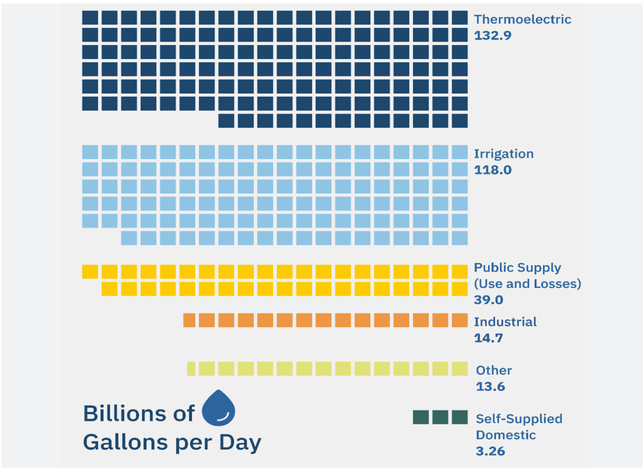
U.S. Water Supply and Distribution

All life on Earth depends on water. Human uses include drinking, bathing, crop irrigation, electricity generation, and industrial activity. For some of these uses, water 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, appealing to consumers, and non-corrosive and non-scaling. The problems and solutions to maintaining water supply vary significantly by region. Failure by governments to enforce drinking water regulations and promptly protect public health resulted in lead contamination and cases of Legionnaires' disease in Flint, MI.[1] The arid southwest faces droughts, and decreasing water levels at the U.S.'s largest reservoirs, Lake Powell and Lake Mead, are impacting hydropower production.[2] In marine systems such as south Florida, increased fresh water use has led to the need for desalination plants.[3]

Patterns of Use

- In 2015, U.S. water use was approximately 322B gal/d, 87% of which was freshwater.[4] Thermoelectric power plant cooling (133B gal/d) and irrigation (118B gal/d) were the largest withdrawals.[4] Between 2005 and 2015 U.S. water use decreased by 21.5%, mainly due to a 33.8% reduction in thermoelectric power withdrawals.[4] Though 41% of daily water use is for power plant cooling, only 3% of these withdrawals are consumptive.[4] Irrigation includes water for agricultural crops and water used for landscaping, golf courses, parks, etc.[4]
- In 2015, California and Texas accounted for 16% of U.S. water withdrawals.[4] These states along with Idaho, Florida, Arkansas, New York, Illinois, Colorado, North Carolina, Michigan, Montana, and Nebraska account for more than 50% of U.S. withdrawals.[4] Florida, New York, and Maryland accounted for 50% of saline water withdrawals.[4]

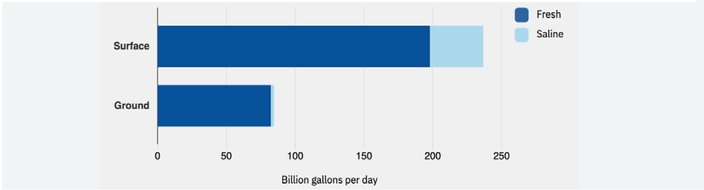
Estimated Use of Water, 2015[4]



Sources of Water

- Surface sources account for 74% of all water withdrawals.[4]
- Approximately 87% of the U.S. population relied on public water supply in 2015; the remainder relied on water from domestic wells.[4]
- Approximately 145,648 publicly owned water systems provide piped water for human consumption in 2024, of which 34% are community water systems (CWS).[5] Of all CWSs, 9% provide water to 84% of the population.[5]
- In 2006, CWSs delivered an average of 96,000 gal/yr to each residential connection and 797,000 gal/yr to non-residential connections.[6]
- Nearly all rural populations rely on groundwater for drinking water.[7] Over 84B gal of groundwater is withdrawn in the U.S. every day, nearly 70% of which is for irrigation.[5]

Withdrawals by Source (%)[4]



Energy Use

- 2% of U.S. electricity use goes towards pumping and treating water and wastewater, a 52% increase in electricity use since 1996.[8] Electricity accounts for around 80% of municipal water processing and distribution costs.[9]
- Groundwater supply from public sources requires 2,100 kWh/M gal, about 31% more electricity than surface water supply, mainly due to higher water pumping requirements for groundwater systems.[8]
- The California State Water Project is the largest single user of energy in California, using 6-9.5B kWh per year, partially met by its own hydroelectric generation.[10] In the process of delivering water from the San Francisco Bay-Delta to Southern California, the project uses 3%-4% of all electricity in the state.[11] 19% of California's total electricity use is from pumping, treating, collecting, and discharging water and wastewater.[9]

