon fee. Our first long-term PPA represents a significant milestone in our commitment to carbon neutrality. We made an agreement with RES Americas to purchase all of the energy from Keechi Wind project, a 110 megawatt wind farm northwest of Fort Worth. By purchasing wind, we will reduce our carbon emissions associated with regional Microsoft facilities and hopefully spur additional investment in clean energy throughout Texas. This initiative is part of our overall efforts to purchase green energy while making responsible decisions regarding energy and other resources. Recognized by the U.S. Environmental Protection Agency as the second-largest purchaser of green energy in the United States, we are proud to have doubled our investment in renewable energy in Fiscal Year 13 by purchasing 2.3 billion kilowatt hours of green power globally.

Over the past year, we have invested in 15 carbon offset projects, including in Brazil, China, Guatemala, India, Kenya, Turkey, and the United States. In addition to helping offset our carbon emissions, we are able to deliver added social and economic benefits that have positive impacts on local communities. For example, in Brazil's Acre state, one of the world's richest habitats, we are supporting a project that works with local communities and other groups to conserve 35,000 hectares of pristine rainforest that also improves local economies by incentivizing farmers and families to avoid significant deforestation. We have offset more than 300,000 metric tons of carbon dioxide emissions throughout our growing portfolio of carbon offset projects.

Instituting the carbon fee has ignited a cultural change, not just within Microsoft but across sectors and industries, increasingly utilizing this successful model to easily and efficiently integrate sustainability into core decision making. By putting a dollar amount on carbon, we are able to more powerfully demonstrate our commitment to fostering low carbon economies we believe are fundamental for mitigating the impacts of global climate change. For organizations seeking to learn more about how we implement our carbon fee, we have a carbon fee guide posted on our website **www.microsoft.com/environment.**

Office Depot Achieves Energy Efficiency Success through Active Piloting

Yalmaz Siddiqui, Senior Director of Environmental Strategy, Office Depot Inc.

Over the past 10 years, Office Depot has been on a journey toward making a positive impact on people and the planet while delivering positive economic return. The company has done this through a range of initiatives—from creating supplier guidelines for the health and safety of workers in factories around the world; to launching community outreach programs through the Office Depot Foundation; to growing their green product assortment year-over-year. But perhaps the company's most powerful driver of environmental and economic benefits is its energy efficiency and carbon reduction program.

Office Depot's energy efficiency efforts began in 2004 and have continued unabated to the current day. In the past few years, their efforts were formalized in a carbon reduction goal established in collaboration with the U.S. Environmental Protection Agency's former Climate Leaders program. Office Depot adopted a goal of reducing its U.S. greenhouse gas (GHG) emissions by 20% by the end of 2012, from a 2007 baseline. By the end of 2011, one year before the target date, Office Depot had exceeded its 20% goal and achieved a 29% reduction. Other results achieved over the same 2007–2011 period include:

- Reduction in electricity use from 625,000 megawatt hours to 433,000 megawatt hours;
- Reduction in electricity costs from $60 million to $46.6 million; and
- Reduction in natural gas use from 361,000 mmBTUs to 338,000 mmBTUs.

Much of the company's success in terms of carbon reduction stems from a willingness to innovate and actively pilot new energy efficiency technologies. Each technology is assessed for fit with building requirements, short- and long-term financial impact, and carbon reduction potential. Technologies that pass the pilot phase are then rapidly rolled out on a national basis to maximize the benefits in terms of financial return and carbon footprint reduction.

One example of an early investment that produced significant financial benefits was a $20 million investment to upgrade lights across nearly 1,000 stores. After piloting different light options, Office Depot decided to switch from T12 and HIDs (high-intensity discharge) lamps to much more efficient T5 lights. The payback period of the project was less than 18 months and led to a dramatic reduction in annual electricity costs.

A second example of a successful pilot and rollout was the use of reflector technology. The company found a reflector that could be placed within a three-light fixture to maintain light output while removing one out of the three lamps. The pilot was so successful that reflective mirrors were adopted as a standard and quickly scaled out across all stores. This project to add reflectors and remove lamps cost approximately $8 million, but the payback period was very fast and an 84% internal rate of return was achieved—an exceptionally high rate for any type of investment.

By testing different ideas in a few stores before scaling to its 1,000-plus retail portfolio, Office Depot ensures its energy upgrades are a good fit for the company's operations, customers, and culture. Sometimes tests prove that technologies are not ready for wide implementation. For example, one pilot a number of years ago tested LED lights. While the LEDs chosen produced significant economic savings, the quality of the light output was not good enough for the retail experience. Recent advances in LED technology may allow a more successful rollout in the future, but the early tests proved challenging.

Office Depot's approach to piloting allows the Office Depot team to test innovative technologies without the potential negative ramifications of failure at large scale. They test new innovations in a low-risk context and then widely adopt the ideas that work. Office Depot has found that some of the best solutions for significant carbon reduction are the simplest and most economically viable to implement.

Combined Heat & Power Produces Big Savings

William R. Ellis, Manager, Demand Side Management, and
Gene Smar, DSM Commercial Program Manager, Pepco Holdings, Inc. (PHI)

Combined Heat & Power (CHP) systems provide customers with cost savings and the ability to provide electricity when power from the grid is not available. A natural gas–driven engine produces electricity when coupled with a generator. Reciprocating engines (similar to those in trucks) produce heat in the engine block and exhaust gas from which heat can be recovered. Turbine engines (similar to those propelling jet planes) produce a very hot exhaust heat that also can be recovered. Typical CHP applications, which produce both heat and electricity, are domestic water heating in hotels, hospitals, schools, and apartment buildings; space heating in all types of buildings; and process heat in factories. A special type of air conditioner can use heat to produce chilled water for space cooling or refrigeration applications.

In 2011, PHI was the one of the first electric utilities in the mid-Atlantic to propose including a CHP component as an energy efficiency offering to business, government, and institutional customers. In 2012, the Maryland Public Service Commission authorized Pepco and Delmarva Power, subsidiaries of PHI, and Baltimore Gas & Electric (BGE) to offer the program. CHP technology can produce large savings to help meet energy reductions in grid-supplied electricity (15% reduction in per capita consumption by 2015) that the utilities in Maryland are required to deliver under the state's EmPOWER Maryland initiative. Pepco and Delmarva Power CHP programs include marketing and direct face-to-face outreach to inform commercial and industrial customers of the benefits of CHP and the financial incentives offered. The financial incentives are $250/kW plus $0.07/ kWh saved during the first 18 months of operation.

CHP has high energy efficiency that is typically greater than 65% as compared to a typical configuration of a natural gas–fired electric generator on or off site and an oil-fired boiler at the same facility. The resulting higher efficiency in energy use creates significant economic and environmental benefits for

the system owner, the electric grid, and society as a whole. CHP currently provides about 12% of the electricity consumed in the United States.

Since 1977, the federal government has supported and encouraged CHP, and currently requires all its agencies to consider the technology as a way to reduce operating costs and reduce greenhouse gas emissions. The U.S. Department of Energy and the Environmental Protection Agency are tasked to identify, develop, and encourage CHP installations by industrial plants and other non-federal entities. Besides using CHP for cost savings and greenhouse gas reductions, it is also an excellent source for power and heat at critical facilities such as hospitals, prisons, police and fire stations, nursing homes, and emergency shelters that must have power when storms or other severe natural events disrupt the power grid.

Interest in PHI's CHP program has been high. Currently, more than three dozen projects are moving through the pipeline. PHI companies have received 13 formal applications for CHP installations ranging in size from 75 kW to 11,000 kW. If all of PHI's pending CHP projects are constructed as proposed, Pepco and DPL customers will realize a savings of 200,000 metric tons of CO2 emissions or the equivalent of removing more than 40,000 vehicles from the road, while earning for these customers more than $12 million in EmPOWER Maryland incentive payments.

Customers are primarily interested in two CHP system attributes: cost savings and backup power.

Project size has a significant influence on the cost per kW of generating capacity. Projects smaller than 65 kW can be difficult to justify economically, while those larger than 1,000 kW frequently show very attractive economic performance. CHP requires significant financial commitment on the part of the customer/building owner. In addition to the significant up-front capital investment, the customer will become responsible for supplying much if not all of the electrical energy consumed within the building. Maintenance staff capable of operating a CHP plant must be hired or trained. Equipment must undergo periodic maintenance to ensure reliable operation.

As an alternative to providing such support from in-house resources, the CHP customer may consider a pay-for-performance contract with a CHP equipment vendor or project developer. If a project has compelling economics, the vendor or project developer may be willing to own the system and sell the heat and electrical output to the host facility.

Large projects entail a long schedule for technical and economic studies, design efforts and permitting, procurement of equipment and installation services, construction, and final testing. It is not unusual for these larger CHP projects to take up to three years to come on-line. Small systems can be installed in a few months.

System vendors can offer extended warranties and full-service, comprehensive maintenance contracts, with terms of five years or longer.

Thinking above the Box: Prudential Real Estate Investors and Solar PV Rooftop Leases

David DeVos, Chief Sustainability Officer, Prudential

Designing, installing, and managing solar photovoltaic (pv) systems require a level of expertise not typically found within most organizations. Other barriers to successful in rolling out solar pv projects include meeting capital requirements and the ability to mitigate risks—fluctuating incentives, energy prices, and regulation/government policy.

Despite these barriers and risks, Prudential Real Estate Investors (PREI) seized the opportunity and from its managed portfolio has leased more than 1.4 million square feet of roof space on industrial, retail, and self-storage buildings to solar "developers." The leases provide the pre-qualified solar developers with the right to install more than 20 solar pv systems to produce more than 10.55 megawatts (MW) of photovoltaic power. The new leases added more than $9.3 million in value to our portfolios.

Under this new lease format, the solar developer provides the technical expertise and the necessary capital to design, permit, install, and operate the photovoltaic systems. In some markets, the solar developer can sell the produced electricity to our building operation teams for common area electricity consumption, our tenants, and/or the utility electrical grid. The developer also retains the incentives and, in some markets, Solar Renewable Energy Credits (S-RECs), further enhancing the value of the roof leases.

Varied Property Types and Tenants

Because roof leases typically have a 20-year term, PREI worked with our solar developers on some industrial and retail properties to extend our roof warranties and/or negotiated with them to provide the necessary capital to install new roofs, adding significant value to the assets. In all cases, tenants benefit from reduced energy costs, helping to retain tenants and further stabilize the assets.

In the case of self-storage facilities, a mix of new incremental roof rent and reduced electricity costs has been projected to significantly offset energy costs, therefore adding value by improving the bottom line while mitigating the risk of future escalating energy costs.

Environmental Benefits

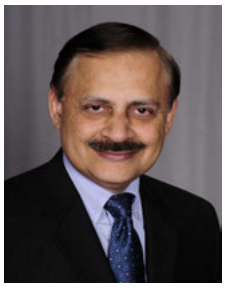
Under the roof lease arrangement, PREI is considered a solar "host," so the company does not claim the emissions reductions created by the solar pv systems. However, the program gives PREI the ability to scale up solar leases, facilitate the installation of renewable energy, and help improve the financial performance of our assets.

