Abstract #214, 224th ECS Meeting, © 2013 The Electrochemical Society

Technical and Economic Opportunities for Water Purification and Sensing for WHO Development Goals

Amul D. Tevar, Will Regan, Varun Mehra

DOE Advanced Research Projects Agency-Energy (ARPA-E)
Washington, DC, 20585

The dependence of energy production on water usage and availability – known as the Energy-Water Nexus – is a critical area of focus. The amount of potable water available has changed globally in recent years, exacerbating the fragile dependency of energy production on water resources in both developed and developing countries. Consequently, creating energy and cost efficient water treatment systems could have impacts on the energy sector and additionally reduce the global burden of water borne diseases[1].

A significant gap in clean water access remains in many areas of the world, and millions continue to suffer water, sanitation and hygiene linked diseases, despite marked improvements in water access from 1990 to 2011 (Fig 1). This gap will likely widen as increasing energy demand diverts more fresh water for thermoelectric power plant cooling[2].

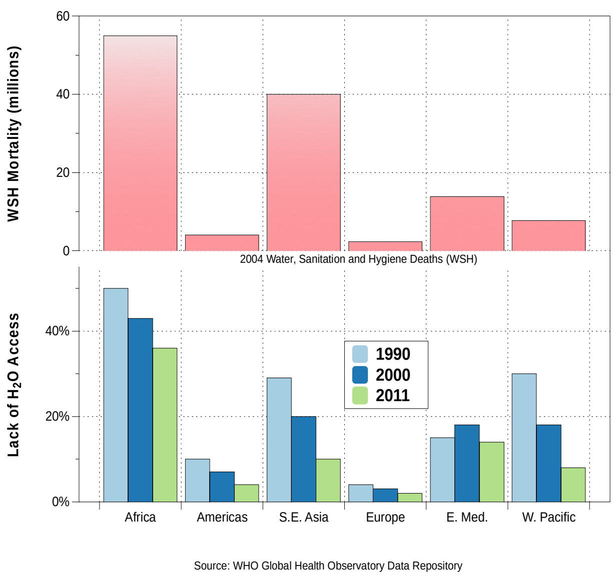

Figure 1: (Upper) Water, sanitation and hygiene (WSH) linked deaths in WHO regions and (Lower) global access to clean water between 1990 and 2011. Source: WHO[1].

There are efficacy issues with conventional methods of water treatment. For example, the well-established sodium hypochlorite approach faces difficulties in consistently neutralizing viral contaminants and addressing non-biological contamination since water characteristics can vary widely regionally. New electrochemical technologies could address some of these gaps if challenges with the water-electrode interface, energy efficiency, and system stability in non-ideal water can be solved[3,5].

There is a tremendous need for new sensing approaches that balance price, specificity and sensitivity. An ideal sensing system would be low-cost, low-energy and able to test for a variety of contaminants, such as arsenic and other pollutants. In addition, this system could be used across geographically variant water sources while remaining viable for populations that live on <$2/day[3,4,6].

For many new solutions to have global impact, especially those solutions based on electrochemistry, there are technical challenges and economic barriers to be considered beyond efficacy and cost. The supply chain, purchasing power, and system size can change the viability of technological approaches as urban vs. rural populations, income stratification, solutes and types of pathogens are considered[1,3,4].

There has been some recent success with novel material innovation, such as the Lifestraw, that seek to address WHO goals and access a potential $20 billion dollar market through new water treatment technologies[4]. In spite of the complexity of creating new technology for low-income users, there are many exciting potential first-markets.

References:

1. WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, *Progress on Sanitation and Drinking-water: 2010 Update*.

2. Bloomberg New Energy Finance, *China's Power Utilities in Hot Water*, 2013.

3. Shannon et al, *Nature*, vol. 452, pg. 301-10, 2008.

4. IFC/WRI, *The Next 4 Billion, Market Size and Business Strategy at the Base of the Pyramid*, 2007.

5. Malato et al, *Catalysis Today*, vol. 147, pg. 1-59, 2009.

6. Li et al, *Biosensors & Bioelectronics*, vol. 26(12), pg. 4656-60, 2011.