

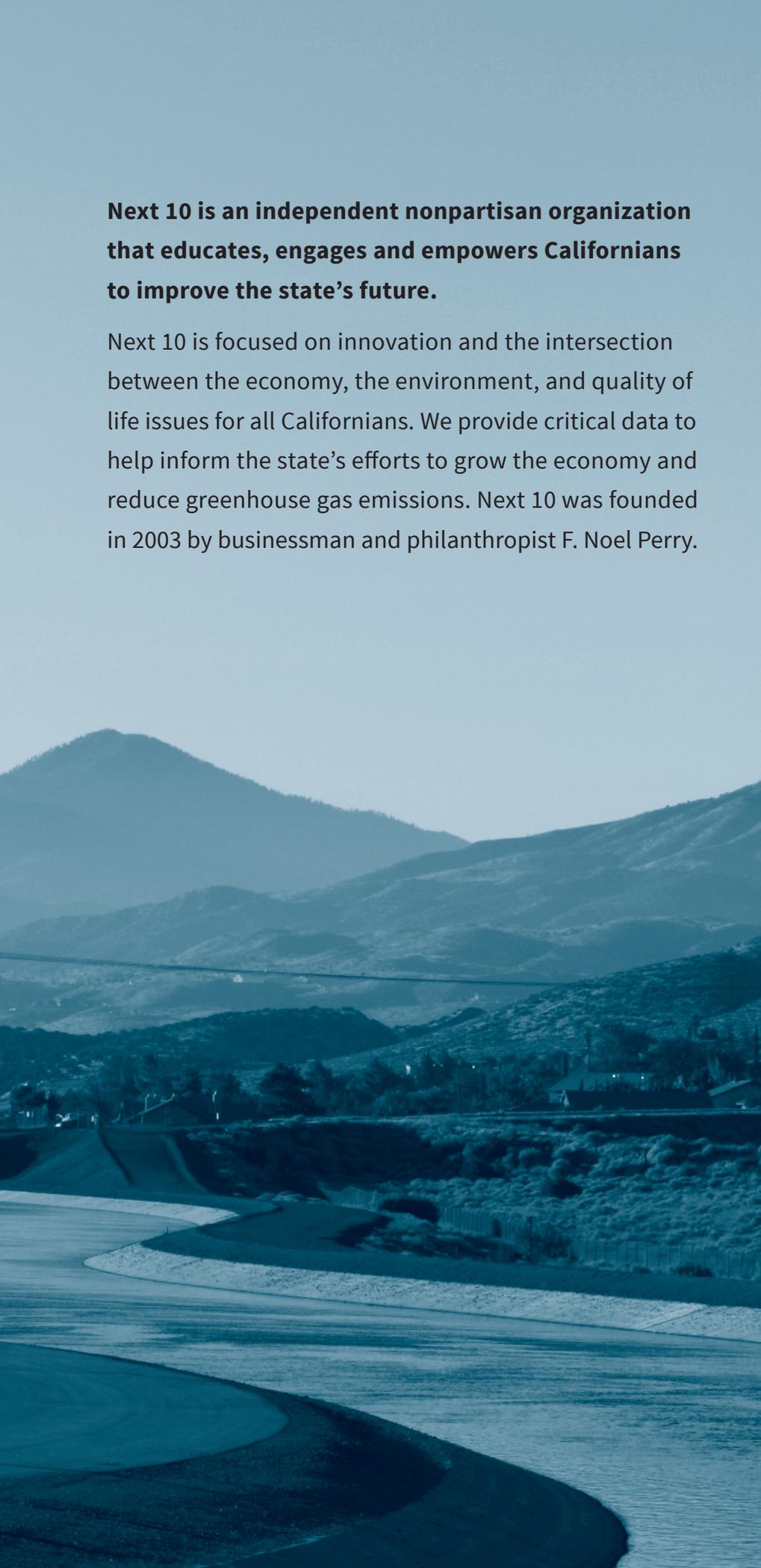


# CALIFORNIA INNOVATION AND MEETING THE WATER CHALLENGE

ISSUE BRIEF

NOVEMBER 5, 2015





**Next 10 is an independent nonpartisan organization that educates, engages and empowers Californians to improve the state's future.**

Next 10 is focused on innovation and the intersection between the economy, the environment, and quality of life issues for all Californians. We provide critical data to help inform the state's efforts to grow the economy and reduce greenhouse gas emissions. Next 10 was founded in 2003 by businessman and philanthropist F. Noel Perry.

