Executive Summary

The largest, least expensive, and most environmentally sound source of water to meet California's future needs is the water currently being wasted in every sector of our economy. This report, "Waste Not, Want Not," strongly indicates that California's urban water needs can be met into the foreseeable future by reducing water waste through cost-effective water-saving technologies, revised economic policies, appropriate state and local regulations, and public education.

The potential for conservation and efficiency improvements in California is so large that even when the expected growth in the state's population and economy is taken into account, no new water-supply dams or resevoirs are needed in the coming decades. Furthermore, the state's natural ecological inheritance and beauty do not have to be sacrificed to satisfy our water needs. In fact, through improvements in efficiency and conservation, we can meet California's future water needs while increasing the amount of water returned to the natural environment – thus ensuring that natural systems are protected and underground aquifers recharged. Another benefit: Saving water saves money – for water providers, consumers, and the state as a whole. Last but not least, cutting our use of water brings with it several significant "co-benefits" – from decreased sewage bills and less polluted landscape runoff to a decrease in energy consumption and improvements in air quality.

Our best estimate is that one-third of California's current urban water use – more than 2.3 million acre-feet (AF) – can be saved with existing technology. At least 85% of this (more than 2 million AF) can be saved at costs below what it would cost to tap into new sources of supply and without the many social, environmental, and economic consequences that any major water project will bring.

Table ES-1 and Figure ES-1 summarize our estimate of current urban water use in California and the potential to reduce this use cost-effectively. We understand that capturing this wasted water will involve new efforts and face educational, political, and social barriers. Overcoming those barriers will require commitments on the part of government agencies, public interest groups, and many others with vested, often conflicting interests in California's water policy. But we also believe that this approach has fewer barriers and more economic, environmental, and social advantages than any other path before us.

Table ES-1
California Urban Water Use in 2000 and the Potential to Improve Efficiency and Conservation (a)

California Urban Water Use by Sector	Current (2000) Water Use (AF/year)	Best Estimate of Conservation (AF/year)	Potential to Reduce Use (%)	Minimum Cost-Effective Conservation (AF/year)
Residential Indoor	2,300,000	893,000	39	893,000
Residential Outdoor	983,000 to 1,900,000 (b)	360,000 to 580,000 (c)	25 to 40	470,000
Commercial/ Institutional	1,850,000	714,000	39	Combined CII: 658,000
Industrial	665,000	260,000	39	(e)
Unaccounted-for Water	695,000	(d)	(d)	(d)
Total	**6,960,000** (+/- 10%)	2,337,000	34	2,020,000

(a) Minimum cost-effective conservation is that for which economically relevant data were available and our estimates of the cost of conserved water were less than $600/AF. The figure for indoor uses in the residential sector assumes natural replacement of devices when accelerated replacement would cost more than $600/AF. See Section 5 for details and definitions.
(b) This is a range of estimated outdoor residential water use. Our best estimate is 1,450,000 AF/yr. See Section 3.
(c) This is the range of conservation potential for this sector, based on the best estimate for residential outdoor use.
(d) No independent estimate of unaccounted-for water was made. We adopt here the 10% estimate from the California Department of Water Resources. No separate estimate of the potential to reduce unaccounted-for water was made in this analysis.
(e) Combined commercial, institutional, and industrial cost-effective savings estimated at around 660,000 AF/yr.

Potential for Urban Conservation: How Much Can We Save?

What is the true potential for water conservation and efficiency improvements in California? Remarkably, no state water organization has ever made a comprehensive effort to find out. Yet this information is vital to decisions about meeting future needs, restoring the health of the San Francisco Bay-Sacramento/San Joaquin Delta, replacing Colorado River water claimed by other states, and setting a whole range of ecological, agricultural, and urban policy priorities. Without information on the potential for water conservation, questions about industrial production, ecosystem restoration, immigration policy, land use, and urban growth will be much harder to answer, or, worse, the answers provided will be wrong.

"Waste Not, Want Not" is an effort to provide a key part of this missing information. In this study, the Pacific Institute quantifies the potential for water conservation and efficiency improvements in California's urban sector, where around 20 percent of the state's water is used to meet commercial, industrial, institutional, and residential needs.

One question that may occur to a skeptical reader is, "Why conserve?" Although it is beyond the scope of this report to examine the threats to California's fresh water in detail, it is important to note that the way we use water today is not sustainable – environmentally or politically.