Stakeholder Benefits

PREI is encouraged by the results from the solar roof lease program. We believe this effort will help to maximize the risk-adjusted returns for our investors, reduce the operating costs of our tenants, and facilitate the environmental benefits for the communities in which we operate.

Green Leadership at Sears Holdings: Bringing Energy Efficiency from Our Home to Yours

Raj Penkar, SVP and President of Supply Chain, Sears Holdings Corporation



Sears Holdings Corporation is a leading integrated retailer with nearly 2,500 full-line and specialty retail stores in the United States and Canada and the home of Shop Your Way, a social shopping experience that allows members to earn points across a variety of formats through **ShopYourWay.com**. At Sears Holdings, we have a long-standing commitment to operating our business in a manner that is protective of the environment and human health. Some of our recent accomplishments include:

- More than 460 of our facilities have met strict energy performance criteria and earned the Environmental Protection Agency (EPA) ENERGY STAR label.
- Since 2006, we have retrofitted more than 1,300 locations with energy-efficient lighting and/or HVAC systems to reduce energy consumption, greenhouse gas emissions, and operating costs.

However, our commitment to the environment extends beyond just our own business operations. We understand that the collective impact of our members' actions provide a tremendous opportunity to make a positive difference on the environment. As such, we are focused on providing our members with the products, services, and information that allow them to make more sustainable purchasing decisions. Fundamental to this effort is our corporate partnership with the U.S. EPA ENERGY STAR program, which began more than 20 years ago and continues to demonstrate our dedication as a leading sustainable retailer.

Through internal and external initiatives, Sears Holdings takes a multi-channel approach to promoting ENERGY STAR awareness to our members. Sears Holdings merchants work to maintain and increase the selection of ENERGY STAR–certified products across home appliance, consumer electronics, lighting, and home improvement product categories. In addition to prioritizing ENERGY STAR in our product assortment, our Green Leadership team works to build strong relationships with utility providers across the country. This enables us to bring product rebates and co-branded marketing activities into stores and on our websites to further increase the awareness of and accessibility to ENERGY STAR–certified products.

Furthermore, we work with our associates, call center representatives, service technicians, and member service specialists to provide ENERGY STAR education and training ranging from in-person educational sessions, iPad reference applications and intranet portals, monthly newsletters, and utility partner field sessions. Our marketing team works to ensure the ENERGY STAR logo is prominently displayed in the majority of our Sears and Kmart national print circulars and that energy-efficient messaging is placed throughout the Sears Holdings corporate communication channels. Lastly, we held more than 250 events across the nation to support the ENERGY STARs Across America campaign and further publicized the significant impact ENERGY STAR–certified products have on energy conservation and climate protection.

In 2012, Sears Holdings sold more than 3.2 million ENERGY STAR–certified home appliance products representing an estimated annual energy savings of 450 million kWh and estimated reductions of more than 300,000 metric tons of carbon dioxide annually, equivalent to the emissions of 67,788 cars for one year. In recognition of our leadership in energy efficiency, Sears Holdings has most recently earned the 2012 EPA ENERGY STAR Corporate Commitment Award and 2013 EPA ENERGY STAR Partner of the Year Sustained Excellence Award.

Protecting the environment and inspiring our members to do the same is important to us at Sears Holdings. It is through key partnerships, such as EPA ENERGY STAR, that we are able to strive for operational excellence as a company, build a team of engaged and passionate associates, and deliver a "wow" experience to each member by offering them the right energy-efficient products and services that fit their lives.

Admiring the Earth from 30,000 Feet and Working to Protect It

Greg Kozak, Senior Manager, Environmental Strategy and Sustainability Programs, United Airlines

As the world's leading airline with the most comprehensive network, United consumed 3.3 billion gallons of jet fuel in 2012. The airline has made significant investments in a modern, fuel-efficient fleet while implementing operational and procedural changes to drive fuel conservation. United's efforts have resulted in a 32% improvement in fuel efficiency since 1994. In 2012, United saved more than 83 million gallons of fuel as a result of several fuel efficiency initiatives throughout the company, which is equivalent to an estimated 811,643 metric ton reduction in CO2 emissions.

We've highlighted several of our fuel efficiency initiatives below, which underscore United's effort to lead commercial aviation as an environmentally responsible company and build on the airline's actions and commitment to environmental sustainability.

Fleet Replacement

We have more than 290 new fuel-efficient aircraft on order through 2022. Through our fleet replacements in 2012, United reduced its CO2 emissions by more than 100,000 metric tons.

Flight Planning Management and Operating Procedures

We work collaboratively across the organization to improve fuel efficiency through the implementation of best practices by providing training to our pilots, mechanics, and dispatchers, and supplying them with the tools needed to execute on those strategies. We have incorporated several fuel-saving procedures into our daily operations, including:

- Using single engine taxi during ground taxi operations when feasible.
- Using ground tugs instead of aircraft engines to move aircraft from gate to gate whenever possible.
- Using continuous descent approaches, or CDA, a procedure that saves a significant amount of jet fuel per flight. The CDA allows for a gradual idle descent approach during arrival, rather than a less efficient step-down arrival for landing aircraft. To adopt CDA, we have invested in new technology onboard our planes.

Through our flight planning management and operating procedures in 2012, United reduced its CO2 emissions by more than 130,000 metric tons.

Winglets

More than 330 aircraft in our fleet are equipped with winglets, which are wingtip extensions that reduce aircraft drag and result in up to a 5% reduction in emissions. In 2012, winglets reduced United's fuel consumption by more than 46.5 million gallons and

an estimated 450,000 metric ton reduction of CO2 emissions. United is also the launch customer for the new "split scimitar" winglet, which is an advanced and improved winglet for the 737 Next-Gen aircraft. This advanced new split winglet results in up to a 2% fuel savings improvement over existing blended winglets we currently have on our 737 fleet.

Performance Improvement Packages (PIPs)

The 777 PIP improves the airplane's aerodynamics, offering greater fuel efficiency and lower carbon emissions. Through our PIPs in 2012, United reduced its CO2 emissions by more than 22,000 metric tons.

Engine Washing

We routinely wash aircraft and engines to reduce drag and emissions. For example, United saved more than 3 million gallons of jet fuel in 2012 through our engine wash program (thereby reducing CO2 emissions by more than 38,000 metric tons per year).

Weight Reduction

Virtually everything on our aircraft is under constant review for lighter-weight alternatives, as lighter aircraft burn less fuel and produces fewer emissions. In 2012, United's weight reductions initiatives included switching from steel to carbon brakes, removing unnecessary cabin equipment, and optimizing the volume of potable water boarded. Through our weight reduction strategies in 2012, United saved more than 5 million gallons of fuel, equivalent to an estimated 38,000 metric ton reduction in CO2 emissions.

Ground Support Equipment (GSE)

Our focus on fuel savings goes beyond our aircraft. At our stations, more than 24% of our GSE is electric or alternatively fueled. In addition, we use fuel-efficient ground equipment rather than aircraft engine power to move aircraft from gate to gate. Through our GSE operations in 2012, United reduced its CO2 emissions by more than 9,000 metric tons.

Energy Productivity: Our Key to Real Energy Security

Kateri Callahan, President, Alliance to Save Energy

Energy efficiency is the most abundant, reliable, clean, and least expensive energy resource we have. Its supply is not only ubiquitous, but also usually cheaper than fuels and new power generation—making it our most secure resource. But while it cannot be embargoed, manipulated by cartels, nor disrupted by distant (or not-so-distant) unrest, unlocking its massive $1 trillion in savings potential[1] poses a different challenge.

That's why the Alliance to Save Energy and leaders[2] from the power sector, financial community, manufacturing, transportation, environmental groups, and government want the focus not on energy-savings, but on the productivity gains derived from energy efficiency. It's called energy productivity, and it means obtaining more economic production (GDP) out of every kilowatt hour (kWh) of energy consumed.

Today, businesses and manufacturers across the country are quickly realizing this economic potential and are taking the lead to not only boost U.S. economic competitiveness but also create an energy-secure future.

The Energy Waste

Sixty one percent of the energy[3] the U.S. economy consumes is still wasted as heat, noise, and leaks. That's a lot of capital and resources being squandered every day, and it puts the private sector at risk to price spikes, disruptions, and shortages. (And this risk extends beyond the private sector: Just a $1 increase in a barrel of oil costs the U.S. Navy more than $30 million.)

Thankfully, industries across the economy are implementing advanced programs, investing in new technologies, and streamlining processes to fight against energy waste. They are finding out that it not only helps their energy security, but it also pays off in increased profits and quick return rates. The following are some admirable examples of private sector leadership:

- Since 1990, the Dow Chemical Co. has reduced production energy intensity per kg of product by 40%, saving a cumulative $24 billion and 5.2 quadrillion Btu (more than the annual energy use of the Netherlands). Dow is now in the process of adopting the new ISO 50001 standard and is a participant in the Department of Energy Superior Energy Performance certification program.
- Encouraging its 75,000 employees to suggest, plan, and implement energy-saving measures, 3M improved its energy productivity 22% since 2005, saving $100 million.
- The machining department of Delta Faucet Company's plant in Tennessee reduced its natural gas consumption by more than 95% and saves $2,000 each month on chemicals by altering its cleaning processes.
- By establishing an optimal benchmark and ongoing evaluation, United Technologies reduced the energy intensity of its operations by 45% from 2003 to 2007 and greenhouse gas emissions by 62% from 2006 to 2010, while sales rose 13%.

As you can see, manufacturers and businesses are discovering that energy productivity is synonymous with economic prosperity. However, the private sector can't deploy energy productivity to its fullest potential alone—government action is needed to fully unleash energy productivity.

[1] The New York Times. http://green.blogs.nytimes.com/2009/07/29/mckinsey-report-cites-12-trillion-in-potential-savings-from-energy-efficiency/?_php=true&_type=blogs&_r=0

[2] Alliance to Save Energy. http://www.ase.org/policy/energy2030/why

[3] Opower. http://blog.opower.com/2013/08/the-tradition-continues-the-united-states-wastes-more-energy-than-it-uses/

Doubling Energy Productivity

The Alliance Commission on National Energy Efficiency Policy[4] was created in 2012 to identify solutions for increasing energy productivity and aid in jump-starting the economy. The result of their effort is Energy 2030, a set of bipartisan energy policy recommendations that urges policymakers at all levels of government—local, state, and federal—to take action in three key areas:

- Invest in energy productivity in all sectors of the economy;
- Modernize U.S. infrastructure, buildings, transportation, and equipment; and
- Educate consumers, business leaders, and policymakers to encourage smarter energy use.

Taken together, this set of bold yet actionable recommendations would put America on the path to not only increase its energy productivity, but to completely double it by 2030. Embraced by President Barack Obama in his State of the Union Speech[5] and Climate Action Plan[6], the Energy 2030[7] goal of doubling U.S. energy productivity by 2030 would save Americans $327 billion annually while reducing energy imports by more than $100 billion and creating 1.3 million new jobs.

Moving Forward

In order to achieve Energy 2030's staggering potential, the private and public sector need to work together to advance energy productivity. Cities and states can't address aging infrastructure if buildings and businesses won't benchmark their energy use, and manufacturers won't invest if they are unable to receive reliable data on performance of efficiency loan projects.