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PRODUCED BY:

**NEXT 10**

F. Noel Perry

Sarah Henry

Marcia E. Perry

Stephanie Leonard

---

PREPARED BY:

**Collaborative Economics**

Renae Steichen

Janine Kaiser

Doug Henton

John Melville

---

DESIGN BY:

José Fernandez

# INTRODUCTION

**As California nears its fifth year of drought, the state is experiencing critical challenges to its water system.** Dwindling water supplies are creating strains on the agriculture industry, urban water management, and the environment. For example, shortages in surface water from reduced snowpack and precipitation have led to extensive groundwater pumping, causing land to sink and reducing future capacity.<sup>1</sup> In addition, in 2015, farmers had to fallow half a million acres of land due to difficulty obtaining water. The economic toll of the drought this year is expected to reach \$2.74 billion, two-thirds of which is from the agriculture industry and the remainder due to ripple effects in the economy.<sup>2</sup>

To address these challenges, California has taken a series of measures in the last few years. In 2014, Governor Brown declared a drought state of emergency and started to enact measures to assist impacted communities and decrease water consumption. Voters approved Proposition 1 in November 2014 for a \$7.5 billion water bond to fund investments in water projects and programs, such as water recycling, groundwater cleanup, and water storage, as part of a statewide water plan.<sup>3</sup> In April 2015, the Governor issued an Executive Order to reduce water use in urban areas by 25 percent through February 2016 compared to 2013 levels. The order also directed 50 million square feet of lawns to be converted to drought-tolerant landscapes, offered consumer rebates for water appliances, and placed restrictions on commercial irrigation such as golf courses.<sup>4</sup> In addition, the state began working with farmers to implement voluntary and mandatory water conservation measures. In June 2015, for example, state officials announced restrictions on water rights holders, including farmers, for using surface water in the San Joaquin and Sacramento watersheds.<sup>5</sup>

In addition to state government measures, public and private stakeholders are working to address water shortages. Companies are developing new technologies and services in California that are critical tools for

water management in the face of drought. In addition, water utilities are implementing new technologies and management solutions. Stakeholders are investigating a wide range of solutions to increase water supply and reduce consumption, such as using recycled water, improving water metering and management, increasing the price of water, revamping water rights, and desalination.

This report focuses on these emerging innovations and some of the possible solutions to water challenges. California is a global leader in innovation and can leverage this strength to meet the increasing demand for water solutions, particularly given the state's extreme drought and relatively high water use. The report starts with an overview of how California's water use compares to other states and California's water usage trends, then focuses on innovation in the water industry and how it can shape the future of water management.

## Highlights

1. California is an innovation leader and can leverage this strength to meet the increasing demand for solutions to its drought and water shortage challenges.
2. California has relatively high water use, ranking 41<sup>st</sup> in the U.S. in domestic water use per capita and 40<sup>th</sup> in average irrigation application rate in 2010.
3. About 80 percent of California's human water use is consumed by agriculture and 20 percent by urban users. In response to Executive Order requirements and the drought, urban water use dropped more than 25 percent in the summer of 2015 compared to 2013.
4. California-based water technology companies received the largest amount of venture capital investment over the last five years of any state in the U.S. In 2014, investors provided nearly \$97 million to California water companies, or 38 percent of the U.S. total.
5. In 2014, California registered nearly twice as many water patents as the next leading state of Texas. Over the last decade, water technology patents grew steadily, reflecting growing research efforts.

# WATER USE IN CALIFORNIA AND THE UNITED STATES

Water is a vital human resource that is used in nearly every aspect of our lives, from drinking, cleaning, and industrial processes, to providing a critical element for food production.

Domestic water use is the most direct use for individuals, and includes indoor and outdoor residential uses such as showering, washing clothes and dishes, flushing toilets, and watering lawns. Nationwide, 87 percent of domestic water is provided by public suppliers, while the remainder is withdrawn from private sources such as wells. In California, self-supplied private sources only account for about four percent of domestic water, while nearly 96 percent is provided by public suppliers.

In 2010, the average American used 87.5 gallons of domestic water per day (Table 1). States ranged widely in use, with Wisconsin achieving the lowest per capita use in the U.S. at 51 gallons per day, while Idaho had the highest per capita use at 167.5 gallons per day. California residents used about 108 gallons per day, ranking 41<sup>st</sup> in the nation and nearly 24 percent higher than the U.S. average.

Water for irrigation includes water that is applied for plant growth in agriculture and horticulture, as well as irrigation of landscapes such as golf courses, cemeteries, nurseries, and parks. The vast majority of irrigation withdrawal (83%) and irrigated acres (74%) are in the 17 Western states, including the Great Plains states, which have low average annual precipitation. Therefore, these states also have higher than average application rates. The average application rate is the total water withdrawn for irrigation per acre of land irrigated by sprinklers, microirrigation, or surface (flood) systems.

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California has the largest amount of irrigated land in the U.S. with about 10 million acres, producing a variety of crops such as fruits, nuts, and vegetables.

