From Scarcity to Abundance:
Business Solutions for a Water Constrained World
SHAPE SUPPORTERS
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INTRODUCTION

Water is essential to support all life on Earth, whether for drinking, cleaning, irrigating crops, or manufacturing the goods and services we depend on every day. Yet, businesses, communities, and countries across the globe are running out of this precious, finite resource.

According to the United Nations, the world will face a 40% shortfall in freshwater in as soon as 15 years under the current scenario. Already, approximately 66% of the world’s population, or 4 billion people, live without sufficient access to freshwater for at least one month out of the year, according to Science Advances. More than half of the world’s cities and three-fourths of irrigated farms experience water shortages on a regular basis.

A rapidly growing population; increasing demand from cities, agriculture, and industry; shifting diets; greater demand for energy; and intensification of extreme weather events are fueling water shortages globally.

Private Sector Solutions for Securing a Sustainable Water Future

By Jennifer Gerholdt, Senior Director, Environment, Corporate Citizenship Center, U.S. Chamber of Commerce Foundation

The private sector increasingly recognizes water as a critical resource for long-term business growth and profitability, and recognizes the need to develop comprehensive water management strategies and initiatives as water scarcity becomes the new normal for many parts of the world.

At the U.S. Chamber of Commerce Foundation Corporate Citizenship Center, we showcase innovative approaches to help solve the global water challenge. Companies are implementing solutions within their fence lines and in communities to help fight water scarcity. Examples in this report include the following:

- **CH2M**: Deploy smart technology and advanced data analytics so local water utilities can improve their response and minimize wet weather overflows into the environment.
- **Intel Corporation**: Treat and return approximately 80% of the water it uses back to municipal water treatment operations for reuse by local communities.
- **MGM Resorts International**: Leverage a wide range of process and technology improvements, including watersmart landscaping and drip irrigation systems, to conserve and reclaim water.
- **The Dow Chemical Company**: Deploy membrane technology to reduce high energy and cost burden associated with water purification, and advance innovative collaboration to get the most out of every drop.

Additionally, we are pleased to include perspectives from some of our other partners, such as Forest Trends and Trucost, that are contributing thought leadership, tools, and resources to help companies develop new approaches for managing water.

We hope you find this report valuable in providing fresh thinking and examples of innovative and scalable solutions for securing a sustainable water future for all.
CHAPTER 1: CONSERVATION AND EFFICIENCY
A Blueprint for Water Conservation in the Supply Chain

By Jennifer Allison, Vice President, Global Supply Chain Sustainability, Dell

According to the World Economic Forum, water crisis is in the top five global risks of highest concern for the next 10 years. Growing demand, pollution, inefficient use of freshwater, and climate change have contributed to increased water shortages and risks. At Dell Technologies, we are committed to putting our technology and expertise to work where they can do the most good for people and the planet—and we are constantly looking to innovate our products and operations to improve the world in which we all live.

As part of our 2020 Legacy of Good plan, Dell is working to reduce our water use in water-stressed regions by 20%. While Dell’s direct water use is relatively limited—approximately 1.4 million cubic meters of water was used worldwide in Dell-operated facilities in 2015 (the same amount that flows over Niagara Falls in 11 minutes)—we are introducing closed-loop and rainwater collection systems to minimize drawing from local sources. In Brazil, a rainwater collection system enabled systems to minimize drawing from local sources. In 2015, we selected the first 50 suppliers with the highest water consumption, and provided them with sophisticated training on how to develop robust and impactful water conservation strategies. We are leveraging expertise from organizations such as Business for Social Responsibility, Shanghai Academy of Environmental Sciences, Alliance for Water Stewardships, and Veolia to provide input and insight into the development of these plans. After those suppliers submitted the first round of plans, our environmental experts provided feedback on how consumption strategies could be improved. By closely reviewing the first round of water plans, we were able to identify 179 water efficiency opportunities, with potential to save 2,734,700 cubic liters of water per year. These suppliers are now reporting their water use through an external, independent tool alongside other sustainability metrics. This year, as we launched round two of our training series and plan development, we have also invited two standout suppliers from the first round to share their experiences and best practices with the second round of suppliers.

In order to keep moving toward the circular economy model that must flourish in the 21st century, we need to continue to develop innovative processes, materials, and products that use fewer virgin resources. Beyond our supply chain water conservation strategies, we are also investigating how Dell can play a role in cleaning up watershed basin areas in stressed regions. We are exploring options to address the presence of plastic material in oceans and freshwater sources through a pilot project to recycle and utilize these plastics in our packaging. Just as we led the transition of protective packaging away from oil-based foam to fiber-based sustainable solutions, our end goal is to help develop a multi-partner program and supply chain for the use of ocean-bound plastics as a viable alternative to virgin plastic.

We are excited about the engagement model that we have built around the critical sustainability issue of water conservation and efficiency in our supply chain. By implementing a framework for action that incorporates capability building, supplier networking, and strategic planning, we have established a blueprint for continual improvement and innovation in our products, operations, and throughout our value chain. We welcome a more active conversation among businesses on product and process innovation to support water conservation and efficiency. Through creative innovation and a collaborative approach, we aim to help bring the industry to a higher standard of sustainable operations.
CHAPTER ONE: CONSERVATION AND EFFICIENCY

Water Conservation and Collaboration in the Desert City

By Yalmaz Siddiqui, Vice President, Corporate Sustainability, MGM Resorts International

At MGM Resorts International, we believe water is the planet’s most valuable natural resource. This belief informs our attitude and approach to water management across our company, but especially in our hometown, the desert city of Las Vegas. With more than 55,000 employees in Southern Nevada, MGM is the region’s largest employer, we believe we have a responsibility to conserve water resources, and set an example for others to follow.

Our focus on water conservation began in 2005, led by our chairman and CEO, Jim Murren, and governed by our Corporate Social Responsibility (CSR) Board Committee. Since then, MGM Resorts has implemented a wide range of process and technology improvements to manage and reduce our water footprint, inside and outside our world-renowned resorts such as ARIA, Bellagio and Mandalay Bay.

Our company’s water conservation efforts are strengthened by the forward-thinking leadership of the Southern Nevada Water Authority (SNWA) which has created some of the world’s best infrastructure for water conservation and reclamation. In fact, due to this infrastructure, approximately three quarters of the 4 billion gallons of water MGM Resorts uses annually in our Las Vegas properties, is rapidly replenished back into Lake Mead.

The Park: A water-smart oasis on the Las Vegas strip

Conservation of outdoor water is particularly important as water used outdoors does not readily get replenished. One example of how MGM has focused on outdoor water is in The Park, our recent addition to the Las Vegas Strip. Created as a microcosm of the Mojave Desert, The Park provides a serene and beautiful water-smart landscape in the heart of the City. An existing well provides the majority of The Park’s water, and a closed-loop system captures, filters and reuses the water flowing in water sculptures. Local and/or drought tolerant plant species are planted, and point-source drip irrigation and anemometers are used to limit water flow. Together, these water-conservation technologies save millions of gallons of water per year, 70% less than if the investments had not been made.

T-Mobile Arena: A water efficient venue for more sustainable shows

One of MGM’s newest developments is the 650,000 square feet T-Mobile Arena, a cutting edge LEED Gold® certified venue featuring shows from some of the world’s most celebrated entertainers. The Arena was designed with water efficient technologies that lead to 40% reduction in indoor water use: waterless urinals; low-flow toilets (1.28 gallons per flush) and low-flow faucets with aerators (0.35 gallons per minute). The Arena’s exterior is also water efficient, with drought tolerant native/adaptive species and drip irrigation systems, leading to 80% reduction in exterior water compared to typical landscape design.

WaterStart: A technology start-up with a difference

As well as investing in water efficient technologies for our operations, MGM is investing in long term innovation for the water sector as a whole. In early 2016, MGM formed a partnership with WaterStart, an organization that brings innovative water-focused startup companies to the State of Nevada. Working with MGM and other partners, WaterStart will identify, pilot and drive market adoption of cutting-edge water technologies.

For potential future use in our own operations, MGM is focusing on advanced technologies identified by WaterStart that monitor water use, and that reduce water used for irrigation, cooling towers, and pool filtering.

These are just a few examples of many water conservation efforts undertaken by MGM Resorts. We plan to continue investing in technologies that help us measure, manage and reduce our water use. And through our funding and support of WaterStart, hope to enable breakthrough innovations that help the world reduce its reliance on this most precious of commodities: water.
Better Barley, Better Beer

By Natalie Lau, Sustainability Brand Manager MillerCoors

At MillerCoors, we are committed to environmental sustainability and the efficient use of our resources. Water is our most important resource; high-quality water is critical to MillerCoors at every point in our value chain, from barley and hops fields to our bottling lines. As a primary ingredient in our beer, we are committed to continuously reducing our water footprint to ensure we have access to this important resource for years to come.

Analyzing Our Water Footprint

Building upon our long-standing tradition in world-class manufacturing and exemplar water-to-beer ratios within our breweries, we wanted to expand our impact beyond our direct operations. A water footprint analysis we conducted in 2011 revealed that 90% of MillerCoors water footprint occurs upstream in our agricultural supply chain.