The Alliance is working at all levels of government, as well as with the private sector, to successfully implement the Energy 2030 recommendations and put America on the path to a stronger, more secure energy future. Join us in our quest to double U.S. energy productivity: **www.energy2030.org**.

[4] Alliance to Save Energy. http://www.ase.org/policy/energy2030

[5] You Tube. http://www.youtube.com/watch?v=gjOPWWwmsYk&feature=c4-overview-vl&list=PLrqHMVTsnaZJf50jT_zOyLx4WTLWDNV0h

[6] The White House. http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

[7] Alliance to Save Energy http://www.ase.org/policy/energy2030/impact

Setting the Context: Global Water Challenges and the Role of the Private Sector

Steve Maxwell, Managing Director, TechKNOWLEDGEy Strategic Group

Despite consistently growing public awareness and recognition, water continues to be under-appreciated and under-valued. And while the global water marketplace is characterized by improving public and technological understanding of key water issues, the risks and challenges that we face as a planet will continue to grow if we cannot learn how to think and act differently with regard to water. By the middle of this century, the Earth will be home to an additional 2 billion people—bringing our total population to around 9 billion. Finite food, energy, and water resources will come under increasing pressure from this expanding, aging, and more affluent population—leading inevitably toward the "stress nexus" that many experts are now forecasting. Water is the critical link.

The value of water will rise dramatically once we start to actually run out of it—but before then the issue seems destined to remain obscure. We hear a lot about "disruptive" technologies as a way of shaking up the status quo, or moving an industry or a society in a new and different direction—but what we really need today is more disruptive behavior. We need fundamental change in the way we manage, utilize, and view our finite water resources—and private industry has a critical role to play in understanding and addressing this challenge. As one observer put it, "there are really only two possible solutions to our long-term water problem—find another planet to occupy, or change human behavior." It's not clear which alternative will be the easier to accomplish.

As is now well known, vast expenditures need to be made to sustain our water and wastewater infrastructure. The United States Environmental Protection Agency (EPA) has estimated necessary wastewater infrastructure investments over the next 20 years at $298 billion, vis-à-vis a similar estimate for the drinking water infrastructure of $335 billion. Where will these dollars come from? The city of Syracuse, New York, for example, recently indicated that their wastewater fees would have to triple just to pay for projects that are already approved. And also in the forefront of the water discussion today in the United States is the need for these same water and wastewater utilities to radically change and reorient themselves—to quit acting like privileged but sleepy natural monopolies and begin to act and market themselves more in the manner of private enterprises—and to help hammer home the real value of abundant and safe water.

In any discussion of current water challenges, one must address the complex and increasingly controversial interconnectedness of food, energy, and water. The interrelated nature and "nexus" of these key resource issues continues to become clearer at the same time as the various underlying causes and effects seem to become murkier and more complex. Changes in consumption, different utilization patterns, or efficiency gains in one of these three critical areas simply cannot be considered independent of considerations and impacts in the other two areas. In other words, it is not always very productive—or at least is of limited use—to try to analyze specific water challenges of a given issue without simultaneously assessing the food or energy implications.

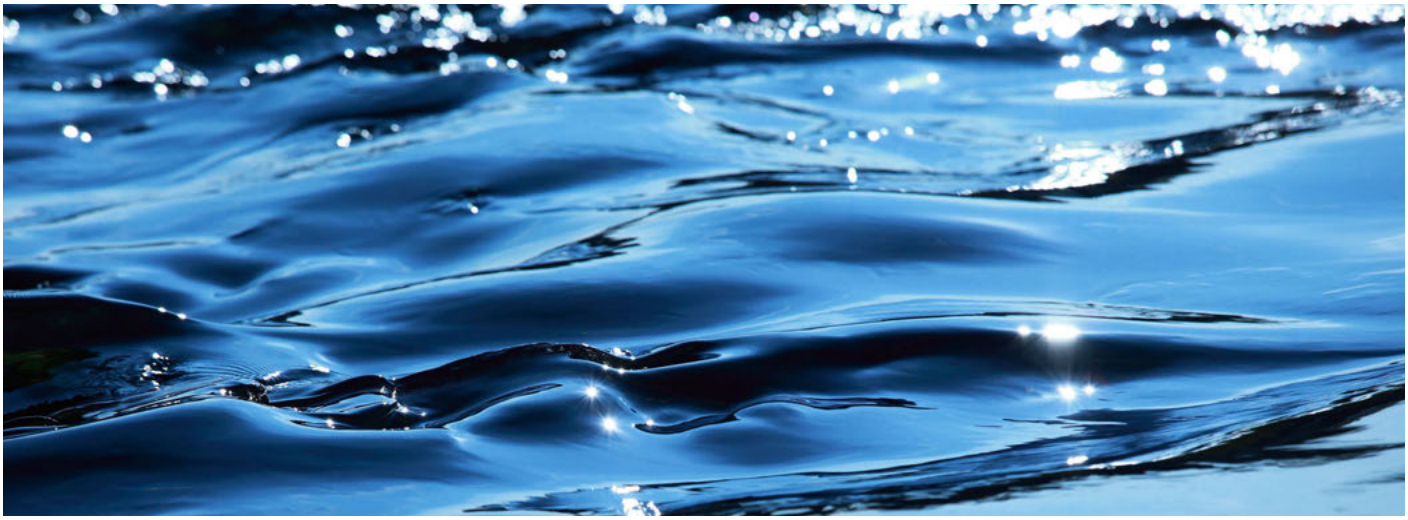
The specific inextricability of water and energy continues to compound. One of the most visible and controversial topics in the water industry over the past couple of years has been the rapid emergence of the deep shale gas industry, the hydro-fracturing or "fracking" technology that allows recovery of the gas, and the vast water requirements that will come with it. Recently discovered and increasingly economical shale gas deposits in the United States could go a long way toward achieving our ephemeral energy independence—but only at the cost of huge water consumption.

There is clearly an important role for private companies and sources of private capital to play in the global water resource challenge. Although the role of private industry has been a contentious issue over the past two decades, it is clear that we are only going to solve our water challenges if and when massive amounts of capital flow into the industry. Because the federal government is essentially standing on the sidelines in this regard, much of that capital will eventually—one way or the other—have to flow from private sources. Whether that be in the form of operating contracts with private companies, variations on the emerging "public-private partnership" model, or true outright privatization remains to be seen, but it seems inevitable that private industry must play a greater role and begin to take a more active and leadership role in addressing these challenges.

There are fundamental and compelling economic drivers that support a growing role for private companies and private capital in the water industry. Few municipalities enjoy overflowing coffers, and few public officials who wish to be re-elected want to impose large user fee or tax increases on their watch. Many public works managers continuously find themselves between a rock and a hard place—technical requirements, regulatory complexities, and overall utility costs continue to increase, but the general public remains very resistant to increasing taxes and user fees. Sometimes, the best solution to this dilemma may be to turn to private companies and/or private capital to finance, build, and operate the water or wastewater system under long-term contract.

Access to clean drinking water obviously has to be viewed as an inalienable human right. And poorer people should not and cannot be denied the right to water simply because they may be unable to afford to pay for it. Subsidies or other types of government involvement in markets may be necessary to protect those at the bottom end of the income scale. However, we also have to be practical and remember that clean drinking water costs hundreds of billions a year worldwide to store, treat, and distribute—and that we as a society somehow have to pay those bills. Despite what some observers may claim, clean water certainly is not—and can never be—free.

In the final analysis—virtually all issues and challenges in this industry can ultimately be reduced to a better public understanding of the issues, recognition of the value of water, and the importance of properly pricing water to better reflect that value and the true cost of producing it. There is obviously no substance more critical to life than water, but today water is still too cheap for most people to spend much time worrying about it. We often hear about how there is no silver bullet in the water industry—usually in reference to technology—but the real silver bullet in the water marketplace will be more rational full-cost-based pricing, resulting in new solutions to consume, preserve, and reuse water resources in a more sustainable long-term manner.



Innovative Wastewater Treatment System Conserves Water and Saves Money

John R. Smith, Director of Sustaining Technologies, Products & Operations, Alcoa

Water is a fundamental natural resource. For Alcoa, with our refining, ingot-casting, and aluminum product processes requiring significant water resources, we recognize the world's water management challenge is everyone's responsibility. It requires additional capital, new tools and mindsets, more cooperation among the various stakeholders, and innovative technologies to better anticipate and effectively respond to the most pressing environmental situations we face.

In early 2012, Alcoa set new internal goals for freshwater-use intensity—we aim to achieve a 25% improvement in freshwater-use intensity by 2020 and 30% by 2030, over 2005 levels.

Key to achieving our water goals as well as assisting customers globally is Alcoa's Natural Engineered Wastewater Treatment technology that mimics natural wetlands to sustainably treat wastewaters.

The system, developed at the Alcoa Technology Center outside of Pittsburgh, imitates the natural process of wetlands to clean and disinfect process water. The system uses 40% less energy and has 60% lower operating costs than traditional systems, functions without the use of conventional water treatment chemicals, and does not emit odors associated with conventional tank systems. Treated water is of high quality and can be reused in manufacturing processes or for irrigation.

A wetland-based system was first developed and installed at the Alcoa Technical Center, the world's largest light metals research facility, treating on average about 40,000 gallons of wastewater daily, with flows during storm events reaching 150,000 gallons daily. Since June 2009, this system has treated 100% of the facility's sanitary wastewater and maintained 100% compliance with all national pollutant discharge permit limits.

Alcoa has been engaged in engineered wetlands technology development and deployment at various Alcoa locations for the past 10 years, with the most recent and largest being a system implemented in the Kingdom of Saudi Arabia at the Alcoa-Ma'aden joint venture project site. There, the technology will reduce the facility's water demand by 2 million gallons a day, saving $7 million a year in water purchase costs for the integrated aluminum complex.

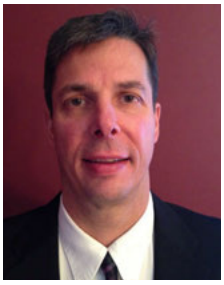
In addition, the design at the Alcoa-Ma'aden project site was constructed six months faster compared to a conventional tank-based system, which eliminated approximately 1,000 metric tons of steel required for tanks and piping. Our joint-venture project site is the first of its kind.

Alcoa is also taking steps to make this technology available to customers anywhere in the world. In fact, earlier this year, Alcoa entered into an agreement with Germany-based engineering and construction company Bauer Resources GmbH, to commercialize the Alcoa technology.

Our innovative wastewater treatment system illustrates our core commitment to operating sustainably in the ecosystems and communities where we do business. We are pleased with our accomplishments, and look forward to achieving even more to support a healthier and more sustainable future for society and the planet.

Onsite Water Treatment Enhances Reuse and Conservation

John Wanalista, Director of Projects, CH2M HILL



The Empire Generating Power Plant, located in Rensselaer, New York, is an environmentally friendly power plant that uses reclaimed water for cooling, processing, and natural gas to fire the combined-cycle turbines to a 535 megawatt base load or 635 megawatts at peaking power—representing the largest beneficial use of municipal treatment plant effluent in New York state.

The facility reduces its need for freshwater by up to 4,800 gallons per minute (summer peak rate) utilizing a combination of filtration, membrane, and ion exchange technologies to supply makeup water to cooling towers, evaporative coolers, and steam generators. The quality of the demineralized water produced is 17+ meg-ohms of resistivity, substantially better than the 10 meg-ohm requirement for steam generator makeup.