In 2010, the U.S. average application rate was 2.07 acre-feet of water per acre of irrigated land (Table 2). West Virginia had the lowest average application rate, while Arizona had the highest at more than twice the U.S. average. California ranked 40<sup>th</sup> in the U.S. at 2.5 acre-feet of water per acre of irrigated land, about 21 percent higher than the U.S. average. In comparison with 2005, several large irrigation water users, including California, decreased their application rates as microirrigation and sprinkler irrigation methods increased.

In California, water use is categorized in three main sectors: environmental, agriculture, and urban. Nearly half of California's total water use is naturally occurring in rivers, streams and wetlands, which is known as the environmental sector. Environmental sector water use plays an important role in California, including maintaining habitats and ecosystem diversity, as well as supporting water quality for agriculture and urban use. However, this sector is largely independent of human water uses.

**Table 1**

Ranking of Domestic Water Use Per Person, 2010

	RANK	DOMESTIC WATER USE PER CAPITA (gallons per day)
Wisconsin	1	51.0
Maine	2	54.4
Pennsylvania	3	59.0
Minnesota	4	61.7
Vermont	5	63.7
Massachusetts	6	64.6
Iowa	7	64.9
Ohio	8	65.7
Kentucky	9	66.8
New Hampshire	10	69.7
North Carolina	11	70.0
Rhode Island	12	72.1
Kansas	13	73.3
Virginia	14	75.0
Connecticut	15	75.1
Indiana	16	76.1
Alabama	17	76.4
Michigan	18	78.8
New York	19	78.9
Georgia	20	78.9
North Dakota	21	79.6
Delaware	22	80.0
New Jersey	23	80.0
West Virginia	24	80.0
Tennessee	25	80.2
Illinois	26	80.5
Oklahoma	27	85.1
Florida	28	87.2
<b>United States Average</b>		<b>87.5</b>
Missouri	29	88.3
Alaska	30	90.1
New Mexico	31	90.3
Texas	32	92.0
South Dakota	33	93.5
Nebraska	34	95.1
Mississippi	35	100.0
South Carolina	35	100.0
Maryland	37	102.6
Louisiana	38	104.4
Arkansas	39	105.5
Montana	40	106.2
California	41	108.3
Colorado	42	111.1
Washington	43	111.2
Oregon	44	112.8
Nevada	45	133.7
Hawaii	46	144.1
Wyoming	47	144.3
Arizona	48	146.9
Utah	49	167.4
Idaho	50	167.5

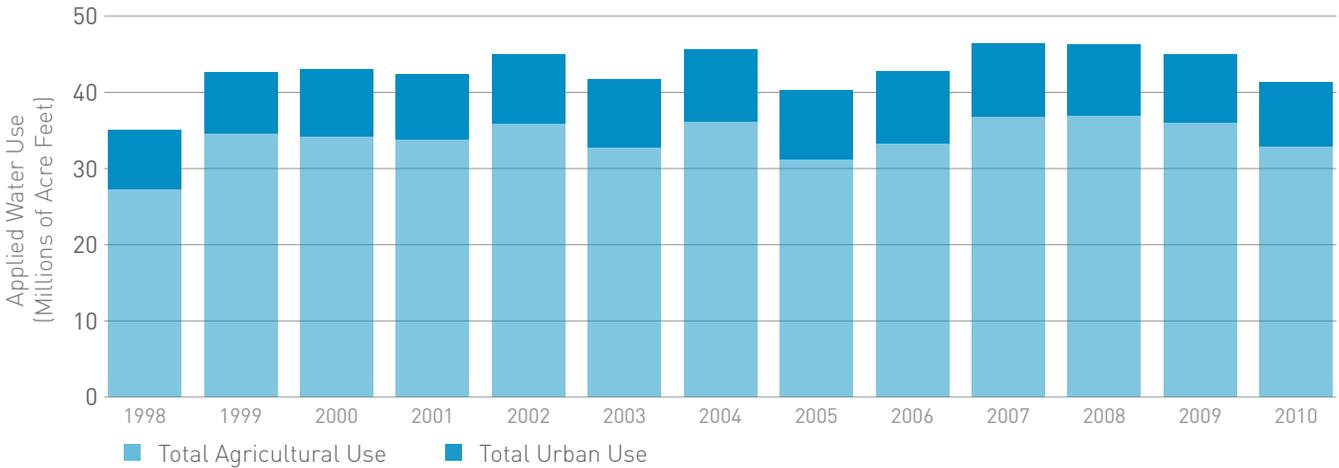
Data Source: U.S. Geological Survey  
 Analysis: Collaborative Economics