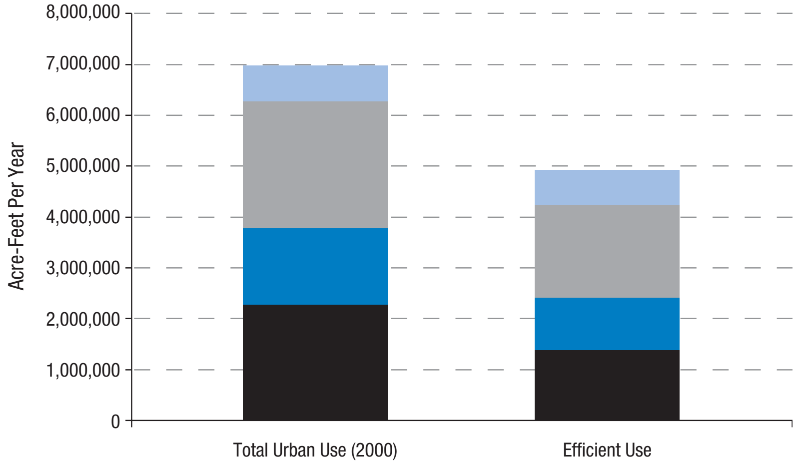


Figure ES-1
Summary of California Urban Water Use (2000) and the Potential for Cost-Effective Conservation Improvements

This figure summarizes our estimates of current urban water use by sector and the potential for cost-effective conservation improvements using existing technology. Current use is around 7 million acre-feet per year. Cost-effective savings could cut this to under 5 million acre-feet per year. Note that these savings represent the potential available. Capturing this potential will require a wide range of new and expanded efforts.

Controversies rage over allocation of water among users, the need to reduce the state's use of Colorado River water, overpumping of groundwater, and ecological damages caused by human withdrawals of water. All these factors, combined with concern over growing populations and the threat of climate change, make it essential that the deadlock over California water policy be broken. The best way to do this is through reducing waste in the system, using proper pricing and economics, educating the public, and improving water efficiency and conservation efforts.

We do not argue that the savings potential we identify will all be captured. Capturing wasted water will require better use of available technology, expanding existing conservation programs, developing new approaches and policies, and educating consumers and policymakers. Further technological advances will also help. Some of the needed improvements will be easy; some will be difficult. But there is no doubt that the path to a sustainable water future lies not with more "hard" infrastructure of dams and pipelines but with the soft infrastructure of responsible local water management, smart application of existing technology, active stakeholder participation in decision-making, and the efforts of innovative communities and businesses. We hope that this report is the beginning, not the end, of a real debate over water conservation in California.

California's Urban Water Use

California uses water to meet a wide variety of needs. By far the greatest amount of water goes to the agricultural sector. Yet urban water use plays a fundamental role in supporting the state's economy and population, satisfying a wide range of residential, industrial, commercial, and institutional demands.

No definitive data on total water used in the urban sector are available, and different sources and methods yield different estimates. Estimates of the fraction used by different sectors or end uses also vary considerably, sometimes within the same report, depending on assumptions about leak rates, indoor versus outdoor uses, regional reporting differences, and other variables. By far the greatest uncertainties are in estimates of outdoor water use, particularly for the residential and institutional sectors.

Overall, we estimate California's urban water use in 2000 to be approximately 7 million acre-feet (MAF), with an uncertainty of at least 10 percent. This estimate is shown in Table ES-1 and Figure ES-1, broken down by sector. This is equivalent to around 185 gallons per capita per day (gpcd) for the nearly 34 million people living in California in 2000. Total indoor and outdoor residential use was roughly 3.75 MAF, with the greatest uncertainty around outdoor landscape use. Commercial and industrial uses in 2000 are estimated to have been 1.9 million AF and approximately 700,000 AF respectively, with governmental and institutional uses included in the commercial estimate. No independent estimate of unaccounted-for water (UfW) was done here; we adopt the California Department of Water Resources estimate for UfW of around 10 percent of all urban use.

A Word About Agriculture in California

Before we delve any deeper into the details of urban water conservation, it is worth noting that the vast majority of water used in California goes to the agricultural sector, which is not discussed in this report. Current estimates are that more than three-quarters of California's applied water, and an even higher percentage of consumed water, is used for irrigation of food, fodder, and fiber crops.

Water use in many parts of California's agricultural sector is inefficient and wasteful, although efforts are underway to address these problems. No comprehensive conservation and efficiency policy – indeed, no rational water policy – can afford to ignore inefficient agricultural water uses. A detailed assessment of the potential to improve efficiency of agricultural water use is urgently needed. Given the proper information, incentives, technology, and regulatory guidance, great water savings will be possible in California's agricultural sector while maintaining a healthy farm economy. However, the potential for significant savings in the agricultural sector does not eliminate the need for greater efficiency in residential, commercial, industrial, and institutional water use.

Conservation and Efficiency in the Urban Sector

The savings that urban water conservation measures can provide are real, are practical, and offer enormous untapped potential. Water users have been improving efficiency for many years by replacing old technologies and practices with those that permit us to accomplish the same desired goals with less water – well-known examples include low-flush toilets and water-efficient clothes washers.

