# Freshwater Withdrawals

Water is one of the Earth's most important natural resources and is used to meet many needs. In addition to domestic supplies (i.e., drinking water), people use water to grow crops, support livestock, and produce a wide variety of products. Water is also vital to producing most of the world's electricity—not only through hydropower (dams), but also through "thermoelectric" methods (e.g., fossil fuels and nuclear energy) in which water is heated to create steam that spins a turbine to generate power. These power plants typically require even more water for cooling. Bodies of water also support commercial navigation, recreation, and a wide range of ecological needs.

Americans withdraw most of their water from fresh surface waters (such as rivers, lakes, and reservoirs) and fresh ground water, supplemented by a smaller amount of water taken from the ocean and saline aquifers. All of this water eventually returns to the environment, but sometimes in a different form, such as agricultural runoff, treated wastewater discharged to surface waters, or evaporation into the atmosphere.

All usable fresh water supplies are limited to some degree, and many parts of the country have already reached a "water-stressed" state. Withdrawing water faster than it can be recharged can lead to a loss of capacity to meet both present and future needs. For example, the High Plains Aquifer supplies water to portions of eight states, and water is being extracted faster than the natural rate of recharge, leading to a continual lowering of the water table and a need to dig deeper wells (USGS, 2011). Overuse of water can also harm ecosystems, particularly those that depend on shallow ground water or perennial streams. Demand that exceeds supply can lead to conflict between users, between upstream and downstream communities, and between withdrawal needs and recreational and ecological interests.

This indicator shows trends in the amount of fresh water withdrawn from both surface waters and ground water by human activities. The indicator also examines nationwide "water use intensity," measured in terms of total water use per capita and per dollar of gross domestic product (GDP) (i.e., the total value of all goods and services produced in the U.S.). Historically, economic growth and increased prosperity have been correlated with increased water use (Fiksel, 2009). Reducing water use without reducing economic well-being is an important goal of sustainable development. By conserving water and using it more efficiently, households, businesses, and society at large can realize cost savings and preserve water to meet future human and ecological needs.

Water use totals were estimated at five-year intervals by the U.S. Geological Survey, based in part on estimates reported by the 50 states and data collected from a variety of industries and government agencies. Exhibit 1 shows total withdrawals of fresh ground water and fresh surface water starting in 1950. Exhibit 2 shows withdrawals by sector starting in 1985, when USGS and the states first followed a consistent approach to estimate sector-specific withdrawals. Exhibit 3 compares total national water withdrawals with the official U.S. population and real (inflation-adjusted) GDP starting in 1950. These data have been indexed such that 1950 equals 1, which allows all variables to be plotted on the same scale.

## What the Data Show

Total freshwater withdrawals more than doubled from 1950 to 1980 before roughly leveling off for a few decades, then decreasing noticeably between 2005 and 2010. Surface water and groundwater

withdrawals have followed a similar pattern, with surface water consistently accounting for 75 to 80 percent of the nation's total freshwater withdrawals (Exhibit 1). As of 2010, the most recent year with data available, the United States withdrew about 306 billion gallons of fresh water per day.

The thermoelectric power generation and agriculture sectors withdraw the most water, each accounting for roughly 40 percent of the national total. Both of these sectors withdrew less water in 2010 than they did in 1985, as did most other sectors. For example, the industrial sector had a 33 percent decrease during this period. In contrast, withdrawals for public supplies increased by about 15 percent between 1985 and 2010 (Exhibit 2).

Withdrawals per capita increased from 1950 through 1980 but have declined since, resulting in 2010 per capita withdrawals being lower than the 1950 level. Meanwhile, the U.S. economy grew nearly seven-fold from 1950 to 2010 (after adjusting for inflation), far outpacing the growth in water withdrawals. In 2010, the U.S. economy produced nearly four times as much value in goods and services per gallon of water as it did in 1950 (Exhibit 3).

## Limitations

- Freshwater withdrawal totals reflect a combination of actual measurements and estimates generated by USGS and by the 50 states. The geographic and sector coverage of the original state estimates has varied from year to year. However, steps have been taken to standardize methods and to estimate quantities that were not reported by the states, so as to allow national totals to be comparable over time.
- This indicator does not describe the extent to which freshwater withdrawals are truly "sustainable" (i.e., at levels that will not adversely impact water availability and the environment for future generations). The extent to which water withdrawals can be considered sustainable depends on local and regional factors such as water availability, groundwater recharge rates, and ecological needs. Moreover, a nationwide decrease in the intensity of water withdrawals could mask an increase in withdrawals within certain water-stressed regions, such as fast-growing parts of the Southwest.
- This indicator does not characterize the manner in which water is returned to the environment after it is withdrawn. Comprehensive data are not available to describe long-term trends in actual water *consumption* or use, which differs from water withdrawals. This distinction is particularly important within the thermoelectric power sector, because many power plants withdraw large quantities of water but return much of it to the environment after a once-through cooling cycle. The distinction between withdrawal and consumption has implications for sustainability, as water that is consumed and not returned to the watershed will not be available to meet other needs.
- This indicator does not address the water quality implications of withdrawal and use. In some cases, water might be returned to the watershed with degraded quality (e.g., pollutants) that makes it unsuitable to support certain uses.
- This indicator does not explain whether specific economic sectors have become more or less efficient with regard to water use, and if so, why. For example, this indicator does not show that the slight decrease in industrial water withdrawals was accompanied by an increase in industrial output (as measured by GDP). It also does not explain the extent to which an apparent increase in productivity reflects improved efficiency within water-intensive industries, as opposed to broader structural shifts toward less water-intensive industries (e.g., the U.S. produces less steel than it used to, but more software and services).