**Table 2**

Ranking of Irrigation Water Use Per Acre of Land, 2010

	RANK	AVERAGE IRRIGATION APPLICATION RATE (in acre-feet per acre of irrigated land)
West Virginia	1	0.03
Iowa	2	0.26
Maine	2	0.26
New Hampshire	4	0.36
Indiana	5	0.39
Minnesota	6	0.41
Pennsylvania	7	0.45
Michigan	8	0.46
Rhode Island	9	0.49
Illinois	10	0.52
Kentucky	11	0.54
Alaska	12	0.56
Virginia	13	0.59
Georgia	14	0.66
Vermont	15	0.69
Nebraska	16	0.73
New York	16	0.73
Maryland	18	0.77
North Dakota	19	0.79
Delaware	20	0.85
Tennessee	21	0.88
Ohio	22	0.89
South Carolina	23	0.91
Connecticut	24	1.04
Wisconsin	24	1.04
Kansas	26	1.11
Louisiana	27	1.12
Alabama	28	1.18
Oklahoma	28	1.18
Missouri	30	1.20
Texas	31	1.29
Mississippi	32	1.31
North Carolina	33	1.53
New Jersey	34	1.55
Florida	35	1.64
<b>United States Average</b>		<b>2.07</b>
Arkansas	36	2.09
South Dakota	37	2.10
Hawaii	38	2.14
Washington	39	2.24
California	40	2.50
Utah	41	2.70
Nevada	42	3.06
Oregon	43	3.10
Colorado	44	3.26
New Mexico	45	3.44
Massachusetts	46	3.87
Idaho	47	4.37
Wyoming	48	4.53
Montana	49	4.90
Arizona	50	5.16

**Figure 1** California Applied Water Use



Data Source: California Department of Water Resources  
 Analysis: Collaborative Economics

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Of the water used for human purposes in California, 80 percent is used by agriculture and 20 percent by urban users (Figure 1). California has the largest amount of irrigated land in the U.S. with about 10 million acres. California is the largest agricultural exporter in the U.S., with nearly \$21 billion in agricultural exports in 2013, twice as much as the next leading state of Iowa. The state is by far the largest exporter of crops such as fruits, nuts, and vegetables.<sup>6</sup> For example, 98 percent of figs, 87 percent of grapes, 90 percent of apricots, and nearly all pistachios, almonds, and walnuts are grown in California.<sup>7</sup> In recent years, farmers have been growing higher value crops and raising crop yields, which have increased the value of agricultural water. While California farmers are increasingly using more efficient forms of irrigation, there is additional room for improvement. In 2010, about 38 percent of farms used low volume methods such as drip irrigation, more than double the amount in 1991. However, 43 percent of farms still used some form of gravity irrigation such as flood irrigation in 2010.<sup>8</sup>

California urban water use decreased seven percent between 2005 and 2010, even while population increased (Figure 1). In 2015, urban water use dropped notably in response to the drought and Governor Brown’s April

2015 Executive Order to reduce water use in urban areas by 25 percent through February 2016 compared to 2013 levels. In August 2015, Californians achieved a 27 percent reduction in urban water use compared to 2013, exceeding the Governor’s goal for the third straight month. Between June and August 2015, Californians saved a cumulative of more than 600,000 acre-feet of water, reaching halfway to the February 2016 goal.<sup>9</sup>

Communities across the state, both inland and coastal, have achieved significant savings in recent months. Each water supplier in the state has a specific savings target based on their usage levels. Of the 406 water suppliers reporting, 85 percent met or exceeded their target, while 14 percent missed their goal. Of the 20 largest suppliers in the state, only four missed their conservation targets (Table 3). In August 2015, the state averaged 102 residential gallons of water used per person per day, down from 123 in August 2014. Los Angeles Department of Water and Power is the largest supplier in the state and averaged 81.1 residential gallons per person per day in August 2015. In the same month, San Francisco’s residential gallons per person per day was about half of Los Angeles’ (41.6), while Modesto’s was more than double (176.9).

**Table 3** California Urban Water Use, Recent Conservation Savings for the Largest 20 Suppliers

Supplier Name	Cumulative Percent Saved (June 2015 - August 2015 as compared to August 2013)	Difference from Conservation Standard by Percent	Missed or Exceeded Standard	Residential Gallons per Person per Day (August 2015 )
Los Angeles Department of Water and Power	18.1%	-2.1%	Exceeded	81.1
East Bay Municipal Utilities District	29.6%	-13.6%	Exceeded	74.3
City of San Diego	24.9%	-8.9%	Exceeded	66.4
San Jose Water Company	36.5%	-16.5%	Exceeded	76.4
San Francisco Public Utilities Commission	16.3%	-8.3%	Exceeded	41.6
Eastern Municipal Water District	20.1%	7.9%	Missed	119.9
City of Fresno	29.6%	-1.6%	Exceeded	154.2
City of Sacramento	34.1%	-6.1%	Exceeded	135.5
City of Long Beach	18.7%	-2.7%	Exceeded	59.7
Irvine Ranch Water District	17.8%	-1.8%	Exceeded	69.6
City of Anaheim	26.5%	-6.5%	Exceeded	87.0
Alameda County Water District	35.3%	-19.3%	Exceeded	74.6
City of Santa Ana	20.1%	-8.1%	Exceeded	65.3
Coachella Valley Water District	29.9%	6.1%	Missed	223.0
City of Riverside	25.6%	2.4%	Missed	125.8
California Water Service Company Bakersfield	34.1%	-2.1%	Exceeded	171.3
San Gabriel Valley Water Company	37.2%	-21.2%	Exceeded	67.4
Golden State Water Company Southwest	14.9%	-2.9%	Exceeded	62.6
Helix Water District	27.9%	-7.9%	Exceeded	81.5
City of Modesto	31.7%	4.3%	Missed	176.9

