

When wastewater isn't wasted

Water reuse and recycling in America's public and private sectors



Introduction

The world's mismanagement of wastewater¹ puts the health of humans and the environment at risk. Over 80% of wastewater flows back into the environment untreated.² This has severe, cascading effects. It exacerbates the rates of water-related diseases, cripples marine and freshwater life, and increases dangerous greenhouse gas emissions of methane and nitrous oxide. Human society and our environment are compromised as a result. The World Health Organization reports that every 90 seconds a child dies from a water-related disease.³ Poisoned, unproductive areas called "dead zones" plague the ocean. One of these "dead zones" as large as the state of Connecticut forms annually in the Gulf of Mexico, due to factors including excess nutrient loading influenced by poorly treated wastewater in the Mississippi River basin.⁴ All of this is occurring in the background of an impending water shortage crisis.

Much work needs to be done to halt and reverse the impact of wastewater. So much so, that it has been included in the U.N.'s Sustainable Development Goals, with a target of substantially increasing water recycling and safe reuse by 2030. A renewed focus on corporate and municipal reuse of water will be vital to both achieving this goal, and protecting companies and cities from the significant risks they are facing. Over a quarter of companies reporting to CDP's investor water program experienced detrimental impacts from water in 2016, and of the 111 US cities reporting to CDP in 2016, 74 of them

report substantive risks to their cities water supply in the short or long term. However, reusing wastewater poses an enormous opportunity for companies and cities to reduce their environmental impact while safeguarding water resources for citizens.

Providing a roadmap for corporate improvement in water reuse, this paper reviews case studies from 138 US companies and a further 111 US cities on water reuse technologies and opportunities that were reported to CDP in 2016. There were more than 1000 instances of companies mentioning reuse and recycle in their 2016 CDP Water responses, from more than 318 companies. The case studies focus on three main areas companies can look to when further integrating water reuse into their work:

- ▶ How companies have successfully prioritized water reuse;
- ▶ A variety of water recycling projects and the associated savings; and
- ▶ Models for collaboration with surrounding communities and/or cities, which is a critical next level in achieving water security.

We hope that by showcasing the positive efforts of US companies on water reuse we spur interest in these opportunities peer companies are pursuing, ultimately driving increased corporate and municipal levels of water reuse and recycling.

Investors are taking interest in water reuse practices, and rightfully so. Corporate water risk is being realized throughout operations. Companies expect over half of the 4,416 water risks they identified through CDP in 2016—such as drought, declining water quality, and regulatory and reputational risks—to materialize within the next six years. Water reuse is a common mitigation strategy for these risks, and will become increasingly essential as global trends continue to lower water security. For example, when water risks are imminent or already impacting business in many basins, reuse may be necessary to ensure business continuity.

▶ **Colgate Palmolive** reports that over the course of 2015 their "manufacturing sites in Brazil have invested in numerous water recycling technologies, including reverse osmosis, as a way to treat and reuse water for utilities such as cooling towers and boilers. These investments ensured continued operation during the recent water crisis in São Paulo."

Sometimes, increasing water reuse and recycling can also increase greenhouse gas emissions, since energy is required to operate most wastewater treatment or reuse systems.

▶ Packaged foods company **ConAgra** reports that "single pass cooling is more energy efficient than recirculated water cooling systems. Our Hebrew National facility in Quincy, MI was able to reduce more than 80 percent of total water use by recirculating water in new condensers. While the project greatly helped our glide path to reducing water use by 20 percent by 2020, it added additional electricity with mechanical cooling and fans to recycle the water."

While water reuse can increase emissions, technology improvements help address this trade off; for example, wastewater treatment plant upgrades that lower the operating energy needed.

▶ Water technology company **Xylem** reports an example of "a wastewater treatment plant in Liberty, New York, which upgraded the oxidation system at the plant using Xylem's new Sanitaire Silver Series and Flygt mixer. Previously, each oxidation system required 100 horsepower. Using the new system, the plant was able to reduce the required energy load to 57 horsepower, a 43% reduction. This has led to a saving of more than \$36,000 per year at the plant."

Water recycling can bring a variety of benefits and tradeoffs, not only to a company's environmental strategy but to their overall operations and growth plans. Companies incorporate water reuse and recycling into their sustainability and business growth strategies in a variety of ways:

▶ American petroleum and natural gas exploration company **Anadarko** reports that their growth strategy includes "implementing comprehensive water recycling programs in the Rockies, Southern and Appalachia regions, and evaluating recycling opportunities globally."

