Center for Sustainable Systems

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factsheets

U.S. Water Supply and Distribution

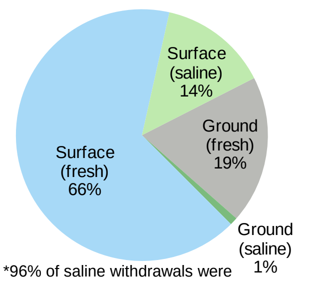
Patterns of Use

All life on Earth depends on water. Human uses include drinking, bathing, crop irrigation, electricity generation, and industrial activity. For some of these uses the available water is not clean enough and requires treatment prior to use. Over the last century, the primary goals of water treatment have remained the same – to produce water that is biologically and chemically safe, is appealing to consumers, and is non-corrosive and non-scaling.

Sources of Water

- 86% of the U.S. population obtains its water from a privately or publicly owned water source; the remainder obtains water from domestic wells.[1]
- Surface sources account for 80% of all water withdrawls.[1]
- About 155,000 privately and publicly owned water systems provide piped water for human consumption – of these, roughly 52,000 (34%) are community water systems (CWSs). 22% of all CWSs provide water to 70% of the population served.[2]
- In 2006, CWSs delivered an average of 96,000 gallons/year to each residential connection and 797,000 gallons/year to non-residential connections.[3]

Sources of Water Withdrawals[1]



*96% of saline withdrawals were for thermoelectric-power use

Water Treatment

- The Safe Drinking Water Act (SDWA), first enacted in 1974 and amended in 1986 and 1996, regulates contaminants in public water supplies, provides funding for infrastructure projects, protects sources of drinking water, and promotes the capacity of water systems to comply with SDWA.[4]
- Typical water quality parameters that are monitored for violations of drinking water standards by EPA include: microbials; organics – volatile organic compounds and synthetic organic chemicals, and inorganics – nitrates, arsenic, radionuclides, lead, and copper.[2]
- Of all CWSs, 91% are designed to disinfect water, 23% are designed to remove or sequester iron, 13% are designed to remove or sequester manganese, and 21% are designed for corrosion control.[3]

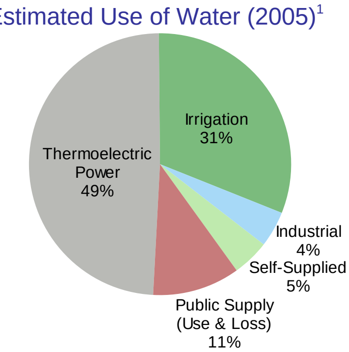
Size Categories of Community Water Systems[2]

System Size (population served)	Number of CWSs	Population Served (millions)	Percent of CWSs	Percent of U.S. Population Served by CWSs
Very small (25-500)	29,160	4.87	56%	2%
Small (501-3,300)	13,858	19.9	27%	7%
Medium (3,301-10,000)	4,838	28.1	9%	10%
Large (10,001-100,000)	3,728	106.3	7%	36%
Very large (>100,000)	404	133.1	1%	46%
Total	51,988	292	100%	100%

Uses[1]

- In 2005, total water use in the U.S. was estimated to be 410 billion gallons per day (Bgal/d). Thermoelectric power (201 Bgal/d) and irrigation (128 Bgal/d) accounted for the largest withdrawals.
- Per capita use was roughly 44% higher in western states than in eastern states, primarily due to the volume of water used for crop irrigation in the west.
- In 2005, California and Texas accounted for 16% of all freshwater withdrawals in the U.S. down from 18% in 2000. CA and TX reduced total water use 11% and 10% respectively from 2000 levels. Florida and California accounted for 40% of saline-water withdrawals in the U.S.

Estimated Use of Water (2005)[1]



Energy Consumption

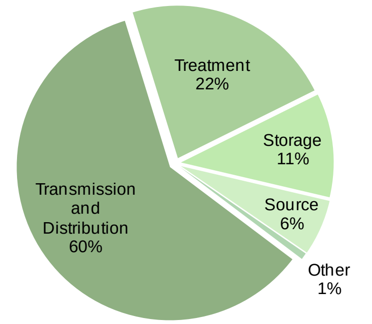
- Four percent of the nation's electricity use goes towards moving and treating water and wastewater. Approximately 80% of municipal water processing and distribution costs are for electricity.[5]
- Groundwater supply from public sources requires 1,824 kilowatt-hours (kWh) per million gallons – about 30% more electricity on a unit basis than supply from surface water, primarily due to a higher requirement of raw water pumping from groundwater systems.[5]
- The California State Water Project is the largest single user of energy in California. It consumes 5 billion kWh/yr, on average – more than 25% of the total electricity consumption for the entire state of New Mexico. In the process of delivering water from the San Francisco Bay-Delta to Southern California, the project uses 2-3% of all electricity consumed in the state.[6]