## Data Sources

This indicator presents water withdrawal estimates developed by USGS and published in a series of reports available at http://water.usgs.gov/watuse/ (USGS, 2014). Additionally, Exhibit 3 incorporates GDP data obtained from the U.S. Bureau of Economic Analysis (2014) and population data from the U.S. Census Bureau (2000, 2001, 2011, 2014).

**References**


BEA (U.S. Bureau of Economic Analysis). 2014. Current-Dollar and "Real" Gross Domestic Product: 1929-2013. http://www.bea.gov/national/index.htm#gdp.

Fiksel, J. 2009. Design for Environment: A Guide to Sustainable Product Development. New York, NY: McGraw-Hill.

U.S. Census Bureau. 2000. Historical National Population Estimates: July 1, 1900 to July 1, 1999. Released April 2000. http://www.census.gov/popest/data/national/totals/pre-1980/tables/popclockest.txt.

U.S. Census Bureau. 2001. Intercensal Estimates of the United States Resident Population by Age and Sex: 1990 to 2000 (US-EST90INT). http://www.census.gov/popest/data/intercensal/national/index.html.

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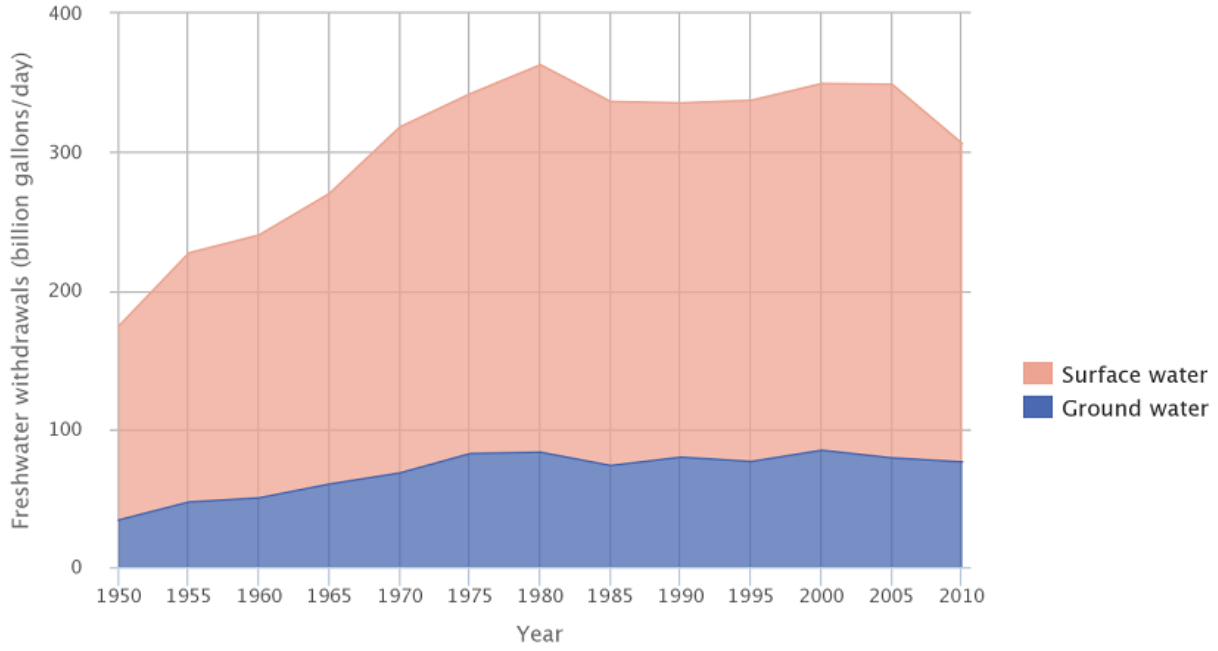
U.S. Census Bureau. 2014. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2013 (NST-EST2013-01). Released June 2014. http://www.census.gov/popest/data/national/totals/2013/index.html.

USGS (U.S. Geological Survey). 2011. High Plains Water-Level Monitoring Study. http://ne.water.usgs.gov/ogw/hpwlms/.

USGS. 2014. Water Use in the United States. http://water.usgs.gov/watuse/.

