

Energy Consumption Associated with Water

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There is a growing interest in the relationship between energy and water.¹ It takes energy to process water, and water is needed to produce energy.² As a result, saving water also saves energy. The reverse is also true.

Energy is used to:

- pump raw water from its source,
- treat it (including pumping it between treatment processes), and
- distribute it

Once the water is used and becomes wastewater, energy is used to:

- collect the wastewater,
- treat it, and
- discharge it.

The amount of energy used per unit volume of water processed varies considerably from situation to situation. For example:

- California moves water hundreds of miles over two mountain ranges requiring much more energy than most water systems;
- Energy use increases with the amount of processing needed depending on the quality of the raw water;
- Energy for distribution depends on the age, efficiency and extent of the distribution network;
- Energy use in process wastewater depends on the ability to use gravity to move raw sewage;
- The more extensive the wastewater treatment, the more energy is required.
- There are considerable economies of scale in the size of wastewater treatment plants; and
- The distance from wastewater treatment plants and the final discharge location impacts the energy required to pump the effluent.

¹ Dr. Allan Hoffman, U.S. Department of Energy, "The Linkage Between Water and Energy," presentation to Roundtable on Science and Technology for Sustainability, The National Academies, September 24, 2009

² For example, driving a conventional gasoline-fueled automobile typically expends between 0.07-0.14 gallons of water/mile when the water consumed in refining the gasoline is considered. Source: Carey King and Michael Webber, "Water Intensity of Transportation," *Environmental Science & Technology*, Vol. 42, No. 21, 2008, pp. 7866-7872. For another example, to produce 10,000 kilowatt-hours of electricity, CPS Energy consumes 4,300 gallons of water. Source: Solar San Antonio, "Local Potential for Solar Power," June 15, 2008.

Average national estimates for the energy intensiveness of water processing are provided in Table 1. The associated CO₂ emissions are estimated to be 290 million metric tons per year, or 5% of U.S. total.³

Table 1. Estimated National Energy Intensiveness of Water Processing⁴

Water Use Cycle Segments	Range of Energy Intensity (kWh/MG)	
	Low	High
Water Supply and Conveyance	0	14,000
Water Treatment	100	16,000
Water Distribution	250	1,200
Wastewater Collection and Treatment	700	4,600
Wastewater Discharge	0	400
Total:	1,050	36,200

A recent report on the water-energy connection in Texas concluded that an estimated 3.2 to 4.9 TWh of electricity is consumed annually in water and wastewater treatment in the State.⁵ This amounts to an estimated average of 2,177 to 3,333 kWh per million gallons of water.

Energy consumption is closely managed in San Antonio where the San Antonio Water System (SAWS) is one of the largest customers of CPS Energy and *vice versa*. SAWS has joined the Energy Research Alliance of San Antonio established by the University of Texas at San Antonio, Southwest Research Institute and CPS Energy. In 2008, facility-level metering at SAWS found that the extraction, processing and distribution of potable water took 1,939 kWh per million gallons, while wastewater treatment took 2,232 kWh per million gallons.⁶

Assuming an average monthly use of 9,000 gallons of water and 7,000 gallons of wastewater⁷, a household in San Antonio consumes nearly 400 kWh in water consumption and processing in a year. This is approximately the same amount of electricity that a dishwasher consumes in a year or that a 45-watt lightbulb burning continuously day and night for entire year will use.

³ Bevan Griffiths-Sattenspiel and Wendy Wilson, *The Carbon Footprint of Water*, River Network, May 2009

⁴ Ibid.

⁵ Ashlynn S. Stillwell, et al., *Energy-Water Nexus in Texas*, The University of Texas at Austin and Environmental Defense Fund, April 2009.

⁶ Personal communication with Dan Titerle, Office of Energy Management, SAWS, January 12, 2009

⁷ SAWS, "Water News," Special Infrastructure Edition, 2004.