To make a significant dent in our overall water usage, we knew we needed to take on the challenge to reduce our resource intensity upstream in the supply chain. Barley is the primary ingredient in our beers and makes up around 90% of all the crops we source in our brewing process. While other commodity and specialty crops have greatly benefited from methods and technologies able to track on-farm operational metrics, the barley community is still in the early stages of adoption. Given this need, we decided to target our barley farmers first to help them manage their water usage more efficiently.

Goal for 2020: Managing Agriculture Risks in All Our Barley Growing Regions

In 2015, we set an aggressive goal to expand our sustainability programs to manage and reduce agricultural resource risks, including water risks, in 100% of our key barley-growing regions by 2020.

MillerCoors has a long-standing relationship with our barley farmers, many of whom have been supplying high-quality barley to our breweries for decades. To make a marked impact on our supply chain, we decided to leverage these relationships to roll out best practices. We codify our relationships with barley farmers in the Direct Grover program in 2011 and recently launched a web portal for growers to capture data from their operations. The Direct Grover program now consists of 885 independent barley growers from Colorado, Idaho, Montana, and Wyoming that supply approximately 80% of the barley we use to brew our beers.

Better Barley, Better Beer Program

Through our Better Barley, Better Beer program, we test new farming techniques and sustainability practices that can be scaled across 100% of our barley-growing regions and impact our water footprint dramatically. Across our Better Barley, Better Beer projects—(1) Showcase Barley Valley in Silver Creek, Idaho; (2) Showcase Barley Farm in San Luis Valley, Colorado; (3) Idaho Sustainable Agriculture partnership; and (4) Walmart Fertilizer Optimization Plan—we have made positive strides to improve our resource usage while meeting top quality standards of barley production.

Building and Scaling Best Practices

In our Showcase Barley Valley, we started with just one farm in 2011, where we tested best practices with The Nature Conservancy. Today, we have expanded our operations to include multiple farms with the help of USDA’s Natural Resources Conservation Service (NRCS) and other nongovernmental organizations. Together, we’ve developed more efficient irrigation methods that have conserved a cumulative total of 600 million gallons of water per year. In the past two years, our work has extended to monitoring pivots and turning them off earlier, resulting in savings of 3.8 million gallons per pivot during late irrigation windows. Our work with pivots also includes improving irrigation techniques over the course of the season, saving approximately 1.3 million gallons per pivot annually. Our recent investments in the Silver Creek Valley have allowed us to learn about how variable rate irrigation positively impacts yield and quality, while soil moisture probes have allowed participants to better understand soil compositions as well as improve watering decisions.

In 2015 alone, MillerCoors saved almost 300 million gallons of water across the various projects in our Better Barley, Better Beer program. We will continue to track all our projects and share our performance data with our grower community and key stakeholders to look for ways to improve. We look forward to continuing to conduct research and explore various techniques and management practices so that we can further expand our impact and help reduce our water footprint in our barley-growing communities.
CHAPTER ONE: CONSERVATION AND EFFICIENCY

Achieving Sustainable Results through Collective Action

By Nelson Switzer, Chief Sustainability Officer, Nestlé Waters North America

When we consider the breadth of the sustainability challenges we face today—from increasing water scarcity, climate change, and volatile weather patterns to population growth and urbanization—the task of tackling these challenges can seem insurmountable. These issues are complex, and in order to be truly successful, we must work toward joint action to achieve sustainable results for the long term.

At Nestlé Waters North America, sustainable resource management is a top priority, and we strive to manage our springwater sources so they can be enjoyed for generations to come. However, we recognize that we cannot do it alone. We are engaged in collective actions with partners and like-minded stakeholders at the local, state, and national levels, including environmental experts, agricultural and industrial business leaders, community leaders, policymakers, and water management experts. Following are a few examples of how we are collaborating to conserve and sustain our shared water resources.

Water Stewardship in California

As a company operating in California for more than 120 years, we have a commitment and clear responsibility to manage and conserve water at all times. In 2014, California was in the throes of an extreme drought that threatened the social, environmental, and economic well-being of the state. During a 2014 CEO Water Mandate meeting in Los Angeles, we joined a diverse group of food and beverage companies, suppliers, conservation groups, and others to form the California Water Action Collaborative (CWAC). Today, the coalition comprises more than 20 organizations and we are working together to accelerate progress toward a sustainable water future for California in two ways: first, by working to identify ways for sectors to work together to accelerate progress toward achieving the goals of the California Water Action Plan; second, by supporting several projects that formed out of the CWAC platform. One such project includes the American River Headwaters Project. Led by The Nature Conservancy, through this project we work with partners from the public, private, nongovernmental organization, and academic sectors to thin forests that are overgrown due to poor forest management and restore habitat disrupted by logging roads in the Northern Sierra Nevada forests. These efforts will reduce wildfire risk and could increase water yield over time if rolled out at the landscape scale—granting additional supply for those downstream.

While this platform is still in the early stages, we are actively looking to bring this concept of shared vision and collective action to other watersheds.

From Cleanup to Collective Action

Leadership in water stewardship means going beyond our own sources and facilities to promote sustainable practices where we operate and live. We get involved in local communities through partnership, education, and advocacy. Each year, we work with partners to support several ongoing watershed improvement initiatives across the country.

For example, the Hillsborough River in Florida is fed by the source of our Zephyrhills® Natural Spring Water brand, and it also sustains a diverse ecosystem and serves as a recreation source for the community. Three years ago, we became concerned with the litter in the river and began sponsoring and participating in a series of cleanups to remove the debris.

We believe that the best cleanup is the one that doesn’t have to occur, so we enabled our partner Keep Tampa Bay Beautiful to build a coalition, collect data, and develop strategies that can protect and restore the Hillsborough River. Through this model for coordinated local action at the catchment level, we now have 36 partners supporting this effort, have restored 137 stream miles, have engaged thousands of residents, and have removed over 300,000 pounds of debris. Additional proactive strategies have been identified and are being rolled out.

We are proud of what we have accomplished through these collective action efforts—by working together, we made a greater difference than we could have alone. But there is more work to do. Going forward, we will continue to focus on learning from each other and collaborating to find new, innovative solutions that create value not only for Nestlé Waters North America, but for all people.
Promoting a Quality Water Supply through Efficiency and Conservation

By Joby Carlson, Director, Global Sustainability, Walmart

The natural world has come under increasing stress from the demands of a growing global population for food, clothing, shelter, energy, and livelihoods, among other things. As the world’s population continues to grow, we face the collective challenge of meeting people’s everyday needs in a way that our planet can sustain. Compared with other industries—like mining, manufacturing, and agribusiness—that extract and consume large quantities of water, retail uses relatively little water directly. At the same time, the products we sell—especially food—can require significant water to produce. The world’s water systems are increasingly depleting, and we estimate that more than 20% of our operations around the world are, or will be, located in regions facing high levels of water stress. We are actively working to preserve the quality and quantity of water available by focusing on the following:

- Improving efficient water use in our own operations
- Supporting water quality and efficient use in supply chains
- Direct conservation of critical habitats with ecological and societal value

Saving Water in the Garden Center

During peak growing season, Walmart’s garden centers hold an average of 12,000 plants, each of which requires 15-20 seconds to properly water. With so much time and water going into irrigation, we looked for a way to cut both, and discovered one in the irrigation mats produced by WaterPulse. A pilot program to replace our hose-based system revealed the irrigation mats produced by WaterPulse. A pilot looked for a way to cut both, and discovered one in

Efficient Approach to Water Cooling

In 2008, Walmart U.S. worked with Phigenics, an independent water management company, to develop a process that utilizes real-time monitoring and independent validation designed to ensure efficient water consumption across Walmart’s portfolio of 403 utility water cooling systems at 227 stores. The process consists of a standardized system for automatic sensor monitoring, secure wireless data communications, and program oversight by experts in water management. Through the development and implementation of this approach, from 2009 through 2014 we reduced water consumption by an average of 25% per open-recirculating system compared with our 2008 baseline. That’s the equivalent of 660 million gallons of water saved.

Enhancing Water Efficiency and Quality in our Supply Chain

Since agriculture accounts for approximately 70% of global freshwater consumption each year, water efficiency in agriculture is central to promoting water availability, especially in water-stressed regions. In California, for example, we recently established a process to review supplier performance and water stewardship plans as part of our annual evaluations. Through this annual evaluation process, we are able to challenge water-intensive suppliers to become more efficient and we are able to strengthen our relationships with suppliers that are good water stewards.

Additionally, fertilizer runoff from agriculture into waterways accounts for a major source of pollution affecting fish and wildlife populations, as well as makes water more difficult to treat for human consumption. Walmart is working with suppliers to improve water efficiency and fertilizer usage in the supply chain. For example, Walmart is a founding member of The Midwest Row Crop Collaborative, a broad-based effort to support, enhance, and accelerate the use of environmentally preferable agricultural practices that help protect air and water quality and enhance soil health throughout the Upper Mississippi River Basin.