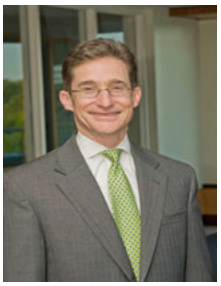
An essential and unique component of the Empire Generating Power Plant, engineered, procured, and constructed by CH2M HILL, was the design, specification, procurement, installation, and startup of the water system, which included a low-noise and plume-abated cooling tower, a 32-inch diameter gray water HDPE pipeline under the Hudson River to convey municipal effluent from the city of Albany's wastewater plant to the new power plant, as well as a submerged effluent outflow structure for the plant wastewater discharge.

With no applicable state regulations governing the use of secondary effluent for cooling towers, the project adopted California's Title 22 tertiary disinfected water quality requirements as an acceptably safe, state-of-the-art practice to control potential pathogen vectors from cooling tower drift. This resulted in gray water being treated on site using a combination of various water technologies, for example, chloramination, coagulation, continuous-cleaning sand filtration, hypochlorination, and chlorine contact.

In addition to supplying cooling tower water, the municipal secondary effluent is used as the makeup source for service water and demineralized water supplies. The service water is used for evaporative cooler supplies, demineralized water treatment, and other miscellaneous process uses. Service water is produced by intercepting the upflow sand-filtered effluent and processing it through ultra-filtration, followed by monochloramine addition, which minimizes the formation of trihalomethane compounds (and therefore total organic carbon [TOC] compounds that cannot be removed by the demineralized water treatment process).

Continuing the process, the ultra-filtered water is then forwarded to the reverse osmosis and mixed bed exchange units to produce demineralized water for a heat recovery steam generator. The TOC measured in the demineralized water is 27 to 48 parts per billion (ppb), less than half of the 100 ppb design limit. All water quality design parameters were confirmed in a full-scale validation performance test, and the actual quality of demineralized water produced is 17+ meg-ohms which is substantially higher than the 10 meg-ohm requirement.

Beginning operations in September 2010, the Empire Generating Power Plant is one of the nation's cleanest and most efficient combined-cycle plants in the country.



Blue Technology's Golden Age?

Ben Grumbles, President, U.S. Water Alliance

Water may be one of the most pressing global and local challenges of our time, but great opportunities are taking root in U.S. communities to grow innovative solutions with colleges and corporations. Whether you call them water clusters or innovation stations, these town-gown-business techno centers are gaining steam in strategic locations and that's good news for water and jobs.

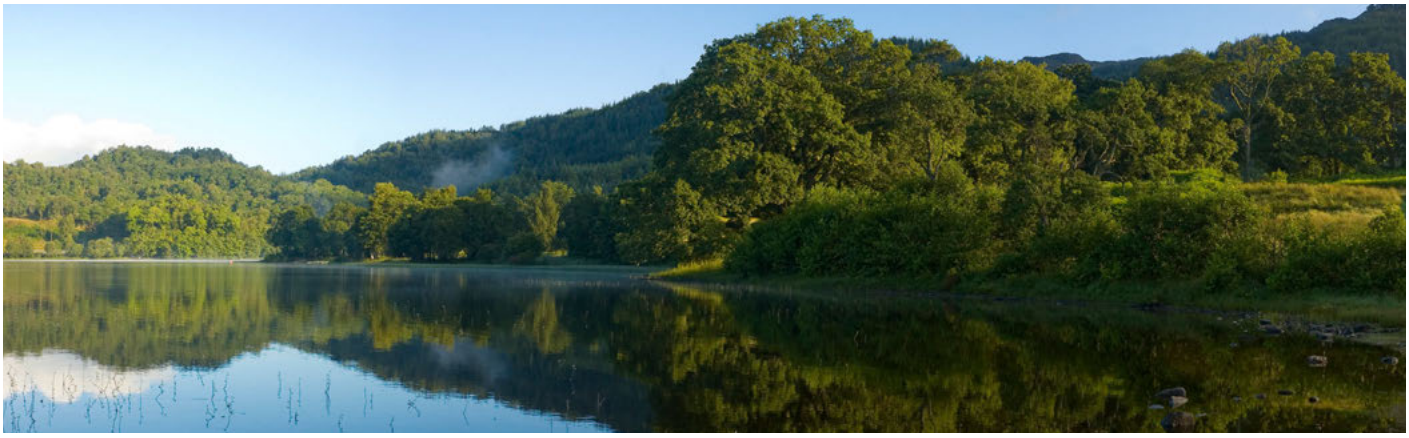
In January 2011, the Environmental Protection Agency (EPA) and the Small Business Administration (SBA) announced the formation of a "Water Technology Innovation Cluster" in the Cincinnati, Dayton, northern Kentucky, and southeast Indiana region, now known as "Confluence." The tri-state organization works with private and public entities, including the Ohio River Valley Water Sanitation Commission (ORSANCO), SBA, and regional economic development organizations to promote the regional effort by bringing water research stakeholders together to foster collaboration (**http://www.watercluster.org**)

Also in 2011, EPA announced the commitment of $5 million to fund innovative water technology research. In 2012, the agency began funding 18 research projects, including green infrastructure, water monitoring, more efficient wastewater treatment, combined sewer overflow reduction, and development of tools to track harmful microbes or contamination events in water systems. Other funded projects include the hosting of workshops on the need for citizen-based water monitoring programs, and collaboration on rainwater and stormwater reuse. EPA's Office of Water also released, in April 2013, a "Blueprint for Integrating Innovative Technology into the National Water Program." The evolving plan identifies 10 priority topic areas/challenges and describes various tactics and strategies, such as supporting the Office of Research and Development's technology clusters. One of my favorite aspects of the EPA blueprint is the agency's stated willingness to look for "regulatory space to foster technology innovation." Finding the right regulatory mix of flexibility and accountability is the golden key for opening doors to innovation.

Milwaukee has been an early leader in clustering. Local leaders formed a Milwaukee Water Council to seize on a vision to become a "world water hub." Their efforts won enough national praise to receive the 2010 U.S. Water Prize; given by the organization I work for, the U.S. Water Alliance. Now known simply as the Water Council, the Milwaukee-area cluster is becoming a regional and global powerhouse for water technology. They are focusing on cutting-edge issues such as the energy-water nexus, or as I like to call it, "the energy-water perplexus," given the many tradeoffs and linkages between the two resources and their respective webs of infrastructure support systems. And, as Dean Amhaus, President/CEO of The Water Council, points out in his blog, "Water Is a City's Economic Link to Sustainability," on the Growing Blue website (**www.growingblue.com**), they aren't simply Internet-based or virtual without tangible storefront windows. They have buildings and facilities that are part of an actual campus, including a seven-story International Water Technology Center and an 18-acre water technology park. The objective is to build a global showcase for water and energy management.

Other efforts across the country are tapping into the talents and assets of area leaders and organizations. EPA and the U.S. Water Alliance have identified the following established or emerging clusters:

- The BlueTechValley (Central and San Joaquin Valleys, California) **–http://bluetechvalley.org/**
- Las Vegas Cluster Effort (Nevada) **–http://watercitizennews.com/clusters**



- Arizona Cluster (Tucson, Arizona) **–http://wsp.arizona.edu/node/309**
- Colorado Water Innovation Cluster (Fort Collins, Colorado) **–http://www.co-waterinnovation.com**
- Michigan Water Technology Initiative
- Confluence WTIC (SW Ohio/N Kentucky/SE Indiana) **–http://watercluster.org/wordpress/**
- NorTech Water (NE Ohio) **-www.nortech.org/water**
- Water Economy Network (Pittsburgh, Pennsylvania) **–http://watereconomynetwork.org/**
- Massachusetts Water Innovation Initiative **–http://www.masscec.com**
- Tacoma, Pierce County (Washington) **–http://www.waterworkshere.org**

These clusters reflect their own region's environmental, economic, and social needs. For example, the University of Arizona (UA) is collaborating with Pima County on a future water campus, an integral part of the county's investment in the largest project it has ever undertaken: the Regional Optimization Master Plan. The effort focuses on reclamation and reuse, in an extremely arid region, so that the Pima County Regional Wastewater Reclamation Department can meet regulatory requirements while protecting the county's environment and future water supplies. The partnership between UA and Pima County will help bring together water and energy experts, the public, government, and private corporations to work on technology development and education in water and energy sustainability.

Contrast that with the focus of a cluster in a water-rich region. In South Puget Sound, many of the challenges involve stormwater and water quality mandates under the Clean Water Act. The cluster includes a strong partnership among the Port of Tacoma, the Economic Development Board for Tacoma-Pierce County, the University of Washington at Tacoma, and other business and community leaders. Their vision is to become a clean water technology center for the region and the nation. They have 340 companies in the area, 12 higher education centers, an international port and airport, and an interstate highway connecting to Canada and Mexico.

What are the essential ingredients for creating and sustaining clusters, whether the centers are in U.S. cities or international cities such as Singapore and Toronto? In my cookbook, you can boil it down to capital and collaboration.

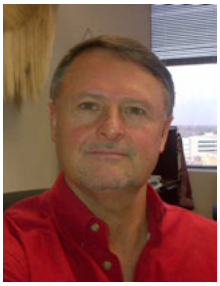
Capital is more than just money, though. It comes in at least four varieties: (1) financial capital, (2) natural capital, (3) intellectual capital, and (4) political capital.

Collaboration is about more than simply communicating and cooperating among sectors. It includes coordination and integration of effort. Verifying and certifying new technologies is a perfect example of a need in the world of clusters so that promising new technologies don't have to go through endless and inconsistent approval procedures but can benefit from some appropriate level of reciprocity among agencies and jurisdictions. In 2014, look for the U.S. State Department and the U.S. Water Partnership, (**www.uswaterpartnership.org**), to focus attention on technology commercialization to create more water-based opportunities abroad for U.S.-based businesses.

Mark Twain got it right: "You can't trust your judgment if your imagination is out of focus."

Water Reuse in Hydraulic Fracturing

David Luna, Operations Engineer, SE New Mexico, XTO Energy, an affiliate of ExxonMobil Corporation



ExxonMobil partnered with a major service company to test the feasibility of recycling produced water rather than using freshwater during hydraulic fracturing of certain types of wells. (Produced water is that which comes to the surface along with the oil and gas.)

An eight-well pilot project in the arid Delaware basin of New Mexico showed that the produced water there could be recycled into a workable hydraulic fracturing fluid, conserving more than 1 million gallons of freshwater per well (equivalent to about 200 truck hauls).

Produced water in the Delaware basin may contain salts and mineral solids in concentrations about eight times higher than seawater, even after initial treatment to remove the heavier contaminants. Water like this is generally considered to be waste and transported off site or injected into deep disposal wells. Recycling the produced water into a substitute for the freshwater component of a hydraulic fracturing fluid could be an economic and environmentally beneficial option—if the recycled produced water is available at the right times and in the right quantities near the drilling rig, and if the high concentration of salts and dissolved solids does not impair the fluid, the formation, or the equipment.