▶ "In 2015 **GE** announced several Ecomagination partnerships, including a partnership with MWH Global and Goldman Sachs to mitigate growing global water scarcity by expanding and financing industrial and municipal water reuse and the adoption of water-saving reuse technologies."

The water challenge: preserving a global resource

Zachary Sadow, Energy Equity Research Analyst, Barclays

In a new report titled *The water challenge: preserving a global resource*, Barclays Bank PLC and the Columbia Water Center explore the extent of the water challenge, and in particular, how the energy sector – a large consumer and user of water – can take advantage of opportunities to become more efficient and sustainable in its water management. The research shows that companies that implement sustainable water practices, such as reusing water and building efficient infrastructure, can lessen the energy industry's contribution to fresh water scarcity and quality issues.

The study focuses on three sectors: oil and gas, electric utilities, and water utilities. It makes the case for investment in water-related technologies and infrastructure that would enable the energy industry to treat wastewater effectively as a resource. The report argues that companies that can reduce freshwater usage and costs will be best positioned for an uncertain water future. It also highlights opportunity for public-private partnerships and capital investment in the water utilities industry, and concludes that collective action is needed to improve transparency and encourage investment in innovative technologies.

Water availability may reach crisis proportions in less than 15 years, with a 40% global shortfall in water supply versus demand predicted by 2030.⁵ The reality is that as the human population grows, higher levels of water reuse will be necessary to ease the stress on aquifers.

¹ Wastewater is any water that has been adversely affected in quality by anthropogenic influence. Wastewater can originate from a combination of domestic, industrial, commercial or agricultural activities, surface runoff or stormwater, and from sewer inflow or infiltration.

² <http://www.worldwaterday.org/resources/> On average, high-income countries treat about 70% of the urban wastewater (industrial and municipal) they generate, while that ratio drops to 38% in upper-middle-income countries and to 28% in lower-middle-income countries. In low-income countries, only 8% of industrial and municipal wastewater undergoes treatment of any kind (Sato et. al. 2013; Agricultural Water Management 130: 1-13).

³ http://www.who.int/water_sanitation_health/monitoring/jmp-2015-update/en/

⁴ <https://weather.com/news/climate/news/gulf-of-mexico-dead-zone-noaa-prediction-forecast-2016>

Learning from success: Achievements in water reuse

One strategy companies can take to prioritize water reuse and recycling is to set an overall goal.

- ▼ **Kellogg's** 2020 sustainability commitments include goals to "implement water reuse projects in 25% of our plants by 2020".
- ▼ The **Coca-Cola Company** has a goal to "recycle the water used in our operations by returning treated process water to the environment at a level that supports aquatic life."

Companies in the Energy and Utilities sectors have reported integrating widespread water recycling into operations, which can reduce withdrawal quantities of freshwater.

- ▼ **CONSOL Energy** reports that "through our partnership with the Center for Sustainable Shale Development, we are required to recycle a minimum of 90% of our flowback water. In our coal operations, we also aim to recycle water where possible. At our Pennsylvania coal facility, we recycled nearly 82% of water used in coal operations."

- ▼ In **Range Resources Corp's** core operating area, the Marcellus Shale, "Range uses treated water from U.S. Pennsylvania-permitted treatment facilities that originated from other Exploration & Production (E&P) operators within the area. This contributes to a play-wide recycling and reuse program... Range recycles nearly 100% of its produced/process water from its E&P operations. This represents a significant percentage of our total water usage."

- ▼ **Sempra Energy** reports that "Given the location of our operations, minimizing water use is a significant priority in our ongoing operations and new facilities. As a result we use very little fresh water: 90 percent of the water we use is salt/brackish; 8 percent recycled and 2 percent freshwater. This helps us to avoid the potential for imposed water restrictions that would impact our operations."

- ▼ **IBM's** Watson Research Centre in Yorktown Heights, New York, has implemented a rooftop rainwater harvesting system that captures more than 1 million gallons (3.78 megaliters) of water for reuse in the site's cooling towers annually.

- ▼ **Lexmark International** reports that their Boulder, Colorado, site has initiated a water reuse program with annual savings of 16.8 megaliters. "The site uses a reverse osmosis cleaning process to recycle a portion of water generated by manufacturing activities and utilizes a portion of the water coming from the labs and industrial processes in cooling towers. In 2015, Boulder estimated approximately 3,940 m³ of water reuse via reverse osmosis and 12,870 m³ of water reuse in cooling towers."

- ▼ A **Lexmark International** facility in Juarez, Mexico, also focuses on water reuse projects, seeing 23.14 megaliters of annual savings. "23,139 m³ of water from production processes were reused in multiple ways, including cooling towers and the toner manufacturing processes, representing 20 percent of the total water consumption at this site."

