

world water

Volume 40 / Issue 6
November / December 2017

Middle East Report
Water Arabia 2017. Page 14

Advanced Metering
Swimming in savings. Page 27

Project Design
Mine water operations. Page 28

Decentralized Treatment
Creative reuse solutions. Page 39



Moving toward water resiliency in arid regions

A Supporting Publication of

weftec
the water quality event™

Saudi Vision 2030

Moving toward optimal water use

The Kingdom of Saudi Arabia is taking proactive steps to achieve reductions in water consumption by promoting desalination, water reuse, and conservation. **Patrick Dube** of Water Environment Federation reports on the nation's water strategy that aims to solve water scarcity challenges.

The Kingdom of Saudi Arabia has begun to take significant steps as part of its national plan – Saudi Vision 2030 – that is designed to solve its impending water crisis by promoting the optimal use of water resources. In early 2017, the government earmarked US\$24.5 billion for the environment, water, and agricultural sectors with the purpose of reducing water consumption and increasing the use of treated and renewable water.

Although water is a cause for concern throughout the world, the Middle East is one of the most water-stressed parts of the world, and the region is facing critical water scarcity issues as a result. Populations continue to grow as large oil reserves represent wealth and opportunity; however, the Middle East is home to some of the harshest environments on the planet. Frequent droughts, low water reserves, and minimal rainfall all combine to place many

of these countries in the “extremely high-water-stress” range in most studies. Furthermore, climate change threatens the region with rising temperatures, increased desertification as the Sahara expands northward, and rising sea levels, which could lead to an estimated 25 million persons affected.

By some estimates, natural water resources in Saudi Arabia could be in danger of disappearing within the next 20 years. Groundwater, which has always been scarce, is not replenishing at rates faster than it is being withdrawn. This issue is partly caused by decades of historical water misuse in the agriculture industry. An agricultural boom led to Saudi Arabia briefly being one of the largest exporters of wheat in the world, but as the agriculture industry continued to draw enormous amounts of groundwater, reserves were depleted. Despite efforts to curtail

agricultural water consumption, which has included the elimination of wheat production, the effects are still being felt to this day.

Saudi Arabia has recognized that water is a critical issue and has begun to take steps toward addressing the country's water problem. Major domestic investments have aimed to update the aging water infrastructure throughout the country. Saudi Vision 2030 is a nationwide plan designed to decrease the Kingdom's dependence on oil, diversify its economy, and develop public service sectors. To achieve this goal, the government outlined three pillars believed to be critical to the Saudi Vision: a vibrant society, a thriving economy, and an ambitious nation. Nested in the first pillar – a vibrant society – is a commitment to the environment and natural resources, as stated in the plan, “We will also promote the optimal use of our water resources by reducing consumption and



Saudi Arabia has recognized that water is a critical issue and has begun to take steps toward addressing the country's water problem.

Above: A group tours the Saudi Aramco North Sewage Treatment Plant to learn how water is treated in Saudi Arabia. Photo by Patrick Dube



utilizing treated and renewable water.”

In addition to increased funding, the Kingdom has begun to work toward meeting this goal in a variety of ways. One example is the recent Water Arabia 2017 conference, held in Al-Khobar, Saudi Arabia, on October 17-19. The Saudi Arabia Water Environment Association (SAWEA) hosts the conference and exhibition event every 2 years. SAWEA is a member association of the Water Environment Federation (WEF). Supported by the Saudi Arabia Ministry of Environment, Water & Agriculture, this year's conference addressed a wide range of topics specific to the region through its focus, “Sustaining Water Resources Through Innovative and Reliable Water and Wastewater Treatment Technologies.” Relevant sessions focused on advanced desalination topics with presentations titled “Desalination in Saudi Arabia: Changing the Game,” “Forward Osmosis Systems for Sea Water Desalination,” and “The Innovative Energy Efficient Seawater Desalination RO System with Advanced Technologies: Mega-ton Water System.”

Keynote speeches made throughout the conference focused on another critical topic area, water reuse, and highlighted the need for further research and implementation of technologies in the region. Saudi Aramco Vice President of Engineering Services Abdullah O. Al-Baiz spoke about the company's commitment to water reuse and called for industry and the government to work together to implement water conservation strategies. Industry partnerships were on full display as Koichi Inoue, director for project coordination at the Japan Ministry of Economy Trade & Industry (METI), gave a presentation describing the unique

symbiotic relationship that Japan and Saudi Arabia share. Many companies in Japan specialize on advanced water treatment while Saudi Arabia is looking for new and innovative ways to meet its growing water demands. As a result, both countries benefit from their relationship as Japan helps its native companies expand globally and the Kingdom works toward meeting Saudi Vision 2030 goals.