Conserving Critical Aquatic Ecosystems

In addition to our efforts to increase efficiency and improve water quality, we are also protecting aquatic habitats through direct conservation in collaboration with the National Fish and Wildlife Foundation (NFWF). In 2005, Walmart helped establish the Acres for America program to conserve lands of national significance, protect critical fish and wildlife habitat, and benefit people and local economies. In its first 10 years, the program has protected more than 1 million acres across 35 states—an area comparable in size to Grand Canyon National Park—and connected over 10 million acres of protected lands to support landscape-scale conservation and wildlife migration. In November 2015, we announced with NFWF a 10-year, $35 million renewal of this program to continue its exceptional work for another decade.

1 https://www.keystone.org/our-work/agriculture/midwest-row-crop-collaborative
2 http://www.nfwf.org/acsforamerica/Pages/home.aspx
At Hilton, we are guided by a vision first articulated by our founder, Conrad Hilton, more than sixty years ago: “to fill the earth with the light and warmth of hospitality.” Put another way, we believe that we can use our passion for hospitality to make a lasting, positive difference in people’s lives and the wider world—and our work to reduce our water consumption is a prime example.

According to one estimate, an average 300-room hotel uses around 60,000 gallons of water each day—nearly 200 gallons per room. Furthermore, according to the U.S. Environmental Protection Agency, hotels and other lodging businesses account for approximately 15% of total water use in commercial and institutional facilities in the United States.

Hilton is focused on reducing water use across our portfolio—which includes more than 4,700 hotels in 104 countries and territories—and we require each of our hotels to have water consumption reduction targets in place, report on their water conservation efforts monthly and have a minimum of one water improvement project in place at all times.

Our approach is based on a simple truth: if we don’t measure it, we can’t address it. That’s why our strategy has focused on measuring water consumption and translating that data into relevant metrics that Hilton Team Members, franchise employees, owners and management groups can use to make informed decisions about their water usage.

We built a proprietary corporate responsibility measurement platform, LightStay, to better track and understand how our teams are managing water and sharing best practices. The platform enables us to project water use and future costs based on historical data, taking occupancy and weather into consideration. It allows us to generate automatic alerts that are sent to hotels if their water consumption reaches higher than expected thresholds, and we also have the ability to uncover best practices that teams have identified and share company-wide tools and programs to avoid wasting water.

Using the data we’ve captured through LightStay, we’ve looked at nearly every aspect of our operations to identify potential water-saving opportunities, whether that’s using compressed air to rinse dishes before they are put through dishwashers, using native plants in hotel landscaping, or purchasing special sidewalk-cleaning equipment that reuses water.

We’ve focused in particular on our laundry operations, because they are often a major consumer of water. For instance, by purchasing “room ready” bedding products (bedding that doesn’t require a first wash), we saved nearly 2 million gallons of water between 2009 and 2014. We’ve also worked with Procter & Gamble and Tide Professional to develop laundry technologies and products that can reduce water use by up to 45%, and we are conducting trials with the Xeros polymer bead-based washing system, which uses less water, energy and chemical detergents and can cut a hotel’s water consumption by about 16%.

By setting clear goals, capturing and analyzing data, reviewing our operations and working with third parties who share our objectives, we reduced our water use by 16.7% between 2009 and 2015—enough water to fill 5,272 Olympic-sized swimming pools. But that’s just the beginning. Commencing in 2016, we are implementing new water risk assessment procedures as part of our three-year partnership with the World Wildlife Fund (WWF). As a first step, we completed an initial water risk analysis using the WWF Water Risk Filter. Through this partnership, we will continue to develop an industry-leading water stewardship strategy that will include new water reduction targets and the creation of centers of excellence in key regions. We look forward to building on what we’ve accomplished thus far—and continuing to push our industry forward in identifying and implementing innovative strategies for preserving one of our planet’s most vital resources.

Water and Hospitality: How Hilton Is Working to Reduce its Water Footprint

By Maxime Verstraete, Vice President, Corporate Responsibility & ADA Compliance, Hilton
Reducing our Water Impact
By Katie Loovis, Director, Corporate Responsibility, GSK

By better understanding our water use across the value chain, we can focus our efforts where we can make the biggest difference. By 2020, GSK is committed to reducing our water impact across the value chain by 20% (vs. 2010).

Performance in 2015
We met our 2015 target to cut water use across our operations by 20% (compared to 2010) a year early. During 2015 we reduced this by a further 5%. Our investment in water-saving initiatives over the past five years has helped us achieve these reductions by targeting sites with the highest water use and those located in regions of water scarcity.

To meet our 2020 commitment, we are working with experts and NGOs to understand how best to reduce our water impact across the entire value chain. We combined data from the World Wildlife Fund (WWF) Water Risk Filter with four focus areas—water scarcity, local water quality, health and social risks, and regulatory and reputational risks—to identify hotspots of high water impact. Many of the projects below emerged from this assessment.

Raw Materials
Around 86% of the water used across our value chain—an estimated 1,200 million m3 a year—is in producing raw materials. Much of this is from agricultural produce such as milk, sugars, and eggs.

We partnered with The Energy and Resources Institute (TERI), a sustainable development nonprofit in India, to assess how we can help reduce water impact in the rural Indian communities that supply us with the wheat, barley, and milk used to manufacture Horlicks. In 2014, we piloted the approach with 10 of our direct suppliers and in 2015 we extended this work further down the supply chain to 20 suppliers at a rural community level. We have identified projects to address water conservation, rainwater harvesting, wastewater treatment, groundwater recharge, and rehabilitation of water bodies, and are investigating options to implement this research.

Our Operations
GSK laboratories, manufacturing sites and offices used 14 million m3 of water in 2015—around 1% of our total value chain water footprint. We are making major investments to reduce this across our sites. For example, we identified several areas at our Nairobi site in Kenya where we can collect and reuse water, and installed a more efficient system to heat water. Between 2013 and 2014 the site’s water consumption decreased by 16%.

Consumer Use
Consumers and patients need water to use many of our products—making a cup of Horlicks, brushing teeth, or to help swallow tablets. We estimate that consumer use accounts for 13% of our water footprint—most from the water used in cleaning teeth. In 2015, we continued to promote “Turn off the Tap” campaign on the Sensodyne UK website and by printing the logo on our Sensodyne Pronamel toothpaste, to encourage people not to leave the water running while brushing their teeth. Consumer use of our products can potentially alter water quality, as well as quantity. The pharmaceutical products they use are not always completely absorbed or broken down by the body, and residues can find their way into the environment— particularly water courses—when the medicines are excreted or disposed.

We assess the environmental risk associated with patients’ use of our products to help ensure that potential concentrations in the environment do not exceed safe levels. This includes testing the active pharmaceutical ingredients for eco-toxic properties. Since 2014, we have published data summaries of our environmental risk assessments for many of our products.
CHAPTER TWO: ENERGY-WATER NEXUS

The Water Imperative: Securing Sustainable Growth in a Water-Stressed World

By Snehal Desai, Global Business Director, Dow Water & Process Solutions

The world is 70% water but only 2.5% of it is fresh. Of this freshwater, just 1% is easily accessible. Advanced desalination technology has enabled us to expand the 2.5% a little by recovering water from the ocean, but by most current projections, what we need to feed and fuel the world’s 6.8 billion and growing population will not be available in adequate supply. Competing needs are drawing from the same pool to quench our sustenance, economic, and leisure thirst. In just 16 years, the world will have only 60% of the water it needs if we do nothing different.

Water is a limited resource and conservation tactics can only go so far. Companies have long caught on to the business risk of water scarcity and are investing to improve water management—over $84 billion worldwide was spent between 2011 and 2014. The truth is that business as usual will simply not work for our planet, for our economy, or for humanity. Our water imperative demands disruptive thinking. I’m not talking about turning off the faucet to disrupt its flow, but rather getting us to the next level of sustainable consumption.

The efficient use of water by industry is a critical step to get the most out of every drop. Processing 15 million gallons of water every minute with our technologies, Dow Water & Process Solutions is engaged at the heart of the water imperative, facilitating conversations about reclaiming wastewater and strategies to renew water sources, and advancing technology to improve water management practices.

A key water management issue that both our customers and our company face is balancing the connection between water and energy. We simply cannot have one without the other, so finding energy-efficient solutions to treat water is essential.

Membrane technology has advanced and helped reduce the high energy and cost burden associated with water purification. For example, the Camp de Tarragona petrochemical complex in Spain previously used freshwater to power its industrial processes. Through the European United-funded DEMOWARE project, we enable the recycling of local municipal wastewater for industrial use. The combination of extra fouling-resistant and low-energy membranes allows high-quality water to be produced and reused for alternative industrial use. The plant’s design and Dow’s low-energy membranes help reduce energy demand by producing treated water with 33% less pressure.

Studies1 have shown that reclaiming and reusing 100% of wastewater produced is costly, carries a higher energy burden, and is difficult to achieve. In fact, getting to the final 3% to 5% of recovery with a Zero Liquid Discharge (ZLD) approach can be expensive—the last few steps needed to achieve complete ZLD status can nearly double costs. To help organizations make greater leaps toward reclamation, Dow developed an alternative approach called Minimal Liquid Discharge (MLD) based on our experience with effective and proven water filtration technologies. MLD enables recovery of up to 96% of liquid discharges compared with ZLD, with minimal cost impact.2 However, technology alone cannot solve the water crisis. We do not need more inventions. We need more fresh thinking. We need disruption and innovation in the way we approach water. The biggest impact we can make is in advancing collaborations—the innovative ways of working with governments and the public and private sectors.