ExxonMobil affiliate XTO Energy teamed up with a major oil field services company in 2012 to test this feasibility, first in a laboratory, and later in the real-world production setting of eight XTO wells near Carlsbad, New Mexico. The tests confirmed that the fluid used in these wells could successfully fracture the rock and carry sand into the fractures to hold them open, even when based on 100% produced water following minimal treatment. Although this may not be applicable in other basins (since feasibility depends on a combination of factors such as geology, proximity, logistics, and water chemistry), the eight-well program in the Delaware basin was able to recycle its produced water and conserve more than 8 million gallons of freshwater, in addition to saving money and reducing waste.

The companies shared their results on the first seven wells in "Development and Use of High-TDS Recycled Produced Water for Crosslinked-Gel-Based Hydraulic Fracturing,"[1]

[1] 2013 Society of Petroleum Engineers Hydraulic Fracturing Technology Conference, DOI 10.2118/163824-MS, http://www.spe.org/events/hftc/2013/

Veolia True Cost of Water Methodology and Tool

Edwin Pinero, Chief Sustainability Officer, Veolia North America

Existing water footprint indicators provide insight into the vulnerability and resilience of a specific activity in regard to water challenges. Now, decision makers are looking at an even more pragmatic and straightforward metric: dollars.

Veolia's True Cost of Water tool focuses on the financial implications of water-related risks. It helps the user anticipate, prioritize, and more effectively mitigate water-related risks that can negatively affect the bottom line by creating a risk-reward tradeoff analysis. This tool allows the user to correct the "price" they pay for water, if any, to more accurately reflect the true cost of a gallon of water. This corrected cost includes the embedded cost of necessary infrastructure, as well as costs associated with water availability.

Now being pilot tested by a variety of companies in food and beverage, mining, and oil and gas sectors, the true cost of water tool provides inputs for a variety of possible risk scenarios such as reduced allocation, loss of license to operate, or other types of disruptions. The tool is intended to help an organization better understand the actual and risk-based true cost of water so that more informed and accurate business case decisions can be made. Knowing this true cost of water will allow an organization to rationalize more sustainable and innovative water solutions.

Because business decisions, risk matrices, and return on investment thresholds tend to be proprietary, tool results are not publicly available. Also, the tool's results are very organization-, site-, and situation-specific. There is no anticipated single regional or widespread value expected. However, an increase in more innovative water management solutions is expected as a result of tool use.

The tool was developed because Veolia believes that unless a financial business case can be made for investment, the relatively low price of water often precludes justifying investments in innovative technologies or sustainable approaches. Interest in this approach by financial communities, such as banks, insurance, companies, and investors, further verifies the need for such an analysis.

Collaborating to Conserve Water Resources: Cases from the Natural Capital Business Hub

Amy O'Meara, Director, Corporate Eco Forum

Earth's stock of living, breathing infrastructure—its natural capital—is responsible for supplying raw materials, regulating flooding, filtering pollution, and providing numerous other benefits for business. Each year, our planet's complex land and water systems produce an estimated $72 trillion in free goods and services that are essential to a well-functioning global economy, yet this capital stock is being depleted at an alarming rate.

Recognizing the value of nature, leading companies are beginning to evaluate their dependence and impacts on ecosystems and incorporate that analysis into decision making and operations. But what is needed is transformational change, and collaboration is going to be the key to reaching scale. Taken alone, one company's effort to quantify their ecosystem dependencies or another's investment in the restoration of a particular forest or watershed may seem to make a small dent in the massive challenges before us; but collectively, they can have a significant impact—fortifying key natural infrastructure, and ushering in a sea change in how industry views its relationship to the natural world. Through collaboration and collective action, companies can help establish markets, bring initiatives to scale, and raise the bar across industries.

To help accelerate effective business responses to these challenges, the Corporate Eco Forum and The Nature Conservancy, together with the Natural Capital Coalition and Tata Consultancy Services, have developed the Natural Capital Business Hub (**www.naturalcapitalhub.org**). The Hub is a collaborative, open, and dynamic online platform to help diverse companies at varying stages of maturity on natural capital issues evaluate and make the business case for action and benchmark against evolving best practices. It includes a searchable database featuring curated case studies, collaborated opportunities from more than 40 leading companies, and offers resources to help companies choose

Photo: Watershed protected by the Latin American Water Funds Partnership.
Credit: Shirley Sãenz/The Nature Conservancy.

appropriate action targets, frameworks, and tools and to identify high-impact partners and projects for collaboration and collective action. The Hub will enable greater "followership" throughout the business community, aggregate impacts of projects that are under way, and help light a way forward for scalable restoration and protection of natural systems that are vital to sustainable business and economic success.

Many of the initiatives featured on the Hub focus on water, an area of increasing concern for business. A recent CDP study found that 70% of responding Global 500 companies identified water as a substantive business risk, with 64% expecting that risk to impact their businesses within the next five years. Following are three examples from the Hub that showcase how leading companies are managing water to cut costs, generate revenues, reduce risks, and improve their brands.

Ecolab

Ecolab is collaborating with the Alliance for Water Stewardship to develop an International Water Stewardship Standard that aims to promote responsible, socially equitable, and environmentally and economically sustainable use of freshwater across the globe. Ecolab is supporting this effort by field testing the standard in the lower Yangtze vicinity of China's Lake Taihu, where a lodging property and a chemical plant with important business implications for Ecolab are located.

"As global populations continue to grow, managing the relationship and tradeoffs between water, food, and energy is only going to become more critical. SABMiller seeks to apply this kind of nexus thinking to our business decisions. We share the risks related to these resources with local communities and other stakeholders, so collective understanding and collective action are key."

— Andy Wales, Senior Vice President Sustainable Development, SABMiller

The Yangtze River is the most important freshwater resource in China, providing water for 400 million people and accounting for almost half of China's agricultural production (more than 40% of Gross domestic product (GDP). Lake Taihu is the third-largest freshwater lake in China, and has provided local communities with valuable fisheries for centuries. It accounts for more than 14% of China's GDP and is a primary water source for more than 33 million people living in and around Shanghai. The lake also plays an important role in flood control, shipping, tourism, and culture.

Given the importance of water in the region, Ecolab is uniquely positioned to promote sustainable use of this resource. Unsustainable use of the watershed jeopardizes the quantity and quality of available water resources. It also poses regulatory and reputational risks, as companies are often blamed when water resources are depleted. Instituting the Water Stewardship Standard is one way that Ecolab can help to ensure responsible water use in the region.

FEMSA Foundation

The FEMSA Foundation established the Latin American Water Funds Partnership in June 2011 with The Nature Conservancy, the Inter-American Development Bank, and the Global Environment Facility to protect watersheds and help ensure water supply. The initiative strengthens and develops Water Funds, an innovative model for long-term conservation, in Latin America. They operate by concentrating investments into a single fund, then using the income generated to preserve essential upstream lands and leveraging further resources, helping ensure healthy water flows to downstream users.

Currently there are 17 Funds in different stages of operation located in Brazil, Colombia, Mexico, Venezuela, and other countries in the region. The Partnership seeks to leverage $27 million to create and invest in 32 Water Funds by 2016, positively impacting as many as 3 million hectares of natural ecosystems. These Funds could potentially benefit up to 50 million people.

For the FEMSA Foundation, the Partnership provided an opportunity to protect water resources and address water supply risks for its parent company and broader community. It also improved the relationship between stakeholders, aligning the interests of companies, governments, and local communities behind the same goal. The initiative has caught the eye of other organizations such as the Rockefeller Foundation and UNESCO.

SABMiller

SABMiller decided to value the environmental externalities associated with procuring malting barley in Rajasthan, India, an area of rapidly increasing groundwater scarcity. The company used the E.Valu.A.Te tool developed by the Natural Capital Leaders Platform, which provides guidance on how to perform an evaluation of environmental externalities.

Prior to the company's arrival in Rajasthan, very little malting barley was grown, but the company did not want to import all its raw material from abroad. To build a local supply chain, SABMiller India had to set up a farm extension service—providing local small-scale farmers with in-field advice on how to grow malting barley and offering them an attractive price. The program enabled the 6,000 participating farmers to achieve a four-fold reduction in irrigation water and increase their yields by 55%.

Despite these gains, SABMiller found that the water reductions achieved by farmers were insufficient to address the unsustainable depletion of the local aquifer caused by broader agricultural activities. Barley was only part of the picture, and wider systemic changes to the entire agricultural system were needed to address the rapid fall in groundwater resources. The program benefited growers by increasing efficiency and production, and helped SABMiller ensure a more reliable source of barley in the region, while also revealing long-term supply chain risks and helping to enhance its brand.

This is just a sample of more than 40 innovative projects on the Hub that are demonstrating how natural capital stewardship can unlock enormous business benefits. To view more natural capital case studies and opportunities for collaboration, or to share your own, visit **naturalcapitalhub.org**.

Industrial Scale Collaboration to Address Water Challenges in Southeastern Louisiana

Susan Fernandes, Director, Operations,
US Business Council for Sustainable Development (US BCSD)

"Water quality and nutrients management unites industry, regulators, and the agricultural community" —this headline from a recent project blog captures the breadth of collaboration routinely under way in US BCSD's Louisiana Water Synergy project where all types of water users are engaged to find mutually beneficial watershed solutions.

Water supply, quality, and stormwater are urgent national and global problems that are increasingly identified as significant risk factors for business continuity. And while business must have reliable water supplies to manufacture products and deliver services, so must agriculture, cities, and the natural environment. And as these potentially collaborative and/or adversarial user communities reveal, water management risks cannot be completely managed within a facility's footprint.

For the past two years, the United States Business Council for Sustainable Development (US BCSD) has worked with 21 diverse companies in the lower Mississippi River watershed to address a range of water issues. Coca-Cola is working with Mosaic Fertilizer to address water quality concerns. Valero Energy and Nucor Steel Louisiana LLC have explored new options for wetlands restoration through changes in water management. Projects and policy recommendations have emerged that have been greeted with high interest by the Louisiana Department of Environmental Quality and from a concurrent public sector regional water planning effort.

This multi-sector teaming demonstrates that there is considerable regional interest in using the speed and efficiency of market-based institutions to seek out ways of converting water problems into economic opportunities, and to develop a collective capacity for conserving watershed systems as both private and public goods.

The US BCSD uses structured work processes to provide a "safe" zone among companies to build trust and the business relationships needed for information sharing that leads to inventive thinking and action. For example, we're now scoping a new participatory simulation game to serve as a shared virtual laboratory for collective action, where project participants can explore shared interests in water quality and quantity, as well as policy innovations, such as water or nutrient markets. This should open some new pathways for ramping up action.

Results—Collaborative work is under way in five working groups: wetlands, nutrient issues, groundwater sustainability, water system sharing, and alternative levee materials.

Wetlands—Identified the potential environmental and business benefits of industrial water diversions to conserve wetlands at three project facilities. Permitting guidance was obtained from the Louisiana Department of Environmental

"When I was initially approached about the Water Synergy Project, I saw it as an opportunity for my members and others to discuss water issues and needs outside the typical day-to-day regulatory constraints. For Louisiana, this includes groundwater protection, wetlands restoration, hurricane protection, Mississippi River nutrient loading, historic industry growth potential, etc. I saw the Project providing a forum to explore these related, yet regulatory separated, issues to identify and explore innovative common sense solutions. It is allowing us to have conversations we otherwise would not have gotten together to discuss."