Despite this progress, our best estimate is that existing technologies and policies can reduce current urban water use by another 2.3 MAF, where at least 2 MAF of these savings are cost-effective. If current water use in California becomes as efficient as readily available technology permits, total urban use will drop from 7 MAF to around 4.7 MAF – a savings of

33 percent. This will reduce California's urban water use from around 185 gallons per capita per day to around 123 gpcd.

For the purposes of this report, we have divided the different users of water in California into several broad categories: residential, commercial, institutional, and industrial.

Residential Water Use

The residential sector is the largest urban water use sector, and it offers the largest volume of potential savings compared with other urban sectors. Californians used about 2.3 MAF of water to meet their indoor domestic needs in 2000 and around 1.5 MAF of water for outdoor residential uses. This is equivalent to approximately 100 gallons per capita per day (gpcd). Figure ES-2 and Table ES-2 show our estimate of indoor residential water use by end use for 2000. Table ES-4 shows our outdoor residential water use estimates.

Table ES-2
Estimated Current Indoor Residential Water Use in California, by End Use (Year 2000)

End Use	Current Use (AF/year)	Fraction of Total Indoor Use (%)
Toilets	734,000	32
Showers	496,000	22
Washing Machines	330,000	14
Dishwashers	28,000	1
Leaks	285,000	12
Faucets	423,000	19
Total Indoor Residential Use	**2,296,000**	**100**

While some water districts evaluate details of local residential water use, there are no comprehensive assessments of statewide end use of water in homes. In order to calculate current residential water use and the potential to reduce that use with conservation technologies and policies, we disaggregated all residential use into detailed end uses, including sanitation, faucet use, dishwashing, clothes washing, leaks, and outdoor landscape and garden demands. For every end use, separate assessments were done to determine how much water was required to deliver the benefits of water use (e.g., clean dishes). This involved evaluating available water-using technologies, current behavior and cultural practices, and likely changes in those factors over time. We then evaluated the potential for technologies and policies to reduce water use without reducing the benefits desired. Finally, we evaluated the cost-effectiveness of conservation technologies and policies whenever feasible. Detailed assumptions are described in Sections 2, 3, and 5; more complete technical appendices are available electronically at http://www.pacinst.org/reports/urban_usage/.

With current technologies and policies, residential water use in 2000 could have been as low as 60 to 65 gpcd without any change in the services actually provided by the water. Table ES-3, ES-4, and Figure ES-3 show total current residential water use in California and the fraction that could be saved with current technologies and policies.

Figure ES-2
Estimated Current Indoor Residential Water Use in California (Year 2000)

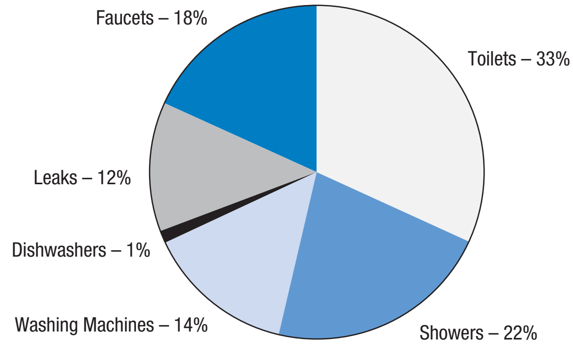
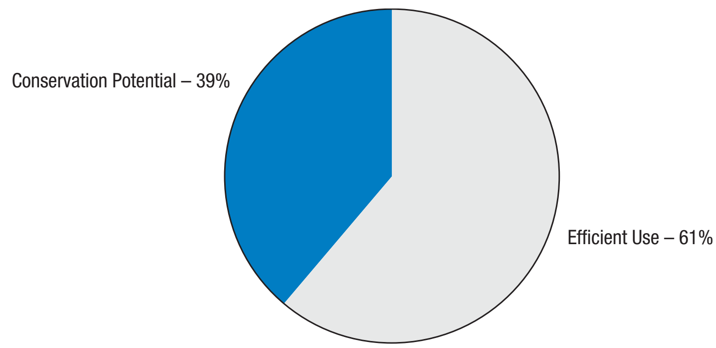


Figure ES-3
Current Residential Water Use in California (Indoor and Outdoor) and Conservation Potential (Year 2000)



Indoor Residential Water Use

In 2000, existing conservation measures reduced California's indoor residential water use by more than 700,000 AF/yr from what it would otherwise have been. If used efficiently, this conserved water could meet the indoor residential needs of 17 million people annually.[1] While these savings are significant, savings could more than double if all reasonable potential conservation could be captured.