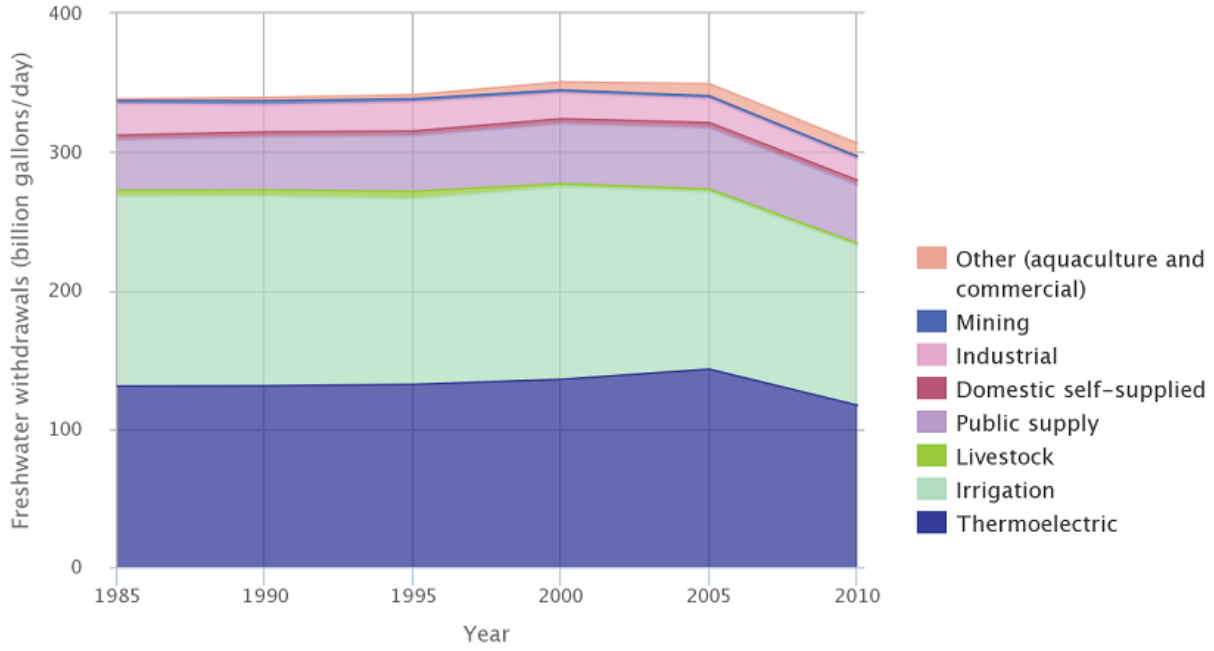
## Exhibit 1. Total U.S. freshwater withdrawals by source, 1950–2010




Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

**Data source:** USGS, 2014

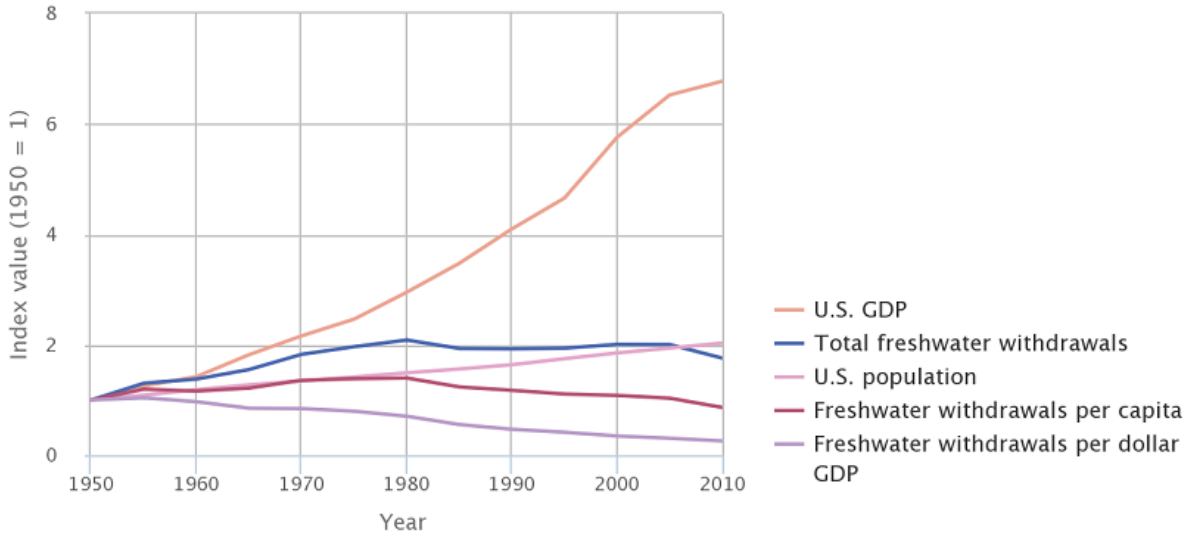
## Exhibit 2. Total U.S. freshwater withdrawals by sector, 1985–2010




Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

**Data source:** USGS, 2014

## Exhibit 3. Intensity of U.S. freshwater withdrawals, 1950–2010




Based on real (inflation-adjusted) GDP.

Data are plotted at 5-year intervals.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

**Data source:** BEA, 2014; U.S. Census Bureau, 2000, 2001, 2011, 2014; USGS, 2014