- ▼ **Integrated Device Technology** reports that their annual water withdrawal total from municipal supply "includes 25.56 mega-liter of recycled water for land irrigation at one facility," representing a 4.54% increase in recycle water use.

- ▼ Of **Marvell Technology's** withdrawal of water in the reporting year, "68 of the 165 megaliters withdrawn from municipal suppliers were recycled water."

- ▼ A **Constellation Brands** case study reviews upgrades in FY16: "our Mission Bell Winery spent \$3.5 million to eliminate high salt wastewater streams from our process water disposal, which is land applied. The dissolved salts will be removed using steam boilers and evaporators, and the dry salts will be hauled offsite. As a result, approximately 250 tons of salt that would normally be disposed of in our wastewater fields will be removed, and we will save more than 18 million gallons of water a year [68 megaliters/year] through reuse of the demineralized water in our boiler system."

- ▼ **Alcoa** continues "to expand the use of the Alcoa-developed Natural Engineered Wastewater Treatment (NEWT™) system to treat sanitary and process wastewater, which is then reused in our manufacturing processes. In March 2016, we began operating a NEWT system at our facility in Wichita Falls, Texas, USA, a region that has been experiencing severe drought. The system is expected to treat and recycle 73,815 cubic meters (19.5 million) gallons of wastewater annually. The location expects to reduce its overall water usage by 68%."

- ▼ **Biogen** reuses "produced/process water for cooling tower makeup as well as irrigation at our Cambridge and RTP-DS sites to reduce the amount of water needed for our operations (83 ML condensate / reclaimed water and 3 ML grey water)."

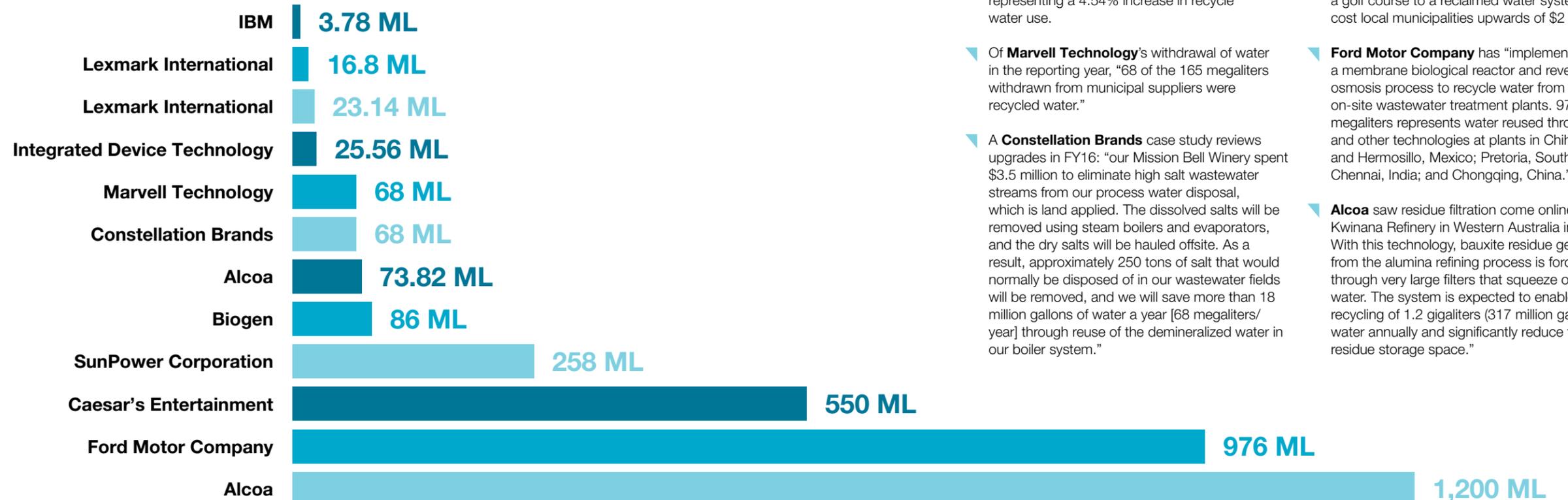
- ▼ **SunPower Corporation** reports that "In 2015 alone, we invested over \$60,000 in over 30 voluntary projects that reduced annual water usage estimated at 258 megaliters. The investments in these projects saved us an estimated \$250,000 in operating costs" and many projects involved water reuse.