Data Source: California State Water Resources Control Board

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# WATER INNOVATION

Innovation is critical in all industries, but given California's water challenges, it is especially important to the water industry. Private and public sector innovation can lead to the creation of new products and services, improving options for consumers to help increase water efficiency, water supply and conservation. Observing changes in venture capital investments and patents can illustrate innovation trends and the role of California's innovators in improving water technologies and management.

## Investment in Water Technologies

Financial investments in water companies help to create, commercialize, and scale new, ground-breaking technologies and services. The market potential for water technologies is notable; for example, by 2030, reducing municipal water leakage presents a \$167 billion global market value opportunity and improving irrigation techniques hold a \$115 billion opportunity.<sup>10</sup> Venture capital is one of the primary avenues for startup companies to secure the capital needed to create innovative products and services. While other types of investors are also important to help grow and expand the market, venture capitalists play a unique role because of their tolerance for early stage, high-risk investments and management expertise.

California-based water technology companies received the largest amount of venture capital investment over the last five years of any state in the U.S. In 2014, investors provided nearly \$97 million to California water companies, or 38 percent of the U.S. total of \$254 million (Table 4). Pennsylvania ranked second for venture capital investment in water companies in 2014 as well as in the last five years. These water companies are tackling problems ranging from water quality and treatment to efficiency and management.

Venture capital investment in water technology has fluctuated in recent years, which is expected in a relatively young and regulated market, though companies are still emerging and receiving investment. 2014 marked the biggest year for California investment as well as the U.S. overall, suggesting a growing interest in water companies (Figure 2). In California, venture capital has been invested in water technology companies across the state, though as with venture capital overall, it is concentrated in urban areas. The San Diego region received the majority of water venture capital in 2014, including for the company Underground Solutions which developed new water infrastructure products. In the Bay Area, several water efficiency companies received investment in 2014 and 2015, including WaterHero, WaterSmart Software, and The Detection Group. Water companies in the state are also achieving successful exits, meaning initial public offerings or mergers and acquisitions, which illustrates a growing interest among large companies and more mainstream investors. For example, in 2014, LG Chem acquired the Los Angeles Area-based desalination and water reclamation company NanoH2O for \$200 million.

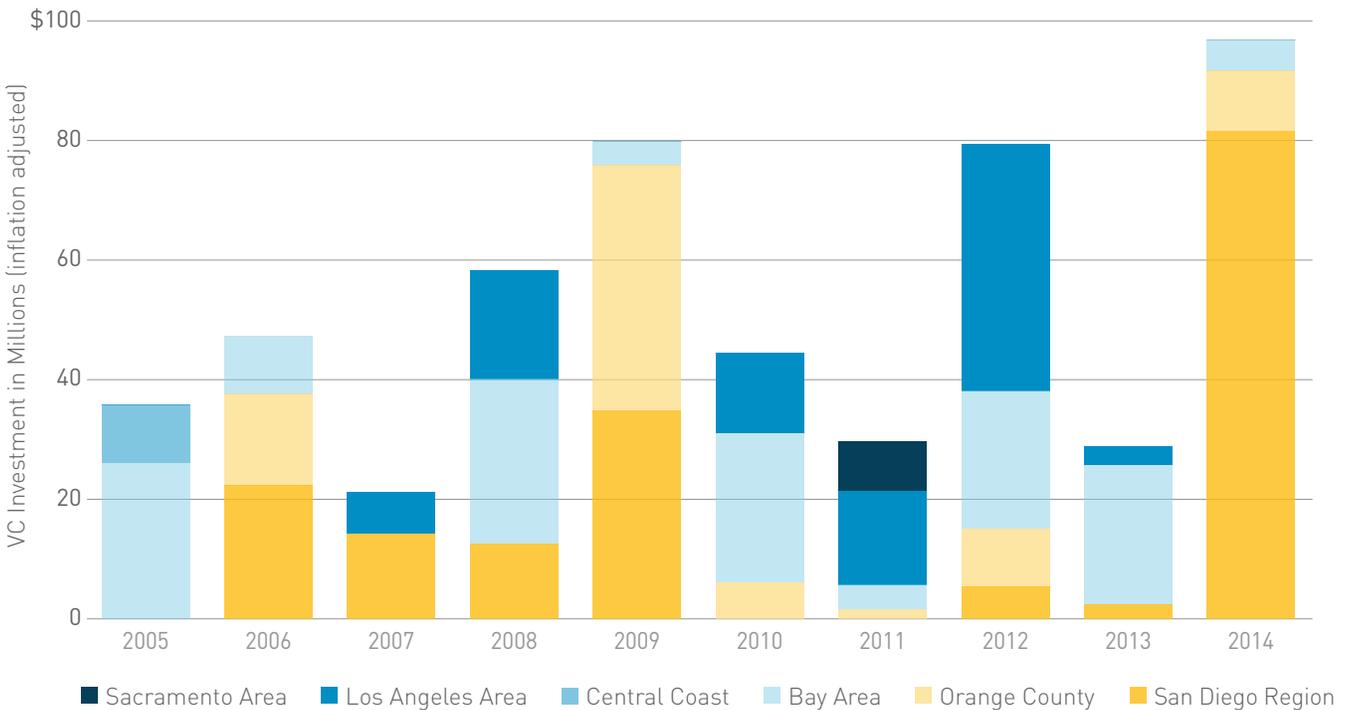
**Table 4** Top States for Venture Capital Investment in Water Companies (in millions of inflation adjusted dollars)