—Richard Metcalf, Director of Environmental Affairs,
Louisiana Mid-Continent Oil and Gas Assn.

Quality (LDEQ) based on these examples. This information provided a starting point for more facilities in the region to make a business case for these types of diversions.

Nutrient Issues—Facilitating outreach for project participants to a multi-agency team developing the Louisiana Statewide Nutrient Management Strategy to encourage voluntary actions rather than more stringent regulations for nutrient discharges. This has led to collaborative discussions with the agricultural sector to find new solutions for non-point source nutrient discharges.

Groundwater Sustainability—Established communications link between industry and the agencies addressing public concerns about saltwater intrusion in the primary drinking water aquifer—recently capped for industrial use. It also provided a forum for sharing best practices for water efficiency and alternative water supplies to reduce industrial groundwater demands.

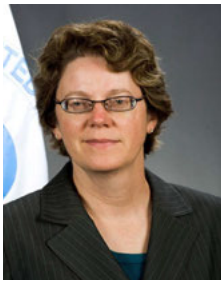
Water System Sharing—Enabling sharing of technical expertise and discussion around alternative water management methods like riverbed filtration systems to replace individual intake structures, shared wastewater treatment systems, and water reuse between facilities to reduce freshwater demands.

Alternative Levee Materials—Facilitating collaboration between alumina and gypsum phosphate fertilizer producers and stakeholders to encourage use of waste byproducts for levee construction that will allow the region to take advantage of substantial cost savings compared with traditional construction materials.

The project is progressing well and is receiving increased recognition as an effective and scalable business solution for watershed stewardship. Yale University will feature the project in a 2014 online MBA class that will highlight how participation is supporting Coca-Cola's corporate commitment to sustainable water use for their operations. Because of this success, US BCSD is identifying other watersheds where this type of project can be replicated.

Technology Innovation and Water: An Ocean of Possibility

Nancy Stoner, Acting Assistant Administrator for Water,
United States Environmental Protection Agency (EPA)



We are in the midst of a historic paradigm shift in how water is viewed, and excitement in the water industry is palpable. We are moving away from a 20th century view of water as a conduit for waste and a resource that has an endless supply. Instead, we are quickly moving to an enlightened, more holistic 21st century view, acknowledging that water is a valuable resource with a finite supply and that we can't afford to waste it. Water is recognized now as a major economic driver and source of businesses and jobs essential to urban revitalization and a centerpiece for innovative technology, sustainability, and renewable energy efforts.

EPA Office of Water's priorities are aligned with this paradigm shift. We are focused on accelerating the progress to a new water future through embracing technology innovation—not only as a means of deployment and development of new technologies, but also as an array of approaches including new applications of existing technology; production changes; and organizational, management, and cultural changes that can improve the condition and sustainability of our nation's water resources.

Innovative technology can be an economic driver, help businesses thrive, create jobs, and be a source of U.S. exports. We can help solve the problems of the world by developing, manufacturing, and marketing innovative technologies here at home. In fact, the United States is a global leader when it comes to environmental technology innovation. Consider these figures:

- According to the Department of Commerce, in 2011 the U.S. environmental industry generated about $319 billion in revenues.
- In 2011, the environmental industry employed nearly 1.7 million Americans and included approximately 117,000 companies.
- Water equipment and chemicals is the largest component of the environmental technology sector—about 37% of exports.
- In 2009, we saw almost $10 billion in these exports and a $3.9 billion surplus in trade.

Last spring, I released a Blueprint for Integrating Technology Innovation to the National Water Program. The blueprint highlights the Office of Water's plans to advance and promote technology innovation across various water programs and identifies key opportunities for innovative technology to help solve water resource challenges. As indicated in the blueprint, the document will continue to evolve with greater collaboration across EPA and with the full spectrum of external partners.

During the past several months, I have visited several projects related to the opportunities identified in the blueprint.

Energy Reduction and Recovery—In May, I visited the East Bay Municipal Utility District in Oakland, California, which has implemented a series of turbine engines to run a renewable energy system at its wastewater treatment plant. The district produces more than 100% of its energy through renewable technologies, including biogas production of more than 55,000 megawatts per year.

Water Reuse—Because of drought and increasing water demands, wastewater is being viewed through a new paradigm as "water that is wasted." There are significant needs for technologies and approaches that foster substantially greater water reuse, which in turn can reduce pollution and conserve energy. In July, I visited Austin, Texas, and saw several facilities involved with Austin Water's Reclaimed Water Program, including BAE Systems. It has built a comprehensive water reuse system that today uses 1.52 billion gallons per year of reclaimed water—equivalent to the amount of water used by 5,300 homes in a year. Future plans call for more than tripling that amount to 8.5 billion gallons annually.

Improved and Less Expensive Monitoring—Last year, I visited Clemson University in South Carolina to see their Intelligent River Project. Clemson is developing methods of harnessing information technology to improve decision making for river systems. Clemson is focused on collecting data from all kinds of water monitoring equipment and developing programs that will accept, array, and analyze all of that data to assist in river management decisions. It can be used not only to provide continual feedback on water pollution, flow levels, aquatic life issues, temperature, and much more, but also to predict how those water quality and quantity conditions will change based on the decisions made by government, utilities, industry, and watershed groups.

It is apparent that technology innovation presents opportunities to achieve greater progress toward clean and safe water substantially faster with significantly less cost and energy consumption. The federal government, in partnership with the private sector, can pursue sustainability and innovation together. We need private sector investments in water technologies and approaches to help foster and deploy innovative technologies and tools, and increase data gathering. The future of water lies in all of our hands and EPA is excited to continue this journey alongside its many partners and stakeholders in the water industry.

To read the blueprint, visit **http://water.epa.gov/blueprint.cfm**.

Water: A New Kind of Savings at Wells Fargo Stores

Curt Radkin, Corporate Properties Sustainability Strategist, Wells Fargo

With more than 264,000 team members in more than 35 countries, at Wells Fargo, we're working hard to conserve resources and lessen our impact on the environment. Efficient use of water is important to the communities we serve, and we're working toward a company-wide goal of reducing our water use by 45% by the year 2020. While we're taking a number of different approaches to cutting water use across our enterprise, we've found that one area of our operation offers particularly significant water savings: the landscaping at our stores.

The old timer-based systems that irrigate the landscaping at stores all over the country simply water by clock, often resulting in over-watering. In order to save water, we've installed "smart" irrigation systems at more than 600 stores across the United States. These systems—which use a controller with a wireless transmitter and a coffee-cup-size weather station—monitor rainfall and a host of other details, including soil and plant types. The data allow the systems to deliver water to our landscaping only if and when it's needed, and only in the amount needed.

A pilot program of these smart irrigation systems that we launched last fall at 40 stores in California, Florida, and Texas returned astonishing results. Together, those stores saved more than 30 million gallons of water—and nearly $250,000 in utility costs—in just one year. Because of the pilot's success, we expanded the program to an additional 600 stores nationwide, selecting locations whose past water bills indicated the biggest potential for savings. At all these locations, we now expect to save more than 300 million gallons of water every year—a reduction of more than 50% that saves more than $1.4 million in utility costs—all because of smart irrigation.

At Wells Fargo, we're committed to the communities we serve. We believe that, when those communities do well, we do well. We aim to be a leader in environmental sustainability, and we're committed to finding new ways to minimize our energy and water consumption and to helping others do the same.

The smart irrigation program is an excellent example of Wells Fargo's commitment to environmental sustainability. Because of the program's success at our retail stores, we have launched a second pilot at 12 of our large corporate campuses. Through eight months of this pilot, we have saved more than 20 million gallons of water. Eventually, we plan to install smart irrigation controls at our 3,000 retail banking stores that have irrigation systems and all of our corporate campuses, and we believe we could save more than a billion gallons of water each year. This program has proven that it can save water and cut utility costs significantly, and that it can be replicated and scaled up. Wells Fargo is proud of the success of our smart irrigation program, and we hope that other organizations looking for cost-effective ways to reduce their environmental impact will consider installing these systems on their properties.

The Big Gulp—Energy Impacts on Water Resources

Mike Hightower, Distinguished Member of the Technical Staff,
Sandia National Laboratories

Water is an integral part of energy development, production, and generation. Water is used directly in hydroelectric power generation and is used extensively for thermoelectric power plant cooling and air emissions control. Water is also used extensively in energy-resource extraction, refining, and processing, as well as for energy resource transportation. The World Economic Forum (WEF) published a report in early 2009 highlighting that water use by the energy sector in developed countries averages about 40% of total water use.[1] Therefore, as global energy consumption continues to increase, as much as 50% by 2030, this growth will place the energy sector into greater competition with other major water users, and exacerbate concerns about how to balance water use for domestic supplies, food production, and energy production with public health and economic development.

Unfortunately, this large growth in energy development and the expected increasing water use are occurring at a time when freshwater availability is already being stressed in many regions of the world, including many regions of the United States (see Figure 1). This is due to changing precipitation patterns, increased ecological and environmental concerns and demands for water, and unsustainable surface water and groundwater withdrawal and use. Therefore, as nations try to balance the demands and availability of water resources to support human health and economic development in the coming decades, it is clear that:

"The water footprint, like the carbon footprint, will become an increasingly critical factor to consider in addressing reliable and sustainable energy development worldwide."

These issues of the growing interdependencies between the energy and water sectors was first highlighted in a report to Congress prepared in 2007 by Sandia and Los Alamos National Laboratories in cooperation with the National Energy Technology Laboratory and the Electric Power Research Institute (EPRI). Since then, concerns over water availability and impacts on future energy development have been recognized by energy and water managers worldwide. The World Economic Forum, the World Business Council on Sustainable Development, and the World Energy Council (WEC) have all published reports outlining the emerging energy and water concerns and the potential impacts on economic growth. WEC's September 2010 report on "Water for Energy," for example, identifies several regions of the globe where water supply availability is currently insufficient to meet proposed energy development.[2] Of increasing concern is that the emerging energy strategies of many countries, increased use of biofuels, shale oils, oil sands, coal-to-liquids, carbon capture and sequestration, and gas shales, all have water needs well above those of more traditional energy resources.

The corollary to the above discussion is that the water sector is very energy-intensive, and like the energy sector, the trend for new water and wastewater treatment technologies to meet increasing stringent water quality issues, are much more energy-intensive. The water and waste sector is typically identified as using about 3% of total U.S. electric power demand. This ranks it as one of the larger electric power use sectors in the United States. Recent research though has identified that the water system, end-to-end, is responsible for more than 12% of national energy consumption. That energy is used for conveyance, treating, distributing, heating, pressurizing, chilling, and remediating water.

[1] World Economic Forum. Energy Vision Update 2009, Thirsty Energy: Water and Energy in the 21st Century. 2009.

[2] World Energy Council. Water for Energy. 2010.