Even without improvements in technology, we estimate that indoor residential use could be reduced by approximately 890,000 AF/yr – almost 40 percent – by replacing remaining inefficient toilets, washing machines, showerheads, and dishwashers, and by reducing the level of leaks. All of these savings are cost-effective and have important co-benefits like saving energy and decreasing the amount of waste water created.

This would have the effect of reducing current indoor residential use, on average, from around 60 gallons per capita per day to around 37 gallons per capita per day. Table ES-3 summarizes our estimate of the potential to further reduce existing indoor residential water use.

1 One acre-foot currently satisfies the annual *indoor* residential needs of approximately 15 people in California. If currently available efficiency technology were used, one acre-foot could meet the indoor residential needs of 25 people. An acre-foot of water would cover one acre to a depth of one foot and equals 326,000 gallons.

Indoor Residential Water Use (Year 2000)	Best Estimate of Additional Cost-Effective Water Conservation Potential (2000) (AF per year)	Conservation Potential: Percent Reduction Over Current Use (%)	Cost of Conserved Water ($ per AF, natural replacement) (f)
Toilets	420,000 (a)	57	$50
Showers	120,000 (b)	24	-$1,038
Washing Machines	110,000 (c)	33	-$74
Dishwashers	13,000	46	-$14
Leaks	230,000 (d)	80	< $200
Faucets/Fixed Volume Uses	(e)	(e)	
Total Additional Indoor Savings	**893,000**	**40**	

Table ES-3
Cost-Effective Water Conservation Potential in the Indoor Residential Sector (2000)

Details are in Section 2.

(a) For toilets, this requires full replacement of inefficient toilets with 1.6 gallon per flush models.
(b) For showers, this requires full replacement of showerheads with 2.5 gallon per minute models (with actual flow rates averaging 1.7 gallons per minute).
(c) For washing machines, these savings would result from the complete replacement of current models with the average (not the best) of the efficient machines currently on the market.
(d) The 80 percent savings estimate comes from assuming that leak rates are reduced to the median value now observed. At the same time, CDWR (2003b) estimates that half of all leaks can be saved for less than $100 per acre-foot and 80% for less than $200 per acre-foot. See Section 2 for more detail.
(e) For faucets and other fixed volume uses such as baths, no additional "technical" savings are assumed in this study.
(f) These costs are all well below the cost of new supply options. Indeed, several have "negative" costs, indicating that they are cost-effective even if the cost of water were zero, because of co-benefits (primarily energy savings associated with the water savings) that come with conservation.

For all indoor uses, additional temporary "savings" can be achieved during droughts by behavioral modifications (e.g., cutting back on the frequency of actions like flushing, showering, washing). We do not consider these to be "conservation" or "efficiency" improvements.

Outdoor Residential Water Use

A substantial amount of water in California is used outside of homes to water lawns and gardens, among other uses. Outdoor water use rises to a maximum during the summer when supplies are most constrained; as a result, residential landscape use plays a large role in driving the need for increases in system capacity and reliability. Furthermore, much of this water is lost to evaporation and transpiration and is thus no longer available for capture and reuse, unlike most indoor use.

While there are great uncertainties about the volume of total outdoor residential water use, our best estimate is that just under 1.5 MAF were used for these purposes in 2000. Table ES-4 shows our estimated range of outdoor residential water use for 2000.

There are a large number of options available to the homeowner or landlord for reducing the amount of water used for landscape purposes. We split our efficiency analysis into four general categories: management practices, hardware improvements, landscape design, and policy options. These options are summarized in Table ES-5 along with estimates of potential savings from each approach. These savings are not always additive, so care should be taken in estimating overall potential.

Estimate	Water Use (AF per year)
Low	983,000
High	1,900,000
Average	1,450,000

Table ES-4
Estimated Outdoor Residential Water Use (2000)

See Section 3 for details on the range of estimates for current outdoor residential water use in California.

We estimate that cost-effective reductions of at least 32.5% (a savings of 470,000 AF/yr) could be made relatively quickly with improved management practices and available irrigation technology. These improvements have the potential to substantially reduce total and peak water demand in

California. Substantially larger improvements can be achieved through long-term changes in plant selection and garden design.

There are additional benefits to such improvements as well. These include reduced energy and chemical use, fewer mowings, and less waste created. We quantified some of these factor – the ones for which several credible sources of data existed – but did not quantify them all, and urge that more work be done to incorporate and capture these co-benefits.

Given the uncertainties in estimates of current outdoor residential water use in California, more data collection and monitoring and better reporting by urban agencies should be top priorities for water policy-makers and planners. Most agencies know little about the characteristics of their residential landscapes; they do not always have reliable estimates of outdoor water use, let alone landscape acreage, type of plantings, or irrigation methods. Residential customers typically do not have dedicated irrigation meters, so site-specific information can be a challenge to collect. Few water districts have collected data on residential landscapes.[2] Statewide estimates are even less reliable.