	2014	Rank 2014	Share of US Total 2014	Total Water VC in 2010-2014
California	\$96.78	1	38%	\$279.09
Pennsylvania	\$38.50	2	15%	\$123.08
Florida	\$26.00	3	10%	\$48.43
Michigan	\$16.08	4	6%	\$17.35
New Jersey	\$15.00	5	6%	\$24.93
Texas	\$12.29	6	5%	\$66.15
Massachusetts	\$11.66	7	5%	\$57.03
New York	\$10.50	8	4%	\$15.52
Washington	\$7.53	9	3%	\$33.06
Georgia	\$6.00	10	2%	\$26.35

Data Source: Cleantech Group i3 Database  
 Analysis: Collaborative Economics

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**Figure 2** Venture Capital Investment in Water Companies, by California Region



Data Source: Cleantech Group i3 Database  
 Analysis: Collaborative Economics

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## Companies Improving Water Efficiency and Management

In the face of water shortages, demand has risen for products and services that improve water efficiency and management. In response, corporations are leveraging established and improved water efficient products, and startups are emerging with new solutions.

For example, Rain Bird provides efficient sprinkler and irrigation systems, Fluidmaster provides products to conserve water in toilets, The Detection Group has new leak detection products, and Eva developed a new smart shower head. Software companies are improving water management as well. WaterSmart Software, for example, works with utilities to provide usage insights and conservation recommendations to customers, while MeterHero works with customers directly to track usage and motivate others to save. These types of California companies are leading the way in innovative solutions to the state's water challenges.



## California Utilities Managing Water With Smart Meters

Utilities across California have installed water meters to better monitor and manage customer water use, and are subject to a legislative requirement to meter all users by 2025. In recent years, some communities have started leading the way on this requirement by installing smart water meters, which collect data every few hours, instead of traditional meters that are only monitored about once a month. This regular monitoring allows utilities to quickly identify leaks and for customers to better understand their water usage. It could also enable different pricing methods to promote water conservation. San Francisco has already rolled out smart water meters to nearly all of its customers, and other areas such as Long Beach, Sacramento, East Bay, and the Central Valley are starting to test smart meters as well.



## California Utilities Conserving Water Supply Through Use of Recycled Water

Recycled water is one of the most economical and sustainable ways to provide a dependable water supply. Recycled water is purified wastewater (from sinks, showers, toilets, and other human uses) and is treated to high standards such that it can be safe to drink, though it is most often used for agriculture and landscape irrigation, industrial uses and/or to replenish groundwater basins.

Several California regions are expanding their use of recycled water as a way to conserve water and meet water needs. For example, in 2015, Orange County Water District expanded its water recycling facility from 70 million gallons per day to 100 million. This facility uses water that would otherwise be discharged into the ocean and pumps treated water back into the ground to recharge basins. In 2014, San Jose and the Santa Clara Valley Water District completed a facility that produces up to eight million gallons of purified recycled water per day and is looking to expand capacity. The Inland Empire Utilities Agency also has a water recycling system, and, in 2015, San Francisco passed an ordinance to mandate onsite water recycling for new developments over 250,000 square feet.

Private and public sector stakeholders are leading the way in water innovation, creating and implementing new products and services

# PATENTS IN WATER TECHNOLOGY

Patents have long been used to measure an important aspect of innovation: the output of research efforts to produce commercializable intellectual property. In 2014, California registered nearly twice as many water patents as the next leading state of Texas, and more than double over the last five years (Table 5). Michigan ranked third in U.S. water patents in 2014, followed closely by Pennsylvania and Illinois. Nationwide, more than half of the water patents are related to water treatment technologies such as desalination, filtration, or purification, with the remainder split among water supply and water efficiency technologies.