The collaboration between the two countries was outlined in Inoue's presentation, and details shared about a recent trip that SAWEA made to Japan also highlighted the work both countries are doing to help meet the needs of their populations. Additionally, workshops, seminars, and a vendor exhibition offered more opportunities to discuss solutions to water scarcity in the Kingdom.

The Kingdom has placed a high priority on the adoption of water reuse techniques, which are considered essential for meeting increasing water demands. Agriculture consumes the most water in the Kingdom, and the industry is a prime candidate to use reused water. Reusing treated wastewater for agricultural irrigation can free up the limited freshwater available while allowing it to be used to augment municipal potable water.

The Saudi Aramco North Sewage Treatment Plant treats an average of 53 million liters per day (mld) before sending the water to a tertiary treatment facility for filtration and reuse. One beneficiary of this reused water is Rolling Hills Golf Club, located in Dhahran, Saudi Arabia. Featuring 18 holes inside the Saudi Aramco Residential Camp, this course is a green oasis that sits amid the typical rocky and rugged Saudi terrain. The golf course is watered with reclaimed water from the treatment plant and

serves as a proof of concept of the benefits of reusing wastewater.

Direct and indirect potable reuse are other options available to help address the lack of water in the region. Direct potable reuse involves the treatment of wastewater to a drinking-water-quality level before being used for consumption. Although direct potable reuse offers the opportunity to turn wastewater directly into a valuable resource, public acceptance and safety concerns keep it from being a realistic technology in the region. Indirect potable reuse, however, discharges treated wastewater into environmental systems such as lakes, rivers, or aquifers and allows the water time to help degrade any unwanted contaminants before it is eventually used for drinkable water. As the water does not go from toilet to tap as direct potable reuse does, it provides an important distinction for users between wastewater and drinking water and is therefore more likely to be widely accepted.

Surrounded on three sides by salty bodies of water, Saudi Arabia has sensibly turned to desalination to meet water needs and, as a result, has become a world leader in desalination. Early in 2017, Saudi Arabia completed the US\$7.2 billion construction of the Ras Al Khair Desalination Plant, the world's largest solar-powered desalination plant. The plant serves approximately 3.5 million people in the capital city of Riyadh by producing 1.025 million cubic meters (m³) of drinking water daily while keeping costs and emissions low via renewable energy. The



The Khobar Water Tower is located off the North Corniche in Al Khobar, Saudi Arabia and is responsible for supplying water to the city. Photo by Patrick Dube

Top: His Excellency Mansour H. Al Mushaiti, Deputy Minister of Environment, Water and Agriculture speaks with Dr. Patrick Dube of the Water Environment Federation at Water Arabia 2017.

plant achieves high efficiency by using a hybrid system of multi-stage flashing distillation and reverse osmosis to produce fresh water on the Persian Gulf coast before it is sent to Riyadh. Excess heat from the distillation process is captured and used to generate energy along with the solar cells, so much that of the 2,400 megawatts (MW) that the plant produces, only 200 MW is used for onsite operations while the remaining electricity is used outside the plant.

The future of desalination in the Middle East is bright with additional investments being made to ensure the region will continue to be the worldwide leaders. Highly saline Gulf waters, however, are a limiting factor. As water is generated, removed salts are discharged into the seas that surround the region, resulting in a high concentration in the water that harms the local ecosystems and drives up the costs of continuing to use the technology. Additionally, although desalination is a proven technology, the high costs of construction and operations further drive research into alternative technologies to investigate better and less costly technologies for future use.

Water in the Middle East will continue to be a problem as rainfall remains low and limited groundwater sources are not being recharged at rates fast enough to support the water demands of growing populations. Governments in the region have invested significant resources in research and development to increase water resources for their constituents; however, water scarcity will continue to be an issue. Furthermore, although water reuse and desalination technologies are available and effective, they alone cannot completely solve the problem.

The agricultural industry could improve water use efficiencies while greater public awareness of water consumption could improve water conservation initiatives and thereby support increased demographic and economic growth with available resources. Countries including Saudi Arabia are taking the right steps by implementing proactive national programs, such as Saudi Vision 2030, to make water efficiency a high priority and to achieve water security in the region.

Author's Note

Patrick Dube, PhD, is a technical program manager in the Water Science and Engineering Center at the Water Environment Federation, based in Alexandria, Virginia, United States.