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GE POWER – WATER AND PROCESS TECHNOLOGIES

BEFORE THE U.S. SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES - SUBCOMMITTEE ON WATER AND POWER

"INCREASING WATER SECURITY AND DROUGHT PREPAREDNESS THROUGH INFRASTRUCTURE, MANAGEMENT AND INNOVATION"

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INTRODUCTION

Chairman Flake, Ranking Member King, and Members of the Subcommittee on Water and Power, thank you for the opportunity to testify before you today regarding the importance of securing a sustainable water future. My name is Heiner Markhoff. I am the President and Chief Executive Officer of the Water & Process Technologies division within the GE Power business. My business provides industrial and municipal customers with innovative equipment and chemistry technologies, connected and optimized by digital solutions; and we work with our customers to solve the world's toughest water challenges as they pertain to water availability, water quality and meeting regulatory requirements. We are driving toward energy neutrality in the treatment of wastewater, ridding wastewater of harmful contaminants prior to discharge back into the environment and capturing the valuable byproducts from wastewater treatment to generate new revenue streams.

GE WATER & PROCESS TECHNOLOGIES

With operations in approximately 130 countries and employing roughly 7,500 people worldwide, GE Water & Process Technologies is one of the world's leading advanced water treatment technology companies. Known for its comprehensive set of chemical and equipment solutions, and a growing portfolio of predictive analytics, GE Water & Process Technologies enhances water, wastewater and process productivity. The business strives to enable customers to meet increasing demands for clean water, overcome scarcity challenges, strengthen environmental stewardship and comply with regulatory requirements. Over 4,000 customers have chosen to connect over 40,000 assets into GE Water & Process Technologies' InSight platform, allowing real-time responsiveness to changing operating conditions. Its installed base of technologies and solutions enables customers to treat over three billion gallons of water per day. To continue its leading position within the water industry, GE Water & Process Technologies anticipates an investment of $500 million in research and development over the next 10 years.

On March 8, 2017, GE entered into a definitive agreement to sell the Water & Process Technologies business to SUEZ, a global services and solutions company with operations primarily in water and waste management. The deal is anticipated to help the company achieve growth in new regions with a complementary suite of products that will continue to solve customers' toughest water challenges. Although the business's name will change, we will continue to be headquartered here in the United States, and continue to serve our customers' needs throughout the United States.

GAINING CLARITY ON THE WATER ECOSYSTEM

According to market research, the global population will grow by another three billion people by 2050. This growth in population will require 55 percent more water and approximately 70 percent more energy[1]; a demand that cannot be met with current resources. Communities worldwide cannot be fed or fueled without a sustainable supply of water.

[1] http://unesdoc.unesco.org/images/0022/002257/225741E.pdf

A common misconception regarding water use positions residential customers as the biggest water consumers. Repeatedly, residents are asked to conserve water, when in fact the biggest impact lies within agriculture and industry. Industry is the second largest consumer of water after agriculture. It takes vast quantities of water to produce items people use every day; everything from electricity and food products to clothing and paper all require water for production. While consumers indirectly use the most water via the products and services they purchase, manufacturers and industrial producers are the primary stewards of this precious resource.

Our industrial and municipal customers face a number of challenges in providing for growing populations. One of the biggest challenges industrial users face is reduced access to water, often termed water scarcity. Water resources are increasingly scarce with populations and industry growing in regions where water may have already been in short supply, where climate cycles impact the regeneration of this normally abundant resource and where water delivery is impacted by aging and damaged infrastructure[2].

It is important to recognize that in many cases our natural environment is changing because of human interaction. This in turn stress water supply and storm and wastewater systems[3]. As humans use land for residential and commercial construction purposes, the interruption in groundwater flows heightens the effect of strengthened weather events. When water can no longer be absorbed into the ground, the volume of water routed around foundational structures requires better storm water management to prevent overflows with disastrous consequences.

Finally, industrialized and developing regions often not only lack access to right-sized and sustainable infrastructure, but they also lack the ability to treat the increased volumes and severity of wastewater being produced to an acceptable level before recharging the ecosystem. As water experts study the origins and impacts of contaminants in wastewater, new problems are often discovered that need to be solved. The rise of micropollutants in wastewater from humans and a growing bio pharmacological industry, as well as an increase in heavy metals from wet scrubbers in power plants to reduce emissions, drive the need for new technologies and solutions to help customers. What we have realized is that by treating wastewater to a level near that of what is found naturally in the environment, in certain circumstances, we can provide a new stream of water supply. This is water reuse at its core.