Table ES-5
Options for the Reduction of Outdoor Garden/Landscape Water Use

Options	Potential Savings (Percent)
Management	
Turf maintenance (a)	10
Turf maintenance, irrigation system maintenance, irrigation scheduling	20
Mulching in ornamental gardens	20
Soil amendments (compost)	20
Irrigation scheduling	~25
Irrigation/soil maintenance	65 to 75
Allow lawn to go dormant	90
Hardware	
Auto rain shut off	10
Soil moisture sensors; soil probes	10 to 30
Improve performance (b)	40
Drip/bubbler irrigation	50
Gray water (c)	Up to 100
Rain barrel catchment (c)	Up to 100 (in some regions)
Landscape Design	
Landscape design (d)	19 to 55
Turf reduction (e)	19 to 35
Choice of plants (f)	30 to 80

Notes: Savings are not necessarily additive. See Section 3 for details.
(a) Includes thatching, aerating, over-seeding, and top-dressing.
(b) Includes repair, removal, or adjustment of in-ground system components.
(c) This option is used to reduce the volume of potable water used; it does not affect the total volume of water used.
(d) Based on minimizing turf area and perimeter.
(e) Non-turf areas are not necessarily comprised of low-water-use plants.
(f) Savings based on ET_0 range of 0.2 to 1.0 and a current ET_0 of 1.0.

Commercial, Institutional, and Industrial (CII) Water Use

California's commercial, institutional, and industrial (CII) sectors use approximately 2.5 MAF of water annually, or about one-third of all urban water use. Previous studies of specific regions and industries have indicated that the potential for water conservation in this sector is high. But none of these studies attempted to aggregate potential water savings in the CII sector at the state level. This report uses data surveys and sec-

2 A handful of agencies, such as the EBMUD and IRWD, have made special efforts in this area. Their experience has been valuable for researchers and practitioners.

toral water studies to present, for the first time in California, a statewide assessment of the potential savings in the CII sector from conservation and improved water-use efficiency.

Within the CII sector, water use varies among individual users in both quantity and purpose. Because of these differences in use, conservation potential varies from one industry to the next, and we had to examine each industry independently. Due to resource and data constraints, we examined industries that account for about 70 percent of total CII water use. Table ES-6 shows the industries examined in detail and their estimated water use in 2000. More general conclusions were made about the remaining sectoral end uses.

Table ES-6
Best Estimate of 2000 Water Use in California's CII Sectors (thousand acre-feet (TAF))

Commercial Sector	(TAF)	Industrial Sector	(TAF)
Schools	251	Dairy Processing	17
Hotels	30	Meat Processing	15
Restaurants	163	Fruit and Vegetable Processing	70
Retail	153	Beverage Processing	57
Offices	339	Refining	84
Hospitals	37	High Tech	75
Golf Courses	229	Paper	22
Laundries	30	Textiles	29
		Fabricated Metals	20
Other Commercial	621	Other Industrial	276
Total Commercial (a)	**1,852**	**Total Industrial**	**665**

(a) Commercial water use, as reported here, includes both commercial and institutional uses.

"Other" commercial and industrial uses reported in this table include a wide range of water uses, but insufficient information on detailed end uses limits the ability to make specific conservation estimates. For these uses, proportional savings were assumed.

When estimating water use in the CII sectors, we used two independent approaches and crosschecked our findings against other published estimates. The first approach involved compiling, reviewing, comparing, and analyzing data gathered from CII water users around the state in various surveys. From these surveys, we calculated water-use coefficients (in gallons of water each employee used per day). These coefficients were then combined with statewide employment data to estimate total water use for each industry. In the second approach, we used water-delivery data by sector, as reported by water agencies across the state. For more details, see Section 4.

The Potential for CII Water Conservation and Efficiency Improvements

Although water conservation potential varies greatly among technologies, industries, and regions, the potential for savings is high. Improving the efficiency of water use in the CII sectors can be accomplished with a broad range of technologies and actions that won't affect production.

Since the total amount of water that can be saved in the CII sectors varies tremendously by industry and end use, our estimates of best practical savings also vary by industries. To address these differences, we report potential savings as "best" (what we judge to be the most accurate estimate based on source of the data, age of the data, and sample size), "low" (lowest plausible estimate available), and "high" (highest plausible estimate available).