Regulatory, financial, and governance structures in the United States have made it increasingly difficult to address water from a policy perspective. To ensure our solutions are realistic and achievable, we must have a strong and reliable regulatory framework in place to accelerate system-wide implementation.3 This will require all of us to break down barriers within the water industry.

We can bring the best technologies to market, but if we do not engage across and beyond traditional players, our capabilities will not mean much. The U.S. Water Alliance’s “One Water Roadmap” puts it best: when all people have a stake in ensuring a water-secure future, we achieve the best results.4

With the technologies, know-how, and human talent in hand, the water imperative demands that we innovate not just in solutions but in business models, and broaden our conversations with people, organizations, and companies across the value chain. Alliances, along with smart water economics, are key components in moving society toward a sustainable water future.

Footnotes:
2 See Figure 1.
4 “One Water Roadmap.”
Optimizing Water Use for More Efficient Power Production

By Sergio Sanchez, Industry Technical Consultant, Nalco Water, an Ecolab Company

Water and energy are inextricably linked. As demand for energy increases and fresh water becomes increasingly scarce, it is necessary for power companies to rethink water use throughout operations. Nalco Water, an Ecolab Company, provides proven, innovative solutions in process and water treatment that can help enhance reliability, profitability and efficiency for power plants while improving overall environmental performance and compliance.

Every year, Ecolab helps customers manage more than one trillion gallons of water with solutions across industries that minimize, maximize and optimize water use throughout operations. A core technology is 3D TRASAR™ Technology, which combines chemistry, remote services and sophisticated monitoring and control to help customers reduce, reuse and recycle water. When used to improve a power plant’s cooling system, 3D TRASAR delivers significant water savings as well as system reliability, efficiency and profitability.

Optimizing Cooling Tower Performance to Drive Water Savings

A combined-cycle electric power plant in Mexicali, Baja California, Mexico was seeking to adopt best practices and technology to increase operating reliability and ensure environmental performance and staff safety.

Since 2008, the power plant had used more than 4.5 million cubic meters of gray water for its processes, trending toward an average index of 1.5 m³/MWh. The plant’s cooling tower, a primary water consumer, was the focus of efforts to improve overall environmental performance and compliance.

Nalco Water’s Solution

Nalco Water conducted studies to determine optimal number of cycles of concentration, avoiding risks of scaling and efficiency losses mainly in the surface condenser and the cooling tower circuit. As a result of this study, the team agreed upon a work plan to maintain seven cycles of concentration to achieve optimal efficiency.

• Leveraged 3D TRASAR Technology for Cooling Water to measure and control cycles of concentration—3D TRASAR Technology for Cooling Water uses tagged polymers to provide real-time monitoring and control of cycles of concentration.
• Continuous monitoring from the control room—A team of Nalco Water experts at the company’s 3D TRASAR System Assurance Center monitor data collected by the Technology to provide better visibility into daily system results and enable real-time problem solving.
• Application of cutting-edge chemistries—Use of advanced polymer technology increased concentration cycles while controlling conditions to prevent scale and corrosion.
• Adapted service to meet the customer’s specific needs and requirements—Nalco Water developed and delivered a Service Plan to maintain system assurance and achieve optimization goals.
• Nalco Water service and support delivered by qualified experts—Ongoing service from Nalco Water professionals with PW200 certification.

Enhanced performance results in water and energy savings

Increased cycles of concentration—3D TRASAR Technology for Cooling Water enabled the control of chemical variables without increasing corrosion, scaling, and biofouling potential. The technology provided real-time monitoring of critical variable impacting cycle performance and alerted the control room to issues for quick resolution.

Water savings—Water use records verified that water consumption decreased from 1.13 m³/MWh to 1.06 m³/MWh over a three year period, resulting in savings of 245,000 cubic meters per year. Additional benefits—Increasing cycles of concentration in the cooling water circuit also resulted in decreases in:

• Pumping power consumption
• Greenhouse gas emissions
• Chemical product consumption
• Handling of chemical products
• Risk of exposure to chemical products

Doing more with less

• Implementation of 3D TRASAR Technology for Cooling Water proved effectively increase concentration cycles without adverse consequences in corrosion, scaling and biofouling control, even under severe stress conditions (high calcium, sulfate and chloride content).
• 3D TRASAR Technology for Cooling Water helped to maintain control over other operative variables.

No negative effects were observed in condenser backpressure or in the cooling water temperature from 2011-2014. The differential between steam temperature and cooling temperature at the condenser discharge (TTD: Terminal Temperature Difference) did not show an increasing trend, which would indicate a problem of fouling or scaling in the main condenser tubes.

• 3D TRASAR Technology helps power plants achieve sustainability goals and reduces the total operating costs for power generation.

About Ecolab

A trusted partner at more than one million customer locations, Ecolab (ECL) is the global leader in water, hygiene and energy technologies and services that protect people and vital resources. With 2015 sales of $13.5 billion and 47,000 associates, Ecolab delivers comprehensive solutions and on-site service to promote safe food, maintain clean environments, optimize water and energy use and improve operational efficiencies for customers in the food, healthcare, energy, hospitality and industrial markets in more than 170 countries around the world.

For more Ecolab news and information, visit www.ecolab.com.
CHAPTER 3: INFRASTRUCTURE AND INVESTMENT
CHAPTER THREE: INFRASTRUCTURE AND INVESTMENT

Water Stewardship Looks “Beyond the Fence”

By Genvieve Bennett, Senior Associate, Forest Trends Ecosystem Marketplace

In 2016, the World Economic Forum rated the risk of a global water supply crisis as a greater threat than energy price shocks or fiscal crises, both in its probability of occurring and the seriousness of impacts. For business, water security poses an undeniable challenge in the coming decades: one in four major global companies report that their business experienced detrimental impacts related to water risk, with total financial impacts exceeding $2.5 billion last year. Any follow-through on these risks most often focuses on direct operations, improving water use efficiency, and monitoring immediate impacts. Yet efficiency, while valuable, is not enough to truly manage risk: at current rates of improvement, improving water use efficiency will close the global supply-demand gap only by an estimated 20% by 2025. Meanwhile, supply chain issues and larger landscape threats go mainly unaddressed. Just 12% of businesses consider their suppliers or other river basin stakeholders in water risk assessments.

The Business Case for Green Infrastructure

Forest Trends’ work centers on strategies to conserve forests and other ecosystems through creative environmental finance and market mechanisms. We find companies are already tackling water risk head-on, taking a green infrastructure approach that looks “beyond the fence,” past direct operations to the larger basin and supply chain context.

Green infrastructure approaches restore, maintain, or mimic natural processes to safeguard water supplies and provide a barrier against natural disasters. Forests or wetlands, for example, can filter out water pollution, regulate stream flows, recharge aquifers, and absorb flooding, limiting the need for engineered infrastructure to perform these functions. For companies, the approach can help address key operational risks—including supply disruptions and emerging regulations—while saving money, increasing resilience to climate and natural disaster shocks, and improving relations with local communities. Investors are beginning to understand this and are rewarding companies with a water stewardship perspective.

Replenishment Commitments Surged in 2015

We found more than 120 cases in 33 countries of companies investing in green infrastructure as part of water stewardship approaches in 2015. The food and beverage sector continues to lead the field, followed by finance and insurance, private water utilities, and energy generation—all industries that face substantive financial and physical water risk.

Still, some sectors, including energy and apparel/textiles, despite being among those most exposed to water risk, reported little activity in terms of green infrastructure approaches.

Many companies partnered with governments, utilities, and nongovernmental organizations on green infrastructure. For a business, collective action provides a way to act quickly on water risk, through leveraging additional funds, taking advantage of the conservation expertise of other partners, and improving governance in coordination with important stakeholders.

“Replenishment” commitments, which aim to generate volumetric benefits equal to a company’s consumptive water use through projects such as watershed restoration and irrigation improvements, also spiked in 2015. Replenishment commitments have been made by more than a dozen major companies, including Coca-Cola, SAB Miller/MillerCoors, Ikea, Diageo, Keurig, Mars, ITC, and Pepsi.

Scaling Up Good Stewardship Requires the Right Partners and Decision Supports

Operationalizing water stewardship across the supply chain is a significant challenge. Our Supply Change project recently found that though hundreds of companies have committed to purging deforestation from their supply chains, only about one-third of the companies are actually reporting progress toward those pledges. Efforts to manage supply chain water risk are even more complicated. Green infrastructure investments require significant stakeholder buy-in, technical capacity, and a long-term commitment to basin approaches.

The conservation field understands these challenges and is working to develop models and tools to advance collective action and a clearer understanding of green infrastructure’s benefits. Forest Trends recently convened world experts to develop practical proposals for public-private co-investment in green infrastructure in Latin America. With our partners in Peru, we also recently piloted new tools to evaluate green infrastructure’s cost performance against “gray” options. These efforts suggest that managing basin and supply chain risks at their source will be critical in navigating a water-insecure future.

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4 CDP. (2015).
5 Ibid.
Sealed Air’s plant in Iowa Park, Texas, partnered with local municipalities on a wastewater reuse project that will conserve 18-20 million gallons of drinking water per year. Instead of using potable water in its chiller process, the plant is now equipped to use recycled water from the city of Iowa Park’s wastewater treatment plant.