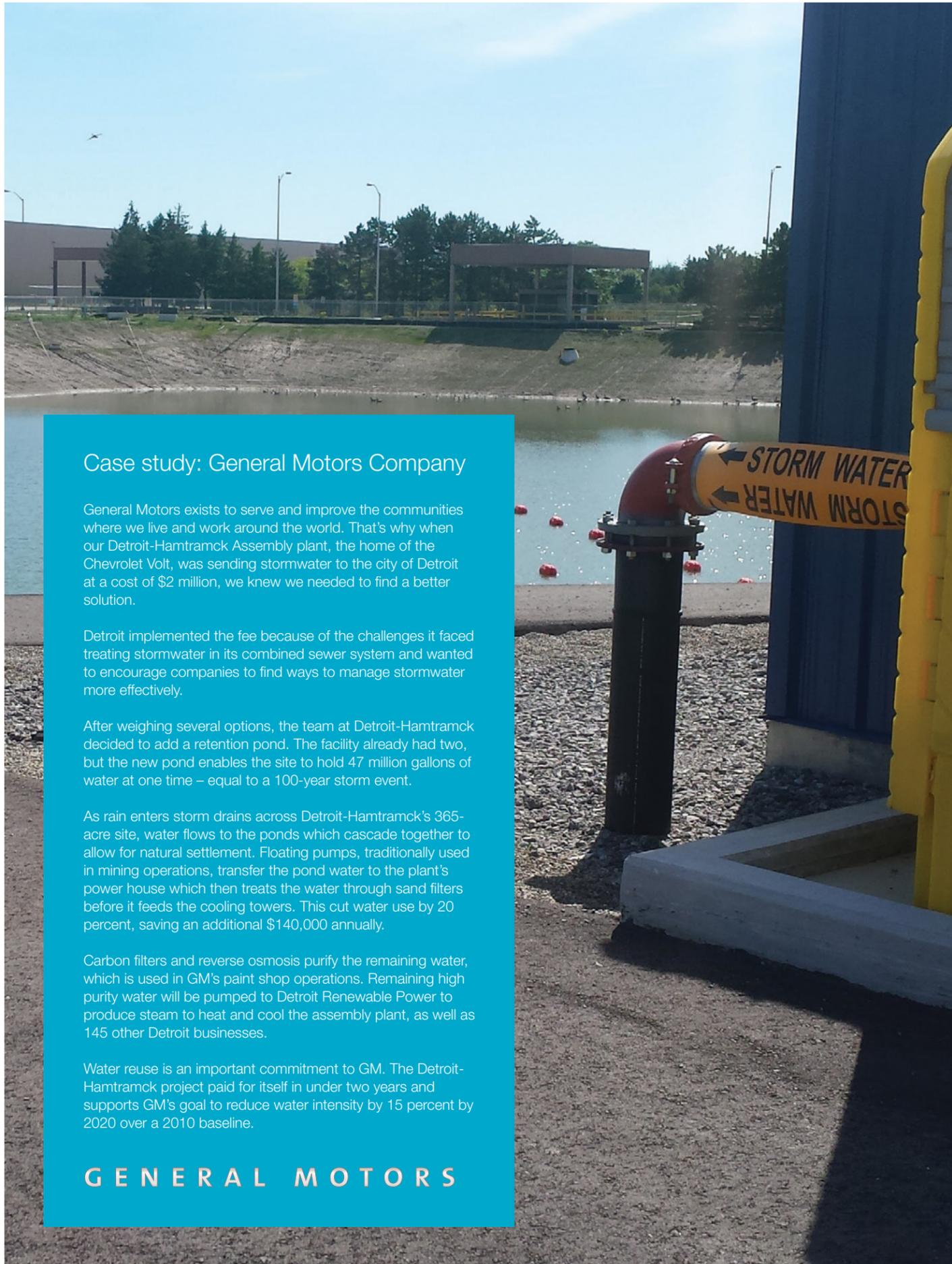
- ▼ **Caesar's Entertainment** has one golf course in the Las Vegas area using recycled water saving 550 megaliters/year. They report that connecting a golf course to a reclaimed water system could cost local municipalities upwards of \$2 million.

- ▼ **Ford Motor Company** has "implemented a membrane biological reactor and reverse-osmosis process to recycle water from our on-site wastewater treatment plants. 976 megaliters represents water reused through this and other technologies at plants in Chihuahua and Hermosillo, Mexico; Pretoria, South Africa; Chennai, India; and Chongqing, China."

- ▼ **Alcoa** saw residue filtration come online "at our Kwinana Refinery in Western Australia in 2016. With this technology, bauxite residue generated from the alumina refining process is forced through very large filters that squeeze out the water. The system is expected to enable the recycling of 1.2 gigaliters (317 million gallons) of water annually and significantly reduce the active residue storage space."