The greatest percentage of water savings could be realized in traditional heavy industries, such as petroleum refining, which could potentially save nearly three-quarters of its total current water use (in this case by replacement of large volumes of cooling and process water with recycled and reclaimed water). Other industries that could save a large percentage of their total water use include paper and pulp (40 percent – through process improvements), commercial laundries (50 percent – mostly using more efficient commercial washers), and schools (44 percent – mostly through toilet and landscape improvements). Overall, we estimate that the range of potential savings is between 710,000 AF/yr and 1.3 MAF/yr over current use. Our best estimate of practical savings in the CII sector is about 975,000 AF, or 39 percent of total current annual water use (see Tables ES-7 and ES-8).

Table ES-7
Estimated Potential Savings in California's Commercial and Institutional Sector for 2000 (TAF/yr)

Note: The commercial sector includes California's institutional water use (government buildings, schools, and universities).

Commercial	Potential Savings (TAF)		
	Low	High	Best
Schools	92	124	116
Hotels	9	11	10
Restaurants	44	51	48
Retail Stores	41	67	56
Office Buildings	101	154	133
Hospitals	11	17	15
Golf Courses	56	212	82
Industrial Laundries	11	18	15
Other Industries	185	330	239
Total Commercial	**551**	**984**	**714**

Table ES-8
Estimated Potential Savings in California's Industrial Sector for 2000 (TAF/yr)

Industrial	Potential Savings (TAF)		
	Low	High	Best
Dairy Processing	2	7	5
Meat Processing	2	5	4
Fruit and Vegetable Processing	7	25	18
Beverages	6	10	9
Petroleum Refining	39	78	62
High Tech	19	37	29
Paper and Pulp	3	10	7
Textiles	9	13	11
Fabricated Metals	5	9	7
Other Industries	66	138	108
Total Industrial	**158**	**331**	**260**

Several data constraints ultimately affect any final estimate of conservation potential in the CII sectors. These constraints were encountered when calculating current water use by specific end uses, penetration rates of efficient technologies, and potential water savings. The primary limitation is lack of data. At the most basic level, reliable end-use data were unavailable for a few industries in the industrial sector, such as textiles. Without this basic information, estimates of the amount of water these industries used for specific tasks must be determined from other sources, adding uncertainty. The penetration rates of some efficient technologies were also unavailable. We discuss data limitations in greater depth in Section 4 and the detailed Appendices (which are available online at http://www.pacinst.org/reports/urban_usage/).

Finally, we evaluated the cost-effectiveness of CII water use whenever feasible. The evaluation was done on a measure-by-measure basis, with some measures (e.g., toilet retrofits) conserving water in many CII sectors. Data were not available with which to assess cost-effectiveness of all measures, however, so our results are labeled as the "minimum cost-effective" conservation levels. We found that at least 657,000 AF of CII water used in California at present could be conserved cost-effectively. More CII conservation may be cost-effective. Most of the measures for which we could not develop estimates have already been adopted by at least some businesses or institutions; suggesting that they are in fact cost-effective.

A Few Key Points: Cost-Effectiveness Analysis

Saving water saves money. Section 5 presents our assessment of the cost-effectiveness of efficiency technologies and conservation options. Economists use cost-effectiveness analysis to compare the unit cost of alternatives (such as dollars spent to obtain, treat, and deliver an acre-foot of water from a particular source). Since each water-conservation measure is an alternative to new or expanded physical water supply, measures are considered cost-effective when their unit cost – what we call "the cost of conserved water" – is less than the unit cost of the cheapest alternative for new or expanded water supply.

We conclude that in California, it is much cheaper to conserve water and encourage efficiency than to build new water supplies or even, in some cases, expand existing ones.

Many credible studies and sources indicate that the marginal cost of new or expanded water supply in most, if not all, of California is greater than most of our estimates of the cost of conserved water. Indeed, because of the non-water benefits of conservation, in some cases consumers or water agencies will find it cost-effective to implement a number of the options described here even if water were free.

The costs of conserved water we estimate in this report are deliberately biased toward the higher end of the cost range to make our analysis more conservative. We also found that one need not include many favorable, but difficult-to-quantify, cost factors for the analysis to show that the water-conservation measures under consideration are cost-effective. Thus we include only the reasonably quantifiable and financially tangible "co-benefits" of water conservation. These are benefits that automatically come along with the intended objective. For example, low-flow showerheads reduce water-heating bills and sewage costs, and improved irrigation scheduling reduces fertilizer use. What our research shows is that even a conservative approach to co-benefits makes the case for water conservation much stronger than less complete assessments that exclude these benefits.

All five indoor residential conservation measures evaluated – toilets, washing machines, showerheads, leak detection and reduction, and dishwashers – are cost-effective under natural replacement. The outdoor measures that we evaluated – improved irrigation scheduling, operation, and maintenance, including some replacement of irrigation technology – are also cost-effective. We did not evaluate changes in landscape type (e.g., replacing turf with low-water use native plants) because this could change the benefit received by the owner of the landscape, which in turn has financial or value implications beyond the scope of this report. We note, however, that these changes could well be cost-effective, given recent evidence from pilot projects, detailed case studies, and large-scale landscape programs (see Section 5 for a description of our methodology).