It is estimated that globally only four percent of wastewater is currently reused[4]. In Israel, nearly 80 percent of wastewater is reused[5], and in Singapore, 40 percent of water demand is met with what is called NEWater, the brand name given to reclaimed water produced by Singapore's Public Utilities Board[6]. Although it is difficult to find data, in the United States, approximately seven to eight percent of municipal wastewater is reused[7], but in areas like California, nearly 16

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[2] American Society of Civil Engineers, Infrastructure Report Card 2017

[3] http://oilandgas.ohiodnr.gov/portals/oilgas/pdf/stormwater/rld_11-6-14all.pdf

[4] WateReuse Association

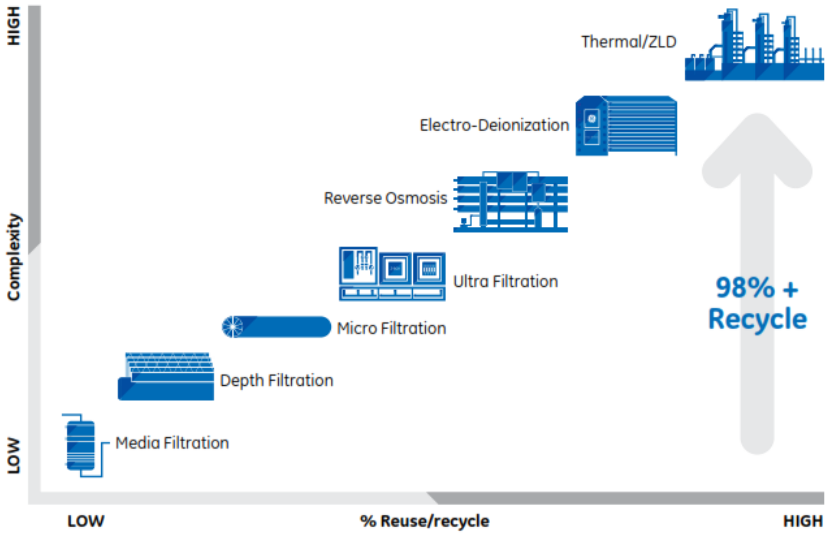
[5] http://www.haaretz.com/israel-news/science/.premium-1.648332

[6] https://www.pub.gov.sg/watersupply/fournationaltaps/newater

[7] Miller, 2006 and GWI, 2009

percent of the 1.6 trillion gallons[8] of municipal wastewater per year is reused. This is an increase of about 6 percent between 2009 and 2015[9]. Whether for municipal, industrial, or agricultural purposes, we have a huge opportunity to tap into that wastewater and reuse it for productive needs.

To help our customers capitalize on this opportunity, GE Water & Process Technologies has built a comprehensive portfolio of technologies and solutions to treat water, wastewater and processes. Our technologies can be configured and combined to treat varying flows and quality of water specific to a customer's plant. One of the areas we focus on is treating wastewater for reuse. As shown in the chart below, we have a complete suite of reuse technologies that can recover 98 percent or more of wastewater, depending on the application.



As Chief Executive Officer for GE Water & Process Technologies, my mission has been to listen to customer needs, to help create solutions for their growing challenges and to sustainably optimize and maximize their industrial growth while preserving water resources.

OVERCOMING WATER SCARCITY THROUGH TECHNOLOGY

Traditionally, technology to increase water supply has often been focused on the desalination of seawater and brackish water. Desalination is a very important part of the mix to enhance supply, and may be the best option for some communities based on specific geographic needs. We supply these systems, but we know they are often challenging to implement and operate, and they are energy intensive. When comparing costs to treat drinking water, some studies have shown that both seawater desalination and indirect potable water reuse cost about six to seven

[8] https://www.nrdc.org/sites/default/files/ca-water-supply-solutions-reuse-IB.pdf
[9] https://www.newsdeeply.com/water/community/2017/07/18/california-is-poised-for-big-gains-in-recycled-water-use,

times more to treat than conventional means[10]. However, since it is often not necessary to treat wastewater to potable standards (e.g., for many industrial uses), reuse often costs far less than seawater desalination. In addition, by streamlining project implementation, by using energy efficient wastewater technologies and by directly reusing treated wastewater in a closed-loop system or routing it for agricultural and industrial purposes, we can reach the point where annualized water reuse costs will begin to achieve parity with conventional water treatment.