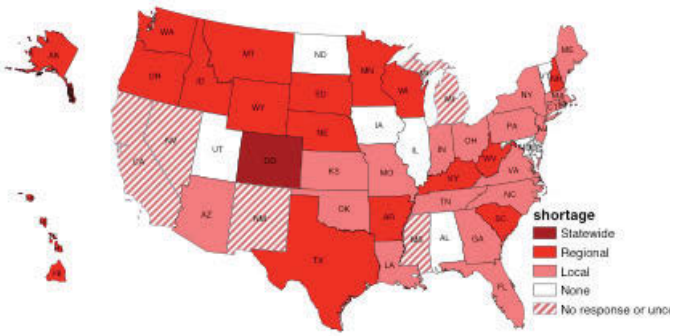
As we exploit poorer-quality water sources—seawater, saline groundwater, and industrial and domestic wastewater—to meet future water demands, the associated energy demands will grow. For example, wastewater reuse in the United States is growing at 15% a year and desalination is growing at 10% per year, and these two water supplies currently require two to five times more energy per unit of water produced than traditional water treatment technologies. On the wastewater side, many current water disinfection approaches, such as chlorination, do not use much energy but are being replaced by very high energy use ultraviolet (UV) systems to reduce the formation of harmful disinfection by-products. And the move to treat and reduce contaminant levels to the part per billion or part per trillion ranges means that sophisticated high energy demand water treatment technologies could likely be required.

To help develop a dialogue on how to address these growing concerns, many agencies have studied ways to reduce these emerging impacts. For example, Sandia conducted a study in 2007, and other groups like the National Science Foundation, General Accountability Office, National Research Council, Electric Power Research Institute, Department of Energy, and Johnson Foundation have also recently evaluated approaches and research needed to address these concerns.[3] Most ideas fall into three major categories:

Reduce water use for electric power and transportation fuels. Many approaches exist that could help reduce water consumption for electric power generation, but technologies like dry and hybrid cooling and renewable energy have cost or intermittency issues that must be improved. Since virtually all new alternative transportation fuels will increase freshwater consumption, major scale-up of these fuels must include approaches that use less water for growing, mining, processing, or refining.

Develop materials and water treatment technologies that more easily enable use of non-traditional water resources. With freshwater supplies becoming more limited, wastewater reuse and non-traditional water use, including sea water, brackish ground water, and produced water will be needed. New water treatment technologies that can meet emerging water quality requirements at much lower energy use will be important. These improvements could reduce energy use for water treatment and pumping, while accelerating the use of non-traditional water resources in the energy sector, such as for cooling or for hydraulic fracking.

Figure 1: Expected State Water Shortages by 2013 for Average Conditions



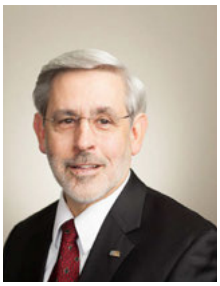
Improve water assessment and energy and water systems analysis and decision tools. Compounding the uncertainty of available water supplies is a lack of data on water consumption. Improved water use and consumption data collection and better water monitoring are needed. Improved decision support tools and system analysis approaches are also needed to help communities and regions better understand and collaborate to sustainably develop solutions that minimize freshwater demand and consumption.

From the private sector, companies and associations have already started to leverage their talent and resources to address these issues. For example, EPRI and their power utility affiliates have initiated studies of new low-water use cooling approaches and have helped develop a $16 million large-scale testing facility at a power plant in the southeastern United States to test innovative, low water use cooling technologies. In the oil and gas area, companies in both Canada and the United States have implemented approaches to use brackish water and water reuse in oil sands and hydraulic fracturing to minimize both the use of freshwater and wastewater disposal. These efforts all support the broader focus of addressing a more balanced and sustainable use of natural and financial resources to support public health and economic development.

[3] U.S. Department of Energy. Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water. 2007

American Water Leverages the Water-Energy Nexus to Gain Efficiency

Mark LeChevallier, Ph.D., Director, Innovation and Environmental Stewardship, American Water



While many Americans know the importance of saving both energy and water, few know the direct connection between the two. Water and energy are intimately interrelated—using water more efficiently conserves energy and, ultimately, decreases carbon emissions. Just as other industries have been "going green" in recent years, the water industry has likewise developed ways to use its resources more efficiently. American Water has deployed various technologies and practices to use water with greater efficiency, to prevent leaks, and, ultimately, to save energy.

Leak detection—Developed comprehensive water preservation and efficiency strategies utilizing leak detection technologies that support conservation and consumption changes significantly impacting overall supply. For example, in Connellsville, Pennsylvania, MLOG acoustic leak detectors and an advanced metering infrastructure system were deployed, resulting in non-revenue water dropping by more than half, from over 25% within six months, saving about $175,000 in annual water purchase costs in just the first year.

Pumping water—Increased use of variable speed drives on pumps by installing them on at least one pump in each station or plant to vary the pumping rate so it only pumps what is needed at a specific time, thus saving energy. American Water also launched a pump efficiency initiative that identifies inefficient pumps and either replaces or rehabilitates them to improve efficiency.

Alternative energy—In 2005, Pennsylvania American Water committed to operate its Yardley Water Treatment Plant with 100% pollution-free, wind-generated electricity. As a result, each year, the company purchases 1,603,200 kWh of green power, which is the environmental equivalent of planting more than 119,000 trees or not driving 1.5 million miles each year.

In New Jersey, American Water installed the state's largest ground-mounted solar electric system at its Canal Road Water Treatment Plant in Somerset, as part of an energy savings initiative. The system, which can produce up to 730,000 kilowatt-hours of energy a year, supplements 20% of the peak usage power needed to run the plant. Reducing energy usage by 585,000 kilowatt-hours a year prevents 1,577 pounds of nitrogen oxide, 4,875 pounds of sulfur dioxide, and 699,856 pounds of carbon dioxide from being emitted into the air. This savings in carbon dioxide pollution is equivalent to planting 94 acres of tree seedlings or preserving 2.6 acres of land from deforestation.

The company also installed solar modules on a reservoir at the Canoe Brook Water Treatment Plant in Millburn, New Jersey. This is the first solar array on the East Coast on a body of water designed to withstand a freeze/thaw environment. Annually, the solar field will produce 135,000 kilowatt hours per year, or approximately 2% of the plant's power.

As we confront the challenges posed by climate change, persistent droughts, and high energy prices across the country, nearly everyone is looking for ways to conserve resources and cut costs. The solutions above not only make environmental sense, they make economic sense as well.

Dow Enables Energy and Water Savings with Public-Private Partnership

Snehal Desai, Global Business Director,
Water & Process Solutions, The Dow Chemical Company

The city of Terneuzen is a major seaport and freshwater-scarce coastal area in the southwestern Netherlands, where competing water demands across agriculture, industry, and residences makes water management difficult.

To help manage freshwater use and reuse, Dow Terneuzen, of The Dow Chemical Company, has partnered with the Water Board Scheldestromen, the City of Terneuzen, and water company Evides—which supplies drinking water and industrial water in the southwestern Netherlands—to create a public-private approach in the early 1990s. The partnership includes recycling municipal and industrial water as well as producing demineralized water.

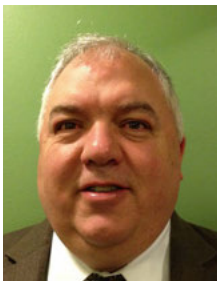
The largest chemical processing plant outside of the United States, Dow Terneuzen is the city's largest employer, and the heaviest industrial water user. Through an innovative recycling program, Dow Terneuzen accepts wastewater each day from the city, has it purified by Evides, and uses it to generate steam and feed its manufacturing plants. By 2020, Dow Terneuzen hopes to entirely eliminate its reliance on remotely sourced freshwater and exclusively use water sourced from this regional water recycling program.

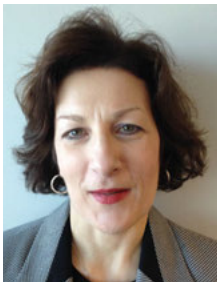
Through the wastewater recycling program, Dow reuses 30,000 cubic meters of wastewater each day from the city. In addition to lowering its reliance on scarce freshwater in the region and decreasing the need to remotely source freshwater, Dow Terneuzen has reduced its energy use by 95% when compared to the energy cost needed for conventional desalination of seawater. The energy reduction at Dow Terneuzen by reusing wastewater from the city is the equivalent of reducing carbon dioxide emissions by 60,000 tons each year.

Freshwater scarcity is an issue that neither government nor industry can solve separately. But together, with an integrated water management model such as the one in Terneuzen, water scarcity issues can be alleviated. The Terneuzen model demonstrates how public-private collaborations and partnerships will result in strong environmental and economic benefits.

Application of Minimum Quantity Lubrication in Powertrain Operations at Ford Motor Company

Mark Panetta, Senior Engineer Environmental Systems and
Susan Rokosz, Principal Environmental Engineer, Ford Motor Company





Ford continues to expand the use of near-dry machining, also known as minimum quantity lubrication, or MQL. MQL replaces the use of large quantities of conventional metal-working fluids and provides the same amount of lubrication with reduced water and oil use, and improves plant air quality by eliminating the airborne mist produced by traditional wet machining.

For a typical production line, MQL can save more than 280,000 gallons of water per year, or enough to fill 5,600 average-sized bathtubs. The Cologne Engine Plant in Germany, which produces the award-winning 1.0 liter EcoBoost engine, decreased water use per engine by 50% from 2011 to 2012 by switching to the MQL process.

MQL also reduces the amount of oil needed to machine an engine or transmission 80% or more, to approximately 100 milliliters—or about half the size of an average drinking glass. Without the need for a coolant system across most engine production lines, MQL also helps to reduce energy use. While conventional wet machining produces an airborne mist, MQL eliminates that mist, improving air quality in the plant.

Ford now has six plants in North America, Asia Pacific, and Europe that have implemented the MQL process. Plants that have switched to the MQL process include:

- Changan Ford Engine Plant (China)
- Craiova Engine Plant (Romania)
- Cologne Engine Plant (Germany)
- Livonia Transmission Plant (Michigan)
- Romeo Engine Plant (Michigan)
- Van Dyke Transmission Plant (Michigan)

Ford has adopted a rigorous and holistic approach to reducing the overall environmental impacts of our manufacturing facilities. We have established global facility environmental strategies including targets that address the range of our environmental impacts, including energy use, emissions, water use, and waste generation.

Each Ford facility has a comprehensive set of environmental targets and uses a detailed scorecard to report against these targets, so that we can track and accelerate improvements. Progress toward the targets is reviewed throughout the year by senior management at regular Business Plan Review meetings. In addition, these targets become part of the performance review metrics for every plant manager and regional manufacturing manager, as well as others in the management hierarchy up to the executive vice president of manufacturing and labor affairs. These targets include reducing greenhouse gas emissions from our manufacturing facilities by 30% on a per-vehicle basis from 2010 to 2025, reducing average energy consumption per vehicle globally by 25% from 2011 to 2016, reducing water use by 30% from 2009 to 2015, and reducing waste to landfill by 40% from 2011 to 2016.

Implementation of MQL, which will nearly double over the next few years, assists Ford in meeting these goals by reducing water use, energy use, and waste generation.