**Table 5**  
Top Ranking States in Water Technology Patents

	Total Water Patents in 2014	Rank 2014	Share of US Total 2014	Total Water Patents in 2010-2014
California	137	1	16%	732
Texas	73	2	8%	328
Michigan	59	3	7%	214
Pennsylvania	50	4	6%	212
Illinois	45	5	5%	196
New York	40	6	5%	179
Florida	40	6	5%	218
Massachusetts	39	8	4%	175
Ohio	37	9	4%	149
Minnesota	30	10	3%	165

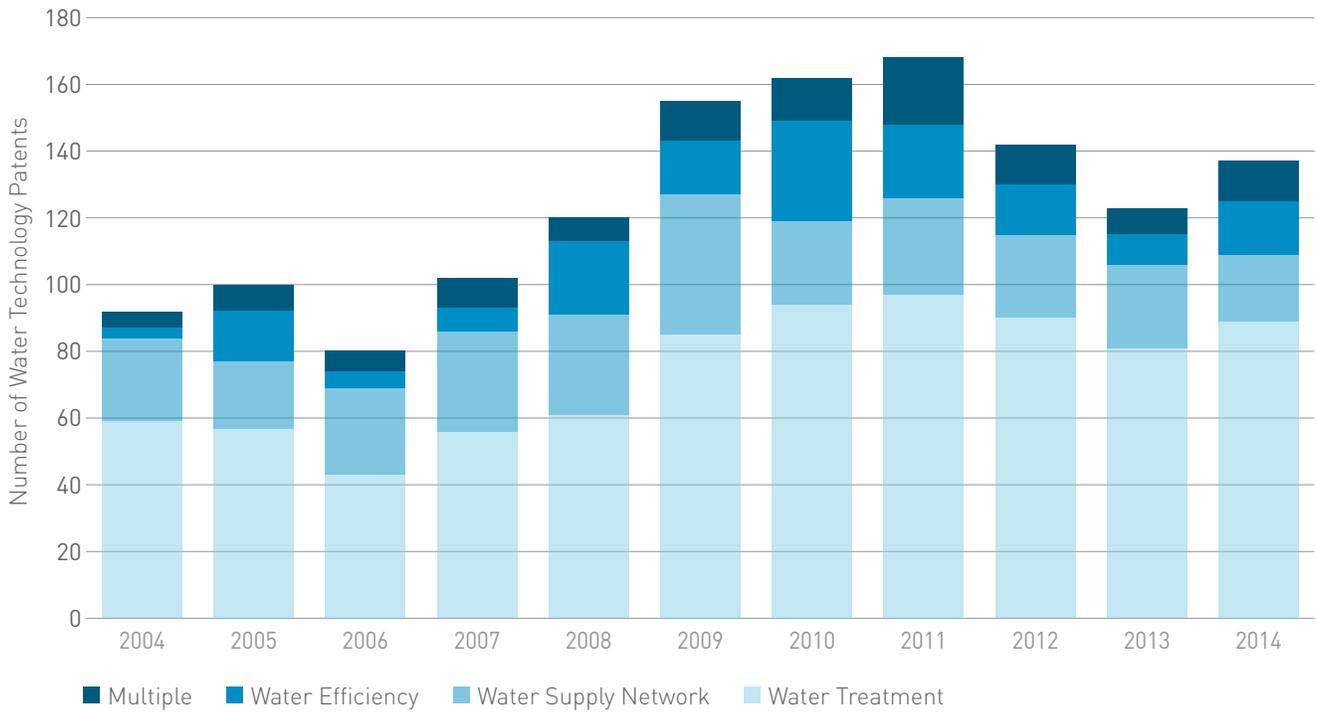
Note: Patents are published patent applications, by location of inventor  
Data Source: Cleantech PatentEdge  
Analysis: Collaborative Economics

In California, water technology patents grew steadily over the past ten years, reflecting growing research efforts. However, patents were down from a peak in 2011, which mirrors the nationwide trend (Figure 3). Water technology patents increased 11 percent between 2013 and 2014, and jumped 49 percent compared to 2004. Between 2010 and 2014, the Palo Alto Research Center had the most patents, followed by companies such as Rain Bird and Fluidmaster.

The Bay Area is the top California region for water technology patents, with 38 in 2014 and a total of 258 since 2010 (Table 6). The Los Angeles Area is home to the second highest number of water patents, followed by Orange County and the San Diego Region. Inland Empire inventors surged in 2014 with 12 patents, up from 3 in 2013.