Another advantage of water reuse over desalination, when and where possible, is the avoidance of a concentrated byproduct discharged back into the original water source. With desalination, often times the brine (salt) that is extracted in the water treatment process, is added back into the original water source at much higher levels per volume than when it was extracted, which can have a negative impact on the water ecosystem. Embracing the importance of the circular economy, we have solutions that can treat these byproducts for use in other marketplaces. While this is not a common practice today, it is one example of what is possible when looking at a holistic approach to water and resource management.

As I mentioned, one of the biggest opportunities the world has yet to capitalize on is the reuse of wastewater streams to alleviate the pressure of finding and creating new water resources. Our business surveyed the public on World Water Day (March 22, 2017) regarding its perceptions of reusing wastewater for potable consumption. The response was reassuring with 49 percent willing to drink reused water, up from 30 percent just five years prior. Even though we work with communities around the world to help them reuse their wastewater, we also focus on water reuse for industrial processes where water does not have to be treated to the same standard to be safely used.

For example, we have customers in upstream oil and gas production, refining and power generation worldwide that are adopting our water reuse solutions.

In Orlando, Florida, a coal-fired power plant is using our brine concentration and crystallization technologies. This combination of technologies create what is known as zero liquid discharge, or ZLD, to treat cooling tower blowdown wastewater. This solution enables the reuse of 95 to 98 percent of that wastewater within the cooling tower unit, with the remainder treated to a quality compliant with discharge limitations.

In addition to facing water scarcity challenges, many of our power customers also face the challenge of meeting effluent limitation guidelines (ELGs). Flue gas desulfurization or FGD systems are used to limit emissions from thermal power plants from being released into the air with the use of wet scrubbers. The contaminants that are removed from the air end up in wastewater streams that often need to be treated before they can be discharged into water bodies such as rivers. In Petersburg, Indiana, our ZLD solutions will be used to treat FGD wastewater, allowing it to be reused within the cooling tower unit. Creating a closed-loop cooling system is one solution that lessens the demand for freshwater withdrawal and protects surrounding water bodies.

[10] Global Water Intelligence

Our solutions for tough-to-treat wastewater also help refineries and petrochemical customers to reach 100 percent reuse. In Canada, the Federated Co-Operatives Limited's Co-op Refinery Complex in Regina, Saskatchewan has been recognized as the Industrial Water Project of the Year by Global Water Intelligence. Combining a membrane bioreactor with a High Efficiency Reverse Osmosis (HERO[11]) system, the refinery is able to process two million gallons of its wastewater and reuse it for steam production for heating, for powering equipment and for use in cooling towers. This system will reduce the refinery's use of freshwater by 28 percent.

In Stockholm, Sweden, membrane bioreactor (MBR) technology is used to treat wastewater at the Henriksdal municipal wastewater treatment facility. It is the largest MBR plant in the world, and it treats two-thirds of the municipal wastewater for the city of Stockholm, Sweden. As a city with one of the fastest growing populations in Europe the facility can process approximately 228 million gallons of wastewater per day. With increasing discharge restrictions on phosphorous and nitrogen into the Baltic Sea and with physical plant expansion limitations, MBR technology can keep up with demand in a smaller footprint while using less energy.

At Doubletree Paper Mill in Arizona, production expansion was limited by capacity at the city water treatment plant. By using GE's membrane bioreactor technology, Doubletree doubled its paper production capacity while demonstrating good environmental stewardship in the water constrained southwest through the use of reuse technology.

In nearby Tempe, Arizona, the Kyrene Water Reclamation Plant was able to double its municipal wastewater treatment capacity with the use of GE's LEAPmbr[12] membranes in the same footprint. The reused water meets Arizona's Class A+ water reclamation standards and is pumped into networks that serve irrigation systems and industrial processes.

LEAPmbr systems for municipal wastewater reuse in the southwest are some of our best examples of how technology is working to help cities hedge against water scarcity. In North Las Vegas, the membrane bioreactor system treats nearly three times the volume of wastewater, 25 million gallons per day, as that of the Kyrene plant. This application enables the city of North Las Vegas, Nevada to reduce its energy and maintenance costs including an estimated 29 percent reduction in membrane scour energy costs.

These noteworthy projects demonstrate the feasibility of reuse and energy savings in multiple settings across the globe. While these larger projects have created a precedent, it is not to overshadow similar, smaller projects that aim to achieve the same goals, and when combined, create the biggest impact in the environments and communities where they operate.

CREATING SUSTAINABLE WATER NETWORKS

Water and energy have a symbiotic relationship, referred to as the water-energy nexus, that presents unique challenges to our customers. Water is needed for energy production, and likewise, energy is needed to purify or transport water to where it is needed.