Life Cycle Impacts

Infrastructure Requirements

- The 2007 Drinking Water Infrastructure Needs Survey and Assessment found that the nation's water systems need to invest $334.8 billion over the next 20 years in order to continue to provide clean and safe drinking water to their customers.[7]
- 60% ($200.8 billion) of the total national need is current need and 40% ($134.1 billion) is estimated as future need: $200.8 billion for transmission and distribution, $75.1 billion for treatment, $36.9 billion for storage, and the remainder for other systems.[7]
- Water systems maintain more than 2 million miles of distribution mains. In 2000, nearly 80% of systems were less than 40 years old, while 4% were more than 80 years old.[8] From 2001-2006, over 56,000 miles of distribution mains were replaced and 225,000 miles were newly added.[3]

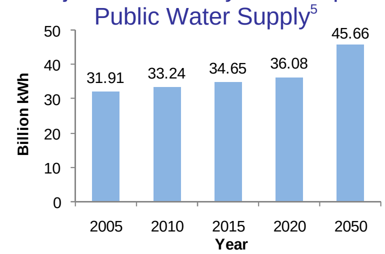
Total 20-Year Need by Project Type[7]



Electricity Requirements

- Electricity required to supply fresh water to public agencies was about 32 billion kWh in the year 2000.
- One study projects electricity consumption to exceed 36 billion kWh by 2020 and 46 billion kWh by 2050 (see figure).[5] This increased production of electricity may result in environmental burdens, whose magnitude will depend directly on the fuel mix at generating facilities – fossil, nuclear, hydro, solar, wind, and biomass.

Projected Electricity Consumption
Public Water Supply[5]



Consumptive Use

- Consumptive use is an activity that draws water from a source within a basin and returns only a portion or none of the withdrawn water to the basin. The water might have been lost to evaporation into the atmosphere, incorporated into a product such as soft drinks or beer and shipped out of the basin, and/or be transpired into the atmosphere through the natural action of plants and leaves.[9]
- Of the 137 Bgal/d freshwater withdrawn for irrigation, 76.2 Bgal/d is lost as a consequence of consumptive use, e.g., losses through evaporation and transpiration. The irrigation sector accounts for 81% of the total freshwater loss through consumptive use. Consumptive use for each of the other sectors including industry, thermoelectric, domestic, livestock, aquaculture and mining, and public uses and losses total only 19%. The total freshwater consumptive use in the United States has been reported as 94 Bgal/d.[1, 10]

Solutions and Sustainable Alternatives

Supply Side:

- Major systems that offer significant energy efficiency improvement opportunities include pumping systems, pumps, and motors.
- Periodic rehabilitation, repair and replacement of water mains infrastructure would help improve water quality and avoid leaks.
- Achieve on-site energy and chemical usage efficiency to minimize the life cycle environmental impacts related to the production and distribution of energy and chemicals used in the treatment and distribution process.
- Reduce chemical usage for treatment & sludge disposal by efficient process design, recycling of sludge, recovery & reuse of chemicals.
- On-site energy generation from renewable sources.
- Effective watershed management plans to protect source water; this is often more cost-effective and environmentally sound than treating contaminated water. For example, NYC chose to invest between $1-1.5 billion in a watershed protection project to improve the water quality in the Catskill/Delaware watershed rather than construct a new filtration plant at a capital cost of $6-8 billion.[11]
- Only 0.4% of U.S. freshwater comes from brackish or saltwater. Desalination technology, such as reverse osmosis membrane filtering, unlocks large resources, but more research is needed to lower costs, energy use and environmental impacts.[12]

Demand Side:

- Better engineering practices:
    - plumbing fixtures to reduce water consumption – high-efficiency toilets, low-flow showerheads and faucet aerators
    - water reuse and recycling – gray water systems and rain barrels
    - efficient landscape irrigation practices
- Better planning and management practices:
    - pricing and retrofit programs
    - proper leak detection and metering
    - residential water audit programs and public education program

Source: http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/awcfund.asp

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2 Environmental Protection Agency (EPA) (2010) *Public Drinking Water Systems:Facts and Figures.*
3 EPA (2009) *EPA (2009) 2006 Community Water System Survey.*
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12 The National Academies (2008) *Desalination: A National Perspective.*