A far wider set of conservation options was evaluated in the CII sector, with a variety of results. Examples of cost-effective options are replacement of all commercial toilets with low-flow models as the new fixtures are needed, accelerated replacement with ultra-low-flow toilets in establishments where toilets are flushed more than 15 times per day, and using low-flow showerheads in all urban sectors. Other examples include recirculating water used by x-ray machines and sterilizing equipment in hospitals, a wide variety of "good housekeeping" and leak-detection options in all establishments, water-efficient dishwashers and pre-rinse nozzles in restaurants, efficient washing machines and recycling systems in laundromats, acid recovery and textile dye-water recycling in the textile industry, a wide variety of microfiltration systems in the food industry, and use of recycled/reclaimed water in refineries, among others.

Although much work has been put into ensuring that our methodologies are clear and consistent, care should be taken in reading and using the numbers in Section 5. While the basic approach taken to calculate cost-effectiveness among the different urban sectors is the same, some important details differ among the indoor residential, outdoor residential, and commercial and industrial analyses. For every sector, see the detailed assumptions described in the body of the report. Additional detail is provided online at http://www.pacinst.org/reports/urban_usage/.

Lessons and Recommendations

General Conclusions

California is using water unsustainably.

The pressures of a growing population and economy, combined with traditional approaches to water supply and management, have led to the unsustainable use of California's freshwater resources. The state must change its ways to avoid water shortages, ecological collapse, and economic disaster.

Improved efficiency and increased conservation are the cheapest, easiest, and least destructive ways to meet California's future water needs.

This report strongly indicates that California can save 30% of its current urban water use with cost-effective water-saving solutions. Indeed, fully implementing existing conservation technologies in the urban sector can eliminate the need for new urban water supplies for the next three decades.

Existing technologies for improving urban conservation and water-use efficiency have enormous untapped potential.

Many technologies are available for using water more efficiently, in every urban sector. These include low-flow toilets, faucets, and showerheads; efficient residential and commercial washing machines and dishwashers; drip and precision irrigation sprinklers; commercial and industrial recycling systems; and many more.

Smart water policies to capture conservation savings are available at all levels of government and society.

Examples of the smart water policies that will help capture the conservation and efficiency potential include proper pricing of water to encourage waste reduction, financial incentives for low-flow appliances, proper design of subsidy and rebate programs, new state and national efficiency standards for appliances, education and information outreach, water metering programs, and more aggressive local efforts to promote conservation. These are described in more detail below and in the full report.

There are barriers to capturing all conservation potential, but these barriers can be overcome.

Becoming more efficient requires both easy and difficult actions. But experience has shown that the barriers to more efficient water use are often overestimated and can be overcome by intelligent planning efforts that collect the right information, identify real conservation potential, and then work with stakeholders to implement policies and programs in a fair and transparent fashion.

The Power of Technology

Existing technologies are available to greatly reduce urban water use without reducing the goods and services we desire.

This report focused on existing, commercially tested, and readily available water-efficiency technologies like low-flow toilets and better water use in landscapes. We found a vast number of options that enable us to reduce urban water use without harming our quality of life.

New technologies are constantly evolving.

Between the times we began and finished this report, new technologies and improvements in old technologies have continued to appear on the market. Computer-controlled “smart” sprinklers can greatly reduce overwatering. Dual-flush toilets that improve upon current technology are now available in the United States and are standard in other countries. Waterless urinals are being installed in government and commercial buildings in California. New efficient nozzles for washing dishes in restaurants are being installed more widely. Efficient washing machines are appearing faster and their prices are dropping more rapidly than expected. This trend of continuing improvements in water use efficiency technology is likely to continue and will make saving water even easier and cheaper.

The Power of Proper Economics

The power of proper pricing of water is underestimated.

When water is not properly priced, it is frequently wasted. Inexpensive water only appears inexpensive. It often carries high or hidden costs for water users and the environment. In all urban uses, pricing water at appropriate levels encourages conservation and efficiency actions and investments. All water use and wastewater discharges should be charged at rates (and with rate structures) that encourage efficiency – but governments do have a duty to ensure that basic human needs for water are met regardless of one's ability to pay.

Economic innovation and financing mechanisms lead to cost-effective water conservation.

Many conservation technologies are cost-effective for customers, but are not perceived as cost-effective. Innovative economic tools and financing mechanisms can help customers make smarter water-use decisions.

The Power of Smart Regulation

Smart regulation is more effective than no regulation.