Water recycling is the use of treated wastewater for non-potable applications such as agricultural and landscape irrigation as well as industrial processes. Wastewater can be treated to meet the most stringent water quality standards. The city of Wichita Falls, Texas, has a direct/indirect reuse for their municipal potable water system. The reuse of effluent water is a drought-proof water source that can be achieved at a lower lifecycle cost than that of developing a new water supply option while delivering environmental co-benefits.

Situation
In the fall of 2014, North Central Texas was entering their fifth year of drought and the reservoirs were reduced to 20% of capacity so Sealed Air did a research study on the plant’s usage of water. Cooling tower water was the single largest water consumption process. The plant needs to air condition the entire 500,000 square feet of production and warehouse space to produce high quality shrink packaging for its customers.

Solution
The solution was to design a complete system to use effluent water from the Iowa Park wastewater treatment facility.

Pipeline construction was completed in 2015 as part of the project, which has been jointly funded by Sealed Air, Iowa Park’s Economic Development and Community Development Corporations, and the Wichita Falls Economic Development Corporation.

In addition to the pipeline construction, the city of Iowa Park had to install equipment to treat and filter the effluent water. This was done to achieve Type 1 effluent water classification. Type 1 effluent water is classified for use in indirect contact applications. Some of these include baseball or football fields, golf courses, and industrial cooling towers.

While those two tasks were being completed the third element of this project was being installed on the plant site. Although the city had processed the effluent water to Type 1 it still had high levels of total dissolve solids and required different chemical treatment than potable water to be used in the cooling tower application. Sealed Air partnered with GE Power & Water to solve this problem and an entirely new water treatment system had to be designed and installed in the Sealed Air facilities building.

Results
The five-year drought had a profound impact on the area. The efforts in the community to reduce, reuse, and recycle water have changed the way people view and use the resource. Post-drought water utility forecast is 47% below pre-drought potable water consumption.

This partnership between Sealed Air and the cities of Iowa Park and Wichita Falls is helping conserve clean drinking water for surrounding communities in this drought-prone area of North Texas. That in turn is strengthening the community while enhancing the security of local manufacturing plants. Employing more than 700 people, this Sealed Air’s Iowa Park plant is one of the largest manufacturing facilities in the area.

Sealed Air is proud to partner with local communities such as Iowa Park and Wichita Falls. Partnerships like these reflect our commitment to contribute to the communities in which we operate and to create a better way for life. Since the installation of the Iowa Park effluent water treatment facility, potable water usage at Sealed Air plant has been cut by 40%.
Arguably one of the most vital assets to communities—as well as mining operations—around the world is access to adequate water supplies. Yet many major deposits of minerals the world needs are located in remote, arid areas. This fact has unfortunately often resulted in competition between local communities and mining interests over this precious resource.

Freeport-McMoRan recognizes the importance of responsibly managing water resources across the portfolio of its mining and mineral processing operations. Our operations require significant quantities of water for mining and ore processing, and most of our operations in North and South America are located in arid regions. The company maintains a global water management program designed to support metal production by supplying required water to process operations; minimize water supply and water storage risks associated with operational, climatic, social, regulatory, and environmental conditions; minimize costs associated with the acquisition and distribution of water; promote innovation; and implement technology for efficient water usage.

Communities are often primary stakeholders whose input our company evaluates by maintaining five-year community engagement and development plans, which identify affected or interested parties and programs for ongoing engagement and consultation. The aim is to find solutions mutually beneficial to local communities and our operations. A perfect example was the steps taken by Freeport-McMoRan’s Cerro Verde copper mine in Arequipa, Peru. First, Cerro Verde co-financed Pillones and Bamputanié dams in the highlands to better regulate the Chili River system for the benefit of the local population, farmers, and industry. Cerro Verde then supported the costs for a new potable water treatment plant to serve Arequipa, which now provides 300,000 local residents 24-hour access to potable water. That was followed by a unique project to provide the additional water required for the recent expansion of Cerro Verde’s mining and mineral processing operations.

Freeport-McMoRan views its Cerro Verde mine—with its large-scale, long-lived reserves and cost efficiencies—as a key asset for the company’s long-term plans. The company recently expanded Cerro Verde operations by tripling the capacity of its concentrator facilities and extending the life of its leaching operations. Water for Cerro Verde’s continuing operations and expansion was a critical need. Yet the quality of the Chili River water was also critical for residents of nearby Arequipa, Peru’s second-largest city. The company’s policy in such situations is to engage proactively with stakeholders in order to find solutions to mitigate adverse impacts and increase the positive benefits of its operations.

To support the needs both of Arequipa and the company’s planned expansion of its mining operations, Cerro Verde financed the design and construction of one of the most advanced wastewater collection systems and treatment plants in all of Peru in a public-private partnership with SEDAPAR, Arequipa’s local water utility company. The wastewater treatment plant, completed in 2015 and located within Cerro Verde’s industrial site, intercepts and treats approximately 90% of metropolitan Arequipa’s domestic sewage and industrial discharges that had previously flowed into the Chili River. An annual average of one cubic meter per second of the processed wastewater is now available for use at Cerro Verde, while the remainder of the treated water enters the river.

Besides increasing the supply of usable water for Cerro Verde, the project has greatly improved the water quality of the Chili River, reducing waterborne illnesses, enhancing the value of local agricultural products, and benefiting tourism. On December 28, 2015, Peruvian President Ollanta Humala toured the new treatment plant and told news media, “This plant surpasses the one we have in Lima. To have a complete wastewater treatment system that will support public health is a reason to make Arequipa feel proud. And by decontaminating the Chili River, agricultural produce will be of better quality.” Moreover, these two community projects supported by Cerro Verde—the water and wastewater treatment plants—align perfectly with the number one stated commitment of newly installed Peruvian President Pedro Pablo Kuczynski, “To bring water and sanitation to all Peruvians.”
Investing in Sustainable Water Use to Enable Business Growth

By Libby Bernick, Senior Vice President, North America, Trucost

The world talks about income inequality as a barrier to economic growth, but the same could be said for water inequality. While there’s more than enough water in some regions, there’s not enough in others. Worldwide, 7 of the 10 largest economies—the very places where businesses want to grow—are in water-scarce regions.

The financial implications of water risks are illustrated by the situation in Brazil, where the majority of electricity comes from hydroelectric dams. A four-year drought resulted in a shift to thermal power generation, pushing electricity prices up by 70%, which eroded profit margins for the businesses in the region.

But businesses that want to invest in water stewardship face many challenges. Water is a shared resource required for basic human survival, but also as an input to manufacturing. Yet there’s no universal standard for the way water is allocated, resulting in a patchwork of regulatory schemes. Moreover, markets do not price water at its true cost to society or in line with supply and demand. In many regions where water is most scarce, it is also cheapest, creating incentives for businesses to grow where their operations will be least sustainable.

Experts suggest a more resource efficient economy will require about $90 trillion in investments over the next 15 years.1 Much investment will be needed to get to a less water constrained economy—whether it is a beverage company CFO directing capital to a water recycling project at a top production facility in a water-stressed location, or a pension fund CIO investing in a corporate green bond that finances a water supply project, or a millennial allocating her retirement benefits into a mutual fund based on a water efficiency index.

Trucost helps businesses solve environmental challenges by using natural capital metrics to assess the financial implications of water scarcity. As an expert in natural capital accounting, Trucost values in monetary terms the societal and business costs of natural capital use. In this way, environmental issues are framed in the language of business. Accounting for the true cost of water enables companies to make the case to allocate capital to business models that provide both a financial and environmental return.

One way Trucost is helping to steer investment toward more sustainable business models is by using robust, science-based data to provide insights on the full value of water. The Water Risk Monetizer, a free, online tool that enables businesses to put a monetary value on water risks, is a groundbreaking collaboration with water technology and services company Ecolab. The Water Risk Monetizer has allowed thousands of users to gain insights into site-specific water risks so they can prioritize investments. Businesses can quantify the increased cost of goods sold or potential revenue lost from water scarcity or pollution, and understand how to set science-based water reduction targets that allow sustained revenue growth.

For example, China Water Risk engaged with over 75 investors to use the Water Risk Monetizer to shadow water price for coal and power companies in Southeast Asia, uncovering how margins could be eroded by water scarcity.

Another way Trucost is steering investment toward more sustainable business models is by providing quantified insights on environmental outcomes. Over five years, the green bond market has surged as investors look to finance projects that deliver environmental benefits. But a barrier to further growth is the uncertainty about environmental benefits from these projects. Bond issuers face reputational risks if green bonds do not deliver environmental benefits, while investors in the bonds can be confused by which bonds are actually better. Working with Golden Credit Rating in China, Trucost created a green bond assessment framework based on the issuer’s disclosure of the project’s positive and negative environmental impacts, the risk mitigation measures, arrangements for performance disclosure, and the issuer’s track record on green bonds.

There are many lessons to be learned from these pioneering efforts to solve global environmental problems, but they all begin with accounting for the true cost of natural capital using robust, science-based data to deliver insights and investment decisions.