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[11] Trademark of General Electric Company; may be registered in one or more countries.

[12] Trademark of General Electric Company; may be registered in one or more countries.

The focus for industries and municipalities alike lies in how each can first reduce their energy consumption, and second, increase water production or utilization. This is an opportunity to transform the economic and environmental sustainability of how we use, treat and manage our water resources.

If we focus on the treatment of wastewater, we realize that the consumption of energy is substantial. Publicly owned wastewater systems use 75 billion kilowatt hours of energy per year – that is enough electricity to power over 6.5 million homes[13].

The energy used for water and wastewater treatment at a typical municipal plant in the United States accounts for 35 percent of that municipality's energy budget[13].

Looking at municipal water systems, electricity can constitute 80 percent of the costs associated with processing and distributing water for human consumption, while electricity costs for wastewater treatment comprise between 25 and 40 percent of a typical plant's operating budget[14]. By implementing technology that focuses on reducing energy consumption, there is a very real opportunity to optimize the water-energy value network.

Consider the fact that the energy content of municipal wastewater is two to four times greater than the energy required to treat it. At Water & Process Technologies, we have existing technologies and solutions that reduce plant energy demand, capture energy from wastewater, and turn that energy into biogas, which can then ultimately be turned into electricity or other valuable byproducts such as fertilizer.

The Metropolitan Water Reclamation District (MWRD) of Greater Chicago is a great example of a municipality that is embracing technology to make significant changes in their water-energy value network. As one of the largest wastewater utilities in the country, MWRD has a progressive goal to be energy neutral by 2023.

Power needed for aeration and pumping accounts for 50 percent of the electricity consumed onsite. Using membrane aerated biofilm reactor (MABR) technology at MWRD's O'Brien Water Reclamation Plant (WRP) estimates that it can save up to 30 percent of the current amount of electricity used for aeration. Compared to conventional fine bubble aeration systems, MABR technology is four times more efficient.

We continue to see plants upgrading equipment to help with energy efficiency and to start on a path of energy neutrality.

These case studies aim to highlight the importance of adopting energy efficient wastewater reuse technology and their impact on water-energy value networks; networks that, when connected to digital monitoring platforms, can create cost savings and productivity gains that move industry toward making technology adoption possible at scale.

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[13] EPA http://www.epa.gov/region9/waterinfrastructure/training/energyworkshop/docs/2009/energystar-benchmark.pdf.

[14] EPA Energy Efficiency in Water and Wastewater Facilities, 2013

BARRIERS TO THE ADOPTION OF TECHNOLOGY IN THE WATER INDUSTRY

In our journey to drive water reuse globally, we have come to understand common barriers. These include scaling advances in technology for increasingly tough-to-treat water, developing financial instruments and mechanisms for project investment and implementing policies that help municipalities operate and reinvest at the rate of population growth.

The majority of this testimony has focused on how advanced water treatment solutions can be adopted by communities and industries to help address challenges. Deploying these technologies across the water ecosystem will help secure our water future, and I believe that GE Water & Process Technologies, and other technology providers and research institutions, will continue to find ways to bring innovation to market.

In addition to developing and implementing water reuse technologies, GE Water & Process Technologies has released a series of reports highlighting a menu of policy options for promoting more rapid adoption of reuse solutions. The major policy options include:

- Education and outreach to provide information on and recognition of water recycling and reuse efforts.
- Reducing or removing regulatory or cost barriers that prevent more water recycling and reuse.
- Providing financial, regulatory or other incentives for water recycling and reuse.
- Requiring more water recycling and reuse.

CONCLUSION

Businesses and communities rely on technology solutions to improve the security and reliability of water supply and delivery networks, to optimize operations for increased productivity and to decrease the impact on the environments and communities where they operate. We are looking forward to collaborative partnerships for the development and creation of business and service models that make investment feasible and more accessible.

We believe that our technology can help unlock the economic power of water by adopting water reuse programs to weather climate cycles, by harnessing the energy in wastewater for energy neutral plant operation and by leveraging data and analytics, via the industrial internet, to solve complex water infrastructure and treatment challenges.

We would welcome the opportunity to collaborate with the Water and Power Subcommittee in furthering the adoption of technology for water reuse and the optimization of our precious water resources for our communities and industries.

Thank you for holding this important hearing and for the opportunity to present this testimony. I look forward to your questions and to working with you over the longer term to help create a sustainable water future.

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