There is a critical role for federal, state, and local standards and rules in moving toward more efficient water use in all sectors. For example, the federal water-efficiency standards have been enormously effective at helping the nation keep total water use well below the levels that would otherwise have resulted from continued inefficient water use. They have also been economically attractive, saving far more money than they cost.

Appliance standards are powerful conservation tools that also help educate consumers.

Experience has repeatedly shown that appliance efficiency standards are powerful tools for reducing waste. The water-efficiency standards of the National Energy Policy Act have been tremendously successful at cost-effectively reducing wasteful use of water in U.S. toilets and showerheads. New standards should be pursued for washing machines, dishwashers, and some commercial and industrial water-using fixtures, but such standards should be flexible enough to permit advances in technology to continue to lead to improvements in water productivity.

The Power of Information

Ignorance is not bliss: Data and information are keys to successful conservation.

As highlighted in different sections of the report, lack of information (or failure to disseminate that information) hinders effective action. Although we calculate the most accurate water use and conservation potential we can with the information available, increasing the accuracy of future estimates is necessary. This will depend on water users, suppliers, and managers at all levels taking specific steps to increase the reliability, quality, and quantity of available data on water use and water conservation options.

Some specific data needs should be a top priority.

Collect and report more water-use data in standard formats, consistently and regularly. Data on landscape use and self-supplied water are particularly poor. Details on end uses of water are limited. And experience with conservation efforts to date is poorly documented.

Meter and measure all water uses.

When water use is not metered, it is wasted. With very few exceptions, water uses should be monitored and measured so that actual use can be evaluated and compared to the benefits that water provides. Unfortunately, several sizeable cities in California, including Sacramento, still do not have water meters.

Appliance labeling is a powerful educational tool.

The success of the Energy Star labeling program highlights the power of information. A "Water Star" label for water-using appliances should be implemented, showing total water use per year (or some comparable measure). Such labeling permits consumers to make more informed choices about their actions and purchases.

Standardize water-use terms.

Confusion over terms such as water use, consumption, withdrawal, new water, real water, conservation, productivity, efficiency, and so on can hinder policy and analysis. Some efforts should be made to standardize terms related to water use and conservation.

Educate decision-makers about conservation opportunities.

Homeowners, individuals, and industries sometimes choose less-efficient technologies because they are operating with incomplete information. Many homeowners do not know that the performance of the new ultra-low-flow toilets is as good as, or better than, older, inefficient models and that such toilets will save a considerable amount of money for the homeowner. Discussions with a specific dishwasher manufacturer, for example, revealed that sales of their inefficient dishwasher models far exceed similarly designed efficient models because initial costs of the efficient models are about ten percent higher.

Give agencies and industries an opportunity to share success stories.

Water-conservation programs are already successfully reducing water use. Sharing information on these success stories in industry forums, user groups, or conferences can help promote more widespread efforts.

California's state and local water agencies should work more closely with industry associations and national agencies on data collection.

When industry associations and national agencies collect water use and conservation data, they often collect these data in the state of California and then combine them with data from other states to calculate a national estimate. If state agencies could obtain this California-specific data in a consistent format, this information could be used for future research.

Reconcile data reported from individual water agencies, industry associations, and various other agencies.

A significant amount of data reported by one agency may conflict with what other agencies are reporting. State and local agencies need to reconcile these differences and work with national and industry associations.

The Power of Smart and Integrated Water Management

Be aware of the water implications of non-water policies.

Water agencies should also encourage the implementation of new policies and technologies that are not intended to achieve reductions in water use but do so anyway. In hospitals, for example, water-ring vacuum pumps were historically installed because flammable gases were used as anesthetics. Once the flammable gases were discontinued, hospitals slowly shifted to oil-based pumps, incidentally saving water. Similarly, digital x-ray film processors are gaining market share for their superior ability to process, transmit, and manipulate x-ray images, yet these systems also use little or no water.

Promote reclaimed and recycled water as a secure source for water supply.

While this report does not discuss the overall potential for using reclaimed or recycled water as a source of new supply, that potential is real and likely quite significant for California's urban sector. A comprehensive water program will address the availability and potential use of this water source. Examples already exist: The desire for a guaranteed water supply during drought conditions has driven some refineries to switch to reclaimed water for their cooling needs. Even if water is not a major cost component, an interruption of water supply can cause shutdowns in many industries and result in lost income. Promoting reclaimed water as a secure supply may encourage some industries to invest in the necessary infrastructure for using this water.

Smart management practices should be encouraged at water districts or within specific industries.

Often, water districts or specific industries will introduce conservation measures, but differences in management approaches can prevent the full implementation of these measures. In the CII sector, for example, failing to budget worker time for implementing water conservation technologies contributes to poor implementation rates and may even increase water use.