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CHAPTER 4: RECYCLING AND REUSE
Freshwater Conservation through Produced Water Recycling

By Sabrina Watkins, Head of Sustainability, ConocoPhillips Co.

Water is an essential natural resource for communities, ecosystems, and economic development. Our operations both use water and produce water, so managing water is a key priority for our business. We focus on advancing technology and innovation to reduce water consumption from freshwater sources through recycling and reuse, and to reduce the volume of water we discharge or dispose. Integrating technology and engineering with our approach to water sustainability has resulted in numerous improvements and innovations.

Water is scarce in the U.S. Permian Basin. Fortunately, up to 90% of the water used in well completions is returned to the surface as produced water. Not surprisingly, water produced during production of oil contains residual oil and must be treated before it is recycled or reinjected into a disposal well. The traditional method for deoiling is based on storing the produced water until the dispersed oil floats to the top to be skimmed off. This method, which relies on density, gravity, and time, is not very efficient. Additionally, it recovers a relatively low percentage of oil and requires large tanks and long wait times, which means a bigger footprint. A pilot project in the Permian Basin has challenged conventional thinking and could impact how we treat produced water as an asset. A new, compact cyclonic deoiler, similar to the cyclonic systems used in offshore production, was tested to see how it stacked up against the old method. The deoiler uses a new liner design that allows processing of dispersed oil at a level that was not possible before. Our team designed an eight-week pilot program to see if the technology could be adapted for use in our unconventional Permian operations. The new cyclonic deoiler performed well, recovering about seven barrels of oil a day and yielding much cleaner produced water. The technology has now been installed at one of our storage facilities in the Permian Basin that stores produced water from approximately 10 unconventional wells, and additional applications are being evaluated for use in conventional and unconventional assets. The process has the potential to reduce our environmental footprint and at the same time save millions in trucking costs over the life of a well, while lengthening the life of owned and operated disposal wells.

Another challenge to produced water treatment is that the water can contain H2S gas, a flammable, naturally occurring gas that is very dangerous at high concentrations. We identified and adopted a degassing process as a chemical-free treatment alternative to remove H2S gas, successfully conducting a 6,500-barrel field trial on a vertical well in the summer of 2015. The treatment removed H2S levels down to zero parts per million. The process was then optimized and successfully tested on a horizontal well, reusing approximately 100,000 barrels of treated produced water on two wells. The treated produced water was stored on site until needed in aboveground tanks featuring a double liner around the storage area and five sensors for leak detection. In the future, we hope to refine and replicate the process, conserving freshwater and reducing project costs. Achievements include the following:

- Recycling and reuse of 100,000 barrels of produced water
- Elimination of more than 800 truckloads of water from local roads
- Implementation of a new treatment technology capable of removing high levels of H2S
- Utilization of a new oxidation technology for bacterial disinfection
- Establishment of guidelines for aboveground storage
Disappearing Act: Are On-Site “Waste to Water” Digesters the Silver Bullet for Institutional Food Waste?

By Hunt Briggs, Consultant, RRS; and Beth Coddington, Consultant, RRS

As the global transition toward circular economies continues to build momentum, the conversations are shifting from “Can we” to “How will we” achieve this locally where we operate? Food waste remains one of the largest material categories headed to landfills and at a hefty price. The U.S. Department of Agriculture and Environmental Protection Agency jointly announced an aggressive domestic goal to cut food loss and waste 50% by 2030, aligning the United States with the related United Nations Sustainable Development Goals. On the heels of that announcement, the Rethink Food Waste through Economics and Data organization published its Roadmap to Reduce U.S. Food Waste by 20% report, which outlines the most promising individual solutions as well as key levers needed to achieve success.

Many corporate campuses and food service operators providing café services are striving to meet zero waste goals, and one solution that has landed on the radar is the on-site “waste to water” machine. These biodigesters, known by names such as “wet” or “gray water” systems or liquefiers, are on-site biological liquefaction machines. The larger biodigesters can daily convert up to a ton of food waste into a watery solution via mechanical and biological processes. Required additives may contain enzymes or microbes, or simply proprietary vitamin/mineral mixes that stimulate already-present microbes to decompose. A purchaser is presented with a wide variety of machines from which to choose, offered by numerous vendors, and they vary in size, daily capacity, water and electricity requirements, and the nature of the accompanying consumables or additives. But the central question is this: how should biodigesters be evaluated as a cost-conscious and environmentally sustainable option for treating food waste?

Business Friendly?
The most attractive quality of the wet digester is the ability to make the putrescible waste “disappear”. This eliminates the need for frequent collection truck trips and costs related to disposal. For food businesses that generate mostly organics, reducing dumpster size and collection frequency can lead to sizable savings, though costs vary widely from one region to another so economics should be evaluated on a case-by-case basis. The purchase or lease price of a machine will vary as well, though a business could easily find itself making a capital investment of $50,000 for a machine and an additional annual operation and maintenance expense for half that amount.

Businesses must also consider operating factors: Can the kitchen accommodate the machine’s footprint? Does the space include the required electrical and water connections? How does the need for daily loading and required additives impact staffing or ongoing costs? Does the machine’s design accommodate the business’s pattern of waste generation—can it accept large and irregular batches, or does it require consistent feeding? All of these questions make the decision more complicated than simply plugging in a box that makes food waste vanish.

Environmentally Friendly?
Perhaps the most important questions are the following: Are biodigesters a food waste solution that is sustainable for the environment? Do they actually constitute a form of recycling in a circular economy? Since these technologies deliver effluent down the drain without any tangible recovery of materials or energy, does this approach simply transfer disposal from landfill to watershed? If the effluent is processed at a water treatment facility, it’s possible some of the food’s nutrients or materials are indeed recycled to the ecosphere through treated wastewater effluent or composted biosolids and might be considered a form of recycling. But beyond recycling, optimized utilization of resources is the aim of sustainable materials management, and many questions remain regarding the net environmental benefits. What actually happens to the calorie-rich fats, proteins, and carbohydrates that constitute the food? Vendors often casually describe the material as simply “going away,” yet the answer depends on the nature of the food waste and the nature of the additives and biological process. The most likely scenario is that large food particles and molecules are partially degraded into smaller ones, and sent into the drain.

Research conducted at Loyola Marymount University on one specific technology suggests that digester effluent can contain exceptionally high nutrient levels, with research samples exceeding 2,000 mg/l in biological oxygen demand (BOD). High BOD imposes additional cost and energy burdens on wastewater treatment facilities, and in some locations may lead to permit violations or surcharges. For example, RRS recently worked with a client whose local treatment plant considers any discharge with BOD greater than 300 mg/l—less than one-sixth the concentration of the sampled effluent—to be “high-strength waste” and will levy additional fees accordingly. Food service waste also contains high levels of fats, oils, and grease as well, which may be subject to reconstitution in sewer lines leading to buildup, clogs, and additional repairs.

Making a Decision
For companies seeking the best solution for food service waste, a variety of other alternatives are available—on-site dewatering systems, dehydrators, grinding/pulping systems, in-vessel composting, vermcomposting and others. Given that reducing food waste has become a business imperative, it is important to holistically evaluate the options and take into account the environmental, economic, and social impacts of each option under consideration.
USG Corporation, an industry-leading manufacturer of building products and innovative solutions around the world, views sustainability from a triple-bottom-line perspective to guide business decisions and create long-term value for the organization, stakeholders, and society.

Overview
The installation of wallboard generates about 10% to 12% of the total waste on construction projects. The 300,000 tons of these materials recycled annually is relatively small compared with the 6 to 13 million tons of wallboard waste that end up in landfills. Wallboard recycling is rarely pursued due to the difficulty of collecting clean wallboard waste from the jobsites, although it is an effort pursued to conserve our world’s natural resources, including gypsum and water.

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USG has recycled wallboard at its manufacturing plants internally for many years, although collecting recycled gypsum and waste at construction projects is challenging. When the opportunity arose to partner with industry groups to develop a methodology for recycling new construction wallboard waste, USG knew it could provide valuable insight and infrastructure.

In May 2014, USG participated in the cross-industry Building Product Ecosystems Initiative (BPE), launched by the Durst Organization with the New School and the City University of New York, to focus on developing a closed-loop wallboard recycling system in New York City. Other building ecosystem organizations that were involved in this pilot program included Lendlease, Cardella Hauling, and USA Gypsum.

Key Learnings
Today, USG has recycled more than 800 tons of gypsum through this pilot program, significantly reducing the amount of water and gypsum that would typically be needed during wallboard production and transportation processes.

Mining, producing, and transporting gypsum require a significant amount of water. However, recycling wallboard reduces water because many steps of the process have been removed, including mining gypsum for new wallboard, preparing synthetic gypsum for use in wallboard manufacturing, and the process of transporting gypsum. The majority of water use in wallboard production occurs during the transportation of the rock from quarry to plant as a method of controlling and suppressing dust. Each day, approximately 1,000 tons of rock are transported, requiring up to 100,000 gallons of water. Recycling wallboard has a potential savings of up to 30 million gallons of water a year.