GM Turns Energy Efficiency into Measurable Results

Al Hildreth, Energy Manager, General Motors

GM reduced its energy intensity 11% compared to its 2010 baseline. In 2013, it led all companies globally in the number of facilities meeting the voluntary U.S. Environmental Protection Agency ENERGY STAR® Challenge for Industry, earned five ENERGY STAR building certifications, converted two coal-fired boilers to natural gas, saved $4 million by real-time management and optimization of HVAC systems, increased landfill gas usage, and avoided 11 million tons of greenhouse gases by diverting 2.6 million tons of waste from landfills. The efforts are aligned to GM's business; earlier this year the company became the first automaker to sign a "Climate Declaration" asserting that responding to climate change is good business.

Altogether in 2013, GM avoided 158,000 metric tons of greenhouse gas emissions—the equivalent of adding 33,000 vehicles to U.S. roads without any greenhouse gas increases. Greenhouse gas disclosure efforts resulted in a score of 100 on the Carbon Disclosure Project (CDP) and inclusion in the CDP Disclosure Leadership Index for Global 500 companies.

GM employs a core team of energy experts who champion GM's energy efficiency approach. Led by a group manager and supported by a senior leadership team, the energy management program focuses on energy, water, and carbon optimization. In addition, each manufacturing and major non-manufacturing site has a local site utility manager focused on site energy issues, including efficiency and conservation. Larger sites also have a dedicated energy conservation engineer focused on specific projects, operations, and keeping employees engaged in the reduction of energy, carbon, and water. Here are some best practices contributing to GM's progress:

- Contracting a third party to provide limited assurance of global energy, water, and carbon data.
- Reporting energy and water use intensity monthly at 284 facilities worldwide.
- Monitoring 2.5 million points of energy data per minute to see opportunities for improvement versus waiting for month-end results, resulting in implementation of nearly $4 million of energy savings with less than a six-month payback.
- Benchmarking annual external energy for global vehicle assembly plants to determine the most efficient facilities and set future targets.
- Sharing successes through a global web-based system where facilities can input energy, water, and carbon-reduction best practices—further communicated through monthly utility cost council meetings and global peer reviews.
- Forecasting budgets and targets using an energy-activity-based forecasting tool.
- Integrating energy and water conservation planning into the business plan of the manufacturing organization.
- Tracking environmental goals alongside other manufacturing goals, showing business alignment.
- Listening to employees on proposed energy and water reduction projects and prioritizing based on return on investment (ROI) and probability of success. Any employee can suggest an improvement and receive a portion of savings up to $20,000.
- Communicating monthly information on energy, water, and CO2e intensity performance-to-targets to facilities via online scorecards, enabling tracking against monthly and annual goals. Any performance without "green" status requires a countermeasure to be developed for corrective action, which is tracked with additional emphasis to ensure achievement to goals.
- Recognizing employee achievement monetarily or through awards.

Protecting Water-Stressed Barley-Growing Regions

Jonah Smith, Sustainability Manager, Policy and Reporting, MillerCoors

MillerCoors is committed to quality, sustainability, and water conservation. By conducting a "water blueprint" of our total business operations, we discovered that more than 90% of our water use occurs in our agriculture supply chain. That is precisely why we focus significant energy and resources into this sector, and as a result, our company is now helping to lead the way in developing and scaling water-efficient farming practices.

In 2008, we teamed up with The Nature Conservancy (TNC) in Idaho's Silver Creek Valley, a region where much of the beer industry's barley is sourced. Together TNC and MillerCoors launched a precision irrigation project to use less water in barley farming without reducing yields. Through this partnership we also developed a Showcase Barley Farm, to help demonstrate water conservation practices as a model for other farmers. Some of the best management practices we're piloting in this project include irrigation updates and installing riparian plants streamside, along with wetland restoration and monitoring. Moreover, in order to reduce our reliance on water at the source, MillerCoors is also developing and testing dry land barley varieties, which can be grown with less water.

From 2011 to 2012, we primarily focused on precision irrigation techniques on the Showcase Barley Farm in Silver Creek Valley. The farm saved a cumulative total of 270 million gallons of water from these techniques, which is enough water to meet the needs of a family of four for nearly 1,850 years. More efficient irrigation techniques result in decreased demand for pumping water, which also decreases the energy needed to power pumps. By pumping less, the farm cut its total energy usage by more than half—from an average of $50 per acre in energy costs to $20–$22 per acre. This is a significant savings for a farm that historically spent $120,000 per year on energy. Not only are these irrigation techniques good for the environment, they are also good for farmers' bottom lines.

To continue these water conservation efforts in Silver Creek, MillerCoors established a water conservation fund. The fund allows TNC to match the investment of farmers interested in retrofitting irrigation systems to improve water efficiency. To qualify for matching funds, a farmer has to (1) enroll in the Idaho Power savings program, (2) discuss potential conservation projects with TNC, and (3) raise the funds that he or she is requesting to be matched. For matching funds recipients, The Nature Conservancy will advise the farmers throughout the design process, through implementation and adaptive management, as well as on monitoring outcomes.

The Energy-Water Nexus: Issues and Opportunities

Blythe Lyons, Senior Fellow, Energy and Environment Program, The Atlantic Council

Defining the Energy and Water Nexus

The term "energy and water nexus" refers to the circular relationship between water and energy. Water is required for every aspect of fuels production and for every form of electricity generation, except for wind. Energy is needed to clean, transport, and recycle water for public use. The sustainable use of energy for water and water for energy is a double challenge.

What's at Stake

For global and U.S. national security, it is essential to meet energy and water nexus issues head on. Globally, poor quality or lack of adequate electricity and water availability are major constraints on economic and human development. More than 1 billion people lack electricity; 783 million people do not have access to safe, clean drinking water; and 2.5 billion people live without proper sanitation. Nearly 4,000 children die each day from unsafe water and lack of basic sanitation facilities.

At home, a lot is at stake, with the United States at a crossroads. Can the country maintain its favorable domestic energy production trend while maintaining sustainable water supplies? Water may become a significant obstacle to U.S. energy security.

The domestic energy revolution is real. New domestic energy supplies have reduced geopolitical stresses on relations with our allies. U.S. carbon emissions have been reduced. Depressed areas in the United States are seeing a dramatic increase in jobs related to unconventional production of oil and gas from shale and coal bed methane.

Overall Nexus Issues

The rosy domestic energy picture faces headwinds. Hurricane Sandy, record droughts, and other extreme weather events spotlight a new reality. An age of growing domestic energy resources butts up against an aging water infrastructure and stressed water supplies, bringing into sharp focus competing urban, power, and agriculture water demands.

The issues at the heart of the nexus include:

- Population growth in water-constrained areas
- Vast quantities of freshwater supplies that are located in difficult-to-reach areas
- The unlikelihood of congressional action due to the current political climate
- Stove-piped federal bureaucracy, with at least 18 agencies having a purview on energy and water
- Lack of water use and availability data at a granular level
- Regulatory regimes that could increase costs, create unfunded mandates and impact innovation
- Water and energy industries not effectively communicating
- Public resistance to paying for the true cost of its water, often not knowing what those costs are

The Nexus and Fuels

Water and energy are front and center in the extraction and processing of primary and transportation fuels, including oil, gas, biofuels, hydrofuel, geothermal fuel, coal, and uranium. Biofuel mandates reduce fossil fuel usage and carbon emissions, but in some locations require significant amounts of irrigation water and cause downstream water pollution. Coal mining requires continued efforts to protect local water quality amid concerns of whether regulations are effective and consistent. Depending on shale play location,

concentrated drilling may pose local water supply concerns. While it appears a consensus is developing that hydraulic fracturing per se does not contaminate groundwater supplies, public concerns must be allayed about chemicals, methane migration, spills, well construction, local impacts, contamination due to disposal of flowback and produced water, and fears over induced seismicity in disposal wells.

Regulators must do a better job to develop consistent, fair rules for the safe and sustainable management of the country's resources all while incentivizing adoption of available water management technologies. The oil and gas drilling industry must seize the moment to demonstrate to the public's satisfaction that, as it claims, its extraction methods are safe and time-tested. It must continue to innovate, and embrace technologies, to reduce the use of water and energy in producing fuels.

The Nexus and Electricity Production

Nowhere is the nexus more evident than in the electricity sector where the linkages between energy and water are growing more complex and interdependent. Water, itself an electricity fuel, is required for cooling a wide variety of power plants. Even though thermal power production in the United States consumes only 3% of the water, it accounts for more than 40% of the withdrawals (close to that for agriculture). If water supplies are constrained, so too is power supply.

There are tremendous opportunities to reduce water withdrawals and consumption for power production and to minimize local water supply environmental impacts. Key solutions include:

- Alternative cooling water from agricultural drainage, seawater, stormwater, municipal effluent, produced water, or saline groundwater
- Adoption, where economically feasible, of closed-loop cooling, dry cooling technologies, or hybrid air-water cooling
- Using renewables, such as wind, or solar photovoltaic, that require less life-cycle water

The Nexus and Water Treatment

The $44 billion water industry sees an equal share of seemingly intractable infrastructure and funding gap issues. Twenty-five percent of water is lost to leaky pipes, which increases the industry's energy demand to compensate. There are 75,000 sewer overflows per year, which, coupled with concerns over pharmaceutical and other nutrient contamination, result in water quality concerns. Yet, water is vastly over-treated—only 2% of the cleaned water is actually used for human consumption. It is priced so low that it is not valued, conserved, or invested in. Water utilities have been slow to raise prices that would encourage conservation, and to fund system upgrades. The funding gap grows ever larger; a recent estimate is that it has reached $4 trillion. The highly fragmented nature of the industry, and its seeming inability to communicate with one voice, makes progress difficult.

Sustainable water supplies require a new paradigm—based on water seen as invaluable, not invisible. The good news is that many of the water industry's challenges can be solved by technologies that are available today. Industry should redouble its public education efforts and develop a true consumer education strategy. Other solutions include:

- Implementation of energy demand-side reductions
- Operating and Maintenance savings that can pay for infrastructure upgrades
- Energy neutral or net positive power plants at wastewater treatment facilities to reduce electricity demand
- Efficiency, conservation, and reuse strategies
- Legislation to give the industry new funding mechanisms
- Holistic, integrated planning between water, energy, and agriculture sectors

- Leveraging private sector and municipal authority partnerships through public-private partnerships
- Collection of energy use and water supply data at the watershed level
- Better use of data by industry to improve its analyses of strategies and technologies

The federal government must ramp up efforts to address the nexus. The 2005 Energy Policy Act directed U.S. Department of Energy (DOE) to provide a roadmap to deal with nexus issues, and it's time to fulfill this directive. A lot can be done without large government expenditures to improve interagency cooperation, and to define each agency's role, in order to reduce overlap. But more federal funding is required for critical data collection. Legislation is needed to provide tax incentives and other policy adjustments to unleash private sector financing for municipal infrastructure upgrades.

Concluding Thoughts

Energy and water industry leaders must come together to lead efforts to solve nexus problems. There are tremendous opportunities to meet the twin goals of expanding domestic energy resources with sustainable practices. In light of the reality of limited water supplies and the public's environmental concerns, it is prudent to consider how the vast quantities of produced water that will accompany exploding domestic oil and gas production might augment conventional water supplies and be recycled in oil and gas production. Beneficial uses of produced water should be explored for crop irrigation, livestock water, stream flow augmentation, and municipal and industrial uses. The energy and water industries should take this golden opportunity to explore mutually beneficial solutions to deal with produced water, and help sustain the promise of the U.S. energy revolution.

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