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**Figure 3** Water Technology Patents, by Technology Type, California



Note: Reflects published patent applications, by location of inventor. "Multiple" reflects water patents classified in more than one water technology type.  
 Data Source: Cleantech PatentEdge  
 Analysis: Collaborative Economics

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**Table 6** California Regions in Water Technology Patents

	Total Water Patents in 2014	Total Water Patents in 2010-2014		Total Water Patents in 2014	Total Water Patents in 2010-2014
Bay Area	38	258	Sacramento Area	4	22
Los Angeles Area	29	148	Sierra Region	4	11
Orange County	23	99	Central Coast	1	20
San Diego Region	17	101	North Coast	1	1
Inland Empire	12	36	Sacramento Valley	1	7
San Joaquin Valley	6	27			

Note: Patents are published patent applications, by location of inventor  
 Data Source: Cleantech PatentEdge  
 Analysis: Collaborative Economics

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# CONCLUSION

**California is building on its innovation strengths to meet the increasing demand for water solutions in response to the state's extreme drought and water shortage challenges.**

California has relatively high water use compared to other states, particularly in domestic water use per capita and average irrigation application rate. Recent efforts in urban water use conservation have demonstrated great potential for improvement, with urban water users saving more than 25 percent of water in the summer of 2015 compared to 2013.

California will need a variety of policy, management, and product solutions to address its water issues. Next 10's California Water Challenge ([cawaterchallenge.org](http://cawaterchallenge.org)) presents dozens of possible policy solutions to meet California's increasing demand for water given its limited supply. This online simulation tool presents users with options including increasing water rates, alternative irrigation practices, desalination, wastewater recycling, stormwater recovery, and building new reservoirs.

Private and public sector stakeholders are leading the way in water innovation, creating and implementing new products and services to enable increased water efficiency, water supply and conservation. California-based water companies received the largest amount of venture capital and registered the most water patents of any state in the U.S. in 2014. Companies are creating and improving new products, and water utilities are using cutting-edge technologies and solutions such as smart water meters and recycling water.

California needs new business models to accelerate the adoption of new products and services. Innovators are striving to push the envelope on solutions, while consumers, industries and utilities are increasingly applying solutions that are driving the state towards a more water-efficient future. Water solutions are critical for solving California's water needs and the state is primed to meet this challenge through innovation.

# APPENDIX

## U.S. and State Water Use

U.S. and state water data are from the U.S. Department of Interior, U.S. Geological Survey. Data are water-use estimates by county for the United States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands which support the State-level water-use estimates published in USGS Circular 1405, *Estimated Use of Water in the United States in 2010*.

Domestic water use includes water used for indoor household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens. Irrigation water use includes water that is applied by an irrigation system to assist crop and pasture growth, or to maintain vegetation on recreational lands such as parks and golf courses. Irrigation water use estimates also include conveyance losses.

## California Applied Water Use

California applied water use data from the California Department of Water Resources, *California Water Plan Update 2013*. Water portfolios estimate and present actual water uses and water supplies for 1998-2010. Applied water use represents the total amount of water diverted from any source to meet the demands of water users, without adjusting for water that is used up, returned to the developed supply, or irrecoverable. Applied water is the quantity of water delivered to the intake to a city water system, a factory, or a farm headgate, either directly or by incidental flows to a marsh or wetland for wildlife areas.

## California Urban Water Use

California urban water use data and conservation savings are from the California State Water Resources Control Board, *Conservation Reporting*. Data is in response to the April 1, 2015 Executive Order, in which Gov. Brown mandated a 25 percent water use reduction for cities and towns across California. In May, the State Water Board

adopted an emergency regulation requiring an immediate 25 percent reduction in overall potable urban water use. The regulation uses a sliding scale for setting conservation standards, so that communities that have already reduced their Residential Gallons per Capita per Day through past conservation will have lower mandates than those that have not made such gains since the last major drought. Each month, the State Water Board compares every urban water supplier's water use with their use for the same month in 2013 to determine if they are on track for meeting their conservation standard.

## Venture Capital Investment in Water Technology

Investment data are provided by Cleantech Group's i3 database and includes disclosed investment deals in private companies. Data is through December 2014. All figures were adjusted for inflation using the U.S. city average Consumer Price Index of all urban consumers, published by the Bureau of Labor Statistics. Venture capital includes Angel, Seed, Series A-E+, and Growth Equity.

## Water Technology Patents

Water Technology Patents are sourced from IP Checkups through the CleanTech Patent Edge™ database, which includes water technology patent data including published patent applications from the U.S. Patent and Trademark Office (USPTO). Patent counts by state included in this analysis reflect the location of the first named inventor, and companies noted reflect first assignee name at time of patent publication.

IP Checkups classifies patents into water technology based on patent classification codes and key word searches. Some patents fell into multiple segment and sub definitions, and if these segments were equally applicable – as defined by IP Checkups and Collaborative Economics – a patent was termed “multiple.”

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## END NOTES

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