Additionally, this reground wallboard waste helps conserve water in another industry by being used for agricultural purposes. Farmers have found that adding gypsum to soil reduces the toxicity associated with using reclaimed water to irrigate crops, a common agricultural practice. According to a study from the University of Purdue, gypsum-treated soil can also reduce agricultural watering needs by increasing water retention by as much as 25% to 100%. This specific recycling program diverted 800 tons of gypsum from landfills, which could have saved up to 160,000 gallons of water if used for agricultural purposes.

USG is honored to be part of an initiative shifting the entire wallboard manufacturing industry forward. Although the program currently operates solely in New York, organizers are working to replicate the process in other cities. Overall, this program illustrates how companies can collaborate across industries to find innovative ways to reduce, reuse, and transform waste into usable products. USG is dedicated to finding ways to leverage natural resources in an efficient manner and contribute to the profitability of its business, all while working with its peers to preserve precious resources for the generations to come.
Recent Survey Shows Solid Support for Potable Water Reuse in California

By Abibail Antolovich, PE, North American Reuse Business Development Manager, Xylem Inc.; Albert Cho, Vice President, Strategy and Business Development, Xylem Inc.; Jennifer Jacobs, Manager, Public Affairs, Xylem Inc.; and Kelly McAndrews, Vice President, Global Public Affairs, Xylem Inc.

Water shortages, population growth, and competition for water supplies are driving water providers to consider reusing water to augment drinking water sources, and potentially go directly into drinking water treatment and distribution systems. One of the historical barriers for potable reuse projects is the lack of public acceptance and poor public perception. Recent initiatives have been implemented by the water reuse community to increase awareness and improve understanding, with an ultimate goal of gaining public acceptance. As part of Xylem’s commitment to the water reuse community, it partnered with the California WaterReuse Association to conduct a public opinion survey of Californians in early 2016 to gauge acceptance of water reuse in general, and potable reuse specifically. Specific hypotheses that were tested in the research included the following:

- Today, Californians are not familiar with the specific technologies and processes used to recycle water and the effectiveness of those technologies.
- Once educated on the treatment technologies used to recycle water, Californians are more supportive of water reuse and more willing to use and drink recycled water.
- Recycled water is seen as a short-term solution to drought management rather than a long-term solution to future water security.
- The anticipation of the forecasted El Niño may be making Californians less supportive of or less concerned about water management practices.

The survey results showed substantial support for water reuse and acceptance of using recycled water for potable reuse purposes, regardless of drought conditions. The findings are outlined below:

- Today, California residents are very supportive of using purified water for drinking and domestic purposes.
- While they agree the drought makes them more supportive of water reuse, respondents do not see it as just a short-term fix. Most believe reused water should be used as a long-term solution, regardless of water shortage.
- Knowledge of the water purification process is weak—less than half feel familiar with the technologies used to clean and purify water.
- Education on the purification process is key to increasing support of purified water. After reading a statement on the purification process, virtually all California residents are more willing to use and drink purified water.
- An El Niño heavy precipitation period would not stop support for purified water. While two-thirds of respondents believe that an El Niño is likely to relieve California’s water shortage, they are still concerned about water conservation and nearly all agree the state should continue to invest in purified water for drinking purposes.

Overall, these results demonstrate that general support for using and expanding recycled water supplies exists, and that continued work on education, particularly the purification process, can increase support for incorporating recycled water into potable supplies.

Advanced technologies are a key part of the foundation to support the development of potable reuse projects. Xylem has provided leading solutions for potable reuse projects, including advanced oxidation, disinfection, and filtration. In California, these technologies are helping to combat the water shortages due to drought.

For example, the Santa Clara Valley Water District is using ultraviolet (UV) light to produce recycled water for use by commercial and industrial customers, and the city of Los Angeles is incorporating UV light and chlorine in a cutting-edge advanced oxidation process to augment dwindling groundwater supplies. Xylem’s ozone and biologically active filtration processes are also being provided to produce high-quality water to supplement surface water supplies in San Diego.

To learn more about Xylem’s advanced treatment solutions for water reuse, visit [http://www.xylem.com/treatment/us/applications/reuse](http://www.xylem.com/treatment/us/applications/reuse).
For years, population explosion, demographic shifts, urbanization, aging infrastructure, limited water resources, and economic development have driven our water market, and with that our world’s need for total water solutions. However, in the past decade, we’ve seen these traditional drivers become amplified by climate change and severe weather events around the world—like Superstorm Sandy; floods in the United Kingdom; and severe drought in California, Australia, and Brazil. In many parts of the world, and right here in the United States, there is either too much or too little water.

Climate change is making it difficult to accurately predict how sea-level rise and the variability and intensity of future storms will impact certain regions, which is why we have seen a trend in clients looking for holistic solutions to address their water system challenges and build resiliency into them for future severe events.

Management of raw sewage overflow during wet weather events is a challenge that has plagued utilities since wastewater collection and treatment began. There are two types of systems in the United States. The first type is combined sewer systems, where the wastewater and stormwater are combined into the same collection system and treated at a downstream treatment plant. The combined flow is treated like a wastewater flow, with strict compliance requirements. The second type is separate systems, where the city or utility operates separate systems for wastewater and stormwater. In these systems, the wastewater is treated at a downstream treatment plant. The stormwater is handled in different ways based on the downstream receiving waters, and typically has a much reduced set of treatment processes due to lower compliance requirements.

In both cases, extreme wet weather events create problems with pipelines surging because of flow that exceeds capacities and causes untreated sewage to be released. The high flow for combined systems is apparent because the added component of stormwater flows directly into the collection system.
Separate systems suffer, in varying degree, from infiltration of stormwater through faulty or poorly placed manholes, illicit connections, or damaged sewer pipelines, which can result in overflow of sewage.

The Internet of Things (IoT) is creating new sensing and monitoring opportunities for utilities to use to manage the far reaches of their collection systems. The IoT explosion will have 50 billion connected devices by 2020 and 100 billion connected devices by 2025. To take advantage of the IoT, CH2M’s Intelligent Water Solutions Team has started to deploy smart technology and advanced data analytics to produce near-real-time information and control for utilities to be able to improve their response and minimize overflows into the environment, without having to invest in large and costly storage or capacity expansion. The systems include using cellular sensors for weather conditions like rainfall, pipeline flows, manhole levels, and water quality sensors. The data from the sensors are merged with weather radar data and processed through advanced analytics and real-time models to adjust operations preemptively.

The existing system capacity is optimized by drawing down storage tanks in advance of wet weather, moving wastewater to areas that have capacity based on weather models and hydraulic models, and performing analytics on the wastewater’s water quality to drive treatment decisions. Two examples of different visualizations are illustrated below.

The first example illustrates the impact of an initial rain event at a lift station that has wet weather overflows. The graph shows two large peaks associated with infiltration. The continued infiltration that occurs after the event is a strong indicator of groundwater infiltration into the upstream collection system. The IoT-enabled data from multiple locations were used by the utility to determine where their greatest infiltration problems were and where future capital expenditures should be focused.

The second example is for an agency that is working under an Environmental Protection Agency consent decree for excessive combined sewer overflows. A system was developed to integrate data from multiple sensors for rain, flow, and level in the collection system, and water quality to provide real-time collection system management and minimize overflow. The figure below is a graphical illustration of the asset readiness (on the left) and also the reduction in combined sewer overflows that were avoided through real-time control.

Utilities are faced with many challenges today, and new capabilities can become available by leveraging the IoT explosion, which will require three steps. First, integrating the new technologies, data processing applications, and response protocols will require upfront vision by utilities, ideally preventing a hodgepodge of implemented solutions that cannot be effectively managed or do not provide full benefit for the utility. Second, cultural acceptance will need to be part of the program, as these systems require that processes that have been in place for years be modified or changed. Last, utilities will need to define roles that are dedicated to the program. The end goal is to take advantage of this new wealth of data and maximize the return on investment for the rate payers.

CH2M leads the professional services industry in delivering sustainable solutions benefiting societal, environmental, and economic outcomes with the development of infrastructure and industry. In this way, CH2Mers make a positive difference providing consulting, design, engineering, and management services for clients in water; environment and nuclear; transportation; energy; and industrial markets, from iconic infrastructure to global programs like the Olympic Games. Ranked among the World’s Most Ethical Companies and top firms in environmental consulting and program management, CH2M in 2016 became the first professional services firm honored with the World Environment Center Gold Medal Award for efforts advancing sustainable development. Connect with CH2M at www.ch2m.com or on LinkedIn, Twitter, and Facebook.
Preparing for Water Scarcity: A Tech Company’s Approach

By Fawn Bergen, Global Program Manager, Water Sustainability, Intel Corporation; and Todd Brady, Global Sustainability Director, Intel Corporation

Have you ever thought about the impact the creation of your computers, mobile phones, or other electronic devices has on water? At Intel Corporation, the potential risk of water disruption has been a consideration for many years since water is essential to manufacturing of semiconductor chips (the microprocessor inside your technology device). Intel is the world’s largest semiconductor manufacturer, operating in more than 60 countries and 190 sites across the world. Intel designs and manufactures advanced digital technology platforms, which consist of a microprocessor and chipset. These platforms are used in notebooks, two-in-one systems, desktops, servers, tables, phones, and the Internet of Things (IoT; e.g., wearables, retail devices, and manufacturing devices).

