Energy-Water Nexus

by Dan Mueller

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There is an old saying, partly flippant but with some thread of truth, that "whiskey is for drinking and water is for fighting." Couple this with the world's ever increasing need for plentiful and reasonably-priced energy and the facts are evident that water needs and energy supply are intimately linked.

Meeting the demand for water, including the need for purification, distribution, and treatment requires energy.

Energy Needs Water

Water is a key factor in the development and utilization of energy resources. An obvious association is hydro-electric power; however, water is also used for the extraction of specific energy resources (just follow the recent issues with hydraulic fracturing to release natural gas from shale formations), as well as refining, processing, and transportation. Add to that the water use associated with environmental controls (e.g., cooling and emission scrubbing) and it's clear that water is an integral component of the production of energy.

Water withdrawn for thermoelectric power is typically returned at nearly the same quantity, although usually at a higher temperature and with some potential changes in quality. Additionally, water withdrawn is, in a large part, available for other uses. With recent advances in technology, newer power plants withdraw less water than older facilities, but many of the newer plants consume more of the water they withdraw by evaporative cooling. Based on a 2004 report produced for the U.S. Geological Survey, U.S. freshwater withdrawals in 2004 were dominated by thermoelectric power facilities (39%)—the second largest water use sector, second only to water use associated with irrigation (40%).[1]

Other energy sectors also require significant water resources. In rough numbers, the refining of oil products requires approximately 1–2.5 gallons of water for every gallon of product. Based on a 2006 study,[2] the United States refined nearly 800 million gallons of petroleum products per day, equating to 2 billion gallons of water per day. Natural gas processing and pipeline operations consume an additional 0.4 billion gallons of water per day.

There are many other water resource impacts associated with energy extraction and fuel production, including water demands associated with mining and the production of biofuels, as well as potential water resource impacts (i.e., water requiring management and treatment prior to release). So it is evident that to provide energy, water resources are needed and impacted. But energy is also required to mange water needs.

Water Needs Energy

Meeting the demand for water, including the need for purification, distribution, and treatment requires energy. A recent Electric Power Research Institute report estimated that 4% of all U.S. power generation is used for water supply and treatment.[3] With an increasing population, there will also be an increase in future water demand. Likewise, the energy costs to provide water will increase, as water will likely have to be transported greater distances.

Additionally, more energy-intensive water treatment needs (both as a result of raw water quality, as well as possible more stringent water treatment requirements) will increase the energy requirements for the water supplied. As mentioned earlier, irrigation needs account for the largest sector of water use in the United States. Technological advances are providing more efficient irrigation techniques (i.e., water-efficient spray irrigation vs. gravity-driven flood irrigation), but these techniques are also more energy-intensive.

Smart resource management is the hallmark of the environmental profession. The link between water and energy is clear and the impact that water policies and regulations have on energy supplies and demands, and vice versa, must be acknowledged. The wise use of our natural resources, water conservation and reuse, energy efficiency and efforts to utilize renewable energy to the fullest extent that technology will allow, and advances in technology to enhance these efforts is critical to a sustainable future. em

Reference

1 Hutson, S. et al. Estimated Use of Water in the United States in 2000; *U.S. Geological Survey* **2004**, *Circular 1268*.

2 *Annual Energy Outlook 2006: With Projections to 2030*; Energy Information Administration: Washington, DC, 2006.

3 U.S. Electricity Consumption for Water Supply & Treatment—The Next Half Century; *Water and Sustainability* **2002**, (4) 1006787; Electric Power Research Institute: Palo Alto, CA, 2002.