Water Treatment

- The UN 6th Sustainable Development Goal aims to secure access to clean water for all. Providing clean water and sound management of water resources are essential for a sustainable future.[12]
- The Safe Drinking Water Act (SDWA), enacted in 1974 and amended in 1986, 1996, and 2018, 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 regulations.[13]

Size Categories of Community Water Systems[5]

System Size (Population Served)	Number of CWSs	Population Served (Millions)	% of CWSs	% of U.S. Population Served by CWSs
Very small (25-500)	26,727	4.5	53.9%	1.4%
Small (501-3,300)	13,317	19.2	26.8%	5.9%
Medium (3,301-10,000)	5,019	29.5	10.1%	9.1%
Large (10,001-100,000)	4,064	117.1	8.2%	36.2%
Very large (>100,000)	472	153.2	1.0%	47.3%
Total	49,599	323.5	100%	100%

- The U.S. EPA monitors drinking water for microorganisms, disinfectants, radionuclides, and organic and inorganic compounds.[14]
- 91% of CWSs 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.[14]
- Use the Municipal Drinking Water Database to learn more about the drinking water systems of over 2,000 U.S. cities and the communities that they serve.[15]

Life Cycle Impacts

Infrastructure Requirements

- The 2023 Drinking Water Infrastructure Needs Survey and Assessment found that U.S. water systems need $625B of investment by 2041 to keep providing clean drinking water.[16]
- Water systems maintain more than 2.2M miles of transmission and distribution mains.[17] In 2020, the average age of water pipes in the U.S. was 45 years, an increase from 25 years in 1970.[18] Each year, 250,000 to 300,000 main breaks occur in the U.S., disrupting supply and risking contamination of drinking water.[19]
- There are an estimated 9.2M lead service lines in the U.S.[20] In 2021, the U.S. Congress passed the Bipartisan Infrastructure Law (BIL) that allocated $15B towards lead service line replacement.[16]

Water Systems Need by 2041, by Project Type ($)[16]

Consumptive Use

- Consumptive water use draws water from a source within a basin and returns none or only a portion back.[4]
- Agriculture is responsible for 80-90% of total U.S. consumptive water use.[21] Of the 118B gal/d of freshwater withdrawn for irrigation, over half is lost to consumptive use.[4] Over the past 50 years, water consumption has tripled.[22]

Solutions and Sustainable Alternatives

Supply Side

- Periodic rehabilitation, repair, and replacement of distribution infrastructure would help improve water quality and avoid leaks.[17] Right-sizing, upgrading to energy efficient equipment, and monitoring and control systems can optimize systems for the communities they serve, while saving energy and water.[9]
- Significant energy efficiency improvement opportunities include pumps and motors.[23] Implementing on-site energy and chemical use efficiency measures, including sludge recycling and chemical recovery, reduces environmental impacts and chemical use.
- Effective watershed management plans to protect source water are often more cost-effective and environmentally sound than treating contaminated water. For example, NYC invested $1-1.5B in a watershed protection project to improve the water quality in the Catskill watershed rather than construct a new filtration plant at a cost of $6-8B.[24]
- Less than 4% of U.S. freshwater comes from brackish or saltwater. Desalination technology, such as reverse osmosis membrane filtering, unlocks large resources, but improvements are needed to lower costs, energy use, and environmental impacts.[8]
- Consider following EPA Sustainable Water Infrastructure guidance when designing and operating facilities.[25]

Demand Side

- *Better engineering practices*: plumbing fixtures to reduce water consumption, e.g., high-efficiency toilets, low-flow showerheads, and faucet aerators; water reuse and recycling, e.g., graywater systems and rain barrels; efficient landscape irrigation practices.[26,27]
- *Better planning and management practices*: pricing and retrofit programs; proper leak detection and metering; residential water audit programs and public education programs.[26,27]
- Communities experiencing environmental injustice can use environmental justice toolkits, such as the Water Justice Toolkit.[28]

Cite as: Center for Sustainable Systems, University of Michigan. 2024. “U.S. Water Supply and Distribution Factsheet.” Pub. No. CSS05-17. October 2024
Sources for this factsheet are here, help with units and abbreviations is here.