So how does the world’s largest semiconductor manufacturer prepare for and mitigate water scarcity risks related to climate change, drought, and a rising population? Intel uses a multifaceted water strategy based on three main objectives:

- **Reduce** the amount of water used in our operations.
- **Return** water to our local communities.
- **Reinvent** the way they use and conserve water.

**Reduce**

Intel invests in innovative water conservation, recycling, and reuse practices in its global operations. Since 1998, Intel has conserved more than 52 billion gallons of water—enough to sustain more than 500,000 U.S. homes for an entire year. As part of this ongoing commitment, Intel recently announced a multi-million investment in a state-of-the-art water recycling facility located at its Ronler Acres campus in Hillsboro, Oregon. The facility will treat industrial water from manufacturing operations and recycle it back to replace incoming water that is currently used for facility systems including cooling towers, scrubbers, and abatement equipment. Once operational, the Oregon site is expected to conserve up to 1 billion gallons of water each year.

**Return**

Intel treats and returns approximately 80% of the water it uses back to municipal water treatment operations for reuse by local communities. At its Ocotillo campus in Chandler, Arizona, Intel has taken this a step further by partnering with the city of Chandler to construct and operate an innovative Reverse Osmosis (RO) facility. Intel donated the land for the RO facility and covers the annual operating costs. The city treats process water from Intel (approximately 2 million gallons per day) to drinking water standards in the RO facility and then recharges the local aquifer near the city of Phoenix, or sends a portion of this treated water back to Intel for use in its cooling towers. Intel also purchases reclaimed water from the city’s treatment plant for use in cooling towers and site irrigation. Both sources of reclaim water reduce the amount of freshwater used at the Ocotillo site.

**Reinvent**

Intel is developing smart technology that empowers others to reinvent the way they use and conserve water. One example of how Intel is driving this type of innovation is an IoT pilot project conducted in partnership with The Nature Conservancy and Bonneville Environmental Foundation in the Camp Verde area of Northern Arizona. This IoT proof of concept takes a new approach to measure and conserve water used in agriculture. The IoT technology accurately collects soil moisture data and precisely applies water to the root of the crop. Instead of guessing when crops need the water, the sensor technology gives the farmer an accurate read. This maximizes crop yield and reduces overall water use. The solar-powered system includes a weather station, hardware, battery backup, an Intel IoT gateway, cloud-based servers, and wireless data connectivity to enable continuous tracking of detailed weather and moisture data.

Intel has taken a proactive approach to prepare for water scarcity; however, there are still significant challenges to overcome that will require new approaches and collaborative partnerships. Intel is committed to being part of the water solution through efficient water management within its operations, water stewardship and innovative partnerships, and development of technologies that help address the world’s water challenges.
Water Management Solutions for the Global Food and Beverage Industry, from Farm to Table

By Phil Rolchigo, Ph.D., Vice President, Technology, Pentair

The world’s population is growing, and with it a global middle class that will soon surpass 5 billion people. It’s estimated that the growing population and changing diets will increase food demand by 70% by 2050. With irrigation and food production consuming significant amounts of water, this will put tremendous stress on the world’s freshwater supply.

At Pentair, we are focused on developing solutions to help our customers get more food, energy, and process efficiency from each drop of water while protecting people and the environment. Specifically, working with the global food and beverage industry, we provide solutions across the entire food value chain from food cultivation and processing to delivery. Pentair’s technologies help efficiently manage food production so that our customers can increase yield and quality, as well as produce food in new ways. Further, our technologies to optimize energy and water resource usage for food and beverage processing provide customers with more sustainable solutions, while helping reduce their impact on the environment.

Precision Agriculture

According to the U.S. Environmental Protection Agency, agriculture is one of the nation’s leading causes of impaired water quality. Nutrients like nitrogen and phosphorus are essential for growing crops, but they can also trigger algal growth in rivers, lakes, and bays. In communities that depend on lakes and rivers for their drinking water supply, water treatment plants can spend millions of dollars to purify the surface waters.

Pentair’s precision spray nozzles can help protect crops through accurate chemical applications, providing improved coverage and uniformity while also helping farmers use significantly less chemical spray on their crops—thereby reducing the potential runoff to nearby surface water.

Aquaponics and Urban Farming

Water and energy shortages, urban food deserts, and pollution of soils and waterways are driving a need for sustainable farming of nutritious food. Aquaponics, the combined culture of fish and hydroponic vegetable crops in a closed-loop, recirculating aquaculture system (RAS), can help address these challenges as it uses up to 98% less water and can yield up to seven times more produce per acre than conventional farming.

Pentair has been instrumental in helping commercial operations around the globe integrate traditional fish farms and plant production with its RAS solutions. In St. Paul, Minnesota, Pentair is collaborating with Urban Organics to accelerate the development of commercial-scale modern aquaponics. The two companies first started working together when Urban Organics opened its inaugural, 8,500-square-foot aquaponics farm in 2014, and are now working to open a second location that will be approximately 10 times the size of the first site. This will be one of the largest commercial aquaponics facilities in the world, and will have the potential to annually produce 275,000 lbs. of fish and 400,000 lbs. of organic produce.

Food and Beverage Processing

Pentair helps food and beverage manufacturers, such as bottling plants, breweries, and dairy processors, efficiently manage water resources safely and effectively—from treating and purifying water used in the production processes to treating wastewater for reuse or disposal. Our solutions target reducing the overall water and energy footprint of manufacturing plants, helping customers operate more efficiently than ever before.

For instance, approximately 70% of the water entering a brewery ultimately leaves as wastewater containing high levels of liquid and solid organic matter such as carbohydrates, alcohols, and biosolids.

By treating this wastewater with Pentair’s anaerobic membrane bioreactor technologies, this wastewater is converted into three valuable resources: (1) water that can be recycled for non-food contact applications within the manufacturing facility, (2) methane that can be used as an energy source, and (3) carbon dioxide that can be reused within the carbonation process. These innovative, integrated solutions enable today’s most sustainable breweries.

Efficient Food Service Operations

Pentair provides clean water solutions to nearly 2 million cafes, restaurants, coffee shops, fast food venues, and grocery stores worldwide. Reverse Osmosis (RO) is often used for water purification as it is extremely effective at substantially reducing a wide variety of contaminants, and provides a consistent taste for beverages, such as coffee or soda, from location to location around the globe.

However, RO traditionally wastes a large amount of water as a portion of the water supply must be used to flush the contaminants to drain. To address this issue, Pentair has innovated a highly efficient RO system to provide an average water recovery of 80%, compared with 20% of conventional systems. The savings are significant. In total, Pentair customers utilizing this technology prevent 2.5 billion gallons of water from going down the drain annually.

Our changing world requires bold solutions, new thinking, and innovative ideas. At Pentair, we combine global perspective and deep expertise to develop real solutions that help the world obtain more food, energy, and efficiency from each drop of water.
Sustainable Management of Produced Water for Chevron’s San Ardo Oil Field

By John Brinker, Vice President, Major Projects, Veolia North America

Project Scope
Chevron’s San Ardo oil field in Southern California recovers more than 10,000 barrels of heavy oil each day. The oil extraction process generates large volumes of produced water that require treatment and management, typically disposed of by deep well injection. Chevron engaged Veolia’s water treatment technology, engineering, and operations experts to provide a solution for sustainably treating the produced water. This would allow Chevron to minimize its water impact while maximizing efficiency and significantly expanding production.

To achieve this objective, Veolia designed the first produced water facility in the world to use its proprietary OPUS® technology, a multiple-treatment process that removes contaminants sufficiently to meet the established requirements for discharge. In this case, the treated water is used in two ways—it is reused for steam generation, and then released into aquifer recharge basins that replenish local water resources and increase available oil for recovery.

Veolia’s Solution
The design for Chevron San Ardo’s produced water treatment process includes a common pretreatment step for free oil removal, followed by Veolia’s proprietary OPUS® technology to achieve the discharge water quality required. The process also uses a Series Softening System for steam generation makeup water.

Since the plant was commissioned in 2008, Veolia has operated and maintained the facility for Chevron. Under its operations and maintenance contract, Veolia provides operations for the plant that treat a combined 150,000 barrels of produced water daily, and oversees the facility’s maintenance according to an established performance guarantee. Additionally, Veolia provides Chevron with on-site and off-site technical and engineering support to troubleshoot issues, maintain optimal operations, prevent failures, and implement processes to help maximize oil production.

Results Delivered
Veolia’s innovative application of its OPUS® technology—groundbreaking for produced water management—has delivered exceptional value back to Chevron San Ardo. By developing a sustainable solution that allows up to 50,000 barrels per day of produced water for surface discharge and another 75,000 barrels per day for steam generation, Chevron is minimizing its environmental impact on water-stressed California by returning water to the aquifer recharge basins. And by avoiding deep well injection, Chevron has a long-term solution for managing produced water that limits its regulatory risk and supports expanded production activities.

Thanks to Veolia’s expert operations and maintenance staff who run the facility for Chevron, the produced water is consistently treated to levels that allow for surface discharge to replenish local water resources—a critically important factor for oil field operations and their social license to operate in California. With plant operations handled by Veolia, Chevron can focus on its core operation of oil production.

By partnering with Veolia, Chevron San Ardo accomplished its objective of achieving a more circular, sustainable, and reliable business operation.