Water reused by companies in megaliters per year





Case study: General Motors Company

General Motors exists to serve and improve the communities where we live and work around the world. That's why when our Detroit-Hamtramck Assembly plant, the home of the Chevrolet Volt, was sending stormwater to the city of Detroit at a cost of \$2 million, we knew we needed to find a better solution.

Detroit implemented the fee because of the challenges it faced treating stormwater in its combined sewer system and wanted to encourage companies to find ways to manage stormwater more effectively.

After weighing several options, the team at Detroit-Hamtramck decided to add a retention pond. The facility already had two, but the new pond enables the site to hold 47 million gallons of water at one time – equal to a 100-year storm event.

As rain enters storm drains across Detroit-Hamtramck's 365-acre site, water flows to the ponds which cascade together to allow for natural settlement. Floating pumps, traditionally used in mining operations, transfer the pond water to the plant's power house which then treats the water through sand filters before it feeds the cooling towers. This cut water use by 20 percent, saving an additional \$140,000 annually.

Carbon filters and reverse osmosis purify the remaining water, which is used in GM's paint shop operations. Remaining high purity water will be pumped to Detroit Renewable Power to produce steam to heat and cool the assembly plant, as well as 145 other Detroit businesses.

Water reuse is an important commitment to GM. The Detroit-Hamtramck project paid for itself in under two years and supports GM's goal to reduce water intensity by 15 percent by 2020 over a 2010 baseline.

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The case for collaboration

The previous section looked at water reuse projects companies are implementing within their own operations; here we switch focus to review the enormous opportunities available from collaboration between companies and cities on wastewater and reuse.

There is a strong need to support cities around the world on water issues. From the 533 cities reporting to CDP in 2016, 61% foresee a risk to their water supply and are seeking investment in existing infrastructure, storm water management, watershed preservation and diversifying their water supply. 111 US cities reported to CDP in 2016, and 74 of them report these substantive risks to their cities water supply in the short or long term. Since water is a shared resource, advancing sustainable use and management requires cooperation of all water users in a river basin, such as corporations, government entities, NGO's, and local communities. When companies work with stakeholders in the surrounding area on local water projects, they are increasing the security of their own water supply alongside building goodwill and license to operate.

Benicia, California could implement a non-potable water reuse project that would supply approximately 2 million gallons/day [2625 ML/year] of water for use in cooling towers at the Benicia Valero Oil Refinery. This project would reduce the City's water needs by more than 20%, thus increasing the reliability of supply for the City and Valero.

Electric utility **Pinnacle West Capital Corporation** "works closely with local water utilities that provide water supplies to our facilities. For example, we work with the City of Phoenix to assure the reliable delivery of recycled water to the Palo Verde Nuclear Generating Station (Palo Verde) and the Redhawk Power Plant (Redhawk)."

The city of **Phoenix, Arizona** reports to CDP that they're seeking funding to install equipment at their water treatment facility to clean up the methane emissions. The equipment will inject the resulting bio-gas into a nearby natural gas pipeline to generate US\$9M in revenue annually. US\$25 million is required to deliver these results.

French waste and water giant **SUEZ's** West Basin County water recycling facility, in Los Angeles, produces 240,000 m3/day of recycled water, equal to the consumption of more than one million people. Representing 22% of water resources of the County by 2020, the facility helps reduce the dependency of the Los Angeles region on conventional resources as well as on imported water, in spite of growing demand.

Ford Motor Company states that "In Chihuahua City, most of the local residents are only able to receive water in their homes at certain times during the day. Ford Chihuahua Engine Plant (ChEP) purchases treated wastewater from the municipality for use as process water. Therefore, the plant uses purchased potable water for human consumption only. Additionally ChEP treats its wastewater onsite and reuses approximately 80 percent back into the industrial process. The rest is used for land irrigation around the plant."

Mining company **Freeport McMoran** reports that "In 2015, Cerro Verde in Arequipa Peru completed construction of a wastewater treatment plant that intercepts raw sewage that would otherwise be discharged into the Chili River and processes it for both use at Cerro Verde mine and for return of treated water into the Chili River. Prior to construction, Cerro Verde reached agreement with the Regional Government of Arequipa, the National Government, the local water utility company, and other local institutions to allow it to reuse an average of one cubic-foot-per-second of the treated water to support the recently completed concentrator expansion. Through local stakeholder engagement, the outcome has been a "win-win" for the local community, regional government and